Original Article


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Introduction

Injuries to the second and fourth metacarpal and metatarsal bones can occur anywhere along the length of the bone in horses of any age (Fig 1). The scarce soft tissue covering of the small vestigial metacarpal and metatarsal bones in addition to their location makes them particularly vulnerable to external trauma.

Injuries such as kicks can result in open fractures of the proximal and middle aspect. The fracture may be comminuted, complicated by the development of osteitis, osteomyelitis and/or bone sequestrum (Bowman and Fackelman 1982; Allen and White 1987; Harrison et al. 1991). Distal fractures may result either from external or internal trauma. Distal and mid-body fractures are recommended to be managed surgically with removal of the distal fragment of the splint bone, removal of callus, and excision of the most distal aspect of the remaining proximal fragment (Bowman et al. 1982). This treatment provides a quick recovery and return to previous use by avoiding excessive callus formation, which may lead to secondary suspensory desmitis and chronic lameness. The prognosis is generally good and complications are rare, unless other abnormalities are present (Bowman and Fackelman 1982; Allen and White 1987) in particular suspensory desmitis (Bowman et al. 1982). Segmental ostectomy of the splint bones has also been described for mid-body fractures with good results (Jenson et al. 2004). Fractures of the proximal third of the splint bones are the most difficult to treat. A variety of management techniques have previously been reported in the literature (Allen and White 1987; Peterson et al. 1987; Doran et al. 1991; Baxter et al. 1992; Walliser and Feige 1993). Some authors have described the surgical removal of the distal splint bone fragment as the treatment of choice for proximal fractures (Bowman and Fackelman 1982; Allen and White 1987). It is generally accepted that no more than the distal two-thirds of the splint bone should be removed. In cases where more than this has to be removed, an internal fixation of the proximal fragment with the help of a small plate is suggested to maintain axial support (Peterson et al. 1987). Screw fixation alone is generally associated with a relatively high incidence of technical failure (Peterson et al. 1987). Proximal fractures are mostly open, comminuted and infected. Complications are common and therefore metallic implants are only recommended if internal fixation is required to stabilise the bone (Harrison et al. 1991).

Complete removal of the entire fourth metatarsal bone has been used successfully to treat open comminuted fractures of the proximal portion (Baxter et al. 1992).

The purpose of this study was to examine fractures of the second and fourth metacarpal and metatarsal bones of patients admitted to the Equine Hospital of the University of Zurich, Switzerland, between January 1992 and December 2001 and to attempt to analyse the outcome data in order to provide evidence-based recommendations regarding the best practice concerning treatment (surgical vs. conservative management).
Materials and methods

All case records of horses with fractures of a splint bone presented to the Equine Hospital of the University of Zurich between January 1992 and December 2001 were reviewed and all were selected for this study apart from 4 cases, because the horses presented with other problems and their splint bone abnormalities, although diagnosed subsequently, were asymptomatic and therefore not treated.

For each horse the history, breed, sex and age were recorded, the affected limb and site of fracture were determined. Additional data retrieved for each case included: 1) cause of the fracture (trauma/unknown aetiology); 2) presence of a skin wound (open/closed fracture); 3) presence of pain and swelling; 4) severity of the lameness at initial examination (lameness on trot/lameness at walk/no lameness); 5) radiological findings: evaluation of the fracture (simple/comminuted/fissure/impression fracture - only the bone surface is depressed into the medullary cavity), presence of callus (in the normal healing process/exuberant callus, with interference to the suspensory ligament and causing lameness), involvement of the third metacarpal or metatarsal bone (sequestrum formation, fissure, fracture); 6) ultrasonographic evaluation of the soft tissues (presence of suspensory desmitis); 7) management (conservative, including local wound care of open fractures of the proximal third of the bone/surgery, excision of distal fragment, application of bone plate, removal of fourth metatarsal bone); 8) outcome (good - horse returned to full athletic function, without recurrent lameness/poor - horse still lame); and 9) complications (infection, sequestrum formation, nonunion, fracture of the third metacarpal/metatarsal bone).

Convalescence time was defined as stall rest and controlled exercise at walk, until the horse was sound and could begin with exercise in trot. Normal convalescence time was considered to be 4 months for fractures of the proximal third of the splint bone (either conservatively or surgically treated); 3 months for conservative treatment of mid-body fractures; and 2 months for surgical treatment of mid-body and distal fractures, and conservative treatment of distal fractures. Convalescence time exceeding the aforementioned are, for the purpose of this study, considered to be ‘long’. Follow-up information was obtained by clinical examination or by telephone inquiry.

Treatment procedure

For clarification of terminology conservative treatment for closed fractures of the proximal part of the splint bone consisted of bandaging, antiphlogistics (phenylbutazone by oral administration, 2.2 mg/kg bwt b.i.d or s.i.d.) and stall rest for 6–8 weeks, followed by 6–8 weeks of controlled exercise. With open fractures of the proximal third of the splint bone conservative treatment consisted of local wound care with the horse under standing sedation at admission, bandaging and antiphlogistics; broad-spectrum antibiotics were administered systemically for 5–10 days and the wound was flushed every second day until the exudation stopped.

Surgical treatment of proximal fractures under general anaesthesia included the excision of the distal fragment of the splint bone (routine procedure, Doran 1996), the application of bone plates (Doran 1996) and removal of the fourth metatarsal bone (Baxter et al. 1992). Convalescence time was the same as for conservative treatment (4 months).

The treatment for distal and mid-body fractures was either conservative with bandaging, antiphlogistics and stall rest for 4–6 weeks, followed by 4–6 weeks of controlled exercise or surgical with the excision of the distal fragment of the splint bone (routine procedure, Doran 1996), antiphlogistics and stall rest for 4 weeks, followed by 4 weeks of controlled exercise. Conservative therapy for mid-body and distal fractures was performed if the fracture wasn’t displaced, showed already a good healing process and or if the owner refused surgical management. All horses recovered from general anaesthesia unassisted, without pool recovery.

Statistics

All data were stored in a FileMaker Pro 2.0 database. The frequency distribution was determined for each variable using the StatView D-4.5 program. The Chi-square test for association was used to compare frequencies. When the observed frequencies were smaller than 5, Fisher’s exact test was employed. A P value of <0.05 was considered significant. Statistical calculations were performed using a final stepback logistic regression model. Independent variables with P values of 0.2 were included. Logistic regression procedure was completed until all independent variables with a P value equal to or less than 0.05 were identified (Altmann 1994). The outcome of injury was defined as a dependent variable.

Results

Population

The mean age of the horses was 8.4 years (range 0.5–22 years) and 51% of the horses were females, 43% geldings and 6% intact males. The breed distribution of the cases revealed 58% Warmblood horses, 12% Thoroughbreds, 9% Icelandic ponies, 8% Arabian Horses, 7% Polo ponies, 4% Freiberger and 2% Ponies. Most horses were used in dressage and showjumping events (24%), followed by pleasure horses (18%), pasture horses (8%), racehorses (7%) and Polo ponies (5%). In 38% of the cases no information relating to activity at the time of injury was available.

History

Fifty-eight percent of all the fractures were the result of a trauma (kick from another horse, self inflicted, injuries in the box): most of the proximal fractures, 18 of 27 (66.6%), 11 of 26 of the mid-body fractures (42.3%) and 29 of 57 (50.9%) of the distal fractures. In 42% of the cases the cause of fracture could not be determined, although in many cases a traumatic
aetiology (kicking injury) was suspected. The correlation of the cause of the fractures with their localisation revealed that external trauma occurred most frequently at the lateral aspect of the limb ($P = 0.0007$) and in the hindlimb ($P = 0.0145$). In 32% of cases the injuries were more than 3 weeks old.

### Clinical findings

Fifty-four fractures involved a thoracic limb and 46 a pelvic limb (Table 1). Most of the horses presented with lameness at the trot (53%), 23% lameness at a walk and 10% no lameness. Generally, lameness depended on the time interval between the injury and the presentation at the clinic and on the extent of soft tissue damage. Most of the proximal fractures, 18 of 27 (66.6%), some of the mid-body fractures, 12 of 26 (46.1%) and a few of the distal fractures, 13 of 47 (27.6%), totalling 43%, were open fractures. Pain on palpation was noticed in 77% of cases, whereas in 9% no pain was observed. No information regarding palpation pain could be found on the records in the remaining cases.

Swelling, especially local, was observed in 43% of cases, in 27% the swelling was extensive and in 10% no swelling was present. No information regarding swelling could be found in the records of the remaining cases.

Most of the fractures were of the simple type (54%), 41% were comminuted, 5% were fissure fractures and 1% was an impression fracture. In the proximal third of the splint bone, fractures were often comminuted (12 of 18, 66.6%), whereas fractures located in the distal third were mostly of the simple type (34 of 47, 72.3%). Mid-body fractures were in 12 cases comminuted and in 11 simple. At admission 32% of all the fractures showed already callus, 6% sequestrum formation, and 3% nonunions. Sequestrum formation was mainly observed in young horses (mean age 3.2 years) after a kicking injury or another external trauma. All sequestra were resultant from open fractures (4 comminuted and 2 simple) of the proximal and mid part of the bone. All of them had large callus at admission. Involvement of the third metacarpal/metatarsal bone (McIII/MtIII) was observed following a kick injury or another form of external trauma in the presence of proximal or mid-body splint bone fractures. A total of 16% showed periosteal reactions, 2% fissures, 2% impression fractures, 1% fracture and 3% sequestrum formation.

### Radiographic findings

Most of the fractures were of the simple type (54%), 41% were comminuted, 5% were fissure fractures and 1% was an impression fracture. In the proximal third of the splint bone, fractures were often comminuted (12 of 18, 66.6%), whereas fractures located in the distal third were mostly of the simple type (34 of 47, 72.3%). Mid-body fractures were in 12 cases comminuted and in 11 simple. At admission 32% of all the fractures showed already callus, 6% sequestrum formation, and 3% nonunions. Sequestrum formation was mainly observed in young horses (mean age 3.2 years) after a kicking injury or another external trauma. All sequestra were resultant from open fractures (4 comminuted and 2 simple) of the proximal and mid part of the bone. All of them had large callus at admission. Involvement of the third metacarpal/metatarsal bone (McIII/MtIII) was observed following a kick injury or another form of external trauma in the presence of proximal or mid-body splint bone fractures. A total of 16% showed periosteal reactions, 2% fissures, 2% impression fractures, 1% fracture and 3% sequestrum formation.

### Treatment

Fifty-seven percent of the horses were treated by surgical excision of the distal fragment of the splint bone (routine procedure, Doran 1996), bone plate were used in 5% of the cases (Doran 1996) and in one case the entire MtIV was removed (Baxter et al. 1992). Thirty-five percent of the horses were managed conservatively. Two horses (2%) had to be subjected to euthanasia (Table 2).

### Open fractures of the proximal third

Open proximal fractures were present in 18 cases. Twelve horses were conservatively treated (Fig 2). A total of 11 horses returned to their intended athletic function: one simple fracture only after 9 months, because of an exuberant callus causing pain in the suspensory ligament. Of 5 horses with fresh comminuted fractures, 4 could return to their intended use, despite the fact that in 2 cases the fractures were intra-articular. A fissure fracture of the third metacarpal bone was observed in one case. One horse with a comminuted fracture was chronically lame because of exuberant callus interfering with the suspensory ligament. One horse developed arthrosis of the tarso-metatarsal joint, although without sign of lameness. In 5 horses surgical management was selected. Two open

### Table 1: Distribution of the splint bone fractures relative to limb and side of the limb

<table>
<thead>
<tr>
<th></th>
<th>Right limb</th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medial</td>
<td>Lateral</td>
<td>Medial</td>
<td>Lateral</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forelimb</td>
<td>10</td>
<td>13</td>
<td>19</td>
<td>11</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindlimb</td>
<td>7</td>
<td>15</td>
<td>9</td>
<td>16</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Outcome according to the treatment of proximal, mid-body and distal fractures (fx)

<table>
<thead>
<tr>
<th></th>
<th>Number fx</th>
<th>Conservative therapy</th>
<th>Wound management</th>
<th>Removal of the distal aspect</th>
<th>Plate application</th>
<th>Removal of the entire bone</th>
<th>Horse subjected to euthanasia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Good outcome)</td>
<td>(Good outcome)</td>
<td>(Good outcome)</td>
<td>(Good outcome)</td>
<td>(Good outcome)</td>
<td>(Good outcome)</td>
</tr>
<tr>
<td>Proximal fx (total)</td>
<td>27</td>
<td>6</td>
<td>12</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Open</td>
<td>18</td>
<td>0</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Closed</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mid-body fx</td>
<td>26</td>
<td>9</td>
<td>0</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Distal fx</td>
<td>47</td>
<td>8</td>
<td>0</td>
<td>38</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>23</td>
<td>12</td>
<td>57</td>
<td>5</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

|                                | Conservative therapy | Surgical therapy |
|                                | (Good outcome)       | (Good outcome)   |
| Total                           | 100                  | 35                 | 63                 |
Comminuted fractures were managed by removal of the distal fragment of the splint bone, removal of the callus, and resection of the distal most aspect of the remaining proximal fragment. In one case a bone sequestrum and callus were removed and the patient could return to its intended use. The other had a mild displacement of the fragment and is still slightly lame. In one case with an open comminuted fracture of MtIV with involvement of the tarsometatarsal joint the splint bone was entirely removed with a good result. Two fractures were treated with internal fixation with a bone plate. In one case a simple fracture developed exuberant callus but the horse returned to its intended use. The other was an articular compound fracture, which hadn’t responded to conservative therapy and where a nonunion had developed. This horse also returned to its intended use, although the plate had to be removed after 8 months because of infection and persistent lameness.

One horse had a comminuted fracture and a very poor prognosis following a bad accident and had to be subjected to euthanasia.

Closed fractures of the proximal third

A total of 9 horses were admitted with proximal closed fractures. Six fractures were treated with conservative therapy: 2 were simple old fractures, 2 were fissure fractures and 2 were comminuted fractures, one of which with a fissure fracture of the third metatarsal bone. Two horses could not return to their intended use for nonrelated reasons; 3 horses returned to their intended use: one had a sequestrum, which was spontaneously resorbed after 3 months, one developed large callus and had a convalescence time of over 6 months, and the horse with comminuted fracture of the splint bone and fissure fracture of MtIII developed no complications. For the other comminuted fracture no information was available, but, interestingly, at the time of examination, the horse showed also an arthrosis of the tarsometatarsal joint, which could have been a consequence of the instability subsequent to the splint bone fracture. Three fractures were treated with internal fixation with a plate. In 2 cases a bone plate was used involving the splint bone alone. One was an old fracture of a pregnant mare and the plate had to be removed after 7 months because of infection and persistent lameness. Then the splint bone developed large callus again, sequestrum formation and osteomyelitis ensued the horse was chronically lame. The third metacarpal bone was also affected with osteomyelitis and sequestrum formation. In the other case with a comminuted fracture no information was available. The third case was a 5 week old fracture with exuberant callus: the distal fragment of the splint bone was removed and a bone plate used to stabilise the remaining proximal fragment. The screws involved the splint bone and near cortex of the third metacarpal bone. The horse could return to its intended use.

Fractures of the middle third

Fractures of the middle third of the bone occurred in 26 horses. Seventeen fractures were treated surgically with removal of the distal fragment (Fig 3). Of these, 13 horses could return to their intended use, despite impression fracture of the third metacarpal/metatarsal bone in 2 cases; 2 were chronically lame, one because of chronic suspensory desmitis, the other because of exuberant callus and sesamoiditis. One horse acquired a fracture of the third metacarpal bone after surgery during recovery from anaesthesia, probably as a complication of the splint bone fracture with McIII involvement, and was subjected to euthanasia. For one horse no follow-up data were available. In 9 horses conservative management was applied (Fig 4): 5 had closed and 4 open fractures. In 2 horses with simple fractures large callus formation was diagnosed. One became lame and was subjected to euthanasia 4 years later because of suspensory desmitis; the other could return to its intended use. One horse suffered from an impression fracture of the

Fig 2: a) Lateral radiographic view of an open comminuted fracture of the proximal splint bone. b) Radiograph of the same fracture 5 months later. Callus formation can be seen.

Fig 3: a) Preoperative radiograph of an old splint bone fracture of the middle third. A sequestrum and large callus formation is seen. b) Post operative radiograph of the same fracture after removal of the sequestrum, the callus and the distal aspect of the bone.
splint bone in addition to an ulnar fissure fracture, but was able to eventually return to its intended use. One open simple fracture developed massive callus and was then treated with local steroid injection; the horse returned to its intended use only after one year. For one horse no information was available. The following problems were diagnosed in the remaining 4 patients: one open simple fracture, 2 open comminuted fractures and one fissure fracture. All of these horses could return to their intended use, although one only after 6 months because it developed large callus.

Fractures of the distal third

Fifty-seven horses presented with distal splint bone fractures. A total of 38 of the presented fractures were managed by removal of the distal fragment of the fractured splint bone and, if necessary, resection of the most distal aspect of the remaining proximal fragment (Fig 5). Out of these, 32 horses returned to their intended use, including 8 horses that were presented with suspensory desmitis, 2 with a nonunion, 2 with sequestrum formation, 2 with sequestrum formation on McIII/MtIII and one with osteomyelitis of the splint bone. One horse developed callus at the distal aspect of the amputated splint bone and could return to its intended use only after a year. For one horse no information was available. The remaining 5 horses showed a chronic lameness: 2 horses because of associated suspensory desmitis, 2 because of exuberant callus. One horse had a re-fracture of the splint bone 2 months after the removal of the callus, followed by the formation of exuberant periosteal reaction, which culminated in a chronic lameness. In 8 cases conservative treatment was performed, the fracture being already in a good healing stage. All were simple fractures. Seven horses returned to their intended use. One horse had suspensory desmitis and was chronically lame. One horse with a distal fracture of the splint bone was subjected to euthanasia at admission because of persistent suspensory desmitis.

Factors influencing outcome

There was no sex-related variation in incidence, although more females than geldings had a good outcome. Comparing the distribution of breeds with outcome, it could be shown that breed doesn’t play an important role; all heal similarly. Kick and self inflicted injuries, together with external trauma had significantly better statistical probability to have good outcomes, whereas fractures of unknown aetiology, where internal trauma was possibly involved, had a poor prognosis (P = 0.0033).

Lameness and pain on palpation did not show any correlation with outcome. Horses suffering from an additional suspensory desmitis tended usually to have a worse outcome than those without (P = 0.06). The most important independent variable for healing was ‘open fracture’ (P = 0.0001). If a fracture was open, the chance for successful healing was statistically 3.5 times worse than if it were closed (it took longer to heal, some of the horses remained lame). Radiographic examination taken at different intervals during the convalescent period, usually after 1, 2 and 3 months, showed, in particular, exuberant callus formation (37%). Interestingly, there was no correlation between radiographic findings and outcome (P = 0.35), which indicates that callus is a mostly incidental finding not associated with lameness. Involvement of the third metacarpal/metatarsal didn’t show any correlation with long-term outcome (P = 0.52).

There was no correlation between treatment variable (conservative/surgical treatment) and long-term outcome (P = 0.73). Nevertheless, we observed longer convalescence time in horses conservatively treated. Also sequestrum formation and nonunion did not show any correlation with long-term outcome, but influenced the convalescence time.

Fig 4: a) Radiograph of splint bone fracture of the middle third. b) Radiograph of the same fracture one month later. Some callus formation can be seen.

Fig 5: a) Preoperative radiograph of a distal splint bone fracture. b) Post operative radiograph of the same animal. Note, the end of the proximal fragment is tapered off.
Discussion

Traumatic injuries and fractures of the vestigial metacarpal and metatarsal bones are predisposed by the relative anatomic exposure to such insults and to a certain extent by the nature of the horse and its management. In this retrospective study, 55% of all fractures were caused by a kick or other external trauma. MtIV was the most frequently involved bone. Similar results were previously reported in the literature (Bowman and Fackelman 1982; Stashak 2002; Derungs et al. 2004). Fissures and/or fractures of the third metacarpal/metatarsal bone were observed only with proximal and mid-body fractures. In one case the horse had to be subjected to euthanasia because of McIII fracture: we recommend therefore that the clinician be alert and check the integrity of the third metacarpal/metatarsal bone. Sequestrum formation of the splint bone was observed in young horses (mean age 3.2 years) after trauma. We observed that sequestrum formation occurred only in the open fractures, mostly in the proximal and mid part of the splint bone, probably due to infection and failure of revascularisation of the bone fragment secondary to total separation of the fragment’s blood supply. Clem et al. (1988) reported an increased incidence of sequestra in younger animals, presumably because of an increased tendency to traumatisate themselves. Also in the series presented here, most of the sequestrum formation resulted after external trauma. However, in none of these cases did the sequestrum formation worsen the prognosis (all of the horses returned to intended use).

Fractures of the proximal third

The lateral splint bone was significantly more involved. We observed a higher incidence of traumatic aetiology, mostly resulting in open fractures. Interestingly, open fractures responded very well to medical management. In a previous report, 12 of 14 horses with open comminuted fractures returned to athletic function following conservative therapy (Walliser and Feige 1993). It is these authors’ opinion that surgery is not always necessary. In fact 11 of 12 horses with open fractures could return to their intended use after conservative therapy and in only one horse did this result in chronic lameness. However, as we have seen, conservative therapy may lead to exuberant callus formation, which in one case led to a longer convalescence time. Another possible complication is instability, resulting from the amount of bone remaining and the integrity of its attachment to McIII/MtIII (Peterson et al. 1987): in 2 cases, we observed the development of arthritis of the tarso-metatarsal joint. In one open comminuted fracture of MtIV with involvement of the tarso-metatarsal joint the splint bone was entirely removed with a good result. This is possible only for MtIV, because the articulation between MtIV and the fourth tarsal bone is small, and the weight transfer through this articulation is probably minimal (Baxter et al. 1992). Baxter et al. (1992) proposed removal of the entire affected bone, rather than internal fixation, if infection and sequestration developed after conservative therapy. Bone plates were used in 5 cases: in one the distal splint bone fragment was removed and the screws engaged the splint and the near cortex of McIII (in the proximal part of the plate), whereas only the near cortex of McIII was engaged in the distal part. In 4 cases the screws of the plate engaged the splint bone alone, providing the most ideal anatomic repair (Peterson 1987). Three of 5 horses returned to their intended use after such treatment; unfortunately, infection was an added complication in 2 horses that led to chronic lameness in one horse. Moreover, implant removal may be necessary at a later date. Therefore, in open fractures it is suggested that plate fixation should be used only when the proximal part of the splint bone has become unstable relative to McIII or MtIII.

Fractures of the middle third

Fractures of the middle third of the splint bone are usually described in the literature as complicated fractures together with fracture of the proximal third (Baxter et al. 1992; Doran 1996; Stashak 2002). We observed a larger number of comminuted fractures, open fractures and complications such as involvement of the third metacarpal/metatarsal bone, exuberant callus formation and associated suspensory desmits. Interestingly, we observed an associated suspensory desmitis in 2 patients, which is described in the literature only for distal fractures (Verschooten et al. 1984; Harrison et al. 1991). Open and displaced fractures should be treated surgically (Jenson et al. 2004). Surgical removal of the distal part of the splint bone may not be necessary with closed fractures (of the 9 patients conservatively treated, only one resulted chronically lame), but in the authors’ finding the convalescence period is longer than after surgery (2 of 7 horses had a longer convalescence time). An alternative treatment of mid-body fractures is segmental ostectomy, where proximal and distal fragments are left in place (Jenson et al. 2004).

Fractures of the distal third

As previously reported, fractures of the distal third were mostly of the simple type (Stashak 2002) and occurred at the narrowest part of the splint bone or immediately distal to the attachment of the interosseous ligament between the third metacarpal/metatarsal bone and the involved vestigial metacarpal/metatarsal bone, respectively. It has been reported that tension of the lateral and medial interosseous tendons and hyperextension of the fetlock are the most important factors in the aetiology of distal splint bone fractures (Verschooten et al. 1984). A hyperextension of the fetlock could lead to increased tension in the soft tissue that originates from the distal end of the splint bone and extends in the dorsal and distal direction towards the proximal sesamoid bones (Jackson et al. 2005). In the cases presented here there was a certain incidence of suspensory desmits, but not in the majority of cases as previously described (Doran...
1994; Stashak 2002). The presence of associated suspensory desmitis may result in chronic lameness (33.3% of the affected horses in this study). Nevertheless healing of associated suspensory desmitis is extremely important. Open fractures and displaced fractures often require surgical management (Doran 1994). Complications after surgical management were rare and included the development of periosteal proliferative changes at the distal aspect of the amputated splint bone in 3 cases, which led in one case to a longer convalescence period and in 2 cases to chronic lameness. Some authors consider surgery unnecessary for fractures of the distal aspect of the splint bone (Verschooten et al. 1984; Stashak 2002). Conservative therapy was performed in this study with good results with simple, nondisplaced fractures. Nevertheless possible complications include nonunion (Baxter et al. 1992), which we observed in 2 cases and is probably the result of the continuous intermittent traction of the soft tissue that originates from the distal end of the splint bone and extends in the distal direction (Jackson et al. 2005), and exuberant callus, which would interfere with the suspensory ligament (Verschooten et al. 1984).

**Conclusion**

The prognosis following splint bone fractures depends in particular on location, type and age of the fracture, as well as additional involvement of tendons, soft tissues and the third metacarpal/metatarsal bone. Fractures of the middle and distal thirds, when no other structures are involved, have the best prognosis, both after surgical or conservative management. It is the authors’ finding that conservative therapy needs a longer convalescence period and is subject to complications, especially exuberant callus formation which could interfere with the suspensory ligament. Complicated fractures including open, comminuted and proximal articular fractures are found mainly in the proximal third of the bone.

According to the results of this study effective conservative management of these fractures without surgical removal of the distal part of the bone or fixation of the fracture had a good prognosis and it is suggested, in particular for open fractures, to try such therapy. Plate fixation is recommended only when the proximal part of the splint bone has become unstable relative to McII or MtIII.

**References**


