How ultrasound can be used to minimise the need for big surgical incisions

Smith, R.K.W. MA VetMB PhD DEO FHEA DipECVSMR DipECVS FRCVS
Professor of Equine Orthopaedics
Dept. of Clinical Sciences and Services
The Royal Veterinary College
London, U.K.

Introduction
Ultrasound lends itself well to intra-operative use because it provides real-time imaging, is portable, and can be applied intraoperatively to image soft tissues but also the surface of bone. It can therefore be used intra-operatively to facilitate minimally invasive surgical procedures.

Technique
Intra-operative use requires the transducer to be sterile. A small amount of ultrasound gel (which does not need to be sterile) should be applied to the surface of the transducer. This should then be enclosed by the gloved surgeon using a sterile covering such as an arthroscopic camera sleeve, sterile ultrasound transducer sleeve, or, in some occasions, a sterile glove. A glove provides the least robust sterile barrier and hence is only useful for standing procedures where the lead hangs down away from the surgical field. In open surgical fields, there is usually sufficient blood for adequate contact, but this can be supplemented with sterile saline (in open wounds), or surgical spirit (alcohol) when the transducer is applied to intact skin within the sterile field. In most situations a linear high frequency (~10MHz) transducer is used because most ultrasound guided surgery is superficial. Wireless transducers are also useful for intra-operative use and have the advantage of lacking a lead which also needs to be enclosed in a sterile covering. Good awareness by the theatre staff of ultrasound machine operation is helpful to optimise image quality and for image storage during the procedure.

Indications

1. Pre-surgical planning

   Ultrasound evaluation of the surgical area is helpful to optimise the surgical approach and hence minimise the size of any incision. This can be done prior to the induction of general anaesthesia or else after the area has been prepared for aseptic surgery.

2. Identifying bony fragments and foreign bodies

   Bony fragments or foreign bodies that require removal can be hard to locate within tissues or fibrinous material inside a joint. Ultrasound can be used either pre-operatively, when the location of the foreign body/bony fragment is marked on the skin, or intra-operatively to help guide instruments in real-time, or locate them when they have moved or when they have not been visible (eg during arthroscopy).

3. Optimising instrument placement – examples will be given showing:

   a. Introduction of the arthroscope in unfamiliar locations.

      When the cavity being accessed is not one for which there are already established portals – such as acquired synovial cavities or areas of fluid collection within tissues. Ultrasound can also be helpful for less easily accessed synovial cavities – such as the caudal pouch of the medial femorotibial joint.

b. Distant debridement
Ultrasound can provide real-time guidance of instruments placed through small incisions to guide them to a more distant site while avoiding important structures.

c. Improving fasciotomy techniques for proximal suspensory ligament surgery
The fasciotomy performed as part of the neurectomy and fasciotomy procedure for the management of proximal suspensory desmitis in the hindlimb requires the introduction of surgical scissors or a fasciotome through the surgical incision and accurately placed at the proximal limit of the metatarsal fascia. Iatrogenic damage to the suspensory ligament has been reported after this procedure [1] and an experimental study suggested the fasciotome required, although did not eliminate, the risk of this damage [2]. The use of concurrent ultrasound using a transversely orientated transducer immediately distal to the incision helps to reduce this risk further by ensuring the instrument is cutting the plantar fascia without entering the adjacent suspensory ligament.

d. Transection of tendons and ligaments
This can be achieved minimally invasively through a small incision with the help of intra-operative ultrasound – such as the accessory ligament of the deep digital flexor tendon [3], the palmar annular ligament [4], medial patellar ligament, and tenotomy of the distal limb tendons (eg superficial and deep digital flexor and extensor tendons).

e. Implant placement and removal
Drains and transphyseal screw placement can be performed minimally invasively with the concurrent use of ultrasound. Removal of bone screws can also be facilitated by identifying the screw head ultrasonographically.

References
1. Dyson, S. and R. Murray, Management of hindlimb proximal suspensory desmopathy by neurectomy of the deep branch of the lateral plantar nerve and plantar fasciotomy: 155 horses (2003-2008). Equine Vet J, 2012. 44(3): p. 361-7.
2. Sidhu, A.B.S., et al., Comparison of Metzenbaum scissors and Y-shaped fasciotome for deep metatarsal fasciotomy for the treatment of proximal suspensory ligament desmopathy in horses. Vet Surg, 2019. 48(1): p. 57-63.
3. White, N.A., 2nd, Ultrasound-guided transection of the accessory ligament of the deep digital flexor muscle (distal check ligament desmotomy) in horses. Vet Surg, 1995. 24(5): p. 373-8.
4. De Gasperi, D., et al., Ex vivo evaluation of a percutaneous thread-transecting technique for desmotomy of normal palmar/plantar annular ligaments in horses. Vet Surg, 2023. 52(3): p. 388-394.

Professor Roger K.W. Smith MA VetMB PhD FHEA DEO DipECVSMR DipECVS FRCVS
Large Animal Imaging Associate of the European College of Veterinary Diagnostic Imaging

Roger Smith is Professor of Equine Orthopaedics at the Royal Veterinary College (RVC) with particular interests in orthopaedic surgery, imaging, lameness, and tendon research. He qualified with a First from Cambridge University in 1987. After 2 years in general practice, he undertook a residency in equine surgery at the RVC and then a PhD on the extracellular matrix of equine tendons. He remained at the RVC and was appointed Professor in December 2003. He holds the Diploma of Equine Orthopaedics, is Diplomate of two European Specialist Colleges (Veterinary Surgery (ECVS) and Veterinary Sports Medicine and Rehabilitation), and is a Royal College of Veterinary Surgeon's Specialist in Equine Surgery. He was awarded an RCVS Fellowship in 2016 and was ECVS President in 2017. He is currently President-Elect of British Equine Veterinary Association.

Methods for screening racehorses for fracture risk

Prof Chris Whitton BVSc FANZCVS PhD, University of Melbourne

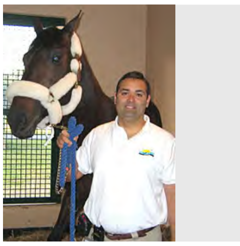
Fatal fractures in racehorses are an animal welfare issue that threaten the racing industry's social licence. As the majority of fractures that occur in racehorses develop over time due to the accumulation of bone microdamage, there is an opportunity to develop screening methods that detect horses at risk of fracture prior to catastrophic bone failure. Important considerations when developing screening methods include determining the level of risk that is tolerable, how long the findings will be valid for, and will the method be used on its own or in combination with other screening methods. It is also important to understand the positive and negative predictive value of any screening method so that the number of false positive and false negative results can be determined. The positive predictive value decreases for all screening tests when the prevalence decreases meaning that false positives are more common for events that are rare. This is an issue when applying screening to fracture risk because fractures in racehorses remain relatively rare. Screening horses for fracture risk with advanced imaging is currently undertaken for the Melbourne Spring Racing Carnival. Evidence for the use of imaging derives from postmortem studies where pre-existing pathology that could be detected with imaging modalities such as standing CT has been identified. The monitoring of horses' gait with wearable technology is a new methodology that shows some promise, but more work is required before it can be effectively applied as a practical screening method.

Chris Whitton BVSc FANZVCS PhD
Professor of Equine Orthopaedics
Specialist in Equine Surgery
Head of Equine Centre
Melbourne Veterinary School
Faculty of Science
University of Melbourne

Chris leads the Equine Limb Injury Prevention Program at the University of Melbourne Equine Centre a multidisciplinary research program funded by Racing Victoria, the Victorian State Government and the University of Melbourne, combining microstructural analysis, histopathology, biomechanics, epidemiology and mathematical modelling, dedicated to developing preventative training and management protocols for racehorses.

Chris trained as a specialist equine surgeon at the University of Sydney, Australia, gaining Fellowship of the Australian and New Zealand College of Veterinary Scientists in Equine Surgery by examination in 1995. He also completed a PhD in Carpal disease of racing horses at the University of Sydney in 1998 before moving to work at the Animal Health Trust in Newmarket, England in 1996. From 1999 to 2004 he ran his own surgical referral practice at the Newcastle Equine Centre in Australia and has worked at The University of Melbourne since 2004 as a Specialist surgeon and researcher.

He has published over 70 peer reviewed papers and contributed to 12 book chapters. He has been awarded over $13million in research grants. He regularly presents educational lectures on injury prevention to trainers in Australia and has also presented to trainers and racing veterinarians in England, Ireland, Wales, Hong Kong, Singapore, Korea, Brazil, and Uruguay.



The Importance of Standing Computed Tomography in Lameness and Orthopedics

Nicolas Ernst DVM, MS, DACVS
Professor of Equine Surgery, Sports Medicine and Lameness
University of Minnesota, Leatherdale Equine Center
St. Paul, Minnesota, USA

The availability and utilization of computed tomography (CT) to aid lameness diagnosis and orthopedic surgery predates magnetic resonance imaging (MRI) and has dramatically increased in the last 5 years. In human orthopedics, CT is considered to be the best diagnostic modality for orthopedic problems and fracture repair. For horses, CT has been a valuable aid in diagnosing lameness in the distal limb, offering more information than radiographs. CT uses similar radiation to radiographs, but is faster, taking an average of few minutes to image a region. This allows the imaging of a significant portion of the horse's limbs from distal radius/tibia to the foot. The new Standing CT systems for horses allows for imaging of both limbs simultaneously whereas other diagnostic modalities require separate acquisition of the contralateral limb. This facilitates a comparative evaluation of the anatomical area of interest and can help identify bilateral causes of lameness.

Historically, CT in horses has been a limited due to the need for general anesthesia and the risks associated with the anesthetic procedure. Now days, CT imaging in sedated, standing horses is now a possibility that provides three dimensional (3D) information that improves the possibility of obtaining a definitive diagnosis for orthopedic problems that cause lameness. Standing CT can provide more information regarding the morphology of bone and some soft tissue injuries due to the possibility of obtaining cross-sectional images in multiple planes. Musculoskeletal lesions (especially soft-tissue) can be further detected with the addition of contrast material (iodine based) through intra-vascular, intra-articular or intra-thecal routes. Based on the volume of information provided, it is essential that one understands anatomy in order to interpret all the CT images.

Radiographs and ultrasound have low sensitivity and specificity for the detection of early bone changes. In lameness cases, CT can provide valuable diagnostic information these other modalities often cannot provide. This makes standing CT a tremendously valuable tool for clinicians when diagnosing lameness in sport horses associated to the distal limb.

Imaging-assisted fracture repair is becoming part of the routine practice in orthopedic surgery. Fracture configurations are complex making it hard to characterize them radiographically. CT is a superior 3D imaging technique for pre-operative diagnosis and planning, intra-operative implant placement and post-operative evaluation of the repair. CT produces cross-sectional images with spatial separation of structures that assists in recognizing and following the number and direction of fracture lines in a comminuted fracture, facilitating a faster surgery and anesthesia time with less patient morbidity and minimal radiation exposure to surgery personnel.

Cone-beam CT scanners have been used in horses; however, movement of the horse during acquisition can affect the final image resulting in streaking artifacts, scatter and noise artifacts, and image distortion. Helical CT systems developed for imaging of human patients are currently being used to scan distal limb in horses. However, only one limb (non-weight-bearing) can be scanned at a time. A new multi-slice, helical, fan beam CT scanner design specifically for horses (Equina system; Asto CT Inc.) has been developed with a sliding gantry that can be tilted from 0° to 90° for horizontal or vertical scanning. For distal limb scanning, imaging from the distal portion of the radius or tibia, including the carpal or tarsal region, to the foot can be performed on both limbs simultaneously. The Equina Standing CT by ASTO was first installed in the University of Minnesota Leatherdale Equine Center in 2019. Since that time, more than 600 horses have been evaluated with this imaging modality in our hospital.

References:

1. Desbrosse FG, Vandeweerd J-MEF, Perrin RAR, et al. A technique for computed tomography (CT) of the foot in the standing horse. Equine Vet Educ. 2008;20(2):93-98.
2. Puchalski SM. Computed tomography in equine practice. Equine Vet Educ. 2007;19(4):207-209.
3. Puchalski SM. Advances in equine computed tomography and use of contrast media. Vet Clin North Am Equine Pract. 2012;28(3):563-581.
4. Porter EG, Werpy NM. New concepts in standing advanced diagnostic equine imaging. Vet Clin North Am Equine Pract. 2014;30(1):239-268.
5. Mageed M. Standing computed tomography of the equine limb using a multi-slice helical scanner: technique and feasibility study. Equine Vet Educ. 2022,34 (2) 77-83.
6. Pauwels FE, Van der Vekens E, Christan Y, et al. Feasibility, indications, and radiographically confirmed diagnoses of standing extremity cone beam computed tomography in the horse. Vet Surg. 2021;50(2):365-374.
7. Barrett M, Acutt E, Redding WR. Diagnostic Imaging. In: Baxter GM, ed. Adams and Stashak's Lameness in Horses. 7 ed. 2020;416.

Nicolas Ernst DVM, MS
Diplomate American College of Veterinary Surgeons
Professor of Equine Surgery, Sports Medicine and Lameness
University of Minnesota, Leatherdale Equine Center
- *Graduated from the University of Chile in 2000.*
- *Equine Rotating Internship (medicine, surgery, anesthesia and reproduction) at UC Davis in 2000.*
- *Equine Surgery Internship at Chino Valley Equine Hospital, Chino, California 2000-2001.*
- *Masters in Clinical Epidemiology at University of Florida 2001-2002.*
- *Equine Surgery Residency at University of Florida 2003-2006.*
- *Diplomate American College of Veterinary Surgeons 2007.*
- *Assistant Professor on Equine Surgery, Emergency and Critical Care at The Ohio State University 2006-2007*
- *Professor of Equine Surgery, Sports Medicine and Lameness at University of Minnesota 2007- present.*

Common complications in orthopaedic surgery

Luis M. Rubio-Martínez DVM DVSc PhD DipACVS DipECVS DipACVSMR MRCVS. Sussex Equine Hospital. Billingshurst Road, Ashington RH203BB, United Kingdom

Surgical complications are defined as 'any undesirable, unintended, and direct result of an operation affecting the patient that would not have occurred had the operation gone as well as could reasonably be hoped' (Sokol and Wilson, 2008). Surgical complications can be categorised as intraoperative or postoperative, depending if the complications occur during or after the surgical procedure. A postoperative complication includes any event that occurs within a 30-day period after the surgery, either during or after hospitalisation (Jacobs er al 2007). Complications can also be categorised as patient-related and practitioner-related. Practitioner-related complications are often a result of a surgical error; however, not all surgical errors end up in surgical complications.

It remains key that errors and complications be recognised, identified and managed timely. The objective of recognising these errors and complications is to be able to anticipate and implement measures to prevent them as much as possible (Tseis et al 2014; Wooley et al 1993). A key strategy to decrease the risk of complications is to ask the members of the team the questions: 'Are we ready to respond?'.

Morbidity and mortality discussions provide analysis of failures and were first implemented in the early 1900s at Massachusetts General Hospital (USA). Implementation of Morbidity and Mortality discussions have led to improved healthcare quality and patient safety (Kravet et al, 2006; Lecoanet et al, 2016; Tignanelli et al, 2017). Professional practice evaluations by peer review of physician individuals and groups lead to improved quality, protected patients from harm and improved patient outcome through implementation of measures to identify and prevent operative complications. (Reines et al 2017; Tignanelli et al 2017).

Implementation of surgical safely checklists improved surgical safety of human patients, but reduced morbidity, reduced hospitalisations, reduced mortality, whilst maintained operating room efficiently (Gawande 2007).

Unprofessional behaviour within the surgical theatre is associated with 14% higher surgical complication rate (Tschan et al 2019) and disruptive doctors have a negative impact on the work of members of the surgical team, with team members making more mistakes in the operating room.

Examples of surgical errors and complications in equine orthopaedic surgery will be reviewed in this lecture.

References:

1. Tschan F, Semmer NK, Timm-Holzer E, Zimmermann J, Candinas D, Demartines N, Hübner M, Beldi G. Disruptive behavior" in the operating room: A prospective observational study of triggers and effects of tense communication episodes in surgical teams. PLoS One. 2019; 14(12): e0226437.
2. Gawande A: The checklist: if something so simple can transform intensive care, what else can it do? New Yorker 2007:86-101.
3. Jacbos JP, Jacbos ML, Mavrudis C, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walkers HL, Kurosawa H et al: What is Operative Morbidity? Defining Complications in a Surgical Registry Database*. Ann Thorac Surg 2007, 84:1416-1421.
4. Kravet SJ, Howell E, Wright SM: Morbidity and mortality conference, grand rounds, and the AC-

GME's core competencies. J Gen Intern Med 2006, 21(11):1192-1194.

5. Lecoanet A, Vidal-Trecan G, Prate F, Quaranta JF, Sellier E, Guyomard A, Seigneurin A, Francois P: Assessment of the contribution of morbidity and mortality conferences to quality and safety improvement: a survey of participants' perceptions. BMC Health Serv Res 2016, 16:176.
6. Reines HD, Trickey AW, Donovan J: Morbidity and mortality conference is not sufficient for surgical quality control: Processes and outcomes of a successful attending Physician Peer Review committee. Am J Surg 2017.
7. Sokol DK, Wilson J: What is a surgical complication? World J Surg 2008, 32(6):942-944.
8. Tignanelli CJ, Embree GGR, Barzin A: House staff-led interdisciplinary morbidity and mortality conference promotes systematic improvement. J Surg Res 2017, 214:124-130.
9. Tsesis I, Rosen E: Approach for prevention and management of surgical complications. In: Complications in endodontic surgery. edn. Edited by Tsesis I. Berlin: Springer-Verlag; 2014: 1-6.
10. Tsesis I, Rosen E: Introduction: an evidence-based approach for prevention and management of surgical complications. . In: Complications in endodontic surgery: prevention, identification and management. edn. Edited by Tsesis I. Berlin: Springer; 2014: 1-6.
11. Wooley CF, Boudoulas H: Clinician. Hellenic Journal of Cardiology 1993, 34:241-243.

Luis M Rubio-Martínez DVM DVSc PhD DACVS DECVS DACVSMR MRCVS
RCVS, European and American Specialist in Equine Surgery
American Specialist in Equine Sports Medicine & Rehabilitation

Luis is originally from Spain and graduated from the University of Zaragoza (Spain). He followed this with a rotating equine internship at the Veterinary School of Hannover (Germany). After two years of equine practice in Mexico, Spain and Argentina, he completed a PhD in equine orthopaedic infections at the Complutense University of Madrid (Spain). He then returned as an equine clinician to the University of Zaragoza, followed by a surgical residency and a doctoral degree (DVSc) in subchondral bone disease in racehorses at the Ontario Veterinary College (Canada). Luis has held faculty positions at the Universities of Guelph (Canada), Pretoria (South Africa) and Liverpool (UK). In December 2017 Luis joined the Sussex Equine Hospital, where Luis is currently a Clinical Director.

Luis regularly speaks at national and international congresses, has over 50 publications in peer-reviewed journals and has contributed to textbook chapters. He is also the co-editor of the recently published textbook Complications in Equine Surgery.

During his free time Luis enjoys attempting skiing, running, swimming and spending time with his wife and 2 kids.

Understanding barefoot methodology: advantages and limitations

Stephen E. O'Grady, DVM, MRCVS
Authors address: Virginia Therapeutic Farriery, 833 Zion Hill Rd, Keswick, VA 22947; e-mail: sogrady@look.net

Introduction
The equine foot with healthy structures is superior in its natural or barefoot state as opposed to being shod with regards to accepting the weight of the horse, shock absorption and dissipating the energy of impact [1,2,3]. Furthermore, the structures of the foot have an inherent ability to change shape, strengthen and improve over time through the process of adaptation[1,3]. With the decline in working horses and the rise in popularity of equestrian sports performed on deformable synthetic surfaces, shoeing should no longer be regarded as a necessity. Indeed, at the 2020 Tokyo Olympics, the Swedish team won the gold medal in show jumping. The fact that sport horses can perform at the highest levels without shoes challenges traditional practice that regards a shod foot as the normal state.

The author does not infer that traditional farriery using horseshoes should be abandoned but that barefoot methodology presents another viable option in equine foot care. Horseshoes provide protection when wear on the solar surface of the foot exceeds growth at the coronet, they maintain or enhance functionality by providing traction and lastly, therapeutic shoes are used to improve compromised structures of the foot and treat disease/lameness. However, there are some negative consequences of a horse being shod. The shoe replaces the single interface between the hoof capsule and the ground with two interfaces[7,8] The abrupt transitions from hoof wall to shoe and shoe to ground, together with the material properties of the shoe alter concussion and dampening by the foot and lower limb, ultimately increasing impact intensity on the hoof [8.9,10]. Furthermore, applying a standard horseshoe to the horse's foot increases the force exerted on the navicular bone by the deep digital flexor tendon by up to 14%[8,12].

There is rivalry between traditional farriers and barefoot trimmers. Certainly, traditional farriery using horseshoes can be performed in a physiological manner with minimal damage to the horse's foot [4,5,6] but a successful outcome in transitioning a horse to barefoot methodology requires a different approach. This paper will distance itself from the conventional trim and outline a simple and easy method of 'shaping' the foot for a barefoot lifestyle based on basic farriery principles[5,6].

Indications for Barefoot
In equine practice, a permanent or temporary transition to barefoot should be considered for horses that:

- Have good quality hooves and are not required to perform a large amount of exercise on abrasive surfaces. These horses can transition from shod to barefoot and be maintained permanently in the barefoot state.
- Will be out of work for a period, i.E., While being rehabilitated from an injury.
- Have poor limb conformation leading to hoof capsule deformation.
- Have chronic foot lameness associated with farriery.
- Have chronic foot lameness with an unexplained cause.

- Have a low heel 'bull nose' conformation in the hind feet.
- Have abnormal gait associated with forging, interfering, and overreaching.
- Are rehabilitating hoof tissues such as
  - Hoof capsule distortions involving compromised heel structures in the palmar/plantar foot.
  - Sheared heels.
  - Frogs that are either recessed or prolapsed relative to the ground surface of the foot.

Benefits of Barefoot
Maintaining horses in a barefoot condition should not be regarded as a fad that is rooted in minimalist ideas of equine management nor should it be regarded as a cure-all. There are, however, many aspects of going barefoot that pose a feasible and practical option to traditional farriery with practical and functional benefits to the horse and owner.

- In comparison with being shod, the barefoot hoof shows a superior ability to absorb shock, dissipate energy and accept the weight of the horse[1,2,3.]
- The structures of the foot have an inherent ability to change shape, strengthen and improve over time through the process of adaptation when not confined by a rigid shoe[1,3].
- A shoe elevates the hoof off the ground and loads it peripherally which places the bulk of the load on the hoof wall whereas a barefoot horse loads the entire foot, and this affects the wear pattern due to friction between the hoof and the ground.
- Allows natural movement and physiological function of the foot including greater heel expansion and vertical movement of the heels in the unshod hoof[10,11.]
- Hoof growth and wear often allow the barefoot horse to maintain the shape of its feet by friction and wear between the entire solar surface of the foot and the ground.
- When a horse is shod, friction/wear is localized between the heel of the hoof capsule and the shoe, which induces greater wear at the heel than the toe and changes the conformation of the foot between shoeing cycles [8,11].

The Barefoot Trim
The preparation of a foot that will remain barefoot, either temporarily or permanently, differs from the preparation of a foot prior to being shod. When the horse is shod, the foot is 'trimmed' and when the horse is barefoot, the foot is 'shaped'.

- The biggest differences in preparing the barefoot hoof are:
- The horny sole remains intact.
- The heels are placed in a load sharing state.
- The hoof wall is left 3–5 mm longer to provide maximal protection [6, 13.]

A thick bevel is created around the perimeter of the hoof wall.
- The transition from being shod to remaining barefoot.
- The prerequisites for transitioning a horse to barefoot are:
- An adequate transition period to allow the feet to adapt.
- Good foot structures or foot structures that will improve.
- A change in farriery ('shaping' vs. trimming)

Removing the horse's shoes without a transition period will seldom be successful. After removing the shoes, all the foot structures are involved in weight acceptance and these structures adapt to withstand changes in the biomechanical forces/load now placed on the foot [8]. The length of the transition time depends on the quality of the hoof capsule structures when the shoes are removed. The feet are shaped at 3–4-week intervals as outlined in the trim protocol above, ensuring the hoof wall at the heels and the frog remain on the same plane to ensure that the palmar/plantar section of the foot 'shares the weight '.

Characteristics of horses that transitioned successfully from shoes to barefoot:

- Foot develops a hard hoof wall, possibly because moisture or urine were not being retained under the shoe.
- A thick sole callus formed at the sole-wall junction of the toe.
- The hoof wall-bar junction became stronger.
- The frog became thicker and wider.
- The foot changes shape by developing an increased depth (cup/concavity)

Conclusions

Success in transitioning horses from shod to barefoot is based on the veterinarian, farrier, trainer, and owner understanding and being willing to adhere to the entire transitional process. The author has had consistent success in transitioning horses to barefoot primarily due to the cooperation of all parties involved. Trainers/riders state that stride kinematics change when the horse is barefoot, and they show greater clearance over the jumps. Based on the records of 70 horses, 50 of which were actively competing, only two horses that met the prerequisites could not be transitioned from wearing shoes to barefoot.

References

1. Clayton HM, Gray S, Kaiser LJ, Bowker RM. Effects of barefoot trimming on hoof morphology. Aust Vet J. 2011 Aug;89(8):305-11.
2. O'Grady SE. Various aspects of barefoot Methodology relevant to equine veterinary practice. Equine Vet Edu 2016 28(6):321-326.
3. Davies, H.M. (2007) Biomechanics of the equine foot. In: Equine Podiatry, Eds: A.E. Floyd and R.A. Mansman, Elsevier, St. Louis. pp 42-56.
4. O'Grady, S.E. and Poupard, D.E. (2003) Proper physiologic horseshoeing. Vet. Clin. N. Am. 19, 333-351.n
5. O'Grady, S.E. (2009) Guidelines for trimming the equine foot: a review. Proc. Am. Ass. Equine Pract. 55, 215-225.
6. O'Grady, S.E. Principles of trimming and shoeing. In: Baxter GM, ed. Adams and Stashak's Lameness in Horses 7th ed. Ames, IA: Wiley-Blackwell, 2020;1112-1133.
7. Parks, A.H. (2011) The practice of shoeing. In: Lameness in the Horse, 2nd edn., Eds: M.W. Ross and S.J. Dyson, Elsevier, St. Louis. pp 301- 303.
8. Eliashar, E. (2012) The biomechanics of the equine foot as it pertains to biomechanics. Vet. Clin. N. Am.: Equine Pract. 28, 284-291.
9. Benoit, P., Barney, E., Renault, J.C. and Brochette, J.L. (1993) Comparison effect of dampening effect of different shoeing by the measurement of hoof acceleration. Acta Anat. 146, 109-113.
10. Roepstorff, L., Johnston, C. and Drevemo, S. (1999) The effects of shoeing on kinetics and kinematics during the stance phase. Equine Vet. J. 31, Suppl. 30, 279-285.
11. Roepstorff, L., Johnston, C. and Drevemo, S. (2001) In vivo and in vitro heel expansion in relation to shoeing and frog pressure. Equine Vet. J. 33, Suppl. 33, 54-57.

12. Willemen MA, Savelberg HH, Barneveld A. The effect of orthopaedic shoeing on the force exerted by the deep digital flexor tendon on the navicular bone in horses. Equine Vet J 2004; 36:431-435.

13. Castelijns, H. (2012) The basics of farriery as a prelude to therapeutic farriery. Vet. Clin. N. Am.: Equine Pract. 28, 314.

Stephen E. O'Grady, DVM

The first title 'Managing hoof wall defects' is perfect. The second title 'Radical hoof surgery for laminitis' presents a problem. I am not familiar with any radical hoof surgery other than the resections that were performed years ago, nor do I practice any radical procedures in my own practice. I have an extensive podiatry practice and the only surgery I do for laminitis is an occasional DDF tenotomy.

As an alternative, I would like to suggest 'Understanding barefoot methodology: advantages and limitations. I have always used barefoot methodology as an option to rehabilitate hoof capsule distortions with great success. I published a paper on this topic in 2015 in EVE. Since the Olympics in Japan where the gold and silver medal winners in the jumpers were barefoot, there has been a renewed interest in competing horses without shoes. This has become popular in Europe and currently, there is a study going on in Sweden. Allowing the horse to compete barefoot for many varied reasons is a viable option to traditional farriery. However, there is a process…determining if the hoof has the structural integrity or can the current structures be improved to remain barefoot, an adaption period that is required, and the hoof care needs to be modified…all of which would be described in the paper. I currently have over seventy upper-level competition horses competing barefoot. To summarize, the paper would describe both using barefoot methodology to rehabilitate problem feet and why/how it can be used in competition horses.

Surgical treatment of laminitis-is there a place for i?

Tracy A. Turner, DVM, MS, Dipl.ACVS, Dipl.ACVSMR
Turner Equine Sports Medicine and Surgery

Several surgical procedures have been recommended for the treatment of laminitis. These procedures are the following:

Inferior check desmotomy. The purpose is to relieve stress on the deep digital flexor tendon. The procedure is very effective for flexural limb deformity. The procedure is effective in releasing tension on the deep digital flexor tendon but may be too little to make a significant impact on laminitis (depending on the severity).

Deep digital flexor tenotomy. Deep digital flexor tenotomy is a surgical alternative that transects the deep digital flexor tendon in either the mid-cannon bone region or mid-pastern region. Transection removes one of the main forces responsible for rotation of the coffin bone in laminitis. In one retrospective study, Seventy-seven percent of the horses that had the operation were still alive after six months, and 60% survived at least two years. This was considered substantial considering the presurgical conditions of the horses.

Transfixation pin casts. This is an external fixation device that uses large pins placed within the metacarpus and sidebar, the apparatus incorporates the foot and transfixation pins. The procedure reduces weight on the hoof and reduces the strain on the deep flexor tendon. There are no studies looking at outcomes relative to laminitis but there are individual cases where it has been effective. There are long-term issues associated with the pin holes.

Lag screw fixation of hoof capsule to the coffin bone. Investigations have been underway to test the possibility of preventing coffin bone rotation in cases of acute laminitis by placing a single screw through the hoof wall and into the bone. After 48 to 72 hours or once the initial inflammation has subsided the screw can be removed. While effective and relatively non-painful in non-laminitic horses, the procedure has so far been disappointing in its initial results with laminitic horses.

Hoof wall resection. Performing a resection is the removal of part or all of the hoof wall can relieve the pressure on the laminae and thereby allow the critical blood circulation to be restored. With meticulous aftercare, the foot's underlying tissues can then repair. Twenty years ago is quite popular but has since lost popularity.

1. Burba JB, Hubert JD, Beadle R: How to perform a mid-metacarpal deep digital flexor tenotomy on a standing horse. In Proceedings An Assoc Eq Practnr, 52; 2006: 547-550.
2. Hunt RJ, Allen D, Baxter GM, et al. Mid-metacarpal deep digital flexor tenotomy in the management of refractory laminitis in horses. Vet Surg 1991;20:15–20.
3. Joyce J, Baxter GM, Sarrafian TL, et al: Use of transfixation pin casts to treat adult horses with comminuted phalangeal fractures: 20cases. JAVMA 2006:229:725-730.
4. Carmalt KP, Carmalt JL: Novel technique for prevention of rotation of the distal phalanx relative to the hoof wall in horses with acute laminitis. AJVR 2019:80:943-948.
5. Rucker A: Chronic laminitis: strategic hoof wall resection. Vet Clin North Am Equine Pract. 2010:26:197-205.

Tracy A. Turner, DVM, MS, Dipl.ACVS, Dipl.ACVSMR

Tracy Turner began his professional career as a farrier and used those skills to help finance his education. He received his DVM degree from Colorado State University in 1978. He completed an internship at the University of Georgia and a surgical residency as well as a Master of Science degree at Purdue University in 1981. His Master's thesis was "Thermography of the Lower Limb of the Horse." He served on the faculty of the Universities of Illinois, Florida and Minnesota. At Minnesota, he was Head of Large Animal Surgery and attained the rank of full Professor before leaving academics to join Anoka Equine Clinic in 2004. In 2016, he started his own practice dedicated to Sports Medicine and Surgery.

Turner's primary research efforts have focused on equine lameness with particular interest in equine podiatry, back issues in horses, rehabilitation and thermography. His podiatry research has evaluated the radiographic and morphologic characteristics of hoof imbalance, as well as the differential diagnosis of palmar foot pain (PFP) and the development of PFP treatment strategies. Turner has researched the use of diagnostic imaging techniques for evaluation of equine back problems (including saddle fit) and developed epidemiological data on overriding spinous processes in horses. He pioneered the use of thermography as a diagnostic aid in lameness evaluation, as well as its use in horse welfare regulation. Turner has extensively published on these topics and been invited to lecture nationally and internationally. In 2004, Turner was inducted into the International Equine Veterinarian's Hall of Fame.

Turner is a Diplomate of the American College of Veterinary Surgeons, a Diplomate of the American College of Sports Medicine and Rehabilitation and is a Fellow of the American Academy of Thermology (AAT). He is an active member of the AVMA, AAEP, AAT and the American Horse Council. Turner has served as chairman of the AAEP's Farrier Liaison Committee, served on the AAEP Foundation Advisory Council, the AAEP Educational Programs Committee and the AAEP Board of Directors. He is currently Vice-President of the AAEP. He is past-president of the American Academy of Thermology. He has consulted for United States Equestrian Federation, The USDA Horse Protection and Federation Equestriene Internationale (FEI). He has served as a Veterinarian Official at 4 Pan America games, 2 World Equestrian Games, at the 2016 Olympic Games in Rio de Janeiro and 2021Tokyo Olympics. He has participated as an instructor at Equitarian Workshops in Mexico, Nicaragua, and Costa Rica and has participated in the Equitarian projects in Honduras, Costa Rica and Peru. He is married to veterinarian Julia Wilson and has two sons. He loves the outdoors and rides whenever possible.