

PERCUTANEOUS OSTEOSYNTHESIS VERSUS CAST IMMOBILISATION FOR THE TREATMENT OF MINIMALLY AND NON-DISPLACED SCAPHOID FRACTURES. FUNCTIONAL OUTCOMES AFTER A FOLLOW-UP OF AT LEAST 12 MONTH

Pavel Dráč^{a*}, Pavel Maňák^a, Ivo Labónek^b

^a Department of Traumatology, Teaching Hospital, Olomouc

^b Clinic of Radiology, Teaching Hospital, Olomouc

Received: April 14, 2005; Accepted (with revisions): May 26, 2005

Key words: Scaphoid fractures/Percutaneous osteosynthesis/Cast immobilisation/Computed tomography

The authors compare the functional outcome of 26 patients successfully treated by percutaneous osteosynthesis and 24 patients successfully treated by a short-arm thumb cast for the acute scaphoid fracture after a follow-up of at least 12 months. The patients treated by percutaneous osteosynthesis showed a significantly better range of wrist motion at the time of re-examination. Differences in persistent complaints and in grip strength compared to the uninjured wrist between both groups were statistically insignificant yet slightly in favour of the surgically treated patients. The higher suitability of percutaneous osteosynthesis is further supported by the significantly lower failure rate compared to conservative treatment. Based on these results, percutaneous osteosynthesis seemed to be the more favourable method of treatment of minimally and non-displaced scaphoid fractures than conservative treatment.

INTRODUCTION

Surgical treatment of acute scaphoid fractures is gradually becoming a standard. This technique has brought about the possibility of early wrist physiotherapy throughout the healing period, better functional outcome and a shorter duration of sick leave¹⁻⁴. Percutaneous osteosynthesis using the palmar approach is suitable for non-displaced and minimally displaced scaphoid fractures type A2, B1 and B2 according to Herbert's classification⁵. We compared the functional outcome in 50 patients treated by percutaneous osteosynthesis or by a short-arm thumb cast after a minimum follow-up of 12 months.

MATERIAL AND METHODS

From March 2002 to February 2005 a total of 38 patients with acute scaphoid fracture were treated by percutaneous osteosynthesis using the palmar approach at the Department of Traumatology of the Teaching Hospital in Olomouc. There were 31 patients with a minimum follow-up of 12 months called for a check-up, 27 of whom (87 %) came for the re-examination. The average age of the group consisting of one female and 26 males was 26,9 years (14 to 47 years of age). Six fractures were type-A2, three type-B1 and 18 type-B2. One patient suffered from associated fracture of the ipsilateral distal radial metaphysis type 23-C3 according to AO classification⁶. A headless bone screw ("HBS" Martin, Tuttlingen - Germany) was used in all 27 cases and a 3.5mm Locking Compression Plate ("LCP" Stratec Medical, Oberdorf - Switzerland) was applied in

a patient with the ipsilateral distal radial fracture. The first consecutive 11 patients (41 %) wore a short-arm thumb-spica splint for a mean of 2 weeks, whereas the subsequent 16 patients were left without a splint. There was one patient with no signs of union 30 weeks after the surgery. He underwent the hardware removal and the application of a vascularized bone graft according to Zaidenberg⁷. This was the only failure of percutaneous osteosynthesis and the patient was excluded from the study.

The control group consisted of 34 patients treated by short-arm thumb cast between March 1999 and December 2001. Only patients with type-A2, B1 and B2 scaphoid fractures and a minimum follow-up of 12 months were included. Nine patients were converted to open osteosynthesis during the conservative treatment because of delayed union and one patient failed to heal according to check-up radiograph. These 10 patients were excluded from the study. There were two females and 22 males with an average age 28.1 years (19-51 years of age). They wore the short-arm thumb cast for a mean of 7.5 weeks (40-91 days).

We found significantly ($p = 0.024$) lower failure rate of percutaneous osteosynthesis compared to conservative treatment. For the details see Table 1.

Table 1. Failures of percutaneous osteosynthesis and conservative treatment.

	Percutaneous	Conservative	Statistical analysis
Successfully healed	26	24	
Failure to heal	1	10	p = 0.024

We compared the presence of persisting complaints, the sensitivity to weather change, pain during sports and physical activities, the range of motion and the grip strength (using a pneumatic dynamometer) compared with the opposite, unaffected wrist in both groups of successfully healed patients.

The differences between the groups were tested by the Student's t-test, the Mann-Whitney U-test and the Chi-square test. The results were considered to be significant if $p < 0,05$.

Surgical technique of percutaneous osteosynthesis: All operations were performed under general anaesthesia or axillary block. A pneumatic tourniquet was applied to the upper arm but was not routinely utilized. A 8–10 mm transverse incision of skin was made palmarly over the tubercle of the scaphoid and dissected down to the bone without opening the capsule of the scaphotrapezial joint. A towel roll was used under the supinated wrist to allow for adequate wrist extension. With the aid of image intensifier a guide wire was inserted into the bone through the tubercle and passed centrally down the scaphoid. The cannulated drill bit was applied over the central guide wire and manually drilled into the scaphoid bone. Its correct depth and placement were confirmed fluoroscopically. The appropriate screw length was determined using a depth gauge and a cannulated screw was then inserted over the guide wire (Fig. 1) to be fully sunk within the bone. To achieve compression with the closing of the fracture cleft, the proximal threaded portion must always be entirely within the proximal fragment and must not cross the fracture line. After removal of the guide wire the wound was closed with one or two skin sutures. A light wound dressing was applied.

RESULTS

Re-examination was performed for a mean of 22 months (12–31 months) after the surgery for the patients treated by percutaneous fixation and 19 months (12–27 months) for the conservatively treated patients, respectively. Definitive union was obtained in all operated patients using clinical, radiological and CT evaluation. We did not perform CT examination at the time of the conservative group check-up evaluation. For the details of results see Table 2.

Table 2. Results of percutaneous osteosynthesis and conservative treatment.

	Percutaneous osteosynthesis	Conservative treatment	Statistical analysis
	n = 26 (%)	n = 24 (%)	
Free of persistent complaints	17 (65)	11 (46)	p = 0.254
Resting pain	0	2 (8)	p = 0.225
Pain during sports and physical activities	9 (33)	10 (42)	p = 0.772
Sensitivity to weather change	3 (12)	3 (12,5)	p = 1.0
Range of motion as a percentage of the uninjured side	97,9 %	83,6 %	p < 0.0001
11–20° loss of movement	5 (19)	15 (63)	p = 0.02
Loss of movement of over 20°	2 (8)	6 (25)	p = 0.132
20% loss of grip strength compared with the uninjured side	5 (19)	6 (21)	p = 0.721
Average grip strength of the uninjured side	93.4 % (63–108)	88.4 % (60–107)	p = 0.174

The conservatively treated patients had a significantly more restricted range of wrist motion compared to the patients treated by percutaneous osteosynthesis ($p < 0.0001$). There were also considerably more patients with 11–20° loss of movement ($p = 0.02$). The differences in the persistent complaints and grip strength compared to the uninjured wrist between both groups were statistically insignificant yet slightly in favour of the surgically treated patients.

DISCUSSION

The treatment of fractured scaphoid by percutaneous osteosynthesis was first reported by Strelí in 1970 (ref.⁸). The development of the headless screw by Herbert, first published in 1984 (ref.⁹), and the use of computed tomography with high resolution images for diagnostics facilitated the extension of this surgical method. Despite the fact that conservative treatment contributes to the restriction of the range of the wrist motion and to the duration of the sick leave, it is widely accepted as a method of choice by many surgeons.

In randomized clinical trials comparing the conservatively and surgically treated patients Bond² and Saedén⁴ with co-workers found a significantly shorter period of sick leave in patients treated by percutaneous osteosynthesis ($p = 0.001$, $p = 0.02$). Nevertheless, return to work is not a good outcome measure because of the existence of bias on the part of both patients and surgeons to return to work sooner when there is no cast¹⁰. Differences in grip strength compared to the uninjured wrist between both groups were statistically insignificant with a better outcome in the surgically treated patients. We found a similar, statistically insignificant difference in the grip strength ($p = 0.174$).

In our study there were considerably more conservatively treated patients with a loss of 11–20° of the wrist movements compared to the unaffected wrist ($p = 0.02$). The results of the comparison of the percentage of the patients with a loss of over 20° of the wrist movements were statistically insignificant ($p = 0.132$). Adolphson¹ reported 13 % mean loss of range of wrist motion in the conservatively treated group and 6 % in the operated group ($p < 0.02$). The outcome differences reported by Bond² ($p = 0.152$) and Saedén⁴ were insignificant.

We found more patients free of persistent complaints in the surgically treated group and less patients with resting pain and pain during sports and physical activities at the time of check-up. Only the percentage of the patients sensitive to weather change was slightly lower. None of the differences were statistically significant ($p = 0.254$, $p = 0.225$, $p = 0.772$, $p = 1.0$). Saedén⁴ reported 80 % of operated patients and 69 % of conservatively treated without pain or discomfort in the wrist 12 years after the fracture.

Because of the almost complete cartilagenous surface of the scaphoid bone, fracture healing is an intraosseous process. Therefore the assessment of fracture healing by conventional radiography is very difficult^{11–13}. Computed tomography imaging along the longitudinal axis of scaphoid bone is best suited for the evaluation of fractures as well as healing process^{14–19}.

We did not compare the time to union in the conservatively and surgically treated patients because, as mentioned above, we did not perform CT examination at the time of the conservative group check-up evaluation in 2001. This was, along with a small sample, the main limitation of our study.

CONCLUSION

The functional outcome in patients with fractured scaphoid treated by percutaneous osteosynthesis utilising the palmar approach after a minimum follow-up of

12 months after the surgery is more favourable than the outcome in the conservatively treated patients. The higher suitability of percutaneous osteosynthesis is further supported by the significantly lower failure rate compared to conservative treatment.

REFERENCES

1. Adolphson L, Lindau T, Arner M. (2001) Acutrak screw fixation versus cast immobilisation for undisplaced scaphoid waist fractures. *J Hand Surg* 26B, 192–195.
2. Bond CD, Shin AY, McBride MT, Dao KD. (2001) Percutaneous screw fixation or cast immobilization for nondisplaced scaphoid fractures. *J Bone Joint Surg* 83A, 483–488.
3. Dráč P, Maňák P, Labónek I, Benýšek V. (2004) Perkutánní osteosyntéza zlomenin člunkové kosti – předběžné výsledky. *Acta Chir Orthop Traum Čech* 71, 165–170.
4. Saedén B, Törnkvist H, Ponzer S, Höglund M. (2002) Fracture of the carpal scaphoid. A prospective, randomised 12-year follow-up comparing operative and conservative treatment. *J Bone Joint Surg* 83B, 230–234.
5. Herebert TJ. The fractured scaphoid. St. Louis: Quality Medical Publishing, Inc. 1990.
6. Müller, ME, Nazarian S, Koch P, Schatzker J. The comprehensive classification of fractures of long bones. Berlin – Heidelberg: Springer-Verlag, 1990.
7. Zaidenberg C, Siebert J, Angrigiani C. (1991) A new vascularized bone graft for scaphoid nonunion. *J Hand Surg* 16A, 474–478.
8. Strelí R. (1970) Perkutane Verschraubung des Handkahnbeines mit Bohrdraht-Kompressionsschraube. *Zentralbl Chir* 95, 1060–1078.
9. Herbert TJ, Fisher WE. (1984) Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg* 66B, 114–123.
10. Ring D. (2003) Clinical Notes. In: Acute nondisplaced scaphoid fractures. *Orthop Trauma Dir* 1, 1–6.
11. Barton NJ. (1992) Twenty questions about scaphoid fractures. *J Hand Surg* 17B, 289–310.
12. Dias JJ (2001) Definition of union after acute fracture and surgery for fracture nonunion of the scaphoid. *J Hand Surg* 26B, 321–325.
13. Dias JJ, Taylor M, Thompson J, Brenkel IJ, Gregg PJ. (1988) Radiographic signs of union of scaphoid fractures: An analysis of inter-observer agreement and reproducibility. *J Bone Joint Surg* 70B, 299–301.
14. Bain GI, Bennett JD, Richards RS, Slethaug, GP, Roth JH. (1995) Longitudinal computed tomography of the scaphoid: a new technique. *Skeletal Radiol* 24, 271–273.
15. Dráč P, Maňák P, Labónek I. (2004) Perkutánní osteosyntéza zlomenin člunkové kosti – hodnocení výsledků a přínos CT vyšetření pro diagnostiku i pooperační sledování. *Úraz Chir* 12, 1–5.
16. Ring D, Jupiter JB, Herndon JH. (2000) Acute fractures of the scaphoid. *J Amer Acad Orthop Surg* 8, 255–231.
17. Slodička R, Masár J, Petrišćák Š. (2002) Nové trendy léčby fraktur scaphoidea. *Úraz Chir* 10, 29–38.
18. Sanders WE. (1988) Evaluation of the humpback scaphoid by computed tomography in the longitudinal axial plane of the scaphoid. *J Hand Surg* 13A, 182–187.
19. Wilson AJ, Mann, FA, Gilula LA. (1990) Imaging of the hand and wrist. *J Hand Surg* 15B, 153–167.