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Comparative Study between Volar Open and Percutaneous Surgical Fixation of Recent Scaphoid Fractures

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ABSTRACT

Background: Since the scaphoid is the most often broken carpal bone, making up to 11% of all hand fractures and 60% of carpal bone fractures, it is regarded as a common injury.

Objective: This study compared the results of open reduction and internal fixation without bone grafting through volar approach versus volar percutaneous fixation by Herbert screw of recent scaphoid waist fractures within 3 weeks.

Patients and Methods: This prospective study included 34 patients with recent middle third scaphoid fracture in the Orthopedic Department of Menoufia University Hospital from 2019 to 2021. Patients were divided into two equal groups according to the treatment method (group A by open reduction, and group B by percutaneous fixation) using the volar approach.

Result: The mean postoperative final score according to MMWS for group A was 69.71±15.26 but for group B it was 77.35±10.33. The mean postoperative pain score for group A was 16.76±4.98 and for group B it was 18.24±3.03. The mean postoperative range of motion score for group A was 15.88±5.07 and for group B it was 19.41±4.96. The mean postoperative hand grip strength score for group A was 15.88±4.76 and for group B it was 17.94±4.70. The mean postoperative radiological fracture union score according to scaphoid fracture union grading scale for group A was 2.24±0.75 but for group B it was 1.53±0.72. The mean postoperative patient satisfaction score according to MMWS for group A was 21.18±3.76 and for group B it was 21.76±2.46.

Conclusions: Both techniques of close reduction and percutaneous fixation or open reduction and internal fixation are reliable options with no superiority of each regarding modified mayo wrist score.

Keywords: Scaphoid, Waist fracture, Herbert, Volar, Open, Percutaneous.

INTRODUCTION

The most frequently fractured carpal bone is the scaphoid, which accounts for 11% of all hand fractures and 60% of carpal bone fractures. A consequence of this is that it is a prevalent injury [(1)].

Because it stabilises both the proximal and distal rows of the joint, the scaphoid is known to play a key role in the wrist's function. Additionally, all five bones in its vicinity are articulated [(2)].

The scaphoid surface is 80 percent covered by cartilage, and the radial artery's retrograde branches penetrate at the dorsal ridge, providing 70-80% of its blood supply [(3)]. A malunion or nonunion may develop if the fracture was left untreated or poorly reduced. 10 to 35% of these fractures result in nonunion, even with proper treatment [(4)]. Due to the scaphoid's distinctive anatomy and limited blood supply, **Herbert and Fisher** developed a new compression fastener in 1984 for the fixation of scaphoid fractures [(5)].

Most fracture classification systems were based on fracture location, displacement, or stability. In 1980, **Cooney *et al.*** [(6)] classified scaphoid fractures as follows: (1) distal tubercle, (2) distal intra-articular surface, (3) distal third, (4) waist, and (5) proximal pole.

In an open approach, **Herbert and Fisher**'s classic description and introduction of the headless, compression screw was executed with a high success rate in achieving union [(5,7)]. Open treatments can be conducted using both volar and dorsal approaches, which facilitate the confirmation of an anatomic reduction and enhanced fracture visualisation prior to screw implantation [(8)].

The volar approach to the scaphoid is most frequently employed for flexed scaphoid deformity and distal third fractures. In the event of volar bone loss, comminution, or the necessity to rectify a scaphoid humpback deformity, it is easier to confirm reduction when the whole volar surface of the scaphoid can be seen [(9)]. More minimally invasive percutaneous approaches have been recommended to mitigate soft tissue injuries to the radiocarpal ligaments and dorsal capsular structures. In theory, it may also enhance fracture union by limiting harm to the surrounding blood supply [(10-12)]. The use of percutaneous procedures, which are less intrusive surgical methods, may offer an extra advantage in the treatment of non-displaced fractures. In order to obtain and confirm an anatomic reduction, misplaced and unstable fractures should be treated using a volar or dorsal open method prior to screw placement [(13)].

In this investigation, the primary objective was to assess fracture union, while the secondary objectives focused on pain, range of motion, hand grip strength, and patient satisfaction. The results of the volar open and percutaneous surgical fixation of recent scaphoid fractures were compared.

PATIENTS AND METHODS

This prospective study included 34 patients divided randomly by using sealed envelope system into two equal groups according to treatment method (Group A / Group B = 1:1)

- Group A: 17 patients treated using open reduction and internal fixation through volar approach.
- Group B: 17 patients treated using volar percutaneous fixation.

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This study started from December 2019 to June 2021 in the Orthopedic Department at Menoufia University Hospital.

Ethical considerations:
All the patients who were enrolled in this study were given a full description of the nature, aims, possible prospective results and complications of the study. All of them have signed a written consent acknowledging understanding the nature, aims, possible prospective results and complications and approving participation. The minimum follow up period was six months. The Helsinki Declaration was followed throughout the study's conduct.

Inclusion criteria: Adult (18 - 60 years old), isolated non-comminuted scaphoid middle third waist fracture, recent closed fractures within 3 weeks.
Exclusion criteria: Age <18 or >60 years old, old and non-united scaphoid fractures, concomitant injuries to the ipsilateral hand, wrist or forearm, neurovascular problems and compartmental syndrome, open fractures and any pathological wrist condition.

METHODS OF TREATMENT

Operative technique:
The patients were all operated on while under general anesthesia. Adequate wrist extension was attained by placing a rolled towel under the supinated wrist while in a supine position on the operating table with the arm abducted over a radiolucent arm board**.** Elevation and application of the pneumatic tourniquet over smooth padding then inflated to a pressure of systolic blood pressure plus 100 mmHg. As a prophylaxis, all patients were given two grammes of third-generation cephalosporin when anesthesia was inducted. By means of skin shaving and sterilisation with povidone iodine, the entire upper limb was prepared.

1. Surgical steps of open reduction and internal fixation by volar approach to scaphoid:

The tuberosity of the scaphoid was palpated, and a longitudinal incision was made just radial to the flexor carpi radialis (FCR). The incision was made four cm from the center of the wrist flexion crease, passing over the FCR tendon. It then moved radially, obliquely and angularly, towards the scaphotrapezial and trapeziometacarpal joints. The deep surface of the FCR tendon was exposed, and the tendon was retracted ulnarly after the sheath was opened. Following the volar capsule being revealed above the radioscaphoid joint, the wrist was stretched in ulnar deviation and longitudinally dissected to expose the fracture site as well as the proximal and distal pieces. The scaphoid fracture was detected and treated by hyperextension and ulnar deviation of the wrist joint.
To get a reliable measurement, a guide wire was placed on the distal surface of the scaphoid tubercle and incised along the mid-axis of the scaphoid. A measuring device was subsequently securely positioned on the tubercle.
To prevent displacing the fracture, a power drill with a gradual rotation was used. A Herbert screw was subsequently inserted over the guide wire using a screw driver, and the wire was subsequently removed before the final tightening. The pneumatic tourniquet was deflated to accomplish hemostasis. The laceration was closed in layers using absorbable Vicryl sutures. A dressing was applied, the skin was closed, and a thumb slab was performed (Fig. 1).

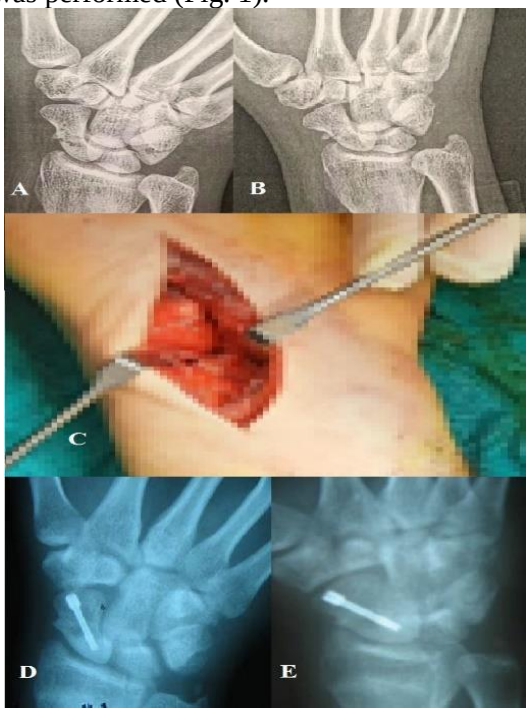

Figure (1): Preoperative and postoperative X-rays in open reduction and internal fixation by volar approach to scaphoid; A: preoperative X-ray in AP view, B: scaphoid view, C: the volar approach to scaphoid, D: postoperative X-ray in AP view, E: scaphoid view.

2. Surgical steps of volar percutaneous fixation for scaphoid:

The position of the patient was the same as in the open method. The distal portion of the scaphoid was the location of the insertion point. When the wrist's ulnar deviation was at its greatest, the scaphoid tubercle was more noticeable and could be felt and noted on the skin. To reveal the distal pole of the scaphoid, a small (3–5 mm) incision was performed across the scaphotrapezial joint. To lessen the fracture, the wrist joint was hyperextended and ulnarly deviated. With the wrist in neutral, the guide wire was started longitudinally at the tubercle and oriented dorsally, aiming in the direction of the proximal pole of the scaphoid (about 45 degrees dorsally and 45 degrees ulnarly). Under imaging, the guide wire was introduced gradually. The measuring instrument was securely inserted into the tubercle and positioned over the guide wire to ensure a reliable measurement. A power drill with a progressive rotation was used to prevent displacing the fracture. The guide wire was removed, and the Herbert screw was inserted over it. The incision was then sutured, and a dressing was applied. A thumb slab was then performed (Fig. 2).

Figure (2): Preoperative and postoperative X-rays in volar percutaneous fixation for scaphoid; A: preoperative X-ray in AP view, B: lateral view, C: scaphoid view, D: postoperative X-ray in AP view, E: lateral view, F: scaphoid view.

- **Postoperative follow up:**

Immediate postoperative period:

The distal circulation was recorded and neurological assessment of the patients was done. Postoperative plain X-ray in three views (Posteroanterior, lateral, scaphoid view) was done. Medications were given to the patient; analgesics, anti-edematous and two grams daily of ceftriaxone as an antibiotic until removal of sutures.

Follow up:

After two weeks; assessment of wound healing and removal of sutures then reapplication of the thumb slab was done. Antibiotic regimen was stopped. At four weeks; assessment of clinical union with plain X-ray in three views was done. At six weeks, the slab was removed and a conventional X-ray was taken in three views. The range of motion and the strength of the hand hold were assessed. Plain X-rays were employed to evaluate clinical and radiological union at three months. In addition, the hand grip strength and range of motion were evaluated, as well as the wound scar. A six-month follow-up was administered to evaluate the final assessment of patient satisfaction, fracture union, range of motion, and hand grip strength.

Methods of assessment:

The modified Mayo wrist score and the scaphoid fracture union grading scale were employed to conduct the clinical and radiological evaluations of the patients, respectively [14,15].

Statistical analysis

The gathered data were computerized and statistically analyzed using IBM SPSS software package Version 22.0. Mean ± standard deviation (SD), range, median and interquartile range (IQR) were used to express quantitative data, which were compared using independent t-test. Numbers and percentages were used to describe the qualitative data, which were compared using Pearson Chi-square (X^2) test or Fisher's exact test. $P < 0.05$ was deemed significant.

RESULTS

The mean age was 33.65 ± 9.14 (range, 20 - 51) years and 29.24 ± 7.21 (range, 18 - 42) years in group A and B respectively. The other demographic data are shown in (Table 1).

Table (1): Patient's demographic data

Character	Group A (n = 17)		Group B (n = 17)		p
Age (years)					
Min. – Max.	20 - 51		18 - 42		
Mean ± SD.	33.65 ± 9.14		29.24 ± 7.21		
Median (IQR)	34 (27 - 40)		28 (24 - 33)		0.128
Gender	**No.**	**%**	**No.**	**%**	
Male	17	100	15	88.2	
Female	0	0	2	11.8	0.485
Mechanism of injury					
Fall	15	88.2	14	82.4	
RTA	2	11.8	3	17.6	1
Domination					
Non dominant	4	23.5	6	35.3	
Dominant	13	76.5	11	64.7	0.452
Smoking					
No	7	41.2	8	47.1	
Yes	10	58.8	9	52.9	0.73
Side					
Right	12	70.6	9	52.9	
Left	5	29.4	8	47.1	0.29

The mean postoperative pain score according to modified Mayo wrist score for group A was 16.76 ± 4.98 (range, 10 - 25) but for group B it was 18.24 ± 3.03 (range, 15 - 25). The other modified Mayo wrist score data are shown in (Table 2).

Table (2): Patient's clinical assessment

Character	Group A (n = 17)		Group B (n = 17)		p
Pain					
Min. – Max.	10 - 25		15 - 25		
Mean ± SD.	16.76 ± 4.98		18.24 ± 3.03		0.306
Median (IQR)	15 (15 - 20)		20 (15 - 20)		
Range of motion					
Min. – Max.	10 - 20		10 - 25		
Mean ± SD.	15.88 ± 5.07		19.41 ± 4.96		0.049*
Median (IQR)	20 (10 - 20)		20 (20 - 20)		
Hand grip strength					
Min. – Max.	10 - 25		15 - 25		
Mean ± SD.	15.88 ± 4.76		17.94 ± 4.7		0.231
Median (IQR)	15 (15 - 15)		15 (15 - 25)		
Time from injury to surgery (days)					
Min. – Max.	1 - 18		1 - 14		
Mean ± SD.	7.41 ± 5.53		5.29 ± 3.44		0.413
Median (IQR)	7 (3 - 12)		5 (3 - 7)		
Patient satisfaction					
Min. – Max.	10 - 25		20 - 25		
Mean ± SD.	21.18 ± 3.76		21.76 ± 2.46		0.593
Median (IQR)	20 (20 - 25)		20 (20 - 25)		
Final score (MMWS)					
Min. – Max.	40 - 90		60 - 95		
Mean ± SD.	69.71 ± 15.26		77.35 ± 10.33		0.097
Median (IQR)	70 (60 - 85)		80 (70 - 85)		
Radiological fracture union					
	No.	**%**	**No.**	**%**	
Grade I	3	17.6	10	58.8	0.042*
Grade II	7	41.2	5	29.4	
Grade III	7	41.2	2	11.8	
Grade IV	0	0	0	0	

*: Significant

Postoperative complications were seen as two patients showed wound dehiscence in group A. Both patients were improved with daily dressing and close follow up.

Three patients in group A showed superficial infection. Local debridement under local anesthesia was done. The patients improved with daily dressing under gram positive antibiotic coverage.

Post-cast wrist rigidity was observed in eight patients in group A and four patients in group B. Except for two patients from group A who later presented with persistent limited flexion-extension with normal ulnar and radial deviation, all of the wrist's range of motion was improved through physiotherapy programs.

After the end of the follow-up, screw protrusion was seen in one patient from group A and another in group B. However, the clinical outcome was not significantly impacted. The two patients were classified as "good" by the modified Mayo wrist score.

DISCUSSION

The prevention of complications from scaphoid fractures requires early treatment. Primary treatment methods include cast immobilisation or surgery, which may be executed through an open or percutaneous approach [13].

The primary objective of this study was to assess the effectiveness of volar percutaneous fixation in the treatment of recent scaphoid middle third girdle fractures in comparison to open reduction and internal fixation through a volar approach.

In this investigation, the mean age was 33.65 ± 9.14 (range, 20 -51) years in group A and 29.24 ± 7.21 (range, 18 - 42) years in group B. In **Dinkar *et al.*** [16] it ranged from 18 - 41 years, in **Dodds *et al.*** [17] it was 26.6 ± 13.3 years, and in **Kumar *et al.*** [15] it was 30 (range, 22 - 48) years. In **Mohamed *et al.*** [18] the ages ranged from 21 - 50 years with an average of 35.5. All these studies are with our results, which could be explained by that most of scaphoid fractures occur at young age performing more physical activity.

In this study, 100% of patients were males in group A but in group B 88.2% were males and 11.8% were females. In **Dinkar *et al.*** [16] the study enrolled 40 patients; 24 males and 16 females. In **Dodds *et al.*** [17] the study enrolled 80 patients who were 88.75% males and 11.25% females. In **Mohamed *et al.*** [18] the study included 21 patients who were 71.4% males and 28.6% females. **Alshryda *et al.*** [19] implemented a systematic review and meta-analysis. It was reported that scaphoid fractures are most prevalent in young, active men. Our result is with these studies, which could be explained by that most of recent scaphoid fractures occur in males performing vigorous work and activities.

In 85.3% of patients, the primary mechanism of injury for fracture scaphoid was reclining on an outstretched hand, while 14.7% reported a traffic accident. The current investigation has demonstrated this. In **Al-Ashhab and Elbegawi** [20] the study reported that mechanisms of trauma were fall on outstretched hands in 93.3% of patients and road traffic accident in 6.7%. **Kibar and Bombaci** [21] reported that the trauma mechanism was a fall in 83.3% of patients, a ball impact during a sports activity in 8.3% of patients, and a traffic accident in 8.3% of patients. Results that are consistent with these studies have been obtained. This may be attributed to the fact that the most prevalent mechanism of injury was a fall on an outstretched hand, which led to hyperextension trauma to the wrist.

In this study, a total of nineteen patients were smokers, with ten patients in group A and nine patients in group B. The P-value of 0.73 served as evidence that the scores of group A and group B did not demonstrate a statistically significant difference. For instance, in **Dodds *et al.*** [17] there were 19% smokers in entire cohort, 14% in the percutaneous approach group and 25% in the open approach group. In **Mohamed *et al.*** [18] the time of union was found to be influenced by smoking, as nonsmokers exhibited a faster healing process than smokers. **Haddad and Goddard** [22] **and Iacobellis *et al.*** [23] confirmed that patients should be informed about the detrimental effects of tobacco use. Our result is with these studies, which could be explained by that tobacco smoking affects the fracture healing but does not affect the results between the two groups in all studies.

Regarding the postoperative clinical evaluation, the current study showed that the mean postoperative pain score in accordance with modified Mayo wrist score (MMWS) for group A was 16.76± 4.98 (range, 10 - 25) but for group B it was 18.24± 3.03 (range, 15 - 25). There was no statistically significant difference between group A and group B in terms of postoperative pain score (P = 0.306). **Dinkar *et al.*** [16] found that the mean pain score was 21.0 (range, 10-25) with the percutaneous technique and 20.4 (range, 10-25) with the ORIF technique, as reported by the MMWS. In the study by **Mohamed *et al.*** [18] according to the MMWS, 18 patients (85%) had no pain at all by the conclusion of the follow-up period, and three patients (15%) had mild intermittent pain. **Kibar and Bombaci** [21] compared volar versus dorsal percutaneous screw fixation for acute scaphoid girdle fractures and discovered no significant difference as far as postoperative pain. According to our findings, there was no significant difference in postoperative pain between the two categories.

In this study, the mean postoperative range of motion score according to MMWS for group A was 15.88 ± 5.07 (range, 10 - 20) but for group B it was 19.41 ± 4.96 (range, 10 - 25). Between group A and group B, a significant disparity in score was found, with a value of P = 0.049. **Dinkar *et al.*** [16] supported

the current results with theirs. The mean range of motion score was 23.8 (range, 15-25) with the percutaneous technique and 22.2 (range, 15-25) with ORIF. Furthermore, **Kibar and Bombaci** [21] compared volar versus dorsal percutaneous screw fixation for acute scaphoid waist fractures and found no significant difference as regard range of motion. Our result is with **Dinkar *et al.*** [16] but against **Kibar and Bombaci** [21], which explains that operative technique used in fixation can affect the result of range of motion between the two groups as there was no stripping of soft tissues and no injury to the wrist joint capsule or ligaments in percutaneous fixation.

In this study, the mean postoperative hand grip strength score according to MMWS for group A was 15.88 ± 4.76 (range, 10 - 25) but for group B it was 17.94 ± 4.70 (range, 15 - 25). The score of group A and group B did not exhibit a significant difference, as indicated by the value of P = 0.231. In the study of **Dinkar *et al.*** [16] it was 23.4 (range, 15-25) with the percutaneous technique and 22.7 (range, 15-25) with ORIF after the procedure. Our result is with this study as there was no significant difference as regard hand grip strength between the two groups, which could be explained by that open or percutaneous technique of fixation does not affect the muscle power of the wrist and hand.

The scaphoid fracture union grading scale for group A consisted of three patients rated as grade 1, seven patients rated as grade 2, and seven patients rated as grade 3, whereas group B had ten patients rated as grade 1, five patients rated as grade 2, and two patients rated as grade 3. This was demonstrated in the current study. The postoperative radiological evaluation was the source of this information. A significant difference in score was observed between group A and group B at P = 0.044. **Dinkar *et al.*** [16] reported that all 40 scaphoid fractures treated in either manner effectively united. In all patients who underwent percutaneous fixation, radiological union was verified postoperatively, with a mean of 8.75 weeks (range, 6-12 weeks), and by ORIF, with a mean of 11.91 weeks (range, 7-16). However, **Dodds *et al.*** [17] reported that there was no significant difference between percutaneous and open fixation as regard fracture union. Furthermore, **Kibar and Bombaci** [21] examined the radiological fracture union of acute scaphoid waist fractures and determined that there was no significant difference between volar and dorsal percutaneous screw fixation.

Additionally, **Polsky *et al.*** [24] used cannulated compression screws to treat 10 scaphoid fractures using a volar approach and 16 scaphoid fractures using a dorsal approach; they observed similar clinical outcomes in both groups with regard to radiological fracture union, achieving 80% union in the dorsal group and 81% union in the volar group.

Our result is with **Dinkar *et al.*** [16] but against **Dodds *et al.*** [17]**, Kibar and Bombaci** [21]**) and Polsky *et al.*** [24], which elucidates that the operative technique employed in fixation can influence the outcome of radiological fracture union between the two groups. In cases that were treated with percutaneous fixation, radiological union occurred more rapidly than in cases that were treated with ORIF more specifically.

Additionally, the present investigation demonstrated that the mean postoperative final score for group A was 69.71 ± 15.26 (range, 40-90), while group B's mean was 77.35 ± 10.33 (range, 60-95; modified Mayo wrist score). There was no statistically significant difference between group A and group B in terms of the postoperative final score (P = 0.097).

In **Dinkar *et al.*** [16] the mean ultimate MMWS score for the percutaneous technique was 95 (range, 90-100), whereas the ORIF score was 85.4 (range, 75-95). In the study by **Mohamed *et al.*** [18] the modified Mayo scoring system was used to categorise clinical results as outstanding, good, or fair, as follows: Excellent in 17 patients (8%), good in 3 patients (14%), and fair in one patient (5%). As a consequence, 20 patients (95%) achieved satisfactory results, while one patient (5%) achieved unsatisfactory results.

Furthermore, **Kumar *et al.*** [15] reported that the mean value of MMWS was 47.30 ± 7.07 (range, 30-55) at the fourth week of the follow-up period in open reduction and internal fixation. The score gradually increased at each subsequent follow-up. The score showed a greater gain in the initial follow-up, with a mean value of 64.83 ± 11.02 (range, 35-80) at the eighth week and 83.5 ± 14.92 (range, 50-100) at the 12^{th} week. It means that the patient had a satisfactory clinical and functional outcome at the conclusion of the 8^{th} week, which progressed to a good outcome at the conclusion of the 12^{th} week. In subsequent follow-up period at 16^{th} week, 20^{th} week, and 24^{th} week, the mean score was 93.67 ± 13.45 (range, 50-100), 95.67 ± 10.73 (range, 60-100) and 96.67 ± 8.54 (range, 65-100) respectively, which shows an excellent clinical and functional outcome. Our result is with these studies as there Was no significant difference regarding modified Mayo final score between the two groups. The difference in the results between our study and the other studies could be explained by that these studies had shorter follow up period of time than our study.

Regarding the complications among the studied patients, two patients showed wound dehiscence in group A. Both patients were improved with daily dressing and close follow up. Three patients in group A showed superficial infection. Local debridement under local anesthesia was done. The patients improved with daily dressing under gram positive antibiotic coverage. Eight patients in group A and four patients in group B were found to have post-cast wrist rigidity. Physiotherapy programs were implemented to enhance the wrist's range of motion. All patients saw improvement in this regard; however, two patients from group A subsequently presented with persistent

limited flexion-extension, despite having normal ulnar and radial deviation. Screw protrusion was observed in one patient from group A and another one in group B after the end of the follow up, but there was no great effect on the clinical outcome, according to MMWS the two patients final result were good.

Mohamed *et al.* [18] reported that screw protrusion was one of the complications he had in his study. However, **Dinkar *et al.*** [16] perioperative complications were not observed. Malunion was not detected in any of the subjects. At the final follow-up, none of the patients exhibited any signs of post-traumatic osteoarthritis in the scaphoid or wrist. As well, **Dodds *et al.*** [17] reported that a total of five complications were identified. The percutaneous group did not experience any significant complications; however, the mini-open group did experience one major complication, which was a delayed union that ultimately healed at six months. Each cohort experienced two minor complications. However, there was no statistically significant difference in the rates of total, severe, or minor complications between the groups.

Also, **Al-Ashhab and Elbegawi** [20] Observed postoperative complications for percutaneous screw fixation, including hypertrophy, hypertrophy, scar pain, reflex sympathetic dystrophy, malunion, and avascular necrosis. The study by **Mohamed *et al.*** [18] reported that the complications included reflex sympathetic osteodystrophy, screw protrusion, and malposition of the Herbert screw. We did not experience any wound infections, non-unions, or fastener loosening. Furthermore **Kang *et al.*** [25] found no significant differences in the nonunion rate, postoperative complications, overall functional outcome, postoperative pain scale, grip strength, or range of wrist motion, including flexion, extension, and radial deviation, between patients who received surgical treatment for acute scaphoid fractures using the dorsal or volar approach. However, compared to the dorsal technique, the volar approach produced a significantly larger ulnar deviation. Because not all acute scaphoid fractures can be treated with a single technique, orthopedic surgeons need to be skilled in both the dorsal and volar percutaneous procedures.

The tiny sample size is the primary constraint of our investigation. Additionally, there were no complaints about the late complications because the follow-up period was relatively short. Moreover, we did not perform CT scan to identify accurate length and shape of scaphoid during management and also at their final follow-up assessments. Also, Herbert screws were not removed postoperatively, so possibly influencing the outcome in the long run.

It is recommended to use large samples in the future studies in order to get more accurate results regarding statistical score. It is also recommended to prolong the follow up period in order to assess the late outcomes and complications. CT scan is recommended for rebuilding of scaphoid length, avoidance of further collapse. In order to achieve a more precise clinical and functional outcome, the Herbert screw is removed after full union postoperatively.

CONCLUSION

The modified Mayo wrist score did not distinguish between the two techniques of close reduction and percutaneous fixation or open reduction and internal fixation, as they were both dependable alternatives. However, the percutaneous fixation technique results in a more rapid return to functional activity and early union, as well as fewer complications, when contrasted with the internal fixation and open reduction techniques.

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