

Fractures of the metabones - II

Fractures of the Metacarpus

掌骨骨折又可依其骨折部位分成基部(近端)、骨幹以及骨頭head(遠端)三種。

Fracture of the Base

最內側(第二掌骨)以及最外側(第五掌骨)是最容易發生基部骨折的位置(Figures 14-25, A, and 14-26, A)，由於此兩處為韌帶insertion的起始點，因此前肢不同程度外翻(外側)易位多伴隨第二掌骨的骨折，而不同程度內翻(內側)易位則伴隨第五掌骨的骨折。

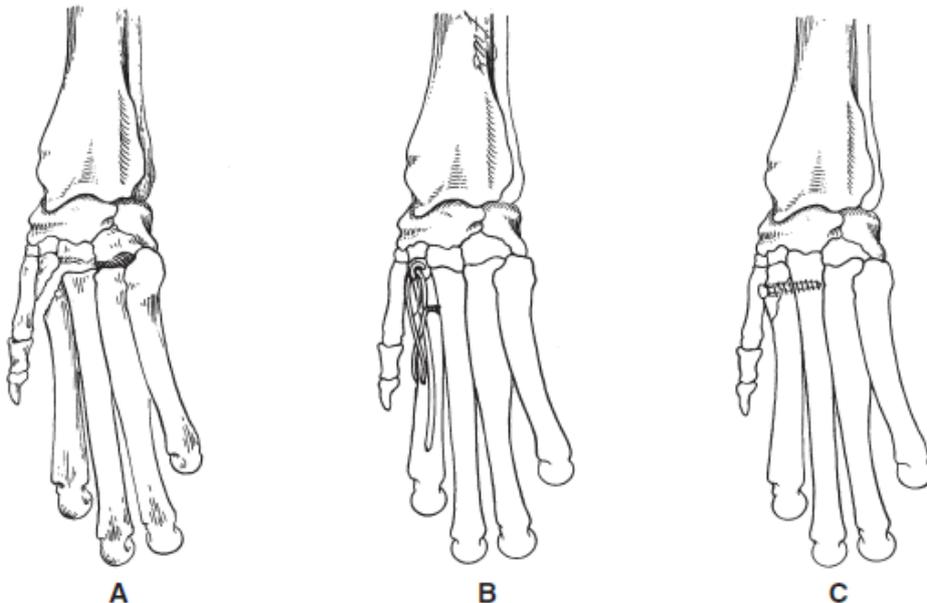


FIGURE 14-25. A, Fracture of the base of the second metacarpal bone is usually associated with valgus (lateral) deviation of the foot. B, Fixation with Kirschner wire and tension band wire. C, Fixation with lag screw.

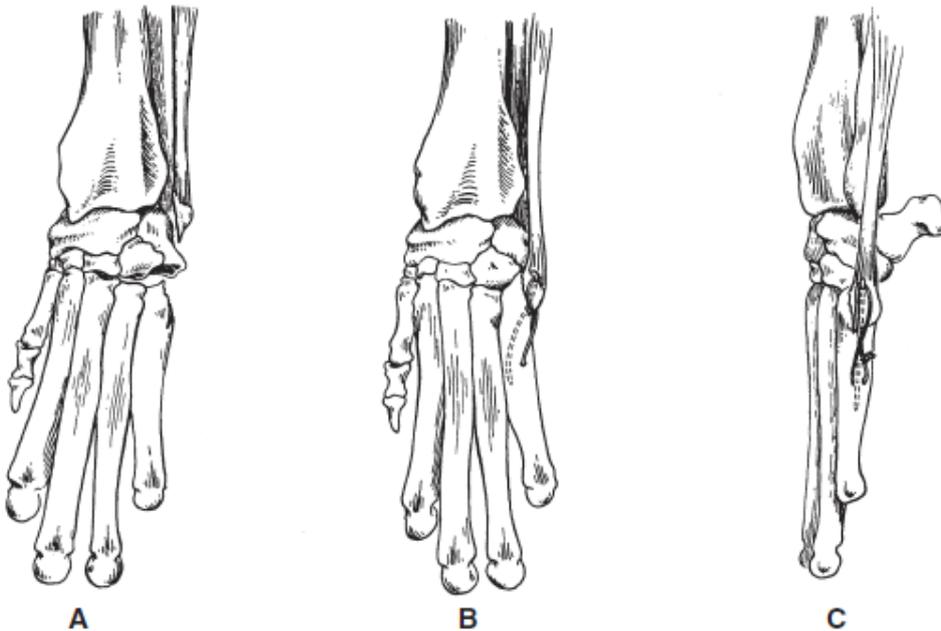


FIGURE 14-26. A, Fracture of the base of the fifth metacarpal bone. The tendon of insertion of the ulnaris lateralis muscle causes the fragment to be displaced proximally. Some varus (medial) deviation of the foot may be present. B and C, Fixation is by the tension band wire technique. The Kirschner wire is 0.045 inch in diameter, and the stainless steel wire is 22 gauge. This fracture could also be repaired with a lag screw.

➤ Closed Reduction

無易位的骨折Undisplaced fractures可利用外固定方式治療，但此處骨折的骨片在癒合過程中常有部分易位而造成內翻或外翻與癒合不良。Secure molded splint或short cast (see Figures 2-27 and 2-22, respectively)皆為建議使用的方式。

➤ Open Reduction and Internal Fixation

固定易位的骨折最常使用的方式為tension band wire technique(Figures 14-25, B, and 14-26, B and C). Lag screws在某些情形也適用(Figure 14-25, C)，大型犬隻的粉碎性骨折可使用small plates配合lag screws與/或cerclage wires(Figure 14-27)。賽犬的右肢常見第二掌骨(與第三跖骨)的骨折，此類骨折多無易位且伴隨部分callus的生成(Figure 14-28, A and B)。固定急性傷害的病畜可使用palmar splint (see Figure 2-27)並持續4週，若無效果則建議使用2.0-mm miniscrews進行固定(Figure 14-28, C)；針對慢性傷害的病畜則可利用骨穿刺術osteostixis刺激其癒合，操作方式為在骨折

處鑽數個1.5-2.0mm的孔洞，之後再用splint包紮4週。

➤ Aftercare

利用cast或splint進行primary fixation通常要持續6週，若為stress fracture則僅需持續4週；使用內固定的方式進行治療，molded palmar splint或short cast (see Figures 2-27 and 2-22)要持續3-4，splint移除後並處仍要限制運動3-4週。

Fracture of the Shaft

單一根掌骨有時候甚至是兩根掌骨骨折都還不算很嚴重的傷害，特別是在中間兩根掌骨並未牽涉其中的時候，使用simple palmar splint即可達到不錯的癒合效果。然而，當三根或四根掌骨皆斷裂 (Figure 14-29, A)，特別是在大型及巨型的犬種時情況則有所不同，simple splints(特別是使用spoon splints)常僅能達到延遲癒合或癒合不良的效果，有時甚至會不癒合；此外，也可能因支持力不足而出現valgus deformity、palmar bowing等情形(Figure 14-29, B and C)。

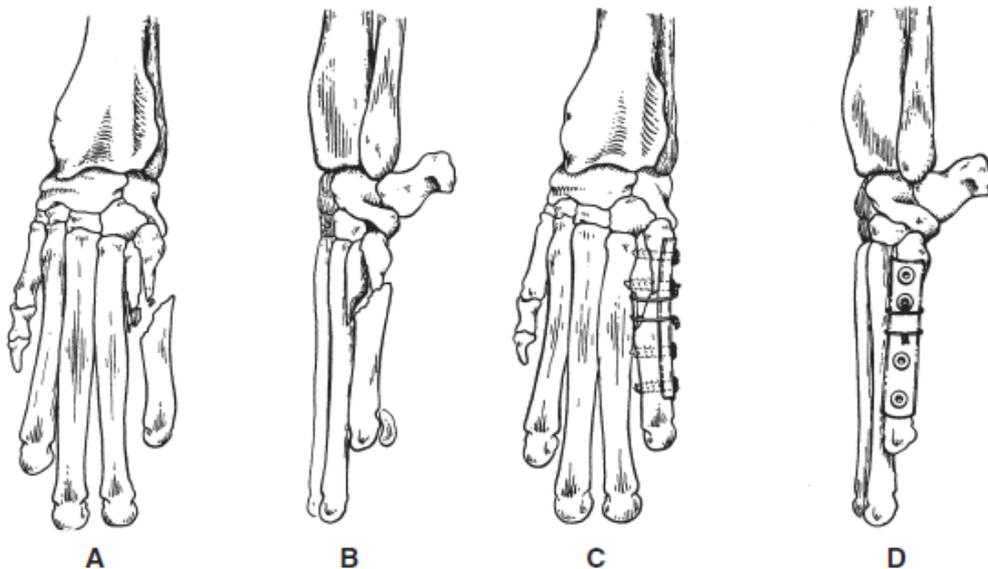


FIGURE 14-27. A and B, Comminuted fracture of the proximal shaft and base of the fifth metacarpal bone. C and D, One-third tubular plate, 2.7-mm screws, and 22-gauge cerclage wire fixation. The two proximal screws were applied in lag fashion.

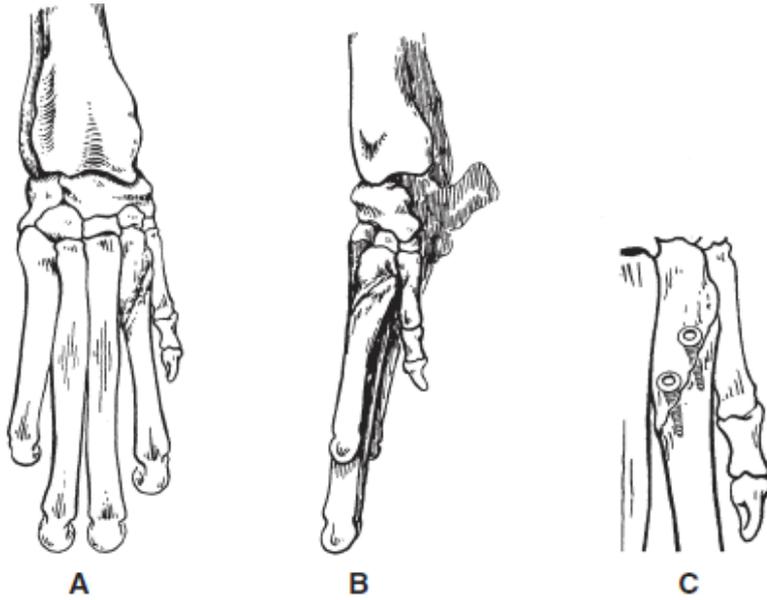


FIGURE 14-28. A and B, Stress fracture of the second metacarpal bone, right forefoot. This fracture is specific in the racing greyhound. The fracture is usually incomplete and undisplaced and may extend into the articular surface of the base; unless it is seen very early, it will have some periosteal callus formation, which is usually palpable. C, Fixation with 1.5-mm or 2.0-mm lag screws placed in a dorsal-palmaromedial direction.

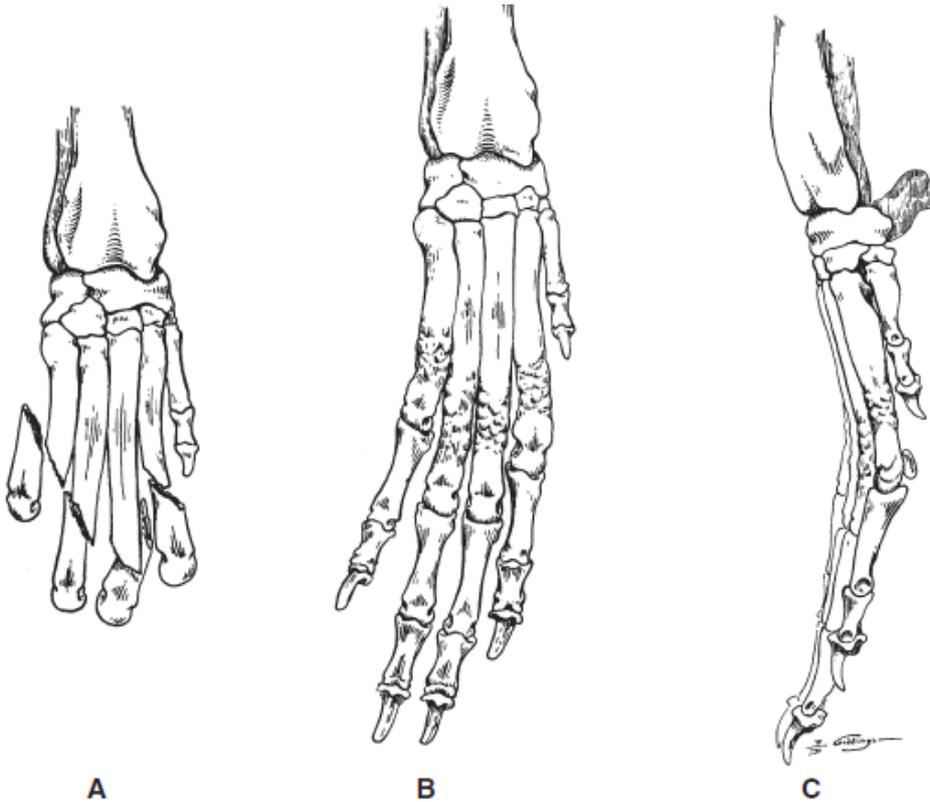


FIGURE 14-29. A, Multiple metacarpal shaft fractures. B and C, Closed reduction and inadequate external fixation resulted in valgus deformity and palmar bowing of the metacarpus.

➤ Closed Reduction

當選擇以closed reduction及外固定的方式治療，建議使用molded

splint或fiberglassshort cast(可參考Figures 2-27與2-22)因其較符合腳的形狀、骨頭可有較佳的支持力，splint或cast必須維持直到影像學可見到良好的癒合跡象，通常需要4-8週，隨病畜年齡的不同而異。

➤ Open Reduction and Internal Fixation

當大於兩根掌骨骨折，特別是中間兩根掌骨牽涉於其中時則建議使用內固定的方式進行治療，其他如嚴重粉碎性或易位的骨折、不癒合或癒合不良者亦建議使用內固定。針對大型、運動型的犬隻，即使只有單一處、單一根掌骨骨折仍建議使用內固定。

- Intramedullary Pins

Kirschner wires (K-wires)、Steinmann pins以及Rush pins皆可用於掌骨/蹠骨骨折，其適應症為橫斷、斜斷且沒有很多骨碎片的骨折，在長骨斜斷骨折可合併使用cerclage wires。置入Pins應避免與medullarycanal過度緊密地充填以免影血液環導致癒合的延遲；基本上0.045-0.062 inch (1.2-1.5 mm)的K-wires就已足夠。術者應將pin視為僅維持骨頭reduction的internal splint，欲使骨折處有更好的固定效果與癒合須配合使用external cast或splint。

掌骨/蹠骨的皮質骨厚而intramedullary (IM) canals較小，導致IM pins或K-wires的穿過困難。植入pins時不要損害或影響metacarpophalangeal joint的活動可使其功能的維持有最佳的結果，當有足夠的callus生成以支持pin即可盡快移除external coaptation。植入pins時可從骨頭的遠端、關節軟骨的背側緣進入；雖然當pins太大或較硬而無法彎折可能導致pins進入骨頭時有一微小的角度，pins仍應置於鄰近medullary canal處，骨折處reduce後將pin植入鄰近處的骨碎片直至其穩定坐落於骨頭的基部，接著將pin回拉出5 mm彎折出一個勾狀並將末端剪掉隨後重新植入骨頭中

直到勾狀的部分接近骨頭表面，此法可以使突出骨頭的pin達到最少以避免影響關節，此外，亦可使pin較易被移除(可參考Figure 14-30)，然而此法較不適用於小型犬。有些人建議使用retrograde insertion (從骨折處)的方式，但此法難以避免穿入遠端關節軟骨。另一種將IM pin傾斜置入掌骨的方式為 先利用high-speed bur在骨折區遠端或近端(取決於骨折的位置)背側cortex處鑽一個slot，此可避免置入pin於medullary space時影響關節面(可參考Figure 14-30, C;以及Figure 14-20, B與C)。最後一種方式可用於有足夠大小可容納1/16-inch (1.5-mm)Rushpin (Osteo-Technology International, Inc., Hunt Valley, Md)的骨頭，術者不須把pin彎折成勾狀可在距離關節面些許距離處置入pin(可參考Figure 14-31, C)，基本上，Rush pin可提供較IM pin佳的穩定效果。

➤ Aftercare for IM Pins

以splint或cast使metacarpophalangeal joint保持伸展的狀態(可參考Figures 2-27 and 2-22)，癒合後可移除pins；若pins穿過關節軟骨則splint要到癒合完全並移除pins、可active weight bearing前才可移除；Rush pins則多不需要移除。

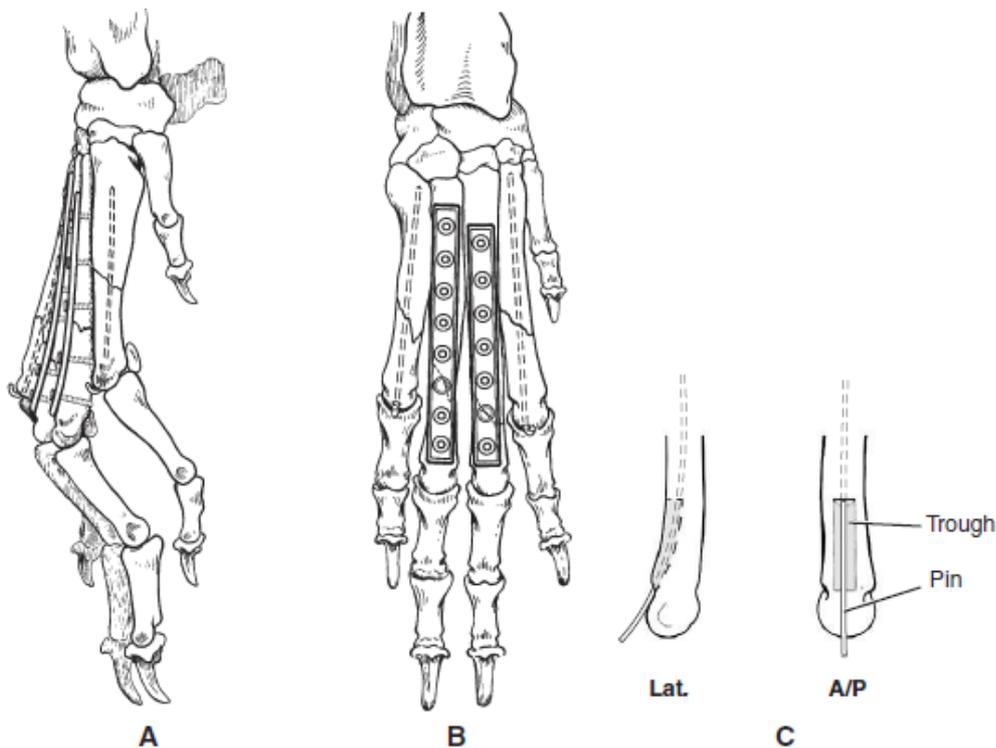
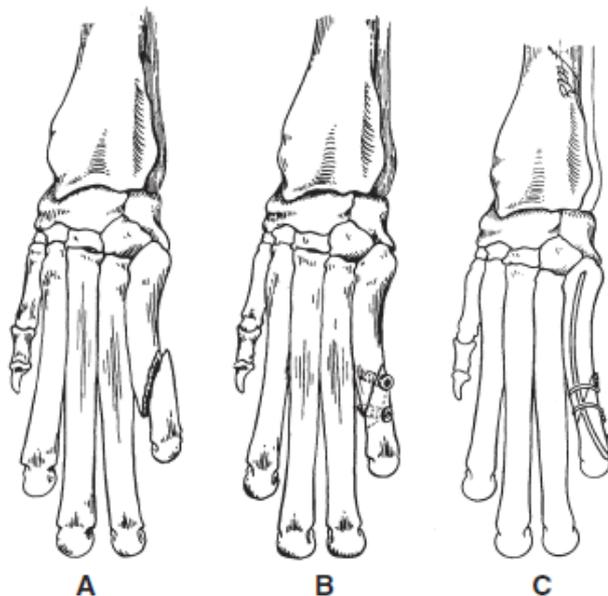


FIGURE 14-30. A and B, Combined bone plate and intramedullary fixation of multiple metacarpal fractures. Kirschner wires are inserted in the distal segment of metacarpals II and V, staying as close as possible to the dorsoproximal edge of the metacarpophalangeal joint capsule. The fracture is reduced, and the pins are driven proximally into the base of the bone. The pins are then bent to a hook shape and driven as close to the bone as possible to allow more extension of the toes and easier removal of the pins. Plate fixation is ideal for fixation of metacarpals III and IV, which are the major weight-carrying bones. Veterinary cuttable plates (Synthes, Ltd., Paoli, Pa) are the most adaptable plate for this application. C, A trough has been created with a high-speed bur in the distal segment to allow oblique cortical pinning. Pinning of all four metacarpals is acceptable if plating is not possible. In either case, the foot must be supported in coaptation for several weeks.

FIGURE 14-31. A, Oblique shaft fracture of the fifth metacarpal in a racing greyhound. B, Fixation by 2.7-mm lag screws. This method was chosen over pinning or cerclage wiring because there is less joint and soft tissue irritation. Primary bone union was achieved. C, Cerclage wires and $\frac{1}{16}$ -inch diameter Rush pin. The articular surface is not invaded.



- Cerclage Wires

在掌骨/蹠骨使用wires的基本原則同其他處的骨折，常用的wire

sizes 介於 20 gauge (0.8 mm) 至 24 gauge (0.4 mm)，確認 cerclage wire 有被拉緊十分重要，因其不穩固、移動可能影響 underlying bone 的血液循環。與其他長骨骨折相比，掌骨/蹠骨很少將 cerclage wires 當成 primary fixation，因其幾乎都會配合使用 external casts 或 splints 來支持 internal fixation，More often, however, cerclage wires are combined with IM pins (可參考 Figure 14-31, C)。

- Lag Screws

在掌骨/蹠骨骨折使用 lag screws 進行骨片間的固定和使用 cerclage wire 相似，較少作為搭配 external cast/splint 使用的 primary fixation。隨著 1.5-mm 及 2.0-mm screws 的問世，其被使用於 long oblique 或 spiral fractures 的成效也增加，欲合併使用 IM pin 與 lag screws 幾乎是不可能的，因此處骨頭較小，screws 基本上單獨使用 (可參考 Figure 14-31, B) 或配合使用 bone plates (參考 Figure 14-37, C 及 D)，其餘使用 lag screws 準則同其他骨折處。

- Bone Plates

Small plates 可用於固定大型犬隻極度不穩定的骨折 (可參考 Figure 14-30) 以及不欲合的骨折 (可參考 Figure 14-32)，由於其可提供相當程度的穩定度，因此配合使用外固定的時間不需向其他固定法一樣長，基本上使用 cast 或 splint 4 週即可使肢體達到可以有限運動的程度。Plate 及 screw sizes 介於 1.5-2.7mm，flat 及 semitubular plates 皆可使用；cuttable plates (Synthes) 由於在單位長度內較傳統骨板可置入更多 screws 且其 low profile design 可降低軟組織覆蓋的問題因此被建議使用。

- Aftercare for Wires, Lag Screws, and Bone Plates

所有使用內固定的病畜皆應配合使用 molded splint 或 cast 以增加穩定性 (可參考 Figures 2-22 及 2-27) 直到影像學顯示有明顯的癒合跡

象，通常是3-6週。Bone plates通常3-4個月後移除，特別是在活動力較強的病畜；Bone screws與cerclage wires通常可以持續放置而無害，從distal joint area置入的IM pins應在callus生成後盡速移除而Rush pins若有必要可以持續放置。

Fracture of the Head

在metacarpal head最常見的傷害之一為condyle的骨折，此種骨折會導致metacarpophalangeal joint的不穩定、luxation或subluxation(可參考Figure 14-33)因為關節處的collateral ligaments起自condyle；condylar fragment可能很小(Figure 14-33, A)或牽涉hea的一半。

➤ Treatment

使用Closed reduction與external cast通常會造成關節的不穩定、骨片的intraarticular alignment不良而出現退化性關節疾病。採用Internal fixation的方式，特別是在運動型的犬隻，有較高的機率可以使肢體恢復正常功能，可直接切開受損處的皮膚進行approach；Internal fixation可使用wire (可參考Figure 14-33, C及D)或lag screws (Figure 14-33, D)。運動型犬隻此處骨折修復若失敗可能必須進行metacarpophalangeal joint的截肢以保留功能性，特別是當第三及第四掌骨牽涉於其中時。

➤ Aftercare

Molded palmar splint或cast通常要維持4週，並限制運動6-8週。

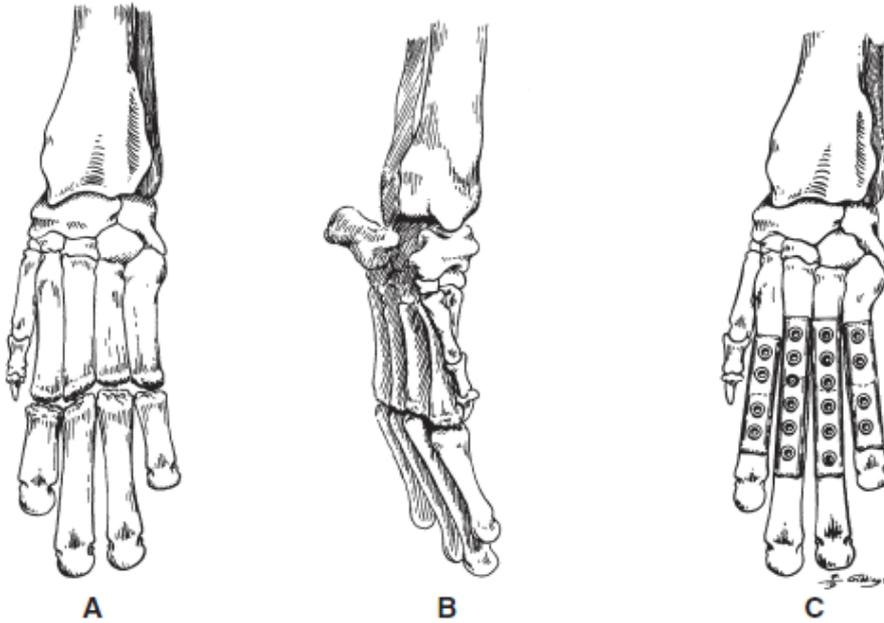


FIGURE 14-32. A and B, Nonunion fracture of all metacarpals, 9 months' duration. C, Multiple bone plate fixation. Size of plate will vary from a 1.5- to 2.7-mm screw size. Good healing was achieved using 2.7-mm plates and screws in this 80-pound (36-kg) dog.

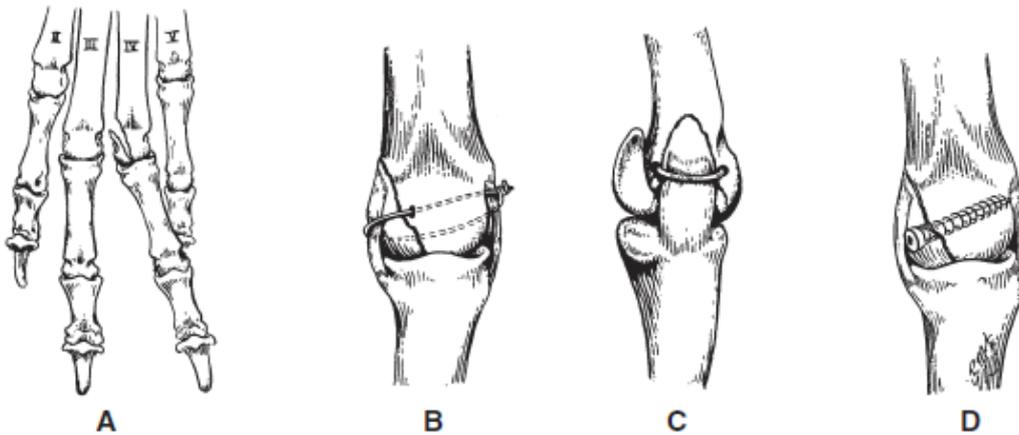


FIGURE 14-33. A, Fracture of the medial condyle of the head of the fourth metacarpal bone. Valgus deformity of the toe results. B and C, Wire fixation of fragments. To avoid drilling a hole through the small fragment, two holes are drilled in the metacarpal bone, and the wire (22 gauge in a 60-pound animal) is passed through the holes and around the fragment. If the wire can be passed through the ligamentous tissue, it will have less tendency to slip off the fragment. D, Lag screw fixation with 1.5-mm or 2.0-mm screws is ideal if the fragment is large enough.

Reference

1. Piermattei DL, Flo GL, DeCamp CE. Handbook of small animal orthopedics and fracture repair. 4th ed. Saunders Elsevier, St. Louis, 2006.