Muscle strain injuries in racehorses

The term 'pulled muscle' has an innocuous sound to it that does not reflect just how debilitating and painful this athletic injury can be. Muscle strain injuries are among the most common traumas seen in human sports medicine yet the incidence in racehorses and role in lameness and poor performance is, one suspects, under-recognised, due mainly to the inability of the horse to speak and the location of some injuries buried under tens of kilos of flesh beyond the reach of human touch or vision.

Research into these injuries in horses is scant, however there is much to glean from human sports medicine. A greater appreciation of muscle strain injuries is important, as even minor impairment to locomotor muscle function can impede power output, coordination, stamina, willingness to train, and ultimately athletic performance on the racecourse.

ROB PILSWORTH

Acute strain of the transversus abdominis and external oblique muscles (abdominals) in a racehorse

MECHANISMS OF INJURY

Sports requiring high speeds or rapid acceleration and deceleration such as football are a common setting for muscle strains in humans (see panel). Equine muscles are especially tested in heavy going, when jumping out of the stalls, or pulling up suddenly after fast work. Muscles are most frequently injured when contracting eccentrically (lengthening under tension) as they apply the brakes on the body and/or its parts. Eccentric contraction generates higher forces than concentric (shortening), which explains why our legs hurt more hiking down a mountain than up. Injury usually occurs due to inadequate strength and conditioning, or inaccurate timing, not from lack of flexibility.

Acute injuries typically result from a single traumatic event, while the more common chronic (overuse) or exercise-induced injuries come about from repetitive micro-trauma over time when forces exceed the tensile capacity of tissue. Muscle strains are graded according to the proportion of muscle fibre disruption, which reflects the severity of injury. One prominent grading system is the British athletics muscle injury classification (see panel).

CLINICAL PRESENTATION

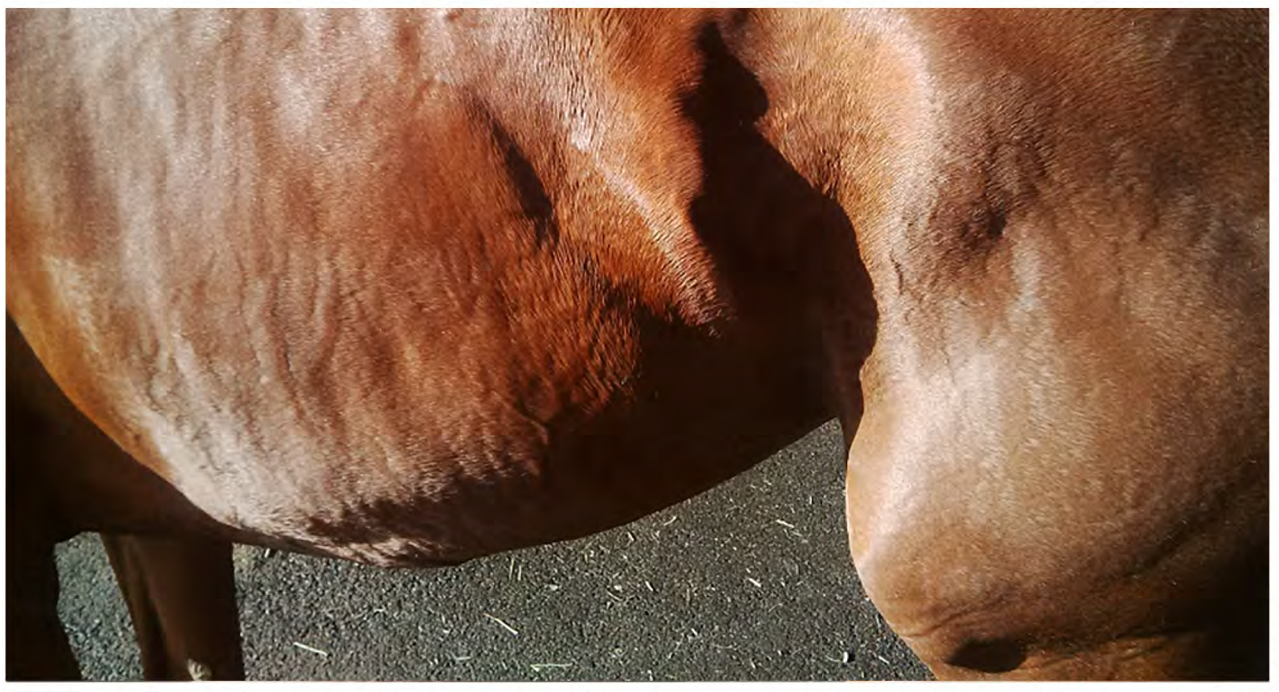
In racehorses, muscle strain injuries are mostly seen in the gluteals, hamstrings, and adductors (inner thigh) in hindquarters; the biceps and pectorals in forelimbs; and in lumbar muscles and abdominals. Classic signs of inflammation may be observable in acute cases – swelling, heat, and pain reactions. Sometimes there is spasm, fasciculation (twitching), and palpable defects. Muscle atrophy (wastage) can be alarmingly quick, appearing within days. Signs of muscle strain range from subtle underperformance, to severe lameness depending on the grade of injury.

The action is often stiff, and stride shortened – particularly obvious at walk (Figure 2). Acute presentation in the back and hindquarters can mimic signs of rhabdomyolysis (tying up); however a blood test for the muscle enzyme creatinine kinase (CK) can quickly separate the two conditions. Most muscle strains do not produce the massive increases in CK observed in rhabdomyolysis. In chronic muscle strains signs may include persistent gait abnormalities, muscle atrophy, and palpable defects – lumps, dreadlock-style clumps, divots, and taut bands like guitar strings.

DIAGNOSIS AND IMAGING

The history holds many clues about the injury. Physical examination focuses on gait assessment, muscle symmetry, and palpation. Ultrasonography can be useful for detecting haemorrhage, swelling, and fibre disruption, using the contralateral leg for comparison (Figures 1 and 2). It is also a valuable tool for monitoring healing, and for visualising tendinous avulsion of muscle at its bony attachment.

Plain radiographs may be useful for identifying bony changes at attachment sites of muscles and may show areas of soft tissue swelling associated with a



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Acute strain of the tensor fascia lata and biceps femoris muscles (lateral thigh muscles) in a racehorse. Note the effect of gravity on oedema

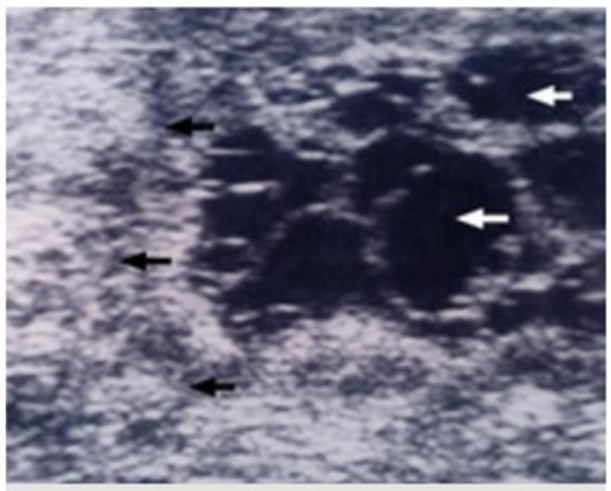

Figure 1 *This ultrasound image is from an Australian study the author was involved in (Walmsley and colleagues, AVJ, 2010). It was obtained four days after an injury to the gracilis muscle (inner thigh) and shows a large multiloculated, fluid filled cavity and fibre disruption consistent with recent haematoma (white arrows). The black arrows point to the border of the torn muscle. The horse successfully returned to racing ten weeks later and had a long career. Proximal is to the left*

strain, but often appear normal. Magnetic resonance imaging, while useful in humans (see panel), is mostly limited to the distal limb in horses and therefore not applicable for investigating muscle strains since muscle fibres stop at the knee and hock. Computerised tomography is all but limited to the head and neck in adult horses, and bone scans, while sensitive, do not show detailed architecture of the injury. This is best seen with diagnostic ultrasound, which despite limitations (see panel) is the veterinary profession's modality of choice for soft tissue injuries and the most cost-effective option.

PHYSIOLOGY OF HEALING

Following muscle damage, regeneration occurs over three phases, starting with

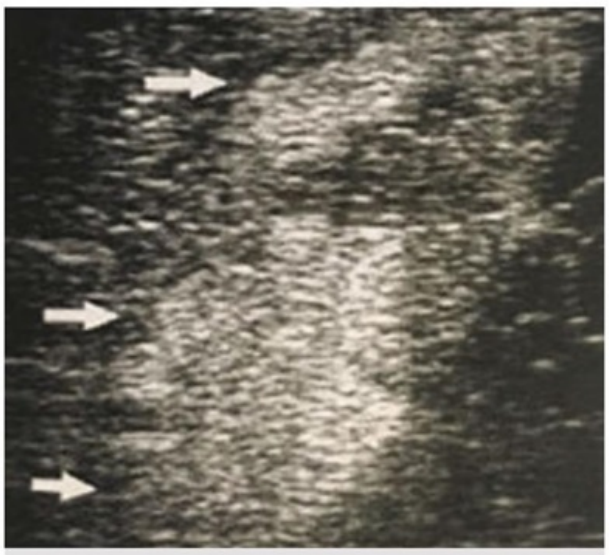

Figure 2 *This ultrasound image is from an Australian study the author was involved in (Walmsley and colleagues, AVJ, 2010). It shows a chronic partial tear of the left semitendinosus (part of the hamstrings) of a racehorse with a one-month history of hindlimb lameness of variable severity after fast work. Well defined echogenic areas are evident (arrows) indicating early fibrosis. Normal fibre pattern has been lost in much of the surrounding muscle. The horse successfully returned to racing after ten months, although at one year post-injury the trainer reported a slightly shortened cranial phase of stride. Lateral is to the left*

a destruction phase and inflammatory response. The repair phase follows with activation and proliferation of satellite cells (muscle stem cells) capable of both hyperplasia (forming new muscle fibres) and fusing with damaged muscle fibres. Finally, a remodelling phase involves maturation of regenerated muscle fibres. When immature muscle fibres are forming between healthy parallel fibres, the load and direction of pull have an important influence on their alignment. In significant injuries involving the fascia that encapsulates muscle (white sheets of tissue as seen in steak), repair mostly occurs via fibrosis (Figure 2). It becomes the weakest point of the affected muscle in the first ten days, but subsequently adjacent muscle tissue is weaker. Both fibrosis and adhesions (tissues stuck together) have a higher risk of re-tearing, especially around their peripheries.

FIRST AID

Initial management in the first 48-72 hours focuses on minimising bleeding within the muscle, hence box rest is so important, along with cryotherapy (e.g. hourly cold hosing or 10-15 minutes of ice). Under no circumstances should you rub, heat, stretch, stimulate or magnetise a fresh muscle injury; and although it is tempting to dust off that archaic therapeutic ultrasound machine, neither serviced nor calibrated since its manufacture decades ago, be warned.

Electrical safety aside, you risk quite literally cooking the horse. In untrained hands at inappropriate doses, these machines can cause thermal damage to biological tissues, resulting in increased inelastic scar tissue. Vets may prescribe phenylbutazone, although judiciously so, because inflammation is essential for healing; a factor that needs careful balancing with the welfare issue of pain relief.

REHABILITATION – *Movement*

An appropriate regimen of movement is the best medicine for healing muscle, initiated once intramuscular bleeding has stopped. Early mobilisation stimulates capillary formation in the centre of the injured area, essential for recovery. Nerves will also regenerate inside the muscle. Movement protects against muscle atrophy, loss of strength, and ››

excessive scar tissue formation.

For racehorses, the first step is in-hand walking or cage turnout, monitored closely for signs of pain. Care must be taken as an over-vigorous, hasty approach risks disruption and delay to the repair process, while prolonged box rest can lead to bulky, disorganised scar tissue and general deconditioning.

Horses cannot perform isolated movements, such as bicep curls, which is why neuromuscular electrical stimulation is helpful initially, by facilitating individual muscles to fire and increase in size and strength. Thereafter, functional activities form the basis of rehabilitation such as walking in hand, on a walker, or treadmill; graduated ridden work; use of gradients and/or poles; and hydrotherapy (e.g. swimming or the sea walker).

Time required to heal

Usually muscle strains take 6-12 weeks to fully heal, but severe injuries can grumble away for 12 months. The notion that you can speed up healing is false. However, optimisation of healing is achievable – by correct management and adequate rehabilitation, which avoids setbacks and ultimately produces the best outcome, for both the affected part and the whole horse. Failed treatment has been shown to delay return to play in sportsmen and women by weeks or months and predispose to re-injury.

To stretch or not to stretch?

In my 25 years as a physiotherapist, as the profession has evolved in line with scientific evidence, I have witnessed a big shift away from machines, increased emphasis on exercise rehabilitation, and a complete rethinking of stretching. Physiotherapy for muscle strains typically involves advice on injury management,

Human muscle injuries in elite sport

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Muscle injuries in sport are extremely common. Accurate injury data is only available in select sports, however. Professional football has the most comprehensive injury data published. The UEFA elite study between 2001 - 2009 by Ekstrand and colleagues (AJSM, 2011) included data from 54 elite football clubs. Muscle injuries comprised 31% of all injuries. Of the muscle injuries identified, 92% occurred within the lower limb. Hamstring injuries at 37% were the most common, with 23% seen in adductors, 19% in quadriceps and 13% in the calf. Sixteen per cent were reinjuries and these had a 30% longer layoff.

Types of injury

Generally speaking muscle injuries are divided into injuries of the muscle body itself or avulsion injuries of the enthesis, i.e. where a muscle joins to a bone (via a tendon). Muscle body injuries are more commonly seen in an explosive power situation (e.g. sprinting). Avulsion injuries are more commonly seen in a sudden or excessive stretch.

Imaging

Although ultrasound is often more readily available, it is generally not the best modality for assessing muscle injuries. When using ultrasound it can be difficult to reliably assess muscle oedema and loss of tension of the tendon. Ultrasound is however useful for assessing cross sectional area of tendon involvement and for a haematoma or seroma (pocket of fluid). It is also invaluable for guiding aspiration procedures.

Magnetic Resonance Imaging (MRI) is more reliable for assessing muscle injury. Using MRI it is possible to correlate the severity of hamstring muscle injuries with return to play in professional football (Ekstrand and colleagues, BJSM, 2012). More recently, the British athletics muscle injury classification system (Pollock and co-workers, BJSM,2014) has confirmed the importance of tendon involvement with muscle tear. Any muscle injury will have a longer recovery time if there is involvement of the tendon additionally.

Interventions

Numerous interventions have been used in an attempt to improve outcomes in acute hamstring injuries. These have included manipulation of the sacroiliac joint, slump stretching (mobilisation of nerves), Actovegin (an injectable biological drug), injection therapy (cortisone and platelet-rich plasma (PRP)), stretching exercises, anti-inflammatory agents, agility and trunk stabilisation, and resistance exercises.

In a systematic review by Pas and colleagues (BJSM, 2015) a meta-analysis of lengthening and loading rehabilitative exercises in acute hamstring injuries showed a positive effect on return to play. Progressive agility and trunk stabilisation may also reduce injury rates. PRP is used on occasions in such injuries, particularly when they involve the tendon. Results of PRP have been variable but some studies have shown benefit. Historically, surgery has been little used in hamstring injuries, but it is becoming more common, particularly with avulsion injuries (Haddad, Bone Joint J, 2020).

Prevention

Clearly prevention is better than treating an injury once it has occurred. Much work is currently being done on injury prevention. One such example is the FIFA 11+ prevention programme, which has been specifically designed to prevent football injuries. It consists of 15 exercises, takes 20 minutes to complete, and is designed to be performed twice a week. No specific equipment is needed, and it has been shown to reduce injury by 30% (Sadigursky and colleagues, BMC Sports Science, 2017).

Summary

Muscle injuries in sport are common and within professional football are the most common injuries seen. In football, hamstrings are the most commonly injured muscles. MRI scanning is the most reliable method of assessing such injuries and can be used to predict duration of injury prior to return to sport. More information is needed on treatment and treatment protocols for muscle injuries. Surgery has had a relatively limited role although is increasingly used for the avulsion type of injury in particular. There is great interest in injury prevention programmes.

exercise prescription, manual therapy to discourage adhesion formation, and gentle passive stretching to regain normal length and encourage hypertrophy (increase in size). Passive or static stretching, which involves lengthening relaxed muscle to its limit and holding it (usually 30 seconds), is best performed after exercise when tissues are warm and pliable.

However, routinely stretching a horse's limbs for injury prevention is not supported by scientific evidence. Recent studies in human sports medicine have found detrimental effects of stretching on performance and no reduction in risk of injury. When performed before exercise, stretching can make muscles weaker and slower due to a reaction in the nervous system, adversely affecting gait. Decreases in explosive performance can last up to 24 hours post stretching. Too much flexibility may have a negative impact on the elastic recoil capability of equine muscle essential for energy efficient locomotion. Except for sports-specific preparation requiring extreme range of motion (e.g. gymnastics), the ritual of static stretching before exercise is more of a habit based on tradition, not science. Time is better spent warming up – involving aerobic movements and dynamic stretching, which uses the athlete's own sports-specific movements inside of normal range to induce a stretch.

PREVENTION – *Warm-up*

Human athletes are increasingly shifting away from static stretching based warm-ups towards more dynamic injury prevention programmes, of which the FIFA 11+ is an excellent example (see panel). As well as dynamic stretching, it incorporates running, strengthening, and sprinting drills. Despite football (being very stop-start with rapid changes in direction) having different demands to horseracing, which mainly involves running fast in straight lines, around bends, and sometimes jumping over obstacles, the ethos of the FIFA 11+ is nonetheless applicable to racing. Gradual progression through walk, trot, and canter for at least 20 minutes before fast work or racing is a sensible foundation for warm-up, as is the use of poles and small schooling hurdles for National Hunt racehorses.

Addressing risk factors

Prevention strategies for muscle injuries are best devised by addressing the causes. Inadequate warm-up, cold temperatures, insufficient strength, poorly timed contraction, fatigue, and incomplete recovery from previous injury are proven factors associated with muscle strain injuries in humans. Likely risk factors in the racehorse also include continued training in the face of low-grade lameness and insufficient training for the task.

CONCLUSION

The prognosis of even severe muscle strain injuries in horses is generally very good thanks to the resilience and responsiveness of muscle. However, as guardians of these animals we have much influence over the quality of muscle healing and a duty of care to ensure it is optimal. Until there is more research into this common athletic injury in racehorses, much can be learned from human experience to guide its management.