

## PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME IN SCAPHOID NON-UNION WITH KIRSHNER WIRE AND AUTOLOGOUS BONE GRAFT

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### ABSTRACT

#### BACKGROUND

The scaphoid is the most commonly fractured carpal bone. These fractures are difficult to diagnose and manage. Degenerative changes occur if scaphoid fracture non-union if left untreated. This study evaluates the outcome of scaphoid non-union treated with K wires and bone grafting.

The aim of this study was to evaluate functional and radiological outcome in scaphoid non-union treated with Kirshner wire and autologous bone grafts.

#### MATERIALS AND METHODS

A total of 36 patients who had scaphoid non-union treated with iliac bone grafting and Kirschner wire fixation between June 2015 to June 2017, were enrolled as subjects of the study. Their clinical results were evaluated, including range of motion of the wrist joint, grip strength, pain and modified Mayo wrist score. Radiographic bone union was also assessed.

#### RESULTS

Bony union was achieved in 32 (88.8%) of 36 cases. 31(86%) of 36 cases achieved near normal (75-99% percentage of normal) range of motion (palmer flexion/dorsal flexion, radial/ulnar deviation) as compared to contralateral uninjured extremity. Excellent results achieved in 4 cases (11.11), Good results achieved in 21 cases (58.33%), fair results in 6 cases (17%), according to Mayo wrist scoring system postoperatively.

#### CONCLUSION

Autologous Iliac bone graft with Kirschner wire fixation can be considered a good treatment option for scaphoid non-union as it provides good clinical and radiological outcome.

#### KEYWORDS

Scaphoid Non-Union, Kirschner Wire, Autologous Bone Grafts.

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#### BACKGROUND

The scaphoid is the most commonly fractured carpal bone, accounting for approximately 60% of all carpal fractures.<sup>1</sup> Avascular necrosis is reported to occur in 13% to 50% of scaphoid fractures, with an even higher incidence in those involving the proximal one-fifth of the scaphoid.<sup>2,3</sup>

Early diagnosis and adequate treatment are important as it allows good healing and prevents late complications. Scaphoid fractures are primarily recognized and treated appropriately, in spite of that non-union may occur in 5% to 15% of cases.<sup>4</sup>

Scaphoid non-unions are difficult to treat successfully and if left untreated, they can progress to carpal collapse and degenerative arthritis with long-term disability<sup>5,6</sup>

Most of patients represents later with pseudarthrosis along wrist pain. These pseudarthrosis are mainly divided in three anatomical regions: distal, middle and proximal. Non-union of the distal segment is very less and has good results<sup>7</sup> due to abundant vascular supply of this region. Mid-scaphoid pseudarthrosis also have good prognosis, although results are vary.<sup>8-10</sup> Proximal pseudarthrosis have poor prognosis because of poor vascular supply of this region.

Scaphoid non-unions have been treated with bone graft and internal fixation and casts for varying durations. Commonly used internal fixation devices include Kirschner (K) wires and compression screws.<sup>11-13</sup>

When scaphoid non-union treated with corticocancellous bone graft and screw fixation, there is difficulty in dealing with cavitory defects in established nonunion<sup>14</sup> because compression screw can split or break the graft material, so there is further risk of loss of reduction, graft failure and finally difficulty in union. Compression screw provides good stability compare to K-wires fixation,<sup>15</sup> but

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several studies showed similar clinical results of use of compression screw and K-wires<sup>16-18</sup> with bone graft.

The aim of this study was to evaluate the clinical and radiographic outcome of autologous iliac bone grafting with K-wire fixation for treating scaphoid non-union

### MATERIALS AND METHODS

This is Prospective study that was carried out in department of orthopaedics, SMS Medical College & Hospital, Jaipur between June 2015 to June 2017.

The study contained 35 (97%) male and 1 (3%) female subjects. Dominant wrist was affected in 35 patients and non - dominant was in 1 patient. Most of patients were students (22/36) 61.11%, followed by labourer (7/36) 19.46%, shopkeeper 8.33% and driver 8.33%. Most common mode of injury was sports injury 66.6% (24/36), followed by RTA 30% (11/36)

### Inclusion Criteria

- 1) Patients with established scaphoid non-union.
- 2) Patients consenting for the study.
- 3) Age group 18-60 years.

### Exclusion Criteria

- 1) Patients not consenting for the study.
- 2) Age group <18 years and > 60 years.
- 3) Fresh scaphoid fracture.
- 4) Other associated fracture, dislocation and ligament injury of the same wrist.

Final outcome assessed by using the modified Mayo wrist scoring system, Range of motion (ROM) at wrist joint, grip strength, and pain. Range of motion was measured and compared to the normal side. Level of pain assess by visual analogue scale (0-10). Pre and Post operative radiographs were assess for radiological outcome. Fracture union was defined according to the criteria described by Dias<sup>19</sup> and assessed at final follow-up from radiographs at 6 months.

### Surgical Technique and Postoperative Management

After usual antisepsis and upper limb elevation, the pneumatic tourniquet was installed. The upper limb was elevated for 5 minutes and then exsanguinated. The pneumatic tourniquet was then elevated to 250 mm Hg pressure. Painting & draping done. A 5 cm incision was carried out along the radial edge of the flexor carpi radialis and over the tip of styloid process of radius Flexor carpi radialis tendon (Figure 1, 2) and radial artery was retracted with fine dissection. The palmer joint capsule was then longitudinally divided and repaired at end of operation. The non-union site, the proximal and distal fragments and scapholunate junction were exposed. The non-union site was debrided. An oval cavity was made with use of fine osteotomes. The fibrous and sclerotic tissue was removed till fresh haemorrhagic cancellous bone was revealed with the use of fine burr.

After the preparation of scaphoid cavity, appropriate size cortical bone graft was harvested from iliac crest. The

cortical bone graft was then inserted into scaphoid cavity so as to keep the two scaphoid fragments in appropriate distraction with normal scaphoid height. After insertion of graft osteosynthesis was performed with use of two Kirschner wire (1.2 mm) which were inserted in longitudinal axis of scaphoid. The alignment of scaphoid and position of K-wire was checked clinically and radiologically. Then closure done.



**Figure 1**



**Figure 2**

The wrist was immobilized for two weeks in a below-elbow thumb spica splint with thumb in abduction. Suture remove after 2 weeks. After that, short-arm thumb spica cast was worn for an additional of eight weeks. At

postoperative 10-12 weeks, if radiographs looked satisfactory, then K-wires were removed. Patients were allowed to normal activities for daily living at 12 weeks post-operatively.

**Statistical Analysis**

All statistical analysis was performed. Descriptive statistics were reported as mean and standard deviation (SD) for continuous variables and number (and percentage where possible) for discrete assessments. A p-value of less than 0.05 was considered statistically significant.

**RESULTS**

A total of 36 patients were included the study, 35 were male and 1 was female. The mean age was 25.4 years (range 18–50). Most common site of fracture is scaphoid waist 64% (23/36), followed by proximal pole 22.22% (8/36) and distal pole 14% (5/36).

Radiological union was achieved in 32 (88.8%) of 36 patients. The mean time of achievement of Radiological union was 16.06± 2.7(range 12-22 weeks).

31(86%) of 36 cases achieved near normal (75-99% percentage of normal) range of motion (palmer flexion/dorsal flexion, radial/ulnar deviation) as compared to contralateral uninjured extremity.

100 percentage of normal grip strength achieved 5(14%) cases and 75-99 % of normal grip strength achieved in 27(75%) of 36 cases compared to contralateral uninjured extremity.

Excellent results achieved in 4 cases (11.11), Good results achieved in 21 cases (58.33%), fair results in 6 cases (17%), according to Mayo wrist scoring system.

31(86%) cases are functionally satisfied, 5(14%) cases are functionally not satisfied due to some degree of pain during working.

Range of Motion	Number
75-99% percentage of normal	31(86.11)
50-74% percentage of normal	5(13.89)
Total	36(100)

**Table 3. Distribution of the Cases according to Range of Motion**

Satisfaction	Number (%)
1. Very satisfied	12(33.33)
2. Moderately satisfied	19(52.78)
3. Not satisfied but working	5(13.89)
Total	36(100)

**Table 4. Distribution of the Cases according to Satisfaction**

Mayo Score	Number (%)
80	12(33.33)
85	8(22.22)
75	6(16.67)
95	4(11.11)
40	3(8.33)
50	2(5.56)
65	1(2.78)
Total	36(100)

**Table 5. Distribution of the Cases according to Mayo Score**

In 67% cases mayo score achieved (80 and >80), means excellent/good results achieved in these cases.

Final Result	Number (%)
1. Excellent	4(11.11)
2. Good	21(58.33)
3. Fair	6(16.67)
4. POOR	5(13.89)
Total	36(100)

**Table 6. Distribution of the Cases according to Final Result (Mayo Scoring System)**

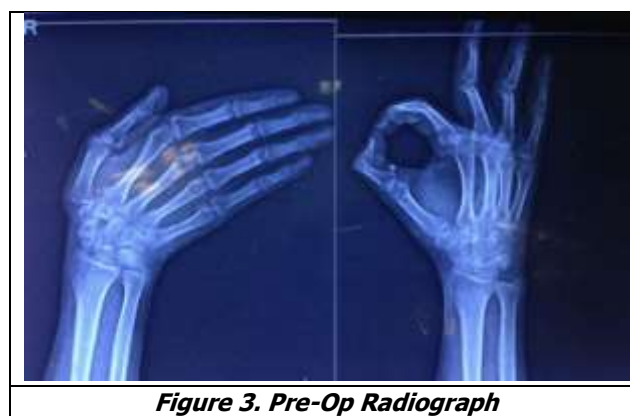
There were no intraoperative complications. Non-union after treatment was occurred in four patients. Although they complain some degree of pain and functional discomfort. Postoperatively one patient developed local infection at K-wires removal site, infection was controlled by local dressing and oral antibiotics had radiological union at an average 16 weeks duration.

Radiological Union	Number (%)
Union	32(88.89)
No Union	4(11.11)
Total	36(100)

**Table 1. Distribution of the Cases according to Radiological Union**

Radiological union (N=32)	Number (%)
12 weeks	5(15.63)
14 weeks	7(21.88)
16 weeks	9(28.13)
18 weeks	7(21.88)
20 weeks	3(9.38)
22 weeks	1(3.13)
Total	36(100)

**Table 2. Distribution of the Cases according to Radiological Union (Range, 12-22 Weeks)**







**Figure 4. Post-Op Radiograph**



**Figure 5. At 6 Months Follow-Up Radiograph**



**Figure 6. At 6 Months Follow-Up Almost Full Range of Motion**

## DISCUSSION

Non-union of scaphoid fractures can cause scaphoid non-union advanced collapse, which can lead to degenerative osteoarthritic changes in the wrist joint. Aim of the treatment of scaphoid non-unions are to achieve good healing and to correct carpal deformities so as to prevent arthritis of the wrist joint.<sup>20</sup> Nonoperative treatments include electrical or ultrasound bones stimulation combined with cast immobilization.

Surgical treatments are more effective than bone stimulation for treatment of scaphoid non-unions. Surgical management of scaphoid non-union improves wrist function and stability. This includes bony union and restoring scaphoid alignment, re-establishment of the scaphoid length which relieves pain, improves grip strength and prevents degenerative changes.<sup>21</sup>

Currently available surgical techniques include bone grafting, with or without supplementary internal fixation.

Commonly used internal fixation devices are K-wires and various compression screw. K-wires are easy to insert and remove and it provides good stability. However, K-wires are unable to provide compression at the fracture site. Along with, there is a need of prolong postoperative immobilization. Compression screws are cannulated. The cannulated screw are easy to insertion. The screw is headless, it may be buried under the articular surface, but compression screw may split the graft material or Small proximal pole fragment or can because displacement of graft. Compression devices can cause the scaphoid shortening, which can affect wrist mechanics.

Several studies give similar results between K-wires and compression screw in scaphoid non-union that show union rates ranging from 55%-97%.<sup>16-18</sup> The Union rate of scaphoid non-union treated by Kirschner wire along bone grafting was 84.6%.<sup>19</sup> Our result (88.8%) are comparable with those of other studies of both K-wire and screw.

In this study range of motion (palmer flexion/dorsal flexion, radial/ulnar deviation) of the operated wrist was compared to contralateral uninjured side, that was 31(86%) of 36 cases achieved near normal (75-99% percentage of normal), 5 patients (13.89%) achieve (50-74% of normal).

In this study Grip strength was accessed and compared to opposite hand. Most of the patients 27(75%) recovered 75-99% of normal of grip strength, 5 (14%) patients 100% of normal grip strength. 4 patients (11%) had 50-74% of normal grip strength according Mayo scoring system that are similar to results of the study "Non-union of the scaphoid fractures treated with Kirschner (K) wires and bone grafting" by Abhijeet Shroff et al<sup>22</sup> in 2013, most of the patients 19 (67%) recovered 80% or more of grip strength.

## CONCLUSION

In established scaphoid non-union, bone grafting and internal fixation with Kirschner (K) wires is a reliable and inexpensive treatment option and the results are comparable with alternative fixation methods.

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