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The two asymmetric, pyramidal shaped proximal sesamoid bones are embedded within a fibrocartilagenous scutum. They are intercalated, in the suspensory apparatus between the elastic suspensory ligament proximally and inelastic distal sesamoidean ligaments distally (Buckowiecki et al, 1985). As a unit, the suspensory apparatus functions to resist hyperextension of the metacarpophalangeal/metatarsophalangeal joints, to store loading energy and to return this, in part, to the limb in the caudal weight bearing phase of the stride (Buckowiecki et al, 1987). The proximal sesamoid bones transfer the dynamic resistance to extension of the metacarpophalangeal/metatarsophalangeal joints, which is generated by the suspensory ligament, around the palmar/plantar angle of the joint. All fractures of the proximal sesamoid bones must therefore be considered in light of the degree of compromise of the suspensory apparatus that their discontinuity creates and, where appropriate, the severity of the articular deficit that also results. The proximal sesamoid bones are subject to complicated loading patterns with tension forces exerted by the suspensory apparatus and compressive forces by the metacarpal/metatarsal condyles (Young et al, 1991; Thompson and Cheung, 1994). Thus, compressive forces are dominant on the dorsal (articular side) and tensile forces on the palmar/plantar sides of the bones. Stress adaptive remodelling of the proximal sesamoid bones in response to training has been demonstrated experimentally (Young et al, 1991). Most proximal sesamoid bone fractures are thought to occur when the joint is maximally extended so that both tensile and compressive/bending forces peak at this time. No evidence of previous fatigue fractures have been found in affected bones (Kristofferson et al, 2009). Some, commonly open, abaxial fractures can be caused by external trauma. Numerous predisposing factors have been suggested supported by data of varying quality. Fractures of the proximal sesamoid bones are most common in Standardbreds although they occur frequently in racing Thoroughbreds, Quarter horses, jumpers and other breeds. In Standardbreds hindlimbs are most frequently involved while in Thoroughbreds these are common in both fore and hindlimbs (Buckowiecki et al, 1995). In Thoroughbred racehorses, fractures of the proximal sesamoid bones are the principal cause of catastrophic suspensory apparatus failure (Bowman et al, 1984; Johnson et al, 1994; Estberg et al, 1996).

In addition to the standard terms of fracture description, fractures of the proximal sesamoid bones are classified according to their location in the bone (Schneider, 1979; Fretz et al, 1984; Buckowiecki et al, 1985; Bertone, 1996 & 2002). Fractures involving the proximal quarter of the bone are defined as apical, fractures involving the middle 50% of the bone as mid body, fractures involving the distal quarter of the bone as basilar. Additionally, fractures are defined as apical-abaxial, abaxial and as axial/sagittal.

Fractures of the proximal sesamoid bones are common injuries in foals up to two months of age. Fore and hindlimbs can be affected and fractures can be uniaxial or biaxial and affect single or multiple limbs. As the bones are not fully mineralised until three months of age radiographs will frequently either underestimate or fail to identify fracture damage (Butler et
A wide variety of fracture configurations can result and lameness is variable in degree. Juvenile fractures can heal, even when markedly displaced, without interference. Distorted, frequently proximodistally elongated bones result (Fig. 1). These generally are considered negative prognostic features with respect to racing potential.

The most common fractures of the proximal sesamoid bones in both Standardbreds and Thoroughbreds are apical (Spurlock and Gabel, 1983; Ruggles and Gabel, 1998; Schnabel et al, 2006). They occur most often in the hindlimbs of Standardbred horses and in the forelimbs of Thoroughbreds (Spurlock and Gabel, 1983; Fretz et al, 1984). They are almost always articular and removal generally is advocated in order to optimise the horse’s potential to return to athletic performance (Bertone, 1996 and 2002; Ruggles and Gabel, 1998; Richardson, 1999; Nixon, 2006). Arthroscopic removal is now universally adopted (McIlwraith et al, 2005). The prognosis for hindlimb fractures appears significantly better than that for forelimbs (Schnabel et al, 2007).

Apical-abaxial fractures involve the apical quadrant and a variable portion of the abaxial margin of the proximal sesamoid bone. These fractures are articular and may be simple but, more commonly, are comminuted. The amount of suspensory ligament insertion disarmed by the fracture is determined by the length of the abaxial arm and the dorsopalmar/plantar depth of the fragment(s). These are most common in the forelimbs and most involve the medial proximal sesamoid bone (Southwood et al, 1998). Managed conservatively, functional healing of apical-abaxial fractures is poor. Fragment distraction is common and persistent lameness results. Occasionally, simple fractures are of sufficient size that reconstruction and internal fixation is appropriate (Fig. 2) but the majority of apical-abaxial fractures, including all comminuted fractures are optimally treated by arthroscopic removal of the fragments. These carry a reasonable prognosis for return of athletic function (Southwood et al, 1998).

Abaxial fractures generally are regarded as avulsions of the suspensory ligament (Ruggles and Gabel, 1998; Richardson, 1999) but this may be an oversimplification. Such fractures can be articular (Fig. 3) or non-articular but all will have some degree of disruption of the associated suspensory ligament branch. Medial proximal sesamoid bones in the forelimbs are most commonly affected (Southwood et al,
Non-articular fractures may be allowed to heal by fibrous union (Bertone, 2002) but in the author’s experience this largely has been unsuccessful. Reconstruction of large abaxial fractures is indicated both to restore the articular surface and to conserve suspensory ligament insertion while in the author’s hands, removal of smaller fragments is preferred to conservative management.

Mid body fractures are primarily racehorse injuries. They can be transverse (horizontal) or oblique. Proximodistal displacement can occur symmetrically or with rotation to produce greater dorsal (articular), palmar/plantar or abaxial fracture gaps. Comminuted fragments also can be found in or adjacent to the principal fracture. Uniaxial fractures involve most commonly the medial proximal sesamoid bones and forelimbs are much more commonly affected than hind (Busschers et al, 2008). Without surgical repair fragment distraction frequently is marked and the resulting fibrous or fibro-osseous union athletically debilitating. There are two principal techniques for repair: lag screw fixation (Fig. 4) and transfixation/hemicircumferential wire. The former currently is the technique of choice using a minimally invasive approach under radiographic and arthroscopic guidance (Busschers et al, 2008).

Biaxial mid body and/or comminuted fractures cause acute, severe lameness and almost invariably occur in forelimbs only. The adjacent palmar neurovascular bundles can be lacerated by fracture fragments or stretched to a point of irreversible damage, as the metacarpophalangeal joint hyperextends. Application of emergency support is essential if the animal’s life is to be saved and ankylosis of the metacarpophalangeal is necessary for humane preservation of life.

Basilar fractures are much less common than their apical counterparts. A wide range of fracture configurations are encountered including small dorsal (articular) chip fractures, transverse articular fractures that involve the whole distal margin of the bone and non-articular palmar/plantar fragments. Comminution of complete basal sesamoid fractures is common and frequently underestimated by radiography. The degree of compromise of the distal sesamoidean ligaments is determined by the width and dorsopalmar/plantar depth of the fracture. Large fragments which disrupt significant portions of the origins of the distal sesamoidean ligaments are ideally repaired with distal to proximal lag screw fixation.
while arthroscopic removal of articular fragments usually is the treatment of choice (Fig. 5). Until recently, the majority of non articular fragments were managed conservatively, relying on second intention healing at sites of avulsion. However, an open, transthecal approach for fragment removal has recently been reported (Brokken et al, 2008).

Sagittal fractures are invariably axial involving the lateral proximal sesamoid bone and occur in association with displaced fractures of the lateral condyle of the third metacarpal bone. They have a negative prognostic influence on the latter.

Fractures caused by external trauma usually involve the abaxial and/or palmar/plantar surfaces of the proximal sesamoid bones. They commonly are accompanied by open wounds which frequently also are contaminated and contused. The palmar/plantar annular ligament and digital flexor tendon sheath also may be involved. As sequestration and/or infected osteitis are common sequelae, acute surgical removal with debridement of adjacent tissues is recommended.

REFERENCES


