

A RE-EXAMINATION OF CASES OF PSEUDARTHROSIS OF THE NAVICULAR BONE OPERATED ON ACCORDING TO BENTZON'S TECHNIQUE

By

OLOF PEREY

Fractures of the navicular bone are not uncommon, since 27 to 35 % of all wrist fractures are of this bone. 7 % of all fractures occurring from athletics are also of the navicular bone. Early diagnosis is often difficult. Amongst New Zealand troops during the war (1939-1945) only 36 % of the fractures were discovered in a month despite the fact that many units were equipped with roentgen apparatus. If fractures of the navicular are kept in mind and roentgen apparatus is available and if the correct technique is used, then no fracture should be missed. To be on the safe side one ought always to take an oblique projection of the navicular and repeat this after fourteen days if there is still a suspicion of a fracture and if the first roentgenogram was negative.

When the anatomy of the navicular is examined, it is seen to include two joints. The radio-carpal joint permits mainly volar flexion and the intercarpal joint dorsal flexion. The proximal pole of the navicular is fixed to the radius and lunate by ligaments and the distal pole to the trapezium, trapezoid and the capitate. Because of this position between two joints the navicular may be exposed to great stress and it fractures easily.

These fractures are of three different types:

1. Fractures of the tubercle.
2. Fractures of the waist.
3. Fractures of the proximal pole.

Fractures of the tubercle are entirely extra-articular and as both fragments always have a good blood supply, union is certain and

rapid. In fractures of the waist, both fragments usually have a good blood supply, but these fractures are intra-articular and this retards union. When the proximal pole is fractured, the small fragment has a bad blood supply and consequently union is very slow.

The treatment of new fractures is conservative, and consists of a well-applied plaster which preferably includes the proximal phalanx of the thumb. Böhler quotes 100 % union when using this treatment. Most writers claim a union rate of between 60 and 80 % (Wilson 63 %, Aleman 74 %, Rehbein 78 %, Hein 82 %). Thus, there remain some which do not heal in spite of orthodox treatment. In addition to this group there are those treated as other wrist injuries and those who have not sought medical advice. In these cases the roentgenograms decide the treatment.

If Dwight's cysts are present, this is an indication that a decalcification process is going on: conservative treatment is not without success however. According to the literature, plugging with a bone pin gives a good result.

If there is a little sclerotic fragment, this is a sign of bad circulation and according to the literature extirpation of it is most commonly proposed. All authors quote good results.

Aleman had 24 cases of which 20 were good. Extirpation should be performed early and before arthrosis begins.

There are many methods quoted in the treatment of fractures of the waist where both fragments are living and recalcification has gone on for so long that two sclerotic surfaces exist. Many patients with pseudarthrosis of the navicular have little or no pain in their wrists and in such cases operation is contra-indicated. For patients with disability due to pain, weakness, or limitation of movement many operative techniques have been recommended in the literature:

1. Drilling (Beck's technique).
2. Fixation with a bone or metal pin.
3. Styloidectomy + fixation with bone.
4. Matti's operation.
5. A transplantation method.
6. Extirpation of a fragment, or the whole or a greater part of the navicular.
7. Autohaemotherapy.
8. Replacement of the navicular by a vitallium prosthesis.
9. Arthrodesis of the wrist.
10. Bentzon's pseudarthrosis operation.

1. According to most authors Beck's drilling is ineffective.

2 & 3. Many authors consider that fixation with a bone or metal pin gives very good results in cases of delayed union (L. Barnaud and S. Stubbing, H. Giesekeing, S. Lindwall, G. Murray, A. Widén). When the pseudarthrosis is bordered by sclerotic surfaces, it is thought that revascularisation occurs along the implanted bone pin.

4. Matti's method consists of removing the cystic and sclerotic bone from the navicular and replacing it with bone chips. This bony filling must be broken down and later rebuilt and therefore the wrist requires a very long period of fixation.

5. A transplantation method has been suggested by Adams and Leonard but it is said to be technically very difficult.

6. Extirpation of the fragment should be reserved for cases with small sclerotic fragments and not used when there are two living fragments. According to the literature, extirpation of the whole or greater part of the navicular gives bad results.

7. Authohaemotherapy has been proposed from Spain but has not been popular.

8. Waught and Rendling have replaced the navicular by a vitallium prosthesis but a late result is unpublished. They have published 3 operated cases of which one has been observed for a little more than a year. All three were clinically good. Plastic was not used in the case of the navicular but A. Danis replaced the lunate by an acrylic prosthesis with a good result after 38 months.

9. Arthrodesis of the wrist is a certain method of eliminating pain, but it results in a 20 to 30 % invalidity and therefore it should only be performed as a last resort.

10. The operation of Bentzon is described in detail below:

Many patients with pseudarthrosis of the navicular have little or no pain and these patients should not be operated on. Bentzon and Randløf-Madsen thought that in patients with a painful pseudarthrosis an operation which changes the condition of this and results in painless movement should be possible and that this could be effected by placing an interposing flap between the fragments. In 1939 at the Orthopaedic Clinic in Aarhus they started to operate on long-standing painful pseudarthrosis cases in the following way: "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. dorso-ulnarly. The skin flap is retracted from the subcutaneous adipose tissue, connective tissue and possibly a little from the tendon sheath; a fairly large flap is made which has its base just proximal to the styloid process of the radius. In 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 control this with a Roentgen picture. The fragments are separated so that the fracture becomes gaping. Now the object is to interpose and precisely fix the adipose-connective tissue flap between the fragments. 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 palmar surface of the wrist, where they are knotted over a small gauze tampon. Thus the flap is pulled right to the bottom of the fracture gap. In this manoeuvre one must avoid piercing the median nerve and the radial artery. Knotting of the suture on the palmar surface of the wrist fixes the flap in the fracture gap, so that this is filled throughout. Finally the fascia and skin are sutured and a plaster cast applied with the wrist in slight dorsal and ulnar flexion. After 2 weeks the cast and sutures are removed 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."

During 1940-1950, 17 cases of pseudarthrosis of the navicular were operated on at the Orthopaedic Clinic of the Karolinska Institutet in Stockholm. Bentzon's technique was used in every case. Of these patients, 15 were re-examined and 2 were foreigners who returned to their home countries after the war. All 15 were heavy workers. (See table.) In 14 the time between the accident and the operation was over a year. In 2 cases the date of the primary accident was unknown, but it was quite safe to state that it had happened more than one year ago because the tip of the styloid process was sharpened in a way that is unseen when the pseudarthrosis has been present for less than one year.

In all cases pain was the indication for surgery. Seven cases were unable to work because of this, and the rest could not completely carry out their work.

A plaster cast was the primary treatment in only 2 cases, this being applied 6 and 7 months respectively after the accident. Two cases had plaster during a period of pain a long time after the accident. Those patients who had a leather support said that they had less pain in their wrists but that the support was often a hindrance to their work. (Many of those, too, who have not been operated on and have a support say the same.) One patient (Case 14, Table) was operated on 7 months after the accident. (Nailing with a tibial pin.) The fracture did not unite. Seven cases did not immediately go to a doctor after the accident nor had they received any treatment prior to their arrival at the

No.	Occupation	Interval bet. accident and op. in yrs.	Age at op.	Insurance cases.	Treatment before op.	Re-examination time, in yrs.	State.	Arthrosis.	Mobility.	Power.
1	Farmer	5	38	×	plaster 7 months	3	++	+	d-15, v-30, u-10, r-15	-35
2	Farmer	2.5	26	×	0	6	+++	++	d-80, v-25, u-20, r-30	-5
3	Inspector	2	37	×	bandage 1 year	7	++	+	d-20, v-20, u-10, r-10	-10
4	Male nurse	1.7	32	×	0	7	+++	+	d-30, v-10, u+5, r-5	± 0
5	Woodman	8	36	-	0	5	+++	++	d-5, v-10, u-10, r-20	-10
6	Woodman	?	22	-	0	3	++	+	d-30, v-5, u-5, r-5	± 0
7	Foreman	1.3	21	-	plaster 6 months	5	+++	++	d-10, v-35, u-5, r-10	-5
8	Woodman	1	31	×	0	5	+++	+	d-15, v-0, u-15, r-0	-5
9	Metal worker (boxer)	0.7	22	-	movement, passage	9	+++	+	d-5, v-20, u-0, r-10	-10
10	Foreman	?	32	-	plaster 8 months	8	+++	+	d-20, v-10, u-15, r-10	-10
11	Mechanic	11	32	×	0	8	+++	+	d-25, v-35, u-15, r-15	-10
12	Supervisor of a packing dept.	17	32	-	plaster 16 times, about 2 years	5	+++	+	d-10, v-5, u-10, r+5	± 0
13	Builder's carpenter	9	38	×	bandage	7	++	++	d-5, v-10, u-5, r-20	-30
14	Animal keeper—caretaker	1.5	32	-	plaster 7 months	2	+	+	d-45, v-45, u-25, r-25	-20
15	Carpenter	4	27	-	0	5	+++	+	d-20, v-10, u±0, r±0	-8

State: +++ = completely all right. ++ = slight trouble. + = improved.

Arthrosis: ++ = a little sinking of the cartilage. + = sharpening of styl. proc.

Orthopaedic Clinic. One only had been treated with massage and movement because of a wrong diagnosis. The time between operation and full employment was not recorded in the hospital files but most patients said that it was many months before they were able to do heavy work. The observation time after operation was 2 years in one case, 3 years in two cases and 5 years or more in the rest.

At re-examination 10 patients said that they were quite free from trouble and satisfied with the operative result. They could do all kinds of work without feeling pain at any time from the injured wrist, and they had all resumed their former work. One of them had even begun to compete as an amateur boxer. Four had a little pain especially after they had done heavy work for a long time, but this was never so severe that they were forced to break off their work. One considered that he was better but still had so much pain that he had to change his employment from an animal keeper to a caretaker. He can do his new job without difficulty.

A slight degree of radiologically visible arthrosis in the radio-navicular joint was present in 11 cases. A sharpening of the radial styloid process is always present in cases of pseudarthrosis of the navicular which are over a year old. A slight sinking of the cartilage was present in 4 cases.

In most cases mobility is limited and the Table shows the varying mobility in different directions in the operated and non-operated wrists. No one complained of trouble owing to decreased mobility. The power of grip was examined with a dynamometer and in only 3 cases was it diminished to such an extent that it was of practical importance. One of these cases is the one indicated as "bad".

The technically easy operation, the short convalescence and the good results all contribute to the recommendation of this technique in the treatment of painful pseudarthrosis when there are two living fragments.

SUMMARY

In 1939 Bentzon and Randløf-Madsen started to operate on pseudarthrosis of the navicular bone by preparing an interposing flap of connective tissue and inserting this between the fragments. 17 patients have been operated on in this way at the Orthopaedic Clinic of the Karolinska Institutet. 15 have been re-examined. All had heavy employment. The average time between the accident and operation was 4 years; between the operation and re-examination it was 5 years. Prior to the operation 7 were quite incapable of work because of pain and the others could only manage their usual work with difficulty.

Since operation all but one have returned to their previous employment. 10 have had not trouble at all and 4 have had slight pain. Mobility is limited in all cases, and in most the power of grip is diminished.

RESUME

En 1939, Bentzon et Randløf-Madsen ont commencé à opérer des pseudarthroses de l'os naviculaire en préparant une partie interposée de tissu connectif insérée entre les fragments. 17 malades ont été opérés d'après cette méthode à la Clinique Orthopédique de l'Institut Karolinska. 15 ont été réexaminés. Tous ont de durs travaux à effectuer. La durée moyenne du temps qui s'est écoulé entre l'accident et l'opération était de 4 ans et entre l'opération et la réexamination 5 ans. Avant l'opération 7 étaient incapables de tout travail par suite des douleurs qu'ils éprouvaient et les autres ne pouvaient faire leur travail qu'avec difficultés. Depuis l'opération tous ont repris leur emploi antérieur. 10 n'ont eu absolument aucun trouble et 4 éprouvèrent de légères douleurs. La mobilité est limitée dans tous les cas et chez la plupart le pouvoir de saisir quelque chose est diminué.

ZUSAMMENFASSUNG

Im Jahre 1939 begannen Bentzon und Randløf-Madsen Pseudarthrosen des Os naviculare zu operieren indem sie einen Bindegewebslappen zwischen die Knochenfragmente einlegten. 17 Patienten wurden in dieser Weise an der orthopädischen Klinik des Karolinska Institutes operiert. 15 wurden nachuntersucht. Alle Patienten waren Schwerarbeiter. Die Durchschnittszeit zwischen dem Unfall und der Operation betrug 4 Jahre, und zwischen Operation und Nachuntersuchung 5 Jahre. Sieben der Patienten waren vor der Operation gänzlich arbeitsfähig wegen der Schmerzen und die übrigen konnten ihre Arbeit nur mit Schwierigkeit durchführen. Seit der Operation haben alle mit Ausnahme von einem ihre Arbeit wieder aufgenommen. 10 haben keinerlei Beschwerden und 4 haben leichte Schmerzen. Die Beweglichkeit ist in allen Fällen eingeschränkt und in den meisten ist die Kraft der Hand herabgesetzt.

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