

Changes in Bone Properties after Extracorporeal Shock Wave Application to the Third Metacarpus of Horses

Hubert J.D., Burba D.J., Bolt D.M., Blackmer J.M., Hosgood G.

Jeremy D. Hubert BVSc, MRCVS, MS, DACVS; Daniel J. Burba DVM, DACVS; David M. Bolt Dr. med. vet. ; Jill McClure Blackmer DVM, MS, DACVIM, DACVP; Giselle Hosgood BVSc, MACVS, MS, DACVS

Equine Health Studies Program, School of Veterinary Medicine, Louisiana State University, Baton Rouge, LA 70803

Introduction. Dorsal metacarpal disease (DMD) is a significant cause of musculoskeletal disease in young racehorses that can result in stress fractures or catastrophic fractures of the third metacarpus. Present treatment methods involve rest and a change in training protocol so as to allow sufficient remodelling of the dorsal cortical bone to occur. Recently the use of extracorporeal shockwave therapy (ESWT) has been advocated as a form of treatment for DMD. There are anecdotal reports and case reports of successful treatment of DMD with ESWT¹ but few controlled studies for the use of ESWT have been conducted in veterinary medicine. Quantitative ultrasonography has been shown to precisely measure superficial cortical bone properties by evaluating the speed of sound (SOS) through the bone.² SOS measurements provide information about factors that affect bone strength including bone mineral density, bone size, mass distribution, elasticity and stiffness.² Our objective in this study is to document the changes in SOS measurements of the dorsal third metacarpal bone in adult horses after application of extracorporeal shock waves. We hypothesized that extracorporeal shock waves applied to the third metacarpal bone would result in an increase in the SOS measurements of the bone over time.

Materials and Methods. Twelve adult horses, kept on pasture, clinically and radiographically free of any signs of disease to the dorsal metacarpus, were used. ESWT (Dolorclast Vet, EMS Electro Medical Systems, Dallas, Texas) was applied to standing horses using a non-focused EWST unit. One limb was randomly selected and treated with 1,000 cycles at 0.9mJ/mm², the other serving as a control. SOS measurements were obtained in standing sedated horses using quantitative ultrasonography with a multisite QUS device (Sunlight Omnisense, SunlightMedical Ltd., Tel-Aviv, Israel). The SOS was measured over three sites, (medial, dorsal and lateral aspects) of the mid-third metacarpus of the treated and control limbs. Group 1 (n=6) had one treatment only, the SOS was measured before treatment and then weekly for three weeks and at 7 weeks after treatment. Group 2 (n=6) had three treatments at two week intervals. SOS was measured before the initial treatment and then every week for nine weeks. The SOS recording followed a normal distribution and was analyzed for fixed effects of bone site and limb treatment, using a mixed linear model

accounting for the random variance of horse, the nested arrangement of horses within Groups and the factorial application of limb treatment. Each group was analyzed separately. Where interaction was significant at $p < 0.05$, least squares means comparisons were made to determine where the differences were occurring. Type I error was maintained at 0.05 for all comparisons.

Results. Both groups showed no differences between treated and control limbs at any site but showed similar significant differences between sites. The SOS was significantly greater on the lateral region than medial, and medial than dorsal. The mean (SEM) SOS (m/s) for group 1 treated limbs: lateral 4232(26.0), medial 4124(29.9), dorsal 3776(24.2); control limbs: lateral 4272(17.4), medial 4108(25.3), and dorsal 3761(30.5). For group 2 the treated limbs: lateral 4274(15.2), medial 4056(27.8), dorsal 3653(21.9); control limbs: lateral 4344(11.8), medial 4088(22.1) and dorsal 3700(26.4).

Discussion. The results from this study suggest that non-focused ESWT does not have any appreciable effect on SOS in non exercised, normal horses. The differences between sites on each leg are similar to those previously reported in normal untreated horses.² Focused shockwaves applied dorsally to equine metacarpal bones are reported to induce subperiosteal and endosteal hemorrhage at the application site,³ thus the use of non-focused shockwaves may explain the lack of changes observed in the SOS. Non-focused waves attenuate rapidly after entering the patient's body, thus their effect is minimized compared with focused waves. Other factors, such as horse age, the time taken for changes in bone properties to occur or lack of controlled exercise and resultant bone remodelling could affect the lack of changes described here. Further studies are required to establish the effect of either focused or non-focused shock waves on equine third metacarpal bone.

References

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