High energy focused shock wave therapy accelerates bone healing. A blinded, prospective, randomized canine clinical trial


Take Home Message
Two sessions of high-energy shock wave therapy (SWT) applied immediately and two weeks after tibial plateau leveling osteotomy (TPLO) accelerate bone healing in patients undergoing TPLO.

Introduction
Delayed bone healing of naturally occurring fractures and osteotomies can lead to patient morbidity, revision procedures, and decreased patient function.\(^1\)\(^2\) Cranial cruciate ligament disease (CCLD), one of the most common causes of hind limb lameness in canine patients, is frequently treated by tibial plateau leveling osteotomy (TPLO).\(^3\)\(^-\)\(^8\) TPLO requires creation of an osteotomy (for more info about the procedure please refer to http://csu-cvmbs.colostate.edu/vth/small-animal/sports-medicine-rehabilitation/Pages/canine-cruciate-ligament-injury.aspx#treatmentsurgical) Complications associated with the creation of an osteotomy include delayed unions, malunions, and implant failure.\(^8\)\(^-\)\(^10\) Strategies to avoid such complications related to bone healing are continually being evaluated. The TPLO provides a relatively standardized procedure allowing the study of the efficacy of therapies intended to promote bone healing in a clinical setting.

Shock wave therapy (SWT) has been utilized for many indications in dogs including tendinopathies, pain control, arthritis management and bone healing.\(^11\)\(^-\)\(^16\) SWT has been shown to stimulate bone healing in dogs, horses, and humans.\(^11\)\(^,\)\(^12\)\(^,\)\(^17\)\(^-\)\(^23\) Canine specific literature includes only four studies showing limited support for the use of SWT for bone healing in dogs.\(^11\)\(^,\)\(^12\)\(^,\)\(^22\) Hastening of bone healing after TPLO would be beneficial to the individual patient to potentially decrease osteotomy complications and to shorten the convalescent period allowing earlier return to optimal function. Furthermore, TPLO can be viewed as a model to answer the broader question of whether SWT has a positive effect on bone healing. To the authors’ knowledge, no study has objectively evaluated the effect of SWT on acute bone healing in canine clinical patients.

The aim of this study was to evaluate if SWT promotes acute bone healing in dogs undergoing TPLO for naturally occurring CCLD. We hypothesized that SWT would result in greater radiographic healing scores at 8 weeks post-operatively when compared to SHAM treatment.

Methods
This study was designed as a randomized, blinded (for radiographic evaluation), prospective clinical study of client-owned dogs presenting for surgical treatment of naturally occurring CCLD. If owners elected to pursue TPLO, they were offered the option to enroll in this study. Healthy dogs between 2-9 years of age who were randomly assigned to receive either SWT or sham treatment (SHAM).
SWT was applied with a VersaTron 4Paws device (PulseVet Technologies, Alpharetta, GA) immediately post-operatively and at the time of suture removal (approximately 2 weeks post-operatively). The first SWT treatment was applied under general anesthesia and the second SWT treatment was applied under sedation. A total of 1,000 shocks at (setting: E6; pulse/min: 360) were applied at each treatment along the osteotomy site identified by palpation of the plate and review of the radiographs. Care was taken to avoid application of shocks over the bone plate; 500 shocks were applied from the caudomedial aspect using the 5mm trode and, then, 500 shocks were applied from craniolateral aspect using the 20mm focal spot trode, both at the E6 setting. The incision site was covered with an adhesive dressing to maintain sterility and acoustic transmission gel was applied directly to the treatment head. The treatment heads were slowly moved while applying the treatment (approximate treatment area 5-8cm). Sham treatment was performed as described above, but the SWT device was not activated.

Three blinded radiologists evaluated orthogonal radiographs performed at 8 weeks post-operatively with both a 5-point and a 10-point bone healing scale. Linear regression analysis was used to compare median healing scores between groups.

Results

Forty-two dogs (50 stifles) were included in the statistical analysis. No major complications were observed and all osteotomies healed uneventfully. The median healing scores were significantly higher 8 weeks post-operatively for the SWT group compared to the SHAM group for the 10-point (P < 0.0002) and 5-point scoring systems (P < 0.0001).

Conclusions

This is the first study evaluating the effect of SWT on acute bone healing in a larger population of clinical canine patients after routine TPLO. In the described study population, two sessions of electro-hydraulic SWT significantly increased radiographic bone healing scores at 8 weeks post-operatively. These results strengthen the available literature and support the use of SWT for promotion of acute bone healing in dogs. Additional studies are needed to evaluate its use for acceleration of bone healing following fracture, or with delayed union.

The ideal dosing frequency and optimal energy density to enhance fracture healing with SWT, however, remains unknown and a wide variety of protocols have been used in the literature. We selected our treatment protocol based upon the available literature, cost associated with treatment, and client convenience. It is unknown which of the 2 treatments produced the beneficial effects in our study. We selected a fairly low number of shocks compared to previous reports, as clients are charged per shock and hence treatment cost rises with the number of shocks applied, and we wanted to mimic a true clinical application of SWT. The amount of shocks applied in this study is likely on the low end of the beneficial spectrum, especially given that we used a non-coupled device.

Acknowledgements

This study was funded by PulseVet Technologies.

References


