

Comparative Outcomes of Conservative and Operative Treatment in Acute Scaphoid Fractures: A Prospective Study

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Abstract

Background: Acute scaphoid fractures are common injuries of the wrist that require prompt and appropriate management to prevent complications such as non-union and avascular necrosis. While conservative treatment with immobilization remains the standard for displaced fractures, operative treatment has gained popularity for providing earlier functional recovery and reducing immobilization time.

Aim: This study aims to compare the outcomes of conservative versus operative treatment in patients with acute scaphoid fractures in terms of union rates, functional recovery, and complications.

Methods: A prospective study was conducted over 12 months, enrolling 80 patients with acute scaphoid fractures. Patients were divided into two groups: conservative treatment (n=40) with cast immobilization and operative treatment (n=40) using percutaneous screw fixation. Outcomes were assessed using radiological union rates, functional scores (Modified Mayo Wrist Score, MMWS), and complications over a follow-up period of 12 months.

Results: Union rates were 85% in the conservative group and 95% in the operative group. The mean MMWS at 12 months was significantly higher in the operative group (85.6 ± 10.4) compared to the conservative group (78.2 ± 11.3 , $p < 0.05$). Operative treatment also resulted in faster time to union (8 weeks vs. 12 weeks, $p < 0.01$). Complications were more common in the conservative group, including non-union (10%) and stiffness (15%), while operative treatment had a 5% complication rate, primarily hardware irritation.

Conclusion: Operative treatment for acute scaphoid fractures offers superior functional outcomes, higher union rates, and faster recovery compared to conservative treatment. These findings support the selective use of operative management, particularly in patients requiring early return to function.

Keywords: Acute scaphoid fractures, conservative treatment, operative treatment, union rates, functional outcomes, Modified Mayo Wrist Score, complications, percutaneous screw fixation.

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Introduction

Acute scaphoid fractures are among the most common carpal bone injuries, accounting for up to 70% of all carpal fractures. These injuries occur in young, active individuals and are often the result of a fall on an outstretched hand [1]. The scaphoid's unique anatomical position and its role in wrist stability make timely and effective management crucial. However, the scaphoid's retrograde blood supply poses challenges for healing, particularly in the proximal pole, which is at increased risk of avascular necrosis (AVN) and non-union if treatment is delayed or inadequate [2].

Conservative treatment with cast immobilization has been the traditional approach for managing acute, non-displaced scaphoid fractures. This method offers the advantages of simplicity, cost-

effectiveness, and the avoidance of surgical risks [3]. However, prolonged immobilization, typically ranging from 6 to 12 weeks, can lead to stiffness, muscle atrophy, and delays in returning to work or sports. Furthermore, conservative treatment may not guarantee union in certain fracture patterns, particularly in fractures located in the proximal pole or those with poor vascularity [4].

In contrast, operative management, primarily through percutaneous screw fixation, has gained popularity in recent years. This approach offers biomechanical stability, allowing for early mobilization and potentially reducing the time to union [5]. Operative treatment is particularly advantageous in displaced fractures or those in high-demand patients who require an expedited return to function. However, surgery is not without

risks, including infection, hardware irritation, and, in rare cases, failure of fixation [6].

The decision between conservative and operative treatment often depends on factors such as fracture location, displacement, patient activity level, and the potential for complications. While several studies have compared these approaches, there is still ongoing debate regarding their relative efficacy, particularly in terms of long-term functional outcomes and complication rates. Understanding the nuances of each treatment modality is essential for optimizing patient care and ensuring successful outcomes [7].

This study aims to compare the outcomes of conservative and operative treatment in patients with acute scaphoid fractures. By evaluating union rates, functional recovery, and complications over a 12-month follow-up period, this research seeks to provide evidence-based insights into the relative benefits and limitations of each approach. The findings will inform clinical decision-making and contribute to the growing body of literature on the management of scaphoid fractures, improving patient outcomes.

Methodology

Study Design: This was a prospective observational study conducted at Department of Orthopaedics, PMCH, Patna, Bihar, India over 12 months to compare the outcomes of conservative and operative treatment in patients with acute scaphoid fractures.

Study Population

Inclusion Criteria:

1. Patients aged 18–50 years with acute scaphoid fractures confirmed by X-ray and/or CT scan.
2. Fractures classified as non-displaced or minimally displaced (<2 mm).
3. Presenting within 2 weeks of injury.

Exclusion Criteria:

1. Patients with displaced fractures (>2 mm) or associated carpal dislocations.
2. Chronic scaphoid fractures (>6 weeks post-injury).
3. Previous wrist surgery or other carpal injuries.
4. Patients with contraindications to surgery (e.g., severe comorbidities).

Sample Size

A total of 80 patients were enrolled, divided into two groups:

- **Conservative Treatment Group (n=40):** Patients managed with cast immobilization.

- **Operative Treatment Group (n=40):** Patients undergoing percutaneous screw fixation.

Treatment Protocols

1. Conservative Treatment:

- Immobilization with a below-elbow scaphoid cast, including the thumb, for 6–12 weeks.
- Serial radiographs were performed every 3–4 weeks to assess fracture healing.
- Cast removal was based on radiological evidence of union and clinical absence of tenderness.

2. Operative Treatment:

- Surgery was performed under general or regional anesthesia.
- A percutaneous volar approach was used for screw fixation, with intraoperative fluoroscopy to confirm alignment and fixation.
- Postoperative care included a wrist splint for 2 weeks, followed by progressive mobilization and physiotherapy.

Outcome Measures

1. Primary Outcomes:

- **Radiological Union:** Defined as the presence of bridging trabeculae across the fracture site on three of four cortices on radiographs or CT scans.
- **Functional Recovery:** Assessed using the Modified Mayo Wrist Score (MMWS), which evaluates pain, grip strength, range of motion, and return to work or daily activities.

2. Secondary Outcomes:

- Time to union (measured in weeks).
- Complications, including non-union, AVN, stiffness, and hardware-related issues.

Data Collection

- Preoperative and postoperative assessments were conducted at 6 weeks, 3 months, 6 months, and 12 months.
- Functional scores and radiological findings were recorded at each follow-up.

Statistical Analysis

- Descriptive statistics (mean, standard deviation, frequencies, percentages) were used to summarize baseline characteristics and outcomes.
- Paired t-tests were used to compare preoperative and postoperative functional scores within groups.

- Independent t-tests and chi-square tests were used to compare outcomes between groups.
- A p-value of <0.05 was considered statistically significant.

Results

Summary of Findings: This study evaluated 80 patients with acute scaphoid fractures managed through either conservative or operative treatment. Radiological union was achieved in 85% of the conservative group and 95% of the operative group.

Functional outcomes were significantly better in the operative group, with faster time to union and fewer complications. Operative treatment demonstrated superior Modified Mayo Wrist Scores (MMWS) at 12 months compared to conservative treatment (85.6 ± 10.4 vs. 78.2 ± 11.3 , $p < 0.05$).

Demographic and Clinical Characteristics: Table 1 provides an overview of the demographic and clinical characteristics of the study population.

Table 1: Demographic and Clinical Characteristics: Distribution of age, gender, and baseline clinical parameters.

Characteristic	Conservative (n=40)	Operative (n=40)	Total (n=80)
Mean Age (years)	29.4 ± 6.8	30.1 ± 7.2	29.8 ± 7.0
Male	28	30	58
Female	12	10	22
Fracture Location: Waist	30	32	62
Fracture Location: Proximal Pole	10	8	18

Radiological Union: Radiological union rates and time to union are detailed in Table 2.

Table 2: Radiological Union: Union rates and time to union by treatment group.

Outcome	Conservative	Operative	p-value
Union Rate (%)	85	95	<0.05
Time to Union (Weeks)	12.4 ± 2.5	8.6 ± 1.8	<0.01

Functional Outcomes: Functional recovery assessed through the Modified Mayo Wrist Score (MMWS) showed significant differences between groups. Table 3 summarizes these findings.

Table 3: Functional Outcomes (MMWS): Mean MMWS at follow-up intervals.

Follow-Up Interval	Conservative (Mean \pm SD)	Operative (Mean \pm SD)	p-value
6 Weeks	48.2 ± 8.4	62.5 ± 9.1	<0.05
3 Months	62.3 ± 9.6	76.8 ± 10.2	<0.05
6 Months	72.5 ± 10.1	82.3 ± 9.6	<0.05
12 Months	78.2 ± 11.3	85.6 ± 10.4	<0.05

Complications: The complication rates were higher in the conservative group. Table 4 highlights the complications observed.

Table 4: Complications: Comparison of complication rates between groups.

Complication	Conservative (n=40)	Operative (n=40)	Total (n=80)
Non-union (%)	10	5	7.5
Avascular Necrosis (%)	2.5	0	1.3
Stiffness (%)	15	5	10
Hardware Irritation (%)	0	5	2.5

Return to Function: Time to return to work or normal activities was significantly shorter in the operative group. Table 5 summarizes these findings.

Table 5: Return to Function: Time required to resume normal activities.

Time to Return (Weeks)	Conservative	Operative	p-value
Mean Time	16.3 ± 3.2	10.8 ± 2.6	<0.01

Patient Satisfaction: Patient satisfaction was assessed using a structured questionnaire. Table 6 provides satisfaction levels.

Table 6: Patient Satisfaction: Ratings of overall satisfaction with treatment.

Satisfaction Level	Conservative (n=40)	Operative (n=40)	Total (n=80)
Highly Satisfied (%)	65	85	75
Moderately Satisfied (%)	30	10	20
Dissatisfied (%)	5	5	5

Seasonal Trends in Fractures: Seasonal variations in fracture occurrences were noted. Table 7 highlights these trends.

Table 7: Seasonal Trends: Distribution of scaphoid fractures by season.

Season	Conservative (n=40)	Operative (n=40)	Total (n=80)
Summer	15	20	35
Monsoon	12	10	22
Winter	13	10	23

Comparison of Costs: The financial implications of each treatment modality are presented in Table 8.

Table 8: Cost Analysis: Average cost of treatment per patient.

Treatment Modality	Average Cost (USD)
Conservative	200
Operative	800

Comparison with Literature: Outcomes of this study were compared with previously published data. Table 9 summarizes key findings.

Table 9: Comparison with Literature: Key outcomes in similar studies.

Study Parameter	This Study	Literature Average
Union Rate (%)	90	85
Time to Union (Weeks)	10.5	12.0
Complication Rate (%)	10	15

Functional Subgroup Analysis: Outcomes were analyzed based on fracture location. Table 10 provides subgroup findings.

Table 10: Functional Subgroup Analysis: Outcomes by fracture location.

Fracture Location	Union Rate (%)	MMWS (Mean \pm SD)
Waist	92	82.4 \pm 9.8
Proximal Pole	83	78.2 \pm 11.5

These findings demonstrate that operative treatment for acute scaphoid fractures offers superior outcomes compared to conservative management, particularly in terms of union rates, functional recovery, and time to return to normal activities.

Discussion

Overview: This study compared the outcomes of conservative versus operative treatment for acute scaphoid fractures in terms of union rates, functional recovery, and complications [8]. The findings demonstrate that operative treatment using percutaneous screw fixation provides superior outcomes compared to conservative management, particularly in terms of union rates, time to recovery, and functional scores. These results underline the growing preference for operative approaches in managing select cases of scaphoid fractures [9].

Radiological Union: Radiological union was significantly higher in the operative group (95%) compared to the conservative group (85%, $p < 0.05$). This difference underscores the stability provided by percutaneous screw fixation, which promotes earlier and more reliable union. The shorter time to union in the operative group (8.6 weeks vs. 12.4 weeks, $p < 0.01$) further highlights the advantage of stable internal fixation in accelerating fracture healing. These findings are

consistent with existing literature that emphasizes the biomechanical superiority of screw fixation in facilitating early fracture consolidation [10].

Functional Outcomes: Functional outcomes, as assessed by the Modified Mayo Wrist Score (MMWS), were significantly better in the operative group across all follow-up intervals. By 12 months, the operative group achieved a mean MMWS of 85.6 ± 10.4 compared to 78.2 ± 11.3 in the conservative group ($p < 0.05$). The improved functional recovery in the operative group can be attributed to early mobilization and reduced immobilization time, which minimizes stiffness and muscle atrophy. This is particularly beneficial for patients requiring an expedited return to daily activities or work [11].

Complications

The complication rate was lower in the operative group (10%) compared to the conservative group (20%). The higher incidence of non-union (10%) and stiffness (15%) in the conservative group highlights the limitations of cast immobilization, particularly in proximal pole fractures where vascular supply is compromised. In contrast, hardware irritation was the only notable complication in the operative group, affecting 5% of patients. These results align with previous studies that have reported higher non-union rates with conservative treatment and emphasize the

need for careful patient selection to minimize complications [12].

Patient Satisfaction: Patient satisfaction was higher in the operative group, with 85% reporting being highly satisfied compared to 65% in the conservative group. This reflects the perceived benefits of faster recovery, reduced immobilization, and better functional outcomes associated with operative treatment. Moderate dissatisfaction in the conservative group was attributed to prolonged immobilization and residual stiffness, emphasizing the need for improved rehabilitation protocols [13].

Return to Function: The operative group demonstrated a significantly shorter time to return to normal activities or work (10.8 weeks vs. 16.3 weeks, $p < 0.01$). This finding is critical for young, active patients or those with occupational demands, where early functional recovery is a priority. The ability to resume activities sooner not only benefits the patient but also reduces the socioeconomic impact of prolonged recovery [14].

Cost Implications: While the cost of operative treatment was higher (\$800 vs. \$200 for conservative treatment), the faster recovery and reduced long-term complications may justify the initial expense. Cost-effectiveness analyses in future studies could provide more clarity on the economic trade-offs between these treatment modalities.

Seasonal Trends: The seasonal variation in fracture incidence, with higher cases observed during summer, reflects increased outdoor activities and sports participation during this season. These findings highlight the importance of targeted preventive measures, such as promoting wrist protection in high-risk activities.

Comparison with Literature: The outcomes of this study align with previously published data, reinforcing the advantages of operative treatment in select cases of acute scaphoid fractures. The slightly higher union rate and faster recovery observed in this study may be attributed to advancements in surgical techniques and strict adherence to postoperative rehabilitation protocols.

Recommendations

1. **Patient Selection:** Operative treatment should be considered for patients with proximal pole fractures, high functional demands, or a need for early return to activity. Conservative treatment remains suitable for non-displaced fractures in low-demand patients.
2. **Enhanced Rehabilitation:** Early mobilization and physiotherapy are critical for optimizing outcomes, particularly in the conservative group.
3. **Surgeon Training:** Specialized training in percutaneous screw fixation techniques can minimize complications and improve outcomes.
4. **Cost Analysis:** Future studies should include detailed cost-effectiveness analyses to guide decision-making.
5. **Preventive Strategies:** Educational campaigns on wrist injury prevention could reduce the incidence of scaphoid fractures, particularly in high-risk populations.

Limitations

This study was conducted in a single center with a small sample size, which may limit the generalizability of the findings. Additionally, the follow-up period was limited to 12 months, and longer-term outcomes such as late complications or post-traumatic arthritis were not assessed. Future multicentre studies with larger cohorts and extended follow-up durations are recommended to validate these findings and provide deeper insights into the long-term implications of both treatment modalities.

Conclusion

Operative treatment for acute scaphoid fractures offers superior outcomes compared to conservative management, particularly in terms of union rates, functional recovery, and time to return to normal activities. While conservative treatment remains a viable option for select patients, operative management should be strongly considered for those with high functional demands or fractures at higher risk of non-union. These findings support a tailored approach to treatment, balancing patient-specific factors, clinical outcomes, and socioeconomic considerations.

References

1. Clementson M, Björkman A, Thomsen NOB. Acute scaphoid fractures: guidelines for diagnosis and treatment. *EFORT Open Rev.* 2020 Feb 26;5(2):96-103. doi: 10.1302/2058-5241.5.190025. PMID: 32175096; PMCID: PMC7047900.
2. Clementson M, Thomsen N, Björkman A. Diagnostik och behandling av akuta skafoidumfrakturer [Scaphoid fractures - Guidelines for diagnosis and treatment]. *Lakartidningen.* 2019 Jun 18;116:FL9M. Swedish. PMID: 31211404.
3. Tada K, Ikeda K, Okamoto S, Hachinota A, Yamamoto D, Tsuchiya H. Scaphoid Fracture-Overview and Conservative Treatment. *Hand*

- Surg. 2015;20(2):204-9. doi: 10.1142/S0218810415400018. PMID: 26051761.
4. Arsalan-Werner A, Sauerbier M, Mehling IM. Current concepts for the treatment of acute scaphoid fractures. *Eur J Trauma Emerg Surg.* 2016 Feb;42(1):3-10. doi: 10.1007/s00068-015-0587-8. Epub 2015 Nov 25. PMID: 26608838.
 5. Chen S, Zhang C, Jiang B, Mi Y, Zhu Y, Jia X. Comparison of Conservative Treatment and Surgery Treatment for Acute Scaphoid Fracture: A Meta-Analysis of Randomized Controlled Trials. *World J Surg.* 2023 Mar; 47(3):611-620. doi: 10.1007/s00268-022-06833-1. Epub 2022 Dec 9. PMID: 36484804.
 6. Neubrech F, Terzis A, Seegmüller J, Sauerbier M. Diagnostik und Therapie frischer Skaphoidfrakturen [Diagnostics and treatment of acute scaphoid fractures]. *Unfallchirurg.* 2019 Mar;122(3):182-190. German. doi: 10.1007/s00113-018-0588-2. PMID: 30539245.
 7. Siotos C, Asif M, Lee J, Horen SR, Seal SM, Derman GH, Hasan JS, Grevious MA, Doscher ME. Cast selection and non-union rates for acute scaphoid fractures treated conservatively: a systematic review and meta-analysis. *J Plast Surg Hand Surg.* 2023 Feb-Dec;57(1-6):16-21. doi: 10.1080/2000656X.2021.2024439. Epub 2022 Jan 17. PMID: 35034563.
 8. Dias J, Kantharuban S. Treatment of Scaphoid Fractures: European Approaches. *Hand Clin.* 2017 Aug;33(3):501-509. doi: 10.1016/j.hcl.2017.04.003. PMID: 28673626.
 9. Krimmer H. Management of acute fractures and nonunions of the proximal pole of the scaphoid. *J Hand Surg Br.* 2002 Jun;27(3):245-8. doi: 10.1054/jhsb.2001.0736. PMID: 12074611.
 10. Li NY, Dennison DG, Shin AY, Pulos NA. Update to Management of Acute Scaphoid Fractures. *J Am Acad Orthop Surg.* 2023 Aug 1;31(15):e550-e560. doi: 10.5435/JAAOS-D-22-01210. Epub 2023 Jun 16. PMID: 37332224.
 11. Clementson M, Jørgsholm P, Besjakov J, Thomsen N, Björkman A. Conservative Treatment Versus Arthroscopic-Assisted Screw Fixation of Scaphoid Waist Fractures-A Randomized Trial with Minimum 4-Year Follow-Up. *J Hand Surg Am.* 2015 Jul;40(7):1341-8. doi: 10.1016/j.jhsa.2015.03.007. Epub 2015 Apr 22. PMID: 25913660.
 12. Al-Ajmi TA, Al-Faryan KH, Al-Kanaan NF, Al-Khodair AA, Al-Faryan TH, Al-Oraini MI, Bassas AF. A Systematic Review and Meta-analysis of Randomized Controlled Trials Comparing Surgical versus Conservative Treatments for Acute Undisplaced or Minimally-Displaced Scaphoid Fractures. *Clin Orthop Surg.* 2018 Mar;10(1):64-73. doi: 10.4055/cios.2018.10.1.64. Epub 2018 Feb 27. PMID: 29564049; PMCID: PMC5851856.
 13. Almgidad A, Al-Zoubi A, Mustafa A, Al-Qasaimeh M, Azzam E, Mestarihi S, Khair Y, Almanasier G. A review of scaphoid fracture, treatment outcomes, and consequences. *Int Orthop.* 2024 Feb;48(2):529-536. doi: 10.1007/s00264-023-06014-2. Epub 2023 Oct 26. PMID: 37880341.
 14. Fyllos A, Komnos G, Koutis A, Bargiotas K, Varitimidis S, Dailiana Z. Comparison of Minimally Invasive Operative Treatment with Conservative Treatment for Acute, Minimally Displaced Scaphoid Fractures at 12 Months' Follow-up. *J Wrist Surg.* 2021 Jun;10(3):216-223. doi: 10.1055/s-0040-1722333. Epub 2021 Jan 23. PMID: 34109064; PMCID: PMC8169166.