

Comparison of management of undisplaced scaphoid fractures: Conservative methods *versus* Open reduction and internal fixation.

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Abstract:

Introduction: Fractures of the scaphoid bone account for approximately 10% of the hand fractures. Traditionally, non displaced fractures of the scaphoid have been treated conservatively with immobilization of hand with cast. Now surgical fixation has been increasing. The aim of this study is to evaluate operative versus non operative treatments for acute undisplaced or minimally displaced scaphoid fractures. **Materials & Methods:** A randomized prospective clinical study was conducted on 15 patients with fracture scaphoid treated with conservative techniques and ORIF by trained surgeons at a tertiary trauma care centre in the Department of Orthopedics, B. J. medical college, Civil hospital Ahmedabad between May 2016 and May 2017. Fracture patterns were classified on basis of Herbert classification. **Observation and results:** Mean age was 21.5 years. 86.7% patients had mechanism of injury as axial load on hyperextended and radially deviated wrist. Average period for immobilization for conservative was 10weeks and after surgery was 2 weeks. 11.11% patient managed conservatively had undergone non-union. 16.7% managed by surgery had undergone non-union. 20% had mean wrist extension deficiency of 14 degrees. 13% had mean volar flexion deficiency of 13 degrees. 86.7% patients had excellent and good results. 13.3 % patients had fair to poor results. 33.33% cases had osteoarthritis in follow-up examination. 19% had grip deficiency. The average wrist score was 88%. **Conclusion:** Undisplaced fractures treated conservatively had less risk of undergoing non-union compared to surgical techniques. Conservative treatment is more effective from cost utility standpoint of view. Surgical treatment needs lesser time in comparison to conservative treatment.

Keywords: Hand fracture, Non-union, Scaphoid fracture.

Introduction:

Fractures of the scaphoid bone accounts for approximately 10% of the hand fractures, with an estimated incidence of 29 per 100,000 persons. Herbert A2 fractures (non-displaced unicortical waist fractures) account for 16.5% of all the scaphoid fractures.^[1]

Traditionally, non-displaced fractures of the scaphoid have been treated conservatively, with the immobilization of the hand with a cast; hence, surgical

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fixation of the fracture has become

increasingly popular because of quicker re-mobilization



and return to its original function. However, this was balanced against the risk of complications of surgery of the fractures. Although reports have shown that operative treatment is safe, effective and produces satisfactory results, outcomes from current studies comparing these two methods are questionable. The aim of this meta-analysis was to evaluate the effects of operative versus non-operative treatment for acute undisplaced or minimally-displaced scaphoid fractures in adults.

Incidence of fracture by location include waist -65% proximal third - 25% distal third - 10%. Distal pole is most common location in kids due to ossification sequence most common mechanism of injury is axial load across hyper-extended and radially deviated wrist which is common in contact sports. [2] Transverse fracture patterns are considered more stable than vertical or oblique oriented fractures. Associated conditions include SNAC (Scaphoid non-union Advanced Collapse) , AVN with proximal 5th AVN rate of 100% and proximal 3rd AVN rate of 33%.

> 75% of scaphoid bone is covered by articular cartilage. Major blood supply of scaphoid is dorsal carpal branch (branch of the radial artery) which enters scaphoid in a non-articular ridge on the dorsal surface and supplies proximal 80% of scaphoid via retrograde blood flow. Minor blood supply is from superficial palmar arch (branch of volar radial artery) enters distal tubercle and supplies distal 20% of scaphoid. Both intrinsic and extrinsic ligaments attach and surround the scaphoid the scaphoid flexes with wrist flexion and radial deviation and it extends during wrist extension and ulnar deviation (same as proximal row).

Presentation of scaphoid fracture is anatomical snuffbox tenderness, dorsally scaphoid tubercle tenderness volarly with pain with resisted pronation.

Image 1 Types of Scaphoid Fracture

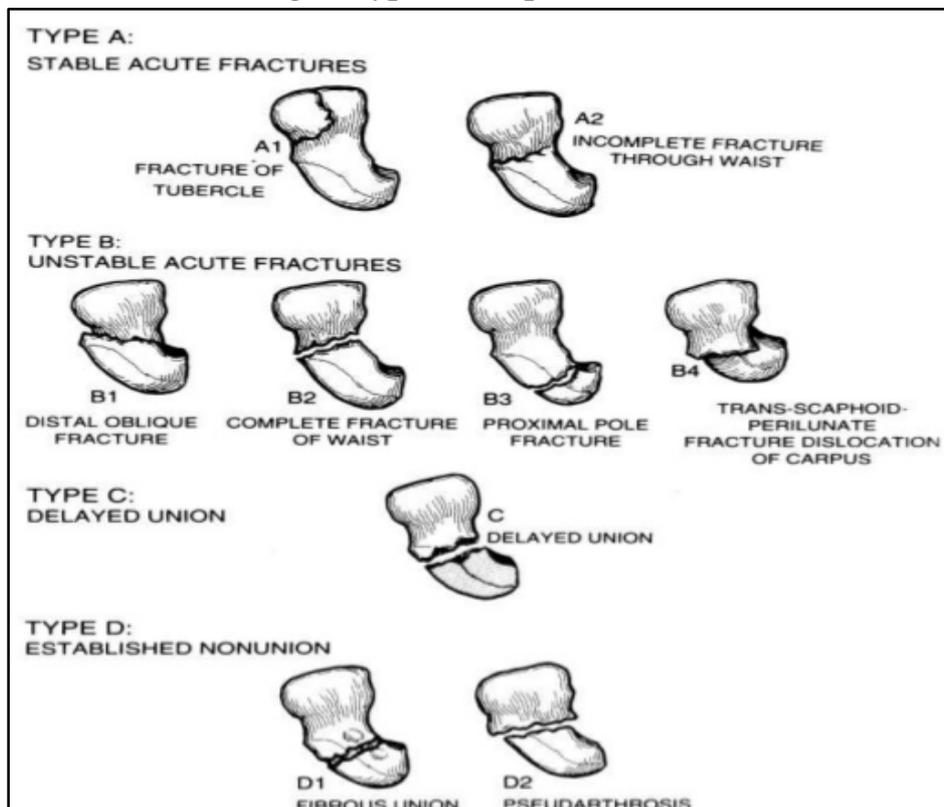


Image 2 Radiograph of Wrist showing fracture of scaphoid

Recommended Radiograph views include AP and lateral Radiographs scaphoid view is 30 degree wrist extension, 20 degree ulnar deviation 45° pronation view. If radiographs are negative and there is a high clinical suspicion one should repeat radiographs in 14-21 days. Bone scan is effective to diagnose occult fractures at 72 hours with specificity of 98%, and sensitivity of 100%, PPV 85% to 93% when done at 72 hours. MRI is the most sensitive for diagnosis occult fractures < 24 hours for immediate identification of fractures / ligamentous injuries and assessment of avascular status of bone (vascularity of proximal pole). Proximal pole AVN is best determined on T1 sequences. CT scan with 1mm cuts is less effective than bone scan and MRI to diagnose occult fracture .can be used to evaluate location of fracture, size of fragments, extent of collapse, and progression of non-union or union after surgery.

Aims and Objectives:

1. To study fracture patterns of scaphoid fractures.
2. To study the results of conservative methods versus ORIF in treatment of scaphoid fracture.
3. To evaluate treatment related complication.
4. To find out basis for selecting the method of treatment for fracture scaphoid.
5. Functional outcome.

Materials and Methods:

This randomized prospective clinical study was conducted on 15 patients with fracture scaphoid treated with conservative techniques and ORIF by trained surgeons at a tertiary trauma care centre in the Department of Orthopaedic, B. J. Medical college, Civil hospital Ahmedabad, between May 2016 and May 2017. These cases were selected for study randomly. Fracture patterns were classified on basis of **Herbert classification**.

Inclusion Criteria

- Skeletally mature patients.
- All patients of undisplaced scaphoid fracture - open/ closed.

Exclusion Criteria

- Skeletally immature.
- Pathological fractures other than osteoporosis.
- Uncooperative patients.
- Displaced fracture scaphoid.

Conservative treatment:

Conservative treatment involves the immobilization of the hand, with a below elbow scaphoid cast, for a period of 8–12 weeks^[6], most commonly for non-displaced fractures.^[5] This immobilization of the hand can either be in wrist flexion or extension. Duration of casting depends on location of fracture distal-waist for 3 months, mid-waist for 4 months, proximal third for 5 month. Between 90%–95% of fractures will heal following treatment with a cast^[9]. Scaphoid fractures are often hard to immobilize, as almost every motion of the hand, wrist and forearm causes movement of the bone, putting pressure on the fracture line^[7]. If radio graphically, there is an evidence of a widening fracture or a failure of union following conservative treatment, patients may be referred back for surgical evaluation and possibly for a surgery also. Different types of casts may be used, including those that are above or below the elbow.

There are no indications showing that a scaphoid or above, elbow cast produces a better outcome than a Colles' fracture cast^[12]. Casting may include the thumb ('scaphoid fracture') or no thumb ('Colles' fracture). Thumb spica cast is indicated in stable nondisplaced fracture (majority of fractures). If patient has normal x-rays but there is a high level of suspicion, immobilize in thumb spica and re-evaluate in 12 to 21 days. Result of long arm spica versus short arm casting is controversial. Scaphoid fractures with <1mm displacement have union rate of 90%. The position of immobilization, whether in slight extension or flexion has not produced a clinically relevant difference in range of movement at six months post-injury^[13]. After immobilization is completed, the patients are encouraged to perform active range of movement exercises to the forearm, wrist and thumb to prevent stiffness^{[8][10]}. Prolonged immobilization can also lead to muscle wasting^[11]. Hand-therapy sessions with physiotherapists should also be prescribed.

Surgical treatment

Surgical treatment has been shown to quicken a patient's time to return to work, sports and other physical activity in comparison to conservative treatment^[14,16,17,18,19,20]. This is not only because of the immobilization for 8–12 weeks for cast treatment, but studies have shown that surgical treatment has a better outcome in short term, when considering range of motion of the wrist, pain and grip strength^[4,17,18,20]. However, these advantages were only transient and by the final follow-up there was no statistically significant difference in these parameters between the two treatment groups. However, one study showed that the injury would not return these parameters to baseline, in either of the treatment groups^[5].

ORIF versus percutaneous screw fixation^[3]***Indications:***

- Main indication is an unstable fracture as seen on x-ray or CT scan.
- Displacement >1mm;
- Radio-lunate angle >15 degrees;
- Scapho-lunate > 60 degrees.

Dorsal approach is indicated in proximal pole fractures. Care must be taken to preserve the blood supply when entering the dorsal ridge by limiting exposure to the proximal half of the scaphoid. The percutaneous technique has higher risk of unrecognized screw penetration of subchondral bone. The volar approach is indicated in waist and distal pole fractures and fractures with humpback flexion deformities which allows exposure of the entire scaphoid and uses the interval between the FCR and the radial artery. Arthroscopic assisted approach has also been described.

Rigidity is optimized by long screw placed down the central axis of the scaphoid. Radial styloidectomy should be performed if there is evidence of impaction osteoarthritis between radial styloid and scaphoid. Post-operatively, splint immobilization or a bulky bandage, covering the wound site follows the surgery.^[4] These post-operative steps of care are often limited to 1 or 2 weeks after surgery, with encouragement for the patient to move the wrist and hand to prevent stiffness. This surgery has traditionally been reserved for displaced fractures, although it is now increasingly being used for patients, who are unwilling to be subjected to prolonged casting.

Complications:

Complications of the post-surgery include scaphoid non-union, superficial wound infections, hypoesthesia in the region of the palmar cutaneous branch of median nerve and mild early algodystrophy^[4]. The main determinant of whether the bone has healed is a radiographic evidence of a union. Scaphoid non-union which can be treated by inlay (Russe) bone graft indicated in minimal deformity and there is no adjacent carpal collapse or excessive flexion deformity (humpback scaphoid), interposition (Fisk) bone graft which is indicated if there is adjacent carpal collapse and excessive flexion deformity (humpback scaphoid), vascular bone graft from radius which is gaining popularity and a good option for proximal pole fractures with osteonecrosis confirmed by MRI, vascular bone graft from medial femoral condyle indicated in proximal pole fractures with osteonecrosis, lack of pancarpal arthritis and collapse.

Observation and Results:

In this study 12 (80%) patients are of age group 15-40 year age group. The mean age was 21.5. This study shows 86.7% scaphoid fractures are in adolescents and young adults (10-25 years).

In our study, the median age of males was significantly younger (17.7%) when compared with females (11.11%) with a male predominance seen. Low-energy falls from a standing height were most common (40.4%), but with males being significantly more likely

to sustain their fracture after a high-energy injury.

Image 3 Acute undisplaced or minimally displaced scaphoid fractures



In 86.7% patients' mechanism of injury is axial load across hyper-extended and radially deviated wrist which is common in contact sports.

6 patients were operated on during the course of initial treatment by surgical technique of which 3 fractures were in waist, 2 in proximal 1/3rd and 1 in distal third.

Average period for intermittent mobilization of wrist is 10 weeks after conservative technique and 2 weeks after surgical techniques. Wrist and fingers mobilization exercises were started.

On each follow up, possibilities of complication was checked. At 6 months clinical and radiological assessment was done.

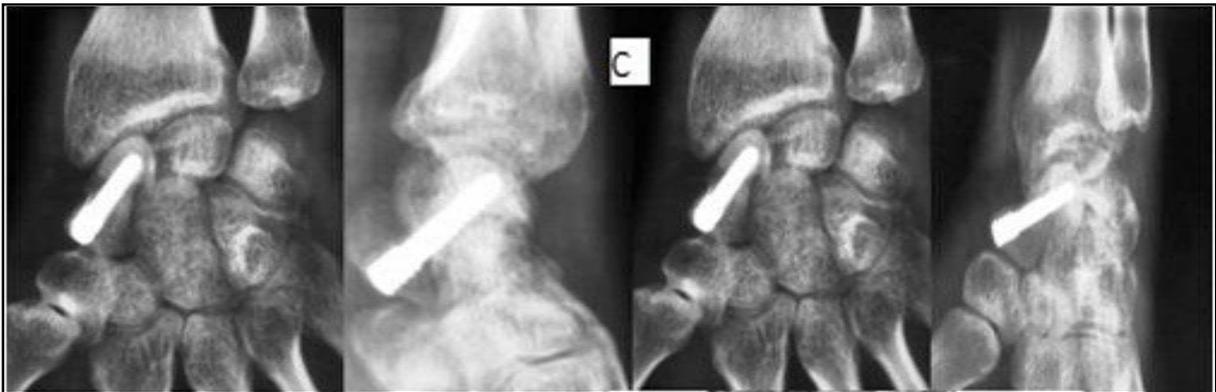
In our study total 60 % patients had undergone conservative treatment. In study total 40% patients undergone surgical treatment. In our study, those treated by cast were provided treatment free of cost while those treated with ORIF were charged depending on implant.

In our study 1(11.11%) patient had undergone non-union out of those managed by conservative treatment. In our study 1(16.7%) patient had undergone non-union out of those managed by surgical treatment. Possible reasons include initial fracture dislocation of two mm or delay of five weeks between accident and diagnosis or less immobilization. In this study 86.7% patients had excellent and good results. 13.3% patients had fair to poor results.

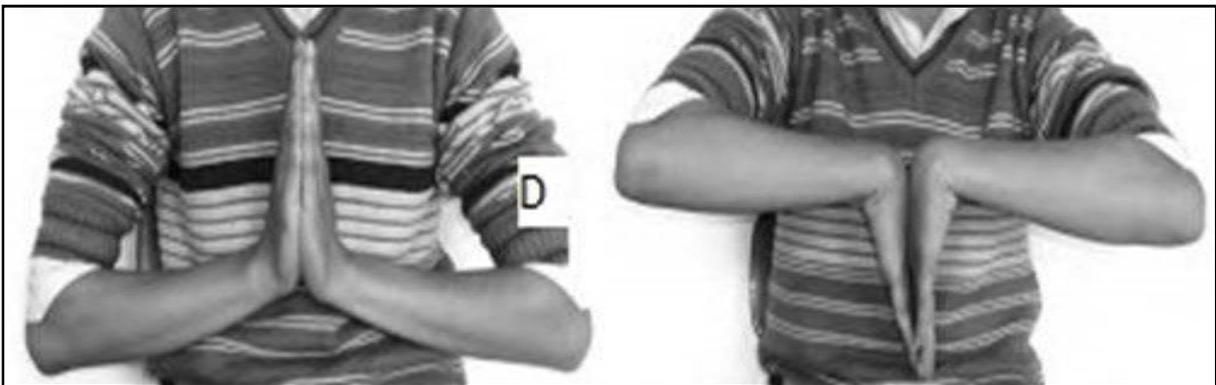
20 % had a mean wrist extension deficiency of 14 degrees (5–25). 13.3% had a mean volar flexion deficiency of 13 degrees (5–25). Grip strength deficiency was found in 3 patients (19 %). The mean grip strength was 79 % compared with the normal healthy side.

Image 4 Scaphoid fractures treated conservatively with cast



Image 5 Scaphoid fractures treated surgically by Herbert screws

At the follow-up examination osteoarthritis was found in 5 cases (33.33 %). Most of the arthritic changes were mild and did not correlate with ability to work or leisure activities. However, osteoarthritic changes correlated with the age of the patient.

Image 6 Clinical movement at end of 12 weeks after conservative method

The average wrist score was 88 (60– 100) and most of the fractures healed uneventfully and the patients were satisfied. Wrist flexion averaged 61 degree (range 35 to 75) and wrist extension averaged 60 degree (range 40 to 70). According to Modified Mayo wrist score (MMWS); the mean pain score was 21.3 (range 10 to 25), mean range of motion score was 23.3 (range 15 to 25), mean grip strength score was 24.6 (range 0 to 25) and activity score was 23.3 (range 15 to 25). Grip strength at final follow up averaged 4 (range 3 to 4.5). The mean MMWS score was 92 (range 45 to 100).

Discussion:

Scaphoid fractures are common injuries of wrist in upper limb. Effective method for the treatment of fracture is demanding due to complex fractures patterns.

This study is essentially preliminary assessment. This study is only short term follow up with average of 6 months. The aim of this study is to evaluate the results of conservative and ORIF in scaphoid fracture.

We had studied 15 patients of scaphoid fracture of which 9 are treated by conservative technique and 6 are treated by ORIFs. In our study most patients were males and mode of injury was axial load across hyper-extended and radially deviated wrist. In our study, undisplaced fractures treated by conservative methods had lesser risk of going into non-union

compared to surgical techniques.

In our study, mean wrist extension deformity is more than mean wrist flexion deformity after fracture scaphoid. Average period for immobilization was around 10 to 12 weeks for conservative techniques and 4-6 weeks for surgical techniques.

Osteoarthritis is seen after fracture of scaphoid.

In our study conservative technique is more effective from the cost-utility standpoint of view and is preferred by the patients compared to surgical techniques as materials for cast application are provided free of cost in our hospital while due to unavailability of implant in our hospital, it has to be ordered from companies which increases cost for the patient. In a study done by Davis EN et al, in cost/utility analysis of open reduction and internal fixation versus cast immobilization for acute nondisplaced mid waist scaphoid fracture; they concluded that compared with casting, open reduction and internal fixation is cost saving from the societal perspective.

The patient's occupation may be an important consideration for deciding the treatment^[16] Athletes or blue-collar workers are more likely to choose surgery, because of the shorter time-off and earlier mobilization.

Surgical treatment needs lesser time in comparison to conservative treatment^[14,16,17,18,19,20]. This is not only because of the immobilization for 8–12 weeks for cast treatment, but studies have shown that surgical treatment has a better outcome in short term, when considering range of motion of the wrist, pain and grip strength^[4,17,18,20]. However, these advantages were only transient and by the final follow-up there was no statistically significant difference in these parameters between the two treatment groups.

In our study 1(16.7%) patient had undergone non-union out of those managed by surgical treatment. Naranje S et al reported 100% union rate with Percutaneous Herbert screw fixation in 32 patients involving both fresh and late scaphoid fracture. presentations with dorsal approach.^[24] Similarly Shin AY et al found that the fracture union occurred at an average of 7.1 week compared to 11.6 weeks with cast treatment using volar percutaneous fixation for stable scaphoid fracture.^[25]

With early diagnosis and adequate immobilization, the majority of scaphoid fractures can be expected to heal by conservative treatment^[8] Even if it is becoming more popular to operate on non-displaced scaphoid fractures with the new percutaneous techniques, we must keep in mind not to expose our patients to avoidable surgical risks. Early internal fixation of these minimally displaced or nondisplaced fractures can lead to overtreatment of a large proportion of such fractures which would heal in a cast. Also, treatment by cast is cheaper compared to those by surgical intervention. Cast treatment is a reliable, safe and reasonably effective method of treating scaphoid waist fractures. Early surgical treatment should be reserved for scaphoid fractures with a dislocation greater than 1– 2 mm, or with significant instability and with multitrauma and associated injuries

Conclusion:

We have studied 15 patients of scaphoid fracture treated with conservative methods

and ORIFs. Conservative method is simple and inexpensive for undisplaced or minimally displaced scaphoid fractures. Surgical method includes its risks, complications and is expensive for the patients making conservative treatment ideal for undisplaced or minimally displaced scaphoid fractures.

References:

1. Duckworth AD, Jenkins PJ, Aitken SA, Clement ND, Court-Brown M, McQueen MM. Scaphoid fracture epidemiology. *J Trauma Acute Care Surg* 2012 Feb;72(2):E41-5.
2. Herbert TJ, Fisher WE. Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg Br* 1984 Jan;66(1):114-23.
3. Geissler WB, Adams JE, Bindra RR, Lanzinger WD, Slutsky DJ. Scaphoid fractures: what's hot, what's not. *J Bone Joint Surg Am* 2012 Jan;94(2):169-81.
4. Dias JJ, Wildin CJ, Bhowal B, Thompson JR. Should acute scaphoid fractures be fixed? A randomised controlled trial. *J Bone Joint Surg Am* 2005 Oct;87(10):2160-8.
5. Mack GR, Wilckens JH, McPherson SA. Subacute scaphoid fracture. A closer look at closed treatment. *Am J Sports Med* 1998 Jan-Feb;26(1):56-8.
6. Rhemrev SJ, van Leerdam RH, Ootes D, Beeres FJ, Meylaerts SA. Non-operative treatment of non-displaced scaphoid fractures may be preferred. *Injury* 2009 Jun;40(6):638-41.
7. Schädel-Höpfner M, Marent-Huber M, Gazyakan E, Tanzer K, Werber KD, Siebert HR. Acute non-displaced fractures of the scaphoid: earlier return to activities after operative treatment. A controlled multicenter cohort study. *Arch Orthop Trauma Surg* 2010 Sep;130(9):1117-27.
8. Kaneshiro SA, Failla JM, Tashman S. Scaphoid fracture displacement with forearm rotation in a short-arm thumb spica cast. *J Hand Surg Am* 1999 Sep;24(5):984-91.
9. Kozin SH. Internal fixation of scaphoid fractures. *Hand Clin* 1997 Nov;13(4):573-86.
10. Gellman H, Caputo RJ, Carter V, Aboulafia A, McKay M. Comparison of short and long thumb-spica casts for non-displaced fractures of the carpal scaphoid. *J Bone Joint Surg Am* 1989 Mar;71(3):354-7.
11. McQueen MM, Gelbke MK, Wakefield A, Will EM, Gaebler C. Percutaneous screw fixation versus conservative treatment for fractures of the waist of the scaphoid: a prospective randomised study. *J Bone Joint Surg Br* 2008 Jan;90(1):66-71.
12. Gellman H, Caputo RJ, Carter V, Aboulafia A, McKay M. Comparison of short and long thumb-spica casts for non-displaced fractures of the carpal scaphoid. *J Bone Joint Surg Am* 1989 Mar;71(3):354-7.
13. Doornberg JN, Buijze GA, Ham SJ, Ring D, Bhandari M, Poolman RW. Nonoperative treatment for acute scaphoid fractures: a systematic review and meta-analysis of randomized controlled trials. *J Trauma* 2011 Oct;71(4):1073-81.

14. Davis EN, Chung KC, Kotsis SV, Lau FH, Vijan S. A cost/utility analysis of open reduction and internal fixation versus cast immobilization for acute nondisplaced mid-waist scaphoid fractures. *Plast Reconstr Surg* 2006 Apr;117(4):1223-35.
15. Abassi, David. "Scaphoid Fracture." *Orthobullets*. N.P., 26 Mar. 2014. Web. 27 Mar. 2014.
16. Arora R, Gschwentner M, Krappinger D, Lutz M, Blauth M, Gabi M. Fixation of nondisplaced scaphoid fractures: making treatment cost effective. Prospective controlled trial. *Arch Orthop Trauma Surg* 2007 Jan;127(1):39-46.
17. Papaloizos MY, Fusetti C, Christen T, Nagy L, Wasserfallen JB. Minimally invasive fixation versus conservative treatment of undisplaced scaphoid fractures: a cost-effectiveness study. *J Hand Surg Br* 2004 Apr;29(2):116-9.
18. Bhandari M, Hanson BP. Acute nondisplaced fractures of the scaphoid. *J Orthop Trauma* 2004 Apr;18(4):253-5.
19. Bond CD, Shin AY, McBride MT, Dao KD. Percutaneous screw fixation or cast immobilization for nondisplaced scaphoid fractures. *J Bone Joint Surg Am* 2001 Apr;83-A(4):483-8.
20. Drác P, Manák P, Labónek I. Percutaneous osteosynthesis versus cast immobilisation for the treatment of minimally and non-displaced scaphoid fractures. Functional outcomes after a follow-up of at least 12 month. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2005 Jun;149(1):149-51.
21. Saedén B, Törnkvist H, Ponzer S, Höglund M. Fracture of the carpal scaphoid. A prospective, randomised 12-year follow-up comparing operative and conservative treatment. *J Bone Joint Surg Br* 2001 Mar;83(2):230-4.
22. Parajuli NP, Shrestha D, Dhoju D, Shrestha R, Sharma V. Scaphoid Fracture: Functional Outcome Following Fixation with Herbert Screw. *Kathmandu Univ med J* 2011;36(4):267-73.
23. Modi CS1, Nancoo T, Powers D, Ho K, Boer R, Turner SM. Operative versus nonoperative treatment of acute undisplaced and minimally displaced scaphoid waist fractures--a systematic review. 2009 Mar;40(3):268-73.
doi: 10.1016/j.injury.2008.07.030. Epub 2009 Feb 4.
24. Naranje S, Kotwal PP, Shamsbery P, Gupta V, Nag HL. Percutaneous fixation of selected scaphoid fractures by dorsal approach. *International orthopedics* 2010;34:997-1003.
25. Shin AY, Hofmeister LCDR EP, MC,USN. Volar percutaneous fixation of stable scaphoid fractures. *Atlas Hand Clin* 2003;8:19-28.