

## RESULTS OF SCAPHOID NONUNION TREATMENT WITH VASCULARISED BONE GRAFTING FROM THE DISTAL RADIUS

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Misdiagnosis or failed treatment of scaphoid fractures are frequently (25-45%) followed by disrupted healing and nonunion. This may reduce the wrist's capacity for occupational and daily use and, over time, lead to wrist arthrosis. Therefore, surgery is recommended even in asymptomatic nonunions of the scaphoid; the goal of this treatment is to achieve bone union and stability of the wrist.

**The aim of the study** was to evaluate the results of operative management of scaphoid nonunion by vascularized bone grafting from the distal radius.

**Material and methods.** Eleven patients, nine men and two women of a mean age of 29 (range 19-45 years) with scaphoid nonunion lasting a mean of 10 months (range 8-20) were recruited. The nonunion was localized in the waist of the scaphoid in seven patients and in proximal 1/3 in four patients. Operations were performed using cancellous bone grafts taken from the distal radius and supplied by the intercompartmental branch of the radial artery. Fracture fixation was accomplished with K-wires or headless cannulated screws. The follow-up assessment at a mean of 10 months included measurements of wrist range of motion, grip strength and Mayo wrist score.

**Results.** All patients achieved bone union. The mean Mayo wrist score increased from 25 points pre-operatively to 75 points at the final assessment, which suggested significant improvement of the hand functions. In a qualitative evaluation, two patients had an excellent result, four had a good result, four had a fair result and one had a poor result. Surgery resulted in significant pain relief and increase in hand strength, but failed to improve wrist range of motion. The modest clinical outcomes do not allow a definitive conclusion to be reached, but the fact that bone union was achieved in all patients with no complications justifies continued use of this technique for the management of scaphoid nonunion.

**Key words:** scaphoid nonunion, bone grafts

Scaphoid fracture is the most common carpal fracture. Because of its discreet fracture line, it is very often not recognised directly after injury, but instead several days afterwards. In Markowicz' study, in only 15 out of 48 patients (31%) was the fracture diagnosed, but in only 2 (4%) was the diagnosis immediately after injury (1). Because of this, and because of the specific vascularity of scaphoid bone (the primary arterial supply enters the bone from distal pole), nonunion of the scaphoid is quite common, reaching a rate of up to 25-45% in proximal pole fracture (2, 3). Operative treatment of scaphoid fracture decreases the rate of the late nonunion (4, 5). Nonunion of the scaphoid causes not only pain but also causes

carpal instability, diminishing the range of motion and increasing arthritic changes with time (6). In a young population, malunion of the scaphoid significantly deteriorated work and daily life activities. The normal course of nonunion indicates that over 10 years, it definitively leads to radio-carpal joint arthritis (7). Therefore, nonunion of the scaphoid bone is an indication for operative treatment in order to achieve bone union and an adequate shape of the bone (4, 8).

Treatment of scaphoid nonunion is a real problem that does not have a universal solution. Conservative treatment with splinting and physiotherapy (e.g., magnetic field, electric stimulation) is one option in cases of pre-

viously non-treated fractures that are diagnosed within six months (6). Delayed union or nonunion is an indication for surgery (3, 4, 8). Classical management includes debridement of the nonunion, followed by osteosynthesis with K-wires, Herbert screws or headless cannulated screws with or without bone grafting (4, 9-13). Some authors choose the method of treatment based on the site of the fracture and vascularity of the bone fragments (4). Vascularised bone grafts have the potential to heal in a sclerotic bone environment and, therefore, are more effective in cases of nonunion of the proximal pole with bone necrosis (2, 14). Many international publications are in contrast to a Polish paper that presents results of the treatment of scaphoid malunion with free bone grafting (1).

The aim of this prospective study was an assessment of the results of the treatment of scaphoid nonunion with vascularized bone grafting from the distal radius.

#### MATERIAL AND METHODS

From 2005 to 2006, 11 patients, 9 males and 2 females, of an average age of 29 years (range 19-45) with scaphoid nonunion lasting a mean of 10 months (range 8-20) were operated on in the Department of General and Hand Surgery, Pomeranian Medical University. The most common mechanism of injury was a fall on a hand in nine cases. The nonunion was localized in the waist of the scaphoid in seven patients and in the proximal 1/3 in four patients. None of the cases had avascular necrosis of the proximal pole or radio-carpal arthritis as determined by X-ray imaging; however, MRI was not performed. The indications for surgery included wrist pain, reduced active range of motion, weaker grip and decreased hand dexterity. Operations were performed using a cancellous bone graft taken from the distal radius and supplied by the 1, 2 intercompartmental branch of the radial artery (fig. 1).

**Operative technique.** Operations were performed under brachial block anaesthesia, with the use of a tourniquet and fluoroscopic assistance. The extremity was not exsanguinated, but only elevated in order to provide a better view of the small arteries. A typical dorsal approach was implemented and the scaphoid bone was visualised through the second compartment. The nonunion was identified and debri-

ded, and traction against thumb was performed (fig. 2). In some cases, K-wires were used as joysticks in order to obtain a better reduction. The identified artery was marked and followed, and the bone fragment, usually 6x10 mm in size, was taken from the distal radius. A vascular pedicle with tissue calf was elevated together with the periosteum. The graft was placed in the nonunion site and fixation was accomplished with two K-wires in five cases, headless cannulated screws in four cases and with a combined technique in one case. In one patient, only external stabilisation after inclination of the graft was implemented. After the operation, a plaster cast was applied for six weeks in cases with K-wires, and osteosynthesis and a plaster splint for four weeks when a headless cannulated screw was used.

Pre-operative assessment included measurements of wrist range of motion, grip strength and Mayo wrist score. This score included as-

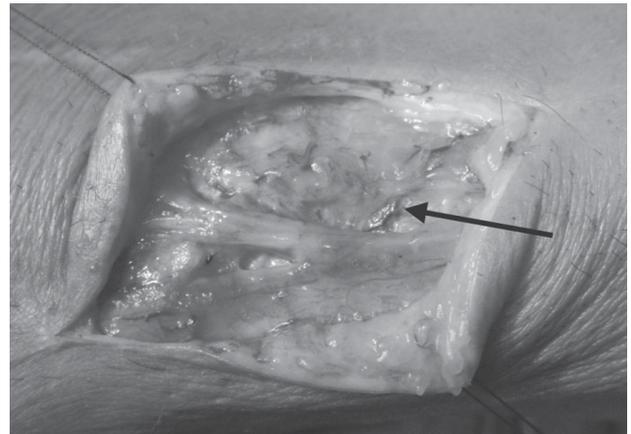


Fig. 1. Intercompartmental artery that supplies the distal end of the radius

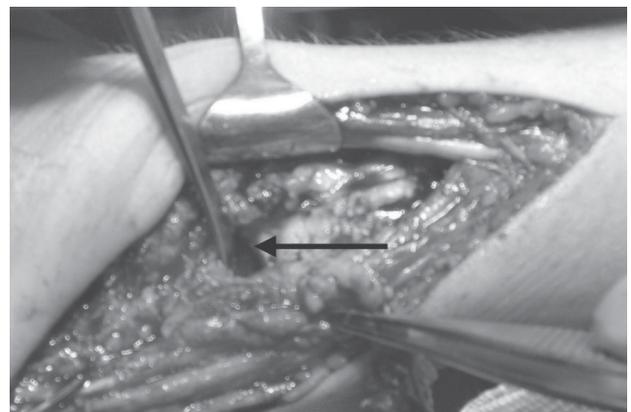


Fig. 2. A fissure in the scaphoid bone after debridement of the sclerotic margins of the fracture

assessment of the pain, wrist range of motion, grip strength and patient satisfaction (tab. 1) (16). Higher Mayo wrist scores indicate better wrist function. The follow-up assessment was performed at mean of 10 months (range 6-18) and included measurements of the same variables. In addition, an X-ray was taken to assess bone union which was classified with Dias criteria (17).

## RESULTS

In the traditional assessment, bone union was obtained in all 11 cases. According to the Dias criteria, seven patients obtained a full bone union five cases achieved an impending bone union. The results of the Mayo Wrist Score are presented in tab. 2. The mean pre-operative score was 42 points and the post-operative score 75 points, which indicates an improvement in hand dexterity. At the final follow-up assessment, pain symptoms were significant-

tly decreased and grip strength was increased (mean of 10.3 kG vs 26.5 kG), but the wrist range of motion did not improved (mean 100° vs 102°) (tab. 2). In the Mayo Wrist Score assessment, an excellent result was achieved in two cases, a good result in four cases, a fair result in four cases, and a poor result in one case. Eight patients were very satisfied with the result, three patients were pleased, and one patient was dissatisfied; however, he was able to work. The cause of his dissatisfaction was failed expectations to return to professional guitar playing. He was a former guitar player, and, despite having pain relief and a stronger grip, the lack of improvement in the range of motion of the wrist caused dissatisfaction.

## DISCUSSION

Treatment of scaphoid nonunion is a real challenge even for experienced surgeons, partly because of the technically demanding ope-

Table 1. The Mayo classification for assessment of complaints and wrist function

Parameter	Score					
	25	20	15	10	5	0
Pain	no pain	slight pain at heavy load; moderate pain related to the weather	moderate pain at heavy load	slight pain at home activity	moderate pain at home activity	pain at rest
Active range of motion*	100%	–	75-99%	50-74%	25-49%	0-24%
Total grip strength*	100%	–	75-99%	50-74%	25-49%	0-24%
Satisfaction	very satisfied	satisfied	–	dissatisfied, but able to work	–	dissatisfied, and unable to work

\* Expressed as a percent of the range of motion or grip strength of the unaffected hand

Classification of outcomes: Excellent: 90-100, good: 80-98, fair: 65-79, poor: 0-65

Table 2. Treatment outcomes of the 11 patients reported in this study. The numbers in lines 1-5 indicate the Mayo scores

Parametr considered	Pre-operative		Post-operative	
	mean	range	mean	range
Pain	12	5-15	23	15-25
Active range of motion	13,5	5-15	13,5	5-15
Total grip strength	12,5	10-15	17,5	10-25
Satisfaction	8,5	0-10	22,5	10-25
Mayo score	42	–	75	–
Active range of motion *	100°	50-140°	102°	60-145°
Total grip strength kG	10,3 kG	8-20 kG	26,5 kG	18-31 kG
Total grip strength %	58%	–	89%	–

\*Active range of motion: a sum of the dorsal and volar flexion, and ulnar and radial deviation of the wrist

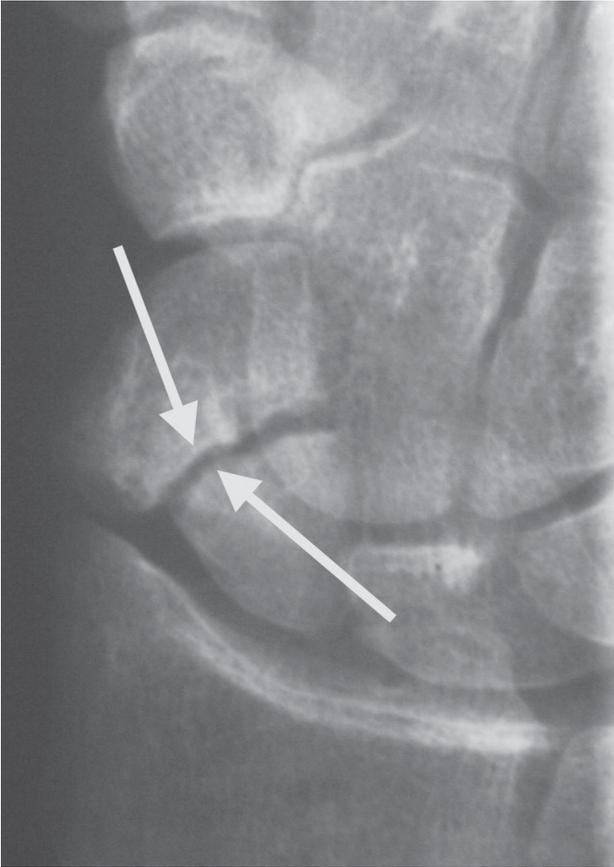


Fig. 3. Nonunion localised in the waist of the scaphoid

ration. In the 1980s, the popular method of treatment was the Matti-Russe treatment, using a cancellous bone graft from iliac crest with osteosynthesis performed with K-wires or a Herbert screw. Bone union was achieved in 80-90% of patients, excluding those with a fracture in proximal pole, which were associated with blood flow impairment. In those cases, the percentage of bone union did not exceed 50% (11, 12, 18). From the 1990s on, the use of vascularised bone grafts significantly improved outcomes, particularly in cases of avascular necrosis of the proximal pole. Vascularised bone grafts provide living bone tissue, providing osteoblasts with a high osteogenic potential and a lower resumption rate. Negative prognostic factors in the management of scaphoid nonunion include avascular necrosis of the proximal pole, long-lasting nonunion, previous unsuccessful operation, and older age (19). Below, we present recently published results on the treatments of scaphoid nonunion with vascularised bone grafting.

Malizos et al. reported the results of treatment of 30 patients with nonunion of the sca-



Fig. 4. An X-ray immediately after operation. Fixation with a screw and single Kirschner wires

phoid bone lasting a mean of three years. Nine patients (30%) had avascular necrosis of the proximal pole and five patients had arthritic changes in the radio-scaphoid joint. In 20 patients, a vascularised bone graft pedicled on the 1,2 intercompartmental branch of the radial artery was implemented, and in 10 patients the palmar artery of the wrist was used via a palmar approach. At the mean follow-up of 2.5 years, a statistically significant improvement was achieved in pain relief (VAS 4.9 vs 0.8) and in the Mayo Wrist Score (58 vs 85 points). The range of motion, however, did not improve. In all cases of avascular necrosis of the proximal pole, post-operative MRI showed good vascularity (14).

Sotereanos et al. presented the results of operative treatment in 13 cases of proximal pole scaphoid nonunion, lasting, on average, two years (range 1-4). In eight cases, the initial fracture did not unite despite prompt diagnosis and conservative treatment, and in five cases the fracture was misdiagnosed or maltreated. The authors implemented the same technique of bone harvesting from distal radius as was used in our study. Bone fixation was accomplished with Herbert-Whipple's screws, and, after surgery, the wrists were immobilised for six weeks. At a mean follow-up of 1.5 years (range 1-



Fig. 5. Nonunion localised in the waist of the scaphoid



Fig. 6. An X-ray 2 months after surgery with the technique described in the study. Fixation with HCS

3.5), firm bone union was achieved in 10 patients, fibrotic union one patient, and the persistence of nonunion in two patients. In all cases, except the two with non-union, pain ceased and the range of motion and grip strength significantly improved. Difficulties with this mode of treatment included lack of humpback deformity correction (19).

Chen et al. reported the results of treatment of 11 patients with scaphoid nonunion lasting a mean of one year (range 3 months – 5 years). Osteosynthesis of the bone graft was performed with two K-wires. At two years follow-up, pain relief and radiological improvement were obtained. In regards to the Mayo Wrist Score, four patients had excellent results, six had good results, and one had fair results (2).

Steimann et al. reported the results of treatment of 14 patients with scaphoid nonunion lasting a mean of two years. Bone union and correction of humpback deformity were achieved in all cases at a mean of 2.5 years. With regard to the Mayo Wrist Score, two patients had an excellent result, four a good result and one a fair result (20). In a later study by Steimann and Adams, the authors presented the results of the treatment of 51 patients, 42 male and 9 female, with scaphoid nonunion, of which 24 (47%) had avascular necrosis of the

proximal pole. Vascularised bone grafts were harvested from the distal radius and fixed with K wires and screws. At a mean of seven years follow-up, bone union was achieved in 36 cases (70%). The authors analysed the negative factors influencing bone union. A statistically significant correlation was found with avascular necrosis, female gender and smoking. Furthermore, the method of bone fixation influenced the outcome: a 53% success rate was achieved after the use of K-wires vs 88% after fixation by screws. The authors did not find an effect of the fracture site or the previous surgery on the final outcome. Certain complications were mentioned: skin infection in three cases, graft migration in three cases and graft absorption in two cases. In four cases, the implemented treatment did not prevent the development of arthritis. six of 10 cases treated with vascularised bone grafting. The authors pointed out that the failures occurred in patients previously treated operatively with free bone grafts. It was suggested that a previous surgical approach might destroy intercompartmental vessels, resulting in decreased viability of the bone grafts (21). Straw et al., who achieved union in six out of 22 patients, suggested that a higher rate of failures was because of the higher rate of patients (72%)

with avascular necrosis (22). In light of this data, the achievement of bone union in all patients by Malizos et al. seems to be somewhat controversial (14).

Another technique is harvesting the bone graft from the distal radius via a palmar approach. The vascular pedicle is based on palmar artery of the wrist, which is elevated with the periosteum and cuff of the surrounding tissue. Mathoulin and Haerle used this technique in the treatment in 17 patients who had undergone previous surgery due to nonunion or scaphoid fracture dislocation. They achieved bone union in all cases in 2 months. Dailana et al. used this technique in 9 cases of nonunion localised in the waist of the scaphoid lasting a mean of 2 years. They achieved union in all cases after 3 months, with 5 excellent and 4 good results assessed by the Mayo Wrist Score (24).

An additional technique is the use of a bone graft taken from second metacarpal bone, supplied by the first dorsal metacarpal artery. The skin flap supplied by this artery is classically used for skin coverage of thumb defects (25). Yuceturk et al. implemented this technique in the treatment of four cases of nonunion of the scaphoid, lasting a mean of two years, and achieved union in all cases within two months (26). Sawaizmi et al. used this method in 14 patients, achieving union in all cases. The results, as assessed by the Mayo Wrist Score, were excellent in five patients, good in four patients and fair in three patients (27). Bertelli et al. presented the results in 24 cases with nonunion of the scaphoid lasting longer than five years. They used the bone taken from first metacarpal bone using a dorsal or palmar approach depending on the fracture site. After one year, bone union was reported in 21 (87%) patients and fibrotic union in 3 (13%) patients. The shape of the scaphoid shape was corrected, which ultimately increased the wrist range of motion and grip strength (28).

Free vascularised bone grafts taken from femoral bone were described by Doi et al. and used in the treatment of 10 patients with long-lasting scaphoid nonunion. Microanastomosis with the radial artery and concomitant vein was performed. Bone union was achieved in all cases after 3.5 years. The Mayo Wrist Score was excellent in four patients, good in four patients, and fair in two patients (29). Harpf et al. presented the results of treatment of 60 patients using free vascularised bone grafts taken from

the iliac crest. In 21 patients, non-union had lasted four years, in 26 the proximal pole showed signs of avascular necrosis and 13 patients had undergone previous operation of the wrist. Bone union was achieved in 55 cases (92%) and in five cases (8%), the graft was absorbed. The authors recommend this method for treating long-lasting scaphoid nonunion (30).

Treatment of scaphoid nonunion with nonvascularised bone grafts has only one Polish publication. Markowicz presented results of treatment of 48 patients with non-union or malunion lasting two years (range 0.5-25) with free bone graft from iliac crest or distal radius. Bone fixation was done with K-wires in 34 cases, screw in 10 cases; in the other four cases the internal fixation was not necessary. At a mean of seven years follow-up, bone union was achieved by 42 patients (82%) and in 41 patients (85%) the shape of scaphoid bone improved, with a mean scapho-lunate angle of 49 degrees (1).

Inoue et al. reported bone union in 144 of 166 patients with scaphoid non-union, treated with free bone graft and screw fixation. At a mean of two years follow-up, the Mayo Wrist Score was excellent in 80, good in 37, fair in 33 fair, and poor in 10 cases. The failure occurred in nonunions localised in proximal pole, with associated avascular necrosis and long lasting. Authors did not note the influence of humpback deformity of the scaphoid on final results, however, presence of arthritis and long postoperative immobilisation worsen the results (31).

Rammamurthy et al. presented the results of operations in 124 patients with 126 fractures lasting a mean of 4.5 years (range 3 months – 16 years). Forty fractures were localized in the proximal 1/3 of scaphoid. The bone graft was taken from the iliac crest in 70 cases and from the distal radius in 54 cases. Osteosynthesis was performed in 46 cases with K-wires and in 80 cases with screws. The wrist was immobilized for 2-3 months. At follow-up at a mean of 13 months, union was achieved in 90 (72%) cases, persistent nonunion in 28 (22%) cases and fibrotic union in eight (6%) cases. Twenty-one of 36 patients with persistent nonunion required an additional operation (3).

Slade and Dodds described a minimally invasive technique for treating nonunion of the scaphoid bone with a percutaneous bone graft harvested from the distal radius. Debridement of the nonunion, reposition of the fracture, and

graft placement was performed during X-ray analysis with arthroscopic assistance. The osteosynthesis was performed with a screw, and a splint or cast was used in the postoperative management (32).

Traditionally, a free graft is advised for treatment when the fracture does not show avascular necrosis. For the most part, these are fractures localised in the distal part or in the waist of the scaphoid. The operation is performed via a palmar approach and the bone graft is harvested from the iliac crest, distal radius or ulna, and it provides an opportunity for humpback deformity correction. Avascular necrosis of the proximal pole is an indication for use of vascularised bone grafts (4). To assess the vascularity of scaphoid bone fragments, an X-ray may be not sufficient, and MRI with contrast is the most accurate technique, with almost 100% accuracy. The operation is per-

formed via a dorsal approach, which allows identification of both the nonunion and pedicle of the graft.

In our study, we did not match our treatment based on localization of the nonunion, but we did correct scaphoid waist nonunions with vascularised bone grafts, similarly to others (13, 14, 19). However, the algorithm described above seems to be reasonable and should be considered in treatment planning (4). The advantage of our material is in a relatively short-lasting nonunion (a mean of 10 months). It is suggested that if bone consolidation is not achieved within six months, operative treatment should be considered (3, 4, 31).

Our modest clinical outcomes do not allow for a definitive conclusion, but the achievement of bone union in all patients without complications justifies the use of this technique for the management of scaphoid nonunion.

## REFERENCES

1. *Markowicz A*: Ocena odległych wyników operacyjnego leczenia stawów rzekomych kości łódeczkowatej metodą rekonstrukcji długości przeszczepem korowo-gąbczastym. Praca doktorska. Akademia Medyczna w Gdańsku 2005.
2. *Chao-Yu Chen A, Chao EK* et al.: Scaphoid nonunion treated with vesicular bone grafts pedicled on the dorsal supra-retinacular artery of the distal radius. *J Trauma* 2006; 61: 1192-97.
3. *Ramamurthy C, Butler L, Nuttall D* et al.: The factors affecting outcome after non-vascular bone grafting and internal fixation for nonunion of the scaphoid. *J Bone Joint Surg* 2007; 89B: 627-32.
4. *Waitayawinyu T, McCallister WV, Nemechek NM* et al.: Scaphoid nonunion. *J Am Acad Orthop Surg* 2007; 15: 308-20.
5. *Yin ZG, Hang JB, Kan SL* et al.: Treatment of acute scaphoid fractures: Systemic review and meta-analysis. *Clin Orthop Rel Res* 2007; 460: 142-51.
6. *Cooney WP*: Nonunion of the carpus. W: *Berger R.A, Weiss A.P.* (red.). *Hand Surgery*. Lippincot, Williams and Wilkins, Philadelphia 2004; t. 1: 225-457.
7. *Ruby LK, Stinson J, Belsky MR*: The natural history of scaphoid nonunion: A review of fifty-five cases. *J Bone Joint Surg* 1985; 67: 428-32.
8. *Schwind F, Haentjens P, van Innis F* et al.: Prognostic factors in the treatment of carpal scaphoid nonunions. *J Hand Surg* 1999; 24A: 761-66.
9. *Carpentier E, Sartorius C*: Scaphoid nonunion: treatments by open reduction, bone graft and staple fixation. *J Hand Surg* 1995; 20A: 235-40.
10. *Cooney WP, Linscheid RL, Dobyns JH* et al.: Scaphoid nonunion: role of anterior interpositional bone graft. *J Hand Surg* 1988; 13A: 635-50.
11. *Merrel GA, Wolfe SW, Slade JF*: Treatment of scaphoid nonunions: Quantitative meta-analysis of the literature. *J Hand Surg* 2002; 27A: 685-95.
12. *Munk B, Larsen CF*: Bone grafting the scaphoid nonunion: A systematic review of 147 publications including 5246 cases of scaphoid nonunion. *Acta Orthop Scand* 2004; 75: 618-29.
13. *Steimann SP, Adams JE*: Scaphoid fractures and nonunions: diagnosis and treatment. *J Orthop Sci* 2006; 11: 424-31.
14. *Malizos KN, Zachos V, Dailiana ZH* et al.: Scaphoid nonunions: Management with vascularized bone grafts from the distal radius: A clinical and functional outcome study. *Plast Reconstr Surg* 2007; 119: 1513-25.
15. *Shah J, Jones WA*: Factors affecting the outcome in 50 cases of scaphoid nonunion treated with Herbert screw fixation. *J Hand Surg* 1998; 23B: 680-85.
16. *Amadio PC, Berquist TH, Smith DK*: Scaphoid malunion. *J Hand Surg* 1989; 14: 679-87.
17. *Dias JJ*: Definition of union after acute fracture and surgery for fracture nonunion of the scaphoid. *J Hand Surg* 2001; 26B: 321-25.
18. *Stark A, Brostrom LA, Svartengren G*: Scaphoid nonunion treated with the Matti-Russe technique. Long term results. *Clin Orthop Rel Res* 1987; 214: 175-80.
19. *Sotereanos DG, Darli NA, Dailiana ZH* et al.: A capsular based vascularized distal radius graft for

proximal pole scaphoid pseudoarthrosis. *J Hand Surg* 2006; 31A: 580-87.

20. Steimann SP, Bishop AT, Berger RA: Use of the 1,2 intercompartmental suprapretinacular artery as a vascularized pedicle bone graft for difficult scaphoid nonunion. *J Hand Surg* 2002; 27A: 391-401.

21. Boyer M, vos Schroeder HP, Axelrod TS: Scaphoid nonunion with avascular necrosis of the proximal pole: Treatment with a vascularized bone graft from the dorsum of the distal radius. *J Hand Surg* 1998; 23B: 686-93.

22. Straw RG, Davis TR, Dis JJ: Scaphoid nonunion: Treatment with a pedicled vascularized bone graft based on the 1,2 intercompartmental suprapretinacular branch of the radial artery. *J Hand Surg* 2002; 27B: 27-31.

23. Mathoulin C, Haerle M: Vascularized bone graft from the palmar carpal artery for treatment of scaphoid nonunion. *J Hand Surg* 1998; 23B: 318-23.

24. Dailiana ZH, Malizos KN, Zachos V et al.: Vascularized bone grafts from the palmar radius for the treatment of waist nonunions of the scaphoid. *J Hand Surg* 2006; 31A: 397-404.

25. Żyłuk A, Walaszek I, Puchalski P: Zastosowanie płyta z I tętnicy grzbietowej śródreżca do rekonstrukcji ubytków kciuka. *Chir Narz Ruchu Ortop Pol* 2005; 70: 17-20.

26. Yuceturk A, Isiklar ZU, Tuncay C et al.: Treatment of the scaphoid nonunions with a vascularized bone graft based on the first dorsal metacarpal artery. *J Hand Surg* 1997; 22B: 425-27.

27. Sawaizumi T, Nanno M, Nandu A et al.: Vascularized bone graft from the base of the second metacarpal for refractory nonunion of the scaphoid. *J Bone Joint Surg* 2004; 86B: 1007-12.

28. Bertelli JA, Tacca CP, Rost JR: Tumb metacarpal vascularized bone graft In long-standing scaphoid nonunion – a useful graft via dorsal or palmar approach: a kohort study of 24 patients. *J Hand Surg* 2004; 29A: 1089-97.

29. Doi K, Oda T, Soo-Heong T et al.: Free vascularized bone graft for nonunion of the scaphoid. *J hand Surg* 2000; 25A: 507-19.

30. Harpf C, Gabl M, Reinhard C et al.: Small free vascularized iliac crest bone grafts in reconstruction of the scaphoid bone: a retrospective study in 60 cases. *Plast Reconstr Surg* 2001; 108: 664-74.

31. Inoue G, Shionoya K, Kuwahata Y: Herbert screw fixation for scaphoid nonunions: an analysis of factors influencing outcome. *Clin Orthop* 1997; 343: 99-106.

32. Slade JF, Dodds SD: Minimally invasive management of scaphoid nonunions. *Clin Orthop Rel Res* 2006; 445: 108-19.

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## COMMENTARY

*The diagnosis and treatment of navicular bone fractures constitutes a problem in current traumatology. Damage to the above-mentioned bone is one of the most common non-diagnosed fractures, the treatment of which has the highest percentage of failures. This problem is significant, as 80% of all fractures of the wrist involve the navicular bone. Therapeutic failure is related to functional insufficiency of the wrist and hand. The above-mentioned injury most often concerns men working physically as well as sportsmen. Diagnostic and therapeutic difficulties concerning navicular bone fractures lend interest to every new publication concerning their treatment. One should not forget that proper and precise diagnosis and treatment enable the avoidance of complica-*

*tions, which are often the cause of permanent disability in case of young and physically active subjects.*

*The authors of the study presented the results of treatment of old navicular bone fractures using pedunculated bone grafts harvested from the distal segment of the radial bone. The method used had only been described in foreign literature, with the presented study being the second Polish publication concerning this problem. Osseous adhesion and an absence of postoperative complications were observed in all 11 operated patients. This is evidence of the value of the therapeutic method and proper operative technique. Due to the operative method used and the anatomy of the wrist, surgery should be undertaken with great care and preci-*

*sion. Only such management will ensure therapeutic success.*

*The study extensively presented different treatment methods and therapeutic effects published by other authors. However, an assessment of the methods was absent. Operative treatment has only been the therapeutic method of choice for the past twenty years, considering patients*

*with posttraumatic proximal necrosis of the navicular bone and the failure of other surgical methods.*

*The presented study might be of great value in the specialized management of navicular bone adhesion problems.*

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