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Case Report
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Ultrasonic debridement with stem cell therapy of suspensory branch desmitis in an equine patient

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Abstract
Ultrasonic debridement as a treatment for tendinopathy and desmitis is a relatively new approach in orthopedic surgery. Previously only used in limited cases, this procedure shows promise for treating ligament-bone and tendon-bone interface injuries. We present a case study of a 2-yr-old thoroughbred male horse, unable to train due to recalcitrant symptoms after extensive conservative management of suspensory branch desmitis. It was then treated with ultrasonic debridement and concurrent manubrial stem cell autograft injection, to treat the ultrasound visualized lesion. Post-surgically, the patient recovered quickly, began training within 16 wk, and went onto win several races. Repeat ultrasound imaging reveals a complete restoration of the internal fiber architecture of the ligament. With a 3-yr follow-up, there has been consistent training and race performance with no re-injury. This study is the first to document the successful outcome of ultrasonic debridement with concurrent stem cell injection in the treatment of equine desmitis.
Keywords: Desmitis, Equine, Orthopedics, Suspensory branch ligament, Ultrasonic debridement.

Introduction

Tendinopathy and desmitis are debilitating pathologies that can severely impact the lives of those affected. In human patients, these diseases result in limited mobility and painful movement. In horses, the detriment of limited mobility can lead to lameness and can mean the end of a racing career, even before it begins. In equine health, almost 10% of 2-yr-old thoroughbred racehorses in a study consisting of 896 horses were affected by suspensory branch desmitis (SBD) (Plevin and McLellan, 2014). SBD in thoroughbreds in training led to a 3.2 times lesser likelihood of starting as a 2-yr-old and 3.6 times less as a 3-yr-old (Plevin and McLellan, 2014). Fifty-eight affected cases from the same study were compared to their maternal siblings and significant difference was found in the earnings per start as a 2-yr-old ($2,068.19 *vs* 2,183.01, $p < 0.001$) and as a 3-yr-old ($2,267.44 *vs* $4,605.93, $p < 0.01$). As we can see, there is a definite effect of SBD on racehorse performance.

Desmitis is characterized as inflammation of a ligament due to an elastic injury from physical activity. Diagnosis of this condition is usually made with an ultrasound scan by searching for hypoechoic (darkened) bands surrounding the bone interfaces (Xie *et al*., 2011; Plevin and McLellan, 2014). These darkened bands represent injured irregular fibers. In horses, specifically, SBD is a condition that affects the suspensory branch ligaments (SBL) and extensor branches proximal to the sesamoid bones. Symptoms include edema, fibrosis, heat, distension of the joint capsules, and pain (Plevin and McLellan, 2014). SBD is a serious issue and if not treated properly can lead to lameness.

Currently, there are only limited treatments for SBD. Previously, treatment of these conditions both in humans and horses has been limited to rest, medication, and injections (Andres and Murrell, 2008). Ultrasonic debridement as a treatment for tendinopathy and desmitis is relatively new to orthopedic surgery. In the past few years, it has been piloted in the treatment of a few limited pathologies, including patellar tendinopathy (Nanos and Malanga, 2015), diabetic foot ulcers and osteomyelitis (Amini *et al*., 2013; Michailidis *et al*., 2014), jumper's knee (Elattrache and Morrey, 2013), and chronic elbow tendinosis (Seng *et al*., 2016). Ultrasonic debridement has the advantage of excising non-structural debris, thereby allowing regenerative cells to populate the newly cleared space (Kamineni *et al*., 2015). The same study also showed that the collagen isomer profile present at the injury site returns to normal following the procedure. Risk of infection is low with this procedure with the following parameters: increasing amplitude of ultrasonic waves, increasing saline irrigation, increasing suction, and minimizing wound area (Michailidis *et al*., 2016).

Through the presentation of this case, we aim to show that ultrasonic debridement can be a viable treatment for SBD and desmitis overall. To our knowledge, this is the first study to publish evidence of ultrasonic debridement in the treatment of desmitis.

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Case Details

A 2-yr-old thoroughbred male horse presented with medial branch suspensory desmitis. There was also associated diseased bone at the ligament bone interface on the proximal aspect of the medial sesamoid bone in the right hind leg. The patient had been unable to participate in normal training; diagnosis was done using ultrasound and X-ray scans (Figs. 1 and 2). Since all conservative treatment modalities had been unsuccessful, ultrasonic debridement was chosen as the course of treatment.

The patient was sedated and placed under general anesthesia in right lateral recumbency and closely monitored. The incision site for the ultrasonic probe entry point was marked and then the limb was prepared with alcohol and betadine. The operative area was then draped, isolating the fetlock joint of the hind right limb. No local anesthetic was used. A 5 mm incision was made superior to the fetlock joint and distal to the carpus. The probe was introduced and positioned at the site of the lesion, using ultrasound guidance, and ultrasonic debridement was then conducted with live ultrasound monitoring (Fig. 3). The ultrasonic debridement was with the Tenex™ ultrasonic probe. Tissue debrided until major hypoechoic regions were thoroughly debrided (Fig. 4). Total cutting time during the operation was less than 4 min. Once the lesion was debrided, it was injected with the previously collected and centrifuged manubrial stem cell autograft (Fig. 5).

Fig. 1. Pre-operative X-ray scan of the medial sesamoid bone (arrow shows the site of injury).

The entry portal was dressed using steri-strips and a circumferential compression wrap.

During recovery, the patient was managed with a regular course of broad-spectrum antibiotics and rest. The patient began training at 16 wk post-surgery and the total time elapsed from surgery to first race was 15 mo. Follow-up study, including a repeat set of scans, conducted 20 wk post-surgery, demonstrates the removal of the underlying bony prominence and reconstitution of the collagen fiber structure without hypoechoic regions (Figs. 6 and 7). In addition, the

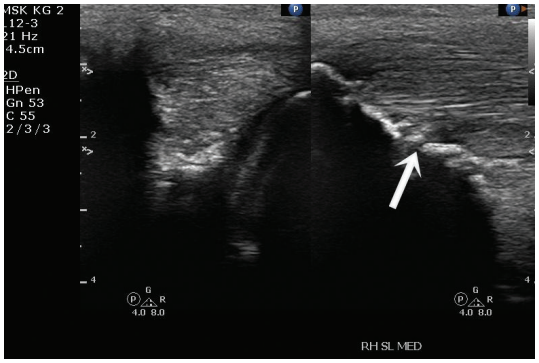

Fig. 2. Pre-operative ultrasound of the SBL ligament-bone interface (arrow points toward the darkened site of injury).

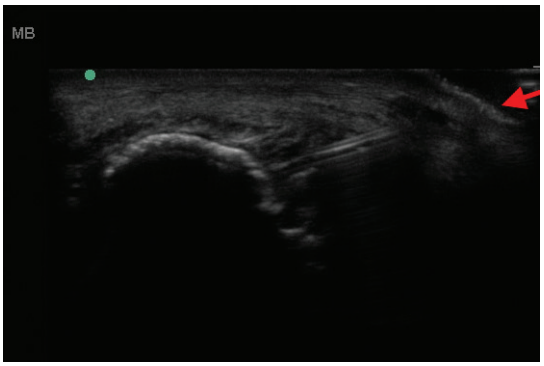

Fig. 3. Debridement probe localized within the lesion with ultrasound guidance.

Fig. 4. Debridement of the lesion with an ultrasonic probe.

Fig. 5. Aspiration of manubrial stem cells.

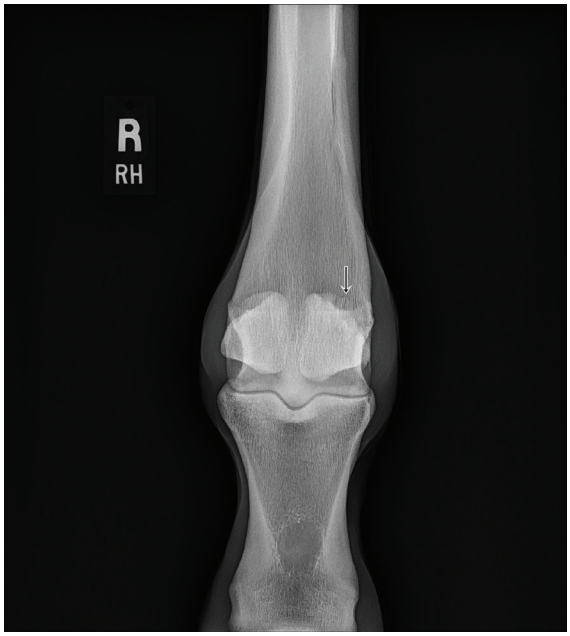

Fig. 6. Post-operative (20 wk) X-ray scan of the medial sesamoid bone (arrow points to SBL).

wound site had healed well with no signs of infection. No complications were observed.

Discussion

Numerous surgical and nonsurgical techniques have been reported to treat SBD. In the hind limb, SBD usually has a worse prognosis than in the forelimb. While rest and rehabilitation are usually good enough to resolve lameness in 90% of horses with minor SBD in the forelimb, it is much less promising for hindlimb recovery (Dyson, 2000). Medication including corticosteroids, hyaluronan, and glycosaminoglycans can be used in mild chronic cases but have limited efficacy for more severe cases (Smith, 2008). Shockwave therapy, bone marrow/stem cell infusion,

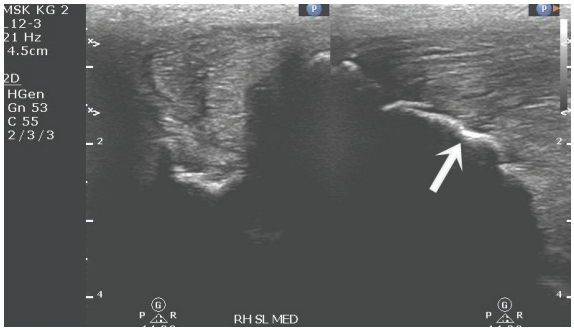

Fig. 7. Post-operative (20 wk) ultrasound scan of the SBL ligament-bone interface (arrow points to healed injury site).

desmoplasty, urinary bladder matrix scaffolds, and fasciotomy/neurectomy have all had varying levels of success in treating SBD (White and Hewes, 2008). In a study by Crowe *et al*. (2002), shockwave therapy for hind leg desmitis had variable results in which ~20% of severe cases were doing reduced work and ~50% were considered lame/retired. In the same study, ~10% of mild cases were doing reduced work and ~20% were lame/retired (Crowe *et al*., 2002). A later study by the same group found that 41% of hindlimb desmitis cases returned to full work 6 mo after undergoing radial pressure wave therapy, whereas 53% of forelimb cases returned to full work (Crowe *et al*., 2004). In a study by Herthel (2001), 100 horses with SBD were administered intralesional autologous bone marrow transplants. Eighty-four of them resolved lameness and returned to full work. In a study by Dyson and Murray (2012), 155 horses were treated for proximal suspensory desmitis (PSD) with plantar fasciotomy and neurectomy of the deep branch plantar nerve. In the group where PSD was the only diagnosis, 78% of cases returned to full work 1 yr postoperatively (Dyson and Murray, 2012). In a study by Mitchell (qtd. in Dyson and Murray, 2012), urinary bladder matrix scaffoldings were used to treat SBD in the hind limb with an 84% success rate. A study by Hewes and White (2006) reported an 87% rate of return to full work after being treated with desmoplasty to the PSD. Overall, these results show that surgical interventions that instigate healing have a higher efficacy rate than other methods of treatment.

Our approach used a combination of manubrial stem cell autograft and surgical debridement to treat SBD. His lameness has resolved post-operatively and is back in training. Post-operative success was measured by observing the thoroughbred's performance on the racetrack and through radiologic examination. Twenty-wk follow-up ultrasound scan showed that the darkened bands attributed to desmitis have been significantly reduced. As of April 2018, he has made 26 starts and in those starts he has had five first place wins, five second places, and two third places. Broken down by year: 2016, six starts, one first, one second, and one

third; 2017, 15 starts, two firsts, four seconds, and one third; 2018, one start and one first. He has won a total of $92,664 in prize money with an average of $3,564 per start. Compared to the average earnings of $21,340 of his paternal siblings, offspring of his sire, the horse has performed well above average. He does not appear to have had any significant time off with the longest interval of time off being close to 2 mo. This suggests no evidence of re-injury. Overall, it has been able to compete with other racehorses successfully.

Results reflect the successful use of ultrasonic debridement in this case of SBD. We are confident that ultrasonic debridement has great potential in the future for the treatment of desmitis. At this time, we are continuing to treat other equine patients and are seeing similar success.

Conflict of interest

The authors declare that there is no conflict of interest.

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