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TREATMENT OF FRACTURES AND PSEUDARTHROSES OF THE LONG BONES BY HOFFMANN'S TRANSFIXATION METHOD (OSTEOTAXIS)

By

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Since *Lambotte* (13) in 1902 introduced the transfixation treatment of fractures, this method has been used, with some modifications as regards the technique, over certain periods of time. The Stader reduction splint, originally designed for use in dogs, was first applied in the treatment of fractures in man at the beginning of the second world war, even for battle casualties. *Stader et al.* (20) (1942) emphasized that the method had the advantage of allowing early transportation of the patient. In those cases in which suppuration developed at the site of the pins, galvanism was considered to be the cause more often than infection. *Shaar et al.* (19) (1944), from the Naval Hospital in Philadelphia, reported 110 fresh fractures treated by *Stader*'s method. In 2 cases, ring sequestra occurred at the site of a pin.

Roger Anderson (1) (1934) described his automatic splint in the treatment of fractures of the forearm. *Naden* (16) (1949) reported a material of 206 tibial fractures treated by *Roger Anderson*'s method at the Vancouver General Hospital. In this material infectious complications occurred, but the incidence of these is not given.

The report of a questionnaire survey conducted among orthopaedic surgeons and certain general practitioners in the U.S.A. on external fixation of fractures, states that of the 768 respondents 48% had no experience with the method. The 395 respondents who had some experience gave replies that were analyzed, and the following results were obtained: 27% considered that the method had a definite place in the treatment of fractures; 29% considered that the method was advisable in exceptional cases only; and 43% had wholly abandoned the method.

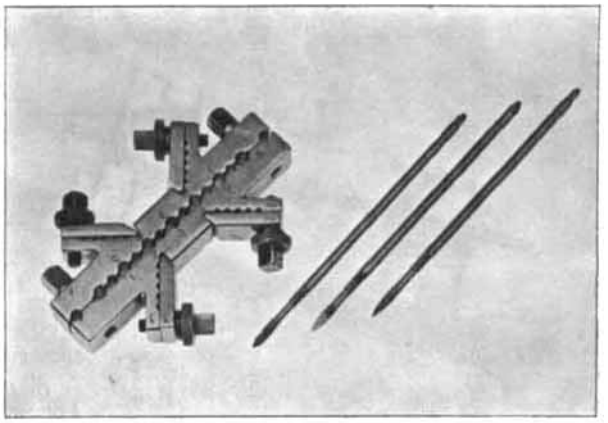

Fig. 1 a.
Guide and bone-screws.

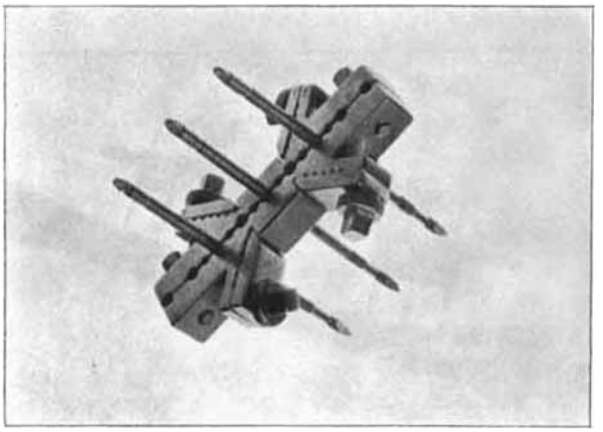

Fig. 1 b.
By means of the guide the screws can be driven into the bone, parallel to and at a certain distance from one another.

Among its main disadvantages were mentioned soft-tissue infection at the site of the pins, ring sequestra and osteomyelitis. Other drawbacks were pain and difficulties in obtaining and maintaining reduction, and inadequate immobilization (*Johnson & Stowall* [12] 1950).

The latest additional instrumentarium for transfixation was designed by *Raoul Hoffmann* (8). In 1938 he described for the first time his method, which he had devised simultaneously with and independently *of Stader* and *Roger Anderson*, and which he called Osteotaxis from

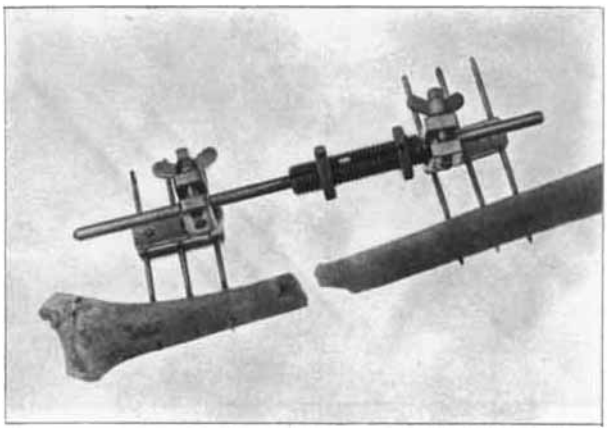

Fig. 2 a.
The instruments are applied on an experimentally fractured autopsy specimen of the tibia. The parallel bone-screws in each set are fastened together with a grip.

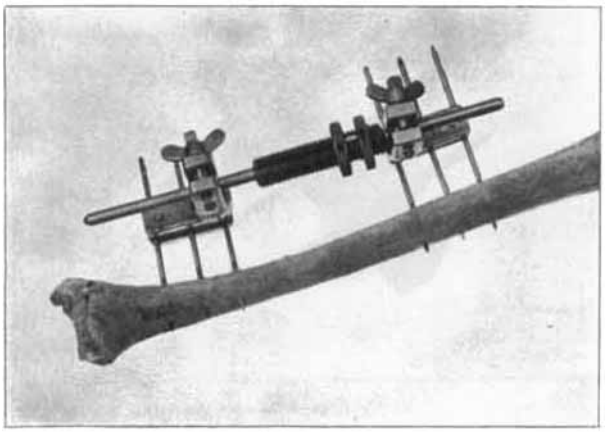

Fig. 2 b.
The same specimen as in Fig. 2 a. The fracture has been reduced exactly and fixed firmly by compression achieved by tightening the left nut on the coupling bar.

τασσω, I arrange). Since then he has successively improved the instruments and in several papers (9, 10, 11) he has given detailed descriptions of the technique of osteotaxis. A brief account of the instruments and the technique will be given here; for further particulars the reader is referred to *Hoffmann*'s original works.[1]

[1] A short descriptive survey in English is available from the manufacturer of the instrumentarium, Jaques Frères, Geneva, and from the retailers, AB Kifa, Stockholm.

Transfixation is done with special screws made of steel alloyed with chromium and nickel 18: 8 (Fig. 1). Through a special piercing model, called "guide" (Fig. 1) 3–5 screws are driven into the bone above and below the fracture. A grip is applied to each set of screws and the sets are fastened together with a coupling bar which has a device for compression of the fracture (Fig. 2). To avoid electrical tension the grips are covered with a non-conducting material (resofil). The Hoffmann apparatus can be regarded as a perfect instrumentarium for transfixation. Osteotaxis has come into use notably in the French-speaking countries, in France, Switzerland and Belgium. In Sweden it was introduced by *Orell* (17). In the English-speaking countries it is probably fairly unknown. Some case-reports have been published (3, 4, 5, 6, 7, 14, 15, 18, 21, 22), but no survey of a collected clinical material can be found in the literature. According to *Hoffmann*, osteotaxis is indicated mainly in open fractures but also in closed fractures where reduction and fixation are difficult, in multiple fractures, fractures with delayed union, and pseudarthrosis.

OWN MATERIAL

At the Orthopaedic Clinic, the St. Göran's Hospital, Stockholm, 49 fractures in 47 patients were treated by this method over the years 1952–1960. It should be emphasized here that they were cases of difficult fractures, in which treatment by usual methods had failed or had from the beginning been rendered difficult by adverse circumstances.

The following data will illustrate this point:

26 of the fractures were open. In 5 there were skin injuries which required some form of plastic operation. 10 patients had multiple fractures, 4 of them in the same limb. 2 patients had nerve-injuries and 1 patient had arterial damage in association with the fracture. 11 patients had earlier undergone operation for a pseudarthrosis, 8 of them once, 2 twice and 1 ten times.

2 patients had two different fractures that were treated by osteotaxis, one with an open fracture of the tibia of both legs, one with pseudarthrosis of the femur of one leg and the tibia of the other leg.

Sex and age. Of the 47 patients 13 were women and 34 men. Their ages ranged from 17 to 78 years.

Localization of the fractures and pseudarthrosis. The distribution according to site is shown in *Table 1*, in which fractures and pseudarthroses are also set out separately. Cases of delayed union and cases

of non-union are listed together. It may be difficult to draw the line between delayed union und non-union and I have therefore found it most expedient to group them together in the table, but in the text I have tried to analyze the cases with delayed union separately.

TABLE 1

Distribution of fracture and non-union according to site.

Localisation	No. of cases	Fracture	Non-union
Humerus	4	2	2
Forearm	6	1	5
Femur	11	3	8
Tibia	28	9	19
Total	49	15	34

Of the 15 cases listed as fractures 5 were primarily treated by osteotaxis. The other 10 were not treated until after intervals that varied between 4 and 42 days, with a mean of 21 days, other methods of fixation having failed.

TABLE 2

Results of osteotaxis distributed according to site of fracture and non-union.

Localisation	No. of cases	Healed	Not healed
Humerus	4	3 (3)	1
Forearm	6	5 (2)	1
Femur	11	8 (4)	3
Tibia	28	24 (13)	4
Total	49	40 (22)	9

Figures in parentheses: Healed with normal function.

Among the 34 cases listed as non-union 28 are cases of true pseudarthrosis in which the patients were admitted for treatment 5 months to 12 years after the accident, the mean being 1 year and 8 months. The other 6 can be designated as cases of delayed union, mostly combined with malposition of the fracture. They were treated 2 to 3 months after the accident.

RESULTS

All the patients were followed up by clinical and radiographic examination after a period of observation varying between 1 year and

6½ years. The therapeutic results are given in *Tables 2 and 3*. The figures in parentheses show the number of patients in whom the fractures healed without giving any clinical symptoms and whose joint-function is now normal or so slightly reduced as to be of no practical importance. Accordingly, healing failed to occur in 9 out of 49 cases, namely, for 2 fractures and 7 pseudarthroses. Further data on the results are given in *Table 4*, in which fracture and non-union are listed separately. Among the forearm pseudarthroses 1 only is recorded as healed without functional impairment. A further 2 patients are very little handicapped, one despite complete loss of pronation and supination, the other one with pronation and supination to half the normal range and slight reduction of movement of the wrist as a result of simultaneous dislocation of the semilunar bone. The fracture of the femur recorded as healed with impaired function has, however, healed with much better function than the concurrent fracture of the femur of the other leg, which was treated by open reduction, osteosynthesis and immobilization in plaster. Many patients with lower-leg pseudarthrosis had on admission considerable knee-stiffness after previous prolonged immobilization in plaster. This explains the great number of cases of healing with impaired function. However, it may be mentioned that 3 of the patients whose fractures healed without impairment of function had on admission considerable stiffness after previous prolonged plaster fixation for 7½ months, 1½ years, and 1¾ years, respectively.

TABLE 3

Results of osteotaxis for fracture and non-union.

	No. of cases	Healed	Not healed
Fracture	15	13	2
Non-union	34	27	7
Total	49	40	9

Osteotaxis without complementary operation on the pseudarthrosis. 10 patients with non-union or delayed union were treated by osteotaxis only, 5 on the lower leg, 4 on the femur and 1 on the forearm. Healing occurred in all of them after fixation for periods varying between 3 and 8 months (*Table 5*). In 3 of these cases the result can be designated as delayed union; the fracture healed after fixation for 3½, 5, and 5 months, respectively, and the course of healing did not differ from that

in cases of true pseudarthrosis. As regards the interval between injury and osteotaxis, its length varies within the whole of this group from 2½ to 13½ months (*Table 6*). In 3 cases of femoral pseudarthrosis treated 9, 13½, and 19 months, respectively, after the primary injury, healing occurred with osteotaxis only, and one of these patients had an infected pseudarthrosis. For the lower-leg pseudarthroses the longest interval between injury and treatment was 9½ months. In 2 patients who were primarily treated by osteotaxis only, this procedure was found to be insufficient and, without removing the instruments, it was completed by operation on the pseudarthrosis. These 2 cases are included in the following account.

TABLE 4

Details of results shown in Tables 2 and 3.

		No. of cases	Healed	Not healed
Humerus	fracture	2	2 (2)	–
	non-union	2	1 (1)	1
Forearm	fracture	1	1 (1)	–
	non-union	5	4 (1)	1
Femur	fracture	3	2 (1)	1
	non-union	8	6 (3)	2
Tibia	fracture	9	8 (8)	1
	non-union	19	16 (5)	3
Total		49	40 (22)	9

TABLE 5

Results and period of fixation by osteotaxis in cases of delayed union and non-union with and without surgical intervention on the pseudarthrosis.

Surgical intervention	No. of cases	Healed	Not healed	Time of fixation in months
Without	10	10	–	3–8
With	24	17	7	3½–9*

* In the healed group.

Osteotaxis with complementary operation on the pseudarthrosis. In 24 cases osteotaxis was combined with some form of operation for non-union; two being only osteotomy of the fibula, the rest operation on the pseudarthrosis itself. The distribution of the pseudarthrosis according to site was as follows: 14 in the lower leg, 4 in the femur, 4 in the forearm, and 2 in the humerus. In 17 cases healing occurred after a period

of fixation varying between 3½ and 9 months (*Table 5*). This group includes 3 cases with delayed union, and they healed after fixation for 4½, 4½, and 8¼ months, respectively. In the whole of this group the interval between injury and treatment ranged from 2 months to 12 years (*Table 6*).

TABLE 6

Results and interval between injury and osteotaxis in cases of delayed union and non-union with and without surgical intervention on the pseudarthrosis.

Surgical intervention	No. of cases	Healed	Not healed	Interval injury—osteotaxis
Without	10	10	–	2½–13½ m
With	24	17	7	2 m–12 yr

TABLE 7

Period of fixation by osteotaxis.

	No. of cases	Time in months
Healed fractures	13	2½–7 (4½)
Not healed fractures	2	4½–13
Healed non-union	27	3–9 (5½)
Not healed non-uion	7	3–6½ (4)
Total	49	2½–13 (5)

The length of fixation with the Hoffmann apparatus is shown in Table 7; it varied between 2½ and 13 months. It should be noted that the period of fixation in the group with healing is not identical with the time required for the healing of the fracture. For additional security, the apparatus was retained longer than necessary. The routine procedure was as follows. After the clinical consolidation had been tested and X-ray assessed as showing satisfactory healing, the patient was allowed to be up and about for a short time with the bone-screws left in place but the coupling bars disconnected. If, after about a week, the patient had no pain and the signs of consolidation were good, the bone-screws were removed. It happened that the patients themselves wanted to keep the instruments fixed on longer than necessary for the sake of safety, which suggests that the fixation is well tolerated.

Complications. In 28 of the 49 treated fractures the course was uncomplicated. In 8 cases slight infection arose at the site of one or several screws, and in a further 8 cases more marked infection occurred with-

out giving rise to manifest osteitis. Only one patient had long-lasting suppuration from a few screw-tracks; granulation tissue was curetted out but no bone sequestra were found and the fistulas healed very soon after the revision. As a rule, the small skin defects at the screw-tracks healed very quickly after the removal of the instruments, even when infection had been present. At the follow-up examination none of the patients complained of discomfort at the sites of the removed screws. Nor were there any complaints relating to the quite inconspicuous scars.

In 5 cases the bone-screws worked loose, so that the treatment had to be discontinued. In 1 of these cases, a patient with an ulnar pseudarthrosis, the osteotaxis procedure was repeated 3½ months after the screws had come loose, and the pseudarthrosis healed.

Analysis of failures.

9 (18%) of the 49 treated fractures did not heal.

In 1 case of ulnar pseudarthrosis the period of fixation was too short, 2½ months. The instruments were removed after misinterpretation of the radiograph. Subsequent checkings by X-ray in oblique views showed clearly that the pseudarthrosis had not healed. It was later treated successfully by onlay grafting.

One patient with an infected pseudarthrosis in the upper part of the humerus had marked osteoporosis, which caused loosening of the screws so that the treatment had to be discontinued.

3 out of 11 femoral fractures did not heal. In one of these cases the screws had incorrectly been inserted on the front of the thigh through the quadriceps muscle, which probably was the reason why they come loose. Healing occurred later on, after operation on the pseudarthrosis and internal fixation with a blade-plate. In the second case, a femoral pseudarthrosis, the treatment had to be discontinued after 5½ months because of infection in the screw-tracks. The fracture healed after operation on the pseudarthrosis and medullary nailing. In the third case the patient had a comminuted fracture of the femur with injury of the sciatic nerve. The fracture was first treated by skeletal traction, but owing to malposition of the fracture osteotaxis was performed but the bone-ends could not be brought into contact with one another. The treatment was discontinued after 13 months of fixation. The fracture healed later, after operation on the pseudarthrosis.

Among the cases of tibial fractures treatment failed in 4. A four-day-old fracture with unsatisfactory position was treated by osteotaxis which was discontinued after 4½ months because of non-healing and slight screw-track infection. The fracture healed after operation on the pseudarthrosis. In a man with a 12-year-old pseudarthrosis, for which he had previously undergone 10 operations, healing was not obtained by osteotaxis combined with inlay grafting. The screws came loose after 3 months, largely because the patient, who was under the effect of ethylism, refused to stay in the hospital and follow the instructions. Later on the pseudarthrosis necessitated amputation. In one case of non-union with a large defect and infection, admitted for treatment 2 years and 8 months after the injury, healing was not

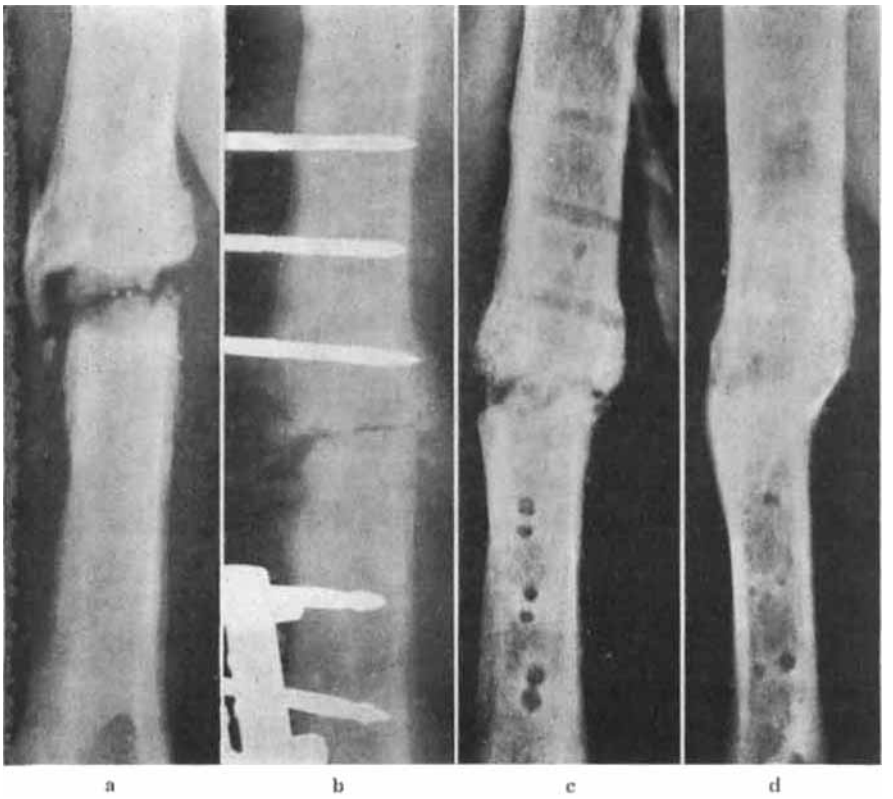

Fig. 3.

Case 1.—a: Pseudarthrosis of the humerus. b: The pseudarthrosis has been resected. Fixation by osteotaxis. c: 5½ months later, healing has occurred. d: 6 years later.

obtained by fixation for 6 months. The screws came loose and later on amputation was performed. One patient with an infected tibial pseudarthrosis was treated by osteotaxis and osteotomy of the fibula, but a fracture line remained right through an excessive callus formation. Because of insignificant symptoms, further treatment was not necessary.

From this analysis it is seen that many of the unsuccessful results occurred in difficult cases. One failure was due to a technical error, and another to misinterpretation of the radiograph taken to check the healing.

CASE-REPORT

To illustrate the advantages of the method and to demonstrate the difficult type of the treated fractures some representative cases will be reported.

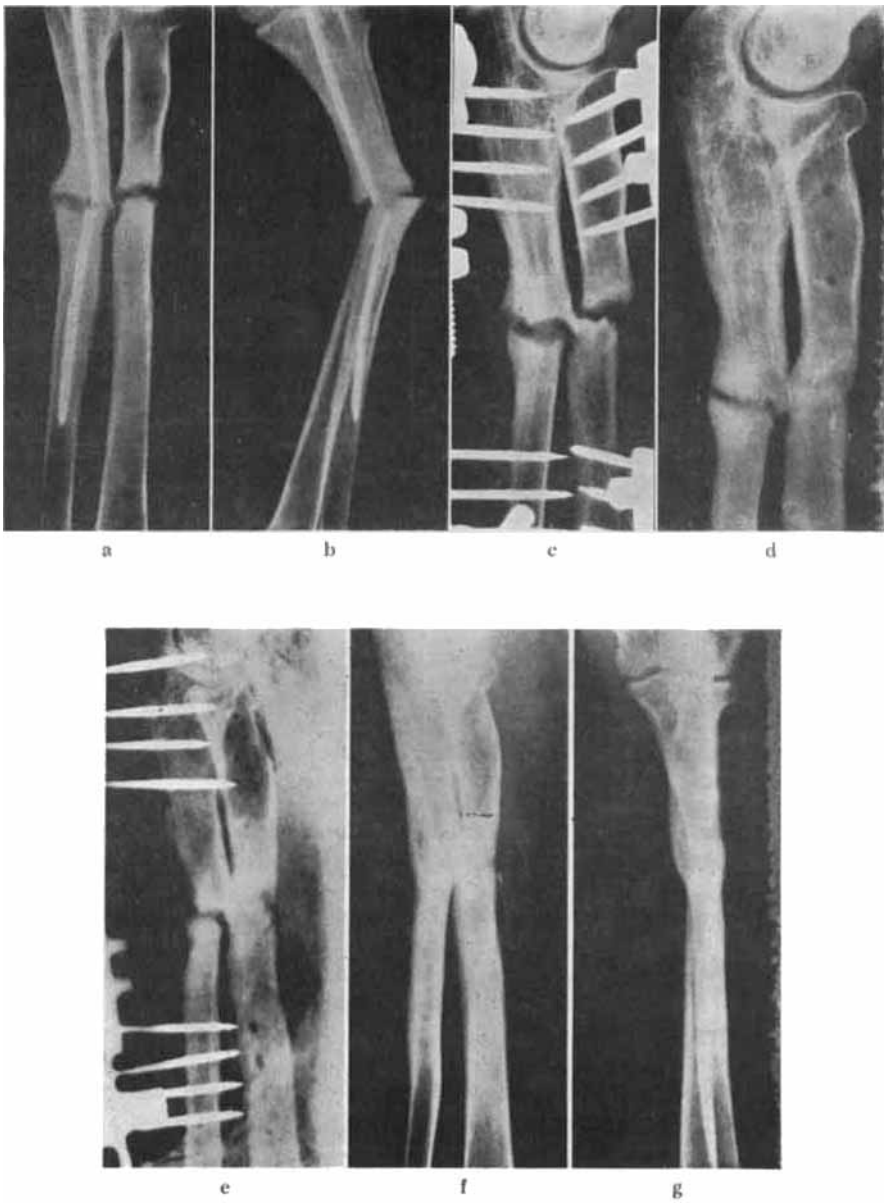

Fig. 4.

Case 2.—a and b: Pseudarthrosis of the radius and ulna. c: Fixation by osteotaxis. d: Radial fracture healed; ulnar pseudarthrosis persists. e: Second osteotaxis on the ulna combined with inlay grafting 10 months after the primary osteotaxis treatment. f and g: 2 years later.

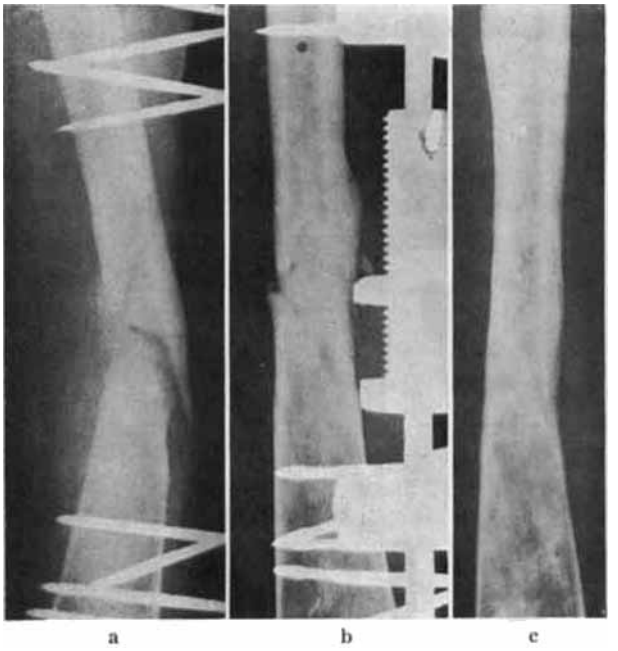

Fig. 5.

Case 3.—a: Pseudarthrosis of the femur. Two sets of bone-screws applied at different levels. b: Coupling bar attached, fracture reduced in exact position and compression established. c: 10½ months later.

Case 1. A 49 year old man with a fracture of the humerus primarily treated by medullary nailing and later twice by operation for pseudarthrosis. Osteotaxis combined with resection of the pseudarthrosis 2 years and 9 months after injury. Period of fixation 5½ months. Patient resumed work as a foreman 6 weeks after operation, wearing the osteotaxis instruments. Healing with normal function of the joint. No symptoms. (Fig. 3.)

Case 2. A 28 year old man with open fracture of the radius and ulna. Primary treatment by Lane's plate on the radius and medullary nailing of the ulna. Later on operation for pseudarthrosis without effect. Osteotaxis 4 years after injury. Period of fixation 5½ months. Healing of the radial but not of the ulnar fracture. Second osteotaxis on the ulna, combined with inlay grafting. Period of fixation 3 months and 3 weeks. Healing with pronation and supination reduced by 2/3 of normal range. No symptoms. (Fig. 4.)

Case 3. A 35 year old woman with a femoral fracture treated earlier by medullary nailing and operation for pseudarthrosis without effect. Osteotaxis combined with splitting of the pseudarthrosis 16 months after injury. Period of fixation 6 months and 3 weeks. Bed-rest for 8 days only. Hospital care for 1 month. Patient able to walk about freely, wearing the appliances. Healing with normal function of the joint. (Fig. 5.)

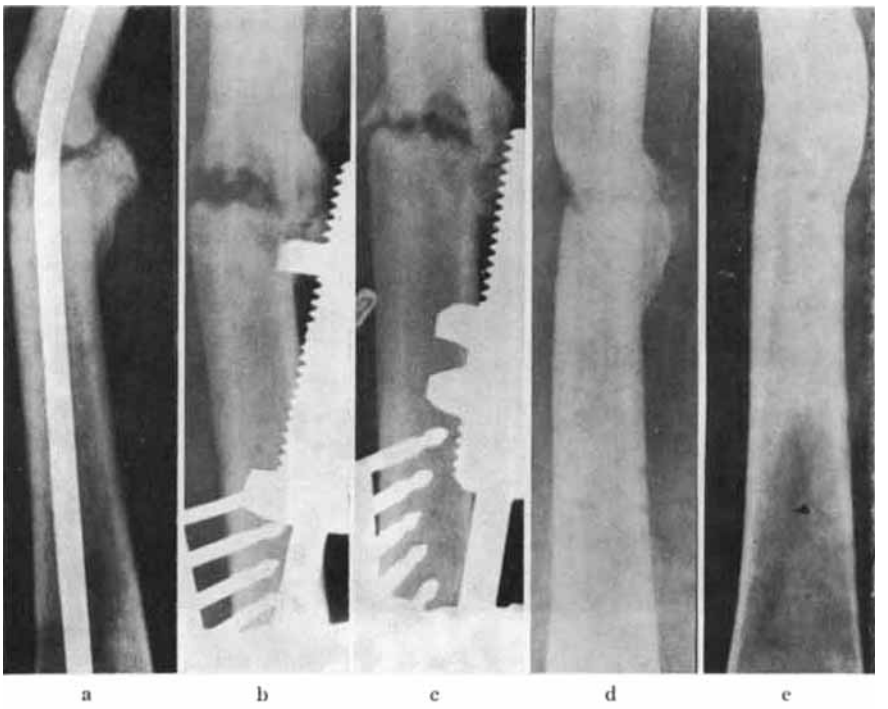

Fig. 6.
Case 4.—a: Pseudarthrosis of femur 9 months after primary treatment by medullary nailing. b: Fixation by osteotaxis without surgical intervention on the pseudarthrosis. c: Compression established. d: 4 months later, clinical and radiographic healing. e: 3 years later.

Case 4. A 42 year old woman with severe injuries; one leg amputated through the thigh, on the other leg a femoral fracture and severe skin damage. Medullary nailing resulted in pseudarthrosis with marked malposition. Osteotaxis 9 months after the accident. Period of fixation 4 months. Treatment carried through despite the poor condition of the skin with extensive grafts and infection in some screw-tracks. Fracture healed with slightly reduced movement in the knee; joint-function otherwise normal. (Fig. 6.)

Case 5. A 52 year old woman with fracture of the femoral neck and the tibia of the same leg. To enable reduction of the femoral-neck fracture on the traction table the lower leg fracture had to be firmly fixed. Osteotaxis on the day after the accident. Simultaneous closed reduction and osteosynthesis of the femoral-neck fracture. The lower-leg fracture fixed by the instruments for 3½ months. Healing with normal joint-function. (Fig. 7.)

Case 6. A 20 year old man with an open lower-leg fracture primarily treated with Lane's plate. Later on operation for pseudarthrosis by onlay grafting; infection intercurred. His leg had been immobilized in plaster for 1½ years and he

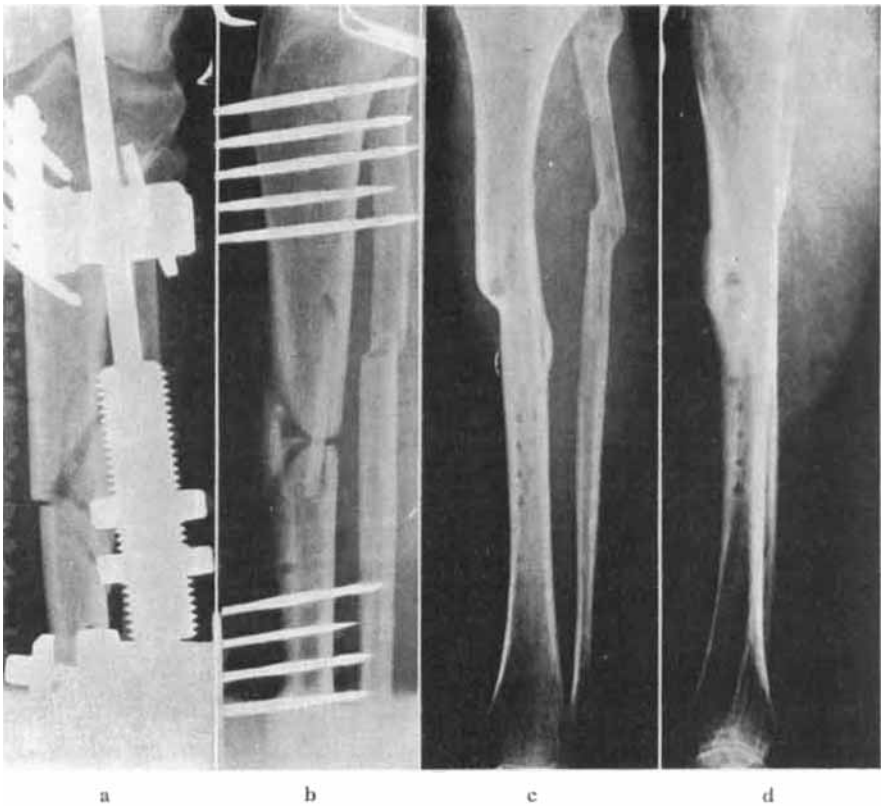

Fig. 7.

Case 5.—Fracture of femoral neck and tibia of the same leg. After transfixation of the tibia reduction and osteosynthesis of the femoral-neck fracture could be carried out immediately. a and b: Anteroposterior and lateral views of transfixed tibial fracture. c and d: Anteroposterior and lateral views 1 year after the accident (fracture healed in 3½ months).

had considerable stiffness of the knee and ankle joints. Osteotaxis 1 year and 9 months after the injury. Osteitic bone removed and replaced by bone-chips. The course was uncomplicated. Period of fixation 5 months. Healing with normal joint-function. (Fig. 8.)

DISCUSSION AND CONCLUSIONS

Hoffmann's method for fixation of fractures enables good reduction, fixation and compression, and allows free movements in adjacent joints. These are exactly the most important factors in the ideal healing of

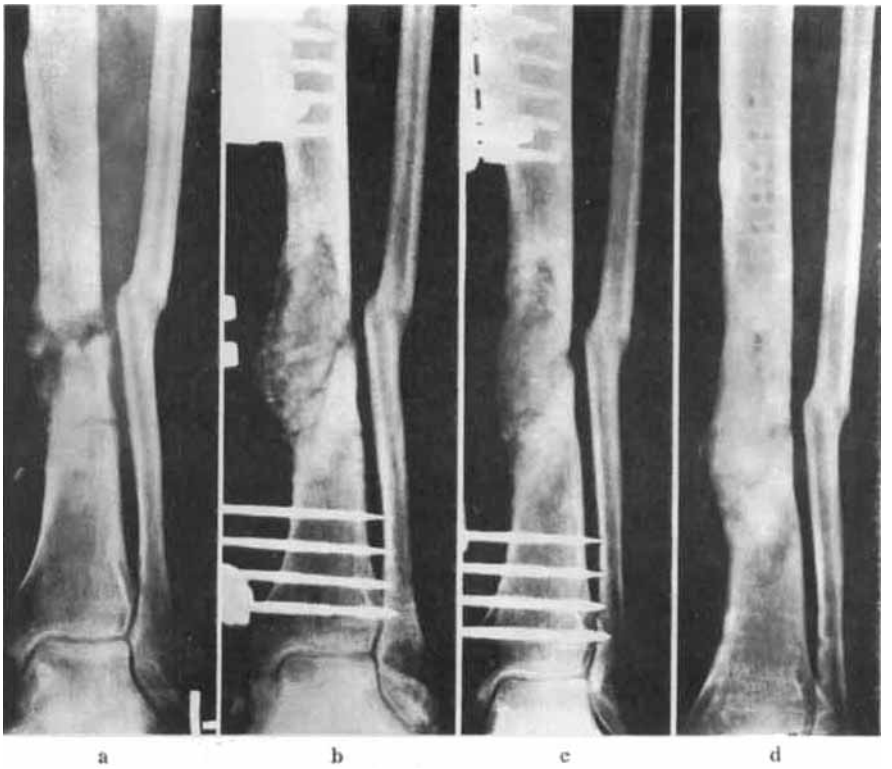

Fig. 8.

Case 6.—a: Infected pseudarthrosis of the tibia. b: Fixation by osteotaxis after removal of osteitic bone and grafting. c: 6 weeks after operation, the bonegrafts have been partly transformed. d: 6 months after operation; the grafts are completely transformed, the fracture has healed.

fractures with optimal function. Our experiences in this respect have been good. The patients can be immobilized early. Even patients with lower-leg fractures are able to be ambulant soon after operation, and in favourable cases very early weight-bearing can be allowed.

In the justified criticism of transfixation methods described earlier the risk of infection has been emphasized in particular. The question whether it is a true bacterial infection or a matter of electrolytic irritation has been discussed. Hoffmann's instrumentarium reduces the last-named factor, because the screws are made of highest quality steel and isolated from one another in a fully satisfactory way. The risk of bacterial infection should be taken into consideration but can be

reduced by an exact technique and meticulous care of the skin.[1] In the series of patients presented here, screw-track infection was no great problem; only in 1 case did long-lasting suppuration occur. Apart from this, the screw-tracks healed very quickly after the instruments had been removed. In no case did osteitis develop.

According to *Hoffmann* and several of his followers, open fractures are the main indication for osteotaxis. We have no experience with this application of the method, since very few patients with acute open fractures were admitted to this clinic during the period of study. As far as we can judge from our experiences in other cases, however, osteotaxis should be the ideal method in severe open comminuted fractures, where other methods of fixation cannot maintain a good position of the bone-ends, provided of course that the surrounding skin allows transfixation.

Our experiences relate to patients with difficult fractures and pseudarthroses, in many cases primarily treated by other methods, and, accordingly, to a selected material of difficult cases. This fact must be considered in the assessment of the results. Looking at the pseudarthrosis cases only, healing failed to occur in 7 cases out of 34, or in 20%. For the sake of comparison may be mentioned the large series of pseudarthrosis cases recently published from the Campbell Clinic at Memphis in the U.S.A. (*Boyd et al.* [2]), in which the incidence of non-healing after the primary operation on the pseudarthrosis was 12%. Our results appear particularly favourable if one considers not only the healing of the fractures but also the joint-function, which is much better after osteotaxis than after prolonged immobilization in plaster.

As regards the treatment of pseudarthrosis, a question of interest is whether or not it is necessary to combine osteotaxis with surgical intervention. In most of our cases we combined osteotaxis with some form of operation on the pseudarthrosis, either primarily or after some time, when we did not notice any tendency to healing. In 10 cases, however, the fractures healed with osteotaxis only. Among these were 3 that would more properly be designated as delayed union, but also some pseudarthroses, even one that was infected. The question whether to operate or not on the pseudarthrosis must be decided from case to case, depending upon the appearance of the pseudarthrosis and the mechanical possibilities for exact fixation.

[1] A suitable protective dressing is obtained by spraying the skin with Nobecutan® (Bofors, Sweden), which forms a thin protective plastic coating, and applying a Telfa bandage (Kendall, Chicago), whose plastic-coated side adheres to the skin.

On the basis of nine years' experience with osteotaxis the following conclusions are drawn.

The method is not suitable for routine use, especially in a surgical department with great accumulation of acute cases. In special departments, where those in charge of the case have time to follow carefully the technical instructions, osteotaxis is an excellent complement to the usual methods of fracture treatment.

Osteotaxis is particularly expedient for difficult fractures, for open fractures, where it can be difficult to achieve a good position and fixation by other measures, for multiple fractures and for pseudarthroses, where it is desirable to avoid too prolonged immobilization of adjacent joints.

All the long bones are suitable for osteotaxis, perhaps the tibia in particular, on which the instruments are easily applied and which is the commonest site of difficult fractures.

The method involves no risks and is strikingly well tolerated by the patients, who often spontaneously state that they prefer osteotaxis to immobilization in plaster.

SUMMARY

A selected series of patients with difficult fractures and pseudarthrosis of the long bones were treated by Hoffmann's method of osteotaxis.

The material consists of 49 fractures, of which 40 healed. The results are assessed as very favourable, in view of the degree of severity of the cases. Very good joint-function was obtained, because the method allows early mobilization.

No serious complications occurred. In no case did osteitis develop in the screw-tracks. To avoid such inflammation it is essential that the technical instruction be followed and that meticulous care be taken of the skin.

Osteotaxis is not suitable as a routine method but it is recommended in difficult cases of fractures and non-union.

RESUME

Une série sélectionnée de malades avec fractures compliquées et pseudarthrose des os longs ont été traités par la méthode de l'ostéotaxis de Hoffmann.

Le matériel d'observation comprend 49 fractures dont 40 se soudèrent. Les résultats sont considérés comme très favorables en raison du degré

de gravité de ces cas. Une très bonne fonction de l'articulation a été obtenue parce que la méthode permet une mobilité précoce.

Aucune complication sérieuse n'a été constatée. Dans aucun cas il ne s'est développé d'ostéite à l'endroit de la vis. Afin d'éviter l'inflammation il est essentiel de suivre strictement les instructions techniques et de prendre un soin méticuleux de la peau.

L'ostéotaxis ne convient pas comme méthode de routine, mais elle est recommandée dans les cas de fractures compliquées et de pseudarthrose.

ZUSAMMENFASSUNG

Eine ausgewählte Reihenfolge von Patienten mit schwierigen Brüchen und Pseudarthrosen der langen Röhrenknochen wurde mittels Hoffmanns Methode der Osteotaxis behandelt.

Das Material besteht aus 49 Brüchen von denen 40 heilten. Die Ergebnisse werden, wenn man die Schwere der Fälle in Betracht zieht, als sehr günstig angesehen. Ausgezeichnete Gelenksfunktion wurde erzielt, da die Methode frühzeitige Mobilisierung gestattet.

Keinerlei ernsthafte Komplikationen traten ein. In keinem Falle entstandt Osteitis in den Schraubenbohrungen. Es ist wesentlich dass man der technischen Anweisung genau Folge leistet und dass man die Haut sorgfältig behandlet, um derlei Entzündungen zu vermeiden.

Osteotaxis eignet sich nicht als eine Durchschnittsmethode, kann aber in Fällen von schwierigen Brüchen oder Pseudarthrosen anbefehlt werden.

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