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OPERATIVE TREATMENT OF ANKLE FRACTURES

By

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The present study is a continuation of an investigation in which a series of ankle fractures from the period 1950–1963 were studied (*Solonen & Lauttamus* 1965). Our aim is now to assess the value of operative treatment.

MATERIAL

During the period 1964–1965, all together 489 patients with ankle fracture were treated at our Clinic. This figure does not include outpatients.

The fractures are classified according to Lauge Hansen-Palmer in Table 1.

Sex

There were 236 males and 253 females.

The different types of fracture were evenly distributed between both sexes, with the exception of the SE group, which comprised 141 females and 103 males.

Age

The patients' ages ranged from 11 to 86 years.

The average age of the males was 36; that of the females, 48.

Nature of Accident

The accidents are classified according to type in Table 2.

Slipping or stumbling cause the highest number (60 per cent) of SE fractures. In traffic accidents, particularly when the patient had been hit by a motor vehicle or had fallen from his motor-cycle, P and S fractures were the commonest.

Treatment

Treatment was operative in 350 cases (72 per cent) and conservative in 139 (28 per cent).

At follow-up we found that 75 (54 per cent) of the patients treated conservatively should have been treated surgically and that 13 patients (4 per cent) who had been operated on should have received conservative treatment.

Table 1. Classification of injuries.

Type	No. of patients	%
S I	4	9
S II	41	
SE I	2	50
SE II	14	
SE III	11	
SE IV	217	
P I	22	17
P II	3	
P III	60	
PE III	18	18
PE IV	68	
Irregular	29	6
Total	489	100

Table 2. Nature of the accident in various groups.

Group	Slipping or stumbling %	Traffic accident %	Fall or jump %	Miscellaneous %
S	20	45	16	19
SE	96	2	–	2
P	65	22	5	8
PE	80	5	12	3
Irregular	38	10	28	24

Time of Operation

Operation was generally carried out on the day of the injury or the following day. For various reasons, (such as late presentation for treatment, skin injury, attempted, conservative treatment) the operation was not done until as much as 2 weeks after the accident.

(The majority of the surgical cases were treated without preceding conservative treatment).

Operation

The technique varied owing to the large number of surgeons. In the absence of contra-indications, a tourniquet was used. After reduction, the fracture was fixed

with screws in 328 cases, but in fracture of the fibula, medullary nailing (Rush) was used in 12 cases and in some cases chromic catgut or steel wire cerclage as the only or supplementary fixation. The deltoid ligament was sutured in 35 cases.

After-treatment

After the operation plaster was applied up to a level below the knee. The plaster was removed after an average period of 8 weeks. The patients left hospital four to three weeks after the operation. In cases where weight-bearing was considered possible, the plaster was replaced by a walking cast after 4 to 6 weeks, in other cases, when consolidation was considered reliable. The transsyndesmotic screw was removed at the latest after 2 to 3 weeks' unprotected weight-bearing.

RESULTS

Our assessment is based on the situation when the patient returned to work and on radiographic examination, it being too early to say anything definite about the late results.

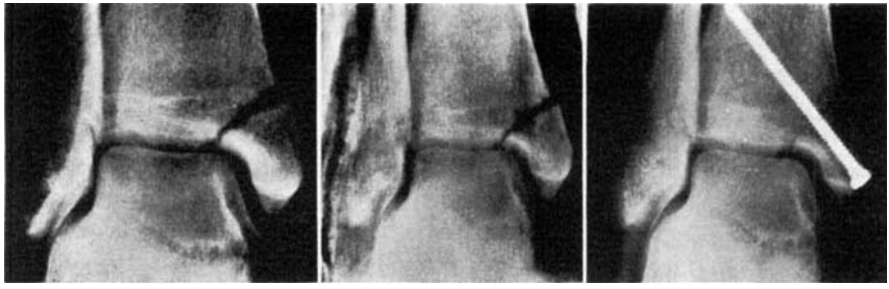

Figure 1. In S II fracture surgical repair is sometimes the best treatment.

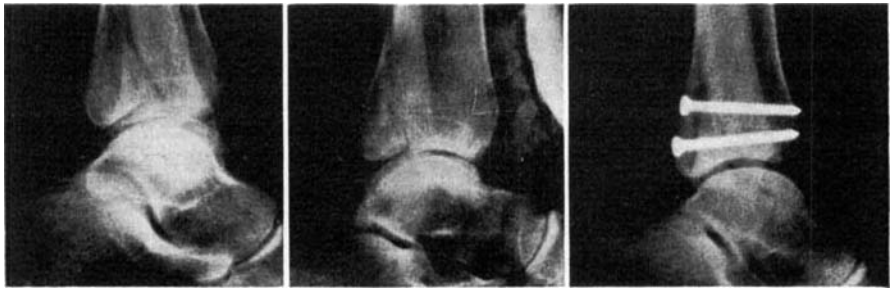

Figure 2. A posterior marginal fracture of the tibia can often not be treated conservatively. Reliable fixation may require two screws.

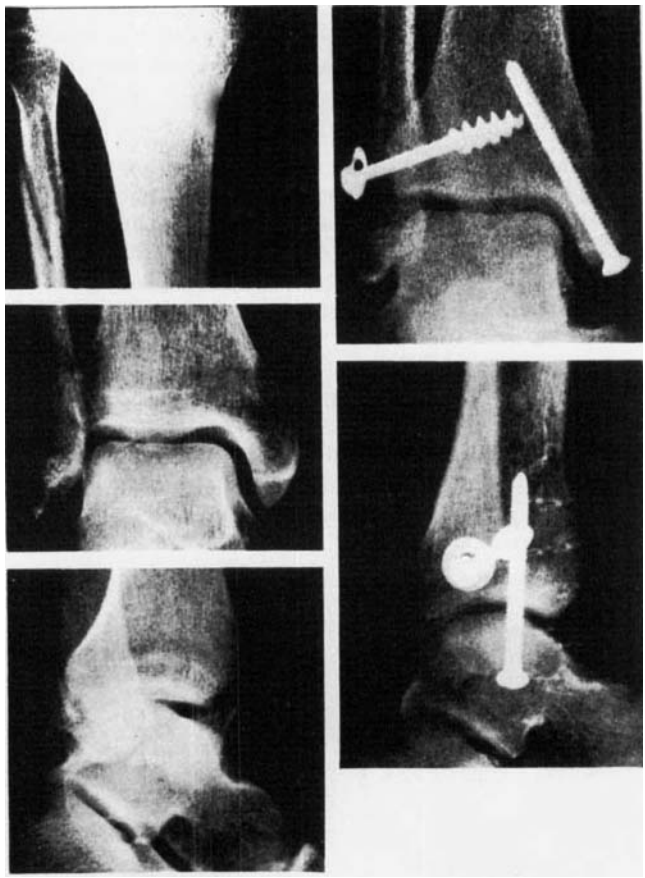

Figure 3. An ankle with a severe PE IV injury may appear intact in an anteroposterior radiogram. The safest procedure is to fix both the syndesmosis and the malleolus fracture and to suture torn ligaments.
(Lag screw is not advisable).

Grading of the Results

The result was accepted as radiographically good only when there was complete anatomical restoration. Thus, no cases with dislocation or angulation of the medial or lateral malleolus were placed in this category. A posterior marginal fragment comprising one-quarter or more of the width of the tibia also had to be replaced exactly and no dislocation of the talus was allowed. Fair: No medial or lateral dislocation of the malleolus, and no angulation were accepted. Dorsal dislocation of the lateral malleolus should not exceed 2 mm, and the large posterior tri-

Figure 4. Persistent displacement of the posterior marginal fragment is an unsatisfactory result of conservative treatment of a PE IV injury.

angular fragment should not be elevated by more than 2 mm. No dislocation of the talus was allowed.

Results not filling these requirements were recorded as unsatisfactory. Otherwise we followed our earlier grading (1965).

The results in the series as a whole were the same as in our series of 1961–1963: acceptable results (good and fair) 88 per cent, unsatisfactory 12 per cent.

However, if the operatively treated cases (350 cases) are considered separately, we obtain following results: acceptable in 95 per cent (good 76 per cent, fair 19 per cent) and unsatisfactory 5 per cent. In conser-

vatively treated cases the corresponding figures were: acceptable in 80 per cent (good 40, fair 40 per cent) and unsatisfactory in 20 per cent.

The results of operative treatment in the individual groups are given in Table 3.

The results of conservative and operative treatment cannot be compared, since, in our opinion, the method of treatment is decided by the type of the fracture.

Of the 13 cases operated upon unnecessarily, the result was good in 9 and fair in 3, and unsatisfactory in 1.

Table 3. Results in different groups of injury.

Group	Total number of operated patients	Results (per cent of total number)		
		Good	Fair	Unsatisfactory
S I	2	100	–	–
S II	26	84	8	8
SE II	9	89	11	–
SE III	8	100	–	–
SE IV	161	70	27	3
P I	18	100	–	–
P II	2	100	–	–
P III	41	78	17	5
PE III	12	75	25	–
PE IV	54	74	13	13
Total	350	76	19	5

Complications

There were no infections of significance. Mild, brief infection occurred in the operative wound in 3 cases.

The operation did not delay ossification or cause non-union. In the conservatively treated cases there were several cases of non-union.

No deaths occurred, nor was thrombosis or embolism diagnosed.

Return to Work

The average period during which the patients were incapacitated for work was 4.3 months in conservatively treated cases and 4.5 months in operatively treated cases.

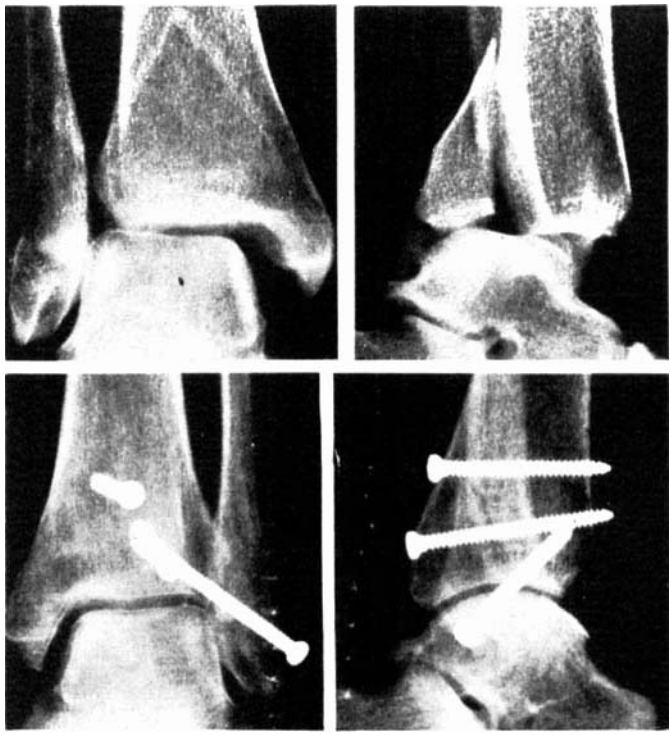

Figure 5. A SE IV injury was treated operatively, the fractures were fixed with screws, the deltoid ligament and the anterior tibio-fibular ligament were sutured. (Unnecessary fixation of the lateral malleolus with a transsyndesmotic screw).

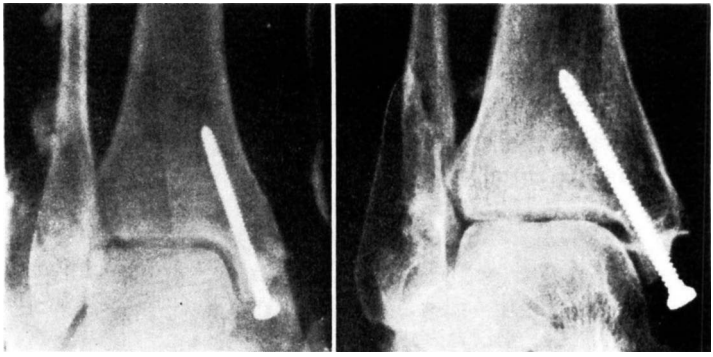

Figure 6. In the treatment of a SE IV injury, the result shown by an antero-posterior roentgenogram appeared to be good. Later a special projection revealed troublesome dislocation of the lateral malleolus.

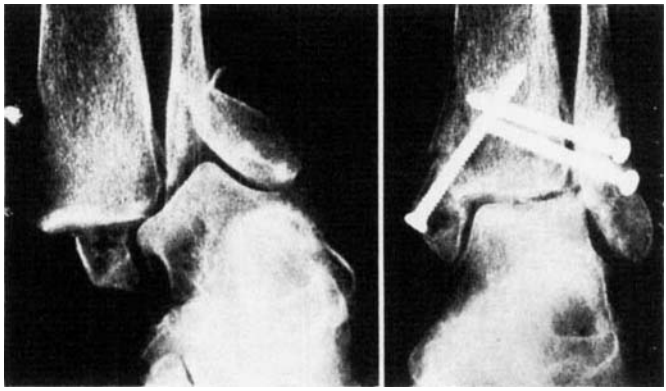

Figure 7. Inadequate treatment. The fragment of medial malleolus has not been reduced, the talus is laterally dislocated, the fragment of the lateral malleolus has been fixed in the wrong position by transsyndesmotic and wrongly directed screws. The fragment of the medial malleolus ought to have been reduced and fixed, the talus should have been reduced, the anterior tibio-fibular ligament should have been sutured and, after reduction, the fracture of the lateral malleolus should have been fixed only to the fibula with a screw or nail.

DISCUSSION

Faults in Treatment

Reduction of the *lateral malleolus* was imperfect in 101 cases. Faulty reduction of the lateral malleolus was the commonest fault in both the conservatively (30 per cent of the series) and the operatively (12 per cent of the series) treated cases. The malleolar fragment remained dislocated proximally, laterally, posteriorly and in outward rotation. A shortened fibula may provoke valgus deformity. The site of the fracture must be exposed. Fixation of the malleolus to the tibia, at any rate without exact reduction, cannot be regarded as adequate treatment.

A *large posterior fragment* had remained elevated in 31 cases, in 14 of the conservatively and 17 of the operatively treated cases. In 10 of these cases the end result was poor; in the rest, fair. Operative reduction is not, as a rule, difficult if the incision is correct, but fixation with only one screw is often inadequate. Even after good reduction of a large posterior fragment, dorsal flexion of the foot remained limited. In these cases the foot should, perhaps, be postoperatively immobilized in slight dorsal flexion.

Unsatisfactory reduction or retention of the *medial malleolus* impaired the result in 12 conservatively and 3 operatively treated cases.

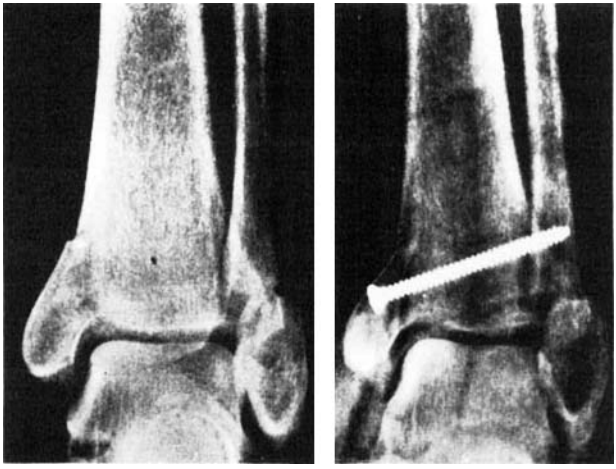

Figure 8. The screw in the medial malleolus introduced at the wrong point and directed wrongly, resulting in faulty positioning of the malleolus. The fracture of the lateral malleolus is neither reduced nor fixed.

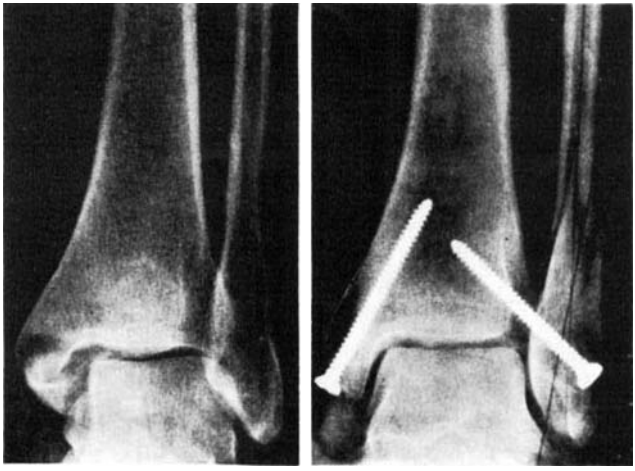

Figure 9. The screw in the lateral malleolus is wrongly directed and pointlessly transsyndesmotic.

Pseudarthrosis of the malleolus was seen in 7 conservatively treated cases. This shows that these cases should have been treated surgically. On the other hand, a small avulsion fracture of the malleolus does not by itself require operation. Neither is pseudarthrosis in

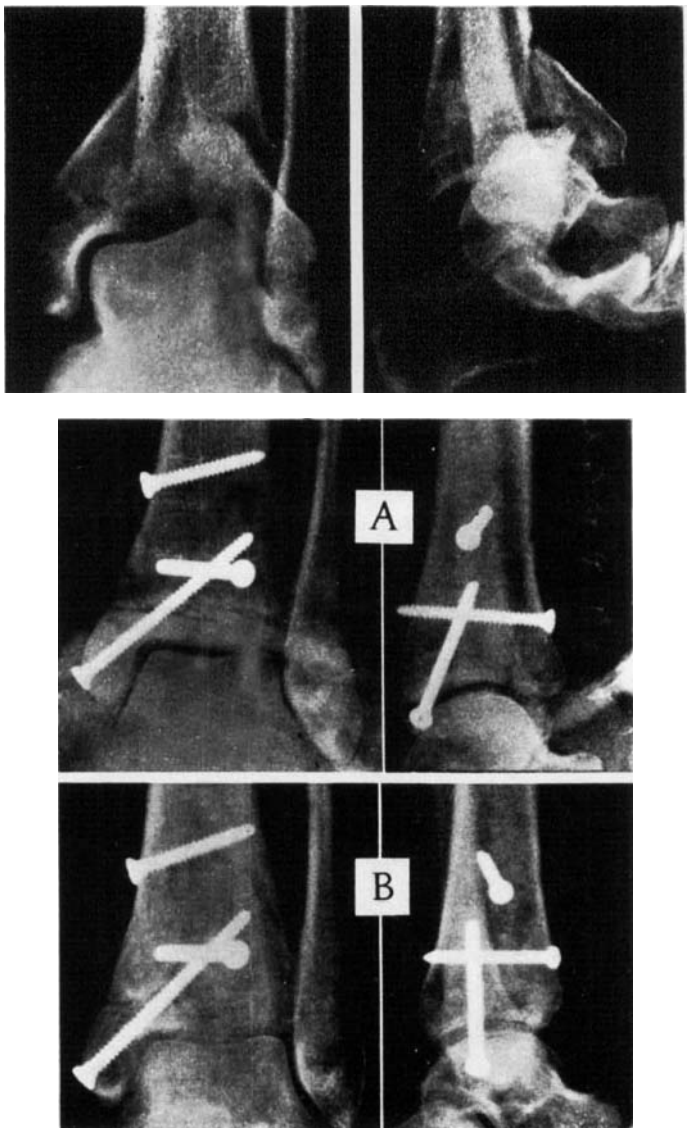

Figure 10. Severe comminuted fracture after a jump from the third floor. Conservative treatment was unsuccessful, but surgery proved successful.
A. Primarily. B. 3 months later.

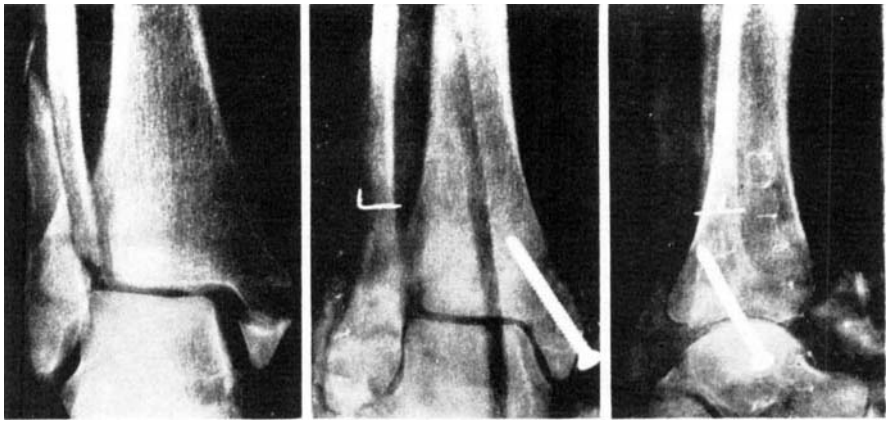

Figure 11. Operative treatment of SE IV injury with reduction and fixation of the fracture of the medial malleolus with screws and the fibular malleolus by temporary cerclage, the anterior tibio-fibular ligament being sutured.

such a case a source of inconvenience. Such cases are not included in the above figure. At operative treatment of the medial malleolus, periosteal interposition was often seen.

Faulty operative treatment of a *syndesmotic lesion* was apparent in 21 cases, the screw having been left for too long or removed too early. The former caused limited mobility and a *wooden feeling* (*Bonnin* 1950) or breaking of the screw. After too early removal of the screw, the syndesmosis spread in 3 cases, in 1 case even after 9 weeks. In 2 cases the syndesmosis had been too firmly tightened. As a rule, the syndesmosis screw had been left in place for 10 to 11 weeks. Fixation of the lateral malleolar fragment with a transyndesmotic screw in SE and P injuries caused unnecessary traumatization of the syndesmosis. *Burwell & Charnley*'s method (1965) is preferable, but we doubt whether this is sufficient in PE fractures with complete rupture of the syndesmosis. In these cases we consider fixation of the syndesmosis important. Otherwise, mono-osseal fixation of fractures with suturation of ruptured ligaments is sufficient.

Non-diagnosis or faulty assessment of *ligamental lesions* are among the commonest errors. Lauge Hansen's "genetic" system clearly shows the nature and extent of the injuries in question. A ligamental lesion is sometimes as important as a fracture. Non-suturing of a ruptured deltoid ligament was, in our opinion, a fault in 28 cases (15 of which had been operatively treated). It is true that insufficiency of this liga-

ment was observed in only 4 cases but healing of the ligament is quicker and more reliable after suturation than after cicatrization. It is impossible, for instance, without operation to retract the ligament from between the malleolus and the talus, where it is sometimes displaced and where it prevents reduction of the talus. Further, the posterior tibial tendon may be interposed between the ligament and its insertion. If these possibilities did not exist, one could certainly agree with *Bonnin's* (1965) opinion that "the bulk of the ligament and its natural form maintain apposition of the torn ends, and surgical repair is very seldom needed".

Insufficiency of the lateral collateral ligaments was observed in 3 cases. This injury is rarer in connexion with fractures than with sprain, but it must be dealt with. Lesion of the inferior tibio-fibular ligament is very common, as is clearly and correctly demonstrated by Lauge Hansen's classification. It is evident that some of the numerous dislocations of the lateral malleolar fragment result from failure to suture this ligament. Suturation should be done after reduction and fixation of the fracture of the lateral malleolus and it may easily be performed through the same incision.

The *direction and point of entrance of the screw* were often faulty. The site and direction of the screw are of decisive importance in securing the position of the fragment. One cannot simply state that a transsyndesmotic screw from the fibula should be placed horizontally or obliquely. The direction of the screw depends on the individual fracture. It is important that the fracture should be carefully reduced under visual control before fixation, otherwise a dislocation will almost always persist.

A screw inserted too close to the cartilage seems to irritate and may even cause nutritional disturbance of the cartilage.

Wrong type of screw: A lag screw is ill suited for these fractures; it is too thick and to tighten it requires so much force that the fragment often turns with the screw. This error had been made in 6 cases.

It is advisable to drill a wide hole for the screw, particularly in the medial malleolus. The proximal part of the screw should preferably be without threads. The screw should reach to the opposite corticalis or near it.

Unnecessary operations. With the exception of PE fractures, in which operative treatment, especially of rupture of the syndesmosis, is, in our opinion, a more reliable procedure than conservative treatment, fractures without dislocation should not be repaired surgically. However,

whether operation is necessary or not should be decided separately in each individual case and not simply according to type.

Operative Technique

The choice of the operative approach has sometimes been faulty. Fracture of the medial malleolus or rupture of the deltoid ligament may well be repaired through a distally curving incision anterior or posterior to the malleolus. A lateral malleolar fracture, the anterior tibio-fibular ligament and the syndesmosis are exposed through an antero-lateral incision placed exactly over the syndesmosis.

A posterior marginal fracture is repaired through a postero-lateral incision.

Procedure: A posterior marginal fracture that requires surgical repair is treated first—with the patient prone—and then the lateral malleolus. In SE fractures, the posterior marginal fracture and the fibular fragment constitute an entity united by the ligaments, which facilitates reduction. The posterior marginal fragment must often be fixed with two screws, for otherwise a primarily good apposition may be lost in the plaster cast.

Closed wound suction is recommended for a period of 1 to 2 days.

Plaster cast should be evenly padded and carefully moulded. The cast must be split anteriorly.

CONCLUSIONS

Since we know that the primary result is generally permanent (*Solonen & Lauttamus*) and that accurate reduction is the best prophylaxis against arthrosis (*Jergesen* 1959, *Klossner* 1962), rigorous demands must be made on the primary treatment of ankle injuries.

A prerequisite for good results is exact diagnosis, which is possible only if the entire mechanism of the injury is fully understood. The Lauge Hansen genetic classification is the most satisfactory of those we know and provides a key to the understanding of the damage as a whole. It must be remembered that the lesion in question is not a fracture of a bone but an injury to a complex weight-bearing joint.

It is often impossible to achieve a sufficiently satisfactory result by conservative methods, particularly in the treatment of lesions of ligaments and of the syndesmosis, but also in fractures of various types. We therefore often consider operative treatment indicated, particularly in SE II–IV and PE II–IV injuries. But the indications must be evaluated separately in each case. All significant components of the injury must

be repaired. After exact reduction, firm fixation must be achieved. Together with faulty treatment of ligamental injuries, unsatisfactory reduction of fracture of the lateral malleolus is one of the commonest faults. The majority of the errors we have detected can be eliminated. We have not observed any disadvantages of operation when it has been indicated and performed with the necessary technical skill.

Convalescence is not significantly longer after operative than after conservative treatment.

SUMMARY

This paper presents 489 patients with ankle injuries treated during a period of two years. 350 patients were treated operatively. Surgical repair led usually to acceptable results (95 per cent). The result would have been better if the whole extent of the injury had been understood in all cases. Technical skill is of high importance in the treatment of these severe injuries.

It is not a question of treatment of a bone fracture but of an extensive joint injury. Syndesmotic and ligamental lesions should be repaired. Unsatisfactory treatment of these and of fracture of the lateral malleolus are the commonest causes of poor results.

The manifold components of the injury are difficult to repair conservatively. Operation is often indicated and no significant disadvantages of surgical repair were observed in the present series. However, each case must be evaluated separately and classification of the type of injury alone is not a sufficient basis for assessing indications for operation.

RESUME

Cette étude présente 489 malades avec lésions de la cheville traités durant une période de deux ans. 350 malades ont été opérés. L'intervention chirurgicale a abouti à une proportion élévée de résultats relativement satisfaisants (95 pour cent). Les résultats auraient pu être encore meilleurs si l'on avait compris dans tous les cas l'étendue de la lésion. L'habileté technique est de la plus haute importance dans le traitement de ces graves lésions.

Il n'est pas question du traitement d'une fracture osseuse, mais d'une lésion articulaire étendue. Les lésions syndesmotiques ou ligamenteuses doivent être réparées. Un traitement peu satisfaisant de celles-ci et de la fracture de la malléole latérale sont les causes les plus courantes de mauvais résultats.

Les multiples éléments de la lésion rendent difficile un traitement

conservateur. L'opération est souvent indiquée et l'on n'a pas observé dans la présente série de désavantages provenant de l'intervention chirurgicale. Quoi qu'il en soit, il convient d'apprécier chaque cas en particulier et la classification du type de lésion n'est pas à elle seule suffisante comme base d'indication opératoire.

ZUSAMMENFASSUNG

Diese Arbeit stellt 489 Patienten mit Knöchelschäden während eines Zeitraumes von zwei Jahren vor. 350 Patienten wurden operativ behandelt.

Chirurgische Wiederherstellung führte in einer grossen Anzahl zu guten Ergebnissen (95 Prozent). Die Ergebnisse würden noch besser gewesen sein, wenn die Ausdehnung der Beschädigung in allen Fällen ganz verstanden worden wäre. Technische Fertigkeit ist bei der Behandlung dieser schweren Schäden sehr wichtig.

Es dreht sich nicht um die Behandlung eines Knochenbruches, sondern um einen ausgedehnten Gelenkschaden. Syndesmose und Bandschäden sollten wiederhergestellt werden. Ungenügende Behandlung derselben und des Bruches des lateralen Knöchels sind die gewöhnlichsten Ursachen von schlechten Ergebnissen.

Die vielfältigen Komponenten der Beschädigung sind schwierig auf konservativem Wege zu behandeln. Operation ist häufig angezeigt und keinerlei Nachteile von Bedeutung wegen des chirurgischen Eingriffes wurde in dem vorliegenden Materiale beobachtet. Jeder Fall muss jedoch separat beurteilt werden und Klassifizierung der Type der Verletzung allein ist keine genügende Grundlage zur Bestimmung der operativen Anzeige.

REFERENCES

Bonnin, J. (1950) Injuries to the Ankle. Heinemann, Medical Books Ltd., London.

Bonnin, J. G.: (1965) Injuries to the Ligaments of the Ankle. *J. Bone Jt Surg.* **47**-B, 609.

Burwell, H. L. & Charnley, A. D. (1965) The Treatment of Displaced Fractures at the Ankle by Rigid Internal Fixation and Early Joint Movement. *J. Bone Jt Surg.* **47**-B, 634.

Jergesen, F. (1959) Open Reduction of Fractures and Dislocations of the Ankle. *Amer. J. Surg.* **98**, 136.

Klossner, O. (1962) Late Results of Operative and Non-Operative Treatment of Severe Ankle Fractures; A Clinical Study. *Acta chir. scand.* Suppl. 293.

Lauge Hansen, N. (1942) Ankelbrud. I. Genetisk diagnose og Reposition. Munksgaard, Copenhagen.

Solonen, K. A. & Lauttamus, L. (1965) Treatment of Malleolar Fractures. *Acta orthop. scand.* **36**, 321.