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PRIMARY RESULTS OF TREATMENT OF FRACTURE OF THE OS CALCIS BY "FOOT-FREE WALKING BANDAGE" AND EARLY MOVEMENT

By

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INTRODUCTION WITH REVIEW OF PRINCIPLES OF TREATMENT[1]

The treatment of fracture of the os calcis presents many problems. The anatomical and functional results vary considerably and are often unsatisfactory. One fracture may heal satisfactorily with a good functional result within 6 months, while an apparently identical fracture may entail pronounced disablement (*Watson-Jones 1946*).

Some have tried to explain this difference on the basis of insurance neurosis (*Mac Farland* 1937). Most writers, however, believe it to be due in the first instance to the inadequate treatment of these fractures. This latter view explains the numerous principles of treatment employed.

The various treatments may be classified in the following groups:

1. Immobilisation without reduction.
   (*Golebiewsky* 1897, *Tietze* 1908, *Eiken* 1917, *Felsenreich* 1935, *Bode* 1937, and *Nissen-Lie* 1946).
2. Active reduction,
   with mallet (*Cotton* 1916, *Wilson* 1926, *Condit* 1926, *Bartley* 1931, and *Hermann* 1937),
   with compression screw of the Phelps-Gocht type (*Hamant* and *Grimault* 1935, *Goff* 1937, and *Böhler* 1938),
   with Steinmann's nails (*Straus* 1921, *Hertel* 1923),

[1] Only main principles are included in the survey. Combinations of the principles and less commonly employed procedures (removal of fragments, astragalectomy, etc.) are thus excluded.

with Kirchner's pins (*Becker* 1923, *Harris* (traction in 3 directions) 1946, and *Lauritsen* 1947),
with tongs (*Harding* 1928, *Gilette* 1930, *Hermann* 1931, and *Olson* 1939),
with sounds (the lever principle) (*Cotton* 1921, and *Wilson* 1926), and with nails (*Westhues* 1934, and *Lehmann* 1940).

3. Open reduction.
(*Morestin* 1902, *Lambotte* 1913, *Cahill* 1916, *Cotton* 1921, *Condit* 1926, and *Bode* 1937).
4. Open reduction and osteosynthesis.
(*Leriche* 1928, *Nové-Josserand* 1928, *Simon* and *Stulz* 1930, *Wertheimer* 1934, *Bachy* 1934, and *Whittaker* 1947).
5. Open osteoplastic reduction.
(*Wilmoth* and *Leceur* 1929, *Desplas* 1931, *Lenormant* and *Wilmoth* 1932, *Sorrel* 1933, *Lafitte* 1934, *Gregoire* and *Couvelaire* 1934, *Mutricy* and *Sicard* 1934, *Goffin* and *Graefschepe* 1934, *Lorenzetti* 1934, *Auvray* 1935, *Stultz* 1935, *Bachy* 1935, and *Palmer* 1948).
6. Primary subtalar arthrodesis.
(*van Stockum* 1912, *Reich* 1926, *Wilson* 1927, *Nové-Josserand* 1928, *Bartley* 1931, *Stulz* 1935, *Conn* 1935, *Hermann* 1937, and *Kiær* and *Anthonsen* 1942).
7. Early movement without reduction.
(*Roberts* and *Sayle Creer* 1947).

We have found the latter principle mentioned only in a brief report of the discussions of the British Orthopedic Association. The authors have followed-up a great number of patients with fracture of the os calcis and found that those presenting compression fractures with intra-articular fracture lines treated by reduction and immobilisation are incapacitated for 1 year on an average. After early movement, on the other hand, the period of incapacity lasts about 6 months. The report says nothing about the number of cases, nor about the procedure of mobilisation. However, in 1946 one of us visited *Roberts* in his hospital department in Liverpool, and discussed there the treatment of calcaneal fractures with him. *Roberts* lets his patients stay in bed for 1½ to 3 months, during which period he trains the movements of the ankle and subtalar joints.

AUTHOR'S PRINCIPLE OF TREATMENT

Of late years an active, functional principle of treatment has given encouraging results in cases of para-articular and intra-articular fractures (e.g. *v. Magnus'* treatment of spinal fractures), and this seemed,

in our opinion, to be worth trying on calcaneal fractures. Since May 1, 1944, in the Surgical Department C of the Rigshospital, we have treated all patients admitted with fracture of the os calcis by circular walking plaster, applied from the malleoli to the condyles of the tibia, in such a way that all the joints of the foot are free to move ("foot-free plaster")[1].

We used the treatment for all calcaneal fractures in the Department, partly because we aimed at creating a definite range of indication for this form of treatment, and partly because the types of fracture seen during the period of investigation were in our opinion, all of a kind to justify foot-free plaster.

The foot-free plaster is applied as soon as the fractural swelling has subsided, on an average, 6 days after the fracture. The first day, a circular plaster is applied from the malleoli to the tibial condyles, and on the next a walking iron is fitted.

The patients are then allowed to use the walking iron with the aid of 2 sticks or elbow crutches. In addition they are encouraged to practise active dorso-plantar flexion of the ankle-joint as well as pro- and supination of the foot.

AUTHOR'S MATERIAL[2]

The series comprises 23 cases treated between May 1, 1944 and April 1, 1945. The total number of admissions was 25, but owing to special circumstances (refugees' transportation, etc.) 2 patients were not treated according to this principle, but by simple circular bandage.

5	cases	were	observed	for	more than 5 years
5	„	„	„	„	4 to 5 years
2	„	„	„	„	3 to 4 years
3	„	„	„	„	2 to 3 years
6	„	„	„	„	1 to 2 years
2	„	„	„	„	½ to 1 year

Numerous classifications are indicated on account of the many varying types of calcaneal fracture: according to manner of occurrence (*Müller* 1925), anatomical principles (*Schofield* 1936), direction course of fracture lines (*Voeckler* 1906, *Westphal* 1912, *Kaufmann* 1917, *Ei-*

[1] In departments with a splint workshop attached, the foot-free plaster may be replaced by a lower-leg splint with heel iron.

[2] Since the conclusion of the investigation a further 3 cases have been treated on the same principle.

TABLE 1

Classification of calcaneal fractures.

	Watson-Jones	Ahlberg	Present cases
1. Extra-articular	20 %	about 15 %	9 (about 40 %)
a. vertical fractures of tuber.	15 %		
b. horizontal fractures of tuber.	1 %		
c. fract. of sustentaculum tali and calcaneal head (ant. proc.)	4 %		
2. Intra-articular without dislocation	25 %	about 8 %	8 (about 35 %)
a. fissures without dislocation			
b. fract. of border and body with reduced tuber.-joint angle without displacement			
3. Intra-articular with dislocation and reduced tuber.-joint angle	55 %	about 77 %	6 (about 25 %)
a. external portion of posterior joint surface	40 %		
b. entire posterior joint surface	5 %		
c. anterior joint surface and cuboid area	10 %		

The individual cases in the present series are reported on in Table 2.

ken 1917, and *zur Verth* 1919), displacement in joint surface (Destot), relation of fracture to joint surfaces (*Böhler* 1938), and finally a combination of these classifications (*Brino* 1914, *Jimeno-Vidal* 1935, *Jackle and Clark* 1937, *Ahlberg* 1940, and *Watson-Jones* 1946).

In the present paper we have employed a classification corresponding approximately to those of *Ahlberg, Watson-Jones,* and *Jimeno-Vidal* (Table 1).

TECHNIQUE OF X-RAY EXAMINATION

On admission of the patients films are taken in the lateral view and from below in a view at right angles to the other. These films are in most cases supplemented by special pictures of the heel region and by oblique films in *Anthonsen*'s (1943) plane, for further elucidation of the relation of the fracture to the subtalar joints, notably the posterior.

At the follow-up all planes are employed; the tuber-joint angle is measured from the picture taken in the lateral view, the breadth of the heel in the special films of the tuber, and the conditions of the

TABLE 2

1. Case No.	948/44	1295/44	1612/44
2. Age and Occupation	48—carrier	37—navvy	57—carpenter
3. X-ray			
a. Fracture type	intra-art. without disloc. and extra-art.	extra-art.	intra-art. without disloc. and extra-art.
b. Tuber-joint angle	reduced	normal	reduced
c. Breadth of heel	normal	normal	moderately increased
4. Obs. period in years	5	5	5
5. Suppl. treatment	—	—	massage
6. Incapacity in months	3	7	11
7. Change of work	—	—	—
8. Reduced capacity	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	pain morning and evening under heel	pain morning and evening when walking
11. Disabl. pension	—	—	—
12. Other damages recovered	—	500 Dan. Kr.	1000 Dan. Kr.
13. Gait	normal	normal	normal
14. Position of foot	normal	normal	normal
15. Flex.-ext. in foot	normal	20°-30°	normal
pro- and supin.	normal	normal	normal
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	normal	normal	normal
b. Tuber-joint angle	reduced		reduced
c. Breadth of heel	increased		slightly increased

subtalar joints are assessed through pictures in the lateral, and specially in *Anthonsen*'s oblique plane.

The most important observations appear in the survey in Table 2.

RESULTS OF TREATMENT

The number of cases and the preponderance of extra-articular and non-dislocated intra-articular fractures do not permit of a definite estimation of the value of the method for all fracture types, especially not for the intra-articular with dislocation and a reduced tuber-joint angle.

The results achieved so far are, however, encouraging, even within the group of severe fractures. Details appear in Table 2.

TABLE 2 (cont.)

1. Case No.	2095/44	2435/44	5/45
2. Age and Occupation .	49—ship-builder	49—driver	31—tinsmith
3. X-ray			
a. Fracture type . . .	intra-art. without displacement	intra-art. with slight displacement	intra-art. without displacement
b. Tuber-joint angle .	normal	normal	normal
c. Breadth of heel . . .	increased	increased	normal
4. Obs. period in years .	5	5	4
5. Suppl. treatment . . .	massage and short wave	massage, supporting bandage, working boot	massage
6. Incapacity in months .	6	6	5
7. Change of work	—	—	—
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	—	intermittent pain in heel
11. Disabl. pension	—	—	—
12. Other damages recovered	—	2100 Dan. Kr.	—
13. Gait	normal	normal	normal
14. Position of foot	normal	moderate flatfoot	normal
15. Flex.-ext. in foot . . .	normal	normal	normal
pro- and supin.	5°-30°	normal	normal
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	slightly displaced	normal	normal
b. Tuber-joint angle .	slightly reduced	slightly reduced	normal
c. Breadth of heel . .	increased	increased	normal

In 16 cases the treatment consisted exclusively in foot-free plaster and movement, while in 7 this was supplemented by physiotherapy (massage, short-wave treatment).

Length of stay in hospital ranged from 5 to 36 days (on an average 13 days); in 5 cases this was distributed over 2 periods (changing of plaster or after-treatment).

The total periods of treatment ranged from 42 to 90 days (on an average 62 days).

The anatomical results may be summed up as follows: During the treatment the tuber-joint angle was increased in 4 cases and reduced

TABLE 2 (cont.)

1. Case No.	751/45	1505/45	2469/45
2. Age and Occupation .	29—telephone fitter	53—electrician	60—window-cleaner
3. X-ray			
a. Fracture type . . .	extra-art.	intra-art. with displacement	intra-art. with displacement
b. Tuber-joint angle .	reduced	reduced	reduced
c. Breadth of heel . .	increased	normal	increased
4. Obs. period in years .	4	4	4
5. Suppl. treatment . . .	massage for 3 months	—	massage for 3 months
6. Incapacity in months .	5	14 (compl. crural ulcer)	5
7. Change of work	—	—	—
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	pain at posterior edge of heel	pain in bad weather
11. Disabl. pension	—	—	—
12. Other damages recovered	800 Dan. Kr.	—	800 Dan. Kr.
13. Gait	normal	does not support himself on the heel	normal
14. Position of foot	slight flat-foot	moderate flat-foot	slight flat-foot
15. Flex.-ext. in foot . . .	normal	normal	normal
pro- and supin.	normal	10°-0	normal
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	normal	normal	displaced posteriorly
b. Tuber-joint angle .	reduced	reduced	further reduced
c. Breadth of heel . .	normal	normal	increased

in 14. Displacement of the joint surface occurred in 1 case only (2094/44) during the treatment, while the intra-articular dislocation caused by the injury disappeared in 2 cases. The heel breadth was increased in 3 cases, but reduced in 3 others. Arthrosis occurred in 2 cases, but the observation periods were too short to give an impression of the incidence of this complication. Flat-foot was demonstrable in 8 cases, but in 3 of these it was ostensibly present before the injury.

The functional results of the treatment correspond to the anatomical. The dorsal and plantar flexions were determined by measurement of the angle between medium position and maximum flexion.

TABLE 2 (cont.)

1. Case No.	1926/46	241/47	1024/47
2. Age and Occupation .	22—musician	24—labourer	45—ship-master
3. X-ray			
a. Fracture type . . .	intra-art. without displacement	extra-art.	intra-art. with displacement
b. Tuber-joint angle .	reduced	normal	reduced
c. Breadth of heel . .	normal	normal	normal
4. Obs. period in years .	4	3	3
5. Suppl. treatment . . .	—	—	—
6. Incapacity in months .	5	4	4
7. Change of work	—	—	—
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	—	pain under lateral malleolus when walking on sloping ground
11. Disabl. pension	—	—	—
12. Other damages recovered	—	—	—
13. Gait	normal	normal	normal
14. Position of foot	moderate flat-foot	normal	moderate flat-foot
15. Flex.-ext. in foot . . .	normal	normal	35°-35°
pro- and supin.	normal	normal	5°-35°
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	normal	normal	slightly displaced
b. Tuber-joint angle .	reduced	normal	reduced
c. Breadth of heel . .	normal	normal	increased

Pro- and supination were estimated in the standing position by measuring the angle between the medium position (heel on the floor) and maximum pro- and supination. Dorsal and plantar flexions were reduced in 3 cases, and pro- and supination in 8. Difficulty of gait was seen in 3 cases, while 9 patients had subjective gait troubles. 12 of the patients were provided with flat-foot support, 1 with a working boot, and 1 with a foot capsule (1844/47).

The results were also satisfactory from a social point of view, as the periods of incapacity ranged from 2 to 7 months. Only 2 patients had to change their occupations. 9 patients recovered damages, which amounted to maximally 15 %. No one received disablement-pension.

TABLE 2 (cont.)

1. Case No.	1290/47	1414/47	1701/47
2 Age and Occupation .	43—dock-labourer	35—typographer	42—foundry-labourer
3. X-ray			
a. Fracture type . . .	intra-art. with small displacement	extra-art.	extra-art.
b. Tuber-joint angle .	reduced	normal	normal
c. Breadth of heel . .	increased	normal	normal
4. Obs. period in years .	2	2	2
5. Suppl. treatment . . .	—	—	—
6. Incapacity in months .	5	4	3
7. Change of work	—	—	to sitting work
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	pain morning and evening when walking	pain under heel when walking
11. Disabl. pension	—	—	—
12. Other damages recovered	2000 Dan. Kr.	—	—
13. Gait	normal	normal	normal
14. Position of foot	normal	normal	normal
15. Flex.-ext. in foot . . .	normal	normal	normal
pro- and supin.	normal	normal	normal
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	slightly displaced anteriorly	normal	free
b. Tuber-joint angle .	reduced	normal	slightly reduced
c. Breadth of heel . .	normal	normal	slightly increased

It does not appear clearly from the present series whether there is a correlation between the result achieved and the severity of the fracture, or the degree of reduction of the tuber-joint angle.

CONCLUSION

The treatment of calcaneal fractures has of late years developed more and more actively, to a great measure in the surgical direction. The improvement in results has, however, been small (*Olovson* 1940, *Anthonsen* 1943), presumably because we have hitherto been unable to put up definite lines of indication for the respective methods of treatment.

TABLE 2 (cont.)

1. Case No.	1844/47	2095/47	851/48
2. Age and Occupation .	66—copyist	45—painter	44—craneman
3. X-ray			
a. Fracture type . . .	intra-art. with displacement	intra-art. without disloc., extra-art.	bilateral extra-art.
b. Tuber-joint angle .	reduced	very reduced	normal
c. Breadth of heel . .	norm. (arthr. change in joint)	increased	normal
4. Obs. period in years .	1½	1	1
5. Suppl. treatment . . .	short wave, foot capsule and flat-foot boot	—	tensoplast
6. Incapacity in months .	7 months	4½	8
7. Change of work	—	—	—
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	tenderness under lat. malleolus	—	much tenderness under both heels, pain when walking
11. Disabl. pension	—	—	—
12. Other damages recovered	—	700 Dan. Kr.	not settled
13. Gait	does not support himself on the heel	normal	stiff and slow, supporting himself with caution on heel
14. Position of foot	normal	normal	bilat. flat-foot
15. Flex.-ext. in foot . . .	normal	normal	norm. on both sides
pro- and supin.	5°-10°	10°-35°	rt. 10°-10° lt. 0-0
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	displaced	normal	normal
b. Tuber-joint angle .	reduced	improved	normal
c. Breadth of heel . .	normal, arthr. changes	slightly increased	increased on left side

On this account we feel justified in omitting attempts at reduction but instead we carry out early mobilisation. We have been prepared to perform subtalar arthrodesis in cases the treatment should prove unsatisfactory.

Although the number of cases is small and the observation periods relatively short we think it justifiable to recommend treatment with

TABLE 2 (cont.)

1. Case No.	1150/48	1473/49	2053/49
2. Age and Occupation .	60—m. w. head postman	35—chauffeur	46—foundry labourer
3. X-ray			
a. Fracture type . . .	extra-art.	intra-art. without displacement	extra-art.
b. Tuber-joint angle .	normal	normal	normal
c. Breadth of heel . .	normal	normal	normal
4. Obs. period in years .	1	1	1
5. Suppl. treatment . . .	—	—	—
6. Incapacity in months .	4	4	2
7. Change of work	—	—	—
8. Reduced capacity . . .	—	—	—
9. Reduced wages	—	—	—
10. Subj. troubles	—	— aft. flat-foot support	—
11. Disabl. pension	—	—	—
12. Other damages recovered	—	—	1200 Dan. Kr.
13. Gait	normal	normal	normal
14. Position of foot	normal	flat-foot (insuff. pedis)	normal
15. Flex.-ext. in foot . . .	normal	20°-35°	normal
pro- and supin.	normal	15°-45°	normal
16. Triceps insuff.	—	—	—
17. X-ray follow-up			
a. Joint surface	normal	normal	normal
b. Tuber-joint angle .	reduced	normal	normal
c. Breadth of heel . .	normal	increased	increased

foot-free plaster and movement, at least in all cases of extra-articular calcaneal fracture and intra-articular fracture without dislocation.

Further, we are not hesitating to continue our experiments with the treatment where intra-articular fractures with dislocation are concerned, as we have seen no unfavourable results, and—like other writers—have been unable to demonstrate a definite correlation between severity of fracture and reduction of tuberosity-joint angle on the one hand and the result achieved on the other.

The frequency of arthrosis, as well as of subjective and objective gait troubles is so low, even considering the relative benignity of the material, that the method of treatment bears comparison with other active-surgical treatments.

Future experiences will probably enable us to distinguish certain types of intra-articular fractures which are best treated by early

TABLE 2 (cont.)

1. Case No.	2115/49	284/50
2. Age and Occupation .	62—wharf-labourer	36—tramway-labourer
3. X-ray		
a. Fracture type . . .	intra-art. without dislоc.	intra-art.
b. Tuber-joint angle .	normal	normal
c. Breadth of heel . .	normal	normal
4. Obs. period in years .	½	½
5. Suppl. treatment . . .	—	—
6. Incapacity in months .	3	2
7. Change of work	—	—
8. Reduced capacity . . .	—	—
9. Reduced wages	—	—
10. Subj. troubles	—	—
11. Disabl. pension	—	—
12. Other damages recovered	—	—
13. Gait	stiff	normal
14. Position of foot	normal	normal
15. Flex.-ext. in foot . . .	10°-40°	normal
pro- and supin.	10°-25°	normal
16. Triceps insuff.	—	—
17. X-ray follow-up		
a. Joint surface . . .	normal	normal
b. Tuber-joint angle .	normal	normal
c. Breadth of heel . .	normal	normal

subtalar arthrodesis. Till then, we are of the opinion that a few months of mobilizing treatment in foot-free plaster should be tried before surgical treatment is decided upon.

The length of hospitalisation is very short, so that the treatment is highly economic.

Like *Roberts* and *Sayle Creer*, we observed that the period of incapacity was much shorter after mobilizing treatment than after reduction and immobilisation; there was almost a 50 % decrease.

The fairly quick rate of discharge makes it possible for the patients to move about and to occupy themselves usefully, a fact of importance —particularly mentally—for their future working prognosis. They do not become possessed by the idea of having been afflicted with a severe lesion which is difficult to treat.

SUMMARY

A brief review of the various principles of treatment of fracture of the os calcis is followed by an account of the results of the treatment of 23 personal cases of fractures by early movement in a foot-free walking bandage. The observation periods were over 5 years in 5 cases, over 3 years in 12 cases, and over 1 year in 21 cases. 9 patients had extra-articular fracture, 8 intra-articular without dislocation, and 6 intra-articular with dislocation.

The average stay in hospital was 13 days, the average period of treatment 62 days, and periods of incapacity lasted from 2 to 7 months. 9 patients only recovered damages, and none over 15 %. Only one patient had to change occupation.

The authors regard the results, anatomical as well as functional and social, as encouraging and recommend the method in all cases of less severe fracture. The principle of treatment, however, also seems justifiable where severe fractures are concerned.

RESUME

Exposé sommaire des différents principes de traitement des fractures de l'os calcis suivi d'un rapport sur les résultats du traitement de 23 cas de fracture avec mobilité rapide dans un bandage laissant le pied dégagé pour la marche. Les périodes d'observation ont été de plus de cinq ans dans 5 cas, de plus de trois ans dans 12 cas, de plus d'un an dans 21 cas. Neuf malades avaient des fractures extra-articulaires, huit intra-articulaires sans dislocation et six intra-articulaires avec dislocation.

La moyenne de la durée du séjour à l'hôpital a été de treize jours, le traitement s'est étendu sur une période moyenne de 62 jours avec incapacité de travail entre 2 et 7 mois. Chez 9 malades seulement il est resté une invalidité qui n'a dépassé chez aucun 15 %. Un seul malade a été obligé de changer d'occupation.

L'auteur considère ces résultats comme très encourageants tant au point de vue anatomique que fonctionnel et social et recommande la méthode dans tous les cas de fractures peu graves. Le principe du traitement semble toutefois justifié également dans les cas de fractures graves.

ZUSAMMENFASSUNG

Eine kurze Übersicht der verschiedenen Grundsätze in der Behandlung der Calcaneusfrakturen wird gegeben und ein Bericht über die Ergebnisse der Behandlung von 23 eigenen Fällen mit frühzeitiger

Bewegung einer fussfreien Gehbandage wird hinzugefügt. Die Beobachtungszeiten waren über 5 Jahre in 5 Fällen, über 3 Jahre in 12 Fällen, und über 1 Jahr in 21 Fällen. 9 Patienten hatten extra-artikulare Brüche, 8 intra-artikulare ohne Verschiebung, und 6 intra-artikulare Brüche mit Verschiebung.

Der Aufenthalt im Krankenhause betrug durchschnittlich 13 Tage. Die Behandlung dauerte durchschnittlich 62 Tage. Die Dauer der Arbeitsunfähigkeit war 2 bis 7 Monate. Nur 9 der Patienten bezogen eine Rente, aber keiner mehr als 15 %. Ein einziger Patient musste seine Beschäftigung wechseln.

Der Verfasser sieht diese Ergebnisse, sowohl anatomisch als auch funktionell und sozial als aufmunternd an und empfiehlt die Methode in allen Fällen von weniger schweren Brüchen. Das Prinzip der Behandlung jedoch scheint ihm auch in Fällen von schweren Brüchen anwendbar zu sein.

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