FROM THE ORTHOPEDIC HOSPITAL, AARHUS, DENMARK
(CHIEF PHYSICIAN: P. G. K. BENTZON, M.D.)

ON FRACTURE OF THE CARPAL SCAPHOID

A Method for Operative Treatment of Inveterate Fractures

BY

P. G. K. BENTZON and AAGE RANDLØV-MADSEN

In a recent article Robertson & Wilkins (Brit. Med. Jour. May 20, 1944) have reported that fracture of the carpal scaphoid was of an extraordinarily frequent occurrence among the patients with fractures of the upper extremities admitted to a Royal Naval Hospital for treatment. In the same period as 100 scaphoid fractures were treated in this clinic the total number of Colles fractures was only 58. This shift in the frequency of the two forms of fracture is quite surprising. In Denmark (calculated after the annual reports of the out-patient clinics) the ratio between the two kinds of fracture is very constant: 1 scaphoid fracture per 10 Colles fractures. Böhler states he has treated 424 scaphoid fractures—recent and old—within a period in which he observed 1251 Colles fractures.

Robertson & Wilkins are surprised at this peculiar shift in the incidence of the lesion, but they do not try to offer any explanation of it. Presumably the explanation is to be looked for in two circumstances: The nature of the patient material and the character of the traumatic injuries. The patients observed by Robertson & Wilkins were men, aged from 20 to 50 years (averaging 27 years), all sailors or airmen. Experience shows that the scaphoid fracture preferably happens to young, vigorous and active persons, especially men. The Colles fracture, on the other hand, is seen preponderantly in elderly persons, mostly women. Undoubtedly a certain role in the shift of the

ratio is to be assigned also to the character of the traumatic injury. Nearly all patients give the information that the injury took place with the wrist-joint in dorsal flexion. It seems safe to reckon that in the majority of these cases the traumatic injury has hit the forearm in its longitudinal axis while the wrist was dorsiflexed. Thus the radius is not particularly exposed to injury in this position, while the scaphoid must be said to be particularly exposed, being compressed as in a vice between the hand and the radius.

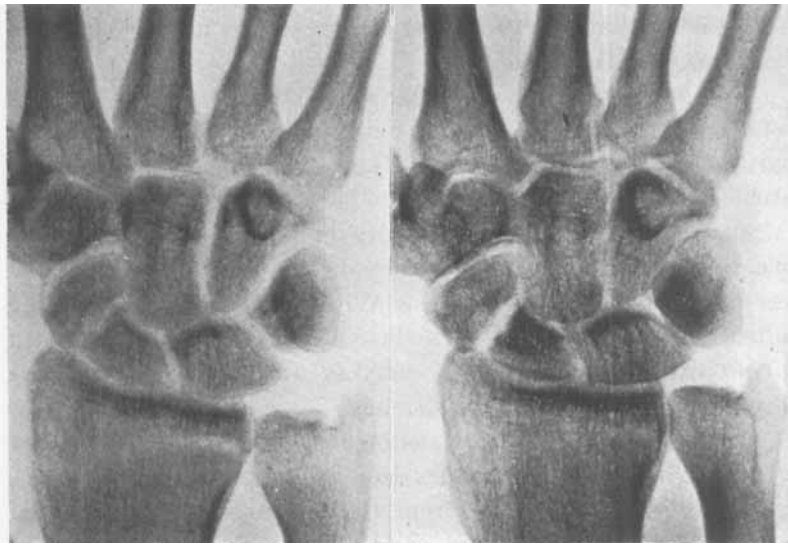
The great frequency of the scaphoid fracture under war conditions indicates renewed discussion of the question, in particular as the treatment of these fractures involves somes problems that cannot be said yet to have been solved adequately.

As is well known, the difficulty in the treatment of a scaphoid fracture lies in the tendency of this fracture to defective osseous healing. In Robertson & Wilkins' material the healing failed to appear in 35 % even though these authors endeavored to institute the treatment as early as possible and to carry it through with creditable consistency.

There can hardly be any doubt about the proper treatment of the fresh fracture. As emphasized by Robertson and Wilkins, an unpadded plaster cast from the elbow to the metacarpal heads ought to be applied as early as possible. Often it will be difficult to distinguish a fracture line at the first X-ray examination even on employment of the most favorable projection: with the wrist-joint in dorsiflexion. Robertson & Wilkins therefore recommend that in order not to lose any valuable time a plaster cast should be applied to any patient whose history and clinical data render a fracture probable even though it cannot be demonstrated roentgenographically. This treatment is carried through till complete osseous healing has taken place, *i.e.*, as a rule, for 8-10 weeks. Robertson & Wilkins obtained osseous healing in all the patients on whom the treatment was instituted within the first week after injury.

Most often the frequent defective healing of the fracture leaves a considerable degree of invalidism, which hitherto has been amenable to operative measures in only few cases. Only

4 of the 12 patients whom Robertson & Wilkins treated operatively because of failure of the fracture to heal became fully able to work. If we try to make the treatment of the inveterate fractures more rational and effective, however, we shall have to aim at a more accurate differentiation and grouping of the



b. a.

Fig. 1.

X-ray showing pseudarthrosis of the carpal scaphoid; a before and b after interposition of the flap between the fragments.

osseous changes encountered when osseous healing is compromised, so that the therapeutic measures may be varied according to the conditions present in each individual case.

Among the scaphoid fractures with incomplete healing and pseudarthrosis we meet with 3 types of osseous changes: 1) necrosis of a small, often proximal, fragment which in the roentgenogram appears as distinctly sclerotic; 2) absorptive processes (traumatic "cysts") round the fracture line that perhaps ought to be classified with the changes seen in the local "malacias"; and 3) pseudarthrosis proper, which as a rule di-

vides the bone in two almost equal parts. As to these conditions the reader may be referred to a paper by Ivar Palmer: "Riktlinjer för navicularfrakturernas behandling" (Nord. Med. 16. 3574, 1943).

The small, isolated, sclerotic fragments ought to be removed operatively. Possibly healing might be obtained by protracted immobilization, but such treatment will imply the risk of jeopardizing the final result, as the healing then is obtained at the expense of the mobility of the wrist-joint.

Treatment with immobilization ought to be reserved for the traumatic "cysts" which as a rule will heal after treatment for a relatively short period.

Among the 48 patients whom Robertson & Wilkins received for treatment later than one week after the injury, union was obtained in 13 with protracted employment of plaster cast—in one case for 60 weeks. Probably these 13 cases belonged to the last two groups mentioned.

For pseudarthrosis proper various methods of treatment have been recommended: immobilization, extirpation of one or both fragments, drilling ad modum Beck, plugging ad modum Matti, and fixation of the two fragments by transplantation of a small bone bridge.

Immobilization may be considered inexpedient, as in pseudarthrosis the healing process has to be looked upon as ceased definitively.

Extirpation of the fragments has given poor results, as in most cases the operation has made no change in the impaired and painful mobility of the wrist-joint, nor in the decreased power of the wrist. Indeed, this is not surprising, for removal of the fragments means a gross interference with the static conditions of the wrist.

Drilling ad modum Beck has been tried often—generally with poor results.

Matti advocates plugging of the cleansed and trimmed fracture with spongiosa taken from some other bone—*e.g.*, the radius. The method appears irrational: necrotic tissue is replaced with tissue that will undergo necrosis. The results are said to be inferior.

The transplantation method is recommended by British authors. It is said to be very exacting technically. In Robertson & Wilkins' material it was employed in 3 cases, resulting in union of the fragments in two of them.

Thus a serviceable method is wanted for the treatment of

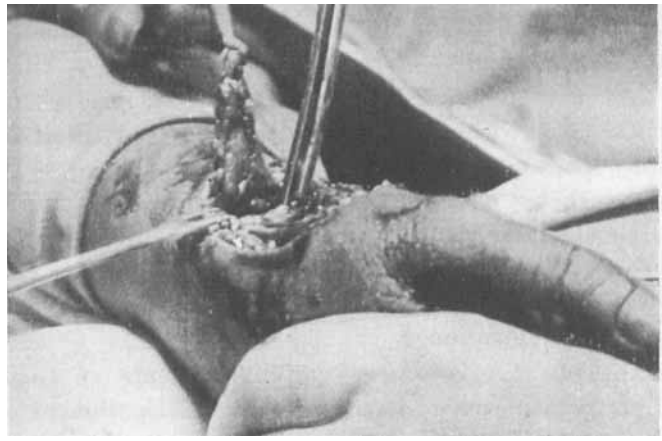


Fig. 2.
Photo showing the size and position of the flap; its basis is placed at the tip of the processus styloideus radii. The probe is put in between the fragments of the scaphoid just distal to the styloid processus.

the patients presenting a pseudarthrosis between two almost equal fragments.

In keeping with the view that the lesion ought to be attacked at its central point—the painful pseudarthrosis—and that no large part of the bone should be removed as this will compromise the static and mechanic functions of the wrist-joint, since 1939, here in the Orthopedic Hospital of Aarhus, in our dealing with scaphoid fractures of this type we have employed the operation described below, the purpose of which is to change the painful invaliding pseudarthrosis to a painless and symptom-free one. It is to be added that sometimes a scaphoid fracture may result in pseudarthrosis without any subsequent impairment of the carpal function (because the pseudarthrosis "happens" to be

painless). Silfverskiöld has told the writer (B.) of such a case, in which the patient was able even to take part in ice-hockey tournaments.

Operative Technique.

Prior to the operation a correct estimation of the form and size of the fragments is ensured by thorough study of stereoscopic roentgenogram of the wrist. A fairly large arcuate incision is made over the "anatomical snuff-box" and the adjacent area just distal to it. The incision ought to be convex, dorsoulnarily. The skin flap is pulled aside, and from the subcutaneous adipose tissue, connective tissue and possibly a little tendon sheath, a fairly large flap is made that has its base just proximal to the styloid process of the radius. In scaphoid fractures of this type the fracture will be located just distal to the tip of the styloid process. So the capsule is opened at this point, and the fracture line is located. If this line be not perfectly clear, it will be of advantage to place a probe in the fracture and take another X-ray picture for control. The fragments are separated so that the fracture becomes gaping. Now the point is to interpose and precisely fix the adipose-connective tissue flap between the fragment. For this purpose a fish gut suture is pulled through the tip of the flap, and both ends of these sutures are passed down through the fracture gap and through the skin on the volar surface of the wrist, where they are knotted over a small gauze tampon. Thus the flap is pulled clear to the bottom of the fracture gap. In this manoeuvre one must avoid piercing the median nerve and the radial artery. In our cases the needles (quite straight—ordinary darning needles) have come out on the volar surface far radially to the nerve. The radial artery, the course of which is less constant, lies just in the vicinity; but then it is palpable, if the operation is performed without a tourniquet—which is quite unnecessary in this operation. Knotting of the suture on the volar surface of the wrist fixes the flap in the fracture gap, so that this is filled throughout. Suturing of the fascia and skin. Plaster cast with the wrist fixed in slight dorsal and ulnar flexion. After 2

weeks, removal of the cast and sutures—including, of course, the one that has fixed the interposition flap. Then the patient is told at once to use the hand and train it.

In this hospital altogether 10 inveterate fractures of the scaphoid have been treated operatively. These patients were from 16 to 35 years old; two of them were women. Only in 1 case had the fresh fracture been submitted to treatment with plaster cast immediately after the injury. 3 of the patients had not received any treatment whatever, and the remaining 6 patients had worn a plaster cast for up to 3 months, but there had been an interval of several weeks between the injury and the application of the plaster. The patients applied to this clinic from 6 months to 3 years after the occurrence of the fracture.

In 3 cases the operation revealed the presence of small isolated fragments that were extirpated. The results obtained in these cases were fairly good, as the patients were enabled to work again, even though heavy work was associated with discomfort: pain on movement, reduction in the power of the joint and a sensation of instability.

In one patient who was treated prior to the introduction of the interposition method, drilling ad modum Beck was employed. This had no effect on the pseudarthrosis, and the condition of the patient remained the same as before.

The remaining 6 patients were operated on after the interposition method. They all precented a pronounced psudarthrosis that divided the scaphoid in two equal parts. The operative results were most encouraging. 4 of these patients were reexamined from 3 months to 4 years after the examination. In a relatively short time they had become able to work and free from pain; now they were capable of even heavy work—*e. g.*, concrete road work—and sport. The only sequelae of the fracture was a slight reduction in the mobility of the wrist-joint—and this did not inconvenience any of the patients in a degree worth mention.

In 1 patient, 16-year-old girl, the operation was followed by a dystrophic condition associated with pains: the hand was

cold, cyanotic, with lowered oscillometric values. The roentgenograms showed pronounced bone atrophy. After 5 months immobilization in plaster her condition improved considerably; at the last reexamination the mobility of her wrist was practically normal, and the movements were free from pain.

One patient was operated on only a few weeks ago, and is now training his hand, and the course of his case appears to become just as favorable as for the above-mentioned 4 patients.

These results suggest very strongly the introduction of the interposition operation as the standard method of operating treatment in the frequent and practically always invaliding pseudarthrosis from fracture in the middle of the scaphoid.

When should the operation be performed?

In our opinion it is important that the operation should not be postponed too long. Under no circumstance should it be postponed so long that arthritic changes make their appearance in the wrist-joint. The question about the final therapy ought to be taken up already after immobilization for 8-10 weeks if this has not given a satisfactory union. The answer to the question will depend on the character of the fracture, *i. e.*, whether a "cyst" formation, a small necrotic fragment or a genuine pseudarthrosis, is present.

SUMMARY

In response to a report by Robertson & Wilkins on the striking frequency of fracture of the carpal scaphoid in young men (airmen and sailors) the question of the treatment of this fracture is discussed.

The writer suggests that the invaliding pseudarthrosis, which very often is encountered after a too late or inadequate primary treatment, should be treated operatively with interposition of an ample flap of adipose and connective tissue between the fragments.

In 4 (5) of the 6 cases treated in this way freedom from pain and full capacity for work were obtained within a few weeks after the operation. In one case there was a complicating

post-traumatic acute bone atrophy, but the effect of the operative treatment on the discomfort resulting directly from the fracture was satisfactory.

RÉSUMÉ

A la suite d'une communication de Robertson & Wilkins sur les manifestations particulièrement fréquentes de la fracture de l'os naviculare carpi chez les jeunes gens (aviateurs et marins), la question de la thérapie de cette fracture est discutée. Il est proposé de traiter les pseudarthroses invalidisantes que l'on constate souvent après un traitement primaire, entrepris trop tard ou incomplètement réalisé, par une opération au moyen de laquelle il est pratiqué l'interposition d'une couche abondante de tissu conjonctif graisseux entre les fragments. Dans 4 (5) des six cas traités suivant ce procédé, on a obtenu l'abolition des douleurs et une capacité entière de travail peu de semaines après l'operation. Dans un cas il y avait une ostéoporose localisée post-traumatique, mais le traitement a eu un résultat heureux rapport aux inconvénients directement provoqués par la fracture.

ZUSAMMENFASSUNG

Anlässlich einer Mitteilung von Robertson & Wilkins über auffallend häufiges Vorkommen von Fraktur des os naviculare carpi bei jungen Männern (Fliegern und Seeleuten) wird die Frage der bei dieser Fraktur anzuwendenden Therapie erwogen. Es wird vorgeschlagen, die invalidisierenden Pseudarthrosen, die sehr oft nach zu spät bewerkstelligter oder mangelhaft durchgeführter primärer Behandlung beobachtet werden, mit einer Operation zu behandeln, wobei Interposition eines reichlichen Fettbindegewebslappens zwischen Fragmina vorgenommen wird. In 4 (5) von den derart behandelten Fällen wurde wenige Wochen nach der Operation Schmerzlosigkeit und volle Arbeitsfähigkeit erzielt. In einem Falle war eine komplizierte, posttraumatische akute Gliedmassendystrophie vorhanden, aber

die Wirkung der Behandlung gegenüber den von der Fraktur direkt hervorgerufenen Leiden war zufriedenstellend.

REFERENCES

Bentzon, P. G. K.: Nord. Med. *11:* 2369, 1941.
Bentzon, P. G. K. & Aage Randløv Madsen: Nord. Med. *21:* 524, 1944.
Bøhler, Lorenz: Technik der Knochenbruchbehandlung, Wien 1937.
Matti: Zentralbl. f. Chir. *41:* 1937.
Palmer, Ivar: Nord. Med. *16:* 3574, 1943.
Robertson, J. & R. Wilkins: Brit. Med. J. May 20, 1944, p. 685.