

Extracorporeal Shock Wave Therapy and the Equine Patient:

A Practitioner's Guide to Methods of Extracorporeal Shock Wave Therapy

Larry A. Metheney, DVM

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Forward

This booklet is a reference guide addressing the clinical use of High Medical Technologies' focused extracorporeal shock wave therapy medical device, the VersaTron. It is not intended as an in-depth exploration into the physics and mechanics of shock wave technology, but rather a clinical starting point for the application of focused shock wave therapy in equine medicine. The detailed treatment protocols included in the appendix are designed to be able to visualize all the necessary information for a topic simply by laying this booklet open on a flat surface.

The use of focused shock wave therapy in equine medicine is an evolving science. It would not be possible without the ongoing communication from practitioners using this device. Individual feedback and comments are welcome to further the understanding and advancement of treatment protocols. Comments and feedback may be directed to me, Dr. Larry A. Metheney at LAMetheney@aol.com. Thank you veterinary colleagues, I hope you glean some useful information from this booklet.

Acknowledgements

The preparation and assimilation of this booklet would not have been possible without the untiring efforts of Jennifer C. Godsey, DVM. Thank you Dr. Godsey for tolerating the odd hours and the many editing changes I inflicted on you. Thank you for your helpful diagrams and technical expertise in pulling this document together. But most of all thank you for understanding extracorporeal shock wave therapy and helping to develop a clinical reference booklet needed as a starting point as we pursue a better understanding of this emerging technology.

--Dr. Metheney

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Acronyms

DDF – Deep Digital Flexor Tendon
ESWT – Extracorporeal Shock Wave Therapy
HMT – High Medical Technologies
SDF – Superficial Digital Flexor Tendon
P1 – Phalanx 1 or Proximal Phalanx
P2 – Phalanx 2 or Middle Phalanx
P3 – Phalanx 3 or Distal Phalanx

Introduction

Veterinary applications of Extracorporeal shock wave therapy (ESWT) to treat performance problems due to injury or diseases have increased exponentially in the past five years. World class athletes to the back yard horse are benefiting from the increased availability of this medical therapy⁶.



Testimonials such as the one below are easy to find among ESWT clients:

“Red Eye had not had a win in over a year-and-a-half when Dr. Metheney began treating his back using ESWT. He has now won 6 of his last 7 races and increased in value,” said Micheal Lenzini, Red Eye’s trainer at the Turf Paradise Racetrack in Phoenix, AZ.

Practitioners are using ESWT to treat a long list of musculoskeletal problems. One of the biggest issues facing these practitioners is what treatment protocols to use to increase the likelihood of a favorable outcome. The use of ESWT to treat equine musculoskeletal injuries is still a new and emerging science. Currently, there are no established or definitive protocols for treatment. Instead, treatment protocols have been developed by individual veterinarians in the field through experimentation and response to treatment.

This article serves to compile the efforts of pioneering individuals using High Medical Technologies’ (HMT) electrohydraulic ESWT device, the VersaTron. This article offers new and current VersaTron users a summary of protocols that have been used to treat various conditions. It should be noted that various shock-wave devices demonstrate significant differences in terms of treatment protocols, indications, and effectiveness.

Due to this, the treatment protocols presented in this article are designed for the VersaTron and should not be extrapolated to other shock-wave devices.

Other topics discussed in this paper are ESWT effects, restraint, site preparation, expected outcome, side effects, adjunctive or contratherapies, and caveats, tips and tricks. The most common conditions currently being treated using ESWT are summarized in Table 1. Detailed treatment information for each of these indications is presented

individually in an attached appendix. Table 2 summarizes the protocols presented in the appendix.

Table 1. Musculoskeletal Disorders Currently Treated Using ESWT

<ul style="list-style-type: none"> • Suspensory desmitis • Tendonitis • Stable stress fractures • Tendon avulsion and avulsion fracture • Periostitis • Proximal splint bone fracture • Spavin (hock degenerative joint disease) • Sacroiliac pain • Lumbosacral pain • Sesamoiditis 	<ul style="list-style-type: none"> • Kissing spines (dorsal spinous process impingement) • Splints (interosseous ligament tear) • Caudal heal syndrome (navicular disease) • Ringbone • Curb (plantar tarsal ligament desmitis) • Muscle strains • Bone cysts of the distal condyle of cannon • Carpalis
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The VersaTron was selected for this article because HMT is the leader in the field of ESWT with a history of funding independent scientific studies. The purpose of this document is not intended to provide a finite list of indications and absolute treatment values. Rather this document attempts to provide the reader with an understanding of the range of common maladies being treated using ESWT and a general treatment plan.

Individual feedback and comments are welcome to further the understanding and advancement of treatment protocols. Comments and feedback may be directed to Dr. Larry A. Metheney at LAMetheney@aol.com.

Effects of Extracorporeal Shock Wave Therapy

ESWT has been documented to have various effects on bone and soft tissue^{1,5,8,9,14}. Clinically ESWT seems to induce a transient and incomplete analgesia and promote healing^{5,9,10}. Shock waves are thought to increase blood supply to the treated area, manipulate inflammatory processes, stimulate osteoclasts and fibroblasts to rebuild injured tissues, promote a linear pattern of healing in tendons and ligaments, decrease pain, increase immune response in acute injuries and jump-start the immune system to promote healing of chronic injuries^{2,3,4,7,8,13,15}.

Many of the indications treated using ESWT occur in the lower limbs. Since the bones, tendons and ligaments of these areas have a limited blood supply, increasing the blood supply to injured or diseased areas can decrease healing times by providing nutrients and more effectively remodeling damaged tissues. ESWT may also modify the immune response by increasing the response in acute injuries and jump-starting the response in chronic injuries.

Site Preparation

The area to be treated is clipped using a #40 clipper blade. Conduction gel is generously applied to ensure good contact between the skin and the probe head. A new “sticky gel” *Litho*CLEAR is available from Sonotech (www.sonotech-inc.com). The sticky gel is thicker and as the name implies will stick to the application site better.



In the situation of show horses where clipping is discouraged, it is recommended to work ultrasound gel down into a dry hair coat with a water scraper. Some practitioners have used alcohol to saturate the hair coat prior to application of the gel, but often this makes the gel more fluid and less likely to stick to the intended target area.

Restraint

Forms of chemical and physical restraints are employed during ESWT for several reasons including safety and the close proximity of expensive equipment. Horses with deep tissue injuries of the back may tolerate ESWT without sedation or restraint, but most practitioners utilize some form of restraint to ensure the safety of the individuals and equipment. If ESWT is applied without sedation, it is recommended to start with a lower energy setting and work up to the higher energy settings during the treatment session.

Xylazine is a good choice for sedation and analgesia for ESWT of muscle injuries. A combination of detomidine and butorphanol is useful for treating bone injuries with ESWT where additional pain relief is desired. Regional or local anesthesia may also be of use during treatment of highly painful conditions or sensitive individuals.

Physical forms of restraint include the use of an engaged chain shank. Although not typically used, twitches could be useful for the horse that still responds even with sedation.

General Treatment Information

In general probes are used to focus shock waves toward affected and surrounding areas to facilitate healing. It is important to define treatment areas through diagnostics (palpation, xrays, ultrasound, etc). This will enable the user to direct sufficient shock waves toward the area where maximum benefit will be seen. The number of shocks needed to achieve a desirable response depends on the “volume” of the treatment area. The surface area and cross-sectional area being treated determine this volume^{8,9}. The larger the volume, the greater number of shocks needed. In addition, the less vascular the tissue, the more stimulation is required. Thus a higher number of shocks are required to effectively treat bony or tendon injuries than soft tissue injuries.

Chronic injuries are generally more refractive to treatment. They will require a greater number of shocks to initiate a response. They also do not respond as completely as acute injuries and thus the outcome is often less favorable.

Historically lower energy levels were used in acute injuries. In truth, the minimum stimulation needed to elicit a response has not been investigated. Since the risk of side effects with electrohydraulic devices even at the highest energy setting is minimal, most practitioners are using higher energy levels for both acute and chronic injuries to ensure they exceed any threshold needed to achieve a favorable outcome from treatment.

It should be noted, the use of ESWT can be useful during any stage of healing to enhance healing quality and decrease healing time.

Adjunctive Therapies, Contratherapies, and Contraindications

Several forms of adjunctive therapies are employed after treatment to aid in the healing phase. Keeping limbs cool post-treatment may reduce swelling and speed healing. Ice may be used along with alcohol wraps to reduce inflammation. A solution of 50% DMSO under mud (no wrap over) may also be of benefit.



Physical therapies such as non-impact or low-impact activities are often used to maintain conditioning while allowing injuries to heal. Examples include swimming and light exercise. Swimming is an excellent way to maintain conditioning without impact stress to the limbs. It is not recommended for stifle injuries, as overextension of the stifle may occur.



Historically, counter irritation was often used to aid healing of several equine limb pathologies. Two examples of counter irritation include pin firing or freeze firing the skin over shin buck as seen at left. Counter irritation is not recommended to be used in conjunction with ESWT. ESWT facilitates and relies on an immune response that may be inhibited by the inflammatory response created by counter irritation

BioVigor trace minerals, manufactured by Global Organics (www.BioFlora.com), can be useful during healing and for the prevention of future problems. BioVigor can be used to correct dietary nutritional imbalances, provide nutritional support needed for rapid bone healing, decrease healing times, and improve overall healing quality.



ESWT has been considered contraindicated with neoplasia or sepsis, however European data indicate that infected non-union fractures have been successfully treated with this modality^{11,12}. Investigation into this area is warranted. Also, care should be taken to avoid directing the probe toward large vessels, nerves, brain, and air-filled structures.

Pain Management

Some clinicians report an incomplete and transient pain reduction lasting three to four days^{5,9,10}. The result of ESWT is not analgesia, but rather a pain reduction. Cutaneous sensation can still be elicited by pinprick. During this period, it is important to rest the animals. If they return to work too soon, they may overwork the injury and re-injure themselves. In light of this, the various racing commissions and FEI have established waiting periods post-ESWT prior to competition. This should be kept in mind prior to performing ESWT on a performance horse.

Side Effects

No serious side effects have been reported by clinicians. Occasionally, swelling has been observed over the tendons after ESWT. No correlation to outcome or future response to therapy has been established for this swelling.

Protocols

The attached appendix provides detailed information for treating each of the conditions listed in Table 1. The following table summarizes the treatment protocols found in the appendix. Probe selection can be determined with the aid of ultrasound to measure depth of intended target.

Table 2. Summary of VersaTron Treatment Protocols

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Proximal Suspensory Ligament (proximal 1/3 of ligament) p. 10				
Palmar/dorsal (sagittal)	R20 and R35	E4 to E6	500	10 days to 3 weeks
Medial and lateral	R05	E4 to E6	500 each side	10 days to 3 weeks
Distal Suspensory Ligament p. 12				
Medial and lateral branches	R05	E4 to E6	800 each side	10 days to 3 weeks
Tendonitis				
Palmar, medial, and lateral aspects from carpus to fetlock	R05	E4 to E6	1000 (treat the full tendon, but concentrate over any cystic lesions)	10 days to 3 weeks
Stable Stress Fractures p. 14				
Depends on area affected	Depends on depth of intended target	E6	1000-3000 depending on size of lesion	Repeat every 3 to 4 weeks
Tendon Avulsion and Avulsion Fractures p. 16				
Directly over affected area	R05	E4 to E6	800-1500 depending on size and severity of lesion	Repeat every 3 to 4 weeks
Periostitis p. 18				
dorsal, medial, and lateral aspects of cannon bone from carpus to fetlock	R05	E6	1000 per cannon	Uncomplicated cases respond to one treatment
Proximal Splint Bone Fractures p. 20				
Directly over affected area	R05	E6	800-1200 depending on severity and duration	14 to 30 days
Hock Degenerative Joint Disease p. 22				
Directly over affected area	R05 and R20	E6	1500-2000 divided equally between both probes	As needed based on clinical signs
Sacroiliac p. 24				
left and right sacroiliac joints	R35 and R80	E6	1000 divided equally between both probes for each location (total 2000 shocks)	As needed based on clinical signs and palpation

Table 2. Summary of VersaTron Treatment Protocols (Continued)

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Lumobosacral p. 28				
left and right cranial joint space, and left and right caudal joint space	R35 and R80	E6	500 divided equally between both probes for each location (total 2000 shocks)	As needed based on clinical signs and palpation
Sesamoiditis p. 32				
Over body of sesamoid	R05	E6	500 per sesamoid	10 to 21 days
Kissing Spines p. 34				
Over affected area.	R35	E6	2000-3000	2 to 4 weeks
Interosseous Ligament Tears p. 36				
Over splint and ligament area	R05	E4 to E6	500-1000	10 days to 3 weeks
Navicular Syndrome p. 38				
Frog and heel bulbs	35 at frog 20 at heel bulb	E6	1000 frog and 1000 heel bulb	At shoeing intervals
Ringbone p. 40				
Dorsal pastern	R05 or R20	E6	800 to 2000	10 days to 3 weeks as needed
Plantar Tarsal Ligament Desmitis p. 42				
Over plantar ligament	R05	E4 to E6	800-1500	10 days to 3 weeks as needed
Muscle Strains p. 44				
Over affected muscle	R05, R20 and R35 depending on thickness of muscle	E6	1000-4000 depending on affected area and divided equally between selected probes	If needed with return of clinical signs
Bone Cysts (Distal Condyle of Cannon) p. 46				
Over lesion	R05 and R20	E6	1000 with each probe	2 to 4 weeks for three to four treatments
Carpitis p. 48				
Over carpus	R05	E6	500-1000	2 to 4 weeks as needed

Treatment Protocols for the VersaTron

Suspensory ligament

Suspensory ligament desmitis or tears can be treated using ESWT.

Site preparation

The palmar aspect of the limb is clipped from carpus to fetlock as shown in the figure to the right. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.



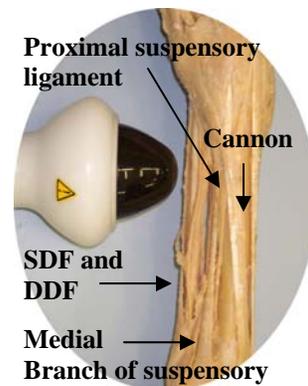
Treatment protocol

The treatment protocol for suspensory ligament injury is divided into two treatment areas, the area of the tendon proximal and distal to the location where the tendon divides into medial and lateral branches.

A summary of the treatment protocol for suspensory ligament injuries is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Proximal Suspensory Ligament (proximal 1/3 of ligament)				
Palmar/dorsal (sagittal)	R20 and R35	E4 to E6	500	10 days to 3 weeks
Medial and lateral	R05	E4 to E6	500 each side	10 days to 3 weeks
Distal Suspensory Ligament				
Medial and lateral branches	R05	E4 to E6	800 each side	10 days to 3 weeks

The picture to the right presents the anatomy of the metacarpal region. The probe is directed toward the proximal portion of the suspensory ligament deep to the superficial digital flexor (SDF) and deep digital flexor (DDF) tendons. The probe should also be directed at the proximal suspensory ligament from a lateral and medial direction. The lateral (not shown) and medial branches of the suspensory ligament are also treated from the lateral and medial sides.



The figures below demonstrate treatment of the proximal and distal medial portion of the ligament and the proximal palmar aspect.



Post-treatment care recommendations

The animal should be stall rested until improved. Try to keep the limb cool. Alcohol wraps for 2 days and application of a 50% DMSO solution under mud (don't wrap over the DMSO) are of benefit. Icing the limb may also help speed healing.

Follow-up

Ultrasound and palpation are useful to determine degree of healing. Weekly monitoring is recommended. Expect three weeks before improvement is evident. The need for additional treatments is dependant on the severity of the injury. Minor strains may respond to one treatment. ESWT may be repeated between ten days and three weeks if the ligament is still painful on palpation or ultrasound shows a lesion. Often, one treatment is curative in mild cases.

Outcome

The use of ESWT on suspensory ligament injuries results in significantly reduced healing times and a more linear alignment of tendon fibers seen by ultrasound⁹.

The prognosis for using ESWT to treat proximal suspensory ligament injuries is considered excellent (scale: poor, guarded, good, excellent). The prognosis for using ESWT to treat distal suspensory ligament injuries is considered good.

Caveats, tips and tricks

ESWT can be combined with bone marrow or A Cell procedures. Counter irritants are not recommended as they may interfere with the positive effects of ESWT.

Tendonitis or Tenosynovitis

Tendonitis or tenosynovitis, with or without core lesions, benefit from ESWT. This is commonly referred to as bowed tendon and typically results from strains and tearing of the flexor tendons.

Site preparation

The site is prepped in the same manner as for suspensory ligament injuries. The palmar aspect of the limb is clipped from carpus to fetlock as shown in the figure to the right. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

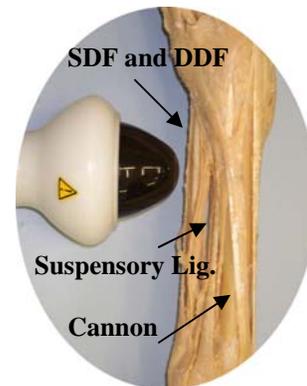


Treatment protocol

A summary of the treatment protocol for tendonitis is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Palmar, medial, and lateral aspects from carpus to fetlock	R05	E4 to E6	1000 (treat the full tendon, but concentrate over any cystic lesions)	10 days to 3 weeks

The picture to the right presents the anatomy of the metacarpal region. The probe is directed toward the superficial digital flexor (SDF) and deep digital flexor (DDF) tendons. The pictures below demonstrate treatment of the superficial and deep digital flexor tendon. The probe is walked along the tendons making sure to treat from the palmar, medial, and lateral aspects. As the probe is walked, the probe is pivoted to fan the shock waves over the entire tendon area.



Post-treatment care recommendations

Application of a moderate pressure bandage can be used to reduce swelling of a core lesion. The animal should be stall rested until improved. Try to keep the limb cool. Alcohol wraps for 2 days and application of a 50% DMSO solution under mud, with or without wraps, are of benefit. Icing the limb may also help speed healing.

Follow-up

Ultrasound and palpation are useful to determine degree of healing. ESWT can be repeated between ten days and three weeks if the tendon is still painful on palpation, or ultrasound shows a core lesion.

Outcome

Practitioners report, the use of ESWT to treat tendon injuries can significantly reduced healing time and increased the linear alignment of fibers seen on ultrasound. Expect a good prognosis for tendon injuries treated using ESWT.

Caveats, tips and tricks

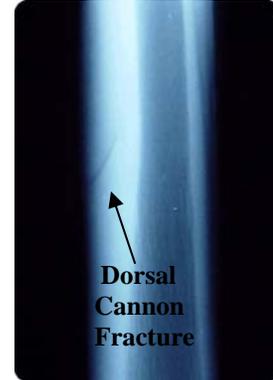
While ESWT can be used to treat core lesions, some practitioners prefer to drain core lesions or split tendons. If core lesions are drained or tendons are split, it is recommended to apply moderate pressure bandages to the affected limb and wait two weeks to initiate ESWT.

The use of counter irritants is not recommended in conjunction with ESWT as they may interfere with the positive effects of ESWT.

Significant post-treatment swelling is occasionally seen, but it has not been correlated with clinical outcome.

Stable Stress Fractures

Examples of stable stress fractures include fractures of the dorsal cortical cannon, greenstick fractures, and saucer fractures. ESWT is useful in reducing healing times and improving quality of healing in stable stress fractures.



Site preparation

Site preparation depends on the location of the stress fracture. In general the area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Sufficient gel is applied to the site to enable good probe to skin contact.

Treatment protocol

The treatment protocol varies depending on the size of the area affected. General recommendations are presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Depends on area affected	Depends on depth of intended target	E4 to E6	1000-3000 depending on size of lesion	Repeat every 3 to 4 weeks

Acute fractures generally require 1 to 2 treatments, while old fractures may require 3 to 4 treatments.

Post-treatment care recommendations

Stall rest or small paddock rest until radiographic resolution is recommended. Alcohol rubs are useful to cool the limb and encourage healing.

Physical therapy such as swimming (non-impact) can be performed 2 to 3 days after treatment to maintain condition. Light exercise can be started after 60 days with radiographic evidence of healing. Do not run animal until the fracture is no longer radiographically apparent.

Follow-up

Radiograph injury 30 to 60 days post-treatment to monitor for healing.

Outcome

Clinicians report a significantly reduced healing time. With early treatment injuries can be clinically healed in 2 months, instead of 4 months without ESWT.

Stress fractures respond best within the first couple weeks post-injury. The response is reduced if treatment is delayed to more than 30 days post-injury. The prognosis for treatment of new stress fractures is excellent.

Caveats, tips and tricks

Old stress fractures may have a slower or muted response. This may be due to a fibrous union that can be seen radiographically. Old stress fractures may require multiple treatments to achieve full benefit from ESWT.

Special considerations

ESWT is not recommended for complete or displaced fractures, such as displaced metacarpal condylar fractures.

Tendon Avulsion and Avulsion Fractures

Examples include any tendon avulsion or avulsion fracture such as, avulsion of attachment of radial carpii dorsalis ligament at proximal end of cannon (cherry splints), proximal sesamoid fractures, and avulsion of the collateral ligaments in stifle.

Site preparation

Site preparation depends on the location of the avulsion. In general the area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Sufficient gel is applied to the site to enable good probe to skin contact.

Treatment protocol

The treatment protocol varies depending on the size of the area being treated and the severity of the avulsion. General recommendations are presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Directly over affected area	R05	E6	800-1500 depending on size and severity of lesion	Repeat every 3 to 4 weeks

Acute fractures generally require 1 to 2 treatments, while old fractures may require 3 to 4 treatments.

Post-treatment care recommendations

Recommend stall rest or small paddock rest until radiographic resolution. Physical therapy such as swimming (non-impact) can be performed immediately after treatment to maintain condition. Light exercise can be started after 60 days in the absence of lameness or pain response to palpation.

For stifle injuries, hand walk and confine to a small paddock for 60 days. The animal may be jogged after 60 days. Healing is determined using ultrasound. Strenuous exercise should not be performed until after healing is apparent. Swimming is not recommended for stifle injuries, as it may result in overextension of the joint.

Follow-up

Palpate for pain and perform radiographic imaging at 60 days to monitor healing.

Outcome

Clinicians report a minimal and transient pain reduction associated with ESWT of avulsion fractures. The duration of effect is limited to a few days duration. But it is important to instruct owners to not allow the horse to stress the limb during this time period.

Expect at least 60 days for injuries to heal. The prognosis for stifle injuries and radial carpii dorsalis injuries is excellent. The prognosis for sesamoid injuries is good.

Caveats, tips and tricks

Counter irritants and iodine injections are not recommended in conjunction with ESWT as they may interfere with some of the positive effects of ESWT.

Periostitis

Periostitis, also known as shin buck or buck shins, responds well to ESWT. Periostitis is characterized by inflammation of the dorsal surface of the cannon bone.

Site preparation

The skin over the cannon is clipped from carpus to fetlock. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

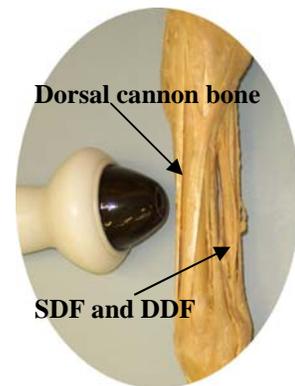


Treatment protocol

A summary of the treatment protocol for periostitis is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Dorsal, medial, and lateral aspects of cannon bone from carpus to fetlock	R05	E6	1000 per cannon	Uncomplicated cases respond to one treatment

One treatment is generally sufficient to result in healing. The picture at right demonstrates the anatomy of the metacarpal region. The probe is directed toward the dorsal cannon bone. The picture below demonstrates treatment of periostitis of the dorsal cannon (shin buck) in a live animal. During treatment, the probe is moved over the treatment area in linear fashion (proximal to distal and back), and making sure to treat dorsal, medial, and lateral cortices.



Post-treatment care recommendations

During recovery, try to keep the limb cool. Alcohol wraps for 2 days and application of a 50% DMSO solution under mud without wraps is of benefit. Only non-impact exercise is recommended during the first three weeks to allow ample time for healing. During this period, machine or hand walking may be performed. Physical therapy, such as swimming may also be used to maintain condition while allowing time to heal.

Follow-up

The cannon bones should be palpated in three weeks for pain. If no pain is present training may be resumed.

Outcome

Clinicians report animals may exhibit evidence of pain reduction by walking better the next day, but they will still palpate sore. It is important to enforce rest during this time period. The prognosis for treating periostitis using ESWT is excellent.

Caveats, tips and tricks

Clinicians report a low incidence of recurrence of shin buck after ESWT.

Considerations

Working or running the horse within the first three days post treatment (during high point of pain reduction) can increase their chance for a more severe injury.

Proximal splint bone fracture

Proximal fractures of the splint bones can be treated with ESWT to decrease healing times and increase the quality of healing.

Site preparation

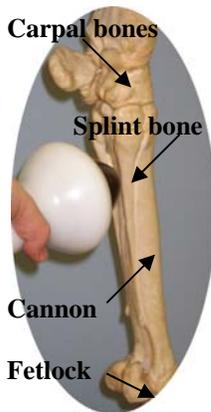
The area over the affected splint bone is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.



Treatment protocol

A summary of the treatment protocol for splint bone fractures is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Directly over affected area	R05	E6	800-1200 depending on severity and duration	14 to 30 days



The number of shocks used depends on the severity of the fracture and the chronicity of the injury; older injuries require more shocks. Treatment may be repeated between 14 to 30 days to achieve resolution. The picture to the left presents a medial view of the bony anatomy of the metacarpal region. The probe is directed toward the proximal splint bone. The picture to the right demonstrates the actual treatment of a fracture to the proximal splint bone.



Post-treatment care recommendations

During recovery, try to keep the limb cool. Alcohol wraps for 2 days and application of a 50% DMSO solution under mud (don't wrap over the DMSO) are of benefit. The horse should be on stall rest and confinement to a small paddock for a minimum of thirty days. After thirty days, care should include hand walking. The animal should not be exercised until after radiographic resolution.

Follow-up

After sixty days, healing is monitored using radiographs.

Outcome

Owners must be informed that a transient pain reduction is experienced for a few days post-treatment. It is important to enforce strict confinement during this period to prevent additional injury. In addition, more proximal fractures are more weight bearing so confinement and rest is very important in these individuals during the first few days after ESWT to prevent further injuries.

The prognosis for treating proximal splint bone fractures with ESWT is excellent.

Considerations

Compound fractures may be less responsive to ESWT.

Hock Degenerative Joint Disease

Degenerative joint disease of the hock, or bone spavin, may be treated using ESWT to reduce pain until bony union of joint space is achieved. Bone spavin typically involves the distal intertarsal and tarsometatarsal joints of the hock.

Site preparation

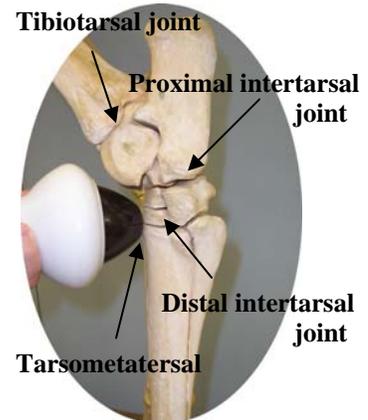
The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

Treatment protocol

A summary of the treatment protocol for splint bone fractures is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Directly over affected area	R05 and R20	E6	1500-2000 divided equally between both probes	As needed based on clinical signs

Make sure to get plenty of coverage over the affected and inflamed synovial membrane with both probes. The picture at right presents the bony anatomy of the hock joint. The probe is directed toward treatment of the distal intertarsal joint and the tarsometatarsal joint. Treatment may be repeated as needed for pain reduction. The pictures below demonstrate treatment of the dorsal, lateral, and medial surfaces for hock degenerative joint disease on an actual horse.



Post-treatment care recommendations

Allow the horse to rest for four to five days before returning to work.

Follow-up

Recheck joint one month post-treatment to determine if animal would benefit from a second treatment. Treatment can be used as needed to increase comfort until fusion occurs.

Outcome

The short-term prognosis is excellent for period of time, but will require repeat therapy to maintain comfort levels. The long-term prognosis depends on time until bony union, when horse will become sound. There is no evidence available to indicate that ESWT decreased time to fusion of the affected joint space. But ESWT is useful for reducing inflammation and increasing the comfort of the patient during this time.

Considerations

Intra-articular injections should be used as the primary therapy. ESWT can be used as an adjunctive treatment to reduce inflammation and increase comfort. The two therapies may be performed at the same time, but separated when possible.

Sacroiliac

Sacroiliac pathologies treated using ESWT include desmitis, subluxations, and degenerative changes such as arthritis.

Site preparation

Generous amounts of ultrasound gel are applied to the treatment area. A water scraper can be used to spread the gel, move the gel to another location, and remove the gel when finished. If the area is not clipped prior to treatment, use the water scraper to work the gel into the coat. The photos below illustrate application of sufficient amounts of gel and the use of a water scraper to apply, spread, and move applied gel.

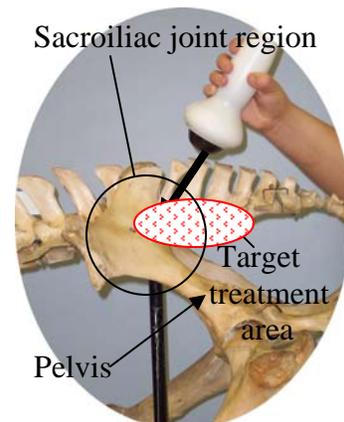


Treatment protocol

A summary of the treatment protocol for sacroiliac pain is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
left and right sacroiliac joints	R35 and R80	E6	1000 divided equally between both probes for each location (total 2000 shocks)	As needed based on clinical signs and palpation

Treatment is targeted toward the sacroiliac joint region. The probe is directed in a lateromedial direction and walked cranial and caudally to affect the sacroiliac ligament and muscles in the area along sacrum. The picture at right demonstrates the relationship of the probe to bony structures in the pelvic region. The thick arrow shows the probe placement for treatment of the cranial region of the sacroiliac treatment area. The red shaded area identifies the target area for treatment.



Treatment benefits may last up to four weeks. For continued benefits, ESWT may be repeated as necessary to achieve adequate comfort levels for the animal.

The following pictures demonstrate actual treatment of the sacroiliac region. Please note the various angles and positions while walking the probe cranially and caudally used to treat the entire sacroiliac area.



Post-treatment care recommendations

Deep massage of the back daily after treatment is recommended for maximal relief.

Follow-up

Palpation is used to determine response to treatment. The horse is usually still sore to palpation in three to four days. After one week they normally are not painful on palpation.

Outcome

The response to ESWT for sacroiliac pain is excellent but not permanent, and will require repeat treatment. The peak pain relief response is seen in five to seven days. The results are similar to those seen with deep cortisone injections. The overall healing time may take weeks to months.

Caveats, tips and tricks

The R80 probe and an energy setting of E01 can be used with light or no sedation as a diagnostic tool to identify painful areas that may need more attention during ESWT.

Use a water scraper to spread the gel, work it into the coat, move it to other treatment sites, and remove post-treatment. This will enable the user to recycle the gel and use less amounts. Some veterinarians use alcohol to saturate the coat prior to application of the gel. This can be used, but may result in difficulty keeping the gel on the coat.

Some practitioners prefer to apply three treatments at three week intervals to treat sacroiliac pain.

Lumbosacral

Lumbosacral pathologies treated using ESWT include desmitis, subluxations, and degenerative changes such as arthritis.

Site preparation

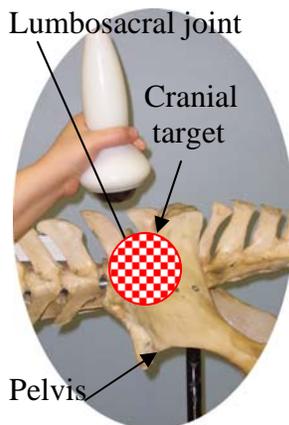
Generous amounts of ultrasound gel are applied to the treatment area. A water scraper can be used to spread the gel, move the gel to another location, and remove the gel when finished. If the area is not clipped prior to treatment, use the water scraper to work the gel into the coat. The photos below illustrate application of sufficient amounts of gel and the use of a water scraper to apply, spread, and move applied gel.



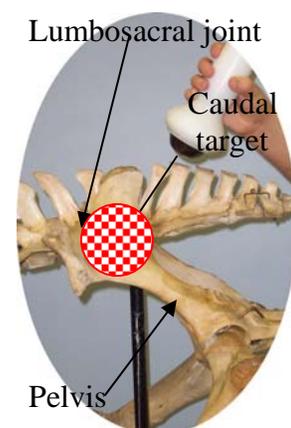
Treatment protocol

A summary of the treatment protocol for sacroiliac pain is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
left and right cranial joint space, and left and right caudal joint space	R35 and R80	E6	500 divided equally between both probes for each location (total 2000 shocks)	As needed based on clinical signs and palpation



Four locations are targeted when treating lumbosacral pain. The left and right sides of the cranial and caudal aspects of the lumbar-sacral joint are targeted when treating lumbosacral pain. The picture to the left demonstrates probe alignment for the left cranial position, and the picture to the right demonstrates probe placement for the left caudal position. Shaded areas represent shock wave target areas.



Five hundred shocks are applied at each of the four locations. The total number of shocks for each location is divided equally between both probes. For the cranial locations, the probe is angled both lateromedial and craniocaudally oblique during treatment to affect the lumbosacral joint. For the caudal points, the probe should be oriented in lateromedial and caudocranial oblique directions. Pain relief from treatment may last up to four weeks. Treatment is repeated as necessary to achieve adequate comfort levels for the animal.

The following pictures demonstrate both cranial and caudal treatment locations.



Post-treatment care recommendations

Deep massage of the back daily after treatment is recommended for maximum relief.

Follow-up

Palpation is used to determine response to treatment. The horse is usually still sore to palpation in three to four days. After one week they normally are not painful on palpation.

Outcome

The response to ESWT for lumbosacral pain is excellent but not permanent, and will require repeat treatments to maintain comfort levels. The peak pain relief response is seen in five to seven days.

Caveats, tips and tricks

The R80 probe and an energy setting of E01 can be used with light or no sedation as a diagnostic tool to identify painful areas that may need more attention during ESWT.

Use a water scraper to spread the gel, work it into the coat, move it to other treatment sites, and remove post-treatment. This will enable the user to recycle the gel and use less amounts. Some veterinarians use alcohol to saturate the coat prior to application of the gel. This can be used, but may result in difficulty keeping the gel on the coat.

Some practitioners prefer to apply three treatments at three week intervals to treat sacroiliac pain.

Sesamoiditis

ESWT can be used to treat sesamoiditis characterized by enlarged vascular channels or cysts seen radiographically.

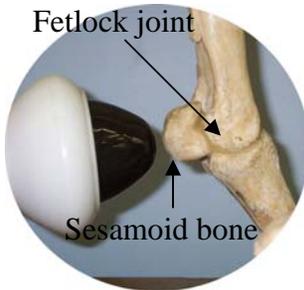
Site preparation

The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

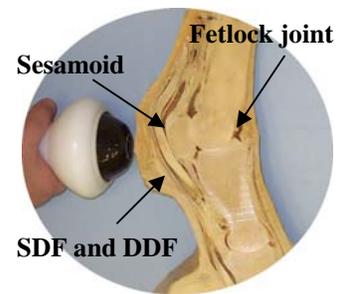
Treatment protocol

A summary of the treatment protocol for sesamoiditis is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over body of sesamoid	R05	E6	500 per sasamoid	10 to 21 days



The probe is applied over the body of the sesamoids and walked across the entire area of the sesamoids. The picture to the left shows the probe in relation to the bony structures of the fetlock joint. The picture to the right demonstrates the probe in relation to a cut-away view of the fetlock.



The pictures below demonstrate medial, lateral, and palmar placement of the probe over the sesamoid bones during treatment of a live horse. The leg can be in a standing or flexed position during treatment depending on tolerance by the patient.



Post-treatment care recommendations

The animal should be hand walked for 30 days post-treatment. Non-impact exercise such as swimming can be utilized to maintain conditioning.

Follow-up

Follow-up radiographs should be taken at 30 days to evaluate healing. Treatment may be repeated between 10 to 21 days as needed. Often one treatment is sufficient.

Outcome

The results of ESWT on sesamoiditis are good to excellent. Often one treatment is sufficient.

Kissing Spines

Kissing spines or dorsal vertebral spinous process impingement can be treated using ESWT.

Site preparation

Generous amounts of ultrasound gel are applied to the treatment area. A water scraper can be used to spread the gel, move the gel to another location, and remove the gel when finished. If the area is not clipped prior to treatment, use the water scraper to work the gel into the coat. The photos below illustrate application of sufficient amounts of gel and the use of a water scraper to apply, spread, and move applied gel.

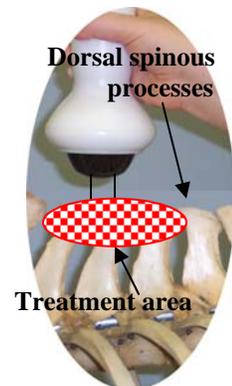


Treatment protocol

A summary of the treatment protocol for kissing spines is presented below:

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over affected area.	R35	E6	2000-3000	2 to 4 weeks

The probe is positioned over the affected dorsal spinous processes of the affected vertebrae. The total number of shocks depends on the size of the affected area. The probe is pivoted to fan the shock waves over and around the entire area to be treated. The picture to the right demonstrates the position of the probe over the dorsal vertebral spinous processes of the thoracic spine. The shaded area identifies the typical target area to be treated.



The pictures below present treatment of a live horse for kissing spines.



Post-treatment care recommendations

Rest 10 days to 2 weeks and then start back at jog, work up to full-regiment. Deep massage of the back daily after treatment is recommended for maximum relief.

Follow-up

The back should be palpated at three weeks for soreness. Treatment may be repeated in two to four week intervals to maintain comfort levels.

Outcome

The outcome from ESWT for kissing spines is good.

Caveat, tips and tricks

Use a water scraper to spread the gel, work it into the coat, move it to other treatment sites, and remove post-treatment. This will enable the user to recycle the gel and use less amounts. Some veterinarians use alcohol to saturate the coat prior to application of the gel. This can be used, but may result in difficulty keeping the gel on the coat.

Some practitioners prefer to apply three treatments at three week intervals to treat sacroiliac pain.

Interosseous Ligament Tears

ESWT can be used to treat interosseous ligament tears, also known as splints, characterized by inflammation of the interosseous ligament and a buildup of bone between the splint bones and the cannon bone.

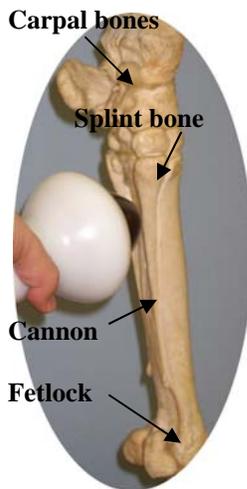
Site preparation

The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

Treatment protocol

A summary of the treatment protocol for interosseous ligament tears is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over splint and ligament area	R05	E4 to E6	500-1000	10 days to 3 weeks



Therapy is directed along the interosseous ligament and splint bone as seen in the picture at left. Using an R05 probe, 500 to 1000 shocks are applied to the area in a linear fashion along the splint bone and ligament. Make sure to approach the area from several angles (palmar, medial, lateral) to ensure good coverage of the bone and ligament. The picture to the right demonstrates treatment of an interosseous ligament tear in a live horse.



Post-treatment care recommendations

Apply alcohol wraps for 2 days. Keep the limb cool. Blistering may interfere with positive benefits of ESWT.

Follow-up

Treatment may be repeated at ten days to three weeks depending on response to the first treatment. Often, one treatment is curative.

Outcome

The response to ESWT for interosseous ligament tears is good to excellent.

Caveat, tips and tricks

The calcium-phosphorus ratio of the diet should be examined. Heavy grain diets are high in phosphorus and low in calcium. Horses fed diets high in phosphorus and low in calcium draw calcium from their bones to maintain a proper balance in the blood. This may weaken ligamentous attachments. These dietary imbalances may lead to interosseous ligament tears. Often a “popped” splint is noticed first.

Navicular Syndrome

Navicular syndrome results from navicular disease, impar ligament desmitis, enthesiophytes, osteophyte formation on the flexor tendon surface, and flexor tendon insertion abnormalities. The result is pain in the caudal heel of the foot. ESWT can be used to reduce symptoms and treat several underlying abnormalities associated with the navicular syndrome.

Site preparation

Site preparation is essential to success. Remove any sole pads. The foot should soak overnight with a wet sponge in a medicine boot. Pare down the frog to petechial hemorrhage or spot blood.

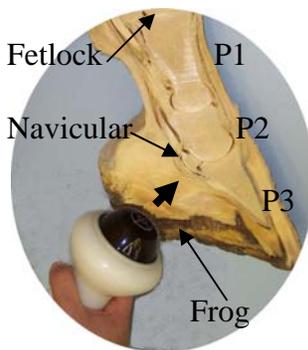
Duct tape can be used to form a well for holding the gel in place during treatment. This gel well is demonstrated in the picture at right.



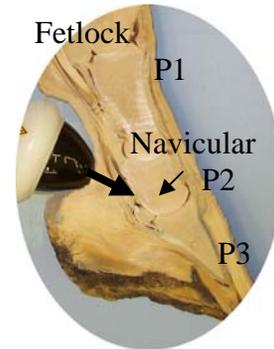
Treatment protocol

A summary of the treatment protocol for navicular syndrome is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Frog and heel bulbs	35 at frog 20 at heel bulb	E6	1000 frog and 1000 heel bulb	At shoeing intervals



The probe is directed toward the navicular bone through the frog and the heel bulbs as shown in the pictures to the left and right. Treatment is generally repeated at shoeing intervals, as it requires a bare foot. The probe is pivoted in place to treat as much area around the navicular as possible.



The pictures below demonstrate treatment for navicular on a live animal. Note the gel well formed by the duct tape.



Post-treatment care recommendations

Therapeutic shoeing is helpful to ease the break-over of the foot. Pads can be applied under the shoes to protect the pared down frog. One week of stall rest post ESWT is recommended. Retreatment at shoeing intervals when shoes are removed is useful to maintain comfort levels.

Follow-up

Proper shoeing is essential to long-term care.

Outcome

Outcome is good with careful case selection. Impar ligament desmitis and other soft tissue pathologies may respond better to ESWT than advanced navicular bony changes.

Caveat, tips and tricks

Deep digital flexor tendon avulsion at the solar site of coffin bone can benefit from this protocol every-other-day for a total of three treatments.

Emu oil has been used to help soften the food before treatment.

Ringbone

Osteoarthritis and periostitis of the first or second phalanx, with or without exostoses, is also known as ringbone.

Site preparation

The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

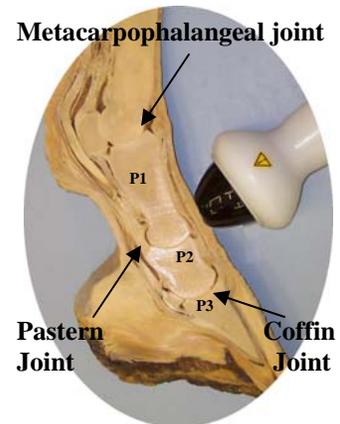
Treatment protocol

A summary of the treatment protocol for ringbone is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Dorsal pastern	R05 or R20	E6	800 to 2000	10 days to 3 weeks as needed

The probe is directed toward the dorsal pastern from the metacarpophalangeal joint to the distant interphalangeal joint. The probe is walked in a linear fashion in an attempt to cover the entire area. The picture to the right presents a cutaway view of the pastern region demonstrating probe placement.

The pictures below demonstrate treatment of the dorsal surface of the pastern and the proximal interphalangeal joint (pastern), and the distal interphalangeal joint (coffin).



Post-treatment care recommendations

The animal should be stall rested and hand-walked for four days post-treatment. Although some horses have remained sound for over six months following treatment ESWT usually needs to be repeated to maintain comfort in performance animals.

Follow-up

At three weeks the limb is evaluated by flexion, palpation, and nerve blocks. The ESWT is repeated if the animal remains painful.

Outcome

Results from ESWT of ringbone are good, but treatment may need to be repeated. Some practitioners report pain relief for over six months. The horses' intended use may have an impact on results and duration of pain relief.

Caveat, tips and tricks

The periarticular ringbone responds better than ringbone with articular involvement. For those cases with articular involvement, use the ESWT in combination with intra-articular injections.

Plantar Tarsal Ligament Desmitis

Plantar tarsal ligament desmitis, also known as Curb, is an inflammation and enlargement of the long plantar ligament of the hock.

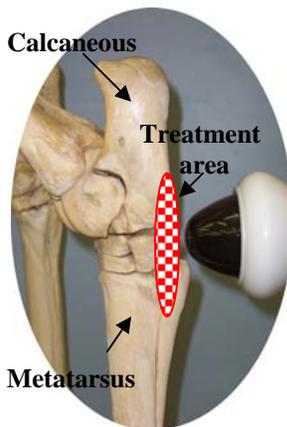
Site preparation

The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

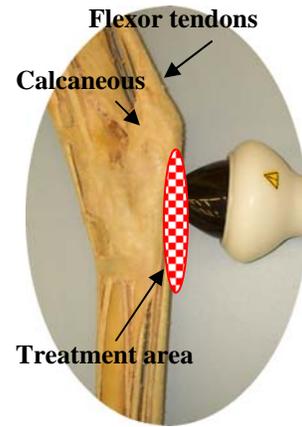
Treatment protocol

A summary of the treatment protocol for plantar tarsal ligament desmitis is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over plantar ligament	R05	E4 to E6	800-1500	10 days to 3 weeks as needed



The long plantar ligament of the hock runs on the plantar surface of the hock from the calcaneus to the metatarsus. The picture at left demonstrates the bony structures of the hock and the desired treatment area. The picture at right demonstrates the soft tissue structures of the hock and the approximate treatment area. The long plantar ligament lies deep to the digital flexor tendons in the picture at right.



The picture at right demonstrates ESWT for curb on an actual patient. It is important to move the probe in a linear fashion to treat the entire long plantar ligament region. Good sedation is also important for this procedure.

Post-treatment care recommendations

The horse should be stall rested and hand-walked post-treatment. DMSO 50% and mud can be applied without bandages to affected area to aid in healing.



Follow-up

Most of the horses with respond to one treatment, but should be evaluated at three weeks post-procedure. If site palpates sore, then the ESWT should be repeated.

Outcome

The result of ESWT on plantar tarsal ligament desmitis is excellent.

Muscle Strains

Muscle strains result from overuse or injury. They can occur anywhere in the body and can affect performance to varying degrees.

Site preparation

Generous amounts of ultrasound gel are applied to the treatment area. A water scraper can be used to spread the gel, move the gel to another location, and remove the gel when finished. If the area is not clipped prior to treatment, use the water scraper to work the gel into the coat. The photo to the right demonstrates the use of a water scraper to remove gel and move it to another location (the other side of the neck in this case).



Treatment protocol

A summary of the treatment protocol for muscle strains is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over affected muscle	R05, R20 and R35 depending on thickness of muscle	E6	1000-4000 depending on affected area and divided equally between selected probes	If needed with return of clinical signs

The treatment protocol for muscle strains varies widely depending on the size of the muscle or muscle group affected. As anticipated, the larger the area to be treated, the higher the number of shocks. The use of several probes allows to maximum treatment to the muscle at various depths of penetration. The thicker muscles will benefit greatly from treatment at several depths. Effected depth of treatment can also be manipulated by varying the amount of pressure used during shock wave treatment.

The pictures below demonstrate the treatment of the sternocephalicus and sternohyoideus muscles of a horse that fell coming out of the gate. Each side of the neck was treated using 400 shocks with a R05 probe and 400 shocks with a R35 probe (total 1600 shocks). This was the second treatment as the horse still palpated sore on the recheck exam.



Post-treatment care recommendations

The horse should be allowed to rest for 3 days post-treatment. They may be walked or allowed to swim.

Follow-up

Hand walk for 4 to 7 days, then slowly return to full work. The affected area should be palpated at 10 to 21 days post-treatment for pain. If painful, then repeat treatment.

Outcome

The response to ESWT for muscle strains is excellent when no underlying lameness or conformational problem exists.

Caveat, tips and tricks

Take care to avoid underlying air-filled structures such as the trachea and lungs.

Bone Cyst (Distal Condyle of Cannon)

Cystic lesions in bone respond well to ESWT. Cystic lesions are seen radiographically, and may be fluid or blood filled lesions.

Site preparation

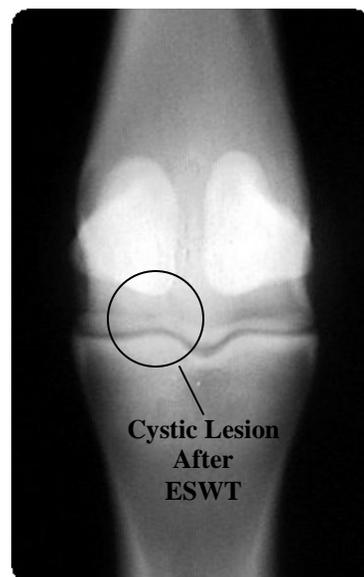
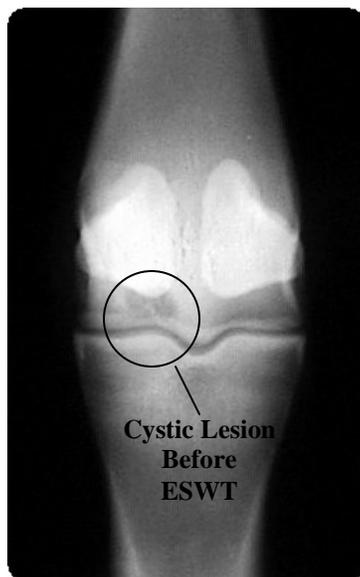
The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

Treatment protocol

A summary of the treatment protocol for bone cysts is presented below.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over lesion	R05 and R20	E6	1000 with each probe	2 to 4 weeks for three to four treatments

Treatment should be applied directly to the cystic lesion. The approach should be designed using radiographs to identify the location, depth, and size of the lesion. The pictures below demonstrate a cystic lesion of the distal cannon before and after ESWT treatment.



Post-treatment care recommendations

The animal should be stall rested while lame. As horse responds to therapy, progress to paddock rest.

Follow-up

Monthly radiographs should be used to evaluate healing progress.

Outcome

The results from ESWT of bone cysts are excellent in growing horses. Older horses require more treatments and the response is slower.

Carpitis

Carpitis represents inflammation in the carpal joint. This inflammation may be the result of straining, hairline fractures, or other fractures (slab, saucer, etc.). Carpitis is also used to describe traumatic arthritis of the carpus, often referred to as popped knees.

Site preparation

The area over the affected area is clipped free of hair. The skin is cleaned with alcohol to remove dirt, oil, and clipping debris. Conducting gel is applied to ensure good contact between the probe head and the skin.

Treatment protocol

A summary of the treatment protocol for carpitis.

Entry Window	Probe	Energy Setting	Number of Shocks	Treatment Interval
Over carpus	R05	E6	500-1000	2 to 4 weeks as needed

The probe is directed at the radiocarpal, the middle carpal, and the carpometacarpal joints. The leg is held with the knee in a flexed position to enable the shock waves to penetrate deep into the joint space. The pictures below demonstrate the ESWT technique for carpitis.



Post-treatment care recommendations

During recovery the limb should be kept cool by applying cooling alcohol gels daily. The horse should be stall rested for one to two weeks followed by paddock rest until no longer palpates sore.

Follow-up

The carpus should be palpated for soreness in 2 to 4 weeks.

Outcome

The result of ESWT on carpalis is very good to excellent in the absence of underlying joint disease.

Caveat, tips and tricks

Some horses may have normal radiographs, but will block sound in the carpus. These horses may have intercarpal ligament tears that may benefit from ESWT.

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Biography

Larry Metheney grew up working with animals in the rural community of Garden City, Kansas. After pursuing a degree in Veterinary Medicine from Kansas State University, he moved to Phoenix, Arizona. He has been a practitioner at Turf Paradise Racetrack in Phoenix for the past 26 years. Dr. Metheney is an active member of the American Association of Equine Practitioners and a long-time member of the Arizona Veterinary Medical Association where he served as the president of its central Arizona Board in 1989. Dr. Metheney currently acts as a spokesman and consultant for several animal health companies, assisting in the development of innovated products for the equine marketplace. In his personal time Dr. Metheney enjoys spending time with family, church, sailing, road-biking, and playing gourmet chef.