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A comparative study of percutaneous fixation versus non-operative management in patients with acute undisplaced or minimally displaced scaphoid fractures

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Abstract

Aim: It is to compare functional outcomes between percutaneous fixation and non-operative management in patients with acute scaphoid fractures.

Materials & Methods: This study is the retrospective study which was carried out in patients with acute undisplaced or minimally displaced (<1 mm) scaphoid fractures who were admitted to department of orthopedics at civil hospital, Ahmedabad between February 2020 to February 2025. 18 patients were included in Percutaneous fixation (group A) and 10 patients were included in non-operative management by a scaphoid cast (group B). Time to union and time to return to work were compared and at 12 months' follow-up range of motion (ROM), pain and overall wrist function was evaluated by Visual analogue score (VAS) and the Mayo modified wrist score (MMWS).

Results: Radiographically mean time to union (SD) in weeks was 6.12(0.67) in group A and 10.3(1.1) in group B (p=0.001). Mean time return to work (SD) in weeks was 5.8(1.4) in group A and 12.5(2.9) in group B (p=0.002). At 12 months' follow-up Mean VAS was 1.8 in group A and 1.6 in group B (p=0.3). At 12 months' follow-up Mean MMWS(SD) for group A was 98.23(4.1) and for group B was 86.9(8.5) with p=0.03.

Conclusion: Percutaneous fixation of undisplaced and minimally displaced scaphoid fractures provides more satisfied wrist function and early return to work as compared to non-operative by using a cast at 12 months' follow-up.

Keywords: Scaphoid fracture, percutaneous fixation, non-operative management

Introduction

The scaphoid bone plays a very important role in the wrist joint function. In the wrist, most common carpal bone fracture is scaphoid fracture. Scaphoid fracture is notorious to go into non-union and leads to AVN (avascular necrosis) with ultimately progresses to arthritis of scapho-radial joint. There is a study which have shown that waist is most common fracture site of scaphoid bone around 95% of total scaphoid fracture and around one-third from these are undisplaced fractures^[1]. Over the years diagnosis and treatment of scaphoid fractures has been still unsolved dilemma.

Acute undisplaced or minimally displaced scaphoid fractures are common carpal injuries, frequently occurring in relatively younger and active individuals. FOOSH (Fall on an outstretched hand) is the main mechanism of injury^[2]. Typically fracture gap is less than 1mm and anatomical alignment is maintained in these fractures^[3]. The scaphoid has retrograde blood supply which is derived mainly from the radial artery, renders it vulnerable to non-union and avascular necrosis, particularly when fractures occur at the proximal pole^[4]. Therefore, accurate diagnosis and appropriate treatment are crucial to prevent complications and preserve wrist function. Management of acute undisplaced or minimally displaced scaphoid fractures can be broadly categorized into operative and non-operative approaches. Non-operative management typically involves a scaphoid cast with immobilization up to 6 to 12 weeks, depending on the healing response and fracture location^[5]. This approach has historically been favoured due to its non-invasive nature and satisfactory union rates in stable fractures^[6]. However, prolonged immobilization can result in wrist stiffness, muscle atrophy, and delayed return to normal activities^[7].

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Operative management, on the other hand, involves internal fixation using percutaneous or open techniques, often employing headless compression screws for stabilization [8]. Surgical intervention is gaining popularity even in minimally displaced fractures due to faster union rates and earlier functional recovery [9]. Recent studies have demonstrated that operative management significantly reduces the time to union and allows for earlier mobilization compared to non-operative treatment [10]. Nevertheless, surgical risks include infection, neurovascular injury, and hardware complications, which must be carefully weighed against potential benefits [11]. The aim of our study was to compare the functional outcomes of percutaneous fixation management for acute undisplaced or minimally displaced scaphoid fractures with nonoperative management.

Materials and Method

Study Design: A retrospective case-control clinical study was conducted from medical records over the period of February 2020 to February 2025 in patients with a confirmed acute undisplaced or minimally displaced scaphoid fractures who were admitted in Department of Orthopedics, Civil Hospital, Ahmedabad-380016.

Study Groups

Group A: Percutaneous Fixation Group

Inclusion criteria

- Patients managed by percutaneous fixation using a cannulated compressive headless screw
- Skeletally mature bone
- Isolated, acute (i.e. gap between injury and management is less than 2 weeks) and radiologically confirmed undisplaced and minimally displaced (i.e. fracture gap is less than 1mm and anatomical alignment is maintained) scaphoid fractures
- Patients who were adherent to rehabilitation exercises for one year
- Radiologically confirmed union

Exclusion criteria

- Patients treated with open surgical techniques
- Patients who have fractures of bilateral hand or missing one hand
- Radiological signs of displaced, comminuted or carpal bones instability
- Open fractures.
- Patients who already have arthritis of wrist joint
- Patients who have past history of trauma to same wrist
- Patients with incomplete records

Group B: Non-Operative Group

Inclusion criteria

- Patients managed by non-operatively by giving a Scaphoid cast
- Skeletally mature bone
- Isolated, acute (i.e. gap between injury and management is less than 2 weeks) and radiologically confirmed undisplaced and minimally displaced (i.e. fracture gap is less than 1mm and anatomical alignment is maintained) scaphoid fractures.
- Patients who were adherent to rehabilitation exercises for

one year

- Patients with radiologically confirmed union

Exclusion criteria

- Radiological signs of displaced, comminuted or carpal bones instability
- Patients who have fractures of bilateral hand or missing one hand
- Open fractures
- Patients who already have arthritis of wrist joint
- Patients who have past history of trauma to same wrist
- Patients with incomplete records

In this study, we compared data from 12 months' follow-up between both groups. We evaluated wrist joint range of motion (ROM), patients' pain, hand grip strength and overall satisfaction using Mayo Modified Wrist Score (MMWS) and Visual Analogue Scale (VAS). We also compared the time to return to work between both groups.

Group A

In Initial research it is noticed that total 30 patients were operated for acute undisplaced or minimally displaced scaphoid fractures in our department between February 2020 to February 2025. Out of 30, eighteen patients fulfilled our criteria for percutaneous fixation group (A). Mean age was 28.2 years (standard deviation [SD] 10.2, range 18-49), There was 13 males and 5 females. Out of 18 patients' dominant hand was injured in 10 males and 3 females. Sixteen out of eighteen patients had scaphoid waist fracture, while rest two had fracture in proximal pole of scaphoid bone. No patients had any medical comorbidities. Percutaneous fixation using a cannulated compressive headless screw within a week of injury was done in all patients. In post-op short arm cast was given to all patients for two weeks followed by rehabilitation was started at end of two week by physiotherapist. Regular follow-up at 6 weeks', 3 months', 6 months', 12 months was done for clinico-radiological evaluation and any complication. Mean follow-up period (SD) in months was 46.5 (22.8).

Group B

In Initial research it is noticed that total 45 patients were managed non-operatively for acute undisplaced or minimally displaced scaphoid fractures in our department between February 2020 to February 2025. Out of 45, ten patients fulfilled our criteria for non-operative group (A). Mean age was 32.1 years (standard deviation [SD] 10.1, range 18-49), There was 5 males and 5 females. Out of 10 patients' dominant hand was injured in 4 males and 4 females. All patients had scaphoid waist fracture. No patients had any medical comorbidities. All patients were given a scaphoid cast for six to twelve weeks until radiologically confirmed union. After that cast was removed and physiotherapy was given for a one month. Regular follow-up at 6 weeks', 3 months', 6 months', 12 months was done for clinico-radiological evaluation and any complication. Mean follow-up period (SD) in months was 30.9 (16.9).

Statistic

The analysis was done using descriptive statistics and student t-test for independent samples.

Table 1: Comparison of demographics and functional outcomes between percutaneous fixation and non-operative management groups in acute scaphoid fractures

	Percutaneous Fixation Group (A)	Non-Operative Group (B)	Significance
Mean Age in years (SD)	28.2(10.2)	32.1(10.1)	p = 0.2
Gender (male/females)	13 / 5	5 / 5	n/a
Dominant Hand	13	8	n/a
Mean Range of Motion (SD)	119.6(3.2)	116.8(4.4)	p = 0.28
Mean VAS	1.8	1.6	p = 0.3
Mean MMWS (SD)	98.23(4.1)	86.9(8.5)	p = 0.03
Mean time to union in weeks (SD)	6.12(0.67)	10.3(1.1)	p = 0.001
Mean time return to work in weeks (SD)	5.8(1.4)	12.5(2.9)	p = 0.002

SD, standard deviation; p<0.05, statistically significant difference; MMWS, Mayo modified wrist score; VAS, visual analogue scale; n/a, not applicable

Results

In terms of age, gender and dominance there is no statistical significance between groups. The mean time to union radiographically was 6.12 weeks with SD of 0.67, range 5-7 weeks in group A while in group B it was 10.3 weeks with SD of 1.1, range 9-12 weeks with p value = 0.001 means statistically significant difference. The mean time return to work was 5.8 weeks with SD of 1.4, range 4-8 weeks in group A while in group B it was 12.5 weeks with SD of 2.9, range 9-15 weeks with p value = 0.002 means statistically significant difference. At 12 months' follow-up mean ROM(SD) was 119.6(3.2) in group A and 116.8(4.4) in group B with no statistical significance (p = 0.28). Mean VAS for group A was 1.8 and for group B was 1.6 with no statistical significance (p = 0.3). Mean MMWS(SD) for group A was 98.23(4.1) and group B was 86.9(8.5) with statistically significant (p=0.03). There were no complications like infection, malunion, non-union or implant failure in either group.



Fig 1: X-rays of anteroposterior (ap) and lateral (lat) images of 22 years old female with fracture of the waist of scaphoid right side.



Fig 2: Post-op immediate x-rays of 22 years old female with fracture of the waist of scaphoid right side treated with a cannulated compressive headless screw via percutaneous approach



Fig 3: X-ray at 12 months follow-up 22 years old female with fracture of the waist of scaphoid right side treated with a cannulated compressive headless screw via percutaneous approach showing complete union



Fig 4: X-rays of anteroposterior (ap) and lateral (lat) images of 25 years old male with fracture of the waist of scaphoid left side.



Fig 5: X-ray 25 years old male with fracture of the waist of scaphoid left side with a scaphoid cast



Fig 6: X-ray of post cast removal at 6 weeks of 25 years old male with fracture of the waist of scaphoid left side showing signs of union



Fig 7: X-ray at 12 months follow-up of 25 years old male with fracture of the waist of scaphoid left side treated with a scaphoid cast for 6 weeks with complete union

Discussion

Although over the decades cast mobilization had been treatment of choice in undisplaced and minimally displaced fractures but there are some disadvantages. Joint stiffness, longer period of immobilization and time to return to work are the main disadvantages. In some cases, immobilization may need for almost 3 months, so lesser patient compliance is also seen. Even in presence of minor symptoms, patients have discarded cast early which leads to non-union or delayed union [12]. On other hand, percutaneous fixation which allows early mobilization of joint and lesser time to return to work is done with aim of reducing damage to blood supply and soft tissue. It can be done via two approaches: volar and dorsal. Former has easier access, better clinical outcomes and less complication [13].

In the study, time to return work between groups was the most important difference, favouring the percutaneous fixation group. In percutaneous fixation group time to return to work was 4-8 weeks which is significantly lower as compared to conservative group in which time to return to work 9-15 weeks. Bond *et al* in randomized prospective study done in military personnel found that 11 patients treated with percutaneous fixation time to return work was 8 weeks as compared to age matched conservatively managed whose time to return to was around 15 weeks [14]. McQueen *et al* in randomized controlled study reported that 26 patients treated with percutaneous fixation fractures returned to work at the mean of 3.8 weeks, while in Conservative group it was the mean of 11.4 weeks [15]. A recent meta-analysis of 376 patients, examining the outcomes of nonsurgical management versus exclusively percutaneous fixation of minimally and nondisplaced scaphoid fractures showed, similarly to our results [16].

There is no statistical difference in mean ROM of wrist joint between both groups at 12 months' follow-up. The Mayo modified wrist score (MMWS) shows comparison with unaffected side and involves pain perception. The MMWS was statistically significant higher in percutaneous fixation group as compared to non-operative management group. There also many studies and meta-analysis which also found that there is difference in ROM of wrist joint in operated and conservative patients at 1 year and later follow-ups [15, 17-20]. There is vulnerability of observer bias during measurements of outcomes. So, results should be analysed in caution. Measurement of patient satisfaction with treatment cannot be assessed on outcomes of ROM and grip strength [18].

In terms of complications, a meta-analysis of six RCT studies shows no statistical significance in operated and non-operated groups [17]. The complications assessed were malunion, non-unions, osteoarthritis and implant failure for which further surgery is required. So, screw fixation was unaccepted by many patients which is also shown in meta-analysis [17,18].

This study also has its own limitation due to the methodology, such as dependent of records, relatively a smaller number of cases in both groups, selection bias, observer bias. Results of this study also supports already published papers, research and studies.

Conclusion

Percutaneous fixation of undisplaced and minimally displaced scaphoid fractures provides more satisfied wrist function and early return to work as compared to non-operative by using a cast at 12 months' follow-up.

Conflict of Interest

Not available.

Financial Support

Not available.

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