

# THE TREATMENT OF LISFRANC INJURIES

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Thirty-one patients with fracture-dislocations of the tarsometatarsal joint were examined to assess the functional end results after a mean follow-up of 2.9 years (range 20 to 56 months).

Sixty-one percent were polytrauma patients ; 39% suffered isolated fractures. Forty-five percent had associated lesions of the tarsal joint complex (Chopart and subtalar joint).

According to the Baltimore Painful Foot Scoring System (PFS), 52% achieved an excellent or good result and 48% a fair or poor result.

Of the four different treatment modalities, open reduction and temporary screw or K-wire fixation yielded the best results.

The major determinants of acceptable results were the type of treatment, type of lesions, the quality of initial reduction and associated involvement of the tarsal joint complex. The extent of the initial injury was the determining factor in the development of late degenerative arthritis. Degenerative changes of the tarsal joint were seen in almost all cases (94%). Such changes were more frequent after temporary screw fixation but did not seem to influence the final results. An initial anatomical reduction did not guarantee excellent results but minimized the chance of late degenerative arthritis.

Primary arthrodesis demonstrated no advantage in our series. Although partial arthrodesis may be necessary in severely comminuted joints, it cannot be routinely advocated and should be used as a salvage procedure.

**Keywords :** fracture-dislocation ; Lisfranc.

**Mots-clés :** fracture-luxation ; tarso-métatarsienne.

ability (2-7, 10, 15, 20, 21). Recognizing the injury is important so that adequate treatment can be instituted. As many as 20% are either misdiagnosed or overlooked and can be a permanent source of pain in polytrauma patients, after the major fractures have healed (14, 15, 20, 21).

Such an injury occurs at the rate of 1/55,000 persons/year and results from direct and indirect forces acting on or through the Lisfranc joint (1, 11, 12, 17).

The anatomy is thought to play an important role in the injury patterns (16, 17). The second metatarsal is firmly keyed into a tight articulation with the five adjacent bones. This mortise effect is considered the primary stabilizer of this area.

In most cases indirect trauma causes a longitudinal force to the foot which is usually plantar-flexed at the time of impact (16, 17). This ruptures the dorsal tarsometatarsal ligaments, and fractures the plantar aspect of the metatarsal bases. Additional forces shift the metatarsals on the tarsus producing abduction and lateral displacement, with compression fractures of the tarsal bones, the Chopart and subtalar joint ('Lisfranc joint complex fractures').

Treatment options in the literature vary from closed reduction or closed reduction and percutaneous pinning in simple dislocations to open reduction and temporary screw fixation, screw

## INTRODUCTION

Tarsometatarsal fracture dislocations are rare, easily overlooked and lead to long-term dis-

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fixation combined with external fixation and primary arthrodesis in severe fracture dislocations.

According to North American authors temporary screw fixation is currently considered the treatment of choice (20, 22).

However anatomical restoration and articular congruity cannot be achieved in severe dislocations, and the effects of compression screw fixation on the involved articular surfaces are not fully known (17, 22).

Much has been written about Lisfranc fracture dislocations, but only scarce data are available on the functional outcome after different types of treatment. Therefore the aim of this study was 1) to review the functional results after this injury and 2) to analyze the factors influencing these results.

#### PATIENTS AND METHODS

Thirty-one patients with a fracture-dislocation of the tarsometatarsal joint complex were treated between 1991 and 1993. All patients were admitted and treated at the University of Leuven Trauma Unit. There were 11 females and 20 males with a mean age of 30.5 years (range : 15-47). None of the patients died ; one patient was lost to follow-up. The average length of follow-up was 2.9 years (range : 20 months to 56 months).

Most of the injuries (26 patients) were traffic accidents. Three patients fell from a height, one of whom was attempting suicide ; two injuries were sports related. The initial treatment was altered in 6 patients (18%). Three (9%) were misdiagnosed or poorly diagnosed and had cast immobilization ; 3 patients (9%) had closed percutaneous reduction which was changed to open reduction and (temporary) screw placement after respectively 3, 7 and 16 days.

Twenty-four patients (78%) had sufficient additional major injuries to be considered as a polytrauma, and 7 (22%) had isolated injuries. Fourteen patients (45%) had associated foot lesions in the Chopart and (less frequently) in the subtalar or tibiotalar joint. There were 6 patients (19%) who sustained direct crush injuries to their feet ; the remaining 25 (81%) suffered indirect injuries.

The patients were carefully questioned regarding pain, activity level, return to work, lifestyle, and cosmesis. The Baltimore Painful Foot Score (PFS-Table I), which evaluates pain, function and cosmesis was used, based on a scale from 0 to 100 points (16).

The radiographic outcome was evaluated separately. Attention was given to the adequacy of reduction and degenerative changes on final review.

The quality of reduction was classified as excellent, good, fair, or poor based on the amount of displacement in the anterior-posterior plane, average width between the base of the first and second metatarsal, or medial and middle cuneiform ( $n < 2$  mm). In the dorsoplantar plane the angulation was measured at the talometatarsal angle (normal value 0-10°).

#### TREATMENT

Our treatment protocol consisted in an attempt at closed reduction. This was performed by longitudinal traction with plantar flexion and supination of the forefoot followed by dorsiflexion and pronation.

Multiple 1.9-mm percutaneous Kirschner wires were then inserted. These were placed, depending on the fracture type, through the second and fifth tarsometatarsal joints (type B2), or the first, second and fifth metatarsal joints (types A and C). Intraoperative xrays were taken to make sure that anatomic reduction was obtained.

In fifteen cases closed percutaneous reduction was impossible, unsatisfactory or unstable. Open reduction was subsequently performed through two dorsal approaches between metatarsals one and two, and between metatarsals four and five, with a broad skin bridge left between the incisions.

After reduction was obtained, stabilization was achieved using 4.5-mm cancellous or cortical screws placed from distal to proximal. In 4 cases cannulated 4-mm screws were used.

Postoperatively a splint or a foot pump was applied for one week. Generally partial weight bearing was started on a bunion shoe after 6 weeks, often depending on the associated lower limb injuries. Full weight bearing was allowed after 10 weeks. K-wires were removed at 6 weeks, before weight bearing was started. Screws were generally removed after 12 weeks.

#### RESULTS

Using the classification of Hardcastle *et al.* (11) we found that 19% of the patients had a type A

Table I. — Baltimore painful foot score (Kenzora / Myerson)

		Points
<i>Pain</i>		
	None, including sports	45
	Slight, no change in work ability	40
	Mild, minimal change in activities of daily living	30
	Moderate, takes aspirin	20
	Marked, during minimal activities	10
	Disabling, frequent use of analgesics	0
<i>Function</i>		
Distance walked	Unlimited	10
	Slight decrease	8
	Moderate	5
	Severe	2
	Indoors only	0
Stability	Normal	4
	Weak feeling	3
	Occasional giving way	2
	Instability	1
	Uses orthosis	0
Limp	None	4
	Slight	3
	Moderate	2
	Severe	1
	Cannot walk	0
<i>Function</i>		
Shoes	Any type	10
	Concessions	9
	Flat only	7
	With orthosis	5
	Space shoes	2
Terrain	No problem	4
	Problem with hills	2
	Problem on flat	0
Stairs	Normally	4
	Bannister	3
	Assisted	2
	Unable	0
<i>Cosmesis</i>		
	Normal	10
	Mild deformity	7
	Moderate	5
	Severe	0
<i>Motion</i>		
	Normal	5
	Slight decrease	4
	Marked decrease	0

injury (n = 6), 6% a type B1 (n = 2), 41% a type B2 (n = 13), 6% of the patients a type C1 (n = 2) and 12% a type C2 (n = 4). In 3 cases (9%), the fracture pattern was so complex, that classification was not possible.

### End results

Based on the Baltimore Painful Foot scoring system (16), 9 results were graded as excellent (90 to 100), 7 as good (75 to 90), 7 as fair (60 to 75), and 7 as poor (less than 60). There were 16 feet with good or excellent results (52%), and 14 with fair or poor results (48%).

Polytrauma patients did not score significantly worse than isolated fractures : 46% achieved good and excellent results, while 57% of patients with isolated injuries achieved excellent and good results.

Direct injuries fared poorly (mean PFS : 47), while indirect injuries fared better (mean PFS : 70). Associated injuries in the foot gave poor results (47% excellent and good results).

### Radiographic results and degenerative changes

The average width between the first and second metatarsal bases in patients with a good or excellent result was 1.2 mm, compared with 3.4 mm in patients with a poor result. The talometatarsal angle, measured from the lateral weight-bearing xray, was 6° in excellent and good results, and 14° in the poor results.

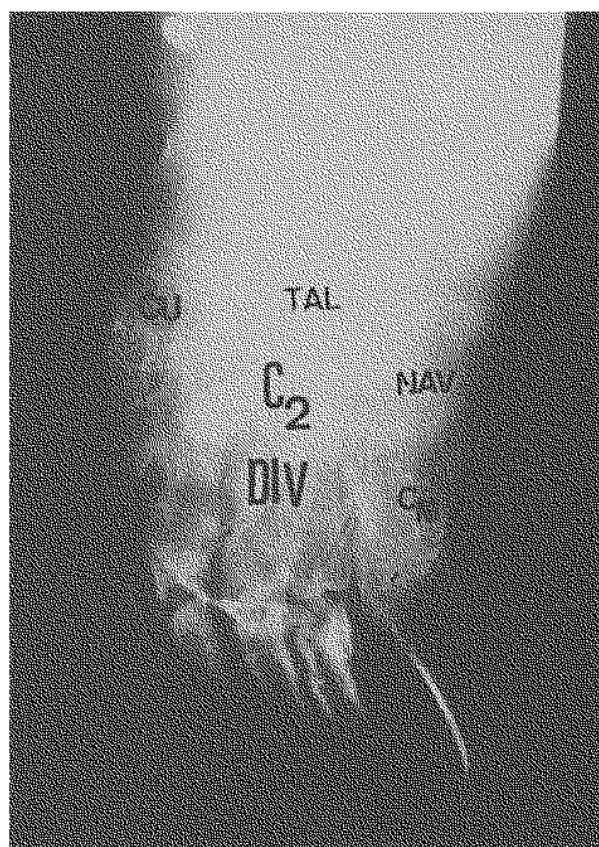
Degenerative changes were found in almost all patients (94%). They were more frequent after open reduction and temporary screw fixation than after percutaneous pinning, although this may be related to the more severe initial injury. There was no relationship between the degenerative changes and the functional end results.

### Results correlated with treatment

#### *Closed reduction and plaster immobilization*

Three patients were treated by closed reduction and plaster immobilization for 6 weeks. This kind of treatment was never intentional and often necessary due to contraindications to more aggressive treatment. After 6 weeks weight bearing was

allowed as tolerated. These patients had a poor outcome with an average PFS score of 62. Subsequent surgery was necessary in two patients : one arthrodesis, one arthrodesis combined with a corrective midfoot osteotomy (fig. 1).



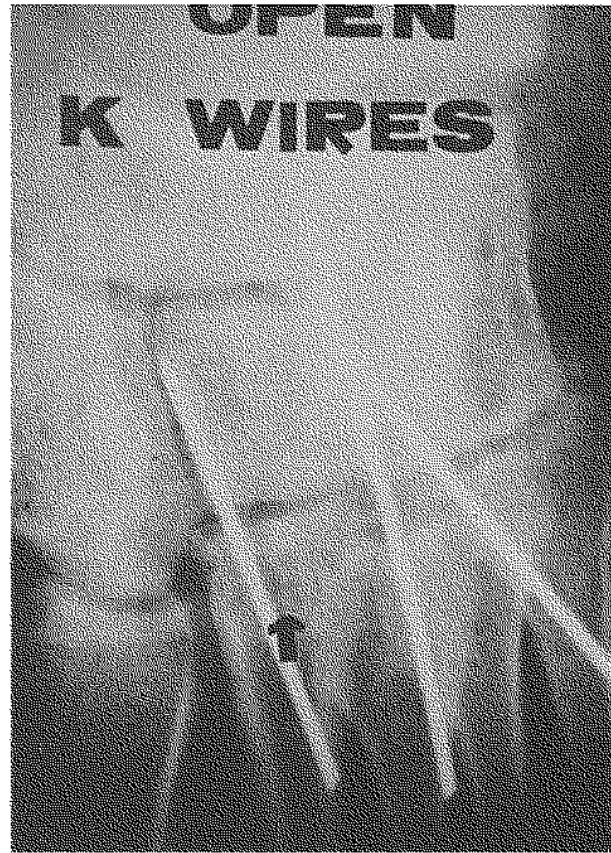
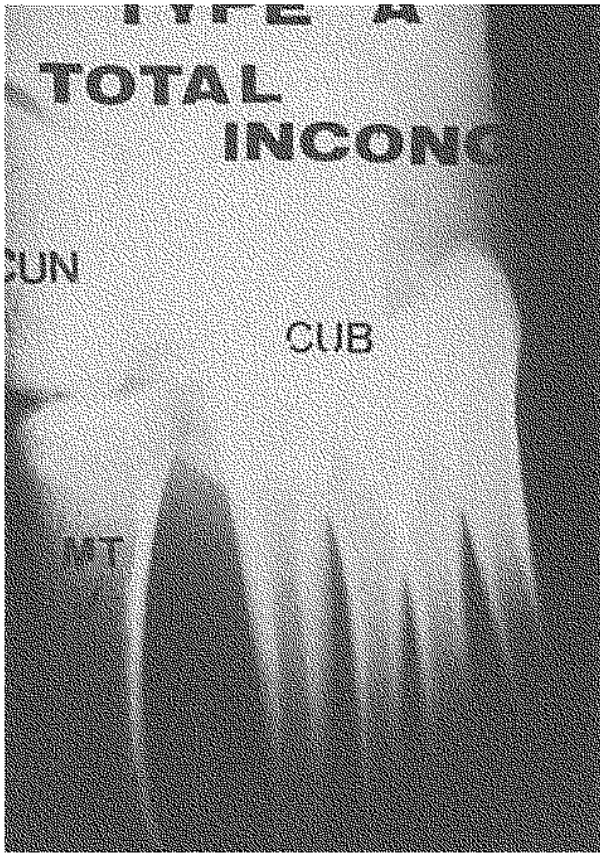
*Fig. 1.* -- Malunion after conservative treatment (Hardcastle type C fracture-dislocation) in a polytrauma patient. Conservative treatment is unacceptable in severe fracture dislocations.

#### *Closed reduction and percutaneous pinning*

Six patients underwent closed reduction and percutaneous pinning with 1.9-mm Kirschner wires (fig. 2). Pinning was performed after an acceptable reduction was obtained. The average PFS for these patients was 79.

#### *Open reduction and temporary screw fixation*

Nine patients underwent open reduction and internal fixation (fig. 3a, b). This was performed when closed reduction and percutaneous fixation



*Fig. 2a, b.* — Open reduction and percutaneous pinning in a type A fracture-dislocation. Ideally the first tarsometatarsal joint should also be stabilized in these types of injury. Nevertheless, an anatomical reduction was achieved in this patient with an excellent functional end result (PFS 90). This case demonstrates that the quality of initial reduction is the major determinant for obtaining an excellent end result.

did not result in a satisfactory reduction. The average final PFS was 77.

#### *Primary arthrodesis*

In 9 patients (fig. 4a, b) primary arthrodesis was performed in acute fracture dislocations when the articular surface was so severely damaged that restoration of articular congruity was not possible. There was an apparent difference in injury distribution between this group and the other groups with other treatment modalities. The average PFS was 59.

#### **Further surgery**

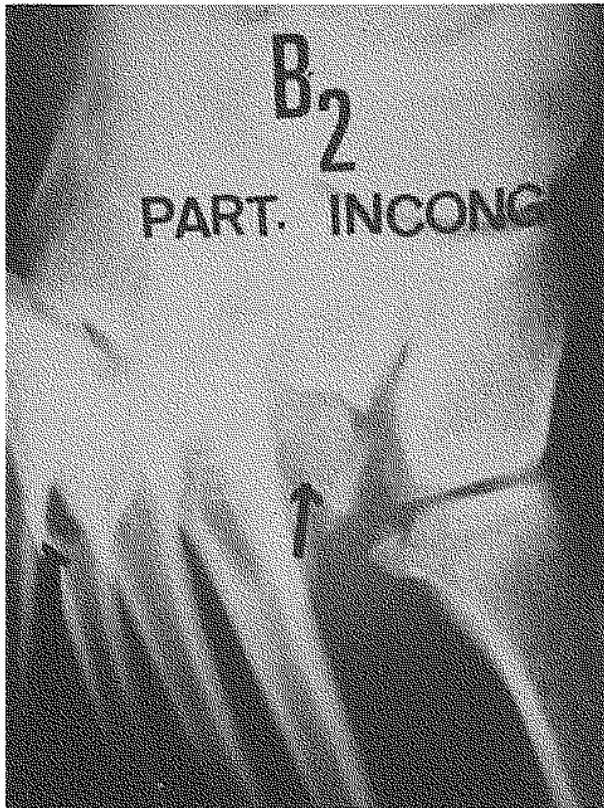
Seven patients needed further surgery at an average time of 12 mos. (range 7 to 45 mos.) after the initial trauma. These procedures were partial

arthrodesis in one case (metatarsocuneiform fusion) and complete tarsometatarsal arthrodeses in 3 cases. These patients were initially treated with closed reduction and cast (2 cases) or unsatisfactory percutaneous pinning (2 cases). Midfoot arthrodesis (intercuneiform) was performed in 2 cases.

There were 2 nonunions after primary arthrodesis of the tarsometatarsal joints. One patient was asymptomatic, and one patient needed a revision arthrodesis.

#### **DISCUSSION**

Tarsometatarsal injuries are rare, but they carry considerable potential for long-term disability (2-7, 9, 10, 13, 16, 17, 19, 20). In poly-

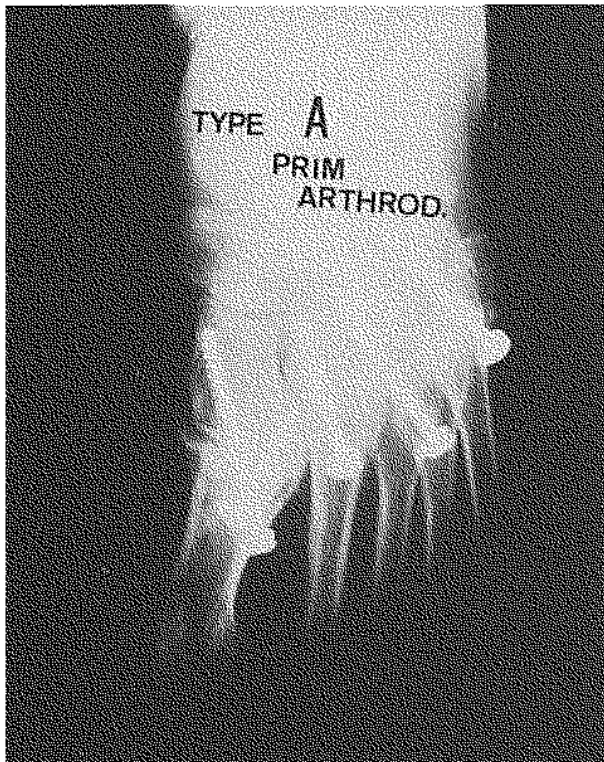


3a



3b

*Fig. 3a, b.* — Open reduction and temporary compression screw fixation of the tarsometatarsal joints in a type B2 fracture-dislocation. Ideally the lateral tarsometatarsal joints should be left free or only be stabilized with K-wires. This prevents degenerative arthritis in these inherently mobile joints.



*Fig. 4.* — Primary arthrodesis was performed in severely comminuted fractures, where reconstruction of the tarsometatarsal joint was not possible. Complications were common, especially reflex sympathetic dystrophy and forefoot stiffness. It should be used as a salvage procedure.

trauma patients, significant disability is often produced by neglected foot fractures after the major fractures are healed (16, 17, 20-22).

The aim of our study was to review :

- 1) the functional results after these fractures
- 2) which factors influenced the end results
- 3) which treatment modality yielded the best results
- 4) the incidence of degenerative arthritis

In our series the Baltimore Painful Foot Score (after a mean follow-up of 3 years) was 56. Nine patients (30%) obtained an excellent result, 7 (23%) a good, 7 (23%) a fair and 7 (23%) a poor result. These results are similar to those reported by Myerson et al in their series of 60 patients with comparable injuries (16).

Results reported in the literature (9, 11, 20, 23-25) vary between 34% and 80% good results : mean 56% (112/200 patients). In these studies, the injuries were often less severe, and more conservative treatment methods were used.

Patients with direct injuries (crush) and patients with additional midfoot injuries seemed to fare less well than those with indirect or isolated tarsometatarsal injuries. The type of lesion did seem to influence the final results. Type A lesions scored better (PFS 85), followed by type B2 (PFS 79), type C1 (PFS 79), type B1 and type C2 (PFS 54).

The best results were obtained in patients treated with open reduction and temporary screw fixation and in patients with percutaneous K-wire fixation.

Internal fixation is often necessary because of the high incidence of redislocation or treatment failure after percutaneous K-wire fixation (22). At present most of the authors (16, 17, 22) advocate open reduction and rigid fixation using multiple screws in the medial tarsometatarsal, intercuneiform joints and K-wires or external fixation in the lateral tarsometatarsal joints. However no long-term results have been reported after this type of treatment. In our study, degenerative changes were more frequent after screw fixation than after K-wire fixation. This may be partially explained by the more severe initial injury pattern in these patients. These degenerative changes did not seem to influence the functional results, as long as the lateral tarsometatarsal joints were not involved.

The degenerative arthritis did not progress with time, but a longer follow-up may be necessary to assess temporary screw fixation as the treatment of choice in Lisfranc' injuries.

The quality of reduction was more important in our series than the type of treatment per se. This was already noted by other authors (11, 17, 22). Within each of the four different treatment groups (closed reduction, closed reduction and percutaneous pinning, open reduction and temporary screw fixation, primary arthrodesis), all patients with excellent or good reductions attained acceptable clinical results.

The major goal is to obtain a stable anatomical reduction by whatever means possible. Of the patients with good long-term results following open reduction and screw fixation, 86% had a reduction which was considered excellent or good, and none of the poor results had a good or excellent reduction.

Trauma to the joint per se is also important. Despite anatomic reduction a portion of these patients develop posttraumatic arthritis of the midfoot (8,12,16). Sixteen percent of our patients with an excellent reduction developed symptomatic degenerative arthritis and poor clinical results, indicating that the injury itself may produce traumatic chondrolysis.

Generally the reported rate of posttraumatic arthritis is variable, ranging from 25% to 50% (1, 8, 11, 24). In all our patients posttraumatic arthritis was present to some degree.

Arthritis has been attributed to articular damage at the time of injury and has been related to the degree of articular surface comminution identified at surgery. The radiological presence or absence of arthritis often shows little correlation with functional outcome or subjective rating (16, 17, 22).

After reviewing the results of our patients, we changed our treatment plan in Lisfranc dislocations to the following protocol :

1. If anatomic reduction can be obtained by closed reduction and stabilization with K-wires, open reduction is not necessary.
2. In comminuted fractures, cases with soft tissue interposition and intra-articular bone fragments or patients with complex injuries of the

midfoot, stable anatomical reduction is difficult to achieve. Rigid screw fixation of the medial tarsometatarsal joints is the treatment of choice. The fourth and the fifth tarsometatarsal joints are left free or temporarily stabilized with K-wires.

### CONCLUSIONS

1. Open reduction and temporary screw or K-wire fixation is the treatment of choice in severe fracture-dislocations.
2. The quality of initial reduction is the major determinant for obtaining an excellent end result
3. Conservative treatment is unacceptable in severe fracture-dislocations.

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### SAMENVATTING

*T. MULIER, P. REYNDERS, W. SIOEN, J. VAN DEN BERGH, G. DEREYMAEKER, P. REYNAERT, P. BROOS. Behandeling van tarsometatarsale dislocaties.*

Eenendertig patiënten met een fractuur-dislocatie van het tarsometatarsaal gewricht werden gevolgd en geëvalueerd naar hun functioneel eindresultaat, na een gemiddelde follow-up van 2,9 jaar (met een variatie van 20 tot 56 maand). Eénenzestig procent waren polytrauma patiënten, 31% hadden een geïsoleerd trauma, en 45% hadden geassocieerde letsels van het tarsaal gewrichtscomplex (Chopart- en subtalair gewricht). Volgens de Baltimore Painfull Foot Scoring System (PFS), bereikten 52% een goed tot zeer goed resultaat, terwijl 48% een aanvaardbaar tot slecht resultaat be-



haalde. Van de vier verschillende behandelingsmodaliteiten, bleken open reductie en tijdelijke schroef- of K-pinfixatie de beste resultaten op te leveren. De belangrijkste determinanten voor een aanvaardbaar resultaat, waren het type fractuur, het behandelingsstype, de kwaliteit van de initiële reductie en geassocieerde letsels van het tarsaal gewrichtscomplex. De uitgebreidheid van het initiële letsel was de terminerende factor voor ontwikkeling van laattijdige degeneratieve artrose. Bijna iedere patiënt (94%) vertoonde degeneratie van het tarsale gewricht, meer frequent na schroeffixatie, zonder echter het eindresultaat te beïnvloeden. Een onmiddellijke anatomische reductie was geen volledige garantie voor een goed resultaat, maar verminderde wel de ontwikkeling van artrose.

Primaire arthrodese toonde geen voordeel in onze reeks. Hoewel partiële arthrodese soms noodzakelijk is bij sterk comminutieve fracturen, kan ze niet routinematig aangewend worden, maar blijft ze bijgevolg een 'salvage' procedure.

### RÉSUMÉ

*T. MULIER, P. REYNDERS, W. SIOEN, J. VAN DEN BERGH, G. DEREYMAEKER, P. REYNAERT, P. BROOS. Traitement des fractures-luxations de l'articulation tarsométatarsienne.*

Trente et un patients qui avaient présenté une fracture-luxation de l'articulation tarso-métatarsienne ont été

examinés afin d'évaluer les résultats à long terme, après un suivi moyen de 2,9 ans (variant de 20 à 56 mois). Soixante et un pour cent des patients étaient polytraumatisés, trente-neuf pour cent présentaient une fracture isolée. Quarante-cinq pour cent avaient des lésions associées de l'articulation de Chopart et de la sous-astragaliennne.

Des quatre modalités de traitement, la réduction ouverte et la stabilisation par des broches ou des vis temporaires donnèrent les meilleurs résultats. Les facteurs les plus importants du résultat étaient le type de traitement, le type des lésions, la qualité de la réduction initiale et les lésions associées du tarse. L'extension de la lésion initiale était la cause principale du développement de lésions articulaires dégénératives. Celles-ci sont apparues dans la majorité des cas (94%), plus souvent après l'utilisation de vis temporaires, mais elles n'ont pas influencé les résultats à long terme. Une réduction anatomique initiale n'était pas une garantie d'un résultat excellent mais diminuait la fréquence des lésions dégénératives tardives. L'arthrodèse primaire ne donnait pas d'avantages dans notre série. Bien qu'une arthrodèse partielle puisse être nécessaire dans des fractures articulaires sévèrement comminutives, elle ne devait pas être envisagée comme traitement primaire.