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Outcome and Racing Performance after Internal Fixation of Third and Central Tarsal Bone Slab Fractures in Horses
A Review of 20 Cases

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Winberg FG and Pettersson H: Outcome and racing performance after internal fixation of third and central tarsal bone slab fractures in horses. A review of 20 cases. Acta vet. scand. 1999, 40, 173-180. – Twenty horses with central and third tarsal bone slab fractures, were treated by internal fixation. Eighteen of the 20 cases were Standardbred trotters, one was a Thoroughbred racehorse and one a Swedish Warmblood. The central tarsal bone (CT) was involved in 12 cases and the third tarsal bone (T3) in 8 cases. The fractures were treated by lag screw fixation with one (18 cases) or two (2 cases) 3.5 or 4.5 mm cortical screws. Horses were confined to stall rest for one month and then put on a gradually increasing exercise programme. Convalescence time was 3–8 months until the fracture had healed and training could be resumed. Fifteen of the horses regained athletic soundness. Thirteen of the horses (72%) raced after surgery (12 Standardbreds and 1 Thoroughbred). Nine (69%) of these 13 horses won races after surgery.

lameness; hind limb; surgery; fractures.

Introduction

Slab fractures of the equine third (T3) and central tarsal (CT) bones are uncommon and can be difficult to diagnose. Predominantly these fractures occur in racehorses and other competitive horses (*Lindsay et al.* 1982, *Tulamo et al.* 1983, *Foerner* 1992, *Martin & Herthel* 1992).

The incidence of slab fractures has been proposed to be higher in the T3 than in the CT (*Foerner* 1992). Others have reported fractures of either one or 2 of the small tarsal bones (*Lindsay et al.* 1982, *Jacovlevic et al.* 1982, *Ramey* 1988, *Riedesel* 1990, *Martin & Herthel* 1992) or a similar incidence for the 2 bones (*Stover et al.* 1986, *Martin & Herthel* 1992). Fracture location, configuration and comminution has been specified in only 2 studies (*Tulamo et al.* 1983, *Foerner* 1992). *Lindsay et al.* (1982), *Ramey* (1988) *and Riedesel* (1990) found that fractures are most common in the dorsal aspect of the bones.

Diagnosis is often difficult because of minimal swelling even in cases with dislocation of fragments (*Tulamo et al.* 1983). However, palpation over the dorsal aspect of the small tarsal bones may reveal heat and cause pain (*Lindsay et al.* 1982). Tibiotarsal joint effusion has been an inconsistent finding in cases of CT slab fractures (*Tulamo et al.* 1983, *Foerner* 1992, *Martin & Herthel* 1992). There is usually a history of severe acute lameness after strenuous work (*Lind-*

say et al. 1982). The symptoms normally diminish during the next few weeks (*Tulamo et al.* 1983, *Martin & Herthel* 1992). Flexion test of the hock aggravates the lameness (*Tulamo et al.* 1983, *Martin & Herthel* 1992)

Radiographic examination using standard projections may not reveal this type of fractures (*Lindsay et al.* 1982, *Tulamo et al.* 1983, *Martin & Herthel* 1992). However, the fracture can usually be identified on a lateral oblique projection. In some cases, serial radiographs taken at one to 2 weeks interval may eventually reveal a fracture line (*Foerner* 1992, *Martin & Herthel* 1992). In these cases, scintigraphy has been shown valuable in confirming early diagnosis (*Stover et al.* 1986, *Martin & Herthel* 1992).

There are few reports on management and outcome of T3 and CT fractures in adult horses (*Ramey* 1988, *Riedesel* 1990, *Stover et al.* 1986, *Lindsay et al.* 1982, *Tulamo et al.* 1983, *Martin & Herthel* 1992). Conservative treatment has not lead to an acceptable level of restored athletic soundness and return to racing (*Foerner* 1992, *Lindsay et al.* 1982, *Tulamo et al.* 1983). Out of a total of 13 cases (*Lindsay et al.* 1982, *Martin & Herthel* 1992, *Tulamo et al.* 1983, *Stover et al.* 1986) only 3 (23%) returned to an acceptable level of performance. The time until these horses could return to racing was 12 to 18 months. Furthermore, a large proportion of these horses developed degenerative joint disease (*Lindsay et al.* 1982, *Tulamo et al.* 1983).

Internal fixation has been successful in small numbers of cases (*Lindsay et al.* 1982, *Martin & Herthel* 1992), and with prolonged healing time (*Tulamo et al.* 1983, *Stover et al.* 1986). *Martin & Herthel* (1992) reported a successful treatment by using the cannulated Herbert compression screw.

The aim of this study was to evaluate internal fixation of T3 and CT slab fractures in 20 horses and to assess their rehabilitation to athletic activity.

Materials and methods

Medical records of 20 horses with tarsal bone slab fractures treated by internal fixation at the Regional Animal Hospital in Helsingborg, Sweden, were reviewed to assess the outcome. Follow up information was obtained by telephone interviews with owners and trainers. Racing records were obtained from the Swedish Trotting Association and the Swedish Jockey Club.

Eighteen horses were racing Standardbred trotters, one was a racing Thoroughbred and one was a Swedish Warmblood used for equestrian sports. Age ranged from yearling to 8 years with fifteen (75%) of the horses being between 2 and 4 years. Fourteen horses were female (70%) and 6 were males. In 12 cases the central tarsal bone (CT) was fractured and in 8 cases the third tarsal bone (T3) was fractured. Of the 20 fractures, 13 were located in the left hind limb (65%).

Radiographic Technique

Radiographs were taken of all horses. Standard projections at our hospital were a straight dorsopalmar, a 45° plantarodorsal-lateromedial oblique (PDLMO) and a 45° dorsoplantar-lateromedial oblique (DPLMO) view. In order to verify a fracture, several projections with 5 degrees difference in angle were taken. A 15° PDLMO projection was usually taken initially as this has proven to be the angle at which most fracture-lines appear. The dorsodistal end and the dorsodistal notch of the lateral trochlear ridge of the talus were used as landmarks to confirm the different projections.

Follow up radiographs based on the initial diagnostic radiographs were taken at 6-8 week intervals until fracture healing had occurred. These radiographs are technically difficult as even small deviations from the correct angle may lead to misinterpretation of the extent of callus present.

Surgical technique

No preoperative antibiotics or anti-inflammatory drugs were given. The horses were positioned in lateral recumbency with the fractured limb uppermost. The limb was placed in full extension to stretch the tissues over the fracture site and minimize the depth of the soft tissues. Following compression by an Esmarch's bandage, a tourniquet was applied 20 cm above the hock.

Most of the fractures were located dorsolaterally. Hypodermic needles were placed and radiographs were taken to identify the correct location for the incision. This was especially useful in cases with soft tissue swelling.

In most cases, a 6 to 8 cm longitudinal skin incision was made over the tarsal bones, lateral to the long digital extensor tendon. In cases with dorsal fractures the incision was made medial to the lateral extensor tendon. The incision was continued through the fascia and the body of the *M. extensor digitalis brevis,* splitting the fibers longitudinally, into the underlying soft tissues. Care was taken to avoid the dorsal pedal artery and vein which course laterally at the proximal limits of the incision.

At this stage, the tarsal joints were located with intra-operative radiographs using hypodermic needles or K-wires.

After incising the dorsal tarsal ligaments and exposing the bone, one or 2 lag screws were used to stabilize the fractures (*Fackelman & Nunamaker* 1979, *Nixon* 1996). In most cases 4.5 mm cortical screws (24-28 mm) were used. In cases where the near component of the bone was only 5-6 mm thick we preferred to use a 3.5 mm cortical screw in order not to weaken the bone, and the gliding hole was not countersunk. In 2 of the horses, 2 screws were used as the first implant did not stabilize the fracture.

The subcutaneous tissues were closed in separate layers by use of interrupted 0 polyglycolic acid (Dexon®, Davis+Geck Inc., Gosport, UK) sutures. Interrupted 1 polyamid (Suturamid®, Ethicon, Norderstedt, Germany) was used for skin closure. The limb was bandaged. Anti-inflammatory drugs (Fenylbutazon vet, Lövens, Malmö, Sweden) were given for 3 days, and antibiotics (Novocillin vet, BI-vet, Malmö, Sweden) were given for 5 days.

The injured limbs were kept bandaged until sutures were removed after 14 days. The horses were kept in a stall for 1 month. Following this period, the horses were put on a controlled walking exercise programme (by hand or driven), increased gradually with regard to the individuals status. Signs such as increased local heat, swelling or lameness were causes for modulating or restricting exercise until the fractures were healed radiographically. Control radiographs were taken at 6-8 weeks intervals. Horses were not allowed to be turned loose during this period.

Results

All horses were lame, most showing grade 4 or 5 lameness after racing or strenuous work measured on a scale ranging from normal (0) to severe 9 lameness (?). Lameness gradually subsided and by the time of examination, usually 10-14 days after initial injury, many horses were only grade 2 or 3 lame. Palpation of the distal dorsal hock revealed increased heat and sensitivity to pressure. Minor swelling was usually noted in the presence of T3 fractures whereas cases with fractures of the CT showed more swelling and usually some degree of effusion in the tibiotarsal joint. Synovial fluid, if aspirated from the tibiotarsal joint was often discoloured by blood in cases of CT fractures. Flexion test of the hock increased the lameness by 1 to 2 grades. In most cases, the lameness could be located to the hock by clinical examination.

On radiographs, fractures were predominantly seen at the dorsal (4 cases) or dorsolateral (9

cases) aspect of the CT and T3. The fracture line could usually be seen in the dorsal quarter of the bone (Fig. 1), but one mid-body and 2 more plantar fractures of the CT (Fig. 2) were also seen.

Lameness gradually subsided after surgery and the horses were usually sound after 10 weeks (6-12 weeks). Convalescence time until the fracture had healed and training could be resumed ranged from 3-8 months.

When training was resumed, 3 horses showed lameness at high speed or at strenuous exercise. In these horses the lag-screws (4.5 mm) were removed. Two of these horses had been treated for a CT and one for a T3 slab fracture.

In the youngest horse, a yearling with a dislocated T3 fracture, the screw (3.5 mm) became loose and dislocated, within a few days after surgery and the horse was very lame. Fixation of the fragment was attempted a second time. This screw also became loose, and the horse was euthanized.

The follow up time was more than 4 years for all horses. Of 20 operated horses, 2 were lost to follow up but have been included as unraced postoperatively as they have no available race-record. Two were retired to stud, one due to bone spavin, the other due to unrelated problems. Two horses, including the Swedish Warmblood regained their ability as riding horses on a competitive level. The Swedish Warmblood was one of the horses which had a screw removed. Furthermore, this horse was one of 2 horses with CT fractures which subsequently developed degenerative arthrosis (bone spavin) of the proximal intertarsal joint, 4 years after surgery. None of the 2 horses with plantar CT fractures returned to an athletic career.

75% of all horses (15 of 20) returned to an athletic career. The racing Thoroughbred started racing only 4 months after surgery and won 7 of 31 races in the following 2 years. Thirteen of the 18 Standardbred trotters (72%) resumed an athletic career in which 12 of them raced (67%). Six horses raced for more than one year (Table 1). Eight of the horses (50%) started more than 10 times after surgery (Table 2). Three horses made more than 25 starts in one season.

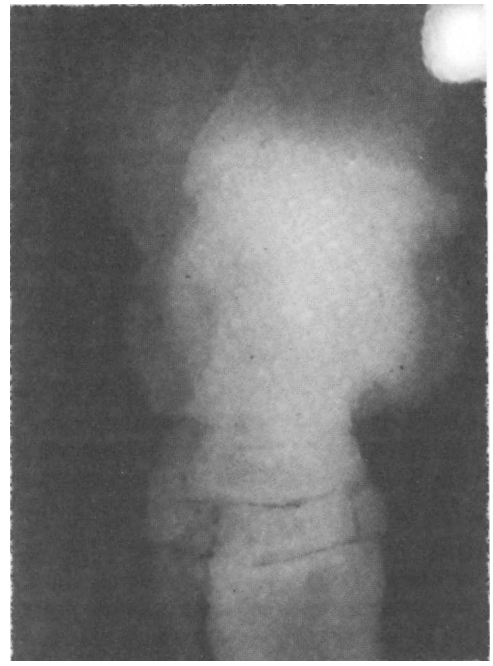

Figure 1. Radiograph (110°, PDLMO) of a slab fracture on the dorsolateral aspect of the third tarsal bone. In this study this was the most common location for slab fractures in both the third and central tarsal bones.

Eight (75%) of the 12 horses which returned to racing, won races after surgery. Of the 5 horses (42 %) which won more than one race, 2 won more than 10 races (11 and 23 respectively).

Discussion

At the Regional Animal Hospital in Helsingborg approximately 5% of fractures treated by internal fixation are slab-fractures of the T3 and CT. In Sweden these fractures are mainly seen

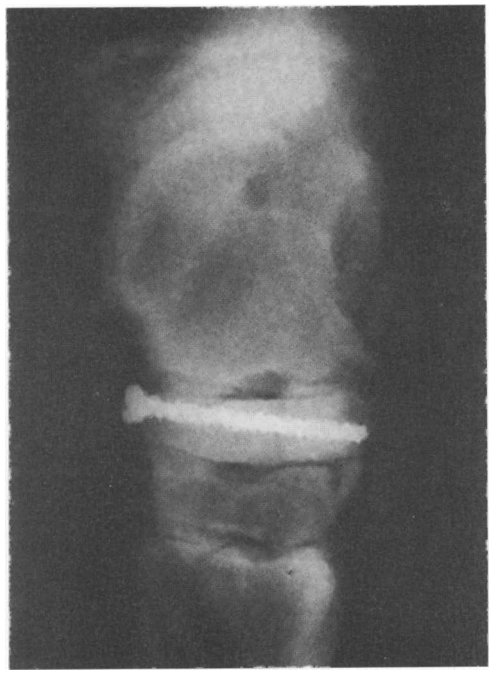

Figure 2. Radiograph (125°, PDLMO) of a plantar slab fracture of the central tarsal bone. In this case a 48 mm long 4.5 mm cortical screw was used in order to stabilize the fracture.

in Standardbred trotters. The distal tarsal bones are subjected to axial compression and torsional and tensile forces during exercise. The fractures often occur at racing speeds, when the tarsal bones are subjected to extreme stress. According to *Rooney* (1967) asynchronous movement of the tarsal bones due to ligament damage may lead to these fractures.

In our study the left hindlimb was more frequently injured than the right hindlimb, 13 and 7 respectively. This could be explained by the fact that racehorses are predisposed to these fractures in the left or more correctly, the "inner" hindlimb. This is supported by *Lindsay et al.* (1982) who only dealt with T3 slab fractures in the left hindlimb of racing Thoroughbreds and Quarterhorses. The Thoroughbred in our study fractured the right hindlimb while racing clockwise, thus 14 of 19 racehorses (74 %) in this study fractured the "inner" leg. On the other hand, 2 other studies, one mainly dealing with Standardbreds, found that the distribution of fractures between the limbs was equal (*Tulamo et al.* 1983) and almost equal (*Martin & Herthel* 1992).

Owners were more inclined to have surgery performed on fillies and mares in order to allow for improvement of racing records. This may enhance the breeding value of the mare after retirement, which is applicable only in the most talented colts or stallions. This was found to be the explanation to the uneven distribution between the sexes.

Early diagnosis of T3 and CT fractures can be obtained by bone scintigraphy, especially in cases when x-rays are inconclusive (*Stover et al.* 1986, *Martin & Herthel* 1992). In recent years the diagnosis of this fracture type has increased, most probably due to the more frequent use of scintigraphy (*Martin & Herthel* 1992). At the time of the present study, scintigraphy was not available at our hospital.

Intra-articular anesthesia has been used for diagnosis in some cases (*Tulamo et al.* 1983). It is the author's opinion that it should be avoided if there is suspicion of fracture in the limb because of the risk of exacerbating the problem by allowing the horse full weight-bearing on the limb. Therefore, diagnostic intra-articular anesthesies were not used in this study.

Fractures in the present material were predominantly located at the dorsal (4 cases) and dorsolateral (9 cases) aspect of both the CT and T3. Others have reported that the fractures occur dorsally (*Lindsay et al.* 1982, *Tulamo et al.* 1983, *Foerner* 1992) One author states that fractures occur mainly on the dorsomedial aspect of the CT (*Nixon* 1996) but we found only one fracture in this location. Only one dorsolat-

Table 1. Number of years raced postoperatively for the 18 Standardbreds in the review.

Years raced:	Not raced	One year	Two years	Three years	Four years
Males:	1	2		1	1
Females:	5	4	1	2	1
Total:	6	6	1	3	2

Table 2. Number of starts postoperatively for the 18 Standardbreds in the review.

Number of starts:	No starts	<10 starts	10-30 starts	30-40 starts	>120 starts
Males:	1	1		2	1
Females:	5	3	4		1
Total:	6	4	4	2	2

eral location for a CT slab fracture has been reported earlier (*Martin & Herthel* 1992), whereas we found this location in 4 (33%) of the cases. Dorsomedial chip fractures of the central tarsal bone have been described in a study by *Jacovlevic et al.* (1982). However, these fractures occurred in conjunction with other fractures of the hock, and are therefore probably a separate entity. Comminution has been described in 4 cases of CT slab fractures (*Tulamo et al.* 1983). We have not observed this complication.

Neither the bone affected (75% success for both the CT and the T3) nor the location of the fracture on the bone seemed to affect the outcome, except for the plantar fractures of the CT. None of the 2 horses with this type of fracture raced after surgery.

Degenerative osseous lesions, seen as lysis around the fracture line, similar to those in the third and radial carpal bones in conjunction with slab and chip fractures, may also be predisposing to slab fractures of the CT and T3 (*Foerner* 1992, *Greet* 1993). The presence of these lesions have been proposed to affect the success rate of surgical repair negatively (*Greet* 1993). In the present study there was no radiographic evidence of this type of lesion as judged by the sharpness of fracture lines on radiographs.

Martin & Herthel (1992) used the 4.5 mm cannulated Herbert compression screw to facilitate correct screw placement. Due to the risk of damaging vascular structures such as the dorsal pedal artery and vein, we do not recommend surgery through stab incisions. Correct screw alignment was also easier when the dorsal surface of the bone could be visualized. This type of screw has no head which seems to make implant removal difficult without extensive soft tissue dissection and removal of bone. Thus, we would recommend the use of the AO/ASIF cannulated 4.5 mm screw which facilitates optimal placement and simple removal.

The cannulated screw system is also useful in cases where the bone has a pronounced curved shape or if the fracture is located at the central or plantar aspect of the bone. In these cases it is difficult to avoid drilling into the tarsal joints spaces which may have affected the outcome in the 2 plantar CT fractures. We have used 3.5 mm screws in this type of cases in later years to minimize the space requirements of the implant.

Implant removal is not uncommon in our hospital. It is used in e.g. third phalanx fractures, tarsal bone slab fractures and proximal sesamoid bone fractures, either electively as a preventive measure or when there are signs of pain when training is resumed, e.g. at high speed work. It is our opinion that this pain is a result of a stiff implant being incorporated in less rigid bone. It is our impression that the horses which have the implants removed have higher rate of return to athletic activity. When implants are removed, slow and fast work can be resumed after 6 and 12 weeks respectively.

Inadvertent incision of the joint capsule of the tibiotarsal joint in the proximal recess of the wound does not seem to cause any problem. The joint capsule is very thin and almost indistinguishable in this area and can be closed together with the soft tissues. This complication is almost unavoidable with a more medial approach as part of the dorsal surface of the CT is within the tibiotarsal joint.

Conservative management of central and third tarsal bone slab-fractures has not proven satisfactory with regard to restoration of athletic ability. Only 3 of 13 reported cases (*Lindsay et al.* 1982, *Martin & Herthel* 1992, *Tulamo et al.* 1983, *Stover et al.* 1986) returned to an acceptable level of performance and the convalescence period before training could be resumed for these cases was 12 to 18 months, i.e. twice as long as for horses treated by internal fixation in this review.

With internal fixation, convalescence time was more predictable and the majority of our cases resumed training within 6 months following surgery. Most of the horses treated by internal fixation also returned to athletic function and raced successfully.

In conclusion, internal fixation is the treatment of choice for acute T3 and CT slab fractures. A predictable and functional result can be achieved.

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Sammanfattning

Utfall och löpsresultat efter intern fixering av slabfrakturer på tredje och centrala tarsalbenet hos hästar, en uppföljning av 20 fall.

Denna studie är en uppföljning av 20 fall av frakturer på tredje och centrala tarsalbenet vilka behandlats

med intern fixering. Av de 20 fallen var 18 varmblodstravare, en var fullblodshäst och en var svenskt halvblod. Det centrala tarsalbenet var involverat i 12 fall och det tredje tarsalbenet i 8 fall. Frakturerna behandlades med intern fixering medelst en eller två 3.5 eller 4.5 mm kortikala skruvar. Hästarna boxvilades strikt i en månad, varefter de sattes på ett gradvis ökande motionsprogram. Konvalescenstiden tills frakturen läkt och träningen kunde återupptas var 3 till 8 månader. Femton av hästarna återfick sin prestationsförmåga. Tretton av hästarna (72%) deltog i löpningar efter operationen och nio (69%) av dessa vann.

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