ORTHOPAEDIC RESEARCH CENTER

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Orthopaedic Bioengineering Laboratory

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Evaluation of Extracorporeal Shock Wave Therapy for Osteoarthritis

Take Home Message:

Extracorporeal shock wave therapy (ESWT) is an effective method of decreasing clinical signs of lameness associated with osteoarthritis; in this model ESWT performed better than intramuscular polysulfated glycosaminoglycans.

Introduction:

Lameness, and more specifically joint disease, causes significant loss of use of athletic horses and has a large economic impact on the horse industry. Despite numerous medical treatments, novel treatments are needed. Recent experimental evidence and anecdotal clinical impressions of extracorporeal shockwave therapy (ESWT) for the treatment of osteoarthritis (OA) have been reported[1-3]. Unpublished clinical studies in the dog have shown promising results, as have anecdotal reports of treating shoulder, pastern and coffin joint OA in horses. This information led to the completion of the current study comparing ESWT to Adequan and sham treatments in horses.

Materials and Methods:

This study was a blinded experimentally controlled randomized block design that utilized 24 horses in an established model of osteoarthritis (OA)[4]. On day 0 of the study, arthroscopic surgery was performed on both mid-carpal joints of all horses, and OA was induced in one of the mid-carpal joints. On day 14 horses were divided into 3 treatment groups: sham control, positive control or shockwave treated (Figure 1). The sham control group had bubble wrap applied to the probe end which absorbed all of the energy but were treated similar to the shockwave treated group in all other respects. The positive control group received intramuscular Adequan® administered every 4 days for 28 days. The shockwave treated horses received ESWT on days 14 and 28 using VersaTron (High Medical Technologies) 12mm probe (Figure 2). Specifically, the ESWT protocol was 2000 shock waves at the E4 energy level on study day 14 and 1500 shock waves at the E6 level on study day 28. The energy was delivered mainly to the intercarpal joint capsule attachment, but some energy was delivered to the area of fragmentation (≈20% of the shocks).

On day 14 the horses began a strenuous exercise regime 5 days per week for the remaining 8 weeks of the study. Synovial fluid and serum were assessed every other week for total protein concentration, white blood cell count (WBC) and levels of the inflammatory marker, prostaglandin E^2 (PGE^2). Additionally, biomarkers for aggrecan synthesis (CS-846), proteoglycan release (sGAG), type II collagen synthesis (CPII) and type I and II collagen degradation ($COL2\text{-}3/4C_{short}$), and bone synthesis (osteocalcin) were also estimated. Horses were assessed for lameness using the AAEP grading scale every 2 weeks. At the termination of the study, operated joints were evaluated grossly, and tissues were harvested for biochemical and routine histologic examinations.

Statistical analysis utilized both a Mixed model analysis of variance and discriminate analysis, with p values <0.05 considered significant.

Results:

Induction of OA resulted in a significant increase in lameness in the corresponding limbs. Significant improvement in clinical lameness (1.7 fold) was noted at the first evaluation time point post treatment (14 days) in the ESWT treated horses when compared to both the sham and positive control horses. This significant improvement was also noted for all subsequent evaluation periods (days 42, 56 & 70). No significant difference was noted between the sham and positive control horses when compared at similar time points. However, the positive control horses had significantly improved in lameness by day 70 compared to day 14, while the sham control horses had not.

Both the positive control and ESWT horses had significant improvement in synovial fluid total protein levels (up to 1.3 fold) within 14 days of treatment, indicating less synovitis as compared to the sham control horses. Improvement with Adequan® and ESWT treatment was also noted in the amount of glycosaminoglycan release into the bloodstream 14 days post treatment.

No significant differences were noted in gross or histologic examination of the tissue comparing any of the treatment groups.

Discussion:

The study presented utilized an established model of osteoarthritis that has been used to test various medical treatments for arthritis, such as intra-articular corticosteroids, intravenous hyaluronan, and intramuscular pentosan polysulfate. Furthermore, the induction of arthritis has been shown to result in clinical lameness, histologic and biochemical alterations. These changes are noted in both the soft tissue and in the articular cartilage. Treatment with ESWT reduced the clinical signs of pain measured by lameness evaluations even 42 days after the last treatment, the longest time point measured. There was however, no significant improvement in response to flexion of the carpus. This suggests that the improvement in lameness was not due to local desensitization of the region or more specifically the joint capsule. Concurrently a parameter of synovitis, synovial fluid total protein, was significantly reduced suggesting a possible mechanism for the treatment effect of ESWT. At the gross or histologic level improvement was not seen with either ESWT or Adequan® treatment and thus would not be considered chondroprotective in this model. These findings would suggest more of an effect on the soft tissues surrounding the joints as compared to the articular cartilage. Computer tomography and bone rate formation studies are being analyzed on these horses and may yield more information on mechanism by which ESWT improved the treated horses.

The results of this study suggest that ESWT is an effective method of reducing clinical lameness and synovitis but does not significantly improve gross or histologic progression of arthritis and therefore would be best considered in combination with a chondroprotective agent. Also further work evaluating ESWT in clinical case of joint disease is definitively warranted.

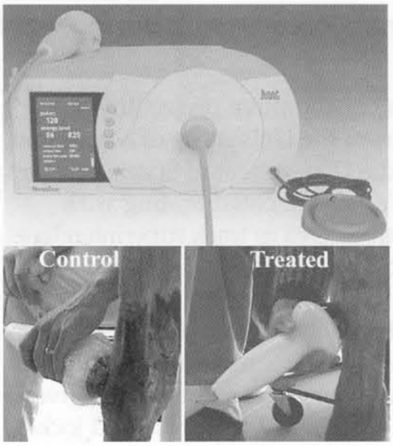

Figure 2 – High Medical Technology unit used in study. Photographs of bubble wrap on probe to block energy transfer (Sham Control) and treatment application at distal joint capsule attachment (Treated), one treatment location.

References:

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2. Scheuch B, Whitcomb MB, Galuppo L, et al. Clinical evaluation of high-energy extracorporeal shock waves on equine orthopedic injuries. 19th annual meeting of Am Assoc Equine Sports Med 2000;18-20.
3. McCarroll GD, Hague B, Smitherman S, et al. The use of extracorporeal shock wave lithotripsy for treatment of distal tarsal arthropathies of the horse. 18th meeting of Am Assoc Equine Sports Med 1999;40-41.
4. Frisbie DD, Kawcak CE, Trotter GW, et al. The effects of triamcinolone acetate on an in vivo equine osteochondral fragment exercise model. *Equine Veterinary Journal* 1997;29:349-359.

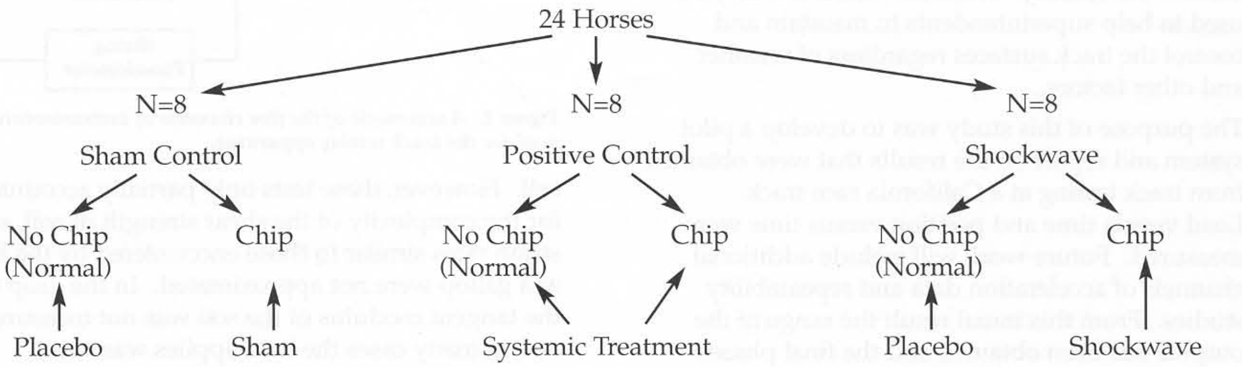

Figure 1 – Experimental design of the study. Overall horse numbers, treatment groups, and treatment applied to specific carpal joints are indicated.