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ORIGINAL ARTICLE

FUNCTIONAL AND CLINICAL OUTCOMES OF PERCUTANEOUS HERBERT SCREWS FIXATION IN SCAPHOID FRACTURES

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ABSTRACT

Background: Among the wrist bones, scaphoid bone is the most commonly fractured carpal bone, which accounts for 50-80% of carpal fractures and 11% of all hand fractures. To achieve early diagnosis, performing a comprehensive clinical examination of wrist and utilizing imaging is important. The management of scaphoid fractures ranging from casting and immobilization to surgical techniques with close or open reduction and internal fixation. Objective of our study was to evaluate the functional and clinical outcome by utilizing percutaneous Herbert screws in the management of acute scaphoid bone fractures.

Materials & Methods: A retrospective study was conducted from 1st January 2022 to 31st December 2023, including 26 patients with acute scaphoid fractures of Herbert classification including B1, B2 and B3. Fixation was done using both volar and dorsal percutaneous techniques. Patients were assessed and evaluated clinically postoperatively by using modified Mayo wrist score (MMWS).

Results: The mean age 27.12 ± 9.53 years, 88.5% of patients were right hand dominant, the majority were with excellent outcome category 21 patients (80.77%) and good in 3 patients (11.54%), fair 1(3.84%), and poor 1(3.84%). The mean time for union was 8.90 ± 1.7 week. Grip strength was 80 % at 3 months and 95% at 6 months.

Conclusion: For all young and active individuals with acute, non-displaced, or minimally displaced scaphoid fractures, percutaneous internal fixation should be considered as a treatment option. This treatment option provides earlier gain of wrist motion, quicker union, faster return to daily activities, and a low rate of complications.

KEY WORDS: Herbert screw; Mayo score; Percutaneous fixation; Scaphoid Fractures.

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INTRODUCTION

Among the wrist bones, scaphoid bone is the most commonly fractured carpal bone, which accounts for 50-80% of carpal fractures and 11% of all hand fractures.[1,2] Scaphoid fractures are usually caused by a fall with hyperextension or axial loading from a direct blow and are common in young athletes aged 15-40.[1,3] The scaphoid bone receives its blood supply from two sources, dorsal and volar branches of the radial artery. As avascular necrosis is most common in the proximal pole due to its retrograde blood supply.[4] Most scaphoid fractures, approximately 80% occur at the waist, then distal pole, proximal pole, and tubercle fractures.[5] The Herbert and Fisher classification has been frequently used to describe scaphoid fractures.[1]

Scaphoid fractures are difficult to diagnose and often result in complications, such as avascular necrosis (13-50%), nonunion, malunion, carpal instability, and radiocarpal arthrosis.[2,6] Non-displaced scaphoid fractures require cast immobilization for at least 6-12 weeks, causing a waste of time and activity in young and active patients.[7] Additionally, about 5%-20% of non-displaced scaphoid waist fractures which are treated conservatively will eventually result in mal-union and non-union.[8,9] As non-displaced scaphoid

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fractures usually require longer periods of cast immobilization, which can lead to wrist stiffness, muscle atrophy, loss of grip strength, and disuse osteopenia, all of which can negatively impact the function of the wrist and hand.[3,10.11] In order to minimize the time needed for cast immobilization, surgical fixation of scaphoid fractures has been recommended. There are different surgical techniques available, including open reduction and internal fixation (ORIF), minimally invasive surgery, dorsal and volar minimally invasive opening, and arthroscopic assisted screw fixation, which have been described in the literature.[8,11]

Undisplaced scaphoid fractures can be treated through surgery for several reasons such as promoting early wrist movement with pain relief, preventing the extended use of casts, reducing the chances of muscle atrophy and joint stiffness caused by prolonged cast usage, and minimizing the chances of complications like delayed union, nonunion, and malunion. Surgery also results in significant reductions in morbidity, loss of work time, lost wages, and enables earlier return to sports.[7,12,13] Among the available surgical techniques, percutaneous fixation has emerged as a superior option over open reduction and internal fixation (ORIF) due to its higher union rates, quicker functional recovery, and reduces surgical morbidities such as scarring and complex regional pain syndrome (CRPS).With the relatively easy percutaneous Herbert screw fixation technique, reduction of fracture and fixation can be achieved without causing additional damage to the vascularity of scaphoid or destabilizing ligament complex of the wrist.[7] Objective of our study was to evaluate the functional and clinical outcome by utilizing percutaneous Herbert screws in the management of acute scaphoid bone fractures.

METHODS AND MATERIALS

This was a retrospective descriptive study conducted at Lady Reading hospital Peshawar from 1 January 2022 to 31 December 2023 for a duration of 2 years after ethical approval from the departmental research committee. A total of 26 patients diagnosed with undisplaced/minimally displaced (<2.0mm) scaphoid fractures were operated with percutaneous Herbert screws fixation in our hospital and those who met the inclusion criteria were included in the study. Post-operative X-ray at Three weeks, Six Weeks, and three months after surgery as per patient's availability. The follow-up period of patients was from 3 - 6 months,

All information was collected manually from the medical records, operation notes, and radiological reports retrospectively to ensure the highest degree of accuracy. Baseline demographic information including medical record number (MR), gender, age. Union status, Mayo score. Image interpretation, pre- and postoperative radiographic measurements, and evaluation of radiographic union was done with Standard anteroposterior, lateral and scaphoid view radiographic images.

Inclusion Criteria:

1. Patients with undisplaced/minimally displaced (<2.0mm) scaphoid fractures.
2. Patients ready to give consent and being followed-up with
3. Age range: 15-65 years.
4. Patients presenting with open wounds, that can be closed primarily.

Exclusion Criteria:

1. Coexisting wrist fractures.
2. Patients with vascular injuries requiring revascularization
3. Uncontrolled diabetes, neoplasia, haemo-coagulative alterations, psychic disorders
4. Transscaphoid perilunate dislocation

Percutaneous Herbert screws fixation technique:

a- Volar approach:

In this study, 20 patients underwent treatment for a scaphoid fracture using a volar approach under general anesthesia. Patients received prophylactic broad-spectrum antibiotics for about an hour before inducing anesthesia and applying pneumatic tourniquet. The patient was placed supine with the affected hand on a radiolucent table to ensure clear visualization using a C-arm. Before draping adequate fluoroscopic anteroposterior and lateral views were obtained for confirmation and visualization of accurately identifying anatomic landmarks and fracture fragments. The affected upper limb was prepared and covered with drapes. To achieve closed reduction, thumb traction was used along with wrist hyperextension and ulnar deviation. A 1.2mm percutaneous guidewire was inserted along the central axis of the scaphoid bone, angled 45° dorsal, ulnar, and proximal to minimize the risk of complications. Subsequently, a 1.2mm K-wire was used to temporarily fix the fracture. A hole was drilled over the guidewire, using a tissue protector to prevent any damage to surrounding tissues. The screw's length was measured to ensure the appropriate size was used. Under image intensifier control, a self-tapping Herbert screw was inserted, and the guidewire and K-wire were removed. Positioning the screw centrally was crucial to achieving appropriate biomechanical stability, as any deviation from the central position could affect the patient's recovery and lead to further complications. An image intensifier was used to achieve and confirm compression. The Herbert screw was buried subchondral distally, and the incision was closed with a single stitch.

b- Dorsal percutaneous technique:

Our study involved six patients who underwent a dorsal percutaneous approach. The patient was placed

in the same supine position with the affected limb abducted up-to 90° and the hand resting on a radiolucent table as for volar approach. The hand was then rotated so that the palm was facing downward and bent at an angle of 45^0 or more to identify the proximal pole by locating the depression between the scaphoid and lunate bones. Next, a 1.2mm guidewire inserted antegradely from dorsal to volar at the proximal pole. The guidewire is prevented from retraction after reaming by insertion into the base of thumb. A small incision of 5mm was made surrounding the guide wire, and the screw length was measured with a depth gauge or alternatively with another guidewire of the same length was used, which was usually 4mm smaller than the measured length. A 2.7mm cannulated drill was then passed within 2mm of the articular surface of the distal pole followed by the use of a 3.5mm cannulated drill to ream the proximal pole only. Finally, a Herbert screw was inserted through the guidewire under image intensifier to achieve compression. After dressing thumb spica was applied.

Post-operative care:

After the surgery, the patients were put in a thumb Spica cast for two weeks. After two weeks, they were advised to begin wrist movements and hand-grip exercises. After 12 weeks, graduated weight lifting was permitted. Follow-up visits were planned for every two weeks till complete union, beyond that every three months.

Evaluation and outcomes:

During each follow-up visit, the patients underwent both clinical and radiological examinations to ensure proper healing. Union was considered achieved when there was no sign of discomfort or tenderness at the anatomical snuffbox or at the scaphoid tubercle, and when there was evidence of trabeculae spanning the fracture on two views. The position of the screw was evaluated radiologically at every follow-up to confirm its placement. The patient's wrist functionality was assessed using the modified mayo wrist score (MMWS). The examiner measured the patient's grip strength by asking them to squeeze their index finger and compared it to the strength on the other side. Most of the patients achieved same functional movements as that of the unaffected hand after 3 months including, full length flexion, extension, ulnar and radial deviation. The grip strength grading was calculated by the Medical Research Council (MRC) grading system. A goniometer was used for range of motion measuring. IBM SPSS software version 23 was used to perform statistical analysis.

RESULTS

A total of 26 patients were included in the study with a male-female ratio of 23(88.5%) and :3 (11.5%) respectively, this shows the predominance pattern of scaphoid fracture in the male population. Different age groups from 16- 51 years were included with a

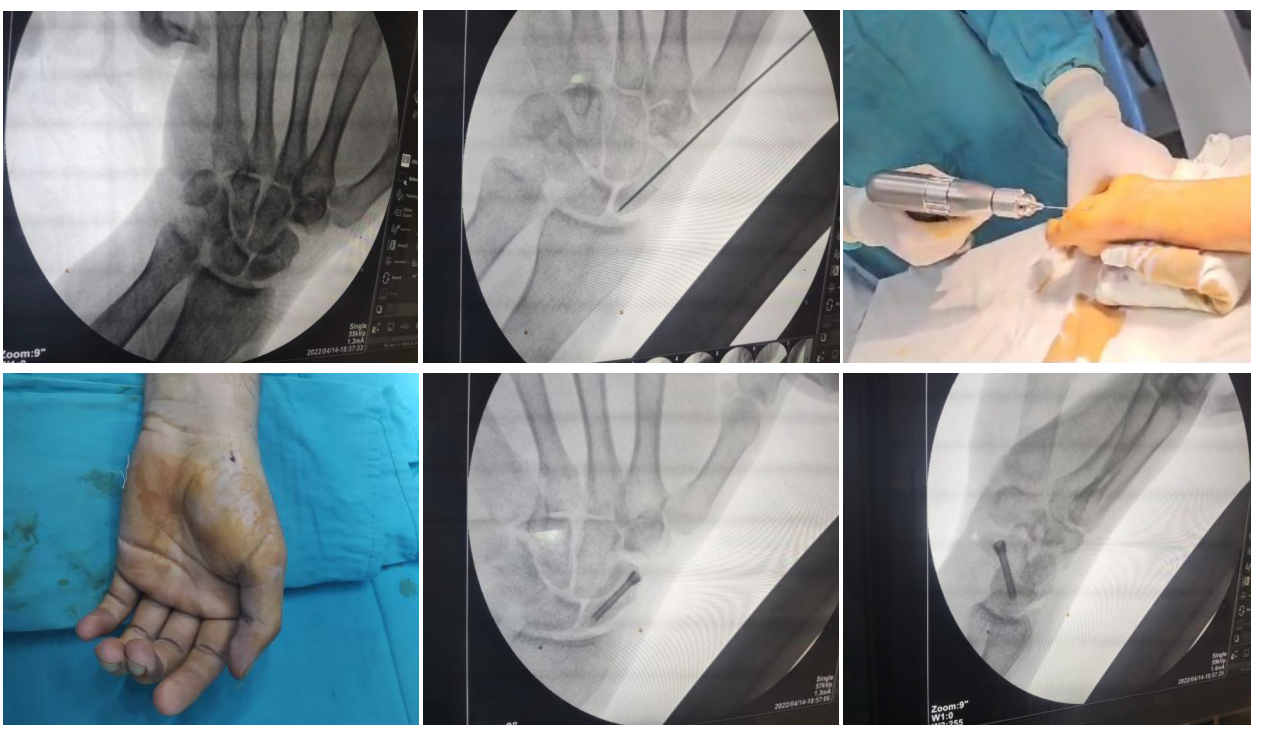

Figure 1: (A) shows pre-operative x-rays of the fractured scaphoid, (B) intra-operative guide wire placement fluoroscopic view, (C) intra-operative, (D & E) post-operative AP and lateral view and (F) post-operative wound size.

mean age of 27.12 ± 9.53 years. 88.5% of patients were right hand dominant. Most of the patients were young and had no associated medical illness except one who had hypertension. Most patient presented within 1st week of trauma 17(65.4%) then 5(19.2%) patients in the 2nd week and 4(15.4%) patients in 3rd week to the hospital and operated. Road traffic accidents (RTA) was the most prevalent cause of scaphoid fractures 13(50.0%) followed by history of fall 11(42.3%) and 2(7.7%) cases were from direct blow to wrist. Most of the cases 22(84.6%) were diagnosed with plain radiographs, only 4(15.4%) cases which were highly suspicious and usually undisplaced were diagnosed with CT-scan. Radiological consolidation was confirmed postoperatively in all patients at 8.90 ± 1.7 weeks (range 6 – 12 weeks).

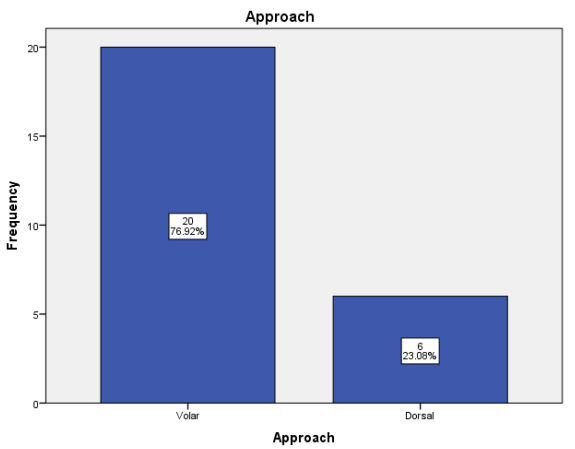

Figure 1: Surgical approach

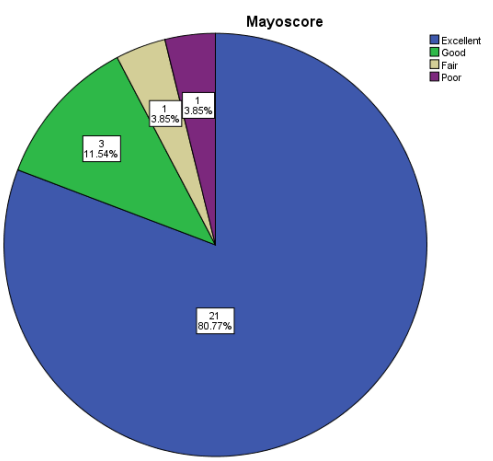

Figure 2: Modified mayo wrist score

DISCUSSION

Regarding functional outcomes when modified mayo wrist rating were applied for scaphoid fractures, the results were rated as excellent in 21 patients (80.77%), good in 3 patients (11.54%), fair 1(3.84%), and poor 1(3.84%),which are similar to a study conducted by Allam AS at el their results showed excellent in 12 patients (80%) and good in 3 patients (20%) while Hu H at el also showed 80% of excellent results.[14,15]

Clinical outcomes were assessed via grip strength and range of motion at wrist joint. Grip strength was 80 % in all our patient obtained at 3month follow-up as compared to normal hand which is comparable to a study in which patients have 90-100% grip strength as compared to the normal side.[14] These cases presented full range of motion, and had no complaints of loss of strength or residual pain. After union the range of movement at wrist was equal to that of the contralateral side at 3 months which are similar to a study conducted by Roy DD. [1]

There was no evidence found radiologically in our study of avascular necrosis of the proximal pole, infection, tendon rupture or nerve injury in any case during the follow-up period.

Makki MK at el and Afsar SS at el. showed no evidence of post-operative osteoarthritis or osteonecrosis in any patient of their study which are similar results as our study, no patient had developed post-operatively these complications. [16,17]

Limitation:

It is important to know that our study has some limitations like the small number of patients, which limited the statistical analysis that could be conducted in greater depth. Additionally, the operating surgeon whom conducted the functional assessment for grip strength and range of motion outcomes, making the study susceptible to observer bias due to the unblinded nature of the study design.

CONCLUSION

In conclusion, percutaneous Herbert screw fixation is an effective technique for treating acute, non-displaced, or minimally displaced scaphoid fractures, especially in young athletes or active individuals. Immobilization for longer duration can be challenging to endure. This technique provides excellent results in terms of functional outcomes, earlier restoration of wrist motion, bone union, faster return to daily activities, and fewer complications were observed. Therefore, it is important to consider percutaneous screw fixation as a safe and useful treatment option for acute scaphoid fractures.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	BH, SFQ
Acquisition, Analysis or Interpretation of Data:	BH, SFQ, AUJ, MS, AI
Manuscript Writing & Approval:	BH, SFQ, AUJ, MS, SIB

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.