

Journal	Title	Authors	Abstract
Vet J. 2007 Dec 7	Short term analgesic effect of extracorporeal shock wave therapy in horses with proximal palmar metacarpal/plantar metatarsal pain.	Imboden I, Waldern NM, Wiestner T, Lischer CJ, Ueltschi G, Weishaupt MA. Equine Hospital, Vetsuisse Faculty University of Zurich, Winterthurerstrasse 260, CH-8057 Zurich, Switzerland.	Extracorporeal shock wave therapy (ESWT) is an accepted form of treatment for chronic cases of proximal suspensory desmitis (PSD). Subjective evaluation of horses shortly after being treated with ESWT has led clinicians to comment on an immediate reduction in lameness. This study aimed to evaluate the analgesic effect of ESWT on 16 horses with PSD or PSD-like pain in a fore- or hindlimb. To objectively assess lameness, gait analysis was performed on an instrumented treadmill before and 6, 24, 48 and 72h after ESWT of the origin of the suspensory ligament and the results compared to the effects of local anaesthesia. Stride frequency, stance duration, vertical impulse and peak vertical force were determined. Thermographic imaging and evaluation of skin sensitivity of the treated area were carried out before and after ESWT in the same interval as gait analysis. The results showed that there were no significant improvements in the investigated parameters at any time after ESWT; however, in horses with affected forelimbs the contralateral weightbearing asymmetry decreased significantly 72h after ESWT. Neither skin sensitivity nor thermographic imaging revealed changes that could be attributed to ESWT.
Equine Vet J. 2007 May;39(3):22 6-31.	Effect of extracorporeal shock wave therapy on the biochemical composition and metabolic activity of tenocytes in normal tendinous structures in ponies.	Bosch G, Lin YL, van Schie HT, van De Lest CH, Barneveld A, van Weeren PR. Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht.	REASONS FOR PERFORMING STUDY: Extracorporeal shockwave therapy (ESWT) has recently been introduced as a new therapy for tendon injuries in horses, but little is known about the basic mechanism of action of this therapy. OBJECTIVES: To study the effect of ESWT on biochemical parameters and tenocyte metabolism of normal tendinous structures in ponies. METHODS: Six Shetland ponies, free of lameness and with ultrasonographically normal flexor and extensor tendons and suspensory ligaments (SL), were used. ESWT was applied at the origin of the suspensory ligament and the mid-metacarpal region of the superficial digital flexor tendon (SDFT) 6 weeks prior to sample taking, and at the mid-metacarpal region (ET) and the insertion on the extensor process of the distal phalanx (EP) of the common digital extensor tendon 3 h prior to tendon sampling. In all animals one front leg was treated and the other front leg was used as control. After euthanasia, tendon explants were harvested aseptically for in vitro cell culture experiments and additional samples were taken for biochemical analyses. RESULTS: In the explants harvested 3 h after treatment, glycosaminoglycan (GAG) and protein syntheses were increased (P<0.05). The synthesis of all measured parameters was decreased 6 weeks after ESWT treatment. Biochemically, the level of degraded collagen was increased 3 h after treatment (P<0.05). Six weeks after treatment, there was a decrease of degraded collagen and GAG contents. DNA content had not changed in either tendon samples or explants after culturing. CONCLUSIONS: ESWT causes a transient stimulation of metabolism in tendinous structures of ponies shortly after treatment. After 6 weeks

Journal	Title	Authors	Abstract
			metabolism has decreased significantly and GAG levels are lower than in untreated control limbs. POTENTIAL RELEVANCE: The stimulating short-term effect of ESWT might accelerate the initiation of the healing process in injured tendons. The long-term effect seems less beneficial. Further research should aim at determining the duration of this effect and at assessing its relevance for end-stage tendon quality.
J Am Vet Med Assoc. 2006 Jul 1;229(1):100-3.	Force platform evaluation of lameness severity following extracorporeal shock wave therapy in horses with unilateral forelimb lameness.	Dahlberg JA, McClure SR, Evans RB, Reinertson EL. Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Iowa State University, Ames, IA 50011, USA.	OBJECTIVE: To measure alterations in lameness severity that occur following use of extracorporeal shock wave therapy (ESWT) in horses with naturally occurring unilateral forelimb lameness. DESIGN: Nonrandomized clinical trial. ANIMALS: 9 horses with unilateral forelimb lameness. PROCEDURES: Force platform gait analysis was performed prior to administration of any treatments (baseline) and after use of local anesthesia to eliminate the lameness. Extracorporeal shock wave therapy was then administered, and gait analysis was repeated 8 hours later and then daily for 7 days. RESULTS: Compared with the baseline value, peak vertical force was significantly increased 8 hours and 2 days after ESWT, and peak vertical force on day 2 was not significantly different from force measured after use of local anesthesia to eliminate the lameness. Similarly, vertical impulse was significantly increased, compared with the baseline value, 8 hours and 2 days after ESWT, but at all times, it was significantly lower than vertical impulse measured after use of local anesthesia. CONCLUSIONS AND CLINICAL RELEVANCE: Results suggest that in horses with naturally occurring lameness, use of ESWT results in a period of acute improvement in lameness severity that typically persists for 2 days. Thus, in horses undergoing ESWT, exercise should be controlled for a minimum of 2 days after treatment to prevent further injury.
Am J Vet Res. 2006 Apr;67(4):57-7-82.	Histomorphologic evaluation of extracorporeal shock wave therapy of the fourth metatarsal bone and the origin of the suspensory ligament in horses without lameness.	Bischofberger AS, Ringer SK, Geyer H, Imboden I, Ueltschi G, Lischer CJ. Equine Hospital, VETSUISSE Faculty, University of Zurich, 8057 Zürich, Switzerland.	OBJECTIVE: To determine via histologic examination and scintigraphy the effect of focused extracorporeal shock wave therapy (ESWT) on normal bone and the bone-ligament interface in horses. ANIMALS: 6 horses without lameness. PROCEDURE: Origins of the suspensory ligament at the metacarpus (35-mm probe depth) and fourth metatarsal bone (5-mm probe depth) were treated twice (days 0 and 16) with 2,000 shocks (energy flux density, 0.15 mJ/mm ²). One forelimb and 1 hind limb were randomly treated, and the contralateral limbs served as nontreated controls. Bone scans were performed on days -1 (before ESWT), 3, 16, and 19. Histomorphologic studies of control and treated tissues were performed on day 30. RESULTS: ESWT significantly increased the number of osteoblasts but caused no damage to associated soft tissue structures and did not induce cortical microfractures. A significant correlation between osteoblast numbers and radiopharmaceutical uptake was noticed on lateral views of the hind limb on days 3 and 16 and on caudal views of the forelimb

Journal	Title	Authors	Abstract
			<p>on day 3. CONCLUSIONS AND CLINICAL RELEVANCE: Results suggested that ESWT has the potential to increase osteoblast numbers in horses. The correlation between increased osteoblast numbers and radio-pharmaceutical uptake 3 days and 16 days after the first ESWT suggested that stimulation of osteogenesis occurred soon after ESWT. No damage to bone or the bone-ligament interface should occur at the settings used in this study, and ESWT can therefore be administered safely in horses.</p>
<p>Vet Comp Orthop Traumatol. 2006;19(2):99-105.</p>	<p>The evaluation of extracorporeal shock wave therapy on collagenase induced superficial digital flexor tendonitis.</p>	<p>Kersh KD, McClure SR, Van Sickle D, Evans RB. Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Iowa State University, Ames, Iowa 50011-1250, USA.</p>	<p>Extracorporeal shock wave therapy (ESWT) is being used to treat desmitis and tendonitis in horses. This paper compares the clinical, ultrasonographic and histological characteristics of ESWT treated collagenase induced superficial digital flexor tendon (SDFT) lesions, versus untreated controls. This blinded study utilizes six mature, healthy horses where bilateral forelimb SDFT lesions were induced. One forelimb was treated while the other served as an untreated control. Three shock wave treatments were administered at three week intervals. At weekly intervals, ultrasonograms were used to measure: 1) percentage lesion at the maximum injury zone (MIZ), 2) the grey scale of the SDFT at the MIZ, 3) the percentage disruption of the longitudinal fibres at the MIZ. The data were also summed from 8-20 cm distal to the accessory carpal bone. Measurements of the external width of the SDFT were obtained through the study period. Examinations were performed on four occasions to evaluate heat, response to palpation, presence/character of swelling over the SDFT, and lameness. At the completion of the study all tendons were evaluated histologically. The lesion size, grey scale, and longitudinal fibre disruption at the MIZ, and sum of each variable changed significantly over time, however, there was no difference between treated and control groups. Histopathology showed increased neovascularization in treated tendons ($p = 0.001$). When compared to untreated controls, ESWT did not change the ultrasonographic appearance of the tendons. However, it did increase neovascularization.</p>
<p>Am J Vet Res. 2005 Dec;66(12):2095-100.</p>	<p>Evaluation of skin sensitivity after shock wave treatment in horses.</p>	<p>Waldern NM, Weishaupt MA, Imboden I, Wiestner T, Lischer CJ. Equine Hospital, Vetsuisse Faculty, University of Zurich, CH-8057 Zurich, Switzerland.</p>	<p>OBJECTIVE: To evaluate the effects of shock wave treatment on cutaneous nerve function, compared with the effects of local nerve block and sedation. ANIMALS: 18 clinically sound Swiss Warmbloods. PROCEDURE: Horses were randomly allocated to 3 groups and received different amounts and types of shock waves (extracorporeal shock wave treatment [ESWT] or radial pressure wave treatment [RPWT]). Horses were sedated with xylazine and levomethadone. Shock waves were applied to the lateral palmar digital nerve at the level of the proximal sesamoid bones on 1 forelimb. Skin sensitivity was evaluated by means of an electrical stimulus at the coronary band before and 5 minutes after sedation and at 4, 24, and 48 hours after application of ESWT or RPWT. On the contralateral forelimb, skin sensitivity was tested before and</p>

Journal	Title	Authors	Abstract
			10 minutes after an abaxial sesamoid nerve block. RESULTS: No significant changes in skin sensitivity were detected, regardless of the shock wave protocol applied. Mean reaction thresholds after sedation were more than twice the baseline thresholds. After the abaxial sesamoid block, no reaction was recorded in any of the horses. CONCLUSIONS AND CLINICAL RELEVANCE: Application of ESWT or RPWT to the palmar digital nerve had no effect on cutaneous sensation distal to the treated region for at least 2 days after application. The analgesic effect of sedation on reaction to electrical stimuli was distinct but varied among horses.
Vet Clin North Am Equine Pract. 2005 Dec;21(3):60 9-25, vi.	Extracorporeal shock wave therapy for treatment of osteoarthritis in the horse: clinical applications.	Revenaugh MS. Northwest Equine Performance LLC, 25230 South Eldorado Road, Mulino, OR 97042, USA. mark@equinepi.com	Veterinarians have begun using extracorporeal shock wave therapy (ESWT) for treatment of osteoarthritis (OA) in horses, although relatively little information has been published about its efficacy or mechanism of action. As a clinician, it can be difficult to know if and when ESWT should be recommended. Case studies in which ESWT is used to treat advanced OA in horses are discussed. ESWT seems to be a valuable adjunct for management of equine OA. It is the purpose of this article to discuss indications and techniques as well as to share clinical experiences using ESWT in the treatment of OA in the horse.
J Vet Med A Physiol Pathol Clin Med. 2005 Nov;52(9):48 1-3.	Osseous lesion of the calcaneus following the use of shock wave therapy in a horse.	Diakakis N, Patsikas MN, Dessiris AK. Department of Clinical Studies, Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, St Voutyra 11, 546 27 Thessaloniki, Greece. diakakis@vet.auth.gr	An 8-year-old Dutch warmblood gelding was presented with a mechanical lameness (2/10) because of the presence of a soft tissue injury on the top of the right tuber calcanei. Plain radiographs of the tarsus demonstrated the presence of soft tissue swelling caudal to the right tuber calcanei, without osseous involvement, and ultrasonography revealed excessive scar tissue within and around the superficial digital flexor tendon. Extra-corporeal shock wave therapy was applied on the right hock to decrease the amount of scar tissue. One month after the therapy the lameness was greater (3/10) and a marginal increase in the size of the swelling was found. Periosteal new bone formation associated with an ill-defined radiolucent area and two bony fragments were detected radiographically at the caudo-proximal aspect of the right tuber calcanei. A blister containing oil of croton, camphor, pine and thyme, turpentine and cantharides was applied on the right calcaneus. Twenty days after blister application, the size of the swelling had been reduced by 50% and the degree of lameness had also been decreased (1/10). On clinical re-evaluation 6 months after treatment, the degree of lameness was stable (1/10) and flexion test of the limb was negative.
Vet Surg. 2005 Nov-Dec;34(6):55 4-8.	Investigation of the immediate analgesic effects of extracorporeal	Brown KE, Nickels FA, Caron JP, Mullineaux DR, Clayton HM. Department of Large	OBJECTIVES: To measure the acute analgesic properties of extracorporeal shock wave therapy (ESWT) in horses with navicular disease using objective ground reaction forces (GRF). STUDY DESIGN: Prospective study. ANIMALS: Nine client-owned horses with unilateral forelimb lameness caused by navicular disease. METHODS:

Journal	Title	Authors	Abstract
	shock wave therapy for treatment of navicular disease in horses.	Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI, USA. brownkei@cvm.msu.edu	Horses were trotted at 3 m/s over a force plate to record pre-treatment GRF of the lame and contra-lateral forelimbs. After ESWT of the lame limb, applied with a radial unit to each of the frog and heel bulb areas with 1500 pulses at 4 bar and 10 Hz, GRF measurements were repeated at 15 minutes and 24-hour intervals for 7 days. From the 5 trials recorded at each time, peak vertical force (PVF) was calculated and averaged. Data were compared between limbs and over time using a 2-way repeated-measures ANOVA. RESULTS: Mean (+/-SD) PVF was significantly different between lame (day 1; 4339+/-626 N) and contra-lateral (day 1; 5236+/-515 N) limbs pre-treatment (P<.05). After ESWT treatment, this difference remained unchanged at 15 minutes and from days 1 to 7. To confirm navicular disease, palmar digital analgesia significantly reduced the lameness (lame 5144+/-430 N; contralateral 5082+/-586 N; P>.05). CONCLUSIONS: Single ESWT treatment applied in this manner does not influence lameness in horses with navicular disease. CLINICAL RELEVANCE: Although many equine regulatory commissions currently ban the use of ESWT before competition, our results suggest that such regulations may be unfounded. Further research is required to determine the long-term analgesic properties of this frequently used treatment modality in equine athletes.
Am J Vet Res. 2005 Oct;66(10):1 836-42.	Assessment of scintigraphic and thermographic changes after focused extracorporeal shock wave therapy on the origin of the suspensory ligament and the fourth metatarsal bone in horses without lameness.	Ringer SK, Lischer CJ, Ueltschi G. Equine Hospital, VETSUISSE Faculty, University of Zurich, Switzerland.	OBJECTIVE: To monitor the effect of focused extra-corporeal shock wave therapy (ESWT) on bone and bone-tendon junction of horses without lameness by use of nuclear scintigraphy and thermography. ANIMALS: 6 warmblood horses without lameness. PROCEDURE: The origin of the suspensory ligament at the metacarpus (OSL-MC) and the fourth metatarsal bone were treated at 2 time points (days 0 and 16) with 2,000 shocks applied by a focused ESWT device at an energy flux density of 0.15 mJ/mm ² . One forelimb and 1 hind limb were treated, and the contralateral limbs served as controls. To document the effect of focused ESWT, nuclear scintigraphy was performed on days -1, 3, 16 (before second ESWT), and 19. Thermography was performed on days -1, 0 (1 hour after first ESWT), 1, 3, 8, 16 (twice; before and 1 hour after second ESWT), and 19. On days 3, 16 (first scans), and 19, thermography was performed before scintigraphy. RESULTS: Scintigraphically, significant variations in radiopharmaceutical activity at the OSL-MC were detected in treatment and control limbs. No significant differences, however, in mean temperature or radiopharmaceutical activity could be detected by use of thermography or nuclear scintigraphy, respectively, between the treatment and control limbs at any time point in response to ESWT. CONCLUSIONS AND CLINICAL RELEVANCE: After 2 treatments of focused ESWT, no physiologic effect on the studied structures could be demonstrated by use of nuclear scintigraphy or thermography. Results of this study

Journal	Title	Authors	Abstract
Am J Vet Res. 2005 Oct;66(10):1702-8.	Evaluation of analgesia resulting from extracorporeal shock wave therapy and radial pressure wave therapy in the limbs of horses and sheep.	McClure SR, Sonea IM, Evans RB, Yaeger MJ. Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Iowa State University, Ames, IA 50011, USA.	<p>indicate that at currently used ESWT settings, no damage to the bone or bone-tendon junction should occur.</p> <p>OBJECTIVE: To identify the duration and potential mechanisms of analgesia following extracorporeal shock wave therapy (ESWT) and radial pressure wave therapy (RPWT) in limbs of horses and sheep. ANIMALS: 6 horses and 30 sheep. PROCEDURE: An electrical stimulus was used to identify the nociceptive threshold for each horse daily for 3 days before treatment (baseline) with ESWT or RPWT, 8 hours after treatment, and at 24-hour intervals for 7 days after treatment. Testing was conducted for the treatment field (midmetacarpus or midmetatarsus) and nerve field (medial and lateral forelimb heel bulbs) distal to a treatment site that included the nerve on the abaxial surface of the proximal sesamoid bone. All 4 limbs of 30 sheep were treated with ESWT, RPWT, or a sham treatment. Two sheep were euthanized daily and tissue harvested for histologic evaluation of nerves, and concentrations of substance P and calcitonin gene-related peptide were measured in the skin and periosteum. RESULTS: Values did not differ significantly between baseline and after treatment for the treatment field or nerve field sensation. There was a large difference in the slope when data for horses were plotted for the first 3 days after treatment, compared with the slope for days 4 to 7 after treatment. No differences were found in neuropeptide concentrations after treatment of the sheep, but there was an inflammatory response in the treated nerves. CONCLUSIONS AND CLINICAL RELEVANCE: A small cutaneous analgesic effect may exist at the treatment site for approximately 3 days after ESWT or RPWT in horses.</p>
Vet Ther. 2005 Fall;6(3):268-76.	Scintigraphic, radiographic, and thermographic appearance of the metacarpal and metatarsal regions of adult healthy horses treated with nonfocused extracorporeal shock wave therapy--a pilot study.	Verna M, Turner TA, Anderson KL. Veterinary Population Medicine Department, College of Veterinary Medicine, University of Minnesota, St Paul, MN 55108, USA.	<p>Nonfocused extracorporeal shock wave therapy (ESWT) treatment protocol is commonly used in veterinary practice. This study investigated the effects of four nonfocused ESWT treatments, given 2 weeks apart, on bone radiopharmaceutical uptake and radiographic and thermographic appearance in the metacarpal and metatarsal regions in six adult untrained horses. There were no measurable treatment effects determined by thermography (daily), scintigraphy (at 2-week intervals), and radiography (before study initiation and at study completion) between treated and control limbs. It was concluded that no gross evidence of bone remodeling is detectable by conventional clinical assessment when nonfocused ESWT is applied to healthy equine metacarpal or metatarsal bone.</p>
Am J Vet	Ultrastructural and	Caminoto EH, Alves	OBJECTIVE: To evaluate the effects of extracorporeal shock wave therapy (ESWT)

Journal	Title	Authors	Abstract
Res. 2005 May;66(5):89 2-6.	immunocytochemical evaluation of the effects of extracorporeal shock wave treatment in the hind limbs of horses with experimentally induced suspensory ligament desmitis.	AL, Amorim RL, Thomassian A, Hussni CA, Nicoletti JL. Faculdade de Medicina Veterinaria e Zootecnia, Universidade Estadual Paulista, Botucatu, SP, Brazil.	on affected ligaments in the hind limbs of horses with experimentally induced suspensory ligament desmitis by use of ultrasonographic, ultrastructural, and immunocytochemical techniques. ANIMALS: 10 horses. PROCEDURE: Suspensory ligament desmitis was induced in both hind limbs of each horse by use of 2 collagenase injections (administered 2 weeks apart) in each suspensory ligament. Two weeks after the second injection, the right hind limb of each horse was treated with ESWT (3 treatments at 3-week intervals); the left hind limb was not treated (control limb). Periodically during the study, the healing process was monitored ultrasonographically and the proportions of ligaments affected with lesions were assessed. Four weeks after the last ESWT treatment, biopsy specimens were collected from all ligaments for ultrastructural evaluation and immunocytochemical analysis of transforming growth factor beta-1. RESULTS: The difference in the proportion of the lesion-affected ligament between ESWT-treated and control limbs was significant ($P < 0.05$) from 3 weeks after the second ESWT treatment to the end of the study. Compared with control ligaments, ESWT-treated ligaments had more small, newly formed collagen fibrils and greater expression of transforming growth factor beta-1 4 weeks after the last ESWT treatment was administered. CONCLUSIONS AND CLINICAL RELEVANCE: Results have indicated that ESWT appears to facilitate the healing process in horses with experimentally induced hind limb suspensory ligament desmitis.
Dtsch Tierarztl Wochenschr. 2005 Feb;112(2):70-3.	[Focused extracorporeal shock wave therapy in an isolated calcification in the equine ligamentum nuchae--case report]	Braun S, Lafrenz R. Tierklinik Vierhöfen. SBraunVET@aol.com	In recent years extracorporeal shock wave therapy (ESWT) is used in veterinary medicine especially in equine orthopedics. Different ESWT generators are commonly used in equine medicine with varying energy density and depth of penetration. The presented case report described the treatment of a ligamentum nuchae calcification with focused extracorporeal shock wave therapy with SONOCUR Plus generator combined with SONOLINE Prima ultrasound. Negligible adverse effects, the non-invasive character of the treatment, the time-saving therapy, and the positive results make the focused extracorporeal shock wave therapy to an useful application.
Am J Vet Res. 2004 Dec;65(12):1714-8. Erratum in: Am J Vet Res. 2005	Determination of functional and morphologic changes in palmar digital nerves after nonfocused extracorporeal	Bolt DM, Burba DJ, Hubert JD, Strain GM, Hosgood GL, Henk WG, Cho DY. Equine Health Studies Program, Department of Veterinary Clinical	OBJECTIVE: To determine functional and morphologic changes in palmar digital nerves after nonfocused extracorporeal shock wave (ESW) treatment in horses. ANIMALS: 6 horses. PROCEDURES: The medial and lateral palmar digital nerves of the left forelimb were treated with nonfocused ESWs. The medial palmar digital nerve of the right forelimb served as a nontreated control nerve. At 3, 7, and 35 days after treatment, respectively, 2 horses each were anesthetized and nerves were surgically exposed. Sensory nerve conduction velocities (SNCVs) of treated and control nerves

Journal	Title	Authors	Abstract
Feb;66(2):34 9.	shock wave treatment in horses.	Sciences, School of Veterinary Medicine, Louisiana State University, Baton Rouge, LA 70803, USA.	were recorded, after which palmar digital neurectomies were performed. Morphologic changes in nerves were assessed via transmission electron microscopy. RESULTS: Significantly lower SNCV in treated medial and lateral nerves, compared with control nerves, was found 3 and 7 days after treatment. A significantly lower SNCV was detected in treated medial but not lateral nerves 35 days after treatment. Transmission electron microscopy of treated nerves revealed disruption of the myelin sheath with no evidence of damage to Schwann cell bodies or axons, 3, 7, and 35 days after treatment. CONCLUSIONS AND CLINICAL RELEVANCE: Nonfocused ESW treatment of the metacarpophalangeal area resulted in lower SNCV in palmar digital nerves. This effect likely contributes to the post-treatment analgesia observed in horses and may result in altered peripheral pain perception. Horses with preexisting lesions may be at greater risk of sustaining catastrophic injuries when exercised after treatment.
Can J Vet Res. 2004 Oct;68(4):28 8-92.	Evaluation of cutaneous analgesia after non-focused extracorporeal shock wave application over the 3rd metacarpal bone in horses.	Bolt DM, Burba DJ, Hubert JD, Pettifer GR, Hosgood GL. Equine Health Studies Program, Department of Veterinary Clinical Sciences, School of Veterinary Medicine, Louisiana State University, Baton Rouge, Louisiana 70803, USA. dbolt@vetmed.lsu.edu	Extracorporeal shock wave therapy is becoming increasingly used in equine practice to treat musculoskeletal disorders. Although the exact effects of extracorporeal shock waves on tissues still need to be elucidated, transient cutaneous analgesia has been observed within treated areas in humans and horses. The purpose of this study was to determine the onset, magnitude, and duration of cutaneous analgesia after non-focused extracorporeal shock wave (ESW) application by comparing the limb withdrawal reflex latency (LWRL) in treated and untreated areas on the metacarpus of horses, using a focused light source. A single treatment with non-focused ESW was applied to 3 areas over the dorsal aspect of one metacarpus in 12 horses. The LWRL was measured to assess cutaneous sensation in treated and untreated control areas of the treated metacarpus and in an untreated area on the opposite metacarpus, before and at various time points after ESW application. Most treated and control areas revealed a significant decrease in LWRL over time compared with baseline values. Although the results of our study do not suggest cutaneous analgesia after ESW application to the equine metacarpus, we advise cautious use of this treatment modality for horses in training or before competition until further research is done.
Ultrasound Med Biol. 2004 Apr;30(4):46 1-7.	The effects of extracorporeal shock-wave therapy on the ultrasonographic and histologic appearance of	McClure SR, VanSickle D, Evans R, Reinertson EL, Moran L. Department of Veterinary Clinical Sciences, College of Veterinary Medicine,	Extracorporeal shock-wave therapy (ESWT) may stimulate healing of desmitis in multiple species. The objective of this study was to evaluate the ultrasonographic and histologic appearance of collagenase-induced suspensory ligament (SUL) desmitis in untreated ligaments and ligaments treated with ESWT in horses. Four mature horses had SUL desmitis induced in both forelimbs. Beginning 3 weeks after induction of the lesions, one ligament per horse was treated 3 times at 3-week intervals with ESWT. The percent lesion, echogenicity and fiber alignment scores of the SULs were

Journal	Title	Authors	Abstract
	collagenase-induced equine forelimb suspensory ligament desmitis.	Iowa State University, Ames, IA, USA. mcclures@iastate.edu	evaluated at 3-week intervals for a total of 15 weeks. At the completion of the study, the horses were euthanized and the SULs collected, fixed and processed for histopathologic evaluation. Ultrasonography showed treated SULs had a smaller percent lesion at the maximal injury zone ($p = 0.001$), and the total percent lesion ($p = 0.01$), total fiber alignment score ($p = 0.0167$) and total echogenicity ($p = 0.0023$) were all smaller in the treated ligaments. The fiber alignment score and echogenicity were not statistically different at the maximal injury zone. The treated SULs had a more concentrated area of metachromasia associated with healing than the untreated ligaments, where metachromasia appeared more diffuse throughout the ligament. ESWT improved the rate of healing as assessed ultrasonographically.
Am J Vet Res. 2004 Feb;65(2):207-12. Comment in: Am J Vet Res. 2004 Apr;65(4):391; author reply 391.	Effects of extracorporeal shock wave therapy and radial pressure wave therapy on elasticity and microstructure of equine cortical bone.	Pauwels FE, McClure SR, Amin V, Van Sickle D, Evans RB. Departments of Veterinary Clinical Sciences, School of Veterinary, Medicine, Purdue University, West Lafayette, IN 47907-1248, USA.	OBJECTIVE: To measure changes in the modulus of elasticity (E) and describe histologic findings after extracorporeal shock wave therapy and radial pressure wave therapy on equine cortical bone specimens. SAMPLE POPULATION: 16 bone specimens from the proximodorsal cortex of an equine third metacarpal or metatarsal bone. PROCEDURE: Baseline E was determined by the density (ρ) and unidirectional ultrasound transmission velocity (C) of each specimen according to the equation $E = \rho C^2$. Eight specimens were treated with 500 pulses of 0.15 mJ/mm ² of extracorporeal shock wave therapy, and 8 specimens were treated with 500 pulses of 0.16 mJ/mm ² of radial pressure wave therapy. After treatment, C was determined again. Four treatment sessions resulted in 2,000 pulses and 5 C measurements. The ρ of each sample was measured again. Mean post-treatment E was calculated for each group. Nondecalfied sections of all specimens were stained with toluidine blue or basic fuchsin for histologic evaluation. RESULTS: Overall treatment group effect was not significant for C or E. Final E was not different from baseline values for extracorporeal shock wave therapy and radial pressure wave therapy. No histologic changes could be attributed to either treatment modality. CONCLUSIONS AND CLINICAL RELEVANCE: Extracorporeal shock wave therapy and radial pressure wave therapy did not affect the material properties of equine bone at the energy and pulse values used in this study.
Vet Surg. 2004 Jan-Feb;33(1):49-55.	Effect of focused and radial extracorporeal shock wave therapy on equine bone microdamage.	Da Costa Gomez TM, Radtke CL, Kalscheur VL, Swain CA, Scollay MC, Edwards RB, Santschi EM, Markel MD, Muir P. Comparative	OBJECTIVES : To determine whether bone microcracks are altered after application of focused and radial extracorporeal shock wave therapy (ESWT) to the equine distal limb. STUDY DESIGN : An ex vivo experimental model. SAMPLE POPULATION : A contralateral limb specimen was obtained from 11 Thoroughbred racehorses with a unilateral catastrophic injury. Distal limb specimens were also obtained from 5 non-racing horses. METHODS : Three separate skin-covered bone segments were obtained from the mid-diaphysis of the metacarpus (MC3) or metatarsus (MT3).

Journal	Title	Authors	Abstract
		Orthopaedic Research Laboratory, School of Veterinary Medicine, University of Wisconsin-Madison, Madison, WI 53706, USA.	Focused (9,000 shockwaves, 0.15 mJ/mm ² , 4 Hz) and radial (9,000 shockwaves, 0.175 mJ/mm ² , 4 Hz) ESWT treatments were randomized to the proximal and distal segments and the middle segment was used as a treatment control for pre-existing microcracks. After treatment, bone specimens were bulk-stained with basic fuchsin and microcracks were quantified in transverse calcified bone sections. RESULTS : ESWT had small but significant effects on microcracks. Microcrack density (Cr.Dn) and microcrack surface density (Cr.S.Dn) were increased after focused ESWT, whereas Cr.Le was increased after radial ESWT. In racing Thoroughbreds, Cr.Le increased with increased number of races undertaken. Cr.Dn and Cr.S.Dn were not significantly influenced by the number of races undertaken. CONCLUSION : ESWT has small but significant effects on bone microcracking ex vivo. CLINICAL RELEVANCE : These preliminary data suggest that ESWT has the potential to increase bone microcracking in equine distal limb bone in vivo. Such effects may be more pronounced in Thoroughbreds that are actively being raced, because in vivo microcracking increases with increased number of races undertaken.
Vet Surg. 2004 Jan-Feb;33(1):40-8.	Effects of extracorporeal shock wave therapy on bone.	McClure SR, Van Sickle D, White MR. Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Iowa State University, Ames, IA 50010-1250, USA. mcclures@iastate.edu	Extracorporeal shock waves have been used for 30 years to fragment uroliths for nonsurgical treatment for urolithiasis in humans. Applied to bone, shock waves delivered at the appropriate energy and pulse number, can stimulate osteogenesis. In Europe, shock waves are routinely used to treat nonunions in humans despite poor understanding of the mechanism of action. Shock wave therapy has also been used clinically in horses. Preliminary experimental studies indicate that shock wave therapy does not damage soft tissue in the distal aspect of the equine limb and can stimulate osteogenesis throughout the depth of the near cortex of the metacarpus and metatarsus.
Schweiz Arch Tierheilkd. 2001 May;143(5):27-32.	[Extracorporeal shock wave therapy in veterinary medicine.]	Schnewlin M, Lischer C. Veterinär-Chirurgische Klinik der Universität Zürich.	This article gives a general overview on a new therapy in equine orthopedics. In human medicine extracorporeal shock wave therapy (ESWT) is used for lithotripsy of stones of the urologic system and also in orthopedics. In equine medicine the therapy is almost exclusively applied for the treatment of orthopedic problems. The main indications are proximal suspensory desmitis (PSD), lesions of tendons and ligaments, osteoporotic changes and spavin. In this paper the mode of action of shock waves and the different shock wave devices are discussed. Also, some information about an ongoing clinical trial at the Animal Hospital University of Zürich is given.