# Efficacy of Percutaneous Herbert screw fixation for treating delayed union and nonunion of the Scaphoid.

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## ABSTRACT

**Objective:** To determine the radiological outcome of percutaneous Herbert screw fixation in delayed union and nonunion of the Scaphoid.

**Methods:** This descriptive study was conducted in National orthopedic and General Hospital Bahawalpur from 20th February 2018 to 20th March 2022.All adults patients with Scaphoid delayed union and non fulfilling the inclusion criteria were treated with percutaneous Herbert screw fixation without bone grafting. Post operative radiographic union was determined at five months.

**Results:** The data of 9 patients fixed with percutaneous Herbert screw fixation were analyzed. All patients were male with mean age of 26±5 years. Delayed union was present in 5(55.55%) patients and non union in 4(44.44%). All fractures achieved radiological union in 15.5±4.2 weeks. Postoperative wrist stiffness was noted in 2(22.22%) patients and was treated with physical therapy. No patient required revision surgery.

**Conclusion:** Delayed union and nonunion of the Scaphoid can be treated successfully with Percutaneous Herbert screw fixation as shown by excellent radiological union in all of our cases.

**Keywords:** Delayed Union, Herbert screw, Nonunion, Percutaneous fixation, Scaphoid fracture.

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## INTRODUCTION

Fracture of the Scaphoid is the most common wrist fracture after distal radius fractures and accounts for about 60 to 70% of all the wrist fractures.[1] The mechanism of injury is usually hyperextension injury resulting from sports injury or fall on the outstretched hand.[2] The overall incidence of Scaphoid nonunion varies between 5% and 25% and the most common site of nonunion is the proximal pole Scaphoid fracture.1 Although treatment of the acute Scaphoid fractures is quite clear several factors however, affect the decision of treating Scaphoid delayed unions and nonunion such as fracture site, amount of bone loss, extent of deformity, vascularity of the fragments, presence of arthritis, age of the patient, activity level and pain.[2] Usually Scaphoid nonunion is treated with open reduction and internal fixation with or without vascularized or non-vascularized bone grafting.[3,4] However, selected cases of minimally displaced and undisplaced Scaphoid delayed union and non-union can be managed successfully with percutaneous Herbert screw fixation alone. This technique has several advantages over the open technique like early functional recovery, less scarring and less morbidity.[5,6]

The objective of our study was to determine the radiological outcome of percutaneous Herbert screw fixation in delayed union and nonunion of the Scaphoid.We postulated that percutaneous drilling and wiring of the Scaphoid delayed union and nonunion improves blood flow to the sclerotic nonunion surface that enhances the healing process thus avoids open reduction and bone grafting.

## METHODS

We conducted this descriptive study in National orthopedic and General Hospital Bahawalpur from 20th February 2018 to 20th March 2022.All adults patients with wrist pain undisplaced/minimally displaced Scaphoid fracture resulting in delayed union and non union(≥ 24 weeks duration)[1,7] with radiographic sclerosis and failure of the conservative treatment were included in this study. All those patients with humpback deformity, previous surgery, Dorsal Intercalated Segment Instability (DISI), osteonecrosis and osteoarthritis were excluded from our study.The study was approved by the Institutional Review Board of our hospital.Informed written consent was taken from all study participants. Complete history was taken.Physcal examination was carried out. Relevant radiological investigations(xrays/MRI wrist) and laboratory investigations were done in all patients.

**Surgical Technique**

All the surgeries were performed under general anesthesia and tourniquet control. A standard uniform surgical technique was adopted in all cases.All the surgeries were performed by the same surgical team. In cases where volar approach was utilized the guide wire was inserted through the base of the thenar eminence under image control with wrist in slight extension. After the ideal guide wire position was confirmed cannulated drill was used to drill and then appropriate size Herbert screw was inserted.(Fig.I) For dorsal approach a guide wire was inserted from the proximal Scaphoid pole using fluoroscopic control and was guided down the scaphoid central axis towards the thumb base from dorsal to volar position. The wrist was kept in flexion to avoid bending of the wire. A small incision was made before drilling to ensure safety of the extensor tendons. After screw insertion wrist was mobilized in full range of motion to confirm complete burial of screw in scaphoid. Thumb Spica cast was applied after surgery. The patients were discharged the next day and followed up after 02 weeks initially and then monthly therafter till union was achieved. The Spica cast was removed after 06 weeks in delayed union and after 10 weeks in nonunion. Post-operative range of motion exercise regimen was started after the removal of cast. In each follow up visit radiographic union was assessed by observing disappearance of fracture lines along with crossing trabeculae on all three Scaphoid radiological views.[8,9]

We analysed our data with SPSS software version 25.0. Mean and standard deviation was calculated for quantitative variables like age, time to surgery and time to union. Frequency and percentage was calculated for qualitative variables. Data was presented in table where necessary.

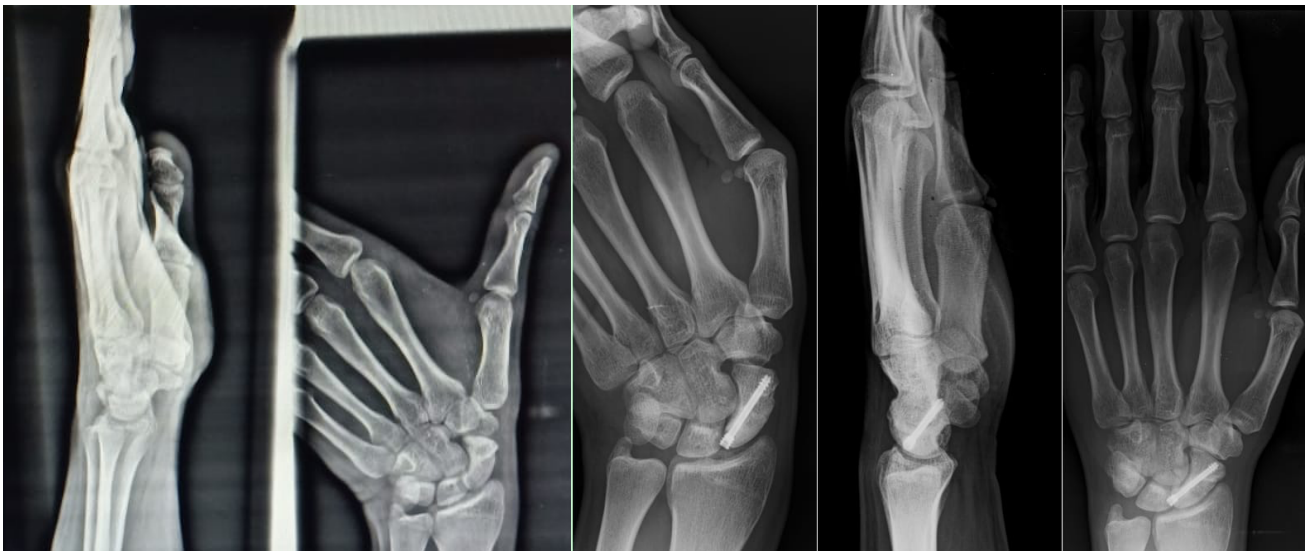

**Fig. I (a):** Radiograph showing Scaphoid Nonunion **Fig. I (b):** Post operative percutaneous Herbert Screw Fixation

## RESULTS

We treated 11 patients with percutaneous Herbert screw fixation but 2 patients were lost to follow up and we excluded them from our final analysis.(Table I) All patients were male with mean age of 26±5 years(range 18 to 42 years).Delayed union was present in 5(55.55%) patients and non union in 4(44.44% ). Right sided Scaphoid fracture was present in 6(66.66%) patients and left in 3(33.33%) patients. All fractures achieved radiological union in 15.5±4.2 weeks. The average time of union in delayed union group was 12±3.2 weeks (range 8 to 18 weeks) and in nonunion group it was 20±5.5 weeks (range 14 to 34 weeks). All the patients returned to their functional level after an average of 18±3 weeks. There was no evidence of post-operative osteoarthritis or osteonecrosis in any patient of our study.Postoperative wrist stiffness was noted in 2(22.22%) patients and was treated with physical therapy. No patient required revision surgery.

**Table I:** Demographic characteristics and clinical outcome of our study participants.

| Patient No. | Age | Gender | Injury Side | Time since fracture | Time to union | Outcome | Complication |
|---|---|---|---|---|---|---|---|
| 1 | 23yrs | Male | Right | 52weeks | 14weeks | Union | Stiffness |
| 2 | 35yrs | Male | Right | 22weeks | 18weeks | Union | None |
| 3 | 21yrs | Male | Right | 30weeks | 14weeks | Union | None |
| 4 | 18yrs | Male | Left | 16weeks | **Lost to follow up(excluded from analysis)** | | |
| 5 | 42yrs | Male | Left | 12weeks | 8weeks | Union | Stiffness |
| 6 | 22yrs | Male | Right | 17weeks | **Lost to follow up(excluded from analysis)** | | |
| 7 | 28yrs | Male | Right | 17weeks | 8weeks | Union | None |
| 8 | 28yrs | Male | Right | 12weeks | 10weeks | Union | None |
| 9 | 21yrs | Male | Left | 18weeks | 16weeks | Union | None |
| 10 | 25yrs | Male | Left | 27weeks | 18weeks | Union | None |
| 11 | 22yrs | Male | Right | 27weeks | 34weeks | Union | None |

## DISCUSSION

Delayed union and non-union of the Scaphoid is difficult to treat.[10].Open reduction and internal fixation with screws has been the most accepted method of fixation.[11] Augmentation with either vascularized or non-vascularized graft has also been reported.[3,4,11,12] Inaparthy[13] demonstrated that delayed union and nonunion of the Scaphoid waist fractures present for less than 5 years can be successfully treated with fracture compression and bone grafting. Dedeoglu[14] reported successful healing in 26(89.65%) out of 29 patients with scaphoid percutaneous fixation but he had combined core decompression of the distal radius along with percutaneous Scaphoid fixation in his series.Slade15 was the pioneer of percutaneous fixation with a headless cannulated screw using mini-fluoroscopy[15] and his classification for nonunion of the Scaphoid has been used in the treatment protocols of Scaphoid nonunion. The main advantages of percutaneous techniques are the optimal screw placement in the central part of the proximal pole thus ensuring good compression and better stability. Possible disadvantages are that the hyperflexed wrist may cause bending of the guide wire and extensor tendon injury.[16,17].

Slade used dorsal percutaneous fixation with a headless screw without bone graft.[15] All 15 fractures healed with the average time to union was 14 weeks and without any complications. He noted that the time to union was substantially less in fractures treated within 06 months of injury (10.8 weeks) compared to those treated later (16 weeks).This was found to be statistically significant( $P < 0.02$). Similarly, in our study the average time of union in all patients was 15.5±4.2 weeks, while in delayed union group was 12±3.2 weeks which was less than the average 20±5.5 weeks in the nonunion group. Contrary to the above observations Vanhees[18] showed absence of any correlation between the time to fracture fixation and the time to complete healing.

Kim[19] treated 12 patients with Scaphoid waist delayed union using the volar percutaneous approach and achieved union in all cases. In another study Capo[20] demonstrated union in 11(91.66%) out of 12 patients, while only 1(8.33%) required revision surgery. Dedeoglu[14] reported revision surgery in 3(10.34%) patients.No patient had undergo revision surgery in our series.

Our study had few limitations. The design of our study was descriptive. Our sample size was small and our follow up period was short. We could not evaluate the functional outcome.We therefore recommend further studies to confirm the usefulness of percutaneous Herbert screw fixation in delayed union and nonunion of the scaphoid.

## CONCLUSION

Delayed union and nonunion of the Scaphoid can be treated successfully with Percutaneous Herbert screw fixation as shown by excellent radiological union in all of our cases. This technique is associated with minimal scarring, less chances of neurovascular damage and low incidence of infection. Drilling and wiring across the fracture surface improves blood flow of the sclerotic surface that enhances the healing process and avoids bone grafting. High union rates however, are ensured if good patient selection, rigid stabilization and minimally displaced Scaphoid waist fractures are chosen.

**Conflict of Interest:** None

**Grants/Funding:** None

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