

Original research article

Scaphoid nonunion treated with bone grafting and Herbert screw fixation: a functional outcome assessment

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Abstract

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

Methods: This study was done in the Department of Orthopedics, Patna Medical College and Hospital, Patna, Bihar, India for 15 months. 80 cases were referred from peripheral centers with a possible diagnosis of scaphoid nonunion after failed conservative treatment. 80 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 were advised to start mobilizing exercises of the wrist.

Results: There were 80 cases of scaphoid nonunion treated with Herbert screw fixation and cancellous bone grafting. The mean age of the patients was 30.35 years. Our study resulted in 60% excellent, 26.25% good and 13.75% fair functional outcomes. 3 patient each in good and fair groups had mild pain post operatively. 96.25% 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 to 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 85% cases had no pain at the last review.

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

Keywords: Herbert screw, scaphoid, fracture

Introduction

Scaphoid fractures represent one of the most frequent fractures of the carpal bones¹, although epidemiology reports differ widely. In the USA, the number of cases reported per year range from as low as 35,000/year up to 300,000/year², while one study in Denmark indicated 8 cases per 100,000/year for women and 38 cases per 1 00,000/year for men. Epidemiological projection of the findings from Denmark suggest that 400 to 500 patients with scaphoid nonunion would require treatment in Greece each year. To this, patients who have been misdiagnosed as sprains or other need to be accounted for, as well. Furthermore, estimates should also include those patients who fell on an outstretched hand and experienced mild

discomfort for a short period and then remained symptom free for years; these patients may develop late symptoms, resulting in discovery and treatment of a scaphoid non-union. It is estimated that almost 10% of the fractures treated fail to unite.³ 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.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 nonunion 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 in done the Department of Orthopedics, Patna Medical College and Hospital, Patna, Bihar, India for 15 months, after taking the approval of the protocol review committee and institutional ethics committee. 80 cases were referrals from peripheral centers with a possible diagnosis of scaphoid nonunion after failed conservative treatment. 80 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 splint 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 80 cases of scaphoid nonunion treated with Herbert screw fixation and cancellous bone grafting. All the patients were males and dominant hand was involved in 65 cases. Out of 80 patients 32 patients had road traffic accidents, 43 had fall on outstretched hand and 5 fracture caused by assault. The right wrist was affected in 64 cases and left in 16 patients. The mean time from injury to surgical fixation was 12 months. The mean age of the patients was 30.35 years. The occupations of the patients in terms of weight loading of the wrist were heavy loading in 47 patients, light loading in 15 patients and clerical work in 18 patients. Since all the patients were referral cases with nonunion, All the 80 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 60% excellent, 26.25% good and 13.75% fair functional outcomes. 3 patient each in good and fair groups had mild pain post operatively. 96.25% 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 to 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 85% 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 in case of the bone graft taken from iliac crest, although this resolved with time. 2 superficial wound infection resolved completely with antibiotic therapy only. None of the wrists had protrusion of the screw or developed nonunion. 2 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	14	17.5
20-30	40	50
30-40	26	32.5
fracture caused		
Road traffic accidents	32	40
Fall on	43	53.75
Assault	5	6.25
wrist		
right wrist	64	80
left wrist	16	20

Table 2: Distribution of functional outcome

Functional outcome	No. of patients =80	Percentage
Excellent	48	60
Good	21	26.25
Fair	11	13.75
Poor	nil	nil

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

Discussion

Scaphoid nonunion is a challenging and complex problem which results owing to multiple factors. Review of literature demonstrates union rates of 74–84% using non-vascularized bone grafts¹² and there is no superiority of bone autografts harvested from the iliac crest or of those from distal radius according to the morbidity.¹³ Fracture healing is a multi-step process that is facilitated by the interaction of different cellular elements to achieve union. Theoretically, the use of VBGs in non-union fractures provides essential components such as cytokines and cellular mediators by maintaining cell viability, which drives the healing process similar to the primary process of fracture healing.¹⁴ The main purpose of this study was to evaluate the short-term functional outcome after internal fixation of scaphoid nonunions 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.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 30.35 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 Egli, 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 has 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

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.

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