

Original research article

Functional outcome of scaphoid nonunion treated with herbert screw and bone grafting

Dr. Rakesh Kumar¹, Dr. Sushil Kumar Singh²¹Senior Resident, Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, India.²Senior Resident, Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, India.

Corresponding Author: Dr. Sushil Kumar Singh

Abstract

Aim: to evaluate the functional outcome of scaphoid nonunion treated with bone grafting and Herbert screw fixation.

Material and Methods: This study was done the Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda Bihar, India from March 2016 to August 2017. 60 cases were referrals from peripheral centers with a possible diagnosis of scaphoid nonunion after failed conservative treatment. 60 patients were initially assessed with fresh radiographs and MRI wrist was taken in all cases. The injuries were classified according to Herbert's Classification. Clinical examination included the assessment of tenderness, active and passive range of movement in wrist, and grip strengths were also measured. A firm padded removable splints were used to support the wrist for the first two weeks and after the suture removal, patients are advised to start mobilizing exercises of the wrist.

Results: There were 60 cases of scaphoid nonunion treated with Herbert screw fixation and cancellous bone grafting. All the patients were males and dominant hand was involved in 50 cases. Out of 60 patients 25 patients had road traffic accidents, 32 had fall on outstretched hand and 3 fracture caused by assault. The right wrist was affected in 50 cases and left in 10 patients. The mean time from injury to surgical fixation was 12 months. The mean age of the patients was 29.7 years. The occupations of the patients in terms of weight loading of the wrist were heavy loading in 37 patients, light loading in 10 patients and clerical work in 13 patients. Since all the patients were referral cases with nonunion, they were initially been all the 60 patients were regularly followed up and were evaluated for clinical and radiological outcomes.

Conclusion: the healing of the nonunion is better than that in other surgeries like k wire fixation or bone graft surgeries alone.

Keywords: Non-union, Herbert screw, Bone graft

Introduction

Scaphoid fractures account for 50–80% of all carpal fractures, with the highest incidence in young and active men.¹ According to epidemiological studies; the incidence of scaphoid fractures varies between 0.08–1.21 per 1000 person-years in different populations. These fractures usually are treated with conservative measures, resulting in union rates between 55–100%.² Scaphoid fracture accounts for 60% of all carpal fractures, and be the second most fractures around the wrists.¹ The highest nonunion rate was 15.5% of scaphoid fracture amongst whole body bones.² Untreated scaphoid nonunion may progress to scaphoid nonunion advanced collapse, dorsal intercalated segment instability (DISI) deformity, and generalised wrist arthritis. Surgical procedures including bone graft and screw fixation are the gold standard treatments for scaphoid non-union.^{3,4} In comparison to percutaneous screw fixation and arthroscopic bone grafting, a combined volar and dorsal approach for bone grafting and

screw fixation is thought to have inferior functional outcomes and prolonged recovery course because of the risks of a disrupted blood supply and scar formation.⁵ However, the detailed recovery course and the functional and radiographic outcomes of this approach are rarely reported in the literature. A better understanding of the recovery course of combined volar and dorsal approaches may fill the gap between clinical science and clinical practice.^{6,8} It is estimated that almost 10% of the fractures treated fail to unite.⁹ Considerable controversy remains regarding the need for treatment of asymptomatic nonunion of the scaphoid. Natural history studies have indicated a positive correlation between duration of nonunion and the development of arthrosis of the wrist.¹⁰ although some of the conclusion may have been biased in these studies. Recent reports propose that surgical management for all nonunions is justifiable, with the exception of asymptomatic patients older than 45 years of age.¹¹ the aim of this study to evaluate the functional outcome of scaphoid nonunion treated with bone grafting and Herbert screw fixation.

Material and Methods

This study was done the Department of Orthopaedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda Bihar, India from March 2016 to August 2017., after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

60 cases were referrals from peripheral centers with a possible diagnosis of scaphoid nonunion after failed conservative treatment. 60 patients were initially assessed with fresh radiographs and MRI wrist was taken in all cases. The injuries were classified according to Herbert's Classification.

Clinical examination included the assessment of tenderness, active and passive range of movement in wrist, and grip strengths were also measured. AP, Lateral and oblique view radiographs of wrist were taken preoperatively, the same technique also being used at follow-up examinations. MRI was taken for assessing the fracture morphology and classification of the fracture properly. The diagnosis of radiological union required clear evidence of bony trabeculae transversing the graft from proximal to the distal pole in standard scaphoid views.

Reconstruction of nonunion (type D) was advised for all symptomatic cases and all consenting patients irrespective of the age group and were included in the study. Patients with associated neurovascular injuries, other carpal bone fracture of same limb, those with previous surgery of fractured area and those with musculoskeletal diseases are also excluded from the study. Surgery was not performed for patients with advanced radiocarpal osteoarthritis or in asymptomatic patients.

A standard volar approach was used for internal fixation in all cases. The state of the articular cartilage and synovium, the presence of any fibrous adhesions or inter-position at the fracture site was assessed intraoperatively. The condition of the fracture surfaces and degrees of fracture mobility were carefully assessed and the fracture site was observed for bleeding after freshening. For type D1 non unions, the synovial adhesions and fibrous tissues were meticulously removed without destabilizing the fracture, and cancellous graft was used to fill any defects after curetting out all the avascular tissue and cysts. All types D2 cases, the pseudarthroses was removed from fracture surfaces and were then reconstructed using a corticocancellous bone graft. The Herbert screw was then inserted freehand, using the drill guide wire. Most bone grafts were taken from the contralateral iliac crest or from the distal radius depending upon the amount of graft needed and size of the nonunion gap. A firm padded removable splints were used to support the wrist for the first two weeks and after the suture removal, patients are advised to start mobilizing exercises of the wrist. During the initial eight weeks after surgery, patients were advised to avoid excessive loading of their wrist and to avoid

contact sports. Light removable splints were prescribed only when the patient was unlikely or unwilling to comply with this advice. Patients were asked to attend for routine review at 3 weeks, 6 weeks, 9 weeks and 3 months and any additional visits being scheduled as required. Standard wrist radiographs were taken at each visit and a detailed clinical assessment was recorded. All assessments and radiographs were reviewed by principal investigator, who analyzed the clinical results using modified Mayo's wrist score. Radiographically fractures were recorded as united only if cross-trabeculation was present and the fracture line was no longer visible on any of the standard views. But our study duration is inadequate comment on radiological outcome analysis and hence it was not included in the main study results.

Results

There were 60 cases of scaphoid nonunion treated with Herbert screw fixation and cancellous bone grafting. All the patients were males and dominant hand was involved in 50 cases. Out of 60 patients 25 patients had road traffic accidents, 32 had fall on outstretched hand and 3 fracture caused by assault. The right wrist was affected in 50 cases and left in 10 patients.

The mean time from injury to surgical fixation was 12 months. The mean age of the patients was 29.7 years. The occupations of the patients in terms of weight loading of the wrist were heavy loading in 37 patients, light loading in 10 patients and clerical work in 13 patients. Since all the patients were referral cases with nonunion, they were initially been All the 60 patients were regularly followed up and was evaluated for clinical and radiological outcomes. Our study was mainly focusing on the short-term functional outcome of the patient rather than radiological outcome. Our study resulted in 61.67% excellent, 26.67% good and 11.66% fair functional outcomes. 2 patient each in good and fair groups had mild pain post operatively. 97.5% of patients were satisfied with the outcome of the procedure mostly because they could return to job with a painless joint. Wrist function was assessed by range of movement and grip strength which was greatly improved after Herbert screw fixation of the scaphoid. The movement which was mostly difficult improve was wrist dorsiflexion after reconstruction. The rigid internal fixation of the scaphoid resulted in significant decrease in pain. Most of our patients had moderate to severe pain preoperatively, but 83.33% cases had no pain at the latest review. Based on our study results we like to propose that the successful internal fixation of scaphoid with Herbert screw and bone grafting can improve the wrist function considerably. The preoperative incidence of arthritis of wrist had not significantly worsened on post-operative follow ups. The most common complication of surgery was the postoperative pain and discomfort at the donor site incase of the bone graft taken from iliac crest, although this resolved with time. 1 superficial wound infection resolved completely with antibiotic therapy only. None of the wrists had protrusion of the screw or developed nonunion. 1 of the patients had early signs of sudeks sympathetic dystrophy (RSD) after surgery.(fig 1. and fig 2.)

Table 1: Demographic profile of patients

Age in years	No. of patients	Percentage
Below 20	9	15
20-30	32	53.33
30-40	19	31.67
fracture caused		
Road traffic accidents	25	41.67
Fall on	32	53.33
Assault	3	5
wrist		
right wrist	50	83.33
left wrist	10	16.67

Table 2: Distribution of functional outcome

Functional outcome	No. of patients =60	Percentage
Excellent	37	61.67
Good	16	26.67
Fair	7	11.66
Poor	nil	nil

**Fig. 1: Volar approach****Fig. 2: Scaphoid nonunion**

Discussion

The main purpose of this study was to evaluate the short-term functional outcome after internal fixation of scaphoid non unions using Herbert screw and bone grafting in those cases initially treated with conservative techniques. Many studies in the literature shows satisfactory outcome after conservative treatment, but the actual incidence of non-union with conventional treatments appears considerably high.¹²⁻¹⁵ The morbidity associated with prolonged use of plaster immobilization is also very concerning especially in young individuals. Even though union can be achieved in majority of cases,¹⁶ long periods of immobilization may be needed. If conservative management fails, then the Matti-Russe procedure may be effective in 83.33% of cases.^{17,18} But this procedure also will not reduce the period of immobilization. In a study Dias, Brenkel and Finlay¹⁹ reviewed 82 patients treated conservatively after almost two years: and concluded that ten patients had definite nonunion and another 20 cases had a visible fracture line.

But conservative management of fracture scaphoid with cast is still a common treatment modality, but it results in unacceptably high rate of nonunion and associated poor functional outcomes. Hence for displaced scaphoid fracture and for non-unions, open reduction and internal fixation will be the ideal modality of management.²⁰

Our study shows that internal fixation using the Herbert bone screw and bone grafting in scaphoid nonunion results in early symptomatic relief and faster functional recovery. It also shows that the screw gives sufficient structural stability to allow normal function of the wrist. The fixation remains stable enough to allow revascularization of the bone. We also encourage early normal use of the wrist by avoiding plaster immobilization postoperatively. This aids in rapid functional improvement of wrist and also reduces the development of stiffness of joint and osteoporosis. We strongly support early postoperative wrist mobilization and condemn the use of plaster after Herbert screw fixation. The results of our study confirm that internal fixation with herbert screw along with bone grafting leads to better results than other standard techniques mainly due to the accuracy of scaphoid reconstruction and the benefits of early

postoperative rehabilitation. We therefore strongly recommend that internal fixation with bone grafting for scaphoid nonunion, even in cases with ischemic nonunion.

In our series the patients are of young working class with a mean age group was 29.7 years and they cannot afford to stay off from job for the two to four months often required after bone grafting surgery alone. One of the important advantages of internal fixation is that it permits an early return to normal job especially in the scenario of more young individuals presenting with nonunion. According to Alexandros E Beris et al.²¹ Herbert screw along with iliac wedge graft was more effective for correcting the bony deformity and gives improved stabilization. They also suggested that the long periods of postoperative immobilization will negatively affect the postoperative wrist function. D. O. Ferguson, V. Shanbhag et al.²² in their systematic review assesses outcomes of 5464 scaphoid non-union outcomes within the 144 studies treated with bone graft surgery for scaphoid fracture non-union, reported that the union rates for vascularized and non-vascularized bone graft were 84% and 80%, respectively. S Eggli, D.L Fernandez et al.¹⁴ conducted a retrospective review of thirty seven patients with scaphoid nonunions treated by bone grafting and internal fixation with an mean follow-up period of 5.7 years. Their study concluded that, fifteen patients had an excellent result, eleven had a good result, four had a fair result and seven had a poor result.

Our study resulted in 61.67% excellent, 26.67% good and 11.66% fair functional outcomes. According to Merrell G.A., Wolfe S.W., et al.²³ who done a systematic meta-analysis of the literature on the treatment of scaphoid nonunion which included 36 articles, for the unstable nonunion, screw fixation with grafting produces 94% union rate compared to K-wires and wedge grafting (77% union). They also suggested that there is no evidence supporting the postoperative immobilization after solid screw fixation. Yi-Chao Huang, Yih Liu et al.²⁴ retrospectively reviewed 49 patients treated with Herbert's screw fixation and bone graft and got a union rate of 93.9% with 59% excellent results and 35% good results. In our study series we encountered 1 case of superficial wound infection and 1 patient had reflex sympathetic dystrophy. This is in consistent with other studies. The bone grafting and Herbert's screw fixation is definitely a reliable modality of treatment which gives satisfactory functional outcome. The important factor is the postoperative immobilization and we support early mobilization of wrist and condemn the use of any plaster splints. We recommend this modality of treatment for all scaphoid non union cases without significant degenerative arthritis of wrist joint.

Conclusion

We concluded that the management of scaphoid non unions with the Herbert screw and bone grafting can provide enough stability to allow fracture healing without much external splint age. The healing of the nonunion is better than that in other surgeries like k wire fixation or bone graft surgeries alone. Wrist function recovers much quicker after rigid internal fixation and early post-operative mobilization.

Reference

1. Van Tassel DC, Owens BD, Wolf JM. Incidence estimates and demographics of scaphoid fracture in the U.S. population. *The Journal of hand surgery*. 2010; 35(8):1242–5.
2. Dias JJ, Brenkel IJ, Finlay DB. Patterns of union in fractures of the waist of the scaphoid. *The Journal of bone and joint surgery British volume*. 1989; 71(2):307–10.
3. Janowski J, Coady C 3rd. CL. Scaphoid fractures: nonunion and malunion. *J Hand Surg [Am]*. 2016;41(11):1087–92.
4. Yeo JH, JY K. Surgical strategy for scaphoid nonunion treatment. *J Hand Surg Asian Pac Vol*. 2018;23(4):450–62.

5. Jegal M, Kim JS, Kim JP. Arthroscopic management of scaphoid nonunions. *Hand Surg.* 2015;20(2):215–21.
6. Mediouni M, R Schlatterer D, Madry H, MBR C. A review of translational medicine. The future paradigm: how can we connect the orthopedic dots better? *Curr Med Res Opin.* 2018;34(7):1217–29
7. Mediouni M, Madiouni R, Gardner M. N V. Translational medicine: challenges and new orthopaedic vision (Mediouni-Model). *Curr Orthop Pract.* 2020; 31(2):196–200.
8. Mediouni M. A new generation of orthopaedic surgeons: “T-model”. *Current Orthopaedic Practice.* 2019;30(5):444–5.
9. Herndon JH. Scaphoid fractures and complications. *Am Academy Orthopaedic Surgeons Monograph Series*, Rosemont, 1994.
10. Vender MI, Watson HK, Wiener BD, Black DM. Degenerative change in symptomatic scaphoid nonunion. *J Hand Surg (Am)* 1987; 12: 514-9.
11. Barton NJ. The Herbert screw for fractures of the scaphoid. *J Bone Joint Surg (Br)* 1996; 78: 517-8.
12. Filan SL, Herbert TJ. Herbert screw fixation of scaphoid fractures. *J Bone Joint Surg.* 1996;78-B(4):519–29.
13. Herbert TJ, Fisher WE. Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg.* 1984;66:114–23.
14. Egli S, Fernandez DL, Beck T. Unstable Scaphoid Fracture Nonunion: A Medium-Term Study of Anterior Wedge Grafting Procedures. *J Hand Surg.* 2002;27(1):36–41.
15. Radford PJ, Matthewson MH, Meggitt BF. The Herbert Screw for Delayed and Non-Union of Scaphoid Fractures: A Review of Fifty Cases. *J Hand Surg .* 1990;15(4):455–9.
16. Cooney WP, Dobyns JH, Linschield RL. Fractures of the scaphoid: a rational approach to management”. *Clin Orthop.* 1980;149:90–7.
17. Dooley BJ. Inlay bone grafting for non-union of the scaphoid bone by anterior approach. *J Bone Joint.* 1968;50-B(1):102–9.
18. Trojan E. Grafting of Ununited Fractures of the Scaphoid. *Proc R Soc Med.* 1974;67(10):1078–80.
19. Dias JJ, Brenkel IJ, Finlay DB. Patterns of union in fractures of the waist of the scaphoid. *J Bone Joint Surg.* 1989;71-B(2):307–10.
20. Mittal VK. Conservative management of fracture scaphoid. *Indian J Orthop.* 2006;40:255–8.
21. Beris AE, Soucacos PN, Xenakis T, Malizos K, Mitsionis G, Varitimidis S, et al. Scaphoid nonunion treated with bone graft and Herbert screw. *Acta Orthop Scand.* 1997;68(sup275):60–4.
22. Ferguson DO, Shanbhag V, Hedley H, Reichert I, Lipscombe S, Davis TRC. Scaphoid fracture non-union: a systematic review of surgical treatment using bone graft. *J Hand Surg.* 2016;41(5):492–500.
23. Merrell GA, Wolfe SW, Slade JF. Treatment of scaphoid nonunions: Quantitative meta-analysis of the literature. *J Hand Surg.* 2002;27(4):685–91.
24. Huang YC, Liu Y, Chen TH. Long-term results of scaphoid nonunion treated by intercalated bone grafting and Herbert’s screw fixation—a study of 49 patients for at least five years. *Int Orthop.* 2009;33(5):1295–1300

Received :10-08-2020 Revised: 11-08-2020. Accepted:22-09-2020