3rd ECVSMR Scientific Meeting

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29th SEPTEMBER - 1st OCTOBER 2022

PULA, CROATIA

EUROPEAN COLLEGE OF VETERINARY SPORTS MEDICINE AND REHABILITATION

PROCEEDINGS

European College of Veterinary Sports Medicine and Rehabilitation

The Faculty of Veterinary Medicine University of Zagreb

IMPRESSUM

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PRESIDENT MESSAGE

Dear colleagues,

At the time of this writing, we hope that we will be able to welcome you in person to our 3rd annual congress at the southern tip of the Istrian peninsula, in the extraordinary beauty of the Pula archipelago. Since ancient times, this area has provided a safe haven for all travellers including the Argonauts, sailors who, according to Greek mythology, were on the run for stealing the Golden Fleece and who, according to this myth, founded Pula.

Our scientific (Virginie Coudry, Giuseppe Spinella, Ana Boado, Barbara Bockstahler, Nika Brkljača Bottegaro, Danae Charalambous, José Manuel Vilar Guereño, Annamaria Nagy, Maarten Oosterlinck, Zoran Vrbanac) and organizing (Zoran Vrbanac, Nika Brkljača Bottegaro, Jelena Gotić, Magdalena Kolenc, Kim Korpes, Lada Radin) committee has been firing on all cylinders. We are thrilled to present an inspiring programme with excellent speakers on a variety of interesting topics, providing new insights, but also ample opportunity for fruitful discussion and new collaborations.

In combination with a growing number of diplomates, official training centres, and residents of the European College of Veterinary Sports Medicine and Rehabilitation, this congress highlights our mission to advance veterinary sports medicine and rehabilitation.

We are grateful for the time and effort the speakers put into sharing their thoughts and experiences with us. Moreover, we acknowledge the support from the University of Zagreb and the dedicated team of student helpers. Finally, we thank all the sponsors for their generous financial support, which is not something we take lightly in these challenging times!

Kind regards,

Maarten Oosterlinck
President ECVSMR

PROGRAMME

SMALL ANIMAL PROGRAM

29/09/2022 PRE-CONGRESS DAY

8.30-18.00 Registration

WORKSHOPS

9.00-12.00 Practical ultrasound for shoulder muscular/tendon lesions in dogs (Giuseppe Spinella)

13.00-16.00 Get the confidence to rehab a canine athlete - approach to a functional rehabilitation and re- conditioning for sporting and working dogs (Jana Gams) - Sponsored by FitPAWS

RESIDENT FORUM

Moderators: Giuseppe Spinella, Ana Boado, Barbara Riccio, Andrea Bertuglia

16.00-16.20 Reliability of the flexion test on a large cohort of canine orthopedic patients: effect of age, gender, neutered status, breed size, tested joint and initial lameness score (Grosjean D., De Bakker E., Mugnier A., Forterre F., Saunders J., Samoy Y., Van Ryssen B.)

16.20-16.40 Ex-vivo computed tomographic evaluation of the proximity of needles placed for palmar digital nerve blocks to synovial structures in the foot (Gruyaert M., Oosterlinck M., Nagy A.)

16.40-17.00 Application of a capacitive resistive electric transfer therapy 24 hours before exercise increases velocity and accelerometric activity in Standardbred trotters (Saitua A., Argüelles D., Miraz R., Calle N., Nocera I., Vitale V., Sgorbini M., Dıaz J.C., Muñoz A.)

17.00-17.20 Variations of the vertical displacement of the withers and tuber sacrale in trotting horses on a water treadmill with different water heights: preliminary results (Fraschetto C., Jacquet S., Moiroud C., Audigi, F., Chateau H., Hatrisse C., Denoix J.M.)

EVENING PROGRAM

18.30-19.00 "Presentation of the new book: Essential Facts of Equine Physical Therapy, Rehabilitation and Sports Medicine. Joao Paulo Marques (Ed.), Steve Adair, Hilary Clayton, Kevin Haussler, Johann Maierl"

19.00-21.00 Welcome reception and announcement of the winners of the VAHL Award

30/09/2022 DAY 1

08.00-8.45 Registration

08.45-9.00 Opening ceremony

THE ELBOW JOINT - PUT IT ALL TOGETHER BEFORE REHAB
Moderator: Oliver Harms

9.00 -9. 30 Elbow arthroscopy before rehab- why is it important (Bernadette Van Ryssen)
9.30-10.00 GRF and kinematics of the elbow joint (Barbara Bockstahler)
10.00-10.30 Biomechanical assessment of regenerative therapy in elbow osteoarthritis (José Vilar)

10.30.-11.00 Coffee break

11.00-11.30 What you should know about elbow surgical techniques before starting rehab (Susanne Lauer)
11.30-12.00 Rehab of elbow - is it evidence based? (Yves Samoy)
12.00-12.30 Panel discussion (all speakers): Residents ask: Elbow disorders from rehab point of vie

12.30-14.00 Lunch, Poster session

13.00-14.00 ECVSMR AGM

PAIN FOCUS IN REHABILITATION
Moderator: Barbara Bockstahler

14.00-14.30 Cannabinoid and cannabinoid-related receptors in the nervous system and joints (Roberto Chiocchetti)
14.30.-15.00 What is new in pain medication? (Stefanie von Ritgen)
15.-00-15.30 Pain management in physical therapy (Marion Mucha)

15.30-16.00 Coffee break

FREE COMMUNICATIONS
Moderator: Marion Mucha

16.00-16.15 Reliability of Balance assessment on a modified Posturomed platform in healthy dogs a pilot study (Wolszky V., Zablotski Y., Lauer S.)
16.15-16.30 Effect of transcutaneous electrical nerve stimulation (TENS) on peak vertical force and vertical impulse in dogs (Pedersen A., Babra A., Dadell L., Bergh A.)

16.30 End of the day 1

EVENING PROGRAM
20.00-23.00 Dinner Park Plaza Histria

01/10/2022 DAY 2

08.00-9.00 Registration

WORKING DOGS TOPIC I
Moderator: Yves Samoy

9.00 -9. 30 Challenges of working dogs - training and injuries (João Alves)
9.30-10.00 Nutrition and suplements of working dogs (Dominique Grandjean)
10.00-10.30 Ground reaction forces and Center of Pressure during heel work (Danae Charalambous)

10.30.-11.00 Coffee break

FREE COMMUNICATIONS
Moderator: Barbara Bockstahler

11.00-11.15 Physical activity and sport-specific training patterns in Swedish working trial dogs? a questionnaire survey (Essner A., Hesbach L. A., Igelström H., Kjellerstedt C., Svensson K., Westerlind H.)
11.15-11.30 Reliability of stifle goniometry in dogs with cranial cruciate ligament rupture (Volz F., Schmutterer J., Vockrodt T., Zablotski Y., Lauer S.)
12.00-12.30 Publish or perish: how to design a clinical study (Renate Weller)

12.30-14.00 Lunch, Poster session

WORKING DOGS TOPIC II
Moderator: Marion Mucha

14.00-14.30 Different types of training in mushing dogs (Dominique Grandjean) 14.30.-15.00 Musculoskeletal disorders in working dogs (James Guthrie)
15.-00-15.30 Internal medicine in working and athletic dogs (Dominique Grandjean)

15.30-16.00 Coffee break

16.00-16.30 Panel discussion - Residents ask: How to achieve a better performance in sporting dogs (Jana Gams, Dominique Grandjean, James Guthrie, João Alves) - Moderated by Danae Charalambous

17:00 Closing Ceremony

EQUINE PROGRAM

29/09/2022 PRE-CONGRESS DAY

8.30-18.00 Registration

WORKSHOPS

9.00-13.00 Equine prepurchase examination - Case discussions (Ana Boado) - Pro & contra of using advanced imaging in the PPE (Erik Bergman) - Pro & contra of using ultrasound in the PPE (Barbara Riccio) - Cardiology as part of the PPE (Mark Bowen)

RESIDENT FORUM

Moderators: Giuseppe Spinella, Ana Boado, Barbara Riccio, Andrea Bertuglia

16.00-16.20 Reliability of the flexion test on a large cohort of canine orthopedic patients: effect of age, gender, neutered status, breed size, tested joint and initial lameness score (Grosjean D., De Bakker E., Mugnier A., Forterre F., Saunders J., Samoy Y., Van Ryssen B.)

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19.00-21.00 Welcome reception and announcement of the winners of the VAHL Award

30/09/2022 DAY 1

08.00-8.45 Registration

08.45-9.00 Opening ceremony

MORNING SESSIONS
Moderator: Annamaria Nagy

9.00 -9. 30 Diagnosis of lumbosacral and sacroiliac joint injuries (Jean-Marie Denoix)
9.30-10.00 Lumbosacral and sacroilias joint injuries in sport horses: treatment and outcome (Stefan Cockelaere)
10.00-10.30 Biomechanics of the horse-rider interaction: a practical perspective (Russell MacKechnie-Guire)

10.30.-11.00 Coffee break

FREE COMMUNICATIONS
Moderator: Virginie Coudry

11.00-11.15 Comparative imaging of the carpus and proximal metacarpal region of 12 endurance horses in training and competition (Nagy A., Dyson S.)
11.15-11.30 Correlations between ultrasound, Doppler, MRI, and histology in a suspensory lesion model (Pluim M., Chantziaras I., van Weeren P.R., Vanderperren K., Martens A., Delesalle C.)
11.30-11.45 Standing computed tomographic assessment of the metacarpophalangeal joint space width in 66 non-lame horses (Tokareva M., Nagy A.)
11.45-12.00 Intra- and inter-observer reliability of a handheld myotonometer to measure equine forelimb superficial digital flexor tendon stiffness (Dıaz-Carrera J.C., Requena F., Jiménez-Fragoso J., Luna-Correa P., Calle-González N., Valladares L., Argüelles D., Muñoz A.)

12.15-14.00 Lunch, Poster session

13.00-14.00 ECVSMR AGM

AFTERNOON SESSIONS
Moderator: Renate Weller

14.00-14.30 Advanced imaging of tendon injuries (Anna Ehrle)
14.30.-15.00 Subclinical, adaptive or incidental findings? What can we see when imaging non-lame horses in full work? (Annamaria Nagy)
15.-00-15.30 Follow-up of prepurchase exams: interesting and unpredictable facts (Ana Boado)

15.30-16.00 Coffee break

16.00-17.00 "Hot topics in the prepurchase examination: Panel discussion (panelists: Ana Boado, Erik Bergman, Barbara Riccio, Mark Bowen; moderator: Maarten Oosterlinck)"

16.30 End of the day 1

EVENING PROGRAM

20.00-23.00 Dinner Park Plaza Histria

01/10/2022 DAY 2

08.00-9.00 Registration

MORNING SESSIONS
Moderator: Mark Bowen

9.00-9.30 Gastric disease in the performance horse (Gayle Hallowell)
9.30-10.00 Upper versus lower respiratory tract diseases, which are bigger culprits of poor performance in horses? (Lisa Katz)
10.00-10.30 Discipline-specific nutrition for performance (Emmanuelle Van Erck)

10.30.-11.00 Coffee break

FREE COMMUNICATIONS
Moderator: Lisa Katz

11.00-11.15 The effects of two different withholding periods of omeprazole on the recurrence of equine gastric ulcer syndrome in Thoroughbred racehorses (Shan R., Steel C.M., Sykes B.)
11.15-11.30 Comprehensive analysis of exercise-induced hemolysis in endurance horses (Pakula P., Al- Noubi M.N., Halama A., Al-Dous E.K., Johnson S., Filho S.A., Schmidt F., Vinardell T.
11.30-11.45 Comparison of two different blood gas analyzers in equine practice (Sandersen C., Dmitrovic P., Cesarini C., Kirsch K., Serteyn D.)
11.45-12.00 Neurological defects and long term prognosis for sport horses infected with West Nile Virus (Guerrero-Carvajal F., Bravo-Barriga D., Frontera E.M., Criado G., Roquet I., Martín-Cuervo M.)
12.00-12.30 Publish or perish: how to design a clinical study (Renate Weller)

12.30-14.00 Lunch, Poster session

AFTERNOON SESSIONS
Moderator: Ana Boado

14.00-14.30 The importance of bridle fit for equine welfare and performance (Rachel Murray)
14.30.-15.00 Practical use of wearables in equestrian sports (Emmanuelle Van Erck)
15.-00-15.30 What is important to consider if planning water treadmill of swimming for training or rehabilitation (Rachel Murray)

15.30-16.00 Coffee break

16.00-16.30 Biomechanical effects of sport surfaces: examples of applications for the rehabilitation of race and sport horses (Nathalie Crevier-Denoix)
16.30-17.00 Diagnosis and rehabilitation of muscle injuries (Jean-Marie Denoix)

17:00 Closing Ceremony

INVITED SPEAKERS RESUMES

RENATE WELLER

After graduating from Munich vet school Renate has worked as an equine vet in several different countries in ambulatory and referral settings. She has taken on the role as dean of University of Calgary Veterinary Faculty in September 2021 and is very much enjoying her new role. Previously she has been employed as Professor of Imaging and Biomechanics at the Royal Veterinary College where she has split her time between clinical work, research and teaching. She is an RCVS specialist in Diagnostic Imaging and a diplomat of the European and American College of Veterinary Sports Medicine and Rehabilitation. She holds a PhD in biomechanics and a Masters in Veterinary Education. Renate has been inducted in the International Hall of Fame of Equine Veterinarians, is an Honorary Fellow of the Worshipful Company of Farriers and has been awarded a National Teaching Fellowship for her contribution to teaching and learning. She has gained experience in the corporate world working as CVS's inaugural director of education where she has put her skills as an educator to good use to facilitate professional development of the whole veterinary team. In her spare time she likes to admire her horse, taking her dog for a walk, baking and eating cakes, and going to the gym and playing table tennis, to offset the aforementioned cakes.

PROF. DR. BERNADETTE VAN RYSSEN

DVM, PHD, DIP. ECVSMR
bernadette.vanryssen@Ugent.be
Faculty of Veterinary Medicine, Ghent University, Belgium

Bernadette Van Ryssen is full professor in small animal orthopedics at the Ghent University, Belgium. She graduated in 1988 in Ghent and did a PhD on 'Arthroscopy for the diagnosis and treatment of osteochondrosis in the dog' in 1996. During several years she worked part-time in a private small animal practice. In 2000 she received a full-time employment at the department of Medical Imaging and Small Animal Orthopedics at the Ghent University. In 2018 she accepted the task of faculty director of studies to take care of the quality of the education in all aspects.
In 2021 she became diplomate of the ECVSMR. Her main interests are lameness examination, arthroscopy, arthrology, rehabilitation and education of students and veterinarians.

PRIV. DOZ. DR. BARBARA BOCKSTAHLER

European Veterinary Specialist in Veterinary Sports Medicine and Rehabilitation, DECVSMR, DACVSMR, FTA, CCRP

Barbara Bockstahler studied veterinary medicine in Vienna, where she initially worked freelance in the small animal practice after completing her studies (1996 - 2002). Since 1999 she has been head of the Service for Physical Medicine and Rehabilitation at the University of Veterinary Medicine Vienna. Barbara Bockstahler has been a specialist veterinarian for physiotherapy and rehabilitation (Austria) since 2004 and a Certified Canine Rehabilitation Practitioner of the University of Tennessee since 2007. Her research interest is dedicated to the biomechanics of dogs and she habilitated on this topic in 2009. In 2016 she became a Diplomate of the American College for Veterinary Sports Medicine and Rehabilitation. She is a founding member and current president of the European College of Veterinary Sports Medicine and Rehabilitation.

JOSÉ MANUEL VILAR

Degree in Veterinary Medicine (1994) and PhD, also in Veterinary Medicine (2001) in the Universities of Córdoba and Las Palmas de Gran Canaria, respectively. Collaborator in 7 public research projects, In Spain and Cuba (Universidad Agraria de la Habana). 60 published papers indexed in JCR, most of them in Q1 Journals and most of them as main coauthor. Presented more than 90 communications to national and international meetings and 5 books and book chapters written. Associated editor of the BMC Veterinary Journal and Animals Journal, Q1. Always involved in the objective assessment of lameness in horses and dogs and, since 2013, in the use of regenerative -reparative medicine, as Mesenchymal stem cells and Platelet-rich Plasma derivatives.

PROF. DR. MED. VET. SUSANNE LAUER

Diplomate European and American Colleges of Veterinary Surgeons (ECVS/ACVS), Diplomate European and American Colleges of Sports Medicine and Rehabilitation (ECVSMR/ACVSMR), Clinic of Small Animal Surgery and Reproduction, Ludwig Maximilians University, Munich, Germany

Susanne studied veterinary medicine at Ludwig Maximilians University in Munich. She pursued an internship and surgical fellowship at University of Georgia and consequently specialized in companion animal surgery. After her surgery residency at Iowa State University, she accepted a tenure track position in small animal surgery at Louisiana State University and established a companion animal rehabilitation program in 2003. After her promotion, she moved to the Pacific Northwest and worked in different private surgical specialty clinics until 2016. In 2017 she returned to Germany and now works as Professor in Small Animal Surgery at LMU Munich. Her current interests include kinematic and kinetic gait analysis, balance , efficacy of therapeutic modalities and osteoarthritis.

YVES SAMOY

DVM, PHD, DIPL. ECVSMR

Yves Samoy was born in 1979 in Izegem, Belgium. In 2003 he graduated cum laude as veterinary surgeon at Ghent University. After graduation, he continued to work at Ghent University at the Faculty of Veterinary Medicine, Department of Medical Imaging and Small Animal Orthopaedics to improve his orthopedic skills. From 2008 to June 2013 he was a full time assistant in the Orthopedic department. Under the guidance of Prof. Dr. B. Van Ryssen he finished his PhD on Elbow incongruity in the dog in 2011. Since July 2013 he is Doctoral Assistant in the Orthopedic department and is involved in all kinds of orthopedic surgery including arthroscopy. He is also the developing surgeon behind the TTA Rapid technique. Since 2015 he is CCRP certified by Ghent University and in charge of the Rehabilitation & Physiotherapy Unit. In 2018 he was granted the title of De Facto Diplomate in the European College of Veterinary Sports Medicine and Rehabilitation (ECVSMR). He currently is Vice-Secretary in the ECVSMR Board. Since November 2022 he split his time between University and private practice. Yves Samoy is author or co-author of several orthopaedic publications in international journals and has given numerous lectures and courses on general orthopaedics, rehabiltitation, small animal arthroscopy and the TTA Rapid system.

DR. ROBERTO CHIOCCHETTI
DVM, PHD
Department of Veterinary Medical Sciences, University of Bologna, Italy

Education:

-July 1992: Graduated in Veterinary Medicine at Bologna University with the thesis: "Biomechanics of the domestic mammals vertebral column"

-September 1996: Doctorship in "Domestic Animal Morphology" with the thesis: "Spinal and cerebellar projections of the Edinger-Westphal nucleus in mammals and birds"

Professional Experiences:

Since 1 July 1995 - Researcher at Department of Veterinary Morphophysiology and Animal Production, Anatomy section.

-Academic Years 1996/98 - Teacher in "Veterinary Anatomohistological Methodology" (Degree in Biotechnology).

-Academic Years 1997/98 - Teacher in "Veterinary Anatomohistological Methodology" (Degree in Biotechnology).

-Academic Year 1998/2002 - Teacher in "Anatomy of Domestic Animals" (Degree in Veterinary Medicine).

-Academic Year 2000/01 - Teacher in "Anatomy of the aquatic species" (Diploma Course in Hygiene and Animal Health – Aquaculture and Ichthyopatology)

-Academic Years 2002/2014 – Teacher in "Veterinary Topographic Anatomy" (Degree in Veterinary Medicine).

-Academic Year 2004/07 - Teacher in "Animal Morphophysiology" (degree in "Scienze e Tecnologie Alementari, Facoltà di Agraria, sede di Cesena, Università di Bologna).

-Academic Year 2005 – Teacher in Fish Anatomy (english language) by "the Centro Residenziale Universitario di Bertinoro", in the course "Sustainable Fisheries and Aquaculture in the Mediterranean", promoted by "the Ministero degli Affari Esteri" and in collaboration with the faculty of Veterinary Medicine, University of Bologna.

-Academic Year 2006/07 – Teacher in "Anatomy and Physiology of Domestic Animals" (degree in "Trasformazione e Valorizzazione dei Prodotti di Origine Animale", Facoltà di Agraria di Modena e Reggio Emilia.

Since 1 October 2007 – Associate Professor at Department of Veterinary Morphophysiology and Animal Production, Anatomy section, University of Bologna.

-Academic Years 2008/09 – 2020/21 - Teacher in "Systematic Comparative Veterinary Anatomy II" (Degree in Veterinary Medicine).

-Academic Years 2014/15 – 2020/21 - Teacher in "Anatomy"" (Degree in Animal Production).

- 2013 - Unanimous enabling national scientific functions Full Professor in the competitive sector 07/H1 (Bando 2012, D.D. 222/2012).

2018 - Unanimous enabling national scientific functions Full Professor in the competitive sector 07/H1 (Bando 2016, D.D. 1532/2016).

- Since 2005 - Member of the departmental board of the PhD

2007 – 2014 Delegate of the Department for the Orientation of prospective Students

2008 - 2020 Member of scientific committee of the Library of the Department

- Since 2013 – included in the EAEVE (European Association of Establishment for Veterinary Education) expert master list.

Research Interest

The capital activities of my research group are focused on the neuromorphology.

The major research interests are concerned with the extrinsic and intrinsic innervation of the intestine in animal species (horse, dog, cat, sheep, rat, mouse, guinea-pig, wild rodents, and fish) and humans.

In the last years we studied: the motor and sensory innervation of the porcine urinary bladder and urethral muscle. The nervous pathways utilized by prion pathogens to reach the central nervous system from the palatine tonsils and digestive system during neuroinvasion

At present, some of my studies are on:

1. Cannabinoid receptors in the digestive tract of domestic carnivores (cannabinoid and cannabinoid-related receptors and cannabinoid agonists are very important in inflammatory bowel disease, IBD).
2. Sensory neurons of the dorsal root ganglia of dog, horse, rat (cannabinoid and cannabinoid-related receptors and cannabinoid agonists are very important to reduce somatic and visceral pain).
3. The distribution of the cannabinoid receptors in the sensory neurons of the canine spinal ganglia.
4. Cannabinoid receptors in the skin of dogs with atopic dermatitis.
5. Cannabinoid receptors in the trigeminal ganglion of the horse with head shaking.
6. Cannabinoid receptors in the taste buds of the pig tongue.
7. Serotoninergic receptors in the horse, dog and cat digestive tract (studies related to the use of prokinetics in human and veterinary medicine).
8. p-Tau protein in a rat model of neurodegeneration (a typical taupathy is Alzehimer disease).
9. Mast cells and canine gastrointestinal inflammation.
10. The enteric nervous system modification in Parkinson's disease.
11. The enteric nervous system modification in the dog with type I diabetes mellitus.
12. The enteric nervous system modification in dogs with intestinal inflammation.
13. Characterization of sensory innervation in the horse and dog dorsal root ganglia.
14. Degenerative myeolopathy in the dog (spontaneous disease comparable to human amyotrophic lateral sclerosis).
15. Intestinal aganglionosis of the horse (disease comparable to the human ileocolic aganglionosis or Hirschsprung disease).
16. The localization of neurokinin-1 receptor in the heathy dog and in dog with chronic enteropathies.
17. The distribution of VIPergic and nitrergic neuron in the canine gastrointestinal tract.
18. Density of cerebellar Purkinje cells in dogs with different age and during neurodegenerative disorders.

Techniques utilized: wholemount preparations of the intestinal layers, paraffin- and cryo-sections, immunohistochemistry, retrograde fluorescent tracers, fluorescence-confocal-electron microscopy, cell and tissue culture, image analysis.
For details of all publications with impact factor (83 at present) see PubMed web site.

Member of
- Italian Companion Animal Veterinary Association (SCIVAC)
- Italian Society of Veterinary Internal Medicine (SIMIV)
- Italian Group for the Study of Neuromorphology (G.I.S.N.)

DR. STEPHANIE VON RITGEN
FTA, CVPP

Dr. Stephanie von Ritgen studied veterinary medicine at the Justus Liebig University in Giessen (Germany), where she received her license in 2005. She discovered her passion for anesthesia and pain medicine during her time as a doctoral student at the Vetsuisse Faculty in Bern (Switzerland), where she received her PhD in 2006 with the dissertation topic: "Effect of intravenous sodium iodide treatment mucus accumulation and inflammation of lower airways in coughing horses". She did an Internship in veterinary anesthesiology at the Vetsuisse Faculty in Bern (Switzerland) from 2007 to 2008, followed by an internship in equine medicine at the Vetmeduni Vienna (Austria), and then returned to Austria via an excursion to a private equine clinic and private practice for small animals and horses in Germany, to the Department of Anesthesiology and Perioperative Intensive Care Medicine at the Vetmeduni Vienna. Here she has been working as a veterinary anesthesiologist for large and small animals since 2010 and has been working as a senior veterinarian in the pain clinic for small and large animals since 2015. In 2014, she successfully completed her exam to become a specialist veterinarian in anesthesiology, intensive care medicine and pain management. As a certified veterinary acupuncturist, osteopath, physiotherapist, chiropractor and pain practitioner, she also has a keen interest in complementary medicine. In addition to her veterinary work, she regularly publishes scientific articles and is a speaker at various continuing education events for veterinarians and veterinary assistants in Germany and abroad. "The exciting thing about anesthesia and pain medicine is that you never stop learning; even with decades of experience, you haven't stopped learning. That's why it's incredibly fun as a speaker to pass on your knowledge to others and share insights."

MARION MUCHA
DECVSMR

Marion Mucha studied veterinary medicine in Vienna, Austria and was already involved in physiotherapy as part of her doctoral thesis, which was completed in 2005. Since 2002 she worked in the outpatient clinic for physical therapy and rehabilitation at the university of veterinary medicine in Vienna (Vetmeduni). In the course of her clinical and scientific career, she has given many lectures in Austria and abroad and also conducted research in the field of movement science, physical therapy and acupuncture in dogs. She has been a certified veterinary acupuncturist of the IVAS (International Veterinary Acupuncture Society) since 2004 and is now a member of the board of directors. Since 2007 she is a certified physiotherapist for dogs (CCRP, Certified Canine Rehabilitation Practitioner, University of Tennessee in cooperation with Schlossseminare). In 2010, her book about acupuncture "Checkliste Akupunktur für Kleintiere" was published. In 2016 she further specialised in the field of veterinary pain management (CVPP Certified veterinary pain practitioner, IVAPM) and since 2018 she is an European Veterinary Specialist in Sports Medicine and Rehabilitation (Dipl ECVSMR).

JOÃO C. ALVES
DVM, MSC, PHD

João Alves graduated from the University of Lisbon, Portugal, in 2012 and has since worked at the Portuguese Gendarmerie with their police working dogs, focusing on sports medicine and rehabilitation, helping these animals to achieve their full potential. He completed his PhD in 2021 from the University of Évora, Portugal, in intra-articular management modalities for osteoarthritis. In addition to osteoarthritis, he also does research and as an interest on working dog sports medicine, photobiomodulation therapy, and canine exercise. João has published dozens of papers and lectures frequently on these topics.

DOMINIQUE GRANDJEAN
DVM, PhD, HDR, Dipl ECVSMR

Dominique Grandjean is a Professor at the national veterinary school of Alfort (France), where he works as Head of the small animals and equine clinical sciences department, and of the canine breeding and sport medicine unit. As a faculty in Alfort he has been focussing most of his work on dog's nutrition and working dogs' performance for the last 30 years, with a special attention to oxidative stress prevention and consequences. He was also a colonel veterinarian for the Paris Fire Brigade (military unit, 9500 firefighters) from 1993 to 2021, in charge, among other tasks, of the canine search and rescue teams. Dominique is also national and regional technical advisor of the civilian security for cynotechnics, and advisor for civilian security working dogs (Ministry of the Interior). He is Head of the Nosaïs biodetection dogs program, working on COVID-19 since march 2020. This program also works on high risk prostate cancers, colon and pancreas cancers.

As a researcher his works are focussed on the consequences of stress and hostile environments (warm, cold, altitude) in the working dog, with a deep involvement in sled dog long distance races since 1980, and in search and rescue dogs since 1990. His unit (Unite de Medecine de l'Elevage et du Sport –UMES-) also includes a physiotherapy service (including a specialization diploma on the subject). Dominique already published more than 170 scientific peer-reviewed papers on working dog physiology, nutrition and medicine, and a total of 29 books all related to this area.

He has been a board member for the International Working Dog Breeding Association and is a member of the International Sled Dog Veterinary Medical Association since…the dark ages.

He is Race Director for Lekkarod international Sled dog race, has been an Iditarod veterinarian from 1983 to 1995, as well as chief vet for the late Scandream, Nenana Come Back, Alpirod and numerous European and World championships.

Dominique is among who founded in 2018 the European College of Veterinary Sport Medicine and Rehabilitation.

DANAE CHARALAMBOUS
ECVSMR resident

Danae Charalambous graduated summa cum laude from the School of Veterinary Medicine of the Aristotle University of Thessaloniki in 2014. She continued her postgraduate studies at the companion animal clinic, Faculty of Health Sciences, Aristotle University where she completed a two-year MSc in small animal internal medicine with a research interest in anaesthetic agents' effect on coagulation cascade in small animals. Through her clinical exposure in neurologic and multi-trauma patients, she developed an interest in physiotherapy and rehabilitation. In 2017, she joined Southern Counties Veterinary Specialists in the UK where she worked with various sports medicine and rehabilitation cases. Currently, Danae Charalambous is completing her ECVSMR residency at the Veterinary University of Vienna with publications and research focus on ground reaction forces and center of pressure during physiotherapy exercises and heelwork.

DR JAMES GUTHRIE
BVM&S CertAVP(GSAS) CCRT DipECVS DipACVSMR DipECVSMR FRSB FRSA MRCVS

Diplomate in Small Animal Surgery (ECVS), Canine Sports Medicine, and Rehabilitation (ACVSMR & ECVSMR). Dr Guthrie is a senior surgeon at Fitzpatrick Referrals and his clinical passion is to maximise patient outcomes with minimally invasive surgery coupled with regenerative medicine and rehabilitation therapies.

Early Career
James graduated from The University of Edinburgh in 2010 and was awarded as the best student of his class in veterinary orthopaedics. He then completed a one-year rotating internship at Northwest Surgeons; a veterinary referral hospital in Cheshire. Following this, he spent two years working in a small animal general practice where he obtained the RCVS Advanced Veterinary Practice Certificate in Small Animal Surgery.

Orthopaedic Surgery
In 2013, James joined Fitzpatrick Referrals as a Duty Vet and completed a one-year surgical internship. Following this, James stayed at Fitzpatrick Referrals to pursue his goal of becoming a specialist surgeon and completed a three-year residency programme in small animal surgery in connection with the VRCC. James became a Diplomate of the European College of Veterinary Surgeons in 2018, and shortly afterwards was recognised as a Specialist in Small Animal Surgery by the Royal College of Veterinary Surgeons.

Sports Medicine and Rehabilitation
On the day James completed his surgical residency he began a residency in canine sports medicine & rehabilitation. James completed the residency and became a Diplomate of the American College of Veterinary Sports Medicine & Rehabilitation in 2021. In 2021 he also became certified as a Canine Rehabilitation Therapist by the Canine Rehabilitation Institute. In 2022 James became a Diplomate of the European College of Veterinary Sports Medicine & Rehabilitation.

Teaching and Research
James is involved with the training of residents and interns at Fitzpatrick Referrals to help develop the specialist vets of the future. He is also a guest lecturer and Clinical Instruction Mentor for the Veterinary Students at the University of Surrey. James has published multiple research papers and presented his findings at national conferences.

JEAN-MARIE DENOIX
Professor, DVM, PhD, Founder ISELP, LAIA-ECVDI, DACVSMR, DECVSMR

Dr. Denoix of the CIRALE (Center of Imaging and Research on Equine Locomotor Affections) in Normandy, France has especial interest in equine musculoskeletal system anatomy, biomechanics and in the diagnosis and rehabilitation of equine lameness. He has founded ISELP in 2006. Jean-Marie has been a speaker at many international meetings in more than 30 countries around the world. Last year, he has been invited to present the 'John Hickman Plenary lecture' at the BEVA meeting and the State of the Art lecture ('Milne Lecture') at the AAEP convention. He has set up a rehabilitation unit at CIRALE where residents of the American and European Colleges of Veterinary Sport Medicine and Rehabilitation are trained. In his spare times, he likes training racing standarbred trotters.

STEFAN COCKELAERE

1995 – 2001: Veterinary Medicine – Ghent University (Belgium): became Veterinarian in 2001.
2001 – 2002: Equine Internship – Equine Clinic de Bosdreef (Moerbeke Waas, Belgium)
2002 – 2005: Large Animal Surgery Residency (ECVS) – Ghent University (Belgium)
2006 – 2008: Equine Clinic de Morette (Asse, Belgium) and Equine Clinic de Bosdreef (Moerbeke Waas, Belgium): surgery and orthopaedics
2007: Diplomate of the European College of Veterinary Surgeons (ECVS)
2008 – 2018: Associate Professor Utrecht University (The Netherlands) –Departement of Equine Sciences:

- Research (PhD): surgical cartilage defect repair, regenerative medicine, controlled intraarticular drug release (PhD defense end 2022)
- Teaching: equine surgery, orthopaedics, regenerative medicine
- Clinical work: surgery/orthopaedics/ sports medicine/ rehabilitation

2009- 2010: Focus on Equine Spine: equine spine + chiropractic, graduate in 2010.
2016: Diplomate of the American College of Veterinary Sports Medicine and Rehabilitation (ACVSMR).
2018 – 2021: ISELP – ISELP certified 2022
2018 until now: Sporthorse Medical Diagnostic Centre, Heesch, The Netherlands

DR. RUSSELL MACKECHNIE-GUIRE

PHD, BHSI, BSC (HONS)

Russell MacKechnie-Guire holds a PhD in Equine Biomechanics, graduating from the Royal Veterinary College in 2019. Russell's thesis was titled 'The Relationship between Saddle and Rider Kinematics, Equine Locomotion, and Thoracolumbar Pressures in Sports Horses'. Russell is based at Centaur Biomechanics, a company which he founded in 2006. He has extensively researched the effect that tack (saddle, bridle and girth) and the rider has on equine health and performance. Russell holds a post at Hartpury University as a Reader in Equine Biomechanics. Russell's current area of research is horse-saddle-rider interaction, spinal kinematics in horses when ridden over ground, the effect that rider asymmetry has on equine back movement, and from a rehabilitation perspective, the effect that training aids and pole work exercise has on back movement. In addition, Russell collaborates with researchers on various research projects associated with equine health, rehabilitation and performance. Russell is a consultant for the British Equestrian Federations World Class, Team GBR programme and is a member of Team GBR's Scientific Advisory Group. Russell also sits on the Society of Master Saddlers Scientific Advisory Group, and is part of the executive committee for the International Task force on Laterality in Sports Horses. Russell is also a Pilates instructor, Intrinsic (Human) Biomechanics Trainer, a BHSI equestrian coach, and a keen competitor in dressage and show jumping.

ANNA EHRLE
European Specialist in Equine Surgery, DVM, MSC (VPS), CERTAVP (ESO, ESST, VDI, CP), DIPECVS, DIPECVSMR, MRCVS

Following graduation in 2010 Anna completed a clinical internship at the equine hospital, Freie Universität Berlin before she moved to North Devon, UK to work in mixed and equine practice. After she finished her residency in equine surgery at Leahurst equine hospital, University of Liverpool in 2017, she moved back to Berlin to take a position as an equine surgeon with a keen interest in equine orthopaedics and sports medicine. Anna became a Diplomate of the European College of Veterinary Surgeon in 2018 and a Diplomate of the European College of Sports Medicine and Rehabilitation in 2021. Her current research is mainly focussed on disorders of the equine thoracolumbar spine as well as structure and innervation of equine tendons and ligaments.

ANNAMARIA NAGY
PHD DIPACVSMR DIPECVSMR FRCVS

Annamaria is an Associate Professor at the University of Veterinary Medicine Budapest, where she is leading the orthopaedic diagnostics and diagnostic imaging department. Formerly, Annamaria was a senior clinician at the Animal Health Trust. Annamaria is a Diplomate of the European and American Colleges of Veterinary Sports Medicine and Rehabilitation and holds an RCVS Fellowship Diploma and Specialist status. Her special interests lie in diagnosing complicated lameness and poor performance cases and in advanced orthopaedic imaging, including MRI and standing CT. Annamaria is also an FEI level 4 endurance official and treating veterinarian

ANA BOADO LAMA
DVM, DIPL ACVSMR, CERT ES (ORTH), ADVANCED PRACTITIONER IN EQUINE SURGERY(ORTHOPAEDICS). MRCVS. COL 6166

- DVM. Bachelor in Veterinary Medicine at the “Universidad Complutense de
- Madrid”(U.C.M)(1996-2001).
- Internship at The Animal Health Trust in Equine Orthopedics and Poor
- Performance, Newmarket, UK . Veterinary surgeon at Huntingdon racecourse
- and Local Veterinary Inspector (LVI)(2002)
- Equine Veterinary Assistant. Walton Lodge Equine, Ltd. Stevenage. United
- Kingdom. Ambulatory 100% equine practice. (2003)
- Residency in Equine Orthopedics. Edinburgh University, UK(2004-2007)
- Certificate in Equine Surgery (Orth) by the RCVS(2008)
- Advanced Practitioner in Equine Surgery (Orthopedics) by the RCVS(2015)
- Diploma in Sports Medicine and Rehabilitation by the American College of
- Sports Medicine and Rehabilitation. (2016)
- Member of the AVP credentials committee RCVS (2018-2019)
- Private Specialist Orthopedic and Sport Medicine Practice. Assistant Professor
- in postgraduate course MSC Physiotherapy in Horses (Universidad
- Complutense de Madrid) and MSC in Equine Sports Medicine (Cordoba´s
- University). Second opinion and imaging consultant for several practices and
- veterinarians. (2008-2018). Speaker at several congresses and equine
- diagnostic imaging and sports medicine courses.

GAYLE HALLOWELL
MA VETMB CERTVA PHD DIPACVIM DIPACVECC DIPECVSMR PFHEA FRCVS

Gayle graduated from the University of Cambridge and completed a rotating internship and then large animal internal medicine and critical care residency at the Royal Veterinary College in London. She then completed a PhD investigating aortic valve prolapse at the University of Nottingham. After 20 years in academia, she left in February 22 to become Director of veterinary Professional Development for IVC Evidensia. She still undertakes clinical work at Pool House Equine Clinic. She is an American Specialist in Large Animal Internal Medicine, American Specialist in Large Animal Emergency and Critical Care, EBVS Specialist in Veterinary Sports Medicine and Rehabilitation and is Associate Diplomate of the European College of Veterinary Diagnostic Imaging. The topics that she holds close to her heart which include large animal cardiology, gastroenterology and imaging (particularly ultrasonography).

LISA KATZ
DVM, MS, PhD, DipACVIM, DipECEIM, DipECVSMR, MRCVS

Lisa is a Professor of Equine Internal Medicine at University College Dublin (UCD) School of Veterinary Medicine. Lisa obtained her DVM from the University of Georgia in 1994, following which she completed an internship in equine medicine and surgery at Peterson, Smith, Matthews, Hahn & Slone in 1995. By 1998, Lisa had completed a combined large animal internal medicine (ACVIM) residency and masters program in equine exercise physiology at Washington State University. Her research focused on the responses of ponies and horses to short-term training and their ventilatory responses to high-intensity exercise. She became an ACVIM diplomate in 2001, completed a PhD at the Royal Veterinary College in 2003 (investigating the pathophysiology of equine acute laminitis), and became an ECEIM Diplomate in 2005 and an ECVSMR Diplomate in 2020. Her current clinical and research interests include equine exercise physiology and genomics. Lisa joined UCD School of Veterinary Medicine in 2003 and is currently the Head of the UCD Veterinary Biosciences Section and President of the European College of Equine Internal Medicine. Lisa has over 80 peer-reviewed publications and book chapters in equine internal medicine and exercise physiology and genomics.

EMMANUELLE VAN ERCK
DVM, PhD, ECEIM

Emmanuelle graduated in 1996 from the French Veterinary School of Maisons-Alfort. She worked at Equine Sports Medicine Centre at the University of Liège (Belgium) obtained a PhD on respiratory function testing in horses. In 2010, she created an ambulatory referral practice, the 'Equine Sports Medicine Practice' which offers specialized service in equine internal and sports medicine throughout Europe, investigating performance and poor performance in equine athletes of all disciplines. She collaborates with the Hong Kong Jockey Club in telemedicine and cardiology. Emmanuelle is team veterinarian for Belgium and veterinary expert for the FEI. She is also a diplomate of the European College of Equine Internal Medicine (ECEIM). She is author or co-author of over 50 peer-reviewed scientific articles and regularly lectures at international conferences.

DR RACHEL MURRAY
MA, VetMB, MS, PhD, Dip ACVS, Assoc ECVDI, MRCVS
Diplomate, American College of Veterinary Surgeons
Associate, European College of Veterinary Diagnostic Imaging
RCVS Recognised and American Specialist in Equine Surgery
Associate and Specialist, Rossdales Diagnostic Centre, Newmarket, UK
Director of Equine Services, VetCT, Cambridge, UK
Team GB World Class programme veterinarian

Dr Rachel Murray is an experienced veterinary surgeon with a particular interest in advanced imaging, sport horse injuries, performance and rehabilitation. She has been integrally involved in development of magnetic resonance imaging (MRI) in horses and in application of advanced imaging techniques in the diagnosis of injury, publishing many articles and book chapters on orthopaedic problems, rehabilitation and advanced imaging in horses, and edited the standard text on Equine MRI.

Rachel graduated from University of Cambridge before specialising in equine surgery, undertaking an internship and surgical residency in the USA, becoming a Diplomate of the American College of Veterinary Surgeons. After 5 years in the USA, she returned to England as an equine surgeon at the University of Cambridge Veterinary School. She subsequently completed a PhD, investigating exercise-associated joint adaptation and injury in horses.

She was based at the Animal Health Trust from 1997-2019 in a variety of roles including Head of the Centre for Equine Studies, where she ran the equine MRI diagnostic service and the orthopaedic research group, and provided a clinical service focussed on poor performance in sports horses. Since 2019, Rachel has shared her time between VetCT and Rossdales Diagnostic Centre in Newmarket, where she is involved in imaging, lameness/performance evaluation, and rehabilitation. In addition to clinical work, she has led many studies investigating sport horse training, injury, performance and rehabilitation, including for British Dressage, British Eventing, British Equestrian Federation and the International Equestrian Federation (FEI).

Rachel also works for the British Equestrian Federation in various roles, from scientific advice to practical veterinary assessments with various GB international squads and remains a GB World class programme vet. Rachel has been providing advice for the British Equestrian Federation World Class Programme since 2009 and has been integrally involved in the maintenance and preparation of numerous team horses for Championships and Olympic Games. She is an FEI treating veterinarian, has worked as a veterinary surgeon with the Great Britain Dressage and Show jumping teams, including as a team vet, and was an official treating veterinarian at the 2012 Olympics.

Rachel has experience training and competing horses to Grand Prix and international level dressage, has competed in a variety of equestrian sports, and is a British Horse Society accredited professional coach.

NATHALIE CREVIER-DENOIX

Nathalie Crevier-Denoix graduated from the Veterinary School of Alfort (France, 1989). *Agrégée* in Veterinary Anatomy (1993), she defended a PhD thesis in Biomechanics (1996). Professor of Anatomy (1999), she is also (since 2003) the head of a research unit devoted to Biomechanics and equine locomotor pathology in Alfort. After a Veterinary Doctorate on the radiographic images of the limbs of the foal, her research activities have been covering two topics: equine tendon imaging and biomechanics, and biomechanical effects of equestrian surfaces. Her main achievements are the development of a non-invasive device for *in vivo* tendon force measurement (*Tensonics*, patented), the development and application of a combined dynamometric and high speed kinematic measurement protocol compatible with equine training conditions, the development of a testing device for equestrian surfaces, mimicking the interaction of an equine forelimb with the ground in the vertical plane (*Equine Track Tester, ET2*, patent deposited). In 2016 she became diplomate of the ACVSMR, and in 2019, *de facto* diplomate of the ECVSMR (equine). Since 2019, she is principal investigator of a research program on the rehabilitation of superficial digital flexor tendinopathy in racehorses.

She published 53 peer-reviewed articles, and presented more than 95 invited lectures and about 110 short communications in international and national conferences.

ABSTRACTS

« INVITED LECTURES »

PUBLISH OR PERISH: HOW TO DESIGN A CLINICAL STUDY

Renate Weller, University of Calgary

A clinical study is nothing other than a project and as with any project a clinical study needs a plan to succeed. Many publications and lectures on the subject of study design focus on the data analysis part, especially statistics (which most people fear), I would like to suggest a more holistic approach. Below are some suggestions that will help you to come up with said plan using a iterative approach including 3 big questions and 10 steps.

Question 1: Why? – Why do you want to do a study? What motivates you to do this?
Generally we can distinguish between external and internal motivators. External motivators may include publications being part of the requirements for a residency programme, a pre-requisite for tenure and promotion, part of the job description and there may even be financial incentives for every study published. Internal motivators include a desire to find the answer to a question, eg a clinical problem with the underlying motivation to make the world a better place by contributing to animal health. In many cases the desire to educate others by generating and sharing knowledge also plays a role. For most people, especially academic clinicians, extrinsic and intrinsic motivators play a role.

The reason the answer to question 1 is important is because it influences what type of study is the most appropriate. There are "low and high hanging fruit" studies…studies who require more resource in terms of time, energy and money and studies who require less. If the motivating factors are mainly external I would advise an extremely strategic approach by picking a study that "ticks the box" while keeping resources needed manageable.

Question 2: Resources
The next important question is about resources. Resource to consider in this context are time, energy and money…..and sadly all of them are usually limited as well as study material (animals, cases, cadavers, samples).

Question 2a, b and c: What resources do you have available? What resources are you willing to spend? What resource is needed to answer the question you want to answer if intrinsically motivated?

- Time:
  - Is there a set time frame and deadline to which you have to?
  - How much time can you allocate to this? Really? Be honest with yourself!
  - This not only involves your time, but also others. Whom do you need and do they have the time to help?
- Energy: somewhat related to time, but not the same…even if you are able to set aside two hours a week, how productive are you going to be after a whole week of busy clinics?
- Money: how much funding do you have available? How much time/energy do you have to generate funding, eg writing grant proposal, talking to donors
- Availability of material: Animals, cases, cadavers, samples, images

Big question 3: What "rocks your boat"? What are you interested in?
Do not start on a project that you have zero interest in…it will be very hard going and the chances of success will be small. In most cases this will be something in your area of work, sometimes research projects are an opportunity to do something different though as well or can even be the start of a change in career direction.

Answering these three big questions first will help you with planning your study step-by step.

Step 1: Come up with a question
Make sure the question is answerable within your resource frame. If the question is too big, break the whole picture down in puzzle pieces and pick one puzzle piece the size of which matches your resources. For example: How can we prevent fractures in racehorses? Is a very valuable question to ask and constitutes more than a lifetime research program for several research groups. So pick one puzzle piece: eg do racehorses change stride length before they sustain a catastrophic fracture?

Some people are better in coming up with questions than others. There is no shame in "shopping around" for a question by asking other people. Personally I have been keeping a list of questions for decades. So feel free to contact me.

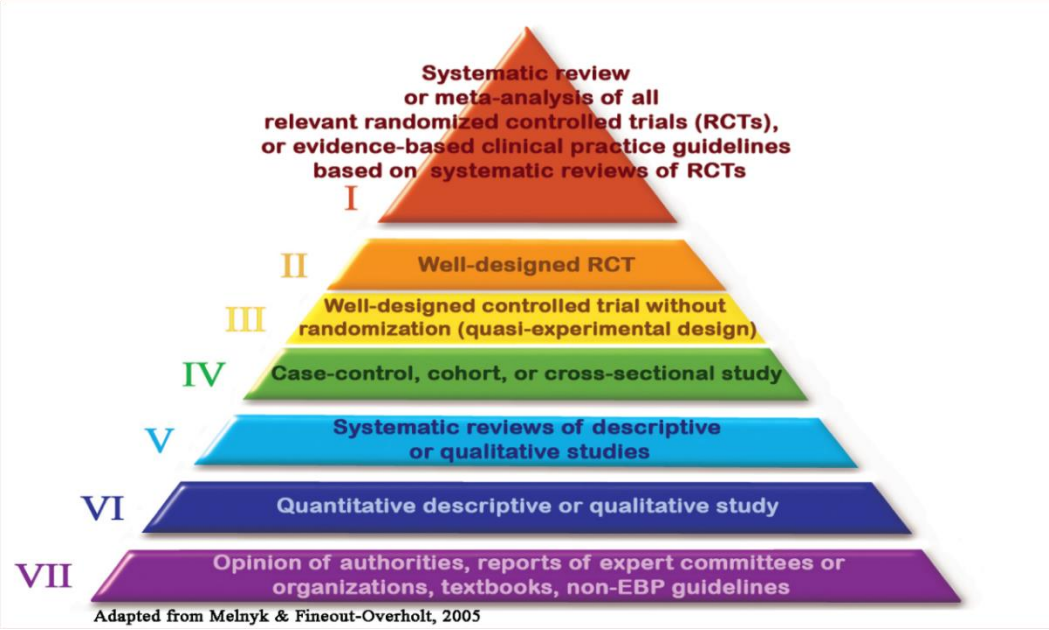
Step 2: What has already been done in this area? What is already known? Has someone already answered your question?
No point in answering the same question unless you have serious concerns about the validity of your answer. Beware that it is often hard to get studies published where the answer has already been given. Scan the literature. Nice if there is a review article as a starting point. Perform a critical literature review rather than a descriptive one. Be comprehensive. Make notes already as this will be the basis for the introduction of your paper write-up.

Step 3: Formulate aim, objectives and hypotheses
- Aim: this is the overarching, often long term aim
- Objectives: these are the smaller units that will combine together to reach your aim. They should follow the SMART principle: specific, measurable, achievable, reasonable, timely
- Hypothesis: a study can have a single hypothesis or several hypotheses, where you speculate on what the outcome will be based on existing literature and/or your experience. Not all studies are hypothesis driven, for example describing the ultrasonography anatomy of the equine temporomandibular joint does not need a hypothesis.

Step 4: Study design
Choose the study design that matches your question, aim, objectives and hypotheses. And think stats already!

There is a hierarchy of evidence in terms of validity of studies:

As a general rule the higher up in the pyramid of evidence you aim for the more resource you will need.



The below table gives some general advice on which study type matches the different question types:

Question type	Best study type
Diagnosis, method evaluation	Prospective, blind comparison to gold standard
Therapy, Etiology, Prevention	RCT > cohort > case-control > case series > case report
Prognosis	Cohort > case-control > case series > case report
Normal reference	Cohort > individual

Depending on the answers to the three big questions you want to weigh the three aspects against each other and consider what type of study you want to choose. For example: are case reports acceptable type of publication to count towards your promotion or do you have to publish a hypothesis driven study? Especially if resources are tight I would advise to look at

- descriptive studies involving existing data (eg radiographs)
- descriptive studies involving “normal” animals
- technique validation studies, involving cadavers or normal animals.

Step 5: Practicalities and logistics

- Material: animals (healthy or diseased), cadavers, data.
- Ethical considerations: Follow the 3R principle of animal use: replacement, reduction and refinement. Make sure your study has been approved by an appropriate ethics board as firstly this is useful and secondly journals now require this.
- Sample size: what sample size do you need, what sample size can you get. Sample size calculator. Getting enough samples is often challenging in veterinary medicine. If this is the case it is advisable to change you study design, eg change from a group comparison to a descriptive study
- Skills: what skill set and expertise is needed to conduct the study? Do you have the skills yourself? Can you learn them within your time constraints? Do you want to learn them? Do you know people who have them and can you “rope” them into the study? Make it clear what they will get out of it! Discuss authorships for example right at the beginning to avoid disappointment later.
- Equipment: what equipment do you need? Is it readily available? Does it need purchasing or

renting? Can you borrow it?
- Consumables: they cost money!
- Logistics: when do you need whom and when where?

Step 6: Come up with a money and time budget: list everything you need
Compare this to the answer to question 3!!!!
If it is not a match, go back to step 1. If it is a match, formulate a cooking recipe" for your study: ingredients and step by step instructions

Step 8: Pilot collect and analyse data and refine plan…or if it is not working at all…go back to step 1

Step 9: Conduct your study: collect, process, analyse data. Describe and discuss results

Step 10: Disseminate: write about it, talk about. Choose your target audience(s) and share your amazing findings with the world.

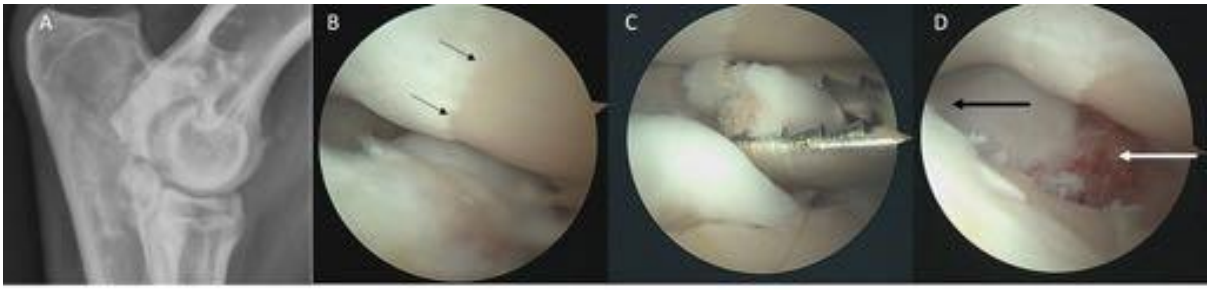
« SMALL ANIMALS »

ELBOW ARTHROSCOPY BEFORE REHAB – WHY IS IT IMPORTANT?

Bernadette Van Ryssen, DVM, PhD, Dip. ECVSMR
Ghent University, Belgium

There are several arguments to justify that elbow arthroscopy before rehab should be performed. Treatment of the medial coronoid lesions and OCD of the medial aspect of the humeral condyle eliminates the continuous irritation of the joint, causing synovitis, cartilage damage, and the development or progression of osteoarthritis.

The goal of rehab is to reduce the pain and to stimulate mobility, muscle development and limb usage. When loose fragments are not removed, rehab of a painful elbow will probably be inefficient or will give only temporary relieve. In the meanwhile, time is lost and damage to the joint is likely to increase. The figure below illustrates the secondary cartilage damage caused by the chronic presence of a coronoid fragment because of a delayed treatment.



German shepherd, age 9 months, lameness of 5 months duration, conservative treatment because of undiagnosed problem. The radiographic image (A) shows a blunt medial coronoid process and moderate osteoarthritis. The joint seems to be incongruent. The arthroscopic inspection (B) demonstrates cartilage loss of the medial part of the humeral condyle (arrows). Via arthroscopy, a large fragment of the medial coronoid process is removed (C). The final image (D) illustrates the incongruity (black arrow) and synovitis. (white arrow)

Even though several studies demonstrated the benefit of an arthroscopic treatment, it has also been questioned by some authors. Indeed, there are some issues that should be considered in the treatment decision making and the expectations during and after rehab.

- The presence of elbow incongruity may cause a less favorable outcome. An additional ulnar osteotomy may be indicated.
- In the majority of the cases, elbow degeneration continues over time. Despite a correct treatment, lameness might not disappear or may recur. Careful follow-up exams should be carried to adapt the rehab program on the long term.
- In chronic cases or when a large fragment is present, an arthroscopic treatment may not be beneficial for the dog or may not lead to any improvement. In chronic cases, cartilage damage may be very extensive with cartilage loss and eburnation of the medial compartment. Sometimes a fragment has grown into a large piece, and removal may be challenging causing surgical iatrogenic lesions.
- In cases of a medial coronoid fissure, the cartilage surface is usually intact and synovitis mild. The benefit of an arthroscopic treatment may be questioned, since also in those joints, DJD will probably progress after the arthroscopic treatment. Specifically in dogs that show only mild or occasional lameness a conservative treatment may be preferable. Similar considerations should be made for the contralateral side of bilateral cases of a fissured medial coronoid process.

- When obvious lesions are detected in dogs that do not show any lameness, especially in adult dogs, the question rises whether fragment removal should be performed or not.
- Studies comparing arthroscopy versus arthrotomy, demonstrated that the results of arthroscopy were better. Arthroscopy allows a more accurate treatment because of the superior intra-articular view. However, experience plays an important role in the success of arthroscopy. A well performed open treatment is still better than a badly performed arthroscopic treatment.

Treatment decision should be made for each specific case, and the history, clinical and imaging findings should be taken into account. Diagnostic arthroscopy may add to the diagnosis and thus help in making the correct treatment decision and prognosis.

- In chronic cases, the direct inspection can demonstrate whether a loose fragment is damaging the joint by the size and position and whether it is feasible to approach it surgically (narrow joint, large fragment, cranial position). The depth and extension of the cartilage damage can be assessed within nearly the entire joint.
- In the same way, arthroscopy gives information about the cartilage damage that has been – or has not been - caused to the joint in mild cases or lesions that do not seem to cause lameness.
- For the diagnosis of discrete lesions such as fissures and microcracks, it has been demonstrated that CT is more reliable because the lesions are located in the subchondral bone and may not be visible in the cartilage surface. The correct interpretation of mild coronoid lesions on either CT or arthroscopic images requires a certain amount of expertise. Ideally both techniques are combined.
- Also in other elbow disorders (flexor enthesopathy, medial compartment erosion, ununited anconeal process and incomplete ossification of the humeral condyle), diagnostic arthroscopy is useful to define the optimal treatment, the rehabilitation protocol and estimate the outcome.

Conclusion:
It is generally accepted that MCD and OCD should be treated (via arthroscopy) before rehab can be started, but this is not true in every case. When a patient is admitted for elbow rehab without a previous treatment, there are several reasons: one reason is an incorrect or missed diagnosis, often when it concerns discrete lesions. In those cases, diagnostic workup is necessary to enable a treatment plan and prognosis. A second reason is advanced OA because of a chronic elbow problem. In those cases, further workup and possibly diagnostic and therapeutic arthroscopy may be useful to obtain a better result.

In any case it is important to identify the type and severity of the primary cause of elbow pain and the presence of secondary damage, to adjust the rehabilitation program and estimate the expected outcome. When imaging techniques do not lead to a diagnosis in a painful elbow, arthroscopy is indicated.

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KINEMATICS OF THE ELBOW JOINT

PrivDoz. Dr. Barbara Bockstahler, European Veterinary Specialist in Veterinary Sports Medicine and Rehabilitation, DECVSMR, DACVSMR
Department for Small Animals and Horses, Small Animal Surgery
Section for Physical Therapy and Rehabilitation
University of Veterinary Medicine Vienna

The canine elbow joint has long been the focus of biomechanical research and numerous studies have been conducted to describe its motion in healthy and diseased dogs. With the help of so-called kinematics, it is possible to describe the movement of body segments and to provide information about, for example, angles, speed and acceleration. Not described are forces acting on the joint. Although motion always takes place in three-dimensional space, many studies only describe motion in the sagittal plane, which allows a description of the flexion and extension movement of the joint. A deeper insight is provided by three-dimensional motion analyses, for example by flouroscopy. An excellent overview of available studies is given by Rhowedder.[1]

The healthy joint in forward straight motion

In most studies describing sagittal motion, an increasing extension of the joint during the stance phase is represented, which is followed by flexion in the swing. From about the middle of the swing phase, the joint is then brought back into an extended position in order to allow the foot to strike the ground.[2,3] However, a deeper insight into kinematics is provided by flouroscopy. For example, this method was used in a study to describe the three-dimensional movement of the segments of the forelimb in Beagles.[4] Here it could be shown that the humerus is in retraction at the beginning of the stance phase, which continues in the course of the stance phase, with a maximum shortly before the beginning of the swing phase. In the swing phase, protraction then occurs until shortly before the end of the hang-leg phase. At the beginning of the stance phase, the humerus was in an abduction position, which was maintained throughout the stance phase. This could also be observed in the first half of the swing phase, and then adduction occurred in the second half. At the beginning of the stance phase, the humerus was in internal rotation; at the walk, both internal and external rotation occurred during the stance phase, while at the trot, it experienced only external rotation. During the swing phase, it again undergoes internal and external rotation while walking, but only internal rotation while trotting. The ulna was in protraction position at the beginning of the stance phase and then retracted during the stance phase. It was then protracted just before the paw lifted off, which continued throughout most of the swing phase. It was then retracted again in preparation for touchdown, although a net retracted position was not achieved until after touchdown. The ulna is also in an adducted position during touch down, which is further increased during the first half of the stance phase. Then in the second half, the adduction reduces, but it did not reach an abducted position. From the beginning to 2/3 of the stance phase, the ulna is in internal rotation, and is then rotated externally in the remaining third of the stance phase and the first third of the swing phase, to then be positioned in internal rotation for the remainder of the swing phase.[4]

The diseased joint

Numerous compensatory mechanisms occur in dogs with diseased elbow joints. Frequently described is a decreased ROM in the sagittal plane.[5–7] For example, in dogs with MPC, this is accompanied by an increased flexion during the touch down, which the authors attribute to a decreased protraction of the limb. Additionally, it was noticed that the joint flexes rapidly at the end of the stance phase without, however, a burst of positive power. This is explained by the fact that the limb is pulled up by the proximal muscles rather than actively pushed.[7] In addition, an increased suppination of the elbow before and shortly after touchdown is described, whereas the forearm was suppinated more during touchdown, but then abducted more in the early stance phase.[5]

Special movements

As important as the study of the movement of the joint during walking is, it is also interesting to study how the joint behaves when particular loads are applied.

For example, Holler et al. investigated early on the kinematics of walking uphill and downhill, and walking over cavaletti.[2] They were able to demonstrate that during upward and downward walking, the acceleration parameters of the elbow decreased significantly. When the dogs were measured with a steeper gradient, they showed a decreased maximum extension and increased flexion of the elbow during downward walking.[8] Carr et al. showed that when walking uphill over a steeper slope, there is increased flexion and extension of the joint.[9]

Walking over obstacles significantly increased elbow flexion, acceleration parameters were significantly decreased, additionally maximum forward velocity was also decreased. In dogs with cubarthrosis, walking over cavaletti resulted in increased flexion and increased ROM, decreased extension was observed when walking downhill.[10] Increased flexion and extension of the joint was described when walking up stairs.[9] Looking at the kinematics during downward stair climbing, the maximum extension decreased compared to trotting on flat ground.[8] Here, however, also increased the maximum flexion of the joint.

Studies have also been conducted on the subject of jumping. Here, for example, it could be shown that with increasing height of an obstacle, the elbow is increasingly flexed..[11]

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BIOMECHANICAL ASSESSMENT OF REGENERATIVE THERAPY IN ELBOW OSTEOARTHRITIS

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Poor correlation has been found between diagnostic imaging findings and functional status of a joint. For this reason, the objective assessment of the true impact of a joint disease on the dog's motion, but also the objective assesment of the effect of a specific therapy against a joint disease should be the core matter in order to chose the best therapeutic option.

That is the reason why the number of research papers regarding biomechanical análisis is exponentially increasing in the last years, with more sofisticate and accurate techniques avalilable. A simple search in pubmed throws more that 20.000 Results in the last 5 years.

In agree with this, the aim of this lecture is to show our experience in the validation of an innovative biomechanical technique, the postural análisis, for the asssessment of the effect of a PRP derivative in dogs with EJD.

Peak vertical force (PVF) and vertical impulse (VI) are two of the most common kinetic parameters used for objective lameness detection in dogs, horses and other domestic animal species; these parameters are usually obtained using force or pressure platforms.

Pressure platforms, with their multiple sensors, have the potential to provide more information than force platforms; however, references describing the use of pressure platforms remain scarce, and the majority of these studies are descriptive, and dynamic (movement)

At the moment of the publication of this paper (2017), no research on static analysis in lame dogs with postural changes could be found, specifically in spatial modifications in body center of pressure (COP) and the derived consequences of changes in paw area, and mean or maximum pressure values, among other parameters.

Different strategies have been proposed for the treatment of OA, some of them regenerative-reparative; among them, Platelet Rich Plasma (PRP)-based products such as plasma rich in growth factors (PRGF) therapy, has been widely used as a single or co-adjuvant therapy in the treatment of OA in dogs . Some of them by our research team, but others authors also published interesting research about this topic.

For our study design, we hypothesized that assessment of COP variations, together with other secondary static parameters, could serve as an objective and quantifiable tool to detect lameness and its variations by disease evolution or by the effect of a given treatment. In this line, to test the static posturography as a potentially reliable, objective methodology to assess lameness in unilaterally lame dogs affected by elbow OA in elbow joints, and assess the effect of PRGF in this disease.

The **balance** is constantly **perturbed** by internal and external factors as breathing, heartbeating or terrain inclination. The balance recovery is performed by constant compensatory movements, jointly exerted by the central nervous system, sight, and muscular system.

This continuous imbalance-recovery is known as *postural sway*. In this way, static posturography becomes an objective evaluation method of the balance system.

In quadrupeds, many clinical practitioners assume that the COP position coincides with the projection of the CG on the support surface, although these two parameters are based on different concepts.

Remember that we should assume that COP is constantly moving, defining the *COP sway*

This sway is recorded in both the latero-lateral (X) and craniocaudal (Y) axes of the body.

In this way we can obtain a *statokinesiogram*, which graphically depicts the movement of COP in an X-Y coordinate system; specifically, the statokinesiogram depicts the area determined by an ellipse that contains 90% of the recorded points of the COP sway. Measured in mm2, a lower value means more stability.

When lameness is present, the associated pain causes loss of balance in the static position which is provoked by the patient transferring weight from the painful limb to the healthy (or less lame) contralateral in an effort to alleviate the pain. In other words, pain can also cause postural (COP) modifications.

PRP derivative that we used was the PRGF®-endoret® (BTI, Vitoria, Spain) characterized by a moderated amount of platelets (double respecting to peripheral blood) and less than 0.3 leukocytes/ µL.

The methology has been previously published elsewhere but briefly: The blood was collected from the external jugular vein of each dog under sterile conditions in Vacutainer sodium citrate 3.8% tubes (Blood-Collecting Tubes®, BTI Biotechnology Institute, Alava, Spain). the tubes were centrifuged at 460 g for 8 min (PRGF® System III, Biotechnology Institute, Alava, Spain) to separate the different blood phases. The fraction located immediately above of the buffy coat (white fraction) corresponds to PRGF. The extraction procedure of the plasma fractions was carried out under the maximum conditions of sterility in the laminar flow cabinet and always by the same individual. PRGF was activated by adding 5% of calcium chloride (CaCl2 10%) to activate platelets for growth factor release. Once the diferent plasma fractions were extracted, a total of 2 mL of PRGF was infiltrated into the affected joints by conventional arthrocentesis site.

For the postural analysis we used a pressure platform (EPS/R1, Loran Engineering, Bologne, Italy), and an acquisition frequency of 100 Hz; the dog should be quiet stance with their forelimbs over the pressure platform. We obtained three valid recordings of 10 seconds.

The obtained parameters were pressure distribution between forelimbs, paw area, mean and maximum pressure and statokinesiogram.

The results showed as all these different static parameters showed a significant improvement after the treatment.

WHAT YOU SHOULD KNOW ABOUT ELBOW SURGICAL TECHNIQUES BEFORE STARTING REHAB

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Developmental elbow diseases are considered a leading cause for forelimb lameness in dogs. Surgical interventions for developmental elbow disorders are manifold including arthroscopic fragment and flap removal, screw fixations, osteochondral transfer/replacement, tendon release, corrective osteotomies, as well as salvage procedures like elbow arthrodesis and total or medial compartmental elbow replacement. Additionally, trauma to the elbow resulting in intraarticular fractures, elbow luxations, and collateral ligamentous injuries requires surgical stabilization to reestablish elbow anatomy and function. Postoperatively, patients are under the care of both, physical therapist and surgeon. Moreover, physical therapists commonly take on an important advisory role for patient owners prior and after surgical intervention. Understanding the main surgical approaches, biomechanics after surgical intervention, risk for complications, expected healing time and outcome, as well as a mutual understanding of the surgeon's and physical therapist's point of views are important to optimize team work and outcome.

Fragmented coronoid disease (FCD): Today, fragmented coronoid disease is primarily treated minimal invasively via arthroscopy allowing for fragment removal and subcoronoidectomy. Open approaches are performed infrequently. Access to the medial coronoid process can be obtained via a medial approach with tenotomy of the pronator teres muscle and incision of the medial collateral ligament allowing for better visualization compared to a tendon/ligament preserving muscle splitting technique between flexor carpi radialis and superficial digital muscles. Morbidity is considered higher for open surgical techniques compared to arthroscopy. Particular complications are rare, but include median nerve damage and iatrogenic ulnar fracture secondary to subcoronoidectomy. Open and arthroscopic release of the biceps insertion on the ulna has been recommended for FCD with the goal to unload the medial humeral condyle and the medial coronoid process allowing for coronoidal microcracks to heal. Therapeutic efficacy of this procedure is unknown.

Medial compartment disease (MCD): Abrasive/erosive cartilage loss in the region of the medial elbow compartment has been addressed surgically with ulnar biceps tendon release and numerous corrective osteotomy techniques with the goal to unload the medial elbow compartment surgically.[1] A recent prospective study indicates that distal dynamic ulnar ostectomy and bi-oblique dynamic proximal ulnar osteotomy both decreased lameness, joint associated pain and ulnar subtrochlear sclerosis. However, osteoarthritis progressed and elbow range of motion decreased.[1] Bi-oblique dynamic proximal ulnar osteotomy is performed via a caudo-lateral approach between the flexor carpi ulnaris and extensor carpi ulnaris muscles with an osteotomy orientation intended to limit severe movement of the proximal ulnar segment in transverse and sagittal planes.[2, 3] Potential specific complications include excessive proximal segment migration, delayed osteotomy union, bacterial infection, seroma and cortical fissure. Radiographic osseous union is expected in approximately 90% of dogs 4 months postoperatively.

Proximal abducting ulnar osteotomy (PAUL) is a surgical procedure intended to unload the medial compartment via a transverse ulnar osteotomy secured with a special locking plate, that results in mild abduction.[4] Major postoperative complications (delayed and non union, implant failure, and infection) were observed in 12 - 25% of dogs.[5, 6]. Questionnaire-based studies on mid- and long term outcome after PAUL are controversial ranging from no difference compared to arthroscopic therapy by itself to improved function.[5, 7] Sliding humeral osteotomy (SHO) is a complex surgical procedure, that has been shown to decrease humeral forces transmitted through the medial joint compartment using a specialized stepping plate applied via a medial approach.[8, 9] Several clinical studies demonstrated short

and long time functional improvements subsequent to SHO.[8, 10] The initially very high major complication rate was considered disadvantageous, but could be substantially decreased with a modified SHO application technique.[8] Overall, there is still a lack of controlled prospective comparative studies evaluating short and long term outcome after corrective osteotomy for MCD. Canine unicompartmental Elbow (CUE) arthroplasty with press-fit humeral and ulnar implants allows focal resurfacing of the medial elbow compartment in dogs with full thickness cartilage loss due to MCD. A recent multicentric study observed acceptable limb function in 77% and good limb function in 22% of dogs. Approach-related complications could be subjectively lowered with a modified caudomedial approach compared to the original medial approach with medial epicondylar osteotomy or tenotomy and desmotomy. In this study, inferior functional outcome appeared to be related to implant-related contact lesions and progressive erosion of the medial coronoid area.[11]

Ununited anconeal process (UAP): Traditional surgical therapy based on removal of the loose anconeal process typically results in substantial progression of osteoarthritis. Ulnar osteotomy has been employed with the rationale, that release of the proximal ulnar segment would allow the anconeal process to heal. A retrospective study indicates, that proximal ulna osteotomy combined with lag screw fixation improves healing of the UAP in young dogs with minimal degenerative joint disease compared to ulnar osteotomy or lag screw fixation by itself.[12]

Osteochondrosis dissecans (OCD): Arthroscopic debridement of cartilage lesions, osteostixis of underlying subchondral bone to stimulate fibrocartilaginous ingrowth and flap removal are mainstay procedures particularly recommended for early disease stages. Osteochondral autograft transfer of cartilage harvested from stifles has been performed to resurface humeral condylar defects via medial arthrotomy in selected patients with OCD and concurrent FCD with favorable short term outcome in the majority of the patients.[13]

Sliding humeral osteotomy has been advocated as adjunct to arthroscopic debridement. However, a case series on juvenile dogs with OCD showed that medial compartment disease still developed after SHO.[14]

Radioulnar incongruence (RUI): In dogs with radio-ulnar incongruence due to elbow dysplasia, restoration of elbow joint congruency is the primary goal of corrective osteotomies as long as osteoarthritis is minimal. Proximal and distal ulnar ostectomies are performed to allow the proximal ulnar segment to move proximally, while proximal radial lengthening combined with ulnar ostectomy level radial and ulnar length simultaneously.

Salvage procedures: Several endoprosthetic implants systems have been developed for total elbow replacement (TER) throughout the last decades. Contrary to total hip replacement, outcome after total elbow replacement is still substantially less consistent due to challenges with range of motion and stability. Caudolateral approaches with lateral epicondylar osteotomy or transection of the lateral collateral ligament have been described for TER. Clinical complications including luxation, fracture, implant loosening and infection may not always be successfully treatable and ultimately require amputation or arthrodesis. Several novel systems (FitzTER, Sirius Generation 3; Tate-System) have been refined and advanced throughout the last years. Results from evidence-based studies are expected soon.

Elbow arthrodesis is a salvage procedure for articular fractures or (sub)luxations that cannot be treated successfully otherwise, but also for failed total elbow replacement. Elbow arthrodesis is also an effective surgical intervention to alleviate joint pain due to end-stage osteoarthritis, but only provides fair outcome with visible lameness due to loss of elbow function.[15] Recently a medial approach with transarticular plating has been proposed to avoid the standard caudal approach with olecranon osteotomy.[15] A recent study confirmed high complication rates for elbow arthrodesis. Surgical approach (medial, lateral or caudal approach) and transarticular stabilization method (

dynamic compression plates, locking plates, and external skeletal fixation) did not appear to affect the complication rate. Radiographic bone union was achieved after 9 weeks. [16]

Articular elbow fractures: Anatomic reconstruction and rigid stabilization are considered a prerequisite for successful repair of articular fractures. A recent study showed that classic stabilization of condylar fractures with lag screw and antirotational Kirschner wire resulted in higher complication rates compared to lag screw fixation with adjunct epicondylar plate.[17] Since then, adjunct epicondylar plating has been also recommended for fracture repair in immature dogs.[18] Complication rates (15-33%) and functional outcome vary (residual lameness: 28-57%) with main complications including implant failure, non-union and osteoarthritis. Postoperative radial, median or ulnar nerve damage is rare and appears to be associated with more complex fracture scenarios extending proximally. In dogs, reduced elbow mobility is frequently observed postoperatively, but does not necessarily affect outcome negatively.[17] Particularly after surgical stabilization of comminuted mechanically demanding fractures, that require complex approaches with olecranon osteotomy or triceps tenotomy, surgeons may be "mechanically protective". In this immediate postoperative period, therapeutic goals of the physical therapist and surgeon's point of views on wound healing, protection of tissue corridors and mechanical stability of the fracture repair should be discussed with the goal to improve outcome.[19]

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REHAB OF THE ELBOW – IS IT EVIDENCE BASED?

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Introduction

The elbow joint is a complex, accurately matching joint, formed by the distal humerus and the proximal radius and ulna. The elbow is designed for flexion and extension, although a limited pronation and supination is allowed.

There are several orthopaedic conditions that can affect the elbow joint, but from a rehabilitation point of view, we should focus on 4 topics that have an impact on the elbow function:

- *Synovium/synovitis*
- *Condition of the cartilage*
- *Range of Motion (ROM)*
- *Surrounding muscles, tendons and ligaments*

This presentation will look for physiotherapeutic evidence to support these structures.

Synovium/Synovitis

Any trauma of any kind to a joint will initially cause an inflammation of the joint capsule or synovitis. This results in a pain response by the body. This pain and inflammation can be addressed using physiotherapy.

Thermotherapy

Most studies are human based and could demonstrate a positive effect of cryotherapy. The optimal effect is reached after 10 to 20 minutes and the more superficial tissues are affected best. This has a impact, as some regions and joints lie deeper than others. The elbow is a superficial joint and should thus benefit more from cryotherapy.

In the human knee, a decrease of interleukin-1β, interleukin-6, and vascular endothelial growth factor was demonstrated. No similar data are available on other joints or in veterinary medicine.

Photobiomodulation

Laser therapy has been demonstrated as effective if the dosage and wavelength is correct. Laser therapy was able to improve the VAS and CBPI score after 1 session and resulted in a reduced need for NSAIDS.

Nevertheless, there is still room for further research in that field.

Condition of the cartilage

Cartilage regeneration in the strict way is still impossible. There are careful steps taken towards regeneration of microfractures, using stem cells, but it all depends on how those are activated.

Cartilage can be supported by food supplementation as well, but not all products do what they promise. So far, the most promising and proven supplements are Collagen type 2 and Omega 3 Fatty acids.

There is one report that claims laser has a positive effect on cartilage regeneration, but it acts on the thermal effects of laser. This is something that cannot be achieved by the commercially available therapeutic devices.

The scientific evidence of the effect of therapeutic laser on cartilage is limited to laboratory animals and could only demonstrate secondary effects like an increase of chondrocyte proliferation, a decrease in proteoglycan loss and a decrease of the MMP-13 expression.

A meta-analysis could conclude that laser has some effect on cartilage in animals, but it's highly dose

and time dependant.

Range of Motion (ROM)

The normal ROM of the elbow is about 35° in flexion and 165° in extension. The ROM can be improved by swimming. Even a single session can already have a positive effect on ROM, stride lenght and stride frequency. Less elbow specific research demonstrated swimming to decrease the catabolic chondroitin sulphate epitope WF6 and an increase of the cartilage anabolic hyaluronan. Passive ROM exercises improve cartilage nutrition, prevent capsular fibrosis and muscle contractures and stimulates blood and lymph flow.

Muscles, tendons and ligaments

More research has been done in human medicine since medial and lateral epicondylitis is far longer known than in veterinary medicine. There was no independent proof that therapeutic ultrasound, acupuncture, laser or extracorporeal shock wave therapy has any benefits in treating those conditions. Rest, ice and (local or general) (N)SAIDS have the best results.

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CANNABINOID AND CANNABINOID-RELATED RECEPTORS IN THE NERVOUS SYSTEM AND JOINTS

Roberto Chiocchetti

Introduction

The endocannabinoid system (ECS) is a system composed of cannabinoid receptors, their endogenous ligands (endocannabinoids) and the proteins involved in the metabolism and transport of these ligands. Recent studies attributes to the ECS an increasingly important role in several pathophysiological conditions, with particular regard to pain and inflammatory process management (Barrie and Manoilos, 2017; Ferreira et al., 2017).

Pain is associated with hyper-excitability of sensory neurons and satellite glial cells (SGCs) of the dorsal root ganglia (DRG) and their down-modulation could thereby decrease pain (Krames et al., 2015). A growing body of literature suggests that cannabinoid receptors play a critical role in nociception through peripheral and central mechanisms. Joint pain can therefore be modulated by the activation of cannabinoid receptors present on the DRG cells.

In addition, cannabinoid receptors could also act at the peripheral level, modulating joint inflammation and, consequently, reducing the perception of joint pain. There are evidences showing that the ECS may modulates synovium homeostasis and that some cannabinoid receptors modulate proliferative and secretory responses in joint inflammation. Therefore, cannabinoids could be a promising target for osteoarthritis therapy.

Although this is an expanding sector, the knowledge available in veterinary medicine is still very limited.

This presentation summarizes the recent studies carried out by my research team with the aim to fill this knowledge gap, at least in part, by analyzing the distribution of cannabinoid and cannabinoid-related receptors in the DRG and the synovial membrane of healthy dogs.

Materials and methods

The cervical spinal ganglia (C6-C8 DRG) and the synovial membrane (hip and stifle joints) were collected from six dogs without neurological symptoms and/or joint inflammation, who spontaneously died. Tissues were fixed in 4% paraformaldehyde and subjected to immunohistochemical reactions on cryosections. The antibodies used were directed against cannabinoid receptors (CB1 and CB2) and the following cannabinoid-related receptors: GPR55 (G protein-coupled receptor 55), TRPV1 (transient receptor potential vanilloid type 1), and PPARα (nuclear peroxisome proliferator-activated receptor alpha). The specificity of the employed antibodies on canine tissues has been tested by Western blot analysis (Galiazzo et al., 2018; Chiocchetti et al., 2019).

The identification of neurons and glial cells of the sensory ganglia was performed through the use of NeuroTrace® (marker of neurons) and GFAP (marker of satellite glial cells; SGCs). The identification of synoviocytes in the synovial membrane was performed through the use of IBA1 (marker of macrophages and dendritic cells) and vimentin (marker for fibroblasts).

Results

Cervical spinal ganglia

About 50% of DRG neurons expressed weak-to-moderate CB1R immunoreactivity (CB1R-IR). Occasionally, satellite glial cells (SGCs) expressed faint CB1R-IR. The nuclei of all the DRG neurons expressed faint CB2, whereas bright CB2R-IR was expressed by Schwann cells. About 40% of DRG neurons expressed moderate GPR55-IR, whereas bright GPR55-IR was expressed by all the SGCs. About

55% of DRG neurons showed TRPV1-IR; the brightest TRPV1 immunolabeling was displayed by small neurons. In the older dogs, TRPV1-IR was expressed also by SGCs. PPARα-IR was expressed by SGCs.

Synovial membrane
The synoviocytes of hip and stifle joints showed immunoreactivity for CB1R, CB2R, TRPV1 and GPR55, whereas PPARα-IR was almost undetectable.

Conclusion
Dorsal root ganglia - The glial and neuronal immunoreactivity of cannabinoid and cannabinoid-related receptors provide a robust anatomical basis for the possible use of the agonists of these receptors in the treatment of pain (Starowicz and Finn, 2017; Pergolizzi et al., 2018). The interactions between sensory neurons and satellite glial cells are in fact involved in the genesis of neuropathic pain.

Synovial membrane - Arthropathies can be a significant source of pain in dogs, and finding new therapeutic treatments to alleviate the pain is of paramount importance. It is known that cannabis-based drugs have a therapeutic potential in inflammatory diseases, including osteoarthritis and rheumatoid arthritis, as demonstrated by pre-clinical and clinical studies in animals and humans (Richardson et al. 2008; O'Brien et al., 2018). Given the expression of the cannabinoid and cannabinoid-related receptors in different synovial elements of the canine joints, these findings encourage the development of new studies supporting the use of molecules, such as cannabidiol or palmitoylethanolamide, acting on these receptors to reduce the inflammation during joint inflammation in the dog.

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WHAT IS NEW IN PAIN MEDICATION?

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Alleviating pain and thereby improving the quality of life of our four-legged patients is one of the most important tasks we veterinarians have. In this sense, the search for new and more efficient options, including pharmacological options for pain control, continues. Recent innovations in this direction include the use of drugs recently approved for veterinary use, such as Grapiprant and species-specific anti-nerve growth factor monoclonal antibodies (anti-NGF MAbs), and others still under investigation, such as cannabinoids.

Due to time constraints, I would like to focus on the species-specific anti-NGF MAbs for dogs and cats, known under the trade names Librela® and Solensia®.

Research in recent decades has clearly demonstrated the important role of NGF in modulating nociception in a variety of acute and chronic pain conditions (1-4). NGF is released by damaged joint tissue as well as by inflammatory and immune cells and is an important messenger for sensitising nociceptors. However, NGF not only sensitises nerve fibres, but also alters the number of activated nociceptors, as well as the amount of neurotransmitters released by the primary afferent neurons in the dorsal horn of the spinal cord. Through these effects, NGF produces pain and contributes to inflammation. The "trapping" of free nerve growth factor using monoclonal antibodies against NGF has been shown to be effective in relieving pain.

There is evidence that it is associated with chronic pain and that the use of species-specific anti-NGF monoclonal antibodies has a beneficial effect on pain control in dogs and cats with arthritis, degenerative joint disease, and other chronic pain conditions (5-14).

Given as a single injection, the efficacy of anti-NGF MAbs appears to last approximately four to six weeks and the magnitude of effect appears equal to, or greater than, that of NSAIDs (8).

Monoclonal antibodies are just proteins that need to be species-specific to prevent a neutralising immune response. Therefore, these antibodies are very specific in their effect, so that the occurrence of side effects is rather unlikely or reduced. The antibodies are further degraded to amino acids and peptides and are therefore not metabolised in the liver or kidney, nor are they converted to reactive or toxic metabolites or excreted in the urine. Therefore, it is not surprising that no significant side effects have occurred in the studies published to date in dogs and cats; only mild injection site reactions (swelling and heat) in dogs and skin reactions (itching, skin inflammation and hair loss) in cats; however, the study populations to date are relatively small. Studies with anti-NGF MAbs in humans have shown that rapidly progressive osteoarthritis (RPOA) can occur, especially when used concomitantly with NSAIDs. RPOA has not been described in the veterinary literature and has not been observed in clinical trials conducted to date.

Recently, however, there have been several indications that the use of bedinvetmab (Librela®) and frunevetmab (Solensia®) may also lead to other side effects that are currently not listed in the package inserts of the drugs. The extent to which a link can be found between the use of anti-NGF MAbs and side effects must and should be part of future research.

Additionally, bedinvetmab (Librela®) and frunevetmab (Solensia®) should be used as part of a multimodal pain therapy concept, i.e. in combination with e.g. physiotherapeutic procedures. This is the only way to ensure that the musculoskeletal system of our four-legged friends, which has become "pain-free" or "less painful" as a result of the medication, is also sufficiently prepared for the additional movement associated with it. It is also important to point out to the owners that they should increase

the additional movement of their animals slowly at first. Otherwise, it is to be feared that we will see more dogs and cats with progressive deterioration of their disease or that many of our chronic patients will become conspicuous with acute pain episodes (breakthrough pain) that cannot be treated with bedinvetmab (Librela®) and frunevetmab (Solensia®) alone.

As further experimental studies and research are mainly in the field of anti-NGF, especially regarding long-term use and the occurrence of certain side effects, the future prospects for innovative pharmacological approaches to pain treatment for our chronically painful four-legged friends are nevertheless very promising.

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PAIN MANAGEMENT IN PHYSICAL THERAPY

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The International Association for the study of pain defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (1). Pain is described as adaptive and maladaptive. While adaptive pain protects the body from injury and promotes healing, maladaptive pain reflects pathologic activity of the nervous system and is of no biological use to the animal (2). Pain leads to numerous unwanted effects such as tachycardia, hypertension, increased peripheral vascular resistance, suppression of the immune system and a risk of developing a chronic pain syndrome (3).

Therefore, it is our duty, to not only be able to accurately diagnose pain, but also provide the best treatment possible and assess the patients in a regular basis.

Unidimensional and multidimensional pain scales, evaluating acute or chronic pain, are available for cats and dogs (please find some examples below). Cats are an especially challenging species to evaluate the presence and severity of pain. To target this issue, a new approach in cats has been defined (4).

Multimodal approach, which includes medications and physiotherapy modalities and methods, is the 'gold standard' for treating pain in animals (3). Medications should be chosen according to the nature of pain and potential comorbidities of the animal , which may aggravate side effects of medications(5). Methods and modalities of physical medicine such as electrotherapy (6), laser therapy (7), extracorporeal shock wave therapy (8), therapeutic ultrasound (9) or MBST (10) are methods that can be used with good success in our animal patients (2, 3). Acupuncture (11) is also a useful additional option.

In addition to treating the pain itself, it is necessary to optimally relax and strengthen the surrounding soft tissues, such as muscles, tendons and ligaments. Those structures are of particular importance since they stabilize affected joints and act as shock absorbers. Tense and painful muscles could benefit from massage and passive range of motion exercises, while active movement exercises are the method of choice to reactivate the usually weakened muscles, in chronic pain patients (3).

Treating pain, and especially chronic pain, can be challenging and the compliance of the owner is imperative. The goals of the treatment should be discussed and decided with the owner during the initial consultation. However, realistic goals should be set depending on the condition and the severity. A senior dog with multiple arthropathies is unlikely to jump again like a young dog. But especially this dog needs a good pain management. Achievable goals could represent for example, being able to jump into the car without assistance, or standing up without constantly slipping away.

Examples for pain scores:

https://www.newmetrica.com/acute-pain-measurement/download-short-form-pain-questionnaire-for-dogs/

https://www.newmetrica.com/acute-pain-measurement/download-pain-questionnaire-for-cats/

http://journals.plos.org/plosone/article/file?type=supplementary&id=info:doi/10.1371/journal.pone.0131839.s001

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CHALLENGES OF WORKING DOGS – TRAINING AND INJURIES

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Dogs have historically been selected to perform multiple tasks. Currently, they are employed by police and military forces throughout the world in different task missions, from patrol, apprehension, search and rescue, to product detection (including explosives, drugs, body fluids, poison, tobacco, guns, paper money, and other)[1]. Independently of the specific task performed, working dogs must have adequate physical capability, mental aptitude, and proper cooperation with their handler. Altogether, these will allow for adequate performance in the face of challenging environmental conditions and situations[2]. For these dogs, the ability to perform ultimately translates into saved lives[3], so working dogs should be considered and treated as performance athletes. This means that, when assisting a working dog, there are additional requirements other than to maintain a proper musculoskeletal condition. Working dog sports medicine is a continuous and neverending process of optimizing performance, preventing injury, and mitigating performance-degradation factors[5,6]. When injured, the goal of veterinary assistance is to allow a return to normal function and duty[7]. Although there is no definition of how frequently a working dog should be examined, there is a recommendation that this should occur at least two times a year[4]. This is the same base reference we follow at our institution. All dogs go through scheduled prophylaxis, an assessment of body and muscle condition, dental assessment, orthopedic and neurological evaluation.

For all of the reasons presented, working dogs require a particularly high standard of healthcare, provided by a close attending veterinarian[4]. To be able to provide high-quality care, attending veterinarians must be familiar with the demands of the tasks, training methods, and understand the language and culture of the working dog world[4,8]. As an example, a protection dog may have to bite and hold or strike with a muzzle on. Although these two modalities share some similarities, they have important differences in the demands they place on the body. This familiriaty will also help to be at ease with some high-value dogs, often showing high energy and ability of on-command agression[4]. Handling working dogs can be challenging, which raises the need for appropriate team routines and techniques[4]. The use of muzzles, although advocated and needed in some situations, may not be in the interest of the dog's task, as the muzzle may be a work tool that should be associated with positive experiences. There may also exist some benefits to examining dogs outside[4], or in taking advantage of their obedience training and conditioning when conducting some procedures.

Working dogs are submitted to a higher degree of physical stress than companion dogs as a consequence of training and active work. This may lead to injury, typically manifesting in musculoskeletal injury, altered mechanics, pain, and lameness[2]. Active police working dogs are reported as having good to excellent physical condition, but injury is a common reason for early retirement[9,10], and they are at risk for developing degenerative conditions, such as osteoarthritis[9,10]. Frequently, osteoarthritis is diagnosed at an early age in working dog populations compared to companion animals[11]. For that reason, a strong argument can be made for early treatment, particularly with regenerative modalities[12]. They are also prone to develop cranial cruciate ligament injuries, tendinopathies, hyperextension lesions, and spinal trauma[3]. For all of this, there is a major need for objective, precise, and individualized evaluation modalities. As an example, dogs with the same hip osteoarthritis grade may exhibit different compensation mechanisms[13]. This needs to be taken into consideration in the development of treatment plans. Recently, weight-bearing evaluation devices became available for in-clinic use and can provide an invaluable source of information for the diagnosis, selection of candidates for a specific treatment, and evaluating response to treatment. Other evaluation modalities, such as musculoskeletal ultrasound and digital thermography are becoming more readily available, and also add more information on specific lesions, sources of

inflammation, and pain, leading to more precise diagnosis[14]. Knowing the particularities of the different breeds employed as working dogs, with their different predispositions and risk of developing injuries and disease, will also help[15,16].

Working dogs are required to sprint, jump over obstacles, turn sharply, scale walls, overcome unstable surfaces, and bite, which adds physical and mental stress[4]. This may be required for short or very long periods, in the snow, desert, woods, or rubble[17,18]. To be able to do so, a proper physical condition is required. Historically, most work has focussed on sprinting greyhounds or sled dogs[19,20], but recently a growing interest has been centered around exercise and physical conditioning. It is important to realize that physical conditioning is still a field neglected by many handlers and agencies responsible for working dogs. And despite the recognition of the importance of a foundational level of fitness, a limited amount of papers have been published on working dogs[21,22]. The Fit to Work program is a good example of a starting point for fitness evaluation and development in working dogs[23]. Other studies have described other approaches, such as high-intensity interval training[24] or the determination of the maximal lactate steady state[25,26]. We must also be able to recommend appropriate levels of exercise for each work, breed, and age.

Assisting veterinarians often are involved with breeding and puppy raising. These programs generally aim to address the demands of future working dogs, from a physical and mental point of view[27,28]. It is described that behavioral problems are the most common reason for the early release of working dogs, and they should be addressed from a very early age[29]. Even when adults, many working dogs can benefit from an environmental enrichment program[30]. This reduces stress and improves the quality of rest time, and overall health. Stress can have a great impact on a working dog's performance[30], and proper rest periods are essential for the consolidation of the learning process[30].

Appropriate nutrition is paramount for a working dog. Feeding for optimal performance and health is quite demanding, as specific missions, work duration, environment, and individual needs can vary significantly[31]. An assisting veterinarian must be able to calculate individual needs and advise handlers on the best diet for a specific dog, and how to make required adjustments to better fit the specificity of that dog[32]. A working knowledge of available supplements, and how they influence performance, is required. Weigh management can be challenging in working dogs[4], as exercise and stress-induced diarrhea are common in working dogs[33]. As many drugs can have an impact on the dog's detection ability[4], there is a need to search and introduce other management modalities, such as photobiomodulation or psyllium husk[34,35]. Many of the breeds used as working dogs are predisposed to gastric dilation-volvulus, making prophylactic gastropexy a common recomendation[3]. Proper oral health is a requisite, as many working dogs need to use their mouth to bite or play. The oral cavity is also juxtaposed to the nasal cavity and can affect the ability to perform as a detection dog[36].

To provide proper care to working dogs, the role of the handler cannot be underestimated. The bond between working dog and handler can be exceptionally strong[4], and handlers have a very close and present relationship with their dog. For that reason, they are a reliable source of information and often will notice early subtle changes in the dog's performance or disposition, which can be an indication of early-onset disease[4]. In addition, the quality of the dog-handler bond impacts the success and well-being of both dog and human[8], and working dogs can perform differently for various handlers[37]. The handler is often the best person to keep caring for a retired working dog. To take advantage of this unique role, there is a need for continuous training and education for canine handlers, focussing on early-disease detection, welfare, exercise, nutrition, and others[38].

Currently, there is a worldwide increased interest in working dogs, recognizing their value and potential. Following this tendency, the field of working dogs sports medicine will continue to grow to better care for these special animals.

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NUTRITION AND SUPPLEMENTS FOR WORKING DOGS

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As humans and horses, intense work and competition cause a specific energy expenditure in dogs (quantity and quality), as well as a physiological and psychological stress. This is especially emphasized on racing sled dogs, in relation with tough environmental conditions and with the fact that the type of races (ultra-marathon, long or mid-distance, sprint) has a great influence on the nutritional requirements. Nutritional adaptation is therefore necessary and must take into consideration quantitative and qualitative energy needs associated with muscular work, and also modifications in nutritional requirements based on the dog's build and stress level.

Generally speaking, food formulated for working dogs should:

- provide an optimal quality of energy in adequate amounts
- minimize the volume and weight of the intestinal bolus as much as possible (highly digestible and highly concentrated food
- possibly have a buffer effect on the metabolic acidification than can occur in some racing conditions (dogs running over their anaerobic threshold in sprint or short-term work)
- help maximize biological results of other ergogenic activities (training, etc…)
- fulfil physiological gaps created by oxidative cellular stress
- be a true preventive factor for effort related gastrointestinal problems
- help maintain the organism hydration at its best as possible

Apart of the purely nutritional design of the food, both palatability (for tired dogs) and practical distribution methods have to be taken into account, as well as ergogenic nutritional supplements dedicated for exercise have to be closely examined, regarding actual knowledges.

Nutritional supplements are part of the game and can be used for some on a daily base (anti-oxidation, digestive security, omega 3 fatty acids…), and some will be useful before, during or after stamina specifically.

GROUND REACTION FORCES AND CENTER OF PRESSURE DURING HEEL WORK

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For heelwork, dogs are trained to heel with their head looking up and to the right toward the handler while performing a series of commands[1, 2]. Two main categories of dogs are trained to heelwork next to the handler, working and competitive obedience dogs.

Competitive obedience was first introduced in 1930 as an adaptation of the military dogs' work. Heelwork is a basic command and is included in all levels of competition. For heelwork, dogs are trained either to hyperextend their neck or to have more flexed position of the head. The guidelines regarding heelwork include that the dog's shoulder should be approximately level with and reasonably close to the handler's leg at all times[3] and that the dog's head position should in no way compromise its top line or impair the natural movement of the dog. No regulations exist for the head carriage[4], as seen in horses during dressage[5].

Due to the increased awareness of preventive medicine, the specific posture that these dogs adapt has started to attract research interest. Two studies are available in competitive obedience sports regarding heelwork; one study investigated the apparent neck hyperextension in competitive obedience dogs through measuring the apparent neck angles during a competitive obedience test[5] and the other study investigated the human preferences for heelwork positions during UK competitive obedience[6].

Studies in police and military dogs have found that they are at increased risk of orthopedic diseases compared to companion dogs[7–9] and only 40% reach the planned age of retirement most commonly due to orthopedic disease[10]. In competitive obedience no research has investigated risk factors or injuries in these dogs, however, some textbooks describe that competitive obedience dogs experience chronic strain injuries to the shoulders, such as supraspinatus tendinopathy, especially at the left shoulder dog due to heeling[1].

The aim of this presentation is to show the preliminary results of ground reaction forces and center of pressure during heelwork in dogs. Ground reaction forces provide objective data on the forces created between the limbs and the ground during the stance phase, in a non-invasive manner and can show compensatory mechanisms in diseased dogs[11, 12]. Analysis of the center of pressure provides a dynamic reflection of global locomotion and postural control[13], and it has been used to quantify gait abnormalities[14].

Understanding the heelwork locomotion may further assist future studies to identify potential risk factors for injuries and give us knowledge to improve training plans, develop sport-specific preventive physiotherapy plans, reduce injuries and subsequently improve the welfare and increase active longevity of competitive sporting and working dogs.

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DIFFERENT TYPES OF TRAINING IN SLED DOG RACING

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As humans and horses, intense work and competition induce physiologic and metabolic responses of the organism that do vary depending on the type of stamina. This is especially emphasized on racing sled dogs, in relation with tough environmental conditions and with the fact that the type of races (ultra-marathon, long or mid-distance, sprint) generates adaptations that require specific training and nutrition programs.

Long distance requires endurance, and therefor the training is mainly orientated to trot slowly increased distance training including “artificial” training during the summer period.

Mid-distance (and stage racing) can be a mix of high speed endurance (high level of aerobiosis) and periods of “over the anaerobic threshold” runs (inducing the involvement of the lactic anaerobic metabolic pathway).

Sprint races require speed endurance and resistance.

Training method will be adapted to these different metabolic systems and described in this presentation, when proprioception training will be constant, warm-up and recovery will be included in the “package”, and the respect of non-stressful environment and rest periods will be essential.

MUSCULOSKELETAL DISORDERS IN WORKING DOGS

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Dogs are used in many roles to assist man complete tasks or 'work'. This relationship is built on the ability for dogs to be readily amenable to training. Many of the activities that working dogs are used for rely on their athletic ability. Therefore, anything that compromises athletic ability has a significant impact on that dogs ability to work. Studies looking at various working dogs have shown that musculoskeletal (MSK) disorders are one of, if not the, most likely reasons that a dog would be lost from the workforce (1, 2, 3). Consequently, being able to acutely identify and treat MSK pathology in working canines may allow dogs to have a more rapid and successful return to work. A knowledge of the types of MSK conditions suffered by working dogs will be vital to those veterinarians, and other canine care professionals, who treat these patients.

Due to their specific tasks, working dogs can be predisposed to specific injuries. These may be due to the locations in which they work; or due to the type of work that they conduct. Specifically, if dogs perform repetitive actions whilst working, and overwork certain tissues, they can be predisposed to repetitive strain injuries and tissue degeneration.

It is also noteworthy, that there are many breeds of dog, but usually relatively few are used for specific working roles. Dogs have been bred for the role. Therefore, many musculoskeletal disorders seen in working dogs are heritable breed related conditions.

Knowledge of the common conditions seen in that specific canine job role, and in that specific breed, can give a clinician a good idea of what the problem may be before the patient even walks into the consulting room. This 'pattern recognition' can be very useful and more often or not will provide an accurate diagnosis. However, it should always be remembered to keep an open approach, at the end of the day the patient is a dog, just because they are a working dog does not mean they need a 'canine sports medicine' diagnosis; they can succumb to any MSK condition that any breed of companion dog may suffer.

Law Enforcement

German and Belgian Shepherd breeds are frequently used by the military and police. Their work may mean they spend a lot of time resting in a confined space (back of a police vehicle) and then suddenly have to sprint into action. This lack of a 'warm up' prior to intense physical activity can predispose to muscle strains with the iliopsoas and sartorius being common casualties.

Another muscular disorder that plagues these breeds is contracture of the gracilis and semitendinosis/semimembranosus (4, 5).

Degenerative stenosis of the lumbosacral spine is one of the most frequently diagnosed conditions that I personally see in working police dogs. For dogs who complete any 'work' this can be a common condition they develop, with repetitive strains across this junction an underlying culprit.

Farm/Herding Dogs

Collie breeds are the most likely breeds to be used on farms to assist in herding livestock. Traumatic injuries to the lower limbs can occur from being caught in cattle grids, trampled by animals, uneven ground surfaces, and farm machinery. This can result in wounds, dislocated phalanges, ligament strains, and fractures.

Although poorly understood, carpal and tarsal joint collapse is seen more commonly in Shetland Sheepdogs and other Collie-type breeds (6). These same breeds also have a high prevalence of luxation to the superficial digital flexor tendon (7).

Border Collies are one of the most common breeds to be diagnosed with osteochondrosis of the humeral head (8). Injuries to musculotendinous anatomy of the shoulder (supraspinatus, biceps, medial shoulder stabilisers) are seen more frequently in Border Collie's; with repetitive strains during athletic activities the believed aetiology (9).

Detection/Search & Rescue

Spaniel breeds are frequently used for detection and search & rescue roles. Spaniels are over-represented for developing humeral intra-condylar fissures and this should always be a consideration for a thoracic limb lameness in this breed.

Although it can be associated with any intensive exercise, the 'classic' narrative for acute caudal myopathy is that this occurs following cold-water swimming. Therefore, this may be seen in water rescue dogs (or any working dog, especially Labradors) (10).

Service Dogs

Service dogs most frequently assist people with disabilities or those who need additional physical/emotional support. Labradors and Retrievers are the most common breeds used for these roles due to their friendly nature and adaptability. They typically lead a less intensive physical lifestyle compared to some of the working dogs already discussed. Therefore, the musculoskeletal disorders they encounter are more commonly because of their breed; rather than activity. The most commonly associated orthopaedic conditions with these breeds are hip dysplasia, developmental elbow disease, and cranial cruciate ligament disease. Breeding programmes can help to reduce the prevalence of HD and DED. Vast amounts of time and money are invested into training these dogs and as a result, they are frequently from good breeding stock. It is important to try to identify these conditions early in life, so that if necessary, dogs can be withdrawn from training programmes. Those who have already began work will likely have formed strong relationships with their handlers and therefore will want to maximise their ability to continue to work.

Stifle instability due to cranial cruciate ligament rupture will be a common differential diagnosis of canine pelvic limb lameness in both working and companion dogs. Working dogs may be more likely to sustain a 'true' traumatic rupture to the CCL and care should be taken not to misinterpret a caudal cranial cruciate ligament, or multi-ligament, rupture.

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SPECIFIC INTERNAL MEDICINE AILMENTS IN WORKING AND SPORTING DOGS

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A knowledge of the various different physiological bases governing the brief, but intense, effort of the racing Greyhound as compared to the endurance require of a sled dog, as well as the body mechanics that control the relationships of such opposing qualities as force, resistance, endurance, speed, and the psyche allow us to better define appropriate training, nutrition, and genetic selection for giver sporting or working dog. Such types of effort can lead to specific health problems that a veterinarian must be able to treat without compromising the dog's future performance. In this area, no doubt that traumatology and cellular oxidative stress remain the major causes of specific problems.

Stress (physical, mental, environmental) is a cumulative concept that leads to oxidative consequences on a cellular level. This induces specific medical situations such as digestive problems (from transit modifications to gastric ulcers and stress diarrhoea), endocrine affections (stress water diabetis syndrome), muscle constraints (rhabdomyolysis and else).

Voluntary or unvoluntary doping situations can also be involved.

Specialised veterinarians must keep in mind these specificities and act as much as possible through prevention as some of these diseases can be very harmful for the animal or his future sporting or working career.

« EQUINE »

DIAGNOSIS OF LUMBOSACRAL AND SACROILIAC JOINT INJURIES

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An objective assessment of low back pain and a clear identification of the cause(s) of the pain are not easy in horses. Osteoarticular thoracolumbar lesions has been well documented in horses. Several papers have been published on the clinical and nuclear scintigraphic evaluation of the sacroiliac joint, but little attention has been attributed to the lumbosacral junction.

Our routine diagnostic approach of low back pain in horses includes a complete radiographic examination of the lumbar spine and a transrectal ultrasonographic evaluation of the caudal part of the lumbar spine (from L4 to L6), lumbosacral junction and sacroiliac joint. Nuclear scintigraphy may help localizing bone pathology in these areas.

In this presentation, the typical complains and anamnesis are presented, manifestations during the clinical examination are illustred based on videorecordings and the diagnosis approach of the lesions of the lumbosacral and sacroiliac joints using transrectal utrasonographic examination is described. This procedure should be used systematically in horses presenting performance limitation, defenses or asymmetrical gaits. Examination of sound horses preforming adequately must also be performed in order to avoid overinterpretation of findings and overmedication.

LUMBOSACRAL AND SACRO-ILIAC JOINT INJURIES IN SPORT HORSES: TREATMENT AND OUTCOME

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Pain originating from the sacroiliac (SI) and/or lumbosacral (LS) joint in horses is a common issue in sports horses. Diagnosing pain and injuries in this area remains a challenge. Knowledge on regional anatomical, neuromotor control and biomechanics, clinical provocative tests (pain, stiffness) together with your diagnostic imaging findings (ultrasonography and scintigraphy mainly) will help you in specifying your diagnosis and subsequent treatment approach. Treatment and rehabilitation strategy might be different to some extent, but mainly depending on if you deal with: functional instability, pain and poor performance or gait changes with or without muscular or bony asymmetries, the extent of concomitant bony and/or ligamentous pathology, and if SI/LS pain is primary or secondary (hind limb lameness, cervical/thoracolumbar dysfunction). Management of SI and LS in horses includes mainly use of anti-inflammatory medication, prolotherapy, physical therapy and exercise. Collaboration with physical therapist in these cases is mainstay in our practice and the best long-term results are achieved by this multi-modal approach. Reduction of pain associated with SI and LS is important and the first step to take. Local peri-articular injection(s) (cranial > caudal injection approach) with corticosteroids (or NSAIDs) has been used the most to achieve this goal. Regenerative medicine like platelet rich plasma or IRAP is also an option to decrease pain in a more durable way. Besides peri-articular pain, bone-related pain and to some extent bone remodelling in SI and LS injuries can be addressed by cautious use of biphosphonates. Besides local injection, mesotherapy and epidural injection of corticosteroids (or regenerative medicine) are used to decrease pain as good as possible. Our manual therapists use a combination of mobilization and chiropractic treatments to address stiffness (and to some extent pain) in these cases. Multiple re-evaluations and manual treatments in a short period (2- to 3- or 4-week interval) might be necessary in most (chronic) cases to regain normal mobility/function. Kinesiotaping and aquatraining (water treadmill preferably) has been used in some cases. Other modalities like shockwave, laser, acupuncture can also be used to decrease mainly pain; although less performed in our practice in these cases.

Complete rest if necessary in cases with severe pain and/or gait changes; although in most cases this may be contra-indicated due to the possible adverse effects of reduced pelvic and hindlimb muscle function and worsening functional instability of the SI-joint. In chronic cases of SI/LS injuries, local treatment can result in temporary improvement in performance; however, it is ideal to rehabilitate the horse so improvement is consistent and lasting. A specific rehabilitation program based on biomechanical findings may achieve this. So far there is no consistency on guidelines for rehabilitation of these horses with SI and LS injuries. Regular contact (direct or videos) and evaluation by vet and/or physical therapist is advocated, to intervene whenever possible and change management if necessary. Improving core-stability, balance and strengthening are the most important goals to focus on initially (and also further along the way). A combination of in-hand work, lunging on big circles (by use of Equiband, Pessoa) or light flat work are initially advised. Tempo changes (shortening and stretching) within the gait can help. Frequent transitions are avoided. Ground pole work and lateral work can be introduced gradually, to improve stability and mobility.

Outcome in these cases depend on the severity of the pathological changes to a certain extent, like grade 4 bony changes together with interosseus and VSIL injuries carry a poorer outcome. In my opinion outcome mainly depend on muscular stability and function. Good training and regular physical therapy can prevent re-injury in most of the cases.

BIOMECHANICS OF THE HORSE-RIDER INTERACTION: A PRACTICAL PERSPECTIVE

Dr Russell MacKechnie-Guire

When considering horse-rider interaction, it is essential to consider the effect that the saddle has on both. The coupled system of the saddle, rider and horse produces complex coordinated patterns that can be used to distinguish between gaits and riding styles. Correct saddle fit should enhance athletic performance (1) of the horse and rider. Incorrect saddle fit contributes to back problems, poor attitude to work and poor performance (1-7) and will have a significant effect on the biomechanics of the rider. With the advent of technology, there is a growing body of evidence on the effect that saddle fit and design can have on the locomotor apparatus of the horse, and rider kinematics.

The effect that the rider and their asymmetries can have on the horse should not be underestimated, and with the growing number of measuring systems available, the effect that the rider has on the horse is becoming better understood. At a population level, humans are right-handed (90%), right-legged (80%), right-eyed (70%) and right-eared (60%). In a group of riders, when asked to sit on a static platform symmetrically, they did so with an increased weight through their left seat bone (8). In advanced dressage riders, all of whom were right-handed, when walking, trotting and cantering in a straight line fitted with rein tension devices, quantifying maxima, minima and mean rein tension, it was found that the right rein (hand) had increased variation when compared to the left hand (9). In a group of right-handed riders, when standing on a force plate, it was found despite the riders confirming that they were standing symmetrically, that they had increased vertical force through their right leg compared to the left. How do these preferences combined with the horse's preferences, affect the athletic performance of both the horse and rider?

Riding simulators provide a useful tool in which therapists can provide tactile and proprioceptive feedback to help riders improve their awareness of where their body is in space. Although riding simulators have grown in popularity, it is important to note that the displacement vectors of the riding simulator don't replicate those of the horse. Using a marker positioned at T18 on a horse trotting on a treadmill and a simulator, It was reported that the simulator had 70% increased mediolateral displacement and in the craniocaudal direction, displacement was increased by 22% (10). The forces seen during over-ground locomotion can not be recreated on a simulator. During locomotion, gravitational and inertial forces increase the effect of the rider's mass. In trot, the maximal force on the horse's back is twice the rider's weight (11). If the weight of the rider is asymmetrically positioned on the horse's back, this presents a biomechanical challenge to the horse. In riders who collapse through one hip, saddle pressures are increased on the contralateral side, and in riders who lean to one side, saddle pressures are increased on the same side that the rider is leaning towards (12). Similar to saddle pressures, these pressures are repeatable and occur every stride. Rider asymmetry is prevalent in all equestrian sports. In a study that induced rider asymmetry by shortening one stirrup by 5cm, it was reported that the horses increased their fetlock extension on the side contralateral to the shortened stirrup and altered their range of motion of the thoracolumbosacral spine (13).

Among horse owners, concerning saddle slip, it is often suggested that the primary cause of saddle slip is the rider with the rider being critiqued for their position, with very little consideration given to the influence that the horse may have on it. From an evidence-based perspective, the horse is the primary cause of saddle slip due to lameness (5) or movement asymmetry (14, 15). In many riders, 78.6% of horses ridden by crooked riders did not have saddle slip (12), and in 80% of riders who collapsed through their left hip, only 16% had saddle slip to the right. Objective rider-based studies are needed to provide quantitative data to support the growing body of evidence that the horse is the primary factor. In a group of horses displaying saddle slip, it was hypothesised that a specific rider intervention (rider: glute activation) would eliminate/reduce saddle slip. No differences were reported for any movement or saddle-derived parameters after the rider intervention (16), the findings of which provide further quantitative data that the horse is the primary factor in causing the saddle to slip and

that the rider follows the movements of the saddle.

During locomotion, regardless of the direction of travel, the saddle should remain balanced and central with minimal craniocaudal, vertical and lateral displacement. Saddle slip (defined as a saddle which consistently laterally displaces to one side) has been reported in lame (5, 17) and sound horses (14). Saddle slip generally occurs on one rein (5). It is more evident during movements which induce lateral bending of the thoracolumbar region, i.e. 10m diameter circles (5) and more noticeable in walk and canter. However, saddle slip does occur in trot. Although there is evidence that saddle slip is influenced by lameness, it should be noted that non-lame horses can still exhibit saddle slip. Therefore, there are other factors which can cause saddle slip. Factors such as laterality, movement asymmetry, and functional and structural differences between the left and right sides of the body are all potential causes of saddle slip. It is important when assessing the interaction between the horse, saddle, and rider, that all three components are assessed from a global perspective and not in isolation. This session will discuss the complexities of horse, saddle and rider interaction and offer some practical tips on how to assess.

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ADVANCED IMAGING OF TENDON INJURIES

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Injuries affecting the superficial or deep digital flexor tendon are a major cause of lameness in performance horses and have considerable impact on equine welfare and the wider horse industry. Ageing and repetitive strain frequently cause varying degrees of tendon micro-damage prior to the recognition of clinically significant tendinopathy.

Whilst B-mode ultrasonography is most commonly utilised for detection and monitoring of tendon lesions at the metacarpal/metatarsal level, several additional techniques including Doppler- angle contrast ultrasonograhy (ACUS) or contrast-enhanced ultrasonography (CEUS) have been advocated for the assessment of the flexor tendons. Additionally, the emphasis of recent research has focused on the identification of subclinical tendon damage in order to prevent further injury and improve outcomes. The introduction of elastography, acoustoelastography and ultrasound tissue characterisation in the field of equine orthopaedics shows promising results, particularly for the imaging analysis of the superficial digital flexor tendon and might find wider use in equine practice as clinical development continues.

Advanced diagnostic imaging modalities including magnet resonance imaging (MRI) and computed tomography (CT) have become more widely available for detection and monitoring of tendon lesions. The current experience with low- and high-field magnetic resonance imaging (MRI) and computed tomography (CT) for the diagnosis of equine flexor tendinopathy will be detailed with focus on the deep digital flexor tendon. Implications of the ‘magic angle’ artefact as well as injection techniques and the use of contrast media are discussed. Future developments in tendon imaging aim to gain enhanced structural information about the tendon architecture with the prospect to prevent injury. Techniques as described for the assessment of the human Achilles tendon including ultra-high field MRI and positron emission tomography are highlighted.

Based on the significant number of research studies on tendon imaging published over the past decade this presentation aims to examine the currently used imaging techniques and their limitations, and to introduce and critically appraise new modalities that could potentially change the clinical approach to equine flexor tendon imaging.

SUBCLINICAL, ADAPTIVE OR INCIDENTAL FINDINGS? WHAT CAN WE SEE WHEN IMAGING NON-LAME HORSES IN FULL WORK?

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In clinical situations, the vast majority of orthopaedic diagnostic imaging is performed in lame horses, ideally following localisation of the lameness either after diagnostic anaesthesia or based on localising clinical signs. Particularly when using advanced diagnostic imaging, often several abnormalities are identified, and it can be challenging to establish, or sometimes even to estimate their clinical significance. Anatomical variations, if they are rare or seen in an infrequently imaged region, can be confused with abnormalities. Adaptive changes, subclinical abnormalities, pathologies of no clinical significance, different pain threshold of individuals and the different ability of horses of different disciplines to cope with certain abnormalities also have to be taken into account.

Abnormalities are often identified in the non-lame limb of bilaterally lame horses and in regions of the lame limb that are not considered to be the source of pain. Imaging the contralateral limb can make interpretation challenging, particularly if similar findings are seen in the lame and non-lame limbs. However, knowledge gained from bilateral examinations contributes to our understanding of adaptive changes and many pathological conditions[1-3]. It also reduces the risk of over-interpretation of abnormalities in the lame limb.

There are only a small number of studies that have investigated diagnostic imaging findings in non-lame horses or in horses with no current orthopaedic pain. Magnetic resonance imaging and histopathological studies described a range of abnormalities in the navicular bone and associated structures in horses without foot pain[4-6]. Variations in magnetic resonance imaging in the proximal metacarpal region have been described and recently the response to endurance training was investigated[7-8]. Ultrasonographic findings in the lumbosacral joint in horses free from back pain have been documented[9]. Most of these studies suffer from the limitation that no complete history and a full clinical examination were available, therefore a previous injury to the imaged region could not be excluded. However, even if some findings can be related to previous injuries, it is important to establish what we can see in horses performing in various disciplines without current pain and lameness.

Bone continues to adapt to training throughout life and age-related changes in tendons and ligaments have been described. There are several regions in the limb where increased bone density or cortical / subchondral bone thickness have been recognised as an adaptation to training, including the medial palmar aspect of the proximal third metacarpal bone, the dorsal cortex of the third metacarpal / metatarsal bones, the carpal bones, the metacarpal condyles, the dorsal and lateral aspect of the hock and the medial aspect of the elbow. While these regions of mineralisation can be seen in horses free from lameness, these locations are also predilection sites of injuries. Longitudinal studies are needed to establish how these changes progress in horses performing in various disciplines.

In conclusion, it is paramount to interpret the results of diagnostic imaging in conjunction with the results of clinical examination and diagnostic anaesthesia and to acknowledge our limited knowledge of what causes pain. Longitudinal studies are required to investigate adaptive responses to exercise in various disciplines, the progression of adaptive and pathological findings and to investigate at what stage they become associated with clinical signs.

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PREPURCHASE EXAMS FOLLOW-UP; INTERESTING AND UNPREDICTABLE FACTS

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Prepurchase exams are a common procedure in equine sports medicine. In horses competing at high level these exams tend to be complex due to the high frequency of imaging findings, either incidental or clinical and the prevalence of low-grade lameness. Orthopaedic abnormalities during the exam are the most common reasons to give a horse a high risk for intended use as already reported (Hoogmoed et al., 2010). It has also been reported that the more severe the changes in diagnostic imaging the higher the risk of future clinical orthopaedic disease (Hoogmoed et al., 2010). Although this is the common situation, we have experienced interesting progression of findings in certain areas during the years in some horses. For this reason, the records of pre-purchase exams and available follow up progression of 200 horses were revised. Dressage horses intended for professional use were the most predominant population, with a medium age of 6 years and a significant male over-representation. Five stage examinations with full radiographic and ultrasonographic evaluation of different areas was the most common type of exam performed although medium and basic level and radiographic examinations were also revised. Risk grade was stablished in 4 degrees-extreme (severe findings at any stage of the exam and discontinued 8%), high 40%, mid 32,5% and low 19,5% all grades depending on the intended use and level. Follow up assessed by competition records in non-bought horses and by clinical records in bought horses revealed similar numbers for good, lower, and poor outcomes for intended use (around 33% for each category).

Lameness observed during the exam was a common finding with a prevalence of 57,81% most commonly low grade (56,45% grade 1/5). Around fifty per cent of the sound horses reached intended level, 47,54% of the grade 1/5 and only 11% of the grade 2/5 lameness. None of the higher-grade lameness reached intended use.

Nonstandard diagnostic imaging findings were present in 87% of the horses that had ultrasonographic evaluations and in 83,66% of the radiographic examinations, thus imaging reportable findings were common at prepurchase exams.

Rotation of the third phalanx had a prevalence of 35,5 % of the horses although this rarely became a problem during the following years and none of the horses developed acute laminitis. A small number of horses developed increased digital pulse, heat and mild pain after shod with may suggest increased sensibility. Hoof deformations and hoof cracks were a more common cause of days off during the competition period.

Imaging findings at the level of the fetlock joints of the were common (prevalence 37,03%), especially sclerotic changes of the medial condyle, osteophytes and osteochondral fragments. Of these horses 17,14% developed moderate to severe lameness associated to subchondral bone injuries (First phalanx, metacarpal and metatarsal). Interestingly had no response to distal limb flexion or mild at the pre-purchase exam and normally developed lameness after a period of 2-3 years after purchased. These horses maintained their level for a medium of 3-4 years with medications and periods of decreased training intensity. Pain was variable over the time independently of medications, which may reflect subchondral bone status.

Ultrasonographic abnormalities detected at the suspensory ligament origin were present in 50% of the scanned horses, some horses competed at very high levels with severely enlarged and heterogenous origins most commonly in hindlimbs but also present in forelimbs without associated lameness. Some of these ligaments had a significant quantity of scar tissue identify by ultrasound or MRI so size and enlargement was not associated with decreased level in these horses. Of these horses 68% developed a period of lameness localized to this region over the followed 3-4 years. Sixteen per cent were retired due to persistent forelimb lameness and 8% decreased level due to hindlimb lameness.

Branch abnormalities were detected in 18,8% of the examined horses, this prevalence is lower than previously reported in other reviews (Read et al., 2020)(Ramzan et al., 2013). Of these horses 55% presented mild abnormalities such as mineralizations, fibrotic areas, small hypoechoic areas and did not correlate with poor progression even with findings at the insertion in the proximal sesamoid bones. Forty-five per cent of the horses with abnormalities were considerate moderate to severe and these horses either dropped level or had bad outcome. No horse with an active and severe doppler at the pre-purchase exam reached high level. Significant lesions in hindlimb branches were easier to manage as were correlated with less degree of lameness compared with the forelimbs so normally greater risk was given to forelimb abnormalities.

Among the followed horses stifle lameness was more common than lameness localized to the tarsal region so in many pre purchase exams ultrasonographic examination of the medial femorotibial joint was included. Medial meniscal abnormalities were detected in some sound horses, which has also been reported in humans in MRI examinations (Abram et al., 2018), but the degree of distension of the medial femorotibial joint seemed to be less severe than in lame horses.

Unexpected results were detected at the back and lumbo-sacroiliac area in some cases. Radiographic examination of the cervical and dorsal spinous processes was performed in 36% of the horses. The more the affected number of dorsal spinous processes with detected abnormalities the more the risk of having associated issues in the lumbo-sacroiliac area and the more risk of having difficulties in canter exercises, piaffe, collection and stepping back in dressage. Fifteen per cent of these horses (15%), all intended for dressage, responded poorly to different treatments probably due to associated neuropathic pain as previously reported (Story et al., 2021). Some of these cases became dangerous to ride and never reached the intended level, and some of them were retired at young age. Associated epaxial and mid gluteal atrophy was a common finding in these cases and this sign is considered important at prepurchase exams. Jumpers seem to tolerate better these lesions.

Mild ataxia, hypermetric gaits were detected in 22% of the horses but severe grades did not achieve high levels probably due to increased risk of lameness due to coordination issues or inability to perform grand prix exercises in dressage.

Despite the level of the exam there was a 7% of complete failure of predictive risk where horses were able to perform with poor prognosis injuries or horses with low risk were not able to be performed at the intended level. Pain threshold, ability to heal, and management are important variables we cannot be predicted at prepurchase exams.

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EQUINE GASTRIC GLANDULAR DISEASE (EGGD) IN ADULT HORSES

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It is now widely accepted that EGGD is a separate entity to equine squamous gastric disease (ESGD)[1]. Recent studies have demonstrated that the risk factors[2] and response to treatment[3,4] of EGGD differs from ESGD. Over the last 10-15 years, there has been increased identification and reported prevalence of EGGD and most feel that this is a true change in disease prevalence. However, despite many recent publications, there is still a significant amount of knowledge lacking on this condition.

Diagnosis

Gastroscopy remains the only reliable method for diagnosis with majority of lesions located around the pylorus and in the antrum.[2-5] It is now widely accepted that the grading system for equine gastric glandular disease does not reflect severity of disease and until a better system is developed, describing lesions based on the ECEIM-ACVIM consensus statement is recommended.[6]A more recent consensus statement focused on EGGD suggested that flat, erythematous lesions were likely to heal more rapidly than those with a nodular, raised, fibrinosuppurative or hemorrhagic appearance.[7] The agreement regarding these descriptors varies between fair to moderate[8] and moderate to good[9] and was better between diplomates.[8]

Differences in the gastric microbiota between healthy horses and those with EGGD have been documented[10,11], but what is currently uncertain is if these are cause or effect and how they can be used clinically.

Pathophysiology

Lesions of the glandular mucosa are usually **not ulcerative**; instead they are erosive and inflammatory in nature consisting of a mixed inflammatory population (lymphocytes, plasmacytes and neutrophils) and as such the lesions are best described as glandular gastritis.[12-14]

It is likely that EGGD results from a breakdown of the normal defence mechanisms that protect the mucosa (bicarbonate and gastric mucus that consists of glycoproteins, water, electrolytes, lipids, and antibodies).[15]

The proposed pathophysiology of these lesions includes changes in blood flow with or without perpetuation of these lesions due to exposure to acid[6] or as an extension of inflammatory bowel disease.[1] Reductions in blood flow may be secondary to 'stress', which influences gastrin production or relate to exercise and feeding.[1] A recent study found horses with EGGD had upregulated salivary proteins relating to immune activation compared with normal horses, which may support the proposal that EGGD is a manifestation of IBD.[16]

Clinical signs

Clinical signs likely associated with EGGD include changes in temperament including nervousness and aggression, changes in rideability including reduced willingness to work and reluctance to go forwards, unexplained weight loss, likely concurrently associated with reduced appetite or altered eating patterns, cutaneous sensitivity manifested as flank-biting, resentment to girthing, leg aids or rugging, mild and/or recurrent abdominal pain.[1] Changes in coat condition, stereotypical behaviour, bruxism or diarrhoea are unlikely to be associated with EGGD.[1]

Prevalence and risk factors

The prevalence of EGGD in clinical and abattoir studies of various horse types worldwide is between 47% to 65%2,12,13,17-22

Risk factors for EGGD are limited and occasionally contradictory but are very different to those for ESGD. Warmbloods are at increased risk of developing EGGD compared with other horse types.21,23 In Thoroughbred racehorses, trainer was identified as a risk independent of other management factors.2 Exercising for more than 4 or 5 days per week has been shown to be a risk factor in racehorses2 and sports horses24 whereas intensity of exercise was not. The more experienced a horse is at its discipline, the lower prevalence of EGGD24,25, which may suggest work adaptation or management differences of elite horses.1 A study in endurance horses demonstrating a higher prevalence of EGGD in the competition season20 which may relate to reduced gastric blood flow during exercise.

The lower prevalence in more experienced polo ponies and showjumpers24,25 may relate to adaptation to physiological stress. It is challenging to know what is 'stressful' to an individual horse and as such changes to minimize stress should be tailored to an individual and ideally kept consistent.

Thus far no association has been documented for involvement of infectious agents12,13, NSAID use in clinical cases2,23-25, diet or lameness between associated with EGGD1,2.

Treatment

It is now widely accepted that treatment and management options for ESGD and EGGD are different. Three or four combinations of treatments have been proposed in a recent consensus statement: oral omeprazole (4mg/kg q24 hours) combined with sucralfate (12mg/kg q12hrs), oral misoprostol (5μg/kg q12hrs) with or without sucralfate (12mg/kg q12hrs); long-acting intramuscular omeprazole (4mg/kg q5-7 days), which is available in some locales or therapeutic combinations for IBD (see IBD section).

Sucralfate provides a physical barrier preventing acid diffusion, stimulates mucus secretion which blocks acid diffusion, inhibits pepsin and bile acid secretion, promotes epithelialization by preventing fibroblast degradation, stimulates epidermal and insulin-like growth factors and increases mucosal blood flow through increased production of prostaglandin E (PGE). Response to oral omeprazole and sucralfate therapy varies with healing rates reported between 22-63%[26,27]; this difference likely relates to differing definitions of healing. When used, omeprazole should be administered on an empty stomach and not fed for 30-60 minutes after administration.[1]

Misoprostal is a PGE analogue and will likely improve mucosal blood flow. It also suppresses acid production in the horse[28] and inhibits neutrophilic inflammation.[29] One study[27] demonstrated a healing rate of 73%. Side effects are rare, but include mild, transient diarrhea, mild abdominal pain and urticaria. Care must be taken in administration to pregnant mares as this drug could induce abortion, although there is some safety data to suggest it can be administered between 100-130 days gestation.[30] Due to abortigenic potential, thus drug should not be dispensed to women who are pregnant or planning to be pregnant. There is no rationale for combining this drug with oral omeprazole.[1]

Long-acting intramuscular omeprazole is more effective than oral formulations at acid suppression when pH is measured in the ventral portion of the stomach.[51] Acid suppression is maintained for 4 to 7 days and as such should be administered at 5-7 day intervals. Healing rates are reported to be 64-75%.[31,32] Transient swelling at the injection site has been reported in <10% of cases and is thus recommended to be administered, after warming, into the gluteal muscles.

There may be some rationale for administration of glucocorticoids and have anecdotally been reported to be efficacious. Initial administration of 1mg/kg prednisolone PO q24hrs or 0.05-0.1mg/kg dexamethasone PO q24hrs, which is then gradually tapered over 4-5 weeks, has been proposed.[1] Other recommendations include dietary simplification, where cereal proteins or alfalfa may play a role in initiation or perpetuation of IBD.

There is no evidence for administration of antibiotics, ranitidine, aloe vera, pectin-lecithin complexes, polysaccharides, kaolin, bismuth subsalicylate, sea buckthorn, acupuncture or homeopathy for the treatment of EGGD.[1]

For concurrent ESGD and EGGD lesions treatment should be aimed at the EGGD.

Expectations for healing and monitoring

Rates of EGGD healing are slow compared with ESGD and unpredictable. Raised, nodular and fibrinosuppurative lesions may take longer to heal than flat, hemorrhagic lesions. Mucosal restitution can occur within 3-5 weeks, but may take several months to completely resolve, especially where raised areas or nodules are visible.

Ideally evaluation should be performed every 6-8 weeks using gastroscopy until resolution has occurred and only then should treatment be discontinued. There is no rationale for reducing the dose of the drugs except for glucocorticoids.

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UPPER VERSUS LOWER RESPIRATORY TRACT DISEASES: WHICH ARE BIGGER CULPRITS OF POOR PERFORMANCE IN HORSES?

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Physiological effects of upper airway obstructive (UAO) disorders

Horses are obligate nasal breathers with a highly collapsible upper respiratory tract, so are prone to develop UAOs, especially during high intensity exercise which creates large variations in airflow and pressures leading to instability. UAOs have been associated with increased resistance and work of breathing and decreased alveolar ventilation and gas exchange (Franklin *et al.* 2002, Boyle *et al.* 2006). Inspiratory pressures have been reported to become more negative with palatal instability (PI), nasopharyngeal collapse (NPC) and epiglottic retroversion (ER) (Lumsden *et al.* 1993, Tessler *et al.* 2004, Holcombe *et al.* 2001). Comparatively, expiratory pressures become more positive with dorsal displacement of the soft palate (DDSP) (Holcombe *et al.* 1998). DDSP has been shown to reduce expiratory flow, tidal volume (V_T), minute ventilation (V_E) and peak oxygen consumption (VO_{2peak}) (Franklin *et al.* 2002, Allen & Franklin 2012). Recurrent laryngeal neuropathy (RLN) has also been shown to decrease V_E (Lumsden *et al.* 1993) and VO_{2peak} (King *et al.* 1994, Ehrlich *et al.* 1995, Seeherman *et al.* 1995). UAOs have been associated with inadequate gas exchange (Couroucé-Malblanc *et al.* 2002, Durando *et al.* 2002, Sanchez *et al.* 2005), with NPC the UAO most associated with blood gas abnormalities (Holcombe *et al.* 2001, Durando *et al.* 2002, Boyle *et al.* 2006, Durando *et al.* 2006). RLN has also been reported to lead to more severe exercise-induced hypoxaemia (Christley *et al.* 1997, Tate *et al.* 1993, King *et al.* 1994).

Physiological effects of mild-moderate equine asthma (MEA) and exercise-induced pulmonary haemorrhage (EIPH)

MEA has been shown to increase impedance, work of breathing and resistance and reduce compliance resulting in a degree of airway obstruction (Couetil *et al.* 2001). Horses with MEA have been reported to have reduced V_T and V_E during intense exercise (Persson & Lindberg 1991). MEA is also believed to impair gas exchange, with horses developing more pronounced exercise-induced hypoxaemia (Couetil & DeNicola 1999, Couroucé-Malblanc *et al.* 2002, Sanchez *et al*. 2005). Horses with MEA often have excessive tracheal mucus (Chapman *et al.* 2000), with MEA related to the severity of mucopus and the percentage of neutrophils in TW/BALF cytology (Chapman *et al.* 2000, Couetil *et al.* 2001). EIPH has been associated with a worsening of exercise-induced arterial hypoxaemia (Couetil & Denicola 1999, Sanchez *et al.* 2005) and a decrease in VO_{2max} (McKane *et al.* 1995, McKane *et al.* 2008).

Associations between MEA and EIPH have been proposed but not proven (Chapman *et al.* 2000, Newton & Wood 2002, Allen *et al.* 2006). Experimentally EIPH elicited a mild, prolonged inflammation (McKane *et al.* 1999, Kingston *et al.* 2002, Art *et al.* 2002). Lower airway inflammation has also been proposed to promote EIPH (McKane & Slocombe 2010).

UAO: high-speed treadmill endoscopy (HSTE) *vs.* overground endoscopy (OGE)
Studies evaluating racehorses via HSTE report a UAO prevalence of 23-65% (Morris & Seeherman 1991, Kannegieter & Dore 1995, Martin *et al.* 2000). Palatal dysfunction (PD) is the most common UAO reported (Morris & Seeherman 1991, Martin *et al.* 2000, Lane *et al.* 2006, Strand *et al.* 2012, Franklin & Allen 2017), with complex disorders often found.

There are few published, large-scale OGE studies. One study evaluating Thoroughbred (Tb) NH/Flat racehorses for abnormal noise and/or poor performance found that 81% of the horses had ≥1 UAO, with 58% diagnosed with complex disorders (Allen & Franklin 2010). Of the UAOs diagnosed, 103 horses had PD, with medial deviation of the aryepiglottic folds (MDAF) commonly associated. Horses exercising over longer distances were more likely to be diagnosed with DDSP versus PI. Another study evaluating Tb Flat racehorses for abnormal noise and/or poor performance reported that 80% of the horses had ≥1 UAO, with 71% diagnosed with complex disorders (Davison *et al.* 2017). AA was the most common disorder, often seen with VFC and/or MDAF. Another study evaluating Tb Flat racehorses in training reported that 34% of these horses had at least one UAO diagnosed, with DDSP the most common disorder. Conversely, the author's research group evaluated Tb Flat racehorses in training. Although 53% of the horses investigated had no history of poor performance and/or abnormal noise, 96.4% were diagnosed with ≥1 UAO, with 84% diagnosed with complex disorders. PD, MDAF and VFC were the most identified UAOs.

Lower respiratory tract (LRT) diseases & poor performance
MEA (Wood *et al.* 2005, Allen *et al.* 2006, Newton *et al.* 2006, Ivester *et al.* 2018) and EIPH (Birks *et al.* 2002, Hinchcliff *et al.* 2005, Morely *et al.* 2015) have up to 80% prevalence rates in Tbs. Poor racing performance has been associated with BALF neutrophilia (Fogarty & Buckley 1991, Nolen-Walston *et al.* 2010, Richard *et al.* 2010, Lavoie *et al.* 2011, Allen *et al.* 2006). The velocity at which blood lactate reaches 4 mmol/l (V_{La4}) has also been found to be negatively associated with BALF neutrophil percentage (Stucchi *et al.* 2020). EIPH has also been shown to negatively affect racehorse performance (MacNamar *et al.* 1990, Couroucé-Malblanc *et al.* 2002, Hinchcliff *et al.* 2005). Horses with an endoscopic grade ≥2 are at lower odds for finishing in the 1st three positions (Hinchcliff *et al.* 2005), with EIPH-positive horses more likely to finish unplaced (Costa & Thomassian 2006).

Respiratory tract disease & poor performance
For most equine poor performance studies reporting URT and LRT evaluations, MEA has been identified in a much higher prevalence than UAO disorders. Furthermore, MEA appears to negatively affect physiological parameters of aerobic fitness and exercise-induced hypoxaemia. Although, no direct links between UAO and LRT diseases (MEA and EIPH) have been found (Davidson *et al.* 2011), combinations of UAOs and EIPH have been reported to have more significant negative effects on indirect measures of aerobic parameters (Sanchez *et al.* 2005).

Conclusions
UAOs (PD, complex) and MEA are commonly found in horses with poor performance. Most poor performance studies have found MEA to be present, with this disorder appearing to negatively affect physiological parameters of aerobic fitness. No direct links have been made between UAO and LRT diseases, although the presence of LRT diseases may accentuate the negative effects of UAO disorders (and/or vice versa) that alone may have minimal effect on performance.

DISCIPLINE SPECIFIC NUTRITION FOR PERFORMANCE HORSES

Emmanuelle van Erck DVM, PhD, ECEIM

Like for any athlete, performance in horses is fuelled by appropriate levels of energy but there is much more to an equine diet than just fulfilling calory requirements.

Every discipline has its own specificities: in racing, energy must be supplied fast and help support sprinting muscles; showjumping and dressage combine a need for power and glycogen sustainability to allow the horse to perform over several days; at the other end of the spectrum, endurance must be allowing the muscles to receive continuous energy to maintain exertion for hours long. Because of their particular digestive physiology, a horse's diet must also maintain him in optimal health, delay the onset of fatigue, promote prompt recovery and avoid causing disease, while providing him and his microbiota all the essential nutrients.

Establishing a nutritional plan for any equine athlete is part of the service a sports medicine practitioner should master and there are simple tools to support him. The foundations of an adapted diet are

1- Respecting the horse's physiology
2- Meeting the needs of the sport
3- Adapting to the weaker points

1 – Respecting the horse's physiology

Digestion starts in the mouth, where proper mastication allows the food to be moistened and a high amount of useful bicarbonates to be produced. Horses have a very small stomach in comparison to their overall size, making up less than 10% of the entire digestive tract and holding only about 5L. It is therefore well adapted to receiving continuous (or else frequent) small meals. On the other hand, the colon makes up almost half of the horse's digestive tract (6-8 m) and can hold about 100L. Horses are hindgut fermenters: the microbial fermentation processes that occur in the large colon are essential to the horse's digestion as the enzymatic digestion is insufficient to provide him with the adequate nutrients.

Horses are physiologically designed to grazing grass throughout the day, whilst moving around and socializing. Performance horses seldom have access to grass pasture and feeding ad libitum quality hay is the next best choice. With many commercial brands offering a broad range of performance feeds, we tend to forget that forage constitutes the base of any healthy equine diet and 2kg/ 100kg BW is a minimal requirement. Because subjective estimation of forage weight tends to be underestimated, hay should be weighed with scales. Not all forages are equal and choosing an appropriate forage cannot be done solely through a subjective visual or olfactive appreciation but by testing its nutritional contents. These can change over time, depending on the season and storage. If the sugar content is too high in non-structural carbohydrates, hay can be soaked to reduce sugar levels. Studies performed in Standardbred racehorses showed that these horses could be fed a forage only diet as long the composition of the hay was aligned with timing of the harvest to ensure energy requirements were met and still pursue a successful career in racing. Microbial quality of forage is also important as horses beyond the age of 7 years-old can develop equine asthma and become hypersensitive to fungi, pollen or dust found in hay and straw. High temperature steaming of hay can be particularly effective in reducing contaminants while conserving nutritional quality. Methods for hay distribution should seek to mimic grazing: hay nets or slow feeders can help prolong mealtimes as well as avoid its contamination by dust or faeces. It also helps reducing the horse's stress, especially for those housed in boxes.

Consistency and stability in a horse's diet is critical and any change should be introduced progressively. Horses should be fed at the same times every day and should have free choice of water and forage

throughout the day. Adjusting feeding schedules may improve the performance of intensive activities such as endurance races. For example, withholding grain for 4 hours before a low-intensity endurance activity may help avoid diverting oxygen and fatty acid-rich blood away from the muscles to the digestive tract. Feeding small amounts of hay or grass during the day will help maintain energy levels. In endurance activities, glycogen stores become completely depleted in fast twitch muscle fibres. These stores are best replenished by grain diets within 12 hours after the endurance race. It takes at least 72 hours for a horse to fully replenish his glycogen stores, given he receives an appropriate diet. After strenuous work, the horse should be rested or lightly worked for 24–72 hours to maximise the restoration of adequate muscle glycogen levels.

Any change in feed should be implemented progressively: not more than a 1/4 of the total weight of the feed per day at a time to allow microbiota adaptation and reduce risks of colic or diarrhoea. The same rule applies to horses going to pasture, especially during springtime when the levels of fructans are very high. The horse should be turned out no more than an hour the first day and the time spent in pasture should gradually increase over a week and monitored for signs of digestive discomfort or laminitis. There are websites that allow to estimate pasture fructans levels and laminitic risk according to geography.

2. Meeting the need of the sport

Before any adjustments are made according to the type of sports the horse is involved in, the diet should cover his basic requirement, estimated according to age, weight, body condition score, lifestyle, temperament, and physiological status. Level of training and intensity of exercise are then taken into consideration. Since scales are rarely available in stables, there are several alternatives to estimate body weight. The simplest is to use a commercial weight tape, as these can be inaccurate, they are best used as a tool to track changes in body condition. A more accurate method of estimating weight is by taking two measurements thoracic circumference (girth measurement) and length from point of the shoulder to point of the ischium and tap in the formula: Weight (kg) = (girth measurement in cm)^2 x (length measurement in cm)/11 877. In addition to estimating body weight, estimating body fat using the Body Condition Scoring Chart (1-9) provides a standard scoring system for the owner, trainer and veterinarian. An average score of “5” is ideal for most breeds and disciplines.

The easiest way to start building a fitting diet according to a particular discipline is to use a dedicated software to calculate basic needs then adjust to the individual horse and context. According to countries, there are different systems of calculation available. Here are a few references:

- https://webassets.nationalacademies.org/nrh/ (USA)
- http://www.horsemath.com/horse-feed-calculator (USA)
- www.equiligne.com (France)
- FRASC (Cavalor, Belgium, NL)

Once the baseline is established, a more in-depth evaluation of the horse’s workload (volume of work x intensity) should be assessed according to his discipline and level of competition. The type of fitness and conditioning program, in combination with appropriate nutrition, will influence how the horse processes and uses energy. Performance horse uses 80–90% of its feed for energy metabolism.

An effective way to estimate energy requirements and the privileged type of fuel utilized by the horse is by measuring oxygen consumption (VO2) and subsequently respiratory exchange ratio (RER) and the respiratory quotient (RQ). RER refers to the ratio between the amount of oxygen (O2) consumed and carbon dioxide (CO2) produced in the breath, determined by comparing exhaled gasses to ambient air. Respiratory quotient (RQ) is calculated from the RER and is an indicator of which source of fuel (carbohydrate or fat) is being metabolized to supply the body with energy. Unfortunately measuring VO2 and respiratory gases is not feasible in routine practice and indirect estimates can be made using HR monitors and performing lactate measurements. Recently, HR monitors have improved to become more user-friendly and reliable for not only measuring HR, but also indicators of workload such as

speed, pace, and location. The formulas for the conversion of HR to energy expenditure (EE) in horses using indirect calorimetry are well established (Robergs and Burnett, 2003; Coenen, 2010).

Muscles can be trained to use carbohydrates and fat energy substrates more effectively. There are two general muscle fibre groups: slow twitch (type I) and fast twitch (type II) muscle fibres. Slow twitch fibres are associated with aerobic capacity and endurance-type activities. Endurance conditioning, by doing long, low intensity, longer distance work, increases aerobic capacity and the use of energy-rich fatty acids. It constitutes the basis of any training program and is modulated according to the duration of training sessions. On the other hand, fast twitch muscle fibres rely mainly on the anaerobic, glycogen-using metabolism. Glycogen (carbohydrate) is a form of energy stored both directly in muscles but also in the liver. Glycogen use and sparing can be modulated with training. Research has shown that muscle glycogen content can be increased by 33% during an interval conditioning program of 10 weeks which includes fast sprint work.

There are many ways to condition horses to optimize the horse's metabolism for a given sport. Interval training stresses the horse's cardiovascular and locomotor systems during repeated short exercise bouts interrupted by rest or recover periods, allowing to increase workload progressively and safely. Heart rate (HR) monitoring can help to determine the suitability of a particular training program. At HR above 150–180 bpm, the aerobic system is saturated, and the cardiovascular system cannot keep up with the demands. As a result, fuel is burned anaerobically. At HR below 100–150 bpm mostly aerobic work is being performed.

3. Adapting to the weak points

There are important factors that will affect the type and amount of nutrients required by an individual horse. External factors include type of management and housing, climatic and environmental factors, and quality of feedstuffs; internal factors include stress from training, competing and shipping, disease or injury, "easy keeper" vs. "hard keeper". Energy-related challenges faced by racehorse trainers include maintaining energy balance in the face of changing training demands, reduced performance from weight loss including exercise induced inappetence, overtraining syndrome and the effect of gastric ulcers on appetite. Adapting the diet is primordial in horses diagnosed with clinical conditions such as rhabdomyolysis, laminitis, gastric ulcers, IBD or horses with Equine Metabolic Syndrome (EMS) or Cushing's Disease (PPID). These require a balancing act between the amount of sugar and starches fibre and sources of fat and the appetence and palatability of the diet.

THE IMPORTANCE OF BRIDLE FIT FOR EQUINE WELFARE AND PERFORMANCE

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Introduction

Horses are frequently ridden or handled in bridles. These should be fitted carefully, similar to a saddle. Recent research shows that the way a bridle is designed and fitted to a horse's head affects the pressures underneath the bridle. Reducing pressures under the bridle have been shown to improve movement so correctly fitting a bridle to the individual horse is likely improve welfare and performance.

Pressure testing has shown specific locations where high pressures occur under the bridle, which can be affected by bridle design and fit. The headpiece and noseband can act as a linked unit so it is important that both are carefully fitted to avoid pressure points occurring under either the noseband or headpiece. Pressure at locations under the bridle tends to be intermittent, related to the timing of the stride as forces are transferred through the limbs or as the horse moves or swallows.

These include:

Headpiece

1. Front and back of the headpiece
    - Impact between the front of the headpiece and the base of the ears
    - Impact between the back of the headpiece and the wings of the atlas
2. Midline over the dorsal poll
3. Browband attachment - Under headpiece close to browband attachment as horse swallows

Noseband

1. Either side of the nasal bone
2. Underneath the chin over the mandibular rami
3. The location of greater pressure appears to depend on the horse's head position: if the head is more horizontal then more pressure tends to be on the lower edge of the noseband and when it is more vertical the pressure is more on the upper edge of the noseband.

GOALS OF BRIDLE FIT

1. Stability to reduce bridle and bit movement and avoid abrasion of the skin or lips during movement
2. Avoid creating pressure points
    a. Good dental care is essential to avoid lacerations of the cheek or tongue from sharp or fractured teeth
    b. Bridle shape and design must fit the horse's individual shape
    c. The noseband and headpiece must be fitted to allow independent movement
    d. The bit needs to be the correct size and shape for the horse's mouth
    e. Avoid sharp edges and stiff material
    f. Avoid buckles or metal fittings over pressure-risk areas on the headpiece and noseband
    g. Protect areas of high pressure under the noseband and headpiece

FITTING TO EACH HORSE'S ANATOMY

Headpiece

- Avoid buckles over anatomical prominences and ensure long enough to be stable.
- To avoid impacting against the back of the ears and/or the wings of the atlas, the headpiece should be narrow enough or shaped to fit between these structures either side of the head. Shaping (narrow at side and wider at top, shaped to the individual horse ears and atlas positioning) may reduce dorsal pressure points. Softer and smoother edges to the headpiece are recommended to reduce impact on the ear and wing of the atlas.

Browband

- Browband must be loose enough to move independently without pulling on headpiece and creating pressure at the sides, and positioned low enough to avoid the base of the ear and osseous prominences.

Noseband

- Tension – avoid over tightening (2 fingers/gauge) but being too loose reduces stability.
- Ensure width of noseband allows positioning far enough rostral to the facial crest and caudal to corners of mouth to avoid pressure points or abrasion of creased skin. Shaping may be an option to allow better individual fitting.
- Length of ventral pad must extent past the rami of the mandible to avoid pressure points.
- Padding at locations of high pressure points.
- Rings at sides may allow easier articulation with head movement
- Position of buckles and hard areas to avoid anatomical prominences.

Monitoring for problems

- Hair rub underneath the bridle or at the edges of the bridle
- White hairs under the bridle
- Skin irritation/rubbing under the bridle
- Skin bruising or rubbing of the cheeks if crushed between the bit and the noseband
- Pain on pressure at potential pressure points at base of ears, over poll, under browband attachment, under noseband
- Sores at corners of lips, inside cheeks or on tongue
- Head shy
- Reluctance to allow bridle to be put on, or to open the mouth for the bit

If any of these are happening, the bridle and bit should be checked carefully. Remember that a horse that has pain or lameness elsewhere can move abnormally and start having problems with the bit and bridle, so your veterinarian should be contacted if you have any concerns.

Further information:

Murray, R., Guire, R., Fischer, M. and Fairfax, V. A bridle designed to avoid peak pressure locations under the headpiece and noseband is associated with more uniform pressure and increased carpal and tarsal flexion, compared with the horse's usual bridle. Journal of Equine Veterinary Science. 2015;35:947-55

How to choose and fit a bridle - World Horse Welfare

2437d0cf-guidelines-for-correct-bridle-fitting.pdf (storage.googleapis.com)

PRACTICAL USE OF WEARABLES IN EQUESTRIAN SPORTS

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Performance is the capacity of an athlete to accomplish a given task at the expected level. To achieve performance, adequate preparation and good health go hand in hand, not only for a competition but also for a successful career. Human athletes are regularly monitored, usually in a laboratory setting, or during their training sessions to ensure they are gaining the required level of fitness. Exercise tests are also helpful in detecting abnormalities that could indicate an underlying clinical issue.

Adoption of exercise testing as been much slower for equine athletes, setting back our knowledge on how to best train our horses. Standardised exercise tests have been historically run on but treadmill tests failed to gain broad adhesion for fitness testing as they were (mistakenly) regarded as unsafe, tedious and expensive to run[1]. Fortunately, the advent of portable, connected smart technology has shifted the paradigms of exercise testing, taking it from the laboratory to the track. These user-friendly devices have revolutionised the way we can follow our equine athletes: tests can be undertaken in a larger number of individuals and on a more regular basis. Field tests can simply be done by following routine training sessions, even remotely, and identifying shifts in selected variables from normal recognised patterns[2–5] Through the monitoring of specific variables, the adequacy of a training program can be objectively assessed, and the workload adjusted accordingly. Fatigue and recovery can be more closely controlled, and the risks of injury or disease is reduced. The performance of an individual horse over a field exercise test can not only be followed longitudinally but also be compared to other horses, matched for activity and level.

The design of appropriately standardised tests is critical to establish a diagnosis. They can provide the clinician with information on the respiratory, cardiovascular, metabolic, muscular, and locomotor response of the horse during exertion, giving an overall assessment of his physical functional capacity. As exertion helps elicit or enhance clinical signs that would otherwise remain absent at rest, testing horses during exercise has become an important tool for veterinarians when investigating of poor performance. It also allows to examine the horse in real conditions, assess his behaviour and interaction with the rider, the fit of his tack, etc… as all these factors influence his response to exercise.[6,7] Several parameters can be measured simultaneously. Speed and heart rate (HR) are commonly used to assess workload and the horse's response. Heart rate recovery is also a simple and interesting variable, affected by fitness level and increased in case of cardiorespiratory or metabolic issues. Calculated variables combining speed and HR, such as V200 (the speed at which the horse reaches a HR of 200 bpm) have proven useful to compare individuals, even in non-strictly standardised conditions.[8] In addition to HR, several devices allow to record ECGs. This is particularly valuable in horses as they can present cardiac arrhythmias during exercise undetectable at rest. Pathological arrhythmias can be identified, their timing and the frequency of their occurrence examined, which is essential for prognosis.[9]

Some devices include inertial motion units that yield information on locomotion. In racehorses, the ratio of stride length and frequency evolves over time with training. Gait changes can be indicative of an underlying lameness, premature fatigue and even pain.

Sampling blood lactates (LA) at specific intervals or post-exercise is also an effective way of gaining insight on cardiorespiratory function. Lactate is a by-product of anaerobic metabolism and will increase if any link of the oxygen transport chain is weakened (anaemia, cardiovascular conditions, respiratory disease…). Handheld monitors have been validated for use in horses and can be used in field conditions.

The functional assessment of the respiratory tract can include overground endoscopy to field tests. Dynamic upper airway dysfunctions can be noiseless, especially in sport horses. Examining the horse under the saddle helps account for rider interaction, a key factor in explaining some upper airway abnormalities.[6]

The unprecedented development of technology validated for fitness monitoring in the horse now allows the practitioner to comprehensively monitor a larger number of horses, prior to competitions, even remotely, helping to target diagnostics more effectively, control the outcome of interventions and guide prognosis. This will help us improve the health and welfare of our equine athletes.

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WHAT IS IMPORTANT TO CONSIDER IF PLANNING WATER TREADMILL OR SWIMMING FOR TRAINING OR REHABILITATION?

Dr Rachel Murray MA, VetMB, MS, PhD, Dip ACVS, Assoc ECVDI, MRCVS

- For any water-based exercise, this is contraindicated if there are open wounds or skin infection, the horse has any infection/fever or acute myositis or severe injury.
- Any new exercise should be introduced gradually, then the quantity and level of challenge only gradually increased.

Important that programmes should be tailored to an individual so:

Individual horse features to consider

- Age, breed, size
- Conformation
- Posture
- Muscle development
- Strength
- Fitness
- Sport
- What other training horse is doing
- Time in competition season
- Injury history

Consider reason for using water-based exercise

- Training
  - Alone
  - Part of training programme – short/long term
- Rehabilitation
  - Alone
  - In conjunction with other specific exercise eg polework, dynamic stabilisation, riding, long reining, dry treadmill

WATER TREADMILL

Use of water treadmill exercise within a training or rehabilitation programme

- Water treadmill exercise provides straight line, unridden, controlled exercise that provides an option for cross training alongside a normal training programme
- Not recommended as the only or primary exercise type unless specifically indicated for rehabilitation of a particular injury, generally for a limited time period
- Drag increases as water depth and stride frequency increase, which has the potential to limit limb protraction, alter muscle use and change stride pattern
- Treadmill belt
- As water depth increases, impact shock of the limbs is reduced
- Water treadmill exercise in walk or trot does not produce high heart rates, so fatigue may not be obvious but horses may still experience fatigue in certain muscle groups, which is important to consider when planning a programme or monitoring within a session.
- Oxygen consumption has been found to reach 20% of maximal oxygen consumption in stifle depth water

Planning a Water Treadmill programme

- Important to assess the horse as an individual before planning a programme, and alter this depending on the horse's response over time

- Speed, water height, duration and frequency of sessions must be tailored to an individual. The best combination of speed, water depth and duration is affected by individual horse size, stride length, joint ranges of movement and capability.
- When introduced to the treadmill, a comfortable walk speed for the horse on the dry treadmill should be determined before water is introduced. As water depth increases, speed needs to be reduced. Walking in a correct posture through water will be slower than overland movement. A suitable belt speed allows the horse to maintain position in the middle of the treadmill leaving room for the head, neck and forelimbs to move without obstruction from the front of the treadmill, breast bar or breast strap.
- Essential to monitor movement patterns of the individual horse throughout the session, including changes in movement that occur in response to alterations in speed or water depth. Ensure that the session and programme are altered in line with horse's ongoing response, as the optimal combination of speed and water height may alter with session duration/fatigue, recent exercise, fitness or stage of rehabilitation. Even small adjustments in speed and/or depth can have significant effects on horse movement so it is important to make changes within a session dependent on the horse response.
- Speed, water height and duration are likely to change over time during a programme, depending on individual response and stage of training/rehabilitation. Adapt speed, water height, duration and frequency of sessions depending on how horse is coping, what else it has done that week/day/previous day, and stage of healing/rehabilitation or training.
- Further work on specific indications and contraindications for different injuries is required, but it is recommended that injuries which are potentially exacerbated by increased retraction (due to treadmill belt and water resistance) (eg DDFT/ALDDFT injury) should avoid using a water treadmill. Care should be taken with increasing water depth with thoracic spinous process pathology as thoracic extension may increase, and for pelvic/sacroiliac region injury as compensatory pelvic roll increases with water depth, particularly above the level at which horses can step over the water with the hindlimbs (which varies with individuals but tends to be in proximal metatarsal or tarsal depth water).

SWIMMING

Use of swimming within a training or rehabilitation programme

- Cardiorespiratory challenge – can operate at high heart rates
- Aerobic to anaerobic exercise
- Muscles are used differently when swimming vs overground, so swimming training will build a different muscle pattern. Eg Quadriceps used more to accerlate limb forward, while hamstrings work less in swimming because less need to decelerate limb coming into landing.
- Variations in technique - can be difficult for horse so may have compensatory movement patterns that are potentially problematic and there is potential for drowning. Some horses cannot swim safely.

Contraindications

- Horses with respiratory disease/compromise should generally not do swimming (increased hydrostatic pressure reduces lung volume), and upper airway compromise can increase risk of water aspiration (eg after laryngoplasty).
- Cardiovascular compromise
- Care should be taken when considering swimming in horses with the following injuries:
    - Thoracolumbar or sacroiliac pathology (swimming associated with dorsiflexion)
    - Hip, stifle, hock injuries (may experience large forces and ranges of motion dependent on swimming technique, fatigue etc).
- History of post-swim colic

Planning a swimming programme

- Difficult to standardise due to individual variations and pool designs (straight, circular, longer vs shorter).
- Important to assess the horse as an individual before planning a programme, and alter this depending on the horse's response over time.
- Watch horse swimming in clear water initially to assess ability and technique. Assess movement patterns and symmetry to check that the movement pattern is positive and not exacerbating problems (eg swimming lopsided reinforcing asymmetry).
- Essential to monitor movement patterns of the individual horse throughout the session, and also heart rate, respiratory pattern and signs of stress or fatigue. Each session should be monitored carefully as horses may work better in one session compared to another.
- Monitor for signs of fatigue, panic or struggling, when the session may need to be terminated as soon as practically possible. Concerns would include struggling to breathe/spluttering, inhaling water, eyes rolling, or an uneven movement pattern, over extended posture with pelvis rising or lowering, drifting, twisting or rolling.
- Start with very short swims and gradually increase duration and frequency is appropriate.

BIOMECHANICAL EFFECTS OF SPORT SURFACES: EXAMPLES OF APPLICATIONS FOR THE REHABILITATION OF RACE AND SPORT HORSES

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Arena and track surfaces used for training race and sport horses not only affect hoof motion at the onset of stance. They can also increase or decrease the stresses to the limb's bones, joints and tendons throughout stance, and modify locomotion. These effects of surfaces must be taken in account in defining the rehabilitation program of horses suffering from injuries to these structures.

Impact shock
Except at landing after a jump, the hoof's first contact with the surface most often takes place at the lateral quarter or heel, or flat. When the entire hoof gets in contact with the surface, it undergoes a sudden deceleration known as the "impact shock", which takes place within the first 5 to 10 milliseconds of the stance. Measured values of maximal deceleration largely vary according to surfaces and activities: from about -300 $m.s^{-2}$ on a harrowed sand&fibre mix (e.g at landing after a jump), to about -6000 $m.s^{-2}$ in a trotter at 40 km/h on a very hard track (9.81 $m.s^{-2}$ = 1 G).

The impact shock is particularly sensitive to the **surface's preparation**: on sand surfaces, **it can be divided by a factor 2 or 3 after harrowing**. Besides, the impact shock is significantly **increased when the superficial layer's thickness is decreased from 13 to 7 cm** (micro-sand with fibres, jumping arena); however, the shock reduction is not significant when the thickness is increased from 13 to 20 cm. In other terms, **beyond 13 cm, the increase in the superficial layer's thickness has very little effect on the impact shock**.

The impact mainly concerns the distal extremity of the limb (hoof and pastern), and the induced vibrations are hardly detectable proximally to the fetlock (bone measurements). However, as high impact deceleration is likely a risk factor for third phalanx contusion and tendinopathy, the impact shock should be reduced whenever possible, especially for a recent injury and/or at high speed.

Braking
After landing, the hoof tend to slide, and to a lesser extent, sink, while moving forward in the surface. Sliding and sinking distance depend on gait (and limb, at canter), speed, and on the compliance of the surface top layer ("cushion"). As the forward motion of the horse's trunk increases the vertical component of the force (Fz) applied to the limb, above a certain Fz threshold, **the hoof's advance is stopped**. The longitudinal component of the force (Fx) has then reached its maximal value, and will decrease afterwards.

The maximal braking force (Fx_max, generally 1500 to 3000 N; 9.81 N = 1 kg) is lower and reached later on soft or compliant surfaces.

Vertical loading of the limb
Once the hoof's longitudinal displacement has stopped, the fetlock goes down and the centre of pressure (point of application of the ground reaction force) moves towards the heels. Fetlock drop increases the tension of the superficial digital flexor tendon (SDFT) and suspensory ligament (SL). The proximal interphalangeal joint extension, in relation with SDFT tension, starts during this phase. These events are more sudden on a firm top layer, and they are generally associated with an early and high Fx_max value. On compliant cushions, sinking of the heels in the surface due to fetlock drop reduces SDFT tension, and proximal interphalangeal extension is more gradual.

At the time the vertical component of the force reaches its maximum (Fz_max: 1.5 to 2 times body weight under training conditions), the reaction force is still oriented backward (load-absorbing phase) on the forelimbs, while it is oriented forward (propulsion phase) on the hind limbs. The vertical loading rate (slope of the Fz-time curve), even more sensitive to the surface properties than Fz max, reflects the ability of the surface, including its deeper layers, to vertically deform, or on the contrary, its tendency to compacting. Fz_max is reached all the more late (lower rate) that the surface is more compliant through its all thickness. In terms of **severe injury risk (e.g. fractures, especially long bones), the vertical loading rate, and *a fortiori* the Fz_max, are key variables**.

The faster the horse runs (or the higher it jumps), the more the properties of the deeper layers of the ground will contribute to the biomechanical effects of the "surface".

Propulsion phase
During this phase, the longitudinal force measured under the hoof becomes negative (propulsive), and reaches its lowest value (Fx_min) at the time of maximal extension of the elbow and stifle (respectively in the fore- and hind limbs). A high Fx_min value reflects a surface that provides a good support.

During this phase the COP moves progressively forward, reflecting more pressure on the ground at the toe. Depending on the shear strength of the ground (that has been compacted by the whole limb pressure), toe will tend to penetrate in the surface. The forward rotation of the hoof observed in a soft surface induces a delayed elevation of the fetlock (due to the relief of the deep digital flexor tendon, DDFT). This is why **deep surfaces are contra-indicated in case of SDFT tendinopathy or suspensory desmopathy**.

Heel raising then take-off
Heel raising (at about 95 % of stance) produces a clear force peak on firm surfaces that allow no, or very little, forward rotation of the hoof. Interestingly, this peak is also present on very deep (muddy, sticky) surfaces. It is produced by the tension of the **deep digital flexor tendon** (DDFT), the only tendon acting in heel raising. This force peak is hardly measurable on soft surfaces, reflecting a lower required tension of the DDFT. Soft surfaces are therefore indicated in horses suffering from **DDFT (and accessory ligament of the DDFT) injury as well as from podotrochlear syndrome**.

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DIAGNOSIS AND REHABILITATION OF MUSCLE INJURIES

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Summary
The purpose of this presentation is to demonstrate the wide variety causes and manifestations of muscles injuries. After the presentation of the etiopathogenesis, the clinical manifestations are illustrated using videorecordings of cases. In the field as well as in hospital, ultrasonography is the most adequate technique to establish a precise diagnosis of the muscle involved and the type as well as extend of the lesion. Practice on sound horses should be done to avoid erroneous interpretation of echogenicity changes induced by slight changes in the orientation of the ultrasound beam

In acute situations, rest is recommended to reduce bleeding and further muscle damage. Cold therapy is indicated. Mobilisation (passive elongation) and ultrasonographic guided massage are indicated to avoid muscle retraction. The rehabilitation program include slow and fast concentric contraction followed by slow and fast eccentric contraction requiring more muscle coordination and proprioceptive control.

« RESIDENT FORUM »

RELIABILITY OF THE FLEXION TEST ON A LARGE COHORT OF CANINE ORTHOPEDIC PATIENTS: EFFECT OF AGE, GENDER, NEUTERED STATUS, BREED SIZE, TESTED JOINT AND INITIAL LAMENESS SCORE

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Objectives: This retrospective study evaluates the effectiveness of a flexion test (FT) to allocate pain to a joint area and factors of variation influencing the outcome of the FT on a large group of canine orthopedic patients.

Materials and methods: Dogs selected retrospectively underwent a FT in a referral orthopedic clinic between 2009 and 2020 and presented a clinical diagnosis with complete medical imaging records. Patients were submitted to the FT method described for dogs: a dog's joint, identified as suspected of an orthopedic problem according to the clinical examination, was flexed for one minute before walking 15 meters on an even surface. The FT was considered positive if the lameness increased after the application of the test and negative if not. The cases fitting the inclusion criteria were submitted to statistical analysis.

Results: Over 1161 patients' files were collected and analyzed for this research. The FT showed 82,8% (95%IC: 80,5-84,9) of true positives and 17,2% of false negatives. None of the patient's intrinsic characteristics influenced the outcome of the test (age, gender, neutered status, and breed size). The orthopedic parameters, such as the initial lameness score and the tested joint, showed to have a statistically significant influence on the outcome of the test. All joints had a similar high rate of success except for the hip joint. Patients not lame or severely lame presented less reliable FT results.

Clinical relevance: The FT is a trustworthy, easy to perform technique that presents added value to the current orthopedic examination.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable due to the retrospective design of the study.

Sources of funding: This research received no external funding.

EX-VIVO COMPUTED TOMOGRAPHIC EVALUATION OF THE PROXIMITY OF NEEDLES PLACED FOR PALMAR DIGITAL NERVE BLOCKS TO SYNOVIAL STRUCTURES IN THE FOOT

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Background: Potential synovial penetration following palmar digital nerve blocks has not been investigated.

Objectives:
To evaluate the proximity of needles placed for palmar digital nerve blocks to nearby synovial structures using computed tomography (CT).

Methods: In 18 cadaver forelimbs, sequential injection of the navicular bursa (NB), distal interphalangeal joint (DIPJ) and digital flexor tendon sheath (DFTS) was performed using 3ml, 5ml and 10ml diluted contrast medium, respectively. After each synovial injection, 25G needles were placed over the palmar digital nerves at the proximal aspect of the ungular cartilages (distal injections) and 1 cm proximal to the distal injection sites (proximal injections), and CT was performed. Subsequently, needles were removed and the synovial structures further distended with the same volume as for the first injection. Perineural needle placement and image acquisition were repeated. The distance between the needle tip and the neighbouring synovial structures were measured in reconstructed images.

Results: Synovial penetration was confirmed following 12/420 (2.9%) needle placements (NB n=5, 1 after proximal and 4 after distal injections; DIPJ n=2, DFTS n=2, NB or DIPJ n=3, all after distal injections). Most penetrations (11/12, 91.7%) occurred after the second distensions. After 11/420 (2.6%) needle placements, the needle tip was adjacent to the DIPJ (n=5) and DFTS (n=6). Following 131/420 (31.2%) needle placements, needles were <5mm from the NB (n=5), DIPJ (n=22) and DFTS (n=104).

Limitations: Ex-vivo study.

Conclusion: There is a small risk of synovial penetration when performing palmar digital nerve blocks, especially in cases with distension of adjacent synovial structures.

Conflict of interest: None.

Ethical committee: Not applicable; cadaver limbs of horses euthanized for reasons unrelated to this study were used.

Sources of funding: This research received no external funding.

APPLICATION OF A CAPACITIVE RESISTIVE ELECTRIC TRANSFER THERAPY 24 HOURS BEFORE EXERCISE INCREASES VELOCITY AND ACCELEROMETRIC ACTIVITY IN STANDARDBRED TROTTERS

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Background: The application of a capacitive resistive electrical transfer (CRET) therapy, a radiofrequency at 448 kHz, resulted in accelerometric changes during a controlled treadmill exercise and during a dressage test.

Objectives: To evaluate the accelerometric modifications in Standardbred trotters during a training session bout when a CRET therapy is applied 24 hours before.

Material and methods: Six sound Standardbred trotters in active training performed two experiments: an exercise bout session (control) and the same exercise 24 h after a CRET therapy. Both experiments were separated by one week and the order was randomly established. Drivers were blinded for the experiment followed. Horses carried a triaxial accelerometer (Equimetrix) fixed in the sternal region. A Kolmogorov-Smirnov test (normality) and a Wilcoxon test (differences between control and CRET) were made. Data are presented as medians and quartiles.

Results: CRET therapy resulted in increased velocity (control: 7.10 m/s, quartiles 5.70-9.10; CRET, 8.30 m/s, quartiles 6.90-10.65). A marked increase in total accelerometric activity (TAA) was found after CRET (75.0 W/kg, 44.5-111.7) compared to control (45.6 W/kg, 34.4-88.9). This increased TAA resulted from significantly higher values in dorsoventral, longitudinal and mediolateral activities. However, when the accelerometric activities in the three body axes were expressed as percentages of TAA, a reduction of dorsoventral, a lack of changes in mediolateral and increased longitudinal activity were detected.

Conclusions: The application of a CRET therapy 24 h before exercise resulted in favourable locomotor changes in Standardbred trotters, mainly increased velocity and longitudinal accelerometric activity.

Main limitations: Limited number of horses.

Conflict of interest: The authors declare no conflict of interests.

Ethical committee: The study was approved by the Ethical Committee for Animal Welfare of the Veterinary Clinical Hospital of the University of Córdoba, Spain (protocol code 28/2018; date of approval: June 20th, 2018).

Sources of funding: This research received no external funding.

VARIATIONS OF THE VERTICAL DISPLACEMENT OF THE WITHERS AND *TUBER SACRALE* IN TROTTING HORSES ON A WATER TREADMILL WITH DIFFERENT WATER HEIGHTS: PRELIMINARY RESULTS

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Backround: Previous studies reported that water treadmill (WT) exercise modifies back kinematics in horses at the walk depending on water depth (WD). Little is known about the effect of the WD at higher speed.

Objective: To assess variations of vertical displacement (VD) of the withers and *tuber sacrale* (TS) when trotting on a WT at different WD.

Material and Methods: Six sound Standardbred horses were trotted (3.5m/s) on a WT. Three WD were tested and compared to a control condition (dry treadmill - DT): mid-cannon bone (WD-CAN), mid-radius (WD-RAD) and shoulder point (WD-SHOUL). Inertial sensors placed at the level of the withers and TS were used to assess ventrodorsal displacement. For each horse and condition, medians of minimal and maximal altitudes and amplitude of VD were analysed. Median differences between WD and DT were used to compare the three WD.

Results: All variables significantly differed from DT except for TS at WD-SHOUL. VD-withers was significantly more increased at WD-RAD than at WD-CAN and WD-SHOUL (respectively +3.8, +2.0 and +1.4 cm, $p<0.05$) and VD-TS at WD-RAD than at WD-SHOUL (+2.4 vs -1.3cm, $p<0.05$). Despite a non-significant statistical difference, WD-RAD and WD-SHOUL seemed to affect differently VD-withers and VD-TS.

Main limitations: Relative small sample size weakening statistical power of the tests.

Discussion and conclusions: Trotting at WD-RAD significantly increases VD of the trunk, the withers being more likely affected than the TS. VD-TS at WD-SHOUL seems to show a large inter-individual variability. These data should be considered when designing training or rehabilitation programs.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: The study was approved by the Ethics Committee ComEthAnses/ENVA/UPEC (protocol code 13/12/18-8 and date of approval: 13/12/2018)"

Sources of funding: This research was possible thanks to the financial support for equipment and facilities by the FEDER (Fonds Européen de Développement Régional), the region Normandie, the Calvados County Council, Eperon Funds and French Ministers of Agriculture and Research.

« FREE COMUNICATIONS »

« SMALL ANIMALS »

RELIABILITY OF BALANCE ASSESSMENT ON A MODIFIED POSTUROMED PLATFORM IN HEALTHY DOGS – A PILOT STUDY

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Introduction: Clinical balance-assessment is a mainstay to predict injury risk and functionality in people. Reliable standardized balance-tests for dogs are not available yet. The purpose of this study was to investigate reliability of static and dynamic posturography in healthy dogs.

Materials and Methods: Healthy dogs (n=20) were positioned with four paws longitudinally and then with the fore paws only transversely on a modified pressure-sensitive balance-platform (Posturomed-FDM-JS, Zebris, Isny, Germany). Three static and three dynamic posturographic trials were recorded (recording-duration: 20 sec) and repeated after 7-14 days. The Center of pressure (CoP) parameters COP-path-length (PL; mm), 95% CoP-confidence-ellipse-area (CEA; mm²) and CoP-average-velocity (AV; mm/sec) were calculated for the first steady-state 5 sec intervals of each trial. Reliability of CoP-parameters was assessed with a paired t-test. Training effect was analyzed with Cohen's d (effect size).

Results: For static posturography, PL, CEA and AV did not differ significantly between time points and CEA had the highest reliability ($p = 0,92$). For dynamic posturography, AV and PL differed significantly between time points (AV: $p \leq 0,043$; PL: $p \leq 0,045$). A slight training effect was observed for transverse positioning (Cohen´s d: PL 0,265; AV 0,267) and a moderate training effect for longitudinal positioning (Cohen´s d: PL: 0,772; AV: 0,783).

Conclusion: This study showed, that static posturography on a modified Posturomed balance-platform was reliable in healthy dogs, but indicated a training effect during dynamic posturography. Further studies with additional time-points are needed to evaluate the nature of this training effect associated with balance-assessment further.

Conflict of interest: The modified Posturomed Platform was provided by Zebris Medical GmbH (Isny, Germany) for the purpose of this study.

Ethical committee: This study was approved by the Ethical Committee of the Centre of Veterinary Medicine, LMU Munich, Germany (approval number: 258-01-03-2021, date of approval 07.06.2021).

Sources of funding: This research received no external funding.

EFFECT OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) ON PEAK VERTICAL FORCE AND VERTICAL IMPULSE IN DOGS

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Background: Transcutaneous electrical nerve stimulation (TENS) is frequently used as a pain relieving treatment in dogs with chronic pain from the locomotor apparatus. The aim of this randomized, controlled cross-over study was to investigate the effect of TENS on peak vertical force (PVF) and vertical impulse (VI) in lame dogs.

Material and Methods: The study included 22 low to moderately lame dogs; 9 with unspecified musculoskeletal pain diagnosed by clinical examination and medical history, and 13 with confirmed osteoarthritis diagnosis by additional diagnostic imaging. The effect of TENS on PVF and VI was evaluated in trot with a pressure sensitive mat (Walkway High Resolution HRV4; Tekscan Inc.) before and after a single treatment, and after an additional 8-day (n=6) or 10-day (n=16) treatment. Participants were randomly assigned to start with TENS (80 Hz pulse, duration=100 µs, individually set intensity) or placebo TENS. Treatment were given once daily, for 45 minutes, with a washout period of 7-10 days between the interventions. Peak Vertical Force (PVF) and Vertical Impulse (VI) were analysed with a paired one-tailed Student´s t-Test in Excel, $p<0,05$.

Results: Results show that PVF and VI changed significantly after TENS, but not after placebo treatment ($p=0.01$ and 0.01). No significant changes were seen for PVF or VI after a single treatment session ($p=0.29$ and 0.47).

Conclusions: The results indicate that lameness, measured as PVF and VI, changed significantly after 8 or 10 consecutive daily TENS treatments in dogs with chronic musculoskeletal pain. Further studies are needed to confirm the results.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: The study was approved by the ethics committee of the Swedish Board of Agriculture (Protocol code 5.2.18-335/18 and C148/13).

Sources of funding: This research was funded by Agria Pet Insurance and the Swedish Kennel Club.

PHYSICAL ACTIVITY AND SPORT-SPECIFIC TRAINING PATTERNS IN SWEDISH WORKING TRIAL DOGS – A QUESTIONNAIRE SURVEY

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Background: Physical activity and sport-specific training prepare dogs for the requirements of working trial tasks and may decrease the risk of injury. The objective of this study was to explore physical activity and sport-specific training patterns among Swedish working trial dogs.

Materials and methods: Dog handlers provided information on trial dogs through an internet-based survey.

Results: We received 1615 replies to the questionnaire. After data cleaning, 1582 dogs (98%) were left for the analysis. Out of these, 847 were working trial dogs, i.e., had competed in messenger, protection, search or tracking disciplines. The vast majority of the dogs (n=589, 70%) received more than one hour of daily physical activity, and only 21 (2.5%) never exercised off leash. Preferred self-selected gait was trot (n=478, 56%) and gallop (n=274, 32%). About a fourth (n=225, 27%) never played with other dogs. The majority (n=722, 85%) received more than one hour of vigorous physical exercise per week. Three quarters (n=602, 71%) received added conditioning, i.e., cardiorespiratory, musculoskeletal or a combination thereof. Two thirds (n=565, 67%) participated in at least three hours of sport-specific training per week. Median total work load was 16.8 hours per week and 5.2% (n=83) were considered specialized since they actively trained only one discipline for ≥10 months per year.

Conclusions: Based on the physical activity and sport-specific training patterns the working trial dogs here were moderately to highly active. Studies regarding risk and protective factors of injuries in working trial dogs are lacking.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable since data about the dogs were reported online by dog handlers and all data was anonymous. The study was conducted in accordance with the national animal ethical guidelines provided by the Swedish codes of statues: SFS 2018:1192 and SJVFS 2019:9.

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RELIABILITY OF STIFLE GONIOMETRY IN DOGS WITH CRANIAL CRUCIATE LIGAMENT RUPTURE

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Objectives: Goniometry is routinely performed clinically in dogs with cranial cruciate ligament (CCL) disease. The purpose of this study was (1) to compare reliability of stifle goniometry in dogs with CCL-disease and healthy dogs and (2) to investigate the effect of compliance on measurements.

Material and Methods: Dogs presented preoperatively for surgery for CCL-disease (CCL-Dogs; n=15) and orthopedically healthy dogs (C-Dogs; n=11) were enrolled in this prospective randomized controlled trial. In each dog, three observers randomly measured maximum-stifle-flexion (mSF) and maximum-stifle-extension (mSE) three times with a goniometer without scale while dog-compliance was scored (Scores: C1:excellent - C4:poor). Intraclass-correlation-coefficient (ICC) was calculated for inter- and intraobserver reliability. Effects on measurements were evaluated with mixed-effect models (MEM).

Results: Stifle extension and mSE-compliance were significantly decreased in CCL-Dogs compared to C-Dogs ($p \leq 0{,}004$), but mSF and mSF-compliance did not differ between groups. Intraobserver reliability was excellent for all dogs during mSE (ICC:0,75-0,99) and mSF (ICC:0,89-0,99). Interobserver reliability was excellent for mSF in both groups (ICC:C-Dogs:0,84, CCL-Dogs:0,9) and for mSE in CCL-Dogs (ICC:0,94) but only fair for mSE in C-Dogs (ICC:0,58). Robust MEM showed that the combined average of all mSE measurements of all three observers was effected by compliance in both groups ($p<0{,}001$). This effect was not observed for single mSE-measurements by themselves.

Conclusion: The results of this study indicate that compliance may affect goniometric stifle extension measurements in healthy and CCL-deficient dogs. In a clinical setting, inter- and intraobserver reliability was excellent for all measurements except for maximum stifle extension in healthy dogs.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: This study was approved by the Ethical Committee of the Centre of Veterinary Medicine, Faculty of Veterinary Medicine, LMU Munich, Germany (approval number: 177-05-06-2019, date of approval 13.11.2019).

Sources of funding: This research received no external funding

« EQUINE »

COMPARATIVE IMAGING OF THE CARPUS AND PROXIMAL METACARPAL REGION OF 12 ENDURANCE HORSES IN TRAINING AND COMPETITION

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Background: Imaging findings in the carpus and proximal metacarpal region of non-lame endurance horses have not been described.

Objectives: To document magnetic resonance imaging (MRI) and computed tomographic (CT) abnormalities in endurance horses; to relate these to radiographic and ultrasonographic findings.

Methods: Radiography, ultrasonography and low-field MRI of both carpi and proximal metacarpal regions of six novice and six experienced non-lame endurance horses were performed. Images were analysed subjectively. Ten horses also underwent standing CT examination. The frequency of distribution of abnormalities between novice and experienced horses and detected with different imaging modalities were assessed using a Chi-square test.

Results: Thickening of the palmar cortex (Pc) of the third metacarpal bone (McIII) was identified on MR and CT images in both limbs of 5/6 experienced horses, associated with increased opacity in radiographs of 3. Endosteal and/or periosteal irregularity (12 limbs of 7/10 horses) and modelling (13 limbs of 7/10 horses) of PcMcIII were most commonly identified in CT images and were over-represented in experienced horses ($p<0.05$). The lateral lobe of the suspensory ligament (SL) was enlarged in 5 limbs of 3 horses in CT images, detectable ultrasonographically in 2. Other abnormalities included: mineralization of the dorsomedial aspect of the third carpal bone (n=4 limbs); second carpal bone osseous cyst-like lesion (n=1); third carpal bone subchondral bone lucency (n=1).

Limitations: Small sample size. Previous proximal metacarpal pain cannot be excluded.

Conclusion: Lesions previously associated with lameness can be seen in endurance horses without current clinical significance.

Conflict of interest: None.

Ethical committee: The study was approved by the Ethical and Animal Welfare Committee of the University of Veterinary Medicine Budapest and by the Government Office of Pest County (PE/EA/00140-4/2022) on the 21.02.2022.

Sources of funding: This study was co-financed by the European Social Fund (grant agreement no. EFOP-3.6.3-VEKOP-16-2017-00005), project title: 'Strengthening the scientific replacement by supporting the academic workshops and programs of students, developing a mentoring process'. The study was also supported by Hallmarq Veterinary Imaging, who generously sponsored the MRI examinations. The National Research, Development and Innovation Office, Hungary, contributed to the project by financing the equipment.

CORRELATIONS BETWEEN ULTRASOUND, DOPPLER, MRI, AND HISTOLOGY IN A SUSPENSORY LESION MODEL

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Objectives: To determine correlations between ultrasonography, Doppler, MRI and histology in a standardized suspensory ligament (SL) lesion model in 12 horses.

Material and methods: A surgically-induced suspensory lesion model was used in all lateral SL branches of 12 horses. Blindly evaluated outcome of ultrasound, Doppler and MRI was available at either 4 weeks (6 horses), or 6 months (6 horses). At these same timepoints tissue samples were harvested, stained with HE and for von Willebrand Factor (VWF) and analyzed blindly. For statistical analysis Spearman's rank correlation coefficient (Spearman's rho) was determined while data was not normally distributed. Results were considered significant with $p<0.05$.

Results: In both groups combined (12 horses), there was a fair positive correlation between VWF staining intensity and Doppler signal, (r_s = 0.338, p = 0.047). There were statistically significant, fair positive correlations between lesion circumference on MRI and ultrasound (r_s = 0.538, p = 0.002), and between lesion cross-sectional area (CSA) on MRI and ultrasound (r_s = 0.522, p = 0.003). Further, a fair negative correlation between MRI mean signal and ultrasound echogenicity (r_s= -0.405, p=0.027), a fair negative correlation between echogenicity and histologic lesion CSA (r_s = -0.366, p= 0.028) and a fair positive correlation between MRI signal and histologic lesion CSA (r_s = 0.477, p= 0.008) was found.

Main limitation: A suspensory lesion model only resembles naturally occurring lesions.

Conclusions: Outcome suggests that Doppler is a useful tool for scoring vascularization in this model. Lesion size on ultrasound correlates with MRI, and ultrasonographic echogenicity correlates to MRI signal and histologic lesion size. These non-invasive diagnostic tools allowed for evaluation of surgically-induced SL branch lesions and can be used to assess various therapeutic options in this model.

Conflict of interest: The authors declare no conflicts of interest.

Ethical committee: The study was approved by the Ethical Committee of Ghent University (LA1400077)

Sources of funding: This research received no external funding.

STANDING COMPUTED TOMOGRAPHIC ASSESSMENT OF THE METACARPOPHALANGEAL JOINT SPACE WIDTH IN 66 NON-LAME HORSES

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Background: During non-weightbearing standing computed tomographic (CT) examination, positioning of the limb might affect joint space width. Knowledge of the range and asymmetry in nonlame horses is required for accurate image interpretation.

Objectives: To describe variation in the metacarpophalangeal joint space width in images reconstructed from non-weightbearing standing CT examinations of non-lame horses.

Materials and Methods: Computed tomographic images of both metacarpophalangeal joints of 66 non-lame horses that had undergone standing, non-weightbearing CT examination were reviewed. The joint space width was measured in frontal reconstructions in set locations in the midline and in the medial and lateral aspects of the joint, in the dorsal, mid and palmar third of the weightbearing surface. Measurements were compared using a Wilcoxon signed-rank test or Friedman's ANOVA.

Results: Joint space width measurements ranged from 0.6-5.7 mm (median 2.0 mm, interquartile range: 0.6 mm). The joint space was significantly wider in the dorsal and middle third on the medial side, and in the palmar third on the lateral side ($p<0.01$). A lateromedial asymmetry of >1 mm was seen in 24/132 (18.2%) limbs in the dorsal third, in 2/134 (1.5%) limbs in the middle and in 21/134 limbs in the palmar third (15.7%) of the joints.

Limitations: The potential impact of subclinical osseous abnormalities on the joint width was not assessed.

Conclusions: There is a wide range of metacarpophalangeal joint space width measurements in standing non-weightbearing CT images of non-lame horses. The smallest range and the greatest symmetry are in the middle of the weight-bearing surface.

Conflict of interest: None.

Ethical committee: The study was approved by the Animal Research Scientific and Ethics Committee of Hungary on the 31st August 2021 (protocol code PE/EA/1051-7/2021).

Sources of funding: The study was funded from grant by the National Research, Development and Innovation Office, Hungary.

INTRA- AND INTER-OBSERVER RELIABILITY OF A HANDHELD MYOTONOMETER TO MEASURE EQUINE FORELIMB SUPERFICIAL DIGITAL FLEXOR TENDON STIFFNESS

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Background: A handheld device to measure stiffness of the human Achilles tendon has been developed

Objective: To assess reliability of a device to measure stiffness of the equine superficial digital flexor tendon (SDFT).

Materials and methods: Twelve Spanish bred horses (7 geldings, 3 mares and 2 stallions), 10-16 years, free of SDFT injury, non-sedated, were studied. A device (MytonPro®), with a probe that generates mechanical impulses causing tissues oscillations was used. Three trained operators performed three consecutive measurements in both forelimbs (ultrasonographic region 2A), with the forelimbs standing (STAND) and raised (RSD). Differences between forelimbs and limb positions were evaluated with a Mann-Whitney test. A Wilcoxon test for repeated samples and a Kruskal-Wallis test assessed intra-observer and inter-observer differences, respectively. Standard error of measurement (SEM) was calculated: standard deviation x √1-ICC (intra-class correlation coefficient) and minimal detectable change (MDC) was calculated: 1.96XSEMX√2.

Results: Mean stiffness of 1451.9±123 and 523.2±98.14 N/m in STAND and RSD were found. No significant differences were observed between measurements of each observer, neither between observers nor between right and left forelimbs. Significant differences were found between STAND and RSD. ICC for inter and intra-observer reliability were 0.87 (95% confidence interval 0.79-0.93) and 0.83 (0.75-0.90). SEM was 61.23 and 65.38 for STAND and RSD respectively. MDC were 64.01 for STAND and 71.20 N/m for RSD.

Main limitations: Limited number of horses. Different gender.

Conclusions: Measurement of SDFT stiffness with a handheld device appears to be repeatable within and between operators. The clinical utility should be evaluated in the sport horse.

THE EFFECTS OF TWO DIFFERENT WITHHOLDING PERIODS OF OMEPRAZOLE ON THE RECURRENCE OF EQUINE GASTRIC ULCER SYNDROME IN THOROUGHBRED RACEHORSES

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Background: The recommended-withdrawal-period (RWP) for omeprazole in some jurisdictions is 2-clear-days, yet the consequence of this on recurrence of Equine-Gastric-Ulcer-Syndrome (EGUS) is unknown.

Objective: To compare recurrence of Equine-Squamous-Gastric-Disease (ESGD) and Equine-Glandular-Gastric-Disease (EGGD) after '2-clear-days' to 'not-on-race-day' omeprazole withdrawal.

Material and Methods: Twelve Thoroughbred geldings in full simulated race training were randomly allocated to group A=2-clear-days or group B=not-on-race-day in a simple cross-over study. All horses received omeprazole at approximately 4mg/kg PO SID throughout the study, except for during the '2-clear-days' RWP and on 'race-days' (days 31 and 62) when horses competed in an 800m mock-race. Gastroscopy was performed on days 0, 28, 31 (post-race), 59 and 62 (post-race) and recorded. Videos were blindly graded 0-4 for ESGD and EGGD by one investigator. A Fischer's exact test was used for all comparisons. Significance was defined as $p \leq 0.05$.

Results: All horses had ESGD ≥ grade 2/4 (12/12; 100%; 95%CI 81-100%) and 7 had EGGD (7/12; 58%; 95% CI 31-82%) on day 0. More horses were affected by ESGD after the '2-clear-days' (10/12; 83%; 95%CI 56-96%) than the 'not on race-day' (3/12; 25%; 95%CI 8-53%) RWP (p=0.012). The prevalence of ESGD post-RWP for '2-clear-days' did not differ from day 0 (10/12; 83%; 95%CI 56-96% vs. 12/12; 100%; 95%CI 81-100%; p=0.478). Neither RWP, nor treatment influenced EGGD prevalence.

Conclusion: More horses developed ESGD during the '2-clear-days' RWP than during the 'not on race-day' RWP. The prevalence ESGD returned to pre-treatment baseline within the '2-clear-days' RWP.

Conflict of interest: B. Sykes has commercial arrangements with Equestra Australia, Troy Australia and Kelato all of which have products relating to EGUS. None of these entities had any input into the study design or execution. The other authors declare no conflict of interest.

Ethical committee: The study was approved by the Ethics Committee of the Hong Kong Jockey Club (protocol code ERC/031/2021)

Sources of funding: This research was funded by the Department of the Veterinary Clinical Service of the Hong Kong Jockey Club.

COMPREHENSIVE ANALYSIS OF EXERCISE-INDUCED HEMOLYSIS IN ENDURANCE HORSES

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Background: Exercise-induced hemolysis occurs as the result of physical exercise and is caused by metabolic and mechanical factors. We hypothesized that exercise-induced hemolysis occurs in endurance racehorses and its severity was associated with the intensity of exercise. In order to provide further insight into the hemolysis in endurance horses we deployed omics strategies beyond standard molecular methods. The aim of this study was to scrutinize hemolysis parameters, including hemoglobin and its subunits, haptoglobin, heme, biliverdin, bilirubin, as well as macroscopical plasma colour change.

Material and Methods: Samples were taken from 47 Arabian endurance horses competing for 80, 100 and 120 km distances. Blood was collected before and after the competition and analyzed macroscopically and with ELISA, non-targeted metabolomics and proteomics with liquid chromatography–mass spectrometry.

Results/Discussion: A significant increase in hemoglobin, bilirubin, biliverdin and heme, and significant decrease in haptoglobin after exercise was seen ($P \leq 0.001$). An association was found between the measured parameters, average speed and distance completed. In horses running long distances with higher speed hemolysis was more prominent. Levels of hemolysis markers were the highest in horses eliminated for metabolic reasons in comparison to finishers and lame horses ($P \geq 0.05$). No significant difference was found between genders.

Conclusion: Hemolysis may contribute to development of metabolic disorders and toxic effects observed in endurance horses after a race. Moreover, erythrocyte breakdown is dependent of the intensity of exercise. Utilization of omics methods alongside conventional methods revealed a broader insight into the exercise induced hemolysis process.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: The study was approved by the Institutional Animal Care and Use Committee from Weill Cornell Medicine- Qatar, under the protocol number WCMQ-2018-003 on the 14th of November 2018.

Sources of funding: This research was funded by the Intramural Grant Program of the Equine Veterinary Medical Center, Doha, Qatar and the Biomedical Research Program at Weill Cornell Medicine in Qatar, a program funded by Qatar Foundation.

COMPARISON OF TWO DIFFERENT BLOOD GAS ANALYZERS IN EQUINE PRACTICE

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Background and Objectives: Blood gas analysis is an essential tool for equine veterinarians to assess blood gas and electrolyte imbalances for performance assessment in equine athletes. Many different blood gas analyzers are used but few have been validated for the use in horses. The aim of this study was to compare the results obtained from the newly marketed GEM5000 machine to the formerly validated epoc® machine.

Material and methods: In this prospective, comparative, non-blinded study, a total of forty-three equine blood samples, taken from 26 client-owned horses were analyzed on each of the analyzers and values for pH, pCO_2, pO2, Na^+, Cl^-, iCa^{2+}, K^+, haematocrit, haemoglobin, base exces, saturation, and HCO_3^- were compared via concordance analysis, Passing-Bablok regression and Bland-Altman analysis. Duplicate measurements were conducted on the GEM5000 machine and coefficients of variation were calculated to evaluate precision.

Results: The GEM5000 failed to achieve the required precision for the determination of pCO_2, pO_2, HCO_3^- and K^+. Concordance correlation analysis revealed poor correlation for Na^+, Cl^-, Ca^{2+}, K^+, while there was a substantial or better agreement for haematocrit and haemoglobin. Passing-Bablok revealed significant constant bias for pCO_2, pO2, Cl^-, and iCa^{2+} and significant proportional bias for pCO_2, $iCa^{2+}$and SO_2. Bland-Altman analysis revealed significant systematic bias for Na^+, Cl^-, iCa^{2+}, K^+, Htc, tHb, and SO_2.

Discussion/Limitations/Conclusions: The number of samples tested is lower than the number recommended for the validation of laboratory equipment. Results of this study show that results from different machines should not be used interchangeably.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable due to samples taken for analysis of clinical cases on the discretion of the treating veterinarian.

Sources of funding: This research received no external funding.

NEUROLOGICAL DEFECTS AND LONG TERM PROGNOSIS FOR SPORT HORSES INFECTED WITH WEST NILE VIRUS

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Background: The encephalitis due to the West Nile Virus (WNV) has a world-wide distribution. Horses infected can exhibit clinical signs of central nerve system affectation, e.g., ataxia, pyrexia and depression.

Objective: To determine the number of horses that return to the same level of performance after infection and evaluate the persistence or absence of neurological signs.

Material and methods: From 17 horses with clinical signs of encephalitis for WNV, 10 were included in the study. Horses used for breeding were excluded. Horses that met the inclusion criteria were sport horses of different disciplines and levels (dressage (7), high level showjumping (1), driving (1) and high level endurance (1)). Retrospective study including clinical histories from horses admitted in the Veterinary Teaching Hospital from the University of Extremadura. All horses were examined when developed neurological signs and were confirmed to suffer West Nile Virus in the Reference National Laboratory. Horses included in the study were positive to Anti-WNV IgM antibodies by competition ELISA and/or confirmed by micro-virus neutralization test (VNT).

Results: The predominant clinical signs were: ataxia (10 horses), muscle fasciculations (9 horses), bilateral blindness (1 horse), difficulties to get up (1 horse) and fever (1 horse). The maximum time to recovery was two weeks in severely affected horses and three days in horses with mild signs. The treatment varied depending on the clinical signs and were mainly supportive therapies.

Conclusions and clinical significance: All the horses with clinical signs included in this study survived and returned to the same level of performance. None showed persistent neurological deficits after three weeks.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable due to is a retrospective study.

Sources of funding: This research was supported by grant GR21085 funded by the Regional Ministry of Economy and Infrastructure, Extremadura Government (Spain), and the European Regional Development Fund “A way to make Europe” and by the grant “Ayudas a grupos de la Universidad de Extremadura”.

« POSTERS »

« SMALL ANIMALS »

INTERNET SURVEY ON INJURY INCIDENCE AND PREVENTION IN WORKING DOGS INVOLVED IN SEARCH AND RESCUE ACTIVITY

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Objective: Aim of this study was to identify the incidence of injuries in search and rescue dogs working on rubble and field and injury prevention management

Materials and Methods: Data by a 97-questions survey from 100 working dogs' owners were analysed.

Results: Labrador, Border collie and Malinois were the more representative breeds (mean age 4.8±3.1 years). 55,1% of dogs were submitted to preventive x-rays for orthopaedic diseases; final x-ray diagnosis at ≥12 months of age was performed in 56,4% of dogs. 37,2% of dogs received a specific veterinary medical fitness assessment for work. All dogs were trained 3 days a week with a general physical activity (walk, running, obedience and search activity), but only 20% of owners correctly perform a specific training programme. Warm-up and cool-down exercises were performed by 40% of the owners. The injury rate was 37.2% and mainly involved carpus, metacarpus and sesamoids (60%), muscles (30%), shoulder (6%) and cruciate ligament rupture (3%). Weight bearing lameness was the most common sign, generally recovered in a few days. 70,7 % of diagnosis was performed by a vet. The most used rehabilitation treatments were Laser and aquatic therapy. 17,9 % of injured dogs were submitted to surgery.

Discussion and Conclusions: The injury rate observed in this study resulted as high as that observed in impact sports (agility, flyball). The owners' knowledge on injury prevention did not seem enough to allow a correct management in the warm-up and cool-down phases. 90% of participants suggested to promote webinars on athletic training.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: All participants to the internet survey signed a declaration of authorization for anonymous use of the provided data for scientific aims.

Sources of funding: This research received no external funding.

SPORT-SPECIFIC TRAINING PATTERNS AND SPECIALIZATION AMONGST SWEDISH SPORTING AND WORKING TRIAL DOGS – A QUESTIONNAIRE SURVEY

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Background: Knowledge regarding educational training patterns, e.g., duration and variability of training focusing on relevant tasks related to the sport or field work, and specialization, in agility, obedience, rally obedience and working trial dogs is lacking. The objective of this study was to explore sport-specific training patterns among Swedish dogs competing in agility, obedience, rally obedience and working trial disciplines.

Materials and methods: Dog handlers provided information on competition-level sporting and working trial dogs through an internet-based survey on physical activity, sport-specific training and management variables.

Results: We received 1615 replies to the questionnaire. After data cleaning, 1582 dogs (98%) were left for the analysis. Number of sports performed by each dog varied from one to five. Most common was participation in one (n=767, 48%) or two (n=541, 29%) sports. Three dogs competed in five sport disciplines, 50 dogs in fours disciplines and 221 dogs (14%) in three disciplines. Of the dogs practicing only one discipline, 38% (n=294) were considered specialized as they actively trained that discipline for ≥10 months per year. Similar proportions of working dogs (n=83, 5.2%) and agility dogs (n=83, 5.4%) were specialized. These proportions decreased slightly among obedience dogs (n=65, 4.1%) and rally obedience dogs (n=60, 3.8%).

Conclusions: Our findings provide valuable insights in sport-specific training patterns among active sports dogs in Sweden. Sport-specialization may positively and negatively affect movement skills. Further studies regarding risk and protective factors of injuries in sporting and working dogs are required.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable since data about the dogs were reported online by dog handlers and all data was anonymous. The study was conducted in accordance with the national animal ethical guidelines provided by the Swedish codes of statues: SFS 2018:1192 and SJVFS 2019:9.

Sources of funding: This research was funded by AGRIA and Swedish Kennel Club Research Fund. Grant number N2019-0020.

PATIENT ACCEPTANCE OF FOCUSED SHOCKWAVE THERAPY IN NON-SEDATED DOGS TREATED FOR MUSCULOSKELETAL CONDITIONS

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Objective: Recent advances in trode technology allow for focused extracorporeal shockwave therapy (fESWT) without sedation. The goal of this study was to report patient acceptance of fESWT in non-sedated dogs with musculoskeletal conditions using a state-of-the-art fESWT trode.

Material and Methods: Client owned dogs (n=17) treated with fESWT using a PulseVet® device with shallow X-Trode™ (Zomedica®, Alpharetta, GA, USA) were included in this retrospective clinical observational case series. Twenty-four fESWT-treatments were performed without sedation with 800-1000 shockwaves per region of interest 1-3 times 16-80 days apart with an energy flux density of 0,13-0.14 mJ/mm^2 [E4-E6]. Association between patient disposition, discomfort during examination (Exam-Scores: E_0 (no discomfort) to E_4 (painful)) and fESWT acceptance (Scores: A_0 (excellent) to A_4 (poor)) was evaluated with Mantel-Haenszel Chi-Square test.

Results: Dogs were treated for osteoarthritis (n=9), tendinopathies (n=2), myopathies (n=2), lumbosacral syndrome (n=2), delayed union (n=1) and arthrodesis (n=1). Disposition was documented as anxious (n=10) or relaxed (n=14). Examination discomfort scores ranged from E_0 to E_3 (E_0:n=9; E_1:n=8; E_2:n=5; E_3:n=2). Acceptance scores ranged from A_0 to A_2 (A_0:n=7; A_1:n=15; A_2:n=2). In none of the dogs fESWT had to be discontinued due to discomfort or stress. There was a positive moderate association between discomfort during exam and patient acceptance (Tau-b=0.50; p = 0.014). Patient acceptance of relaxed dogs was significantly higher compared to anxious dogs (mean score difference=0.53; p = 0.037).

Conclusions: Non-sedated dogs tolerated fESWT with X-Trode technology well without sedation, but dogs with anxious disposition or higher exam discomfort had lower patient acceptance levels.

Conflict of interest: The PulseVet® device was provided by Zomedica®, Alpharetta, GA, USA for the purpose of an unrelated study. Qing Kang is a consultant for Zomedica®, Ann Arbor, MI, USA.

Ethical committee: Not applicable due to the mere observational character of this clinical case series

Sources of funding: This study received no external funding.

REPEATABILITY AND INTERSESSION-RELIABILITY OF KINETIC AND TEMPOROSPATIAL GAIT VARIABLES MEASURED WITH A PRESSURE-SENSITIVE TREADMILL IN HEALTHY CATS

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Objectives: Interest in feline kinetic gait variables has risen tremendously. The goal of this study was to investigate repeatability and intersession-reliability of kinetic gait analysis in healthy cats using a pressure-sensitive treadmill.

Material and Methods: Healthy client-owned cats (n=9) and cats housed at the Chair of Animal Nutrition and Dietetics[b] (n=5) without orthopedic abnormalities based on history, examination and subjective gait analysis participated. Cats (mean bodyweight: 5.2±0.9 kg; age: 4.1±1.7 years) were acclimated with a pressure-sensitive treadmill-system (FDM-T-CanidGait; sensitivity 0.5 N/cm^2; sampling-frequency 100 Hz; Animal-Analysis-Suite RC-2.3.28; Zebris, Isny, Germany), while treadmill velocity was adapted to allow a comfortable walk. For data-acquisition, cats were placed by the handler on the treadmill and replaced when jumping off [total time: 10 min (5x 2 min)]. The first 5 sequences with 6 gait cycles (straight walking; no velocity changes or head movement) were selected. Data-acquisition was repeated after two weeks at the same velocity.

Repeated measure ANOVA or Friedmann-test were used to assess repeatability. Intraclass-correlation-coefficients (ICC) were calculated to determine intersession-reliability of gait variables.

Results: Average maximal force and loaded paw-surface, step- and stride-length, step-width, stance- and swing-phase percentages, step-stride ratio, symmetry-indexes and step/double-step-ratio did not differ significantly between the two time points ($p \geq 0.05$). The data was therefore regarded as repeatable.

ICC showed good to excellent reliability for all variables (0.885-0.988) except for symmetry-indexes (moderate reliability; forelimbs: 0.547; hindlimbs: 0.676).

Conclusions: This study showed that a pressure-sensitive treadmill-system allows for repeatable and reliable data-acquisition with good to excellent intersession-reliability in healthy cats.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: This study was approved by the Ethical Committee of the Centre of Veterinary Medicine, LMU Munich, Germany (approval number: 218-16-06-2020, date of approval 13.08.2020).

Sources of funding: This research received no external funding.

LONG-TERM EVALUATION OF A SINGLE INTRAARTICULAR POLYACRYLAMIDE HYDROGEL INFILTRATION FOR OSTEOARTHRITIS IN DOGS

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Background: Hydrogels for intraarticular viscosupplementation play a physiological role in joint homeostasis. Polyacrylamide hydrogel (PAAG) is a non-degradable homogeneous gel, similar to hyaluronan sodium in overall structure and tissue compatibility, but with a longer-lasting viscous effect.

Objective: The purpose of this work is to evaluate the long-term effect (2 years) of a single PAAG intraarticular infiltration in ostheoarthritic dogs.

Material and Methods: This study was performed in 11 dogs, older than 5 years of age and with different degrees of osteoarthritis in one or more joints. The affected joints were injected with 1,5-2 ml of PAAG and the efficacy of PAAG was evaluated before and after treatment (at 1, 3, 12 and 24 months) by a kinetic analysis (GRF: including peak vertical force (PVF) and vertical impulse (VI) and symmetry index (SI)).

Results: Significant differences were observed in the PVF, IV and SI between pre and post-treatment at 1 month (Wilcoxon, $p<0,05$), however, at 3 months these parameters worsened. At 12 and 24 months there was a not significant improvement in the degree of lameness compared to the pre-treatment values.

Main limitations: One of the limitations of the study is that it does not take into account the degree of osteoarthritis, nor the number of affected joints. On the other hand, it would be necessary to increase the sample size.

Conclusions: A single infiltration with PAAG significantly reduces the degree of lameness a month after treatment, although its effectiveness decreases in the medium and long term.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable due to it is a clinical act carried out with the consent of the owners.

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« EQUINE »

SKIN THERMOGRAPHIC CHANGES IN THE THORACOLUMBAR REGION OF THE HORSE, INDUCED BY THE APPLICATION OF A CAPACITIVE RESISTIVE ELECTRIC TRANSFER THERAPY

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Introduction: Capacitive-resistive electrical transfer (CRET) is a deep diathermy technique applied at 448 kHz.

Objective: To analyze thermographic changes in skin temperature after a moderate-high intensity protocol, and low capacitive therapy afterwards.

Materials and methods: Ten horses free of thoracolumbar pain were subjected to several treatment protocols in the T15-L2 region: sham treatment ('SH', machine off) and medium-high intensity therapy (TREAT; intensity 40%), divided into A (3 min 'capacitive CAP' 5% after 'resistive RES'), and B (without CAP 5%). Maximum temperature (Tmax) was measured with thermography at the beginning (baseline), after gel application, after 5 min of capacitive 40%, after 5 and 10 min of RES 40%, after 3 min of CAP 5% (only TREAT-A) and at 5, 10 and 30 min after therapy in standardized conditions.

Results: SH protocol did not affect skin temperature, with only significant differences when comparing after gel application (mean values and standard deviation, 23.45±1.83ºC) and 15 min post-treatment (26.57±2.27ºC). In TREAT-A protocol, a mean decrease of 5ºC was found after CAP5%. In TREAT-B protocol, mean increases of 7ºC with CAP and 12ºC with RES was found. No significant differences were found between 5 and 10 min of RES application. The reduction of Tmax in TREAT-A protocol with CAP persisted throughout the first 30 min after therapy.

Conclusions: The application of CRET at medium-high intensity significantly increases skin temperature in the thoracolumbar region of horses, that persist elevated during the first 30 min after treatment. Moreover, capacitive therapy applied at low intensity decreases temperature, supporting its use in acute processes.

Conflict of interest: The author declares no conflict of interest

Ethical committee: The study was approved by the Ethical Committee for Animal Welfare of the Veterinary Clinical Hospital of the University of Córdoba, Spain (protocol code 28/2018; date of approval: June 20th 2018)

Sources of funding: This research received no external funding.

LIMB CIRCUMFERENCE MEASUREMENTS IN HORSES- A RELIABILITY STUDY

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Background: Evaluating muscle strength is vital when following the progress of physical training and rehabilitation. However, muscle strength in horses may only be assesses indirectly, for instance as limb circumference. Since tape measure is a simple way of measuring circumference, it is of importance to investigate its reliability. Thus, the aim was to determine the inter- and intra-observer reliability of limb circumference measures in standing horses.

Material and Methods: Measurements were conducted in 11 healthy horses, of various breeds, sex and age. It was performed, with a tape measure, at standardized locations distal to the elbow, and proximal and distal to the stifle. A total of 9 circumferences and semi-circumferences (for instance the forelimb distal extensor muscles were measured from the craniomedial edge of radius and the boundary between m. extensor digitorum communis and m. ulnaris lateralis), were measured in triplicates by three examiners, blinded to the measurement results. Consistency within and between examiners was analyzed using intraclass correlation coefficient: ICC [95% confidence interval], with $p<0.05$.

Results: Results showed a moderate to good inter-examiner and excellent intra-examiner reliability, with lowest values for inter-examiner reliability for semi-circumference measurements for forelimb distal extensor muscles (ICC=0.51 [0,26:0,73]) and highest for intra-examiner reliability for hind-limb distal circumference (ICC=0.98 [0,96:0,99]).

Conclusions: Results indicate that tape measures represent a promising tool for estimating limb circumference in standing horses, if used by the same examiner. Future studies should investigate the correlation between circumference measures and muscle mass, as an indirect measure of muscle strength.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: The study was approved by the Ethics Committee of Uppsala, Sweden (protocol code 15533/2018)

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IMAGING FINDINGS IN THREE HORSES WITH MEDIAL PROXIMAL STRESS LESIONS OF THE PROXIMAL PHALANX

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Background: Sagittal groove stress injuries of the proximal phalanx in horses have largely been addressed in the literature. This report describes the cross-sectional appearance of stress injuries with a less usual medial location in three horses, associated with catastrophic injury in one case.

Material and methods: Cross-sectional imaging findings of 4 fetlocks from 3 sport horses were described, including *in vivo* low-field standing magnetic resonance (MR) images of 2 horses, *post-mortem* computed tomography (CT) images in 1 horse and *post-mortem* high field MR images in another horse.

Results: The four limbs presented dorsomedial to medial slightly irregular periosteal reaction at the proximal aspect of the proximal phalanx, associated with endosteal sclerosis and enlarged regional trabecular vascular channels. All limbs had signs of degenerative metacarpophalangeal joint disease as well as chronic overload bone injury, including periarticular osteophyte production, medial thickening of the proximal phalanx proximal subchondral bone plate and dorsal / dorsomedial sclerosis of the third metacarpal bone condyle. Medial subchondral bone resorption was observed on the MR images of 3 limbs. Mild bone marrow lesion was present in the third metacarpal bone condyle and proximal phalanx of one limb. In the limb with the catastrophic fracture one of the fracture planes transected the area of trabecular sclerosis and periosteal reaction.

Discussion: This study describes the imaging features of fetlock subchondral stress injuries located in the medial aspect of the proximal phalanx in three horses. Periosteal reaction and trabecular sclerosis in a comparable medial location in the fractured limb are suggestive of prodromal signs of a stress fracture which could lead to a catastrophic fracture.

Conflict of interest: The authors declare no conflict of interest.

Ethical committee: Not applicable as the poster is a retrospective case series on clinical cases and no experimental study.

Sources of funding: This research received no external funding.