

# Management of metacarpal and metatarsal fractures

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Metacarpal and metatarsal fractures are common injuries in small animals. They account for 8.1% and 3.3% of all fractures in dogs and cats respectively. This article will discuss the management options available including both surgical and conservative options of metacarpal and metatarsal fractures and the treatment options available. Surgical options discussed include bone plating, dowel pinning and external skeletal fixation.

## MC AND MT



**Figure 1 - Normal anatomy of the metatarsal bone.**

Metacarpal (MC) and metatarsal (MT) are often a result of trauma such as road traffic accidents, jumping, being stepped on, fights or falling objects<sup>1</sup>. The metacarpus is divided into the base, body and head from proximal to distal. The first metacarpal bone or the most medial is the shortest and most slender. Metatarsal bone one is usually absent and an oblique groove is present between the second and third metatarsal bone. The perforating metatarsal artery a branch of the dorsal pedal artery run through this groove.

Figure 1 demonstrates how

both the metacarpal and metatarsal bones are aligned in the frontal plane proximally. However, as the bones extend further distally the bones adopt more of a curved configuration. Clinically, this makes it difficult to engage more than two metacarpal or metatarsal bones distally when placing external skeletal fixator pins or screws. In racing greyhounds, characteristic stress or fatigue fractures often involve the fifth MC of the left thoracic limb; it is not unusual for these types of fractures to be comminuted<sup>2</sup>. MC fractures are more common than MT fractures in dogs. Fractures of four MC or MT bones are present in 41-56% of cases (Figure 2)<sup>3,4</sup>. Dogs which have fractures of four MC or MT bones are highly likely to have displacement of at least one digit<sup>3</sup>. Displacement of a fracture or axial malalignment has been shown to be significantly associated with fractures of the mid or distal regions of the MC or MT bones<sup>2</sup>. Fractures of the base of the second or fifth MC or MT can lead to valgus or varus instability respectively.

Surgical indications of MC and MT fractures traditionally



**Figure 2 - Mediolateral and dorsopalmar radiograph of a dog with metacarpal fractures II-V.**

include more than two MC or MT fractures in the same leg, fractures of the main weight bearing bones (3rd and 4th MC/MT), articular fractures, open fractures, fractures of the base of the 2nd or 5th MC/MT bones resulting in valgus or varus instability, fractures with significant displacement and fractures in racing animals<sup>5-7</sup>. In a small retrospective study in dogs that compared conservative versus surgical treatment of MC or MT fractures, no significant difference in outcome was found between the two treatment groups<sup>8</sup>. This study provided useful data, but must be taken in context as there were several limitations including a small case number, non randomised groups and owner assessment as final outcome. Even though significance was not reached owners/clinicians reported a perfect outcome in 77% of cases treated surgically whereas only 56% of conservatively treated dogs had a perfect outcome. Conservative management involves stabilising the affected limb in a cast. If this option is chosen it is imperative to warn the owner



**Figure 3 - Soft tissue injury following application of a cast.**

about potential complications and what to monitor for. Approximately 63% of animals will develop soft tissue injuries following application of a dressing (Figure 3). The most severe of these injuries may necessitate amputation. Owners should be warned about the importance of regular dressing changes. Dressings should be changed every five-to-seven days, but in young animals dressings may need to be changed more often. The third and fourth digits should be checked daily for any signs of swelling, but swelling of the digits is not a sensitive or specific sign for soft tissue injuries. The animal should weight bear with the cast, if there is a deterioration in limb use or the animal starts chewing at the dressing the cast should be removed and the limb assessed by a veterinarian.

Numerous surgical options have been reported. Lag screw fixation has been reported for treatment of MC and MT fractures that were reconstructable in racing greyhounds. External coaptation was used postoperatively<sup>2</sup>. It has subsequently been shown that 63% of animals will develop soft tissue related injuries following application of a cast. Sighthounds are significantly more likely to develop cast related soft tissue injuries compared to other breeds<sup>9</sup>.

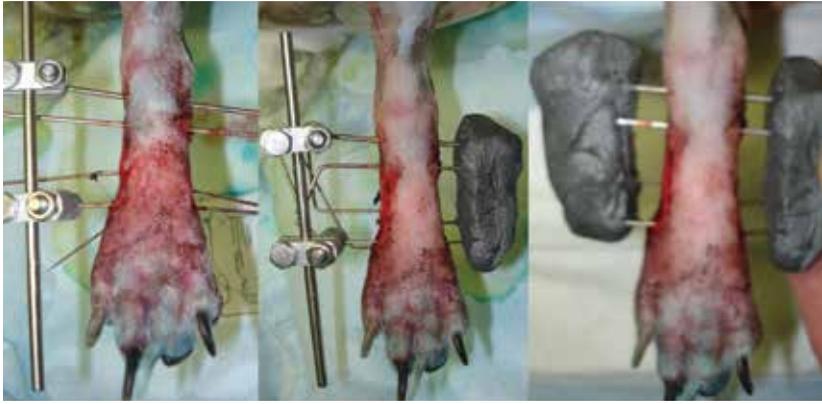
External coaptation should be avoided in these breeds if possible. Plating of MC and MT fractures can be performed using the maxillofacial mini-plate compact 1.0 (titanium cuttable plates) or veterinary cuttable plates. Both implants allow multiple screw placement in small bone segments<sup>10,11</sup>.

Benedetti reported a 'slotting technique' for intramedullary pinning of the metatarsals and metacarpals. A hole is drilled at the dorsal aspect of the distal MC or MT bone. This allows retrograde placement of a Kirschner wire (K-wire) which has the tip of the pin bent approximately 35 degrees. As a result the K-wire can be placed from the fracture site without disruption of the MC/MT phalangeal joint. The fracture is reduced and the K-wire can be driven into the proximal segment<sup>12</sup>. External coaptation is recommended postoperatively. The "slotting technique" can be challenging in cats due to bone size. 'Dowel' pinning in cats is a simple technique that can be used. It involves placement of a K-wire within the intramedullary cavity of the MC or MT bones. Dowel pinning was shown to be superior to external coaptation when all fractured bones could be pinned. In those cases where a combination of external coaptation and dowel pinning were used due to comminution or short fragments there was no difference in outcome compared to external coaptation alone<sup>5,13</sup>. Both of these techniques will provide good resistance against bending forces, but will perform poorly against rotational stability.

A variation to the technique reported by Bendetti involved placement of a retrograde intramedullary pin into the distal fragment of the four fractured MT bones; the pins protrude distally through the skin and are subsequently bent 90 degrees dorsally and joined with an epoxy resin putty<sup>14</sup>. At the author's centre we have treated numerous MC and MT fractures with an epoxy putty external skeletal fixation (ESF) system. General principles of external skeletal fixation are followed with care taken not to exceed 25-30% of the maximum diameter of the bone. A closed approach is used, avoiding disruption to the soft tissues at the fracture site. The proximal pin is placed through the base of the four MC or MT bones. In cases where fracture location is too proximal to allow this a full pin can be placed across the numbered tarsal or carpal bones. Due to the anatomy of the MC and MT bones it



**Figure 4 - Dorsoplantar and mediolateral radiograph of the metatarsus of a cat with fractures of metatarsal bones II-V. The fractures were stabilized with dowel pins.**



**Figure 5 - Bilateral uniplanar epoxy putty ESF, temporary alignment is maintained with a linear ESF before applying the epoxy putty.**

becomes difficult to engage more than two bones with the distal pins. Although proximally all MC and MT bones are aligned in the frontal plane distally the bones diverge and adopt a more curved configuration. It is not necessary for pins to be in the same plane as each other. At this stage postoperative radiographs are performed to assess alignment of the fracture fragments and pin placement. Alignment can be maintained by using a temporary linear ESF, once alignment has been confirmed on radiographs the metal pins on the opposite side are incorporated into an epoxy putty frame (Figure 5). A disadvantage of this type of ESF is that adjustment in the postoperative period is very difficult, hence the importance of obtaining radiographs prior to application of the epoxy putty. Care is taken to try to ensure that the joint proximal to the fracture is aligned with the digits and paw distally. The pins are subsequently bent 1-2cm from the skin surface. These pins will act as a scaffold for the epoxy putty<sup>1</sup>. The result is a modified type II epoxy putty ESF<sup>15</sup>. This method allows increased versatility in the location and angle of pin placement compared to conventional clamp and connecting bar constructs. Any concurrent wounds can be easily managed as external coaptation is not necessary. As a result the bandage related injuries seen with the placements of casts can be avoided<sup>9</sup>. However, removal of individual pins from the epoxy putty ESF following pin tract infections can be difficult. A good functional outcome can be achieved despite the formation of a malunion or synostosis<sup>3,4,15</sup>. Animals will readily weight bear with the frame on (Figure 6).

In cases of distal juxta-articular fractures of the MC or MT bones a combined intramedullary and external skeletal fixation has been described<sup>7</sup>. A limited surgical approach to align the bones is performed prior to retrograde placement of intramedullary pins in the distal fragments of the MC or MT bones. One or two pins are placed transversely across the base of the MC or MT bones. All of the pins are contoured dorsally and epoxy putty is placed over the pin ends. Care is taken to contour the intramedullary pins as close to the skin as possible to avoid impingement of the metacarpophalangeal or metatarsophalangeal joint.

This type of frame is known as a secured proximal intramedullary dorsal epoxy resin (SPIDER) frame. The author's personal preference is to avoid the use of these frames if possible due to the possible damage to the metacarpophalangeal or metatarsophalangeal joints. This may result in transitory lameness, but should resolve following removal of the fixator. Fracture union was shown to occur in less than 10 weeks in all cases. Oblique radiographs are often required postoperatively to assess the fracture site. A small proportion of cases experienced mild degenerative joint changes in the metacarpophalangeal and metatarsophalangeal joints in the long term. However, the clinical relevance of the changes in the metacarpophalangeal and metatarsophalangeal joints currently remains uncertain.

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**Figure 6 - Consistent weight bearing of the limb at 8 weeks, radiographs documenting radiographic union of previous fracture in Figure 2.**



**Figure 7 - SPIDER frame for stabilisation of distal juxta-articular metacarpal fracture.**

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## Reader Questions and Answers

### 1. WHAT IS THE PROXIMAL ASPECT OF THE METACARPUS KNOWN AS?

- Head
- Body
- Base
- Styloid

### 2. WHAT SIZE DIAMETER ESF PIN SHOULD BE USED IN PROPORTION TO THE METACARPUS?

- 10%
- 25%
- 40%
- 50%

### 3. WHICH OF THE FOLLOWING IS A SURGICAL INDICATION FOR METACARPAL OR METATARSAL FRACTURES?

- Fracture of MC/MT III

- Fracture of the body of MC/MT V
- Fracture of MC/MT IV
- Fracture of the base of MC/MT V

### 4. WHICH OF THE FOLLOWING BREEDS ARE MOST LIKELY TO DEVELOP CAST RELATED SOFT TISSUE INJURIES?

- Greyhound
- Labrador
- Border collie
- Bull dog

### 5. WHEN PLACING AN ESF PIN AT WHAT LOCATION ARE YOU MOST LIKELY TO ENGAGE ALL FOUR MC/MT BONES?

- Body
- Base
- Head
- None of the above

ANSWERS: 1, C, 2, B, 3, D, 4, A, 5, B.