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# Functional Outcome of Surgical Management of Non Union Scaphoid Fracture

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**Abstract**
**Background:** *Incidence of scaophoid fracture non union is estimated to be 5-10% despite treatment. Considering the poor prognosis, a number of treatments have been advocated. Though literature supports open reduction, internal fixation and bone grafting, controversy exists regarding the mode of fixation and method of grafting.*
**Objective:** *The purpose of this study is to analyze the results and functional outcome of patients with non union scaphoid treated with open reduction and K wire fixatin and bone grafting.*
**Materials & Methods:** *20 patients with Non union waist of scaphoid, treated surgically with K wire fixation and distal radius bone grafting were assessed for the functional outcome using Modified scaphoid outcome scoring system.*
**Results:** *At an average follow up of 6 months, there is 95% union rate with this technique. Functionally,15% excellent, 65% good, 15% fair and 5% poor results with the described technique.*

## Introduction

Amongst all wrist injuries, the incidence of scaphoid fractures is second only to that of fracture of the distal radius[1,2]. Despite proper treatment, it has been estimated that non-union occurs in between 5% and 10%[3,4,5,6,7]. Non-unions have been attributed to a number of risk factors including smoking, delay in beginning treatment, inadequate immobilisation, displacement of the fragments, instability due to ligamentous injury and inadequate blood supply of the proximal fragment[8,9]. Patients with scaphoid non-unions are likely to develop traumatic arthritis with increasing pain, decreased wrist mobility and weakness [10,11].

Given the relatively high incidence of non-union of scaphoid fractures and their poor prognosis, it is not surprising that a number of treatments have been advocated for un-united fractures of the scaphoid[12,13,14,15,16,17,18,19]. Traditionally, the most popular surgical treatments include bone grafting, vascularised bone grafting and internal fixation. While each method achieves a high predictability of bone union (80–90%)[20], many disadvantages emerge among the techniques. Technical difficulties arise with the routine use of cortico-cancellous bone grafts and screw fixation when dealing with cavitary defects in established scaphoid non-unions[21]. Problems present when attempting to obtain the correct shape when using

solid bone grafts and then also when keeping the graft reduced during screw insertion[21]. Compression screw devices can further split the graft material or cause the graft to displace [22]. With cancellous grafts, compression devices can also cause the scaphoid to shorten, which is undesirable for subsequent wrist mechanics.

In the published literature, the most successful and reliable procedure for obtaining bone healing in established scaphoid non-union has been internal fixation with Kirchner wires and cortico-cancellous iliac crest bone graft (97% success rate in 151 patients)[23].

**Aim of Study**

Is to analyze the functional outcome following surgical management of non-union scaphoid fracture and to evaluate the complications

Functional outcome is evaluated based on modified scaphoid scoring system (Modified by Robbins et al.[13] in 1995 from the system proposed by Jiranek et al.[9] in 1992)

**Review Of Literature**

Nonunion of the scaphoid is a severe problem, causing arthritis secondary to abnormal loading on the articular surfaces of the midcarpal joint, severe pain, and weaknes. A systematic review by Munk et al. [23] found that treatment of scaphoid non-union using non-vascularised bone graft and internal fixation led to a union rate of 84% after an average period of 7 weeks of immobilisation.

Cancellous bone grafting for scaphoid nonunion, as first described by Matti and modified by Russe, has proved to be a reliable procedure, producing bony union in 80% to 97% of patients. This technique is most useful for ununited fractures that do not have associated shortening or angulation. [24]. Of 27 patients seen an average of 12 years after surgery, Stark et al. [25]reported that 24 were satisfied with the result, and all but one had returned to work. Stark et al.[25] in their series of 25 patients with DISI, achieved a union rate of 96% over an average of 17 weeks. Zaidemberg et al.[26] used a vascularized bone graft from the distal dorsolateral radius to obtain healing in 11 patients with long-standing nonunions of the scaphoid.

In short, the following operations can be useful for nonunions of the scaphoid: (1) radial styloidectomy; (2) excision of the proximal fragment, the distal fragment, and, occasionally, the entire scaphoid; (3) proximal row carpectomy; (4) traditional bone grafting; (5) vascularized bone grafting; and (6) partial or total arthrodesis of the wrist.

**Materials and Methods**

It is a case series study. All male/female patients above 18 years and below 60 years treated for nonunion scaphoid in the Department of Orthopedics, Medical College, Trivandrum during the period Feb 2012 to Sept 2013 and who underwent surgery were included in the study. Those who have associated ipsilateral fracture upper limb, associated chest/abdominal/head injuries and those underwent primary fixation were excluded from the study. The Modified scaphoid outcome scoring system was used for evaluation of functional outcome.

MODIFIED SCAPHOID OUTCOME SCORING SYSTEM*

| | No. of Points† |
|---|---|
| Pain | |
| No pain | 4 |
| Occasional ache | 3 |
| Ache after work or sports | 2 |
| Pain after work or sports | 1 |
| Daily pain not associated with activity | 0 |
| Motion and strength of wrist | |
| Able to return to preinjury work | 2 |
| Unable to return to preinjury work | 1 |
| Always limits work or activities | 0 |
| Occupation (with regard to wrist injury) | |
| Never limits work or activities | 2 |
| Occasionally limits work or activities | 1 |
| Always limits work or activities | 0 |
| Overall satisfaction with result of operation | |
| Improved quality of life | 2 |
| Did not change quality of life | 1 |
| Worse quality of life | 0 |

A perfect score (10 points) was considered an excellent result; 8 or 9 points, a good result; 6 or 7 points, a fairresult; and 5 points or less, a poor result.

Also, physical and radiological examinations were carried out as part of study variables.

- Dorsiflexion, palmar flexion, radial deviation, and ulnar deviation of the

affected wrist using a goniometer pre and postoperatively.

- Grip strength of both the affected hand using dynamometer with elbow flexed 90 degrees and the forearm in neutral rotation pre and postoperatively assessed.The presence or absence of tenderness in the anatomical snuffbox and the scaphoid tubercle was also assessed.
- Radiologically, three standard radiographs were analyzed for degenerative changes, carpal collapse, the size of the intrascaphoid angle, failure of the hardware, and union. Criterion for osseous union was trabeculation across the site of the fracture on all three radiographs. Carpal height ratio and interscaphoid angle were also measured.

**Procedure**

It was done under regional anaesthesia on a radiolucent table under tourniquet.

A volar approach is used going down through the bed of flexor carpi radialis (FCR) tendon. scaphoid bone is identified and exposed the non-union site. The fibrous non-union was resected. Fibrous tissue and any dead bone were removed using small sharp curettes or with k wire . Careful attention was made to preserve as much viable bone as possible. Bony resection was continued until both fragments showed solid healthy looking and feeling bone. Cancellous autograft was harvested via a separate 1 cm dorsal skin incision from the ipsilateral distal radius adjacent to Lister's tubercle. The graft was packed around the Kirschner wires into the created cavity. Two 1.25-mm diameter Kirschner wires were used to internally fix the scaphoid. The wires were driven distally to proximally and generally parallel to each other using fluoroscopic guidance. Fluoroscopy was used to ensure placement of wires, reduction of scaphoid and carpal angles and implantation of autograft before closure. A thumb spica is given on table after wound closure and dressing.

At 6weeks,cast is removed and x rays are taken for graft and k wire position. Patient is instructed to perform wrist movements. At 12$^{th}$ week, k wires are removed after assessing the union. Follow ups done at 15 weeks and at 6 months. X rays are taken to assess union

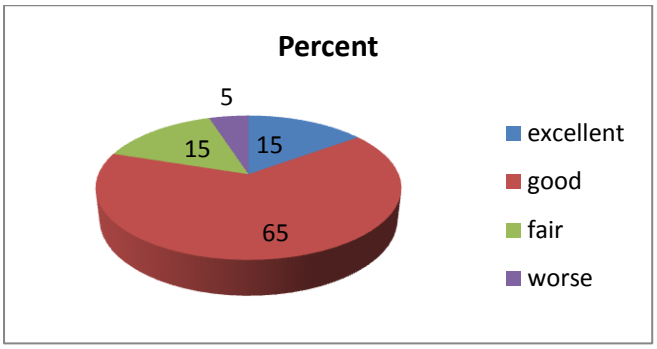
The average follow-up period of patients ranged from 6 months to 1.2years . Functional assessment included scoring according to modified scaphoid scoring system and range of motion (ROM) and grip strength pre and post operative of hand was performed on 20 patients as part of regular follow-up.

**Results**

This study was conducted on 20 patients falling in age group of 19 to 39 years .All patients had unilateral nonunion scaphoid waist fracture. Most of the people belongs to age group between 20 to 30 age group (65%). All the patients who presented with complaints in outpatient department were males. This may be due to various mechanism of injuries that are more common in the adult male. There is no job predeliction for this but more common in this manual labourer(40%). Most common method of mechanism is fall on outstretched hand(60%). 85% of people have fracture on non-dominant hand Side. 80% of the people have injuries on left hand. 90% of the patients were treated at the time of initial trauma with below elbow cast. Two patients didn't take any treatment .65% were D1 type. 65% of the patients took treatment between 6-12 months. Only 2 patients(2%) took treatment at 19$^{th}$ and 20$^{th}$ month. All patients presented with occasional ache or pain . 13 patients (65%) had ache after work or sports while 2 patient have pain after work or sports.

**Modified Scaphoid Outcome Scoring System**

15% have excellent results, 65% have good, 15% have fair and 5%have poor result.




**Motion and strength of wrist:** 85% of the patients returned to their pre injury work and 3% unable to return to their pre injury work

**Occupation:** 70% of the patients did not have any limitation to work or activities

**Overall satisfaction with result of operation:** 75% had improved quality of life while did not change quality of life in 25% of patients

**Table 1**

| | Frequency | Percent |
|---|---|---|
| Improved quality of life | 15 | 75 |
| Did not change quality of life | 5 | 25 |
| Total | 20 | 100 |

**Union:** Bony union occurred in 95%of the patients as per X rays on AP and lateral views. 1 Patient had no evidence of union on 12 month follow up

**Degenerative changes:** At the end of follow up 5 patient(25%) had evidence of degenerative changes in wrist.

**Table 2**

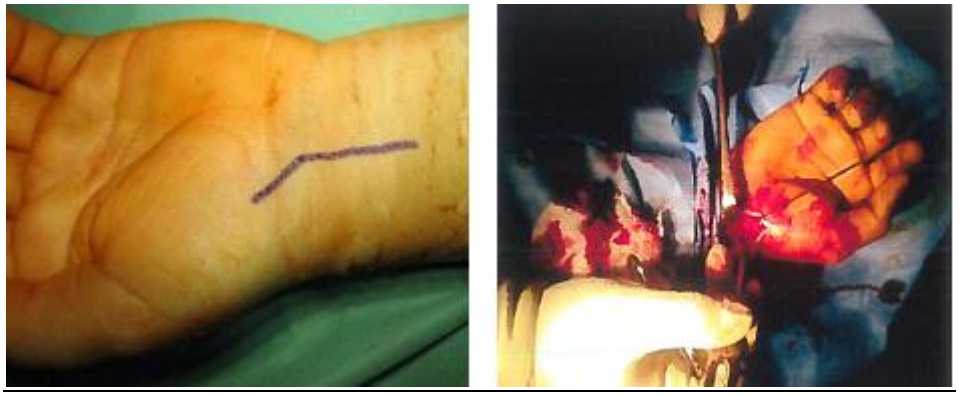
| degenerative changes | Frequency | Percent |
|---|---|---|
| Present | 5 | 25 |
| absent | 15 | 75 |
| Total | 20 | 100 |

**Failure of hardware**

Only one patient had migration of k wire that was removed at 4th month that is the same patient in whom scaphoid was not united with fixation

**Clinical Cases**

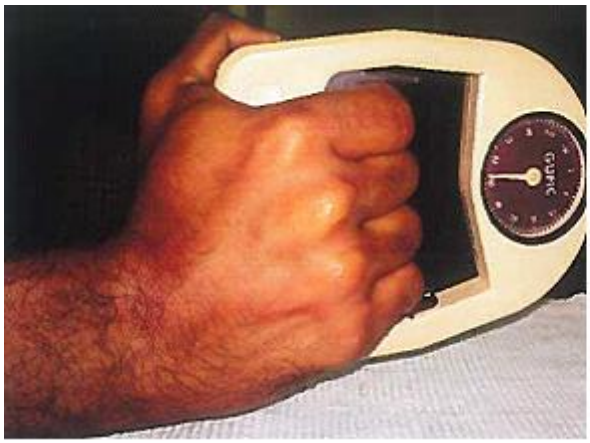
Volar Approach to Scaphoid



34 yrs old male with 3months old Non union waist of Scaphoid treated by ORIF with K wires and Bone grafting

Post Operative Wrist Movements

Post operative Grip Strength.



Patient sowing migration of K wire

**Conclusions**

Functional outcome following scaphoid fracture non-union treated with K wire fixation and bone grafting in 20 patients gave 15% excellent, 65% good, 15% fair and 5% poor outcome according to Modified scaphoid outcome scoring system. Scaphoid fracture non-union treated with k wire and bone grafting gives 95% union at 6 months follow up. Our technique of fixation with K wires and bone grafting from radius is simple compared to other techniques and gives excellent results. Kirschner wires have low surface area compared to compression screw implants, thus leaving greater surface area of bone graft in contact at fragment interfaces to allow more reliable bone union, while simultaneously allowing upper limits of carpal height to be restored by deliberately choosing to avoid compression. With this technique, 85% returned to their pre injury work and patients were symptomatically improved.

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