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Direct fixation of posterior malleolus fractures-posterolateral or posteromedial approach?

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Ankle fractures involving the posterior malleolus (PM) generally have worse prognosis. There is a trend towards it's direct fixation, yet the exact indications are a subject of debate. The purpose of our study was to present our treatment protocol and to discuss the advantages and limitations of the direct posterolateral and posteromedial approaches. We present a prospective series of 35 ankle fractures involving the PM, operated for a period of 4 years (2018-2022). Direct posterolateral approach was used in 20 ankles, 15 were operated via a posteromedial approach. Clinical and functional assessment was performed according to the criteria of AOFAS. 14 patients received an excellent score, 16 had good and the rest had an average score. The overall score was 85,4 (54-100). The average range of motion was 50° (15°-55°).Eight patients had superficial skin necrosis along the surgical incision. Thirteen patients need their fibular plates removed due to local irritation. Five patients, operated through a posterolateral approach, had lateral heel numbness suggestive of a sural nerve disfunction. PM is important for normal ankle kinematics. When it's direct fixation is considered appropriate, the safest and shortest route is optimal. It is determined by the preoperative CT. The posterolateral approach is more versatile, but lead to more complications in our study.

Keywords: posterior malleolus fracture, posterolateral approach, posteromedial approach, mid term results.

INTRODUCTION

The posterior malleolus (PM) fracture is generally considered as poor prognostic factor[1] , yet its biomechanical and clinical significance is still a subject of debate. In a cadaveric study, Hartford et al. reported a progressive decrease of tibiotalar contact area following increase in PM resection size[2] . Authors hypothesised that this may lead to increase in contact pressure, followed by cartilage degeneration. In a somewhat contradicting study Papachristou et al. demonstrated that under normal range of motion the PM does not bear any significant load[3]. Harper found that resecting up to 50% of the PM did not lead to ankle instability, as long as the syndesmotic ligaments are intact and the fibula is centered in its tibial incisura[4]. Fitzpatrick et all created PM fracture that involved 50% of the tibial plafond and entered the fibular incisura. They tested the dynamic load distribution of the ankle. Although the contact pressure did not increase significantly , there was an anteromedial stress shift . The authors speculated that this may contribute to early arthritic changes[5].

It seams that the PM does not bear much weight and is more important for syndesmotic integrity and normal ankle kinematics. This understanding shifts decision making focus away from sheer PM fragment size, motivating a more aggressive approach for its reduction and fixation[6]. The purpose of our study was to explore the indications and the limitations of the two most common direct approaches utilised to achieve this.

MATERIALS AND METHODS

Thirty five ankle fractures with PM involvement we operated for a period of 4 years (2018-2022). Open reduction and posterior to anterior fixation was performed, if there was articular depression, intercalated articular fragments, fibular notch disruption or posterior fracture dislocation with posterior cortical comminution.

CAT scan investigation was performed in all of the cases.

PM fractures were classified according to Bartonicek[7]. Seven consisted of a small fragment that extended into

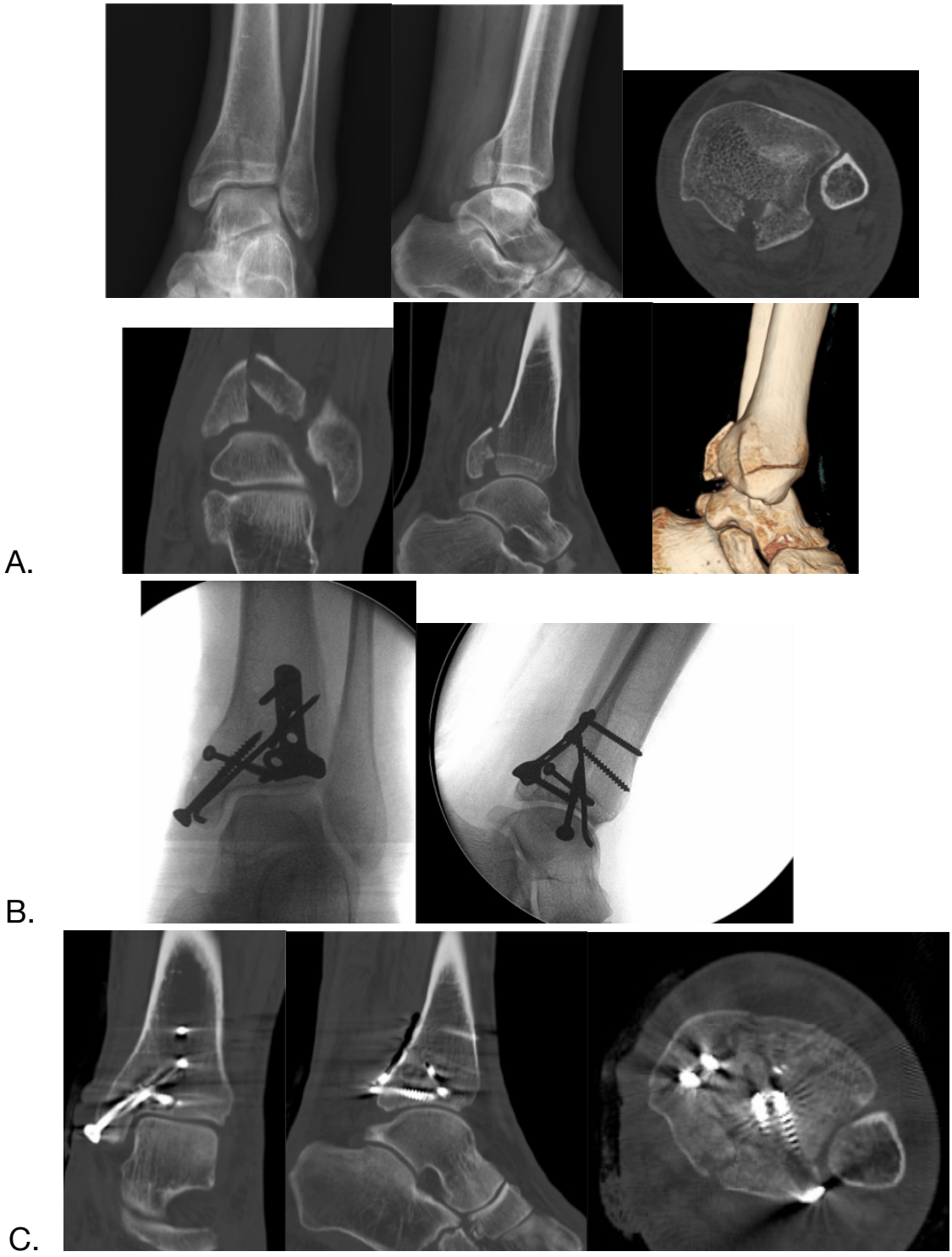

Figure 1 — A. Bartonicek type 3 fracture with an intercalated fragment (note the anterior shift of the fibula); B. Result after open reduction through posterolateral approach and separate medial approach; C. Postoperative CAT scan showing anatomical reduction of the intercalated fragment (note the corrected position of the fibula-no syndesmotic screw necessary).

the fibular notch-type 2. Eighteen PM fractures were fragmented and involved the posteromedial side- type 3. Ten fractures had a large posterolateral triangular fragment- type 4. The choice of an approach depended on the fracture anatomy as seen on the preoperative CAT scan.

Direct posterolateral approach was used in 20 ankles (all types 2 and 4 and three type 3 fractures that had lateral intercalated fragments), the rest 15 were operated via a posteromedial approach (those were all type 3 fractures). The extraincisural type 1 PM fractures were not operated.

Table I. — Patient data

Fracture type Bartonicek	AOFAS rating	Healing time (weeks)	Complications	Approach
Type 3	Excellent	9	Skin necrosis, fibular plate removal	Posteromedial +lateral
Type 3	Excellent	8	None	Posteromedial +lateral
Type 2	Good	10	Sural nerve neuropraxy ,	Posterolateral
Type 3/intercalated fragments/wagstaffe fragment	Excellent	8	Sural nerve neuropraxy	Posterolateral +limited anterolateral
Type 3/intercalated fragment	Average	12	Marginal skin necrosis/prolonged oedema	Posterolateral+medial
Type 3	Good	9	None	Posteromedial +lateral
Type 2	Excellent	8	Sural nerve neuropraxy	Posterolateral
Type 4	Good	10	None	Posterolateral
Type 3	Excellent	9	None	Posteromedial +lateral
Type 3	Good	9	Marginal skin necrosis	Posteromedial +lateral
Type 3	Good	9	None	Posteromedial +lateral
Type 3	Average	9	Stiffness	Posteromedial +lateral
Type 3/intercalated fragments/wagstaffe fragment	Excellent	9	None	Posterolateral +limited anterolateral
Type 3	Avetrage	10	marginal skin necrosis	Posteromedial +lateral
Type 3	Excellent	9	None	Posteromedial +lateral
Type 2	Excellent	9	Sural nerve neuropraxy	Posterolateral
Type 4	Excellent	9	Fibular plate removal	Posterolateral
Type 4	Good	9	Fibular plate removal	Posterolateral
Type 3	Good	8	Skin necrosis	Posteromedial +lateral
Type 4	Excellent	9	None	Posterolateral
Type 2	Good	9	Fibular plate removal	Posterolateral
Type 2	Excellent	9	None	Posterolateral
Type 3	Good	10	Fibular plate removal	Posteromedial +lateral
Type 4	Good	10	Fibular plate removal	Posterolateral
Type 4	Excellent	9	None	Posterolateral
Type 3	Good	9	Skin necrosis	Posteromedial +lateral
Type 4	Good	9	Fibular plate removal	Posterolateral
Type 3	Average	11	Fibular plate removal	Posteromedial +lateral
Type 4	Good	9	Fibular plate removal	Posterolateral
Type 4	Good	9	Fibular plate removal	Posterolateral
Type 3	Average	10	Skin necrosis	Posteromedial +lateral
Type 4	Good	9	Sural nerve neuropraxy, Fibular plate removal	Posterolateral
Type 2	Excellent	8	None	Posterolateral
Type 3	Excellent	9	Skin necrosis, fibular plate removal	Posteromedial +lateral
Type 2	Good	9	Fibular plate removal	Posterolateral

Seventeen of the patients were male, 18 were female. The average age was 51 years (ranging 35-68 years). X ray and clinical examination was performed monthly till the sixth postoperative month and yearly after that. The average follow up was 1 year. Clinical and functional assessment was performed according to the criteria of American Orthopaedic Foot & Ankle Society-AOFAS[8]. A maximum of 100 points was awarded in two categories: objective assessment (pain, stability , ROM) and functional assessment (ability to walk on rough surfaces and to climb stairs).

When performing a posterolateral approach, the patient was placed prone on the operating table. Skin incision was placed lateral to the Achilles tendon.

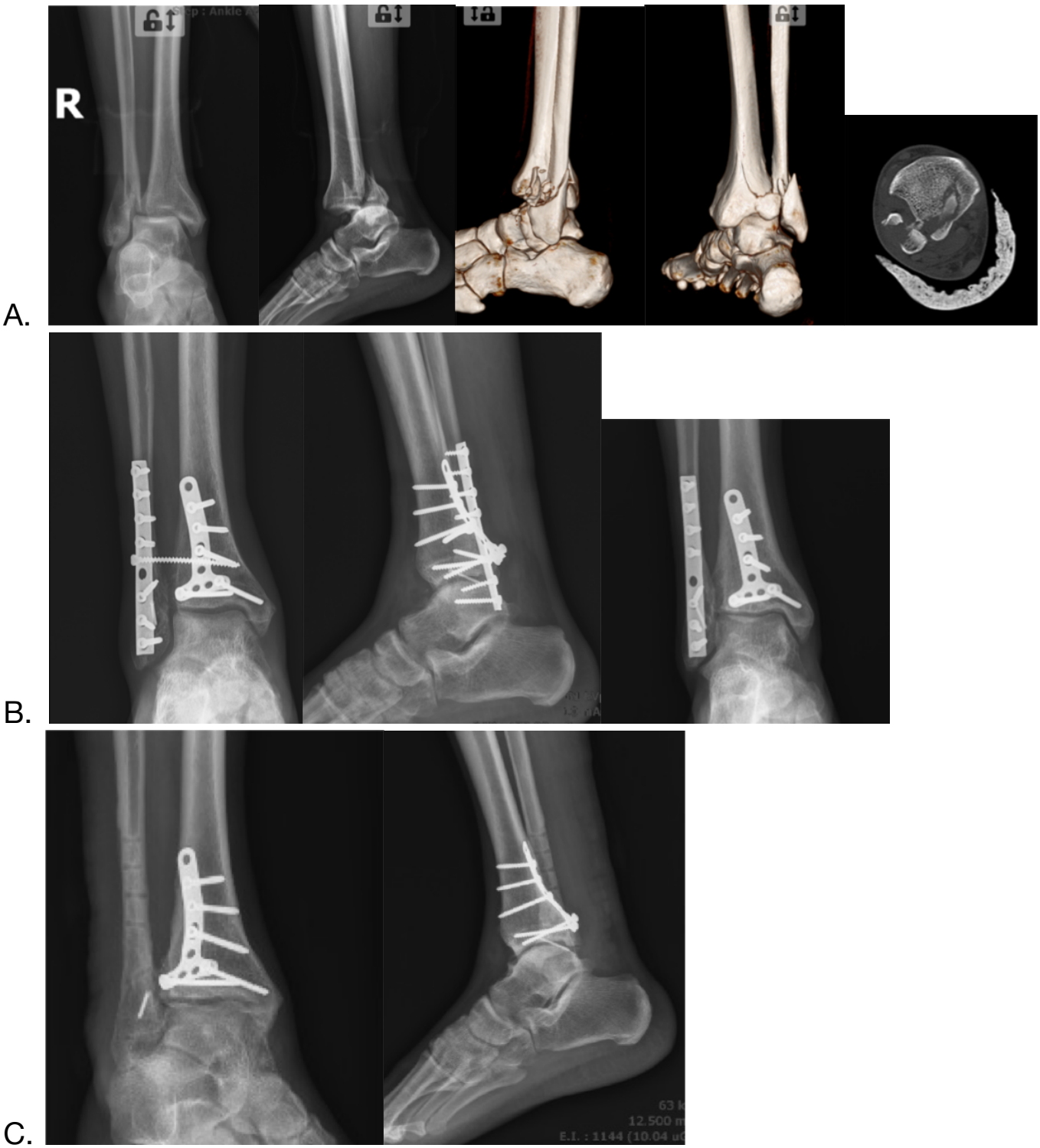

Figure 2 — A. Bartonicek type 3 fracture-dislocation with posterior intercalated fragment (note the Wagstaffe fragment of the fibula); B. Result after open reduction through posterolateral approach and separate anterolateral approach for fixation of the Wagstaffe fragment (before and after removal of the syndesmotic screw at 3 -rd month); C. Removal of the fibular plate due to irritation at 1 year. Excellent functional result in spite of some arthritic changes.

The sural nerve was identified and protected.After incision of the facia, peroneal muscle bodies were retracted laterally. Branches of the perineal artery were identified and protected whenever possible.The muscle belly of flexor hallucis longus was retracted medially, giving access to the posterior tibial lip. In case of an intercalated articular fragment, PM was opened on a lateral hinge (figure 1). Any intercalated fragments

Figure 3 — A. Bartonicek type 3 fracture (posterior Pilon fracture variant) without intercalated fragments; B. Result after open reduction through posteromedial approach and separate lateral approach for fixation of the fibular fracture; C. Removal of the fibular plate due to irritation at 1 year; D. X rays at 2 years. Excellent functional result, no arthritic changes.

were thus visible.They were reduced and held in place by temporary K wires.The posterolateral fragment was then closed and fixed by a buttress plate and lag screws. The plate was usually under contoured for additional compression. If present the fibular fracture was addressed through the same approach. The peroneal

muscle bellies were retracted medially. A 1/3 tubular plate was applied posteriorly in a anti-glide position. Syndesmosis stability was tested and additional syndesmotic screw was added if deemed necessary. Wagstaffe or Tillaux fragments were addressed through a separate anterolateral incision that was performed by flexing the knee and externally rotating the leg (figure 2). If present, medial malleolus fracture was fixed through a medial approach. The patient had to be turned in a supine position and redraped.

This time consuming manoeuvre was not necessary when we performed a posteriomedial approach (figure 3). Medial malleolus fractures could be operated in prone position, without turning and redraping the patient. He or She was placed supine on the OR table. The calf was flexed in a figure of 4 position. The skin incision was placed medially to the Achilles tendon and curved around the medial malleolus. The length was determined by the metaphyseal component of the fracture. Deep dissection depended on fracture morphology. The interval between flexor hallucis longus and the tibial artery was developed, if a better approach to the lateral tibial portion was needed. More often than not, we preferred to enter in front of tibialis posterior and flexor digitorum longus tendons. In those cases the tibial artery and nerve were not visualised. After reduction was verified on a true lateral X ray projection, definitive fixation was completed by a posterior buttress plate. The medial malleolus fracture was reduced and fixed through the same approach. The fibular fracture was then reduced and fixed in an usual manner, through a separate lateral approach.

All patients received low molecular weight heparin for 30 days.

Postoperatively all ankles were splinted for a period of 14 days, active range of motion exercises were started as soon as the pain subsided (typically on day 3 after the operation). Touch weight bearing was allowed immediately. Full wight bearing was advised after the second month.

RESULTS

All fractures healed for an average period of 9,7 weeks (8-12). According to the criteria of the American Orthopeadic Foot and Ankle Society, 14 patients received an excellent score, 16 had good and the rest had an average score. The overall score was 85,4 (54-100). The average range of motion was 50° (15°-55°).

At the time of their last follow up, thirty patients had no pain and five reported of minor pain. Three patients could walk less than a kilometre, two needed a cane. All were elderly women.

All patients of working age returned to their previous occupation.

COMPLICATIONS

We didn't encounter any serious intraoperative complications, deep infections, septic arthritis or thrombophlebitis. Eight patients had superficial skin necrosis along the surgical incision, which healed by secondary intention, without any additional procedures. Five of those were operated through a posterolateral approach.

One patient had significant swelling (that lasted till the sixth month). The functional recovery was impeded and took significantly longer. There might have been some lesser venous thrombosis that couldn't be diagnosed.

Thirteen patients need their fibular plates removed due to local irritation. Of those 10 were treated through a posteriolateral approach.

Five patients, operated through a posterolateral approach, had lateral heel numbness suggestive of a sural nerve disfunction. None had painful neurinoma symptoms and all recovered with time (table I).

DISCUSSION

There is a clear trend towards direct repair of the PM fractures, but the precise indications and approaches are a subject of debate. She et al. compared the quality of reduction and functional results of two groups of patients[9]. All had a PM fracture that involved more than 25% of the articular surface. Sixty four were treated through a direct approach. Fifty four had their PM reduced indirectly. The authors reported better quality of reduction and functional outcome in the first group. In a randomised controlled trial, Vidovic et reported similar results and favoured direct reduction of the PM fragments larger than 25% of the articular surface[10]. Zhong S et al compared posteromedial with posterolateral approach in 48 trimalleolar fractures. Both groups of patients had similar fracture morphology. The authors reported comparable clinical and radiographic outcomes and concluded that the choice of approach should be dictated by the surgeon's experience[11] . Bois et al. operated 17 cases with posterior fracture dislocation of the ankle using a posteromediall approach. An additional posterolateral approach was added in 2 cases. The authors explored the interval between the tibialis posterior and flexor digitorum tendons.The patients were followed up for 9,4 year period. Most of

them (67%) developed osteoarthritis, but had good or excellent function regardless. As in our study, authors concluded that the postromedial approach was safe and did not cause wound healing problems[12]. Bali N et al. treated 15 patients with PM ankle fractures[13]. Authors used Haraguchi classification[14]. All of the fractures were type 2, which roughly corresponds to Bartonicek type 3 that we used. As in our study, those were treated through a posteromedial approach. The authors concluded that the approach is safe and reproducible and allows fragment specific visualisation and fixation. Zbeda et al also recommended postero-medial approach PM fractures with medial extension. Authors argued that it is needed, because there are no ligamentous insertions that can aid fracture reduction by ligamentotaxis[15]. In a cadaver study, Mitsuzawa et al, compared posteromedial, modified posteromedial (mPM), Achilles tendon-splitting (TS), and posterolateral approaches to the PM[16].The authors found that the latter, directly endangers the sural nerve and branches of the peroneal artery and does not allow sufficient visualisation of the medial side.The modified posteromedial approach originally described by Assal M[17], was developed in the interval between the medial neuromuscular bundle and the Achilles tendon. It was found it to be safest and to offer best visualisation, both to the lateral and medial side of the posterior pilon.

Confusingly, in their retrospective study, De Vries et al., found no correlation between the size, or fixation of the PM fragment and the final result[18]. Fracture-dislocations faired worse and were usually associated with larger PM fragments, so authors recommended specific fixation in those cases only. White speculated that, if after lateral and medial fixation, the ankle mortise is stable and there is neither a joint impaction or large intercalated fragments, direct fixation of the PM fragment is not necessary[19].

In our study we followed those recommendations, but also considered the disruption of the fibular notch to be important for the reduction of the ankle mortise, as suggested by Bartonicek[7]. We believe that precise restoration of the syndesmosis is quite unreliable if the fibula is not reduced to length and seated in its anatomical location. We also considered posterior cortical comminution as an indication for a direct approach and reduction. As a result of a higher energy trauma, it is usually combined with articular depression and, or fragmentation.

The choice of an approach was largely dictated by PM fracture morphology[7,20].

The posterolateral approach was chosen in all type 2 and 4 fractures that involved the fibula and PM. It allowed open reduction and simultaneous fixation of both fractures.

The presence and exact location of intercalated fragments guided our approach decision in type 3 fractures. If present and located laterally, a posterolateral approach was chosen. The PM was hinged on the posterior tibiofibular ligament. The depressed or intercalated fragments then were visualised , reduced or discarded. An additional medial approach was used to fix the medial malleolus fracture (figure 1).

A definite disadvantage of the posterolateral approach is the proximity of the sural nerve. We dissected and protected it every time and still a quarter of our patients experienced some form of transient heel numbness. Superficial skin necrosis was also more often after a posterolateral approach. Peroneal muscle bodies had to be mobilised and retracted medially, jeopardising the blood supply of the lateral skin flap. Most of the symptomatic fibular plates were also placed in an antiglade position, through a posterolateral approach. Although a disadvantage, this did not to impair functional recovery.

Posteromedial approach was chosen for the majority of the type 3 fractures (figure 2) . It allowed fixing PM and medial malleolus without redraping and turning of the patient. Addressing Wagstaffe or Tillaux fragments was also easier.

Posteromedial approach was safer, as few patients developed skin problems and none had sensory disfunction.

CONCLUSION

In conclusion, achieving concentric mortise and talus reduction should be the end result of any ankle surgery. When direct fixation is considered appropriate, the safest and shortest route to the fracture is probably optimal.

There isn't one approach fit all PM fracture types. Both posterolateral and posteromedial approaches should be in the skill mix of the treating surgeon to allow optimal visualisation, reduction and implant placement.

Disclosure summary: The author has nothing to disclose.

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