"PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION"

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CERTIFICATE

This is to certify that this dissertation **"PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION"** is a bonafide record of work done by **DR. SATHISH M,** during the period of his Post graduate study from March 2017 to August 2018 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfilment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamil Nadu Dr. M.G.R. Medical University to be held in April 2019.

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DECLARATION

I declare that the dissertation entitled **"PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION"** submitted by me for the degree of M.S ORTHO is the record work carried out by me during the period of March 2017 to August 2018 under the guidance of Prof. **N. DEEN MUHAMMAD ISMAIL, M.S.Ortho., D.Ortho.,** Director, Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, in partial fulfilment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2019.

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INDEX

INTRODUCTION

Scaphoid fractures constitute about 2%- 7% of all fractures with the highest incidence in young men in their third decade[1]. The incidence of scaphoid fracture is estimated to be 8 per 100,000 women and 38 per 100,000 men[2]. It is the most commonly fractured carpal bone which accounts for approximately 82- 89% of all carpal fracture[3].

Scaphoid fractures affecting the waist (70%) are the commonest type in adults, followed by distal pole fractures (10-20%), proximal pole fractures (5-10%), and tubercle fractures (5%)[4]. Scaphoid fractures are commonly prone to complications due to difficulty in routine radiographic diagnosis with x rays and delayed treatment or misdiagnosis. Avascular necrosis is particularly common with the scaphoid fractures at the rate of 13 to 50%[5]. Other complications such as non-union, malunion, carpal instability, and radiocarpal arthrosis are also frequently seen.

Clinicians should have a high index of suspicion and must be meticulous in studying the clinical examination findings and radiographs. Thus, early diagnosis and treatment are critical for a better prognosis. Even with proper treatment around 10 to 35% of these fractures go into non union[6]. This leads to altered carpal biomechanics with resultant pain, diminished motion of wrist, grip strength, and carpal arthritis.

The management option for patients with acute non displaced scaphoid fracture or with delayed union have expanded from open surgical technique to percutaneous fixation technique that reliably expedite fracture healing and return to work or sport relative to traditional cast treatment assigned to them previously.

Predicting successful scaphoid healing after a fracture can be difficult because reported union rates range between 10% and 50% with traditional cast treatment[7]. The most influential factors for non-union includes displaced fractures, fractures with ligamentous injuries and proximal pole fractures. Long term studies confirm a 10% to 12% failure rate with plaster immobilization of presumed stable fracture[8]. Although the failure rate of stable fracture is not high, one must balance the odds of fracture union against three to six months cast immobilization, especially in young patient population who are active and least tolerant to prolonged immobilization.

The benefit of Herbert screw fixation lies in the fact that, fracture reduction and fixation can be accomplished without further injury to the scaphoid blood supply and stabilizing ligament of the wrist. Encouraging results have been reported after open reduction and internal fixation of scaphoid fractures using the Herbert screw for fractures which are displaced, unstable and for those with delayed union. Our study was intended to review the clinical, radiological and functional outcome of open reduction and Herbert screw fixation for scaphoid fractures.

AIM & OBJECTIVES

Our aim is to analyse both prospectively and retrospectively, the outcome of management of scaphoid fractures with open reduction and internal fixation with Herbert screw in cases admitted and followed up in Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital over a period of 18 months from March 2017 to August 2018.

REVIEW OF LITERATURE

Herbert and Fisher [9] first described the technique of Open reduction and internal fixation for unstable scaphoid fractures in 1984, and proposed a classification of scaphoid fractures and a grading system for reporting results. Their prospective series of 158 acute fractures and non-union showed that Herbert screw fixation gave enough stability to allow healing of the scaphoid without additional plaster immobilisation. The rate of union which we found, 88% for all types of acute fracture, suggests that internal fixation does improve the prognosis for healing [10].

Smith et al [11] in their study on scaphoid fractures management found that screw fixation supplemented when necessary with bone grafts, is a reliable and efficient treatment for scaphoid fractures. Good rates of fracture union and good functional results were seen in all fractures types, including proximal pole fractures. Early post-operative mobilisation, when it is possible, contributes to these satisfactory clinical results. Careful attention to details of operative technique led to a very low rate of technical errors.

Elizabeth et al [12] from their study reported that Herbert screw can be successfully used in the treatment of acute scaphoid fractures and also in scaphoid non-union. The technique of insertion is technically demanding, but the benefits of stability and early mobilization are critical to a functioning pain free wrist.

Moran and Curtin et al [13] in their study compared the results of Herbert screw with more conventional screws and concluded that the Herbert screw is an effective fixation device in management of unstable scaphoid fractures and also in delayed union.

Dias and colleagues [14] performed a prospective randomized trial comparing nonoperative treatment in a below-elbow thumb-free cast with fixation with a headless compression screw. From their study they concluded that 10 of 44 patients in the nonoperative group had delayed union at 16 weeks. Patients in the operative group regained range of motion and grip strength at a much earlier time point compared to the conservative group.

Adolfsson and colleagues [15] in their study randomized 53 patients with nondisplaced scaphoid fractures to below-elbow plaster cast or internal fixation with a headless compression screw. The authors found no difference in union rates, but early increased range of motion in the surgical group. In a study randomizing military recruits with nondisplaced scaphoid waist fractures to either cast treatment or headless compression screw, patients treated operatively returned to full military duty an average of 7 weeks sooner and had radiographic evidence of union 8 weeks sooner than the nonoperative group.

Similarly, McQueen and colleagues[16] randomized patients to surgery with placement of a headless compression screw or cast treatment and found faster time to union in the operative group. Inoue and Shionoya and Modi and colleagues [17] also noted that operatively managed scaphoid waist fracture returned to work sooner than nonoperatively managed fractures.

A cost-utility analysis by Davis et al[18] found that operative treatment of all scaphoid waist fracture was a cost-effective treatment compared to the conservatively managed scaphoid fractures at the time of final follow up.

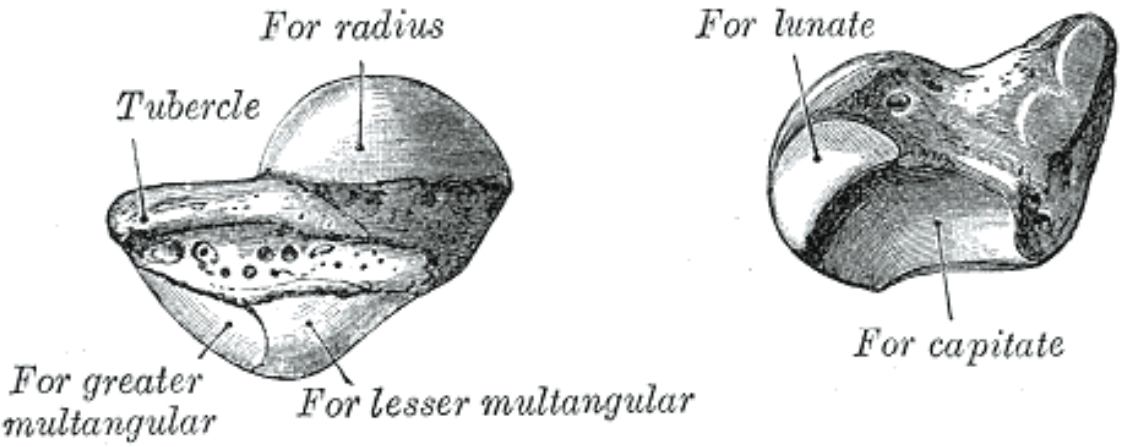
Vikas gupta et al [19] found in his literature review on the results of the Herbert screw on the scaphoid fracture management found that the overall results of recent studies of percutaneous fixation of scaphoid fractures have shown a 100% union rate for surgically fixed fractures from both the palmar and dorsal approach. The importance of screw position in the scaphoid has been emphasized by various authors. The central placement of the screw in the proximal fragment of the scaphoid is of utmost importance and is associated with excellent clinical outcome

A meta-analysis by Bhandari and Hanson [20] showed that internal fixation resulted in a significantly earlier return to work (by 8 weeks) as compared with casting. They also insisted on the decrease in the morbidity of the patient treated surgically compared to the conservative group.

ANATOMY OF SCAPHOID

The scaphoid fracture was first described in 1905 by Destot, a French surgeon, anatomist and radiologist [21]. Scaphoid is derived from the Greek term skaphe, meaning boat or skiff. Scaphoid has unique anatomy to its credit when surrounding bones and its arterial supply is considered The scaphoid functions as a mechanical link between the distal and proximal rows of the carpus.

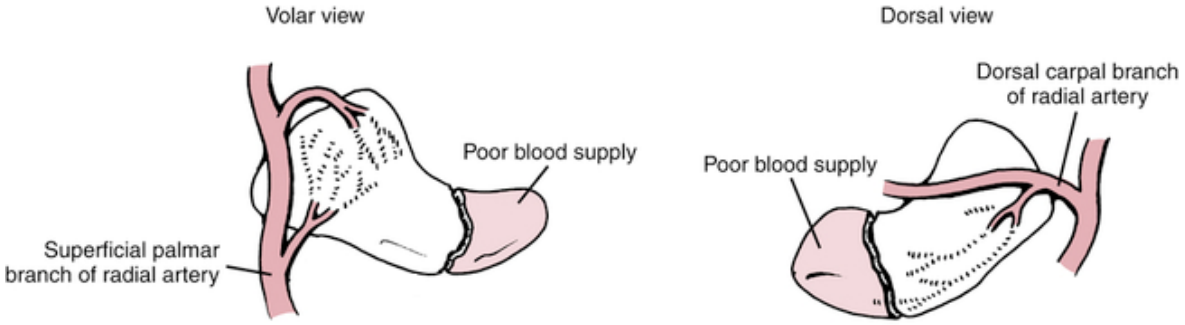
Proximally it articulates with the radius at the scaphoid fossa, distally with the trapezium and trapezoid, and ulnarly with the capitate Articular cartilage covers 75% of the surface of the scaphoid, an important distinction with respect to blood supply and later healing potential[22].



Scaphoid was an essential stabilizer for the midcarpal joint (radial column), the triquetrum (triquetrohamate joint) was the pivot point for rotation of the carpus, and that radial and ulnar deviation was facilitated through rotation of the scaphoid laterally and the triquetrum medially[23].

BLOOD SUPPLY

Direct branches from the radial artery enter through nonarticular foramina along the dorsal ridge at the level of the waist, accounting for vascularity of the proximal 70% to 80% of the scaphoid[24]. The proximal pole is supplied via intraosseous retrograde flow from the dorsal branches. The distal 20% to 30% of the scaphoid receives its blood supply from the volar scaphoid branches of the radial artery that enter near the distal pole [25].



The proximal pole of the scaphoid relies entirely on intramedullary blood flow. This unusual retrograde nature of blood supply renders proximal pole and the waist susceptible to avascular necrosis after a fracture through waist [26].

An average of 3 to 6 months is required for healing in these fracture types and non-union is quoted to ensue in 5 to 10%.[27] Additional nutrient arteries supply the distal pole via the area of the scaphotrapezium ligamentous attachment. No perforators are found at waist, cartilage, or SL ligament. [28]

BIOMECHANICS

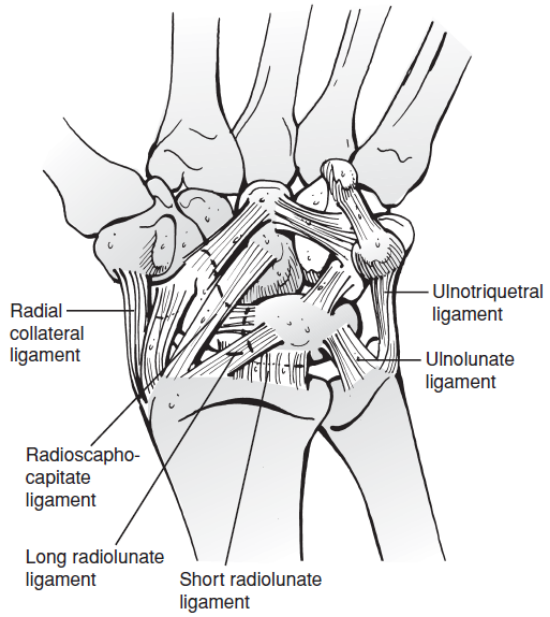
Location of scaphoid is such that it crosses both proximal and distal rows. Scaphoid flexes and extends with wrist flexion and extension respectively. Scaphoid controls flexion and extension of lunate and distal carpal row. When the wrist moves from neutral to ulnar deviation, proximal row flexes dorsally and scaphoid appears longer and clearer, hence necessitating an ulnar deviation view radiograph[29]. With scaphoid fractures, proximal scaphoid extends and distal scaphoid flexes causing gap dorsally which gradually assumes a humpback deformity. [30]

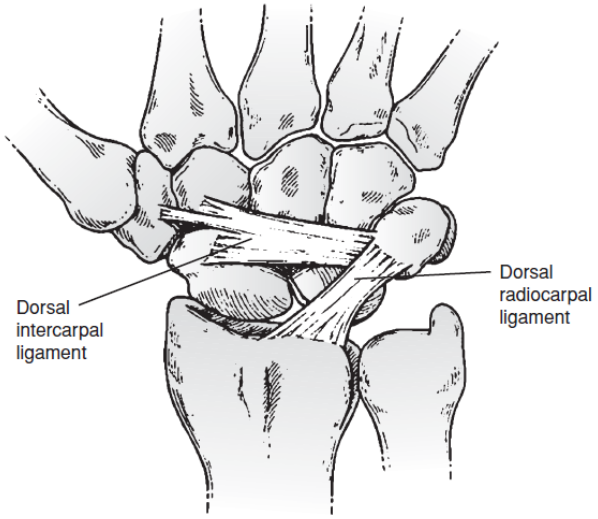
There are 7 ligaments that crossover or attach to the scaphoid or lunate. These are the scapho-lunate interosseous ligament (SLIL), the radioscaphocapitate ligament (RSC), the long radiolunate ligament, the short radiolunate ligament, the scaphotrapezial ligament (ST), the dorsal radiocarpal ligament (DRC), and the dorsal intercarpal ligament (DIC) [31]. Of these, SLIL is the primary stabilizer of the SL joint. Dividing the DIC alone or the ST alone had no effect on scaphoid and lunate kinematics during either wrist flexion/extension or wrist radial/ulnar deviation hence open approach has not much of the disturbance to the kinematics of the wrist bones when dealt with caution[32].

The RSC ligament does not attach to the bone itself but crosses the waist, acting as a sling across it and allowing it to rotate. [33] There are no tendon attachments to the scaphoid. Motion of the scaphoid includes rotation proximally and gliding distally, while providing stability to the midcarpal joint. [34] Hence its reconstruction is essential in open approaches to scaphoid.

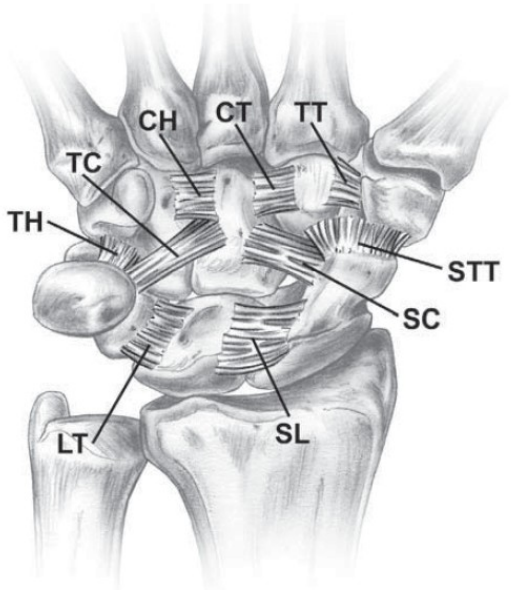
LIGAMENTS AROUND THE SCAPHOID

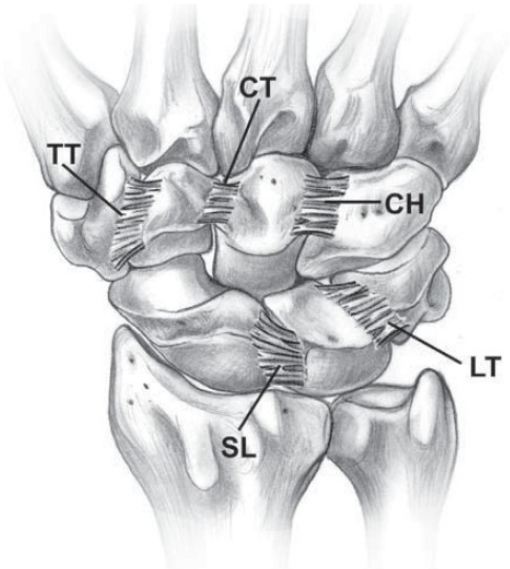
EXTRINSIC LIGAMENTS





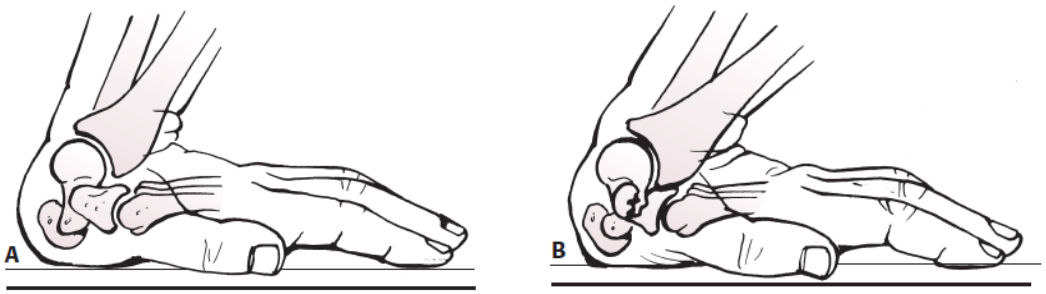
INTRINSIC LIGAMENTS





MECHANISM OF INJURY

The most common mechanism is fall on an outstretched, pronated, and ulnarly deviated hand, typically with the wrist in greater than 90 degrees of dorsiflexion causing the scaphoid bone to impact against the distal radius concavity, most likely resulting in a fracture in the middle of the scaphoid. [35] There is an increased chance of a proximal pole fracture when falls occur on the wrist in abduction. [36] Other mechanisms include a direct blow or axial loading with the wrist in neutral flexion or extension. [37] Patients may exhibit minimal swelling and mildly decreased range of motion, increasing the risk of missing an occult fracture.



All patients with snuffbox or scaphoid tubercle tenderness or radial wrist pain should be treated as having a scaphoid fracture until proved otherwise. [38]

The scaphoid waist is composed of thinner and less dense trabeculae when compared with the stronger proximal pole, which also may explain why waist fractures are the most common location of injury. [39]

Cadaveric studies have shown that fractures occur when the wrist is kept in 95 to 100 degrees of extension and a dorsiflexion load is applied to the radial half of the wrist with the radioscaphocapitate ligament kept as the fulcrum.[40]

Failure in compression occurs on the dorsal side of the bone and failure in tension on the palmar side. [41] Dorsal angulation of the fracture is caused by opposing rotational moments on the proximal and distal poles of the scaphoid. [42]

Furthermore, dorsal intercalated segmental instability (DISI) ensues if the proximal carpal row is in extension. Bending forces to wrist fractures are resisted by intact scaphoid-carpal ligaments. Distal pole and tubercle fractures are due to direct impact and forced ulnar deviation causes avulsion fractures at radial collateral ligament attachments. [43]

DIAGNOSIS

Classical examination findings of tenderness at the anatomic snuffbox and the volar aspect of the distal tuberosity and positive scaphoid compression test (pain on axial compression of the thumb metacarpal) raise suspicion that warrant further investigation. [44]

Anatomical snuff box tenderness, scaphoid tubercle tenderness, longitudinal thumb compression has 100% sensitivity with 100% negative predictive value. [45] Pinching of the thumb and index finger and pain with pronation have been shown to be sensitive provocative manoeuvres consistent with scaphoid fracture. [46]

Unfortunately, acute scaphoid fractures may be incorrectly diagnosed as sprains and treated without adequate radiographs and immobilization. Untreated or undertreated scaphoid fractures may develop non-union, which may occur in 5% to 25% of cases. [47]

In addition to the short-term pain, weakness, and disability, scaphoid non-union results in a predictable pattern of wrist arthritis that, if left untreated, typically requires treatment with salvage operations. [48]

A study by Unay et al [49] suggested that pain during thumb-index pinching (sensitivity 73%, specificity 75%, positive predictive value 96%, and negative predictive value 23%) and pain during forearm pronation (sensitivity 79%, specificity 58%, positive predictive value 82%, and negative predictive value 54%) aid the diagnosis of scaphoid fractures, but are absent in 27% of cases. Overall, the specificity for clinical examination shown in the literature was only 74 to 80% and the mean positive predictive value was quoted to be only 21%.

Other physical findings that may help to diagnose scaphoid fractures include limitation in end arc of motion with flexion and radial deviation, and reduced grip strength. Therefore, scaphoid fractures must be identified early and immobilised appropriately. [50] Imaging techniques can aid in the diagnosis of occult fractures.

IMAGING

The standard Scaphoid series consists of PA, lateral and ulnar-deviated views[51]. PA view in ulnar deviation (scaphoid view or Banana view[52] or Ziter view[53]) may visualize the fracture because the ulnar deviation of the wrist distracts unstable fracture fragments. The sensitivity (true-positive rate) of plain radiographs is approximately 70% for scaphoid fractures. [54]

Semi pronated oblique view visualises the waist of the scaphoid best and may be required to make a correct diagnosis. [55] Lateral X-rays may only detect tuberosity and distal third fractures, but are also essential to show the carpal alignment and distal radioulnar joint alignment.

A proper view should show a co-linear capitate and radius, with the pisiform located between the distal pole of the scaphoid and the body of the capitate. [56] Radiographs tend to underestimate true displacement, and therefore a visible fracture line on plain radiographs should be considered a displaced fracture.

SCAPHOID SERIES OF RADIOGRAPHS

PA View

LATERAL View

SCAPHOID View

SEMISUPINATED OBLIQUE View

Patients with negative radiographs and clinical signs and symptoms concerning for scaphoid fracture should be subjected to Computed tomography (CT) to identify occult fractures with a mean sensitivity of 94% and specificity of 96%. It was found to have a mean negative predictive value of 99% in a study by Ty et al, [57] which means it is very unlikely to miss a scaphoid fracture. It can also be used in fracture non-union and for preoperative planning. Furthermore, CT is readily available in urgent care settings and is more cost-effective than magnetic resonance imaging (MRI).

Magnetic resonance imaging has a mean sensitivity of 98% and specificity of 99%.[58] It can locate trabecular fractures and help identify other causes of wrist pain if a fracture is not found, besides helping to determine the vascularity of the proximal pole preoperatively. It is especially useful in diagnosing proximal pole fractures, which may develop avascular necrosis.

Acute fractures show normal or decreased T1 and increased T2 intensity. Non-union and impaired vascularity are often seen with low T1 and T2 marrow signal intensity which correlates with poor healing. [59] Notably, MRI is more sensitive in detecting occult scaphoid fractures, with fewer false positives than bone scans. Thus, it can accurately exclude patients without scaphoid fractures and facilitate discontinuing immobilisation.

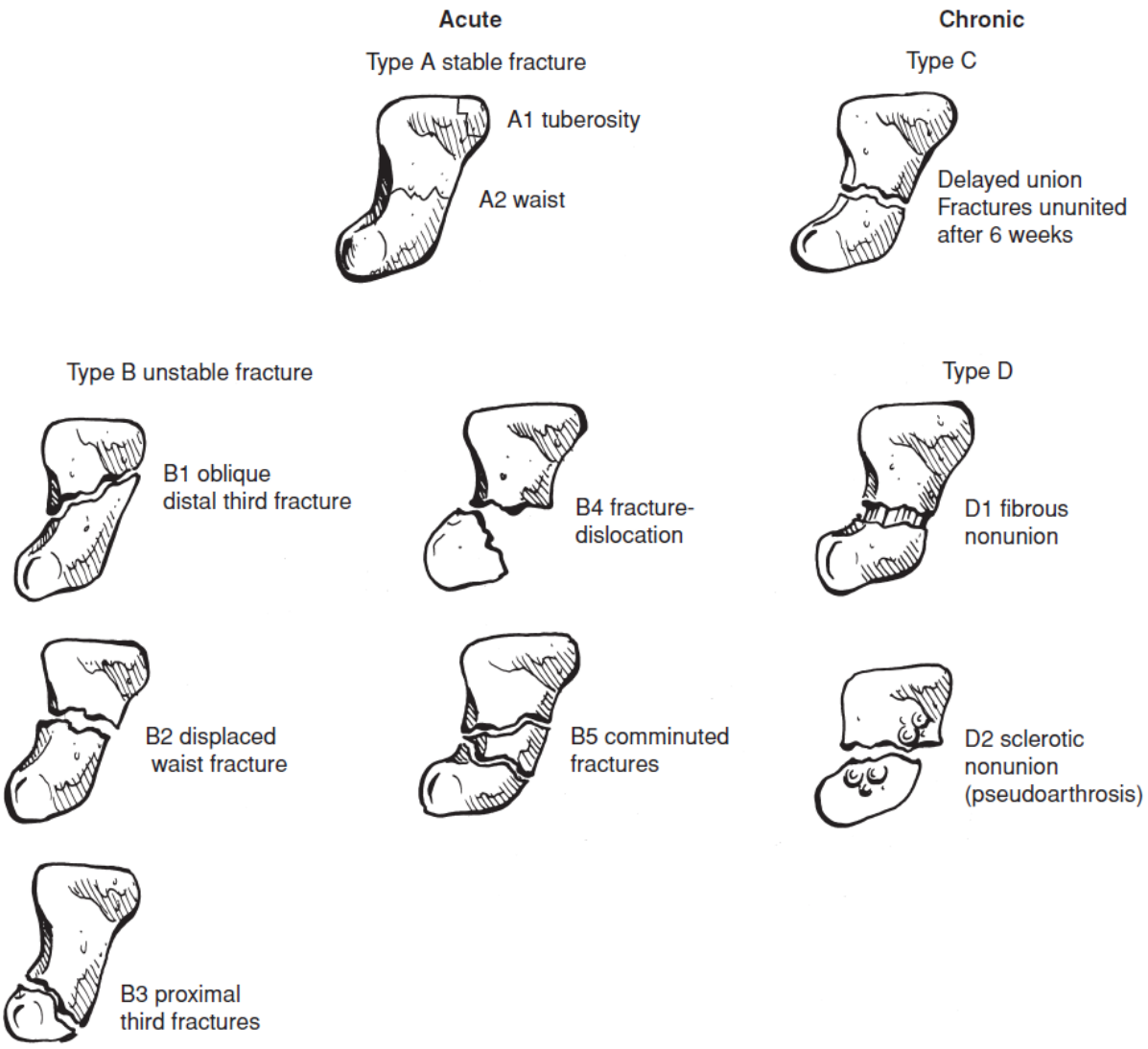
For planning the management of cases of scaphoid non-union, MRI can be used following internal fixation, as the bone marrow signal can be assessed even in the presence of a titanium alloyed Herbert screw. [60] Scaphoid fractures are commonly associated with injuries to the carpal ligament or triangular fibrocartilage complex, and reported in 35% of affected patients and intercarpal soft tissue injury may ensue in 86% of instances. [61]

CLASSIFICATION

There are several classification systems available for fractures of the scaphoid. These include the following.

1. Herbert and Fisher classification
2. Russe classification
3. AO classification
4. Mayo classification

HERBERT FISCHER CLASSIFICATION [62]

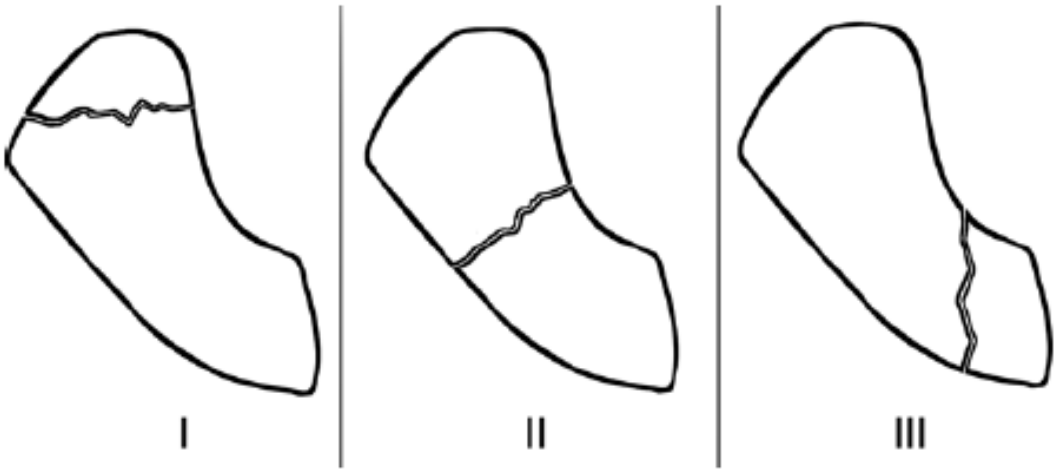


The ideal classification system by Herbert is simple, yet guides in the treatment. The Herbert classification is the most commonly used because it defines stable and unstable fractures, a significant delineation when determining surgical versus nonsurgical treatment.

Herbert divided acute fractures into stable (type A) and unstable (type B). Scaphoid tubercle fractures and incomplete waist fractures are stable in the classification system, whereas comminuted fracture, fracture-dislocations, oblique distal pole fractures, proximal pole fractures, and complete/displaced waist fracture are considered unstable.

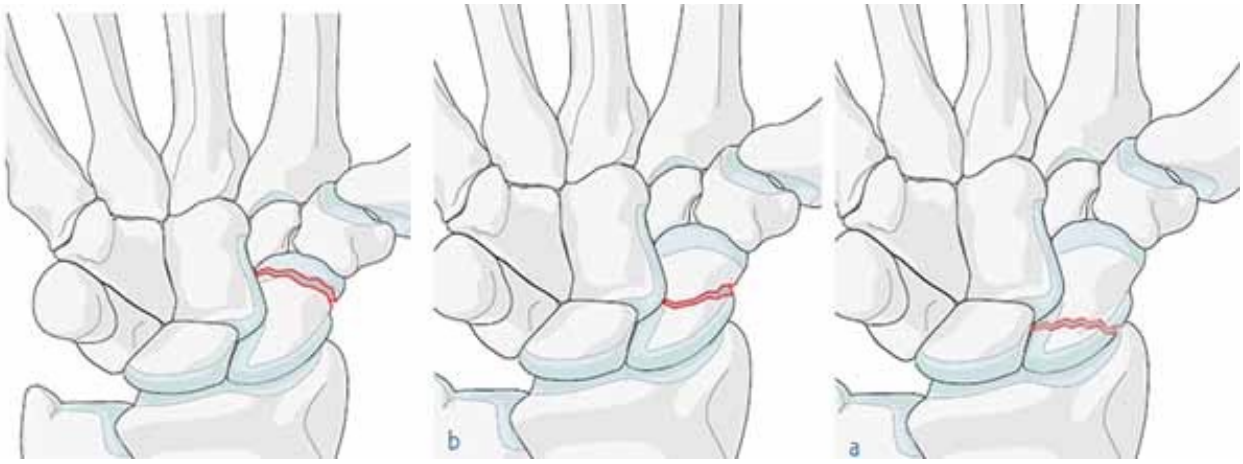
Delayed unions (type C) and established non-union (type D) concludes the Herbert classification system. According to Herbert system Unstable fractures are fractures with a displacement of more than 1 mm or an angulation of more than 15 degrees between the fragments.

RUSSE CLASSIFICATION [63]



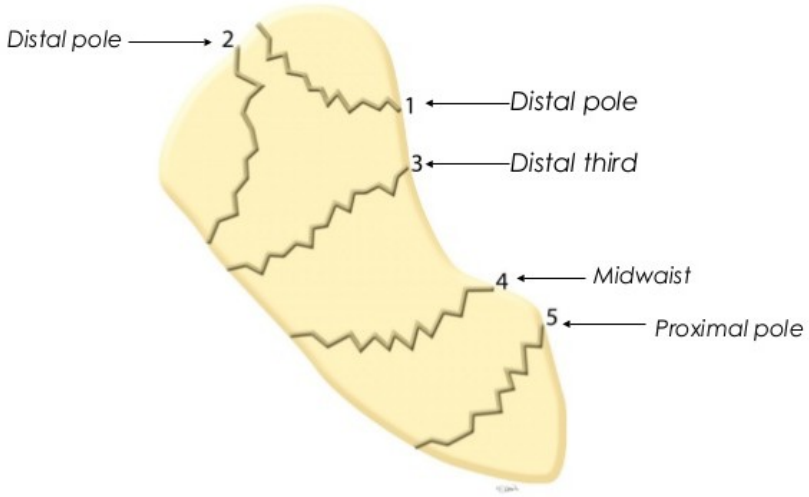
The Russe classification describes scaphoid fractures based on the orientation of the fracture line (horizontal, oblique, transverse, or vertical oblique). Russe determined that vertical oblique fractures were the most unstable type because of shear forces across the fracture site. Horizontal oblique fractures were the most stable, because they experience the most compressive force.

AO CLASSIFICATION [64]



The AO classification breaks the fracture down into simple anatomic location (distal pole, waist, proximal pole) and comminution.

MAYO CLASSIFICATION [65]



The Mayo classification divides scaphoid fractures into proximal (10%), middle (70%) and distal (20%) fractures. Within the distal third, distinction is made between the distal articular surface and the distal tubercle.

The criteria for instability said by Mayo are as follows: [66]

1. >1 mm of fracture displacement
2. A lateral intrascaphoid angle of >35 degrees
3. Bone loss or comminution
4. Fracture malalignment
5. Proximal pole fractures
6. DISI deformity
7. Perilunate fracture-dislocation

MANAGEMENT

The surgeon must consider multiple factors when determining the optimal treatment of scaphoid fractures. Fracture location is an important consideration, because waist fractures, which account for more than 70% of fractures, often demonstrate healing in 8 to 12 weeks. Distal pole fractures heal fastest, usually within 6 to 8 weeks, and proximal pole fractures the slowest, ranging from 12 to 24 weeks and are prone to avascular necrosis and may be better treated with screw fixation even when it is undisplaced. [67]

Fracture displacement is a critical component in the surgical algorithm because truly nondisplaced fractures have high union rates, whereas displaced fractures are more susceptible to further displacement and non-union. [68] Finally, patient needs and expectations must be considered. Surgical treatment results in faster return to work and/or sports compared with cast treatment.

Though any treatment that promotes scaphoid fracture healing can be considered successful, one that promotes primary healing is clearly favourable as scaphoid fractures do not make callus and are unable to heal by secondary bone healing.

Delay of even 4 weeks for treatment can lead to significantly higher rates of delayed union and non union, highlighting the importance of early diagnosis and treatment. [69]

NON OPERATIVE MANAGEMENT

Location of the fracture is a major predictor of time to union with nonoperative treatment. Proximal pole fractures even when undisplaced takes long time to union and are more prone to AVN are better treated surgically than with cast management. Inadequate immobilization of a scaphoid fracture increases the chances for pseudo-arthrosis by 30%.[70]

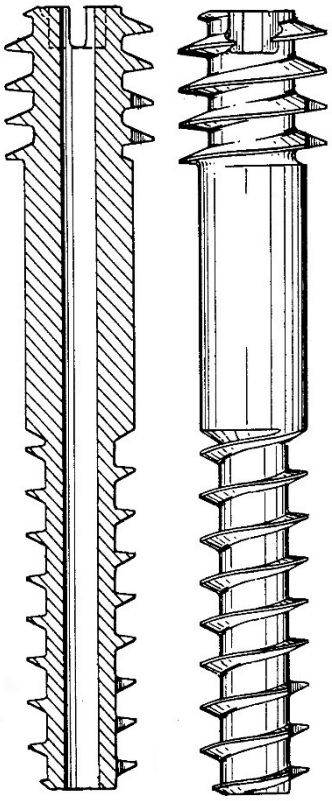
Undisplaced stable fractures can be treated non operatively with short thumb spica cast for a period of 6-8 weeks. [71] While prolonged immobilisation disrupts collagen homeostasis resulting in loss of normal connective tissue characteristics and carries the risk of stiffness of the carpal joints and delayed union or non-union in 10-50% cases of displaced fractures. [72]

OPEN REDUCTION AND INTERNAL FIXATION

The most common indication for internal fixation is acute displaced fractures and proximal pole fractures and all unstable fracture patterns described by Herbert classification and Mayo classification enlisted before.

HERBERT SCREW [73]

The Herbert screw is a double-threaded titanium alloy screw. It is 2.5 mm in diameter and ranges from 12 to 32 mm in length. The pitch and diameter of the distal threads is greater than the proximal threads, allowing for compression across the fracture site. There is no need to remove the screw because it is recessed beneath the articular surface. The screw was devised to provide secure fracture fixation and allow early mobilization of the wrist. The distal threads are self-tapping and the discrepancy in pitch between the two threads allows for further compression of the fracture site.



SURGICAL APPROACHES

The Dorsal and Volar approach to Scaphoid are the two commonly used approach for the open reduction and internal fixation of the Scaphoid fractures.

VOLAR APPROACH [74]

With the patient supine and under suitable anaesthesia, prepare the hand and wrist and one iliac crest and inflate a pneumatic tourniquet. The volar approach usually gives the best exposure for scaphoid fractures at and distal to the waist. Make a longitudinal skin incision over the palmar surface of the wrist, beginning 3 to 4 cm proximal to the wrist flexion crease over the flexor carpi radialis. Extend the incision distally to the wrist flexion crease and curve it radially toward the scaphotrapezial and trapeziometacarpal joints.

Protect terminal branches of the palmar cutaneous branch of the median nerve and the superficial radial nerves. Reflect skin flaps at the level of the forearm fascia. Open the sheath of the flexor carpi radialis, retract the tendon radially, and open the deep surface of its sheath. Expose the palmar capsule of the joint over the radioscaphoid joint.

Extend the wrist in ulnar deviation and open the capsule in the longitudinal axis of the scaphoid bone, obliquely extending the incision toward the scaphotrapezial joint. With sharp dissection, expose the fracture, incise the long radiolunate and radioscaphocapitate ligaments, preserving each leaf of these capsuloligamentous structures for later repair.

Inspect the fracture to determine the need for bone grafting. If comminution is absent or minimal, reduction and fixation suffice. If comminution is extensive, especially on the palmar surface, with a tendency to flexion of the scaphoid at the fracture, obtain an iliac crest bone graft.

Kirschner wires placed in the distal and proximal poles as toggle levers ("joysticks") help to manipulate the fragments. Reduce the fracture and fix it with Kirschner wires avoiding rotation or angulation. Ensure that the guidewire is centered in the proximal and distal poles. Image intensification with C-arm fluoroscopy is helpful for this step.

For fractures through the waist and in the distal pole, insert the fixation device through a distal entry point. Create the distal entry point by opening the scaphotrapezial joint with a longitudinal capsular incision. Remove a portion of the trapezium with a rongeur to allow placement of the guidewire from distal to proximal to better place the wire in a more center-center position. Insert the screw until the trailing end (head) is flush with subchondral bone, countersunk beneath the articular cartilage.

Placement of Kirschner wires down the long axis of the scaphoid is made easier by gentle radial deviation of the wrist, aligning the scaphoid vertically. With the wrist in this position, direct the wires almost dorsally into the scaphoid.

After stable reduction and fixation are obtained, check the position and alignment of the reduction and the placement of the internal fixation with image intensification or radiographs. Deflate the tourniquet and obtain haemostasis. Insert a drain if needed, and close the wrist capsule with nonabsorbable sutures or long-lasting absorbable sutures. Close the skin and apply a dressing that includes thumb spica cast.

Below figure shows the volar approach with A-F showing the exposure in the following sequence skin marking, FCR tendon sheath exposure, volar ligament sparing incision and carpal capsule exposure, G showing the proximal & distal ends manipulation with K wire as joysticks and H showing the reduction attempted and I showing the suturing of the volar ligaments.

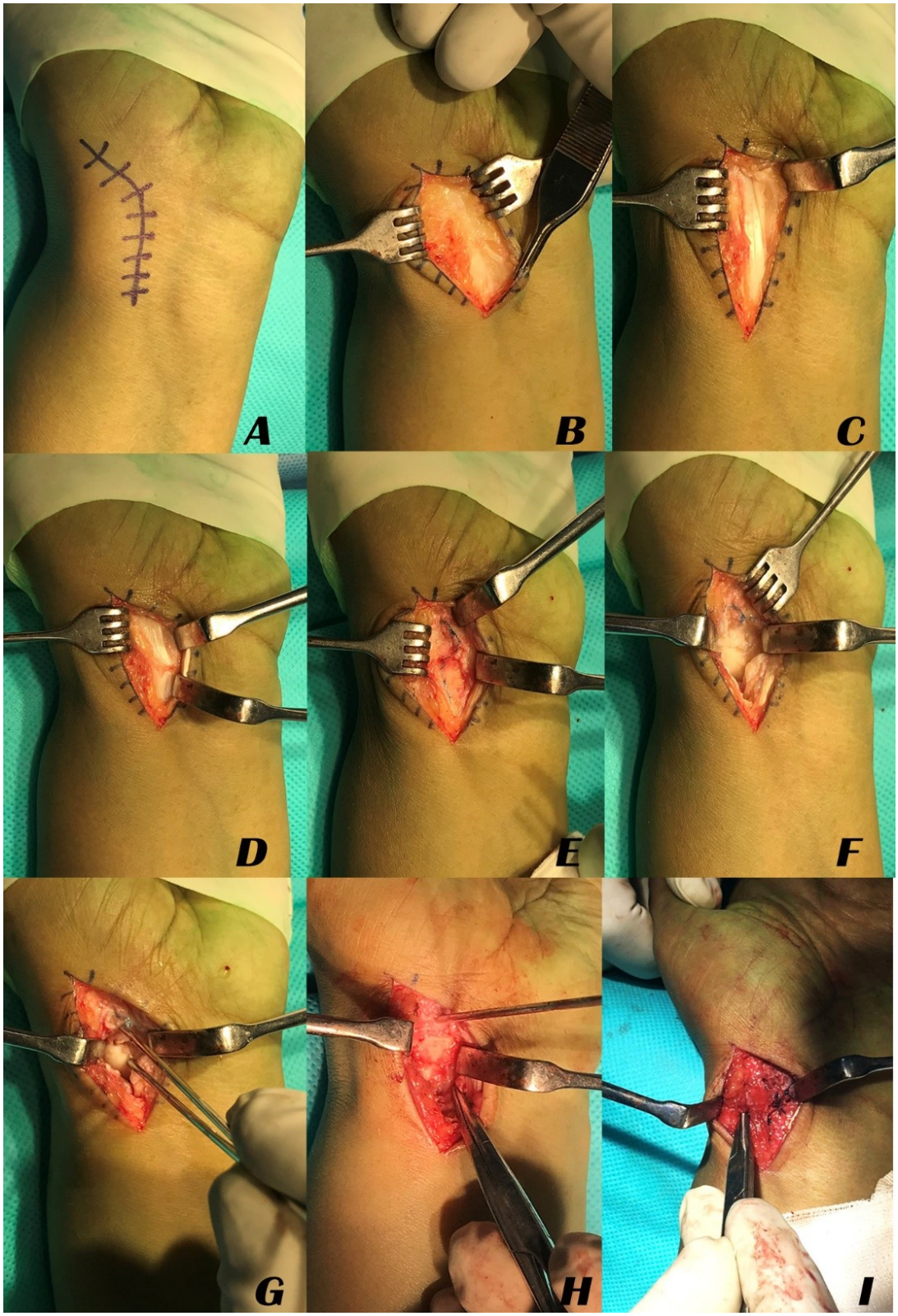


Figure showing the open volar approach to scaphoid

DORSAL APPROACH [75]

For non comminuted fractures in the proximal pole of the scaphoid, exposure of the fracture site and placement of internal fixation can be ideally done through a dorsal approach. Make a dorsal vertical incision 5 to 10 mm along the anatomical snuff box exposing the interval between the first and second dorsal compartment radiocarpal joint. Protect the sensory branches of the radial and ulnar nerves. Preserve, cauterize, or ligate and divide dorsal veins.

Make vertical incisions in the extensor retinaculum, protect the extensor tendons, especially the extensor pollicis longus tendon as it exits the third dorsal retinacula compartment. On incising the retinaculum, it allows access to the dorsal wrist capsule.

Pass a loop of umbilical tape around the extensor tendons, and retract them ulnarly. Open the dorsal capsule by creating a radially based flap, incising along the dorsal intercarpal ligament and the dorsal radiotriquetral ligament. Retract the capsular flap radially and expose the fracture.

Insert a Kirschner wire into the proximal fragment parallel to the central axis of the scaphoid. Use this wire as a toggle lever (“joystick”) to manipulate the proximal fragment into a reduced position. When the fracture is reduced, pass the first wire across the fracture for temporary interfragmentary fixation. Center the guidewire in the proximal and distal poles, monitoring this placement with C-arm fluoroscopy.

Determine the appropriate length of the screw to be used. Drill and tap the bone and insert the screw of appropriate length. Ensure that the guidewire or screw fixation is placed in the center of the long axis of the proximal and distal poles of the scaphoid, using C-arm fluoroscopy. Close the capsular flap and repair the retinacula flap. Close the skin and apply a thumb spica splint.

The dorsal approach has the advantage that it does not violate the scaphotrapezial joint for the entry of the screw track and hence the iatrogenic complication of scaphotrapezial arthritis is avoided in the future.

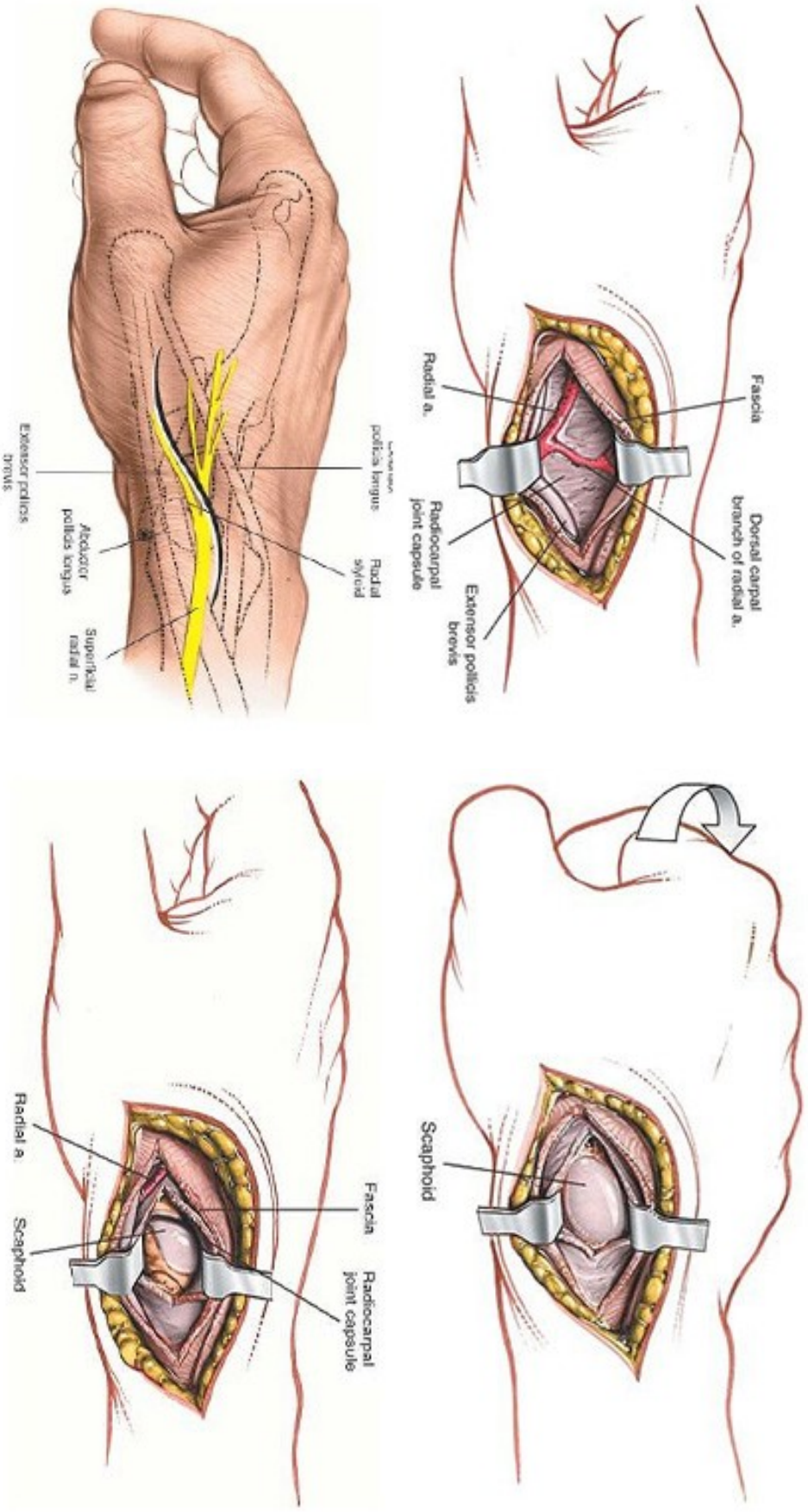


Figure shows the open dorsal approach to scaphoid.

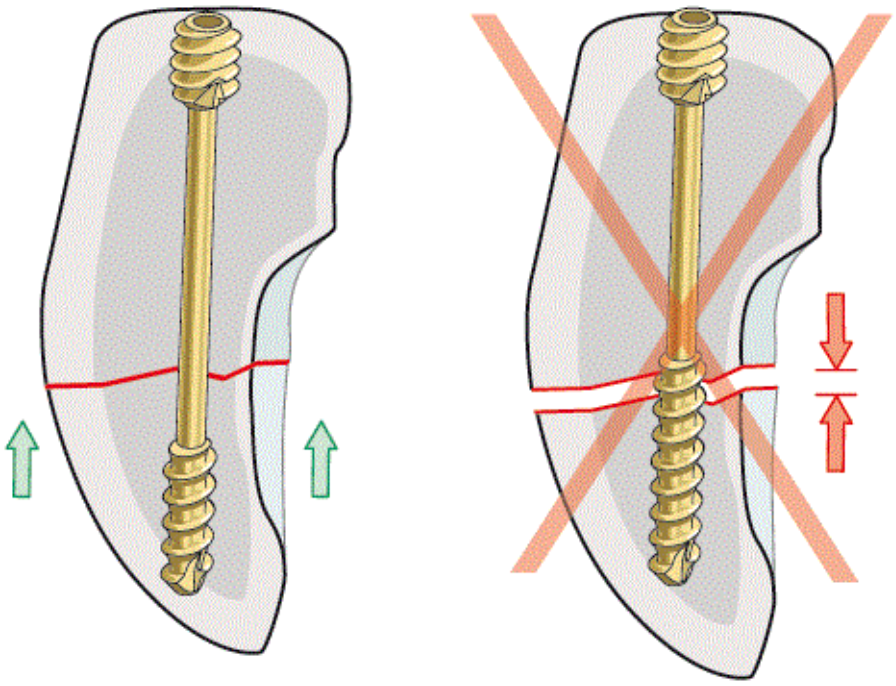


Figure showing ideal length and position of screw across the fracture

The length of the screw must be determined in such a way that the fracture line must have the smooth shank of the thread to enable fracture compression at the fracture site as shown in the above figure.

Yip et al [76] suggested the 45-degree supination oblique view when determining the length of the screw and avoiding over-penetration into the radioscaphoid joint space. The headless screw must be fully buried beneath the articular cartilage of the proximal scaphoid, so as to avoid radioscaphoid impingement.

Scaphoid fixation is best accomplished with the longest screw placed in the distal scaphoid poles. Bone density is greatest in the scaphoid poles, where it provides the best

fixation. [77] Fractures of the distal two thirds can also be approached volarly, as this approach avoids injury to the dorsal blood supply.

The volar technique is contra-indicated in proximal pole and oblique fractures, as the screw cannot cross the fracture line perpendicularly to obtain adequate compression and purchase. This leads to displacement of the fracture. [78]

The drawback of volar surgical approaches is the difficulty in obtaining fracture reduction, which may therefore result in non-union of proximal scaphoid pole fractures. [79] The trapezium is in a position that blocks wire placement volarly, and therefore placing a guidewire along the central scaphoid axis is difficult such that the screw can also penetrate the joint.

For the dorsal approach, the distal point aimed at is the centre of the scaphotrapezial joint or the base of the thumb. Thus, this allows for a more central placement in the distal pole. [80] The dorsal approach provides direct unobstructed access to the proximal pole permitting the placement of a central axis guidewire for screw implantation. There is better fracture fixation as the purchase of the screw threads in the proximal fragment tends to be greater.

However, the disadvantages of this technique include poor exposure to the distal third of the scaphoid, damage to the articular cartilage of the proximal pole of scaphoid, potential entrapment of the extensor tendons, damage to the dorsal ligaments, and risk of vascular injury. Moreover, to insert the screw through the most proximal part, the wrist has to be fully flexed during the procedure. Flexing the wrist may cause the distal fragment to adopt a flexed posture and cause the proximal fragment to follow the lunate into an extended posture, producing the hump-back deformity.

Distal pole fractures can present technical difficulties for insertion of a volar screw perpendicular to the fracture line and are therefore best suited for fixation using the dorsal fixation technique. [81]

Approximately 4mm - 6mm mm should be subtracted from the measured screw length to permit burying the screw under the chondral surface of the distal pole without breaching the chondral surface of the proximal pole. [82]

PERCUTANEOUS FIXATION:

After thorough preoperative radiological examination, minimally displaced waist fractures of the scaphoid are managed with percutaneous approach. Closed reduction manoeuvre consists of hyperextension and ulnar deviation of the wrist facilitating any necessary reduction of the fracture. Hyperextension also assists in bringing the trapezium dorsal to the insertion point of the guide wire, at the scaphoid tubercle. A short stab incision is made distally to the scaphotrapezial joint. Use a hypodermic needle to determine the insertion of the guide wire radiologically before insertion of the threaded guide wire.

The insertion point is on the distal surface of the scaphoid tubercle at the edge of the scaphotrapezial joint. The threaded guide wire is inserted at the confirmed entry point through a drill guide. If no drill guide is available, use a protective sleeve.

The trajectory of the guidewire is that it must be angled 45 degrees dorsally and 45 degrees medially along the mid axis of the scaphoid. The position of the wire must be perpendicular as possible to the fracture line. In oblique fractures, this principle may have to be compromised. Do not penetrate the proximal cortex of the scaphoid.

Two methods can be employed for measuring the desired screw length:

1. Insert the dedicated measuring device over the guide wire, through the drill guide, which must be firmly positioned on the tubercle for a reliable measurement.

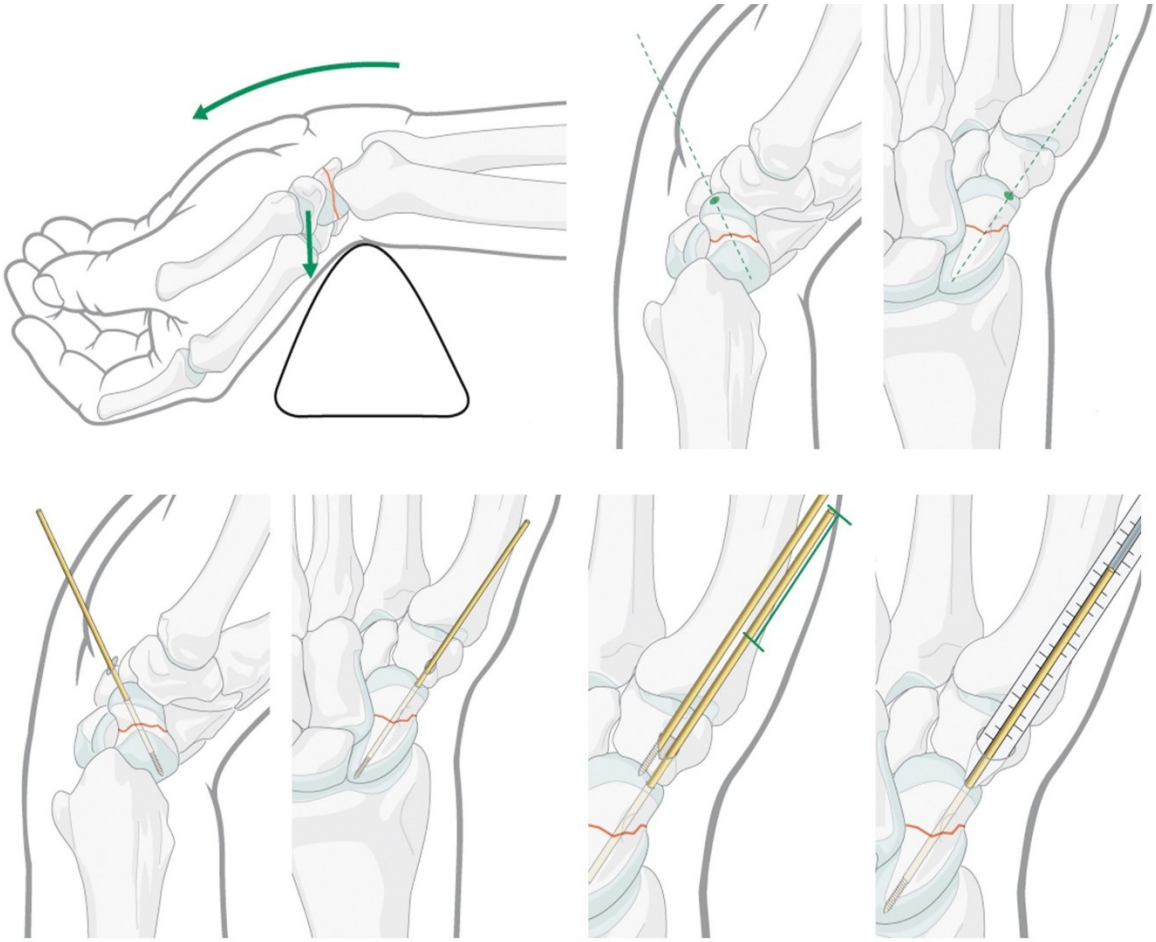
2. If the dedicated drill guide is not available, take another guide wire of the same length and place its tip onto the bone at the insertion point. The difference in length between the protruding ends of the two wires indicates the length of the drill hole for the screw. Subtract 4 mm to determine the screw length.

Use only the dedicated drill bit. A power drill will exert a smaller and more controlled force on the fragments than manual drilling, and will reduce the risk of displacing the fragments. A small power drill with slow rotation is preferable. Use Ringer lactate solution to cool the drill bit, in order to minimize thermal injury. Check the position of the tip of the drill bit using image intensification. Tap the drill hole manually if not using self-tapping screws.

Insert the screw manually over the guide wire. It is vital that the threaded section of the tip of the screw pass completely beyond the fracture plane, if interfragmentary compression is to be achieved. Before final tightening, remove the guide wire.

Make sure that the threads at the near end of the screw are fully buried in the bone at the insertion site. Make sure that all threads on the far side have crossed the fracture plane in order to ensure interfragmentary compression. Check the final position of the screw and the scaphoid stability using image intensification.

THE METHOD OF PERCUTANEOUS FIXATION OF SCAPHOID FRACTURE.



POST OPERATIVE CARE

The sutures are removed and the cast is removed at 2 weeks. As healing progresses as shown by radiographic examination at follow up a short arm thumb spica brace is worn until bone healing is ensured. [83] If healing cannot be determined with certainty, CT can be helpful to evaluate for bridging trabeculae. Finger, thumb, and shoulder motion is encouraged throughout follow up period and after cast removal wrist motion and elbow motion are increased gradually, followed by strengthening exercises. [84]

COMPLICATIONS

Complications of open repair include hypertrophic scarring, avascular necrosis, carpal instability, screw protrusion. [85] Injury to the superficial branch of the radial artery, delayed union, complex regional pain syndrome and infection using the palmar approach have been reported in literature. [86]

The main disadvantage of Herbert screw fixation is its technical difficulty. The operation requires skill and practice. [87] Problems with the scar can be reduced by modifying the incision in patients at risk. We found no evidence of significant osteoarthritic changes in the scaphotrapezial joint after use of a volar approach for internal fixation.

The palmar approach may be advantageous in certain cases as it is easy to find the entry because the guide wire does not cross the radiocarpal joint, it is technically less demanding and it is easy to maintain fracture reduction with wrist extension. Further, there is no risk of injuring the extensor tendons. [88]

MATERIALS AND METHODS

PLACE OF STUDY

Institute of Orthopaedics and Traumatology,

Rajiv Gandhi Govt. General Hospital & Madras Medical College, Chennai.

PERIOD OF STUDY

18 months from March 2017 to August 2018

INCLUSION CRITERIA

1.Age >18yrs

2.Both Male and Female patients

3.Displaced distal pole and waist fractures of Scaphoid

4.Proximal pole fracture of Scaphoid

EXCLUSION CRITERIA

1.Age <18 yrs

2.Tuberosity fractures of scaphoid

3.Compound injuries

4.Associated fractures, dislocations or ligament injuries of same wrist

SAMPLE SIZE: 10

MANAGEMENT PROTOCOL

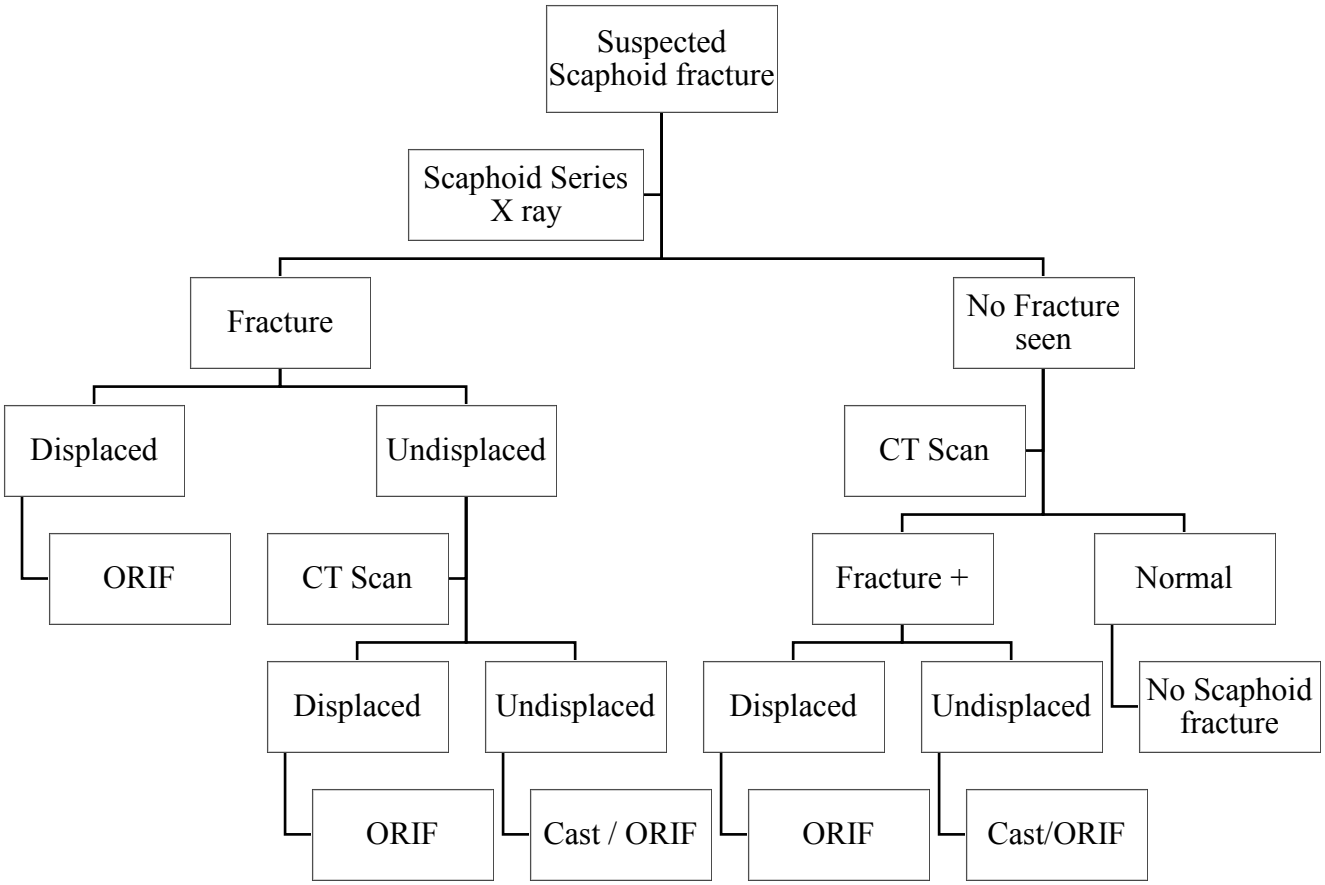
Patients who came with clinical findings in suspicion of scaphoid fracture is evaluated radiologically with Scaphoid series of X rays. Scaphoid series included, postero anterior view, lateral view, postero-anterior view with wrist in ulnar deviation (scaphoid view).

If there is a scaphoid fracture visible in the initial radiograph they are classified according to Herbert Fisher classification and operated with open reduction and internal fixation with Herbert screw. If the initial radiographs are does not show any evident fracture but if there is a strong suspicion of fracture, then they are evaluated with CT scan to rule out fracture and if CT also doesn't show any fracture then patient is treated symptomatically.

If the CT shows evidence of fracture, then the fracture pattern and displacement is analysed and fractures are classified and operated as mentioned above. Volar approach was used to all waist fracture and displaced distal pole fractures and dorsal approach to all proximal pole fracture.

Retrospective cases who were followed up during the study period were also included in the study and analysed for their functional outcome.

MANAGEMENT PROTOCOL



POST OPERATIVE PROTOCOL

Post operatively intravenous antibiotics was administered for 5 days and oral antibiotics for 7 days. Suture removal was done on 12^{th} post operative day. In all cases scaphoid cast was applied post operatively with a window at surgical wound site. Two weeks post operatively; sutures were removed and cast was removed and replaced with removable wrist immobilizer brace for another four weeks along with physiotherapy. Hand grip strengthening exercise with active assisted range of motion exercise of wrist was started. All patients were evaluated at four weeks interval until fracture united.

At each follow up, patients were subjected to clinical as well as radiological examination with scaphoid profile. Union was considered to have occurred when there was no tenderness at the anatomical snuff box or at scaphoid tubercle and there was evidence of trabeculae crossing fracture on at least two views. Radiological assessment of the screw position was confirmed on every follow-up.

On final follow up clinical assessment were performed based on Modified Mayo Wrist Score (MMWS) Grip strength was measured asking the patient to squeeze the examiners index finger, and the strength was compared on contralateral side. To avoid subjective bias two surgeons assessed grip strength separately and the average of two findings was taken as a final outcome. Grip strength was graded according to MRC grading. Range of motion was measured using goniometer.

MODIFIED MAYO WRIST SCORING CHART [89]

CATEGORY	SCORE	FINDINGS
PAIN (25 points)	25	No Pain
	20	Mild pain with vigorous activities
	15	Moderate pain with vigorous activities
	10	Mild pain with ADL
	5	Moderate pain with ADL
	0	Pain at rest
SATISFACTION (25 points)	25	Very satisfied
	20	Moderately satisfied
	10	Not satisfied but working
	0	Not satisfied, unable to work
RANGE OF MOTION (25 points) (% of normal)	25	100
	15	75-99
	10	50-74
	5	25-49
	0	0-24
GRIP STRENGTH (25 points) (% of normal)	25	100
	15	75-99
	10	50-74
	5	25-49
	0	0-24

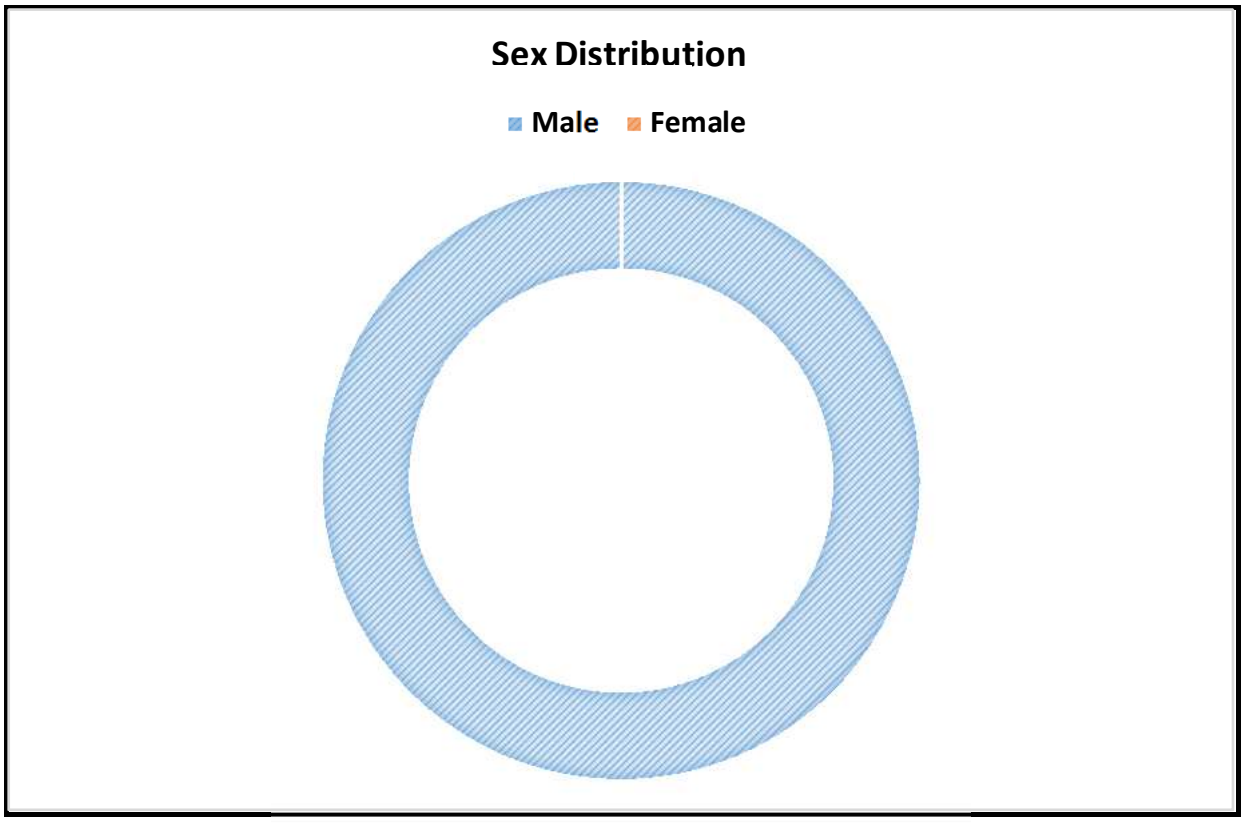
MODIFIED MAYO WRIST SCORING CHART [89]		
FINAL RESULT	90-100	Excellent
	80-89	Good
	65-70	Fair
	<65	Poor

STATISTICAL ANALYSIS:

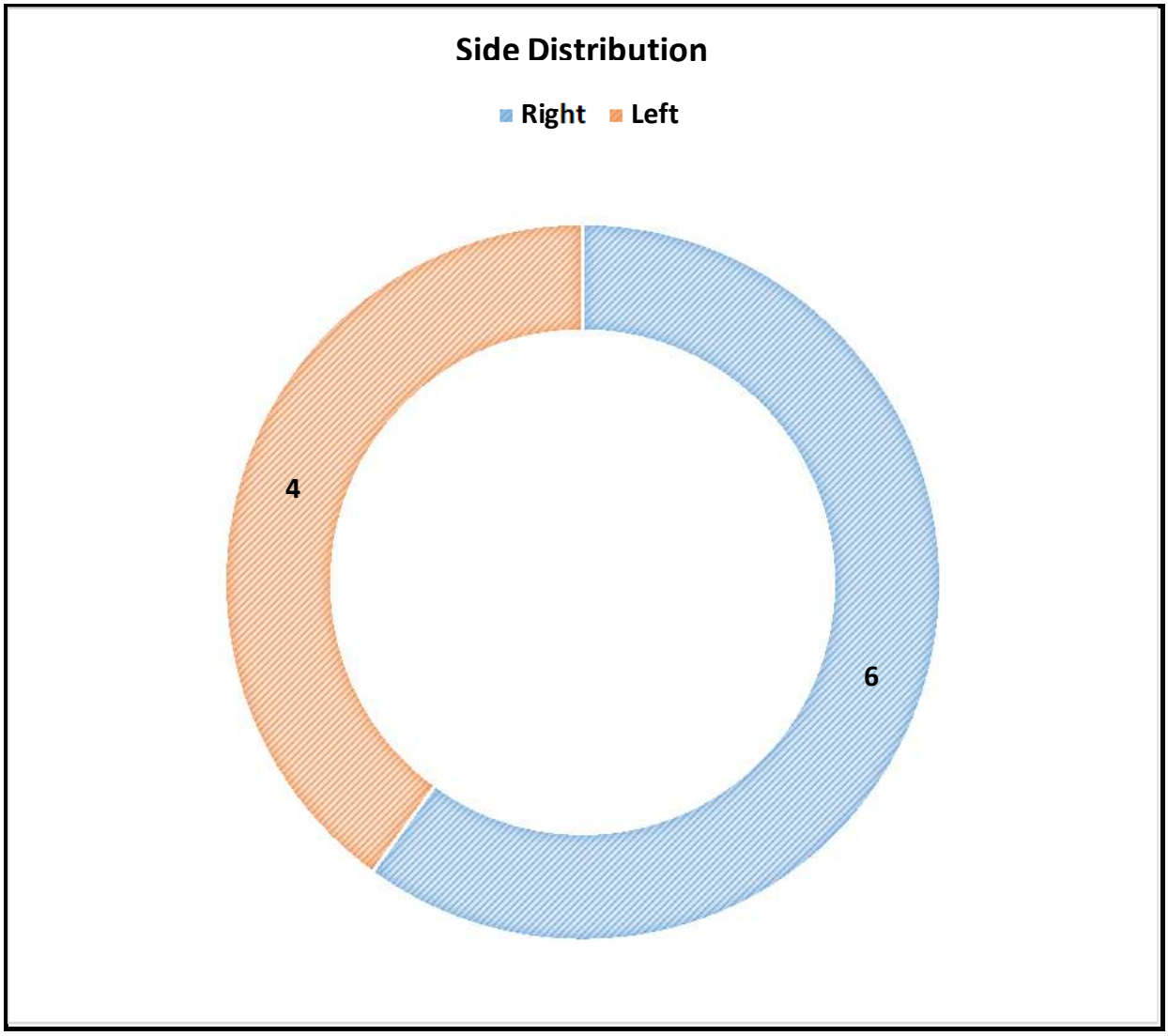
Statistical analysis was done using IBM SPSS software version 25. Descriptive statistics were applied for the patient demographics, presentation data and frequency distribution was found for each parameter under evaluation like duration of union, screw length used, outcome measures. Mean, Median and Standard deviation was determined for all the relevant data under analysis. Relationship of the factors under analysis was done by measuring their correlation coefficient and a p value less than 0.05 was considered significant.

OBSERVATION & RESULTS:

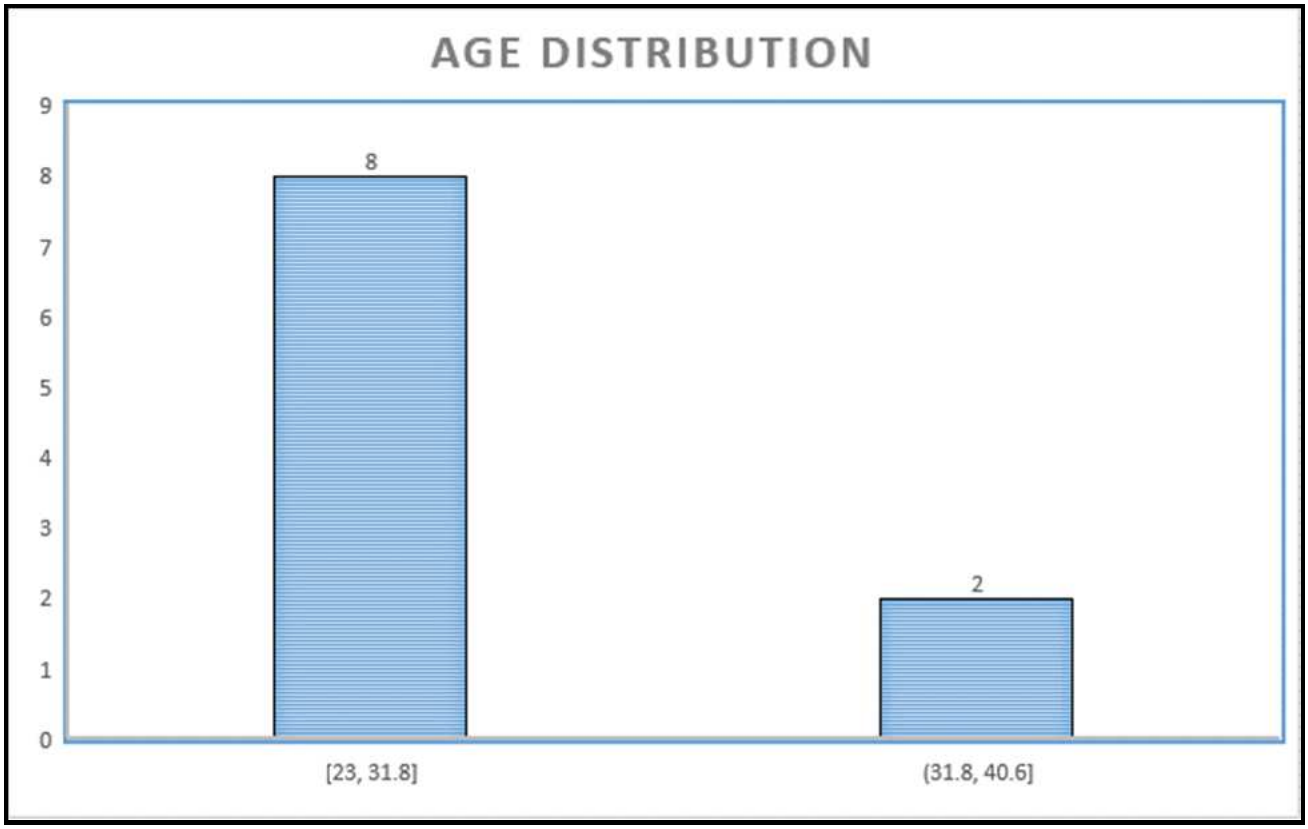
In our study we analysed the functional results of scaphoid fractures managed by Herbert screw fixation in 10 patients. All 10 patients were male showing a male preponderance in the injury. All the patients were Right hand dominant and the injury occurred in both Right and Left Scaphoid at a ratio of 6:4. The age of the study population ranged from 23 – 39 years with a mean age of 27.1 years.



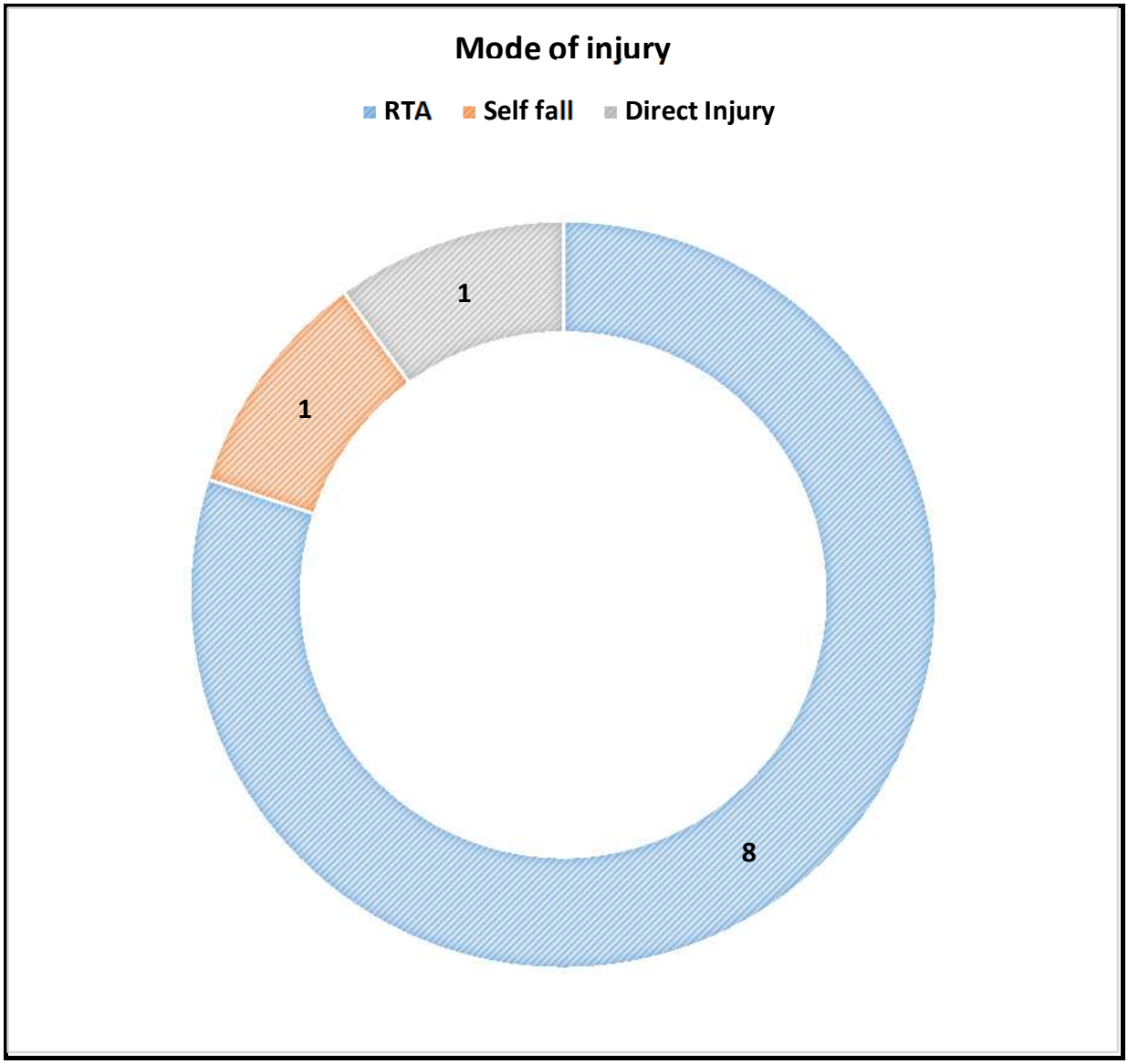
Male predominance of the injury was noted from the above chart.



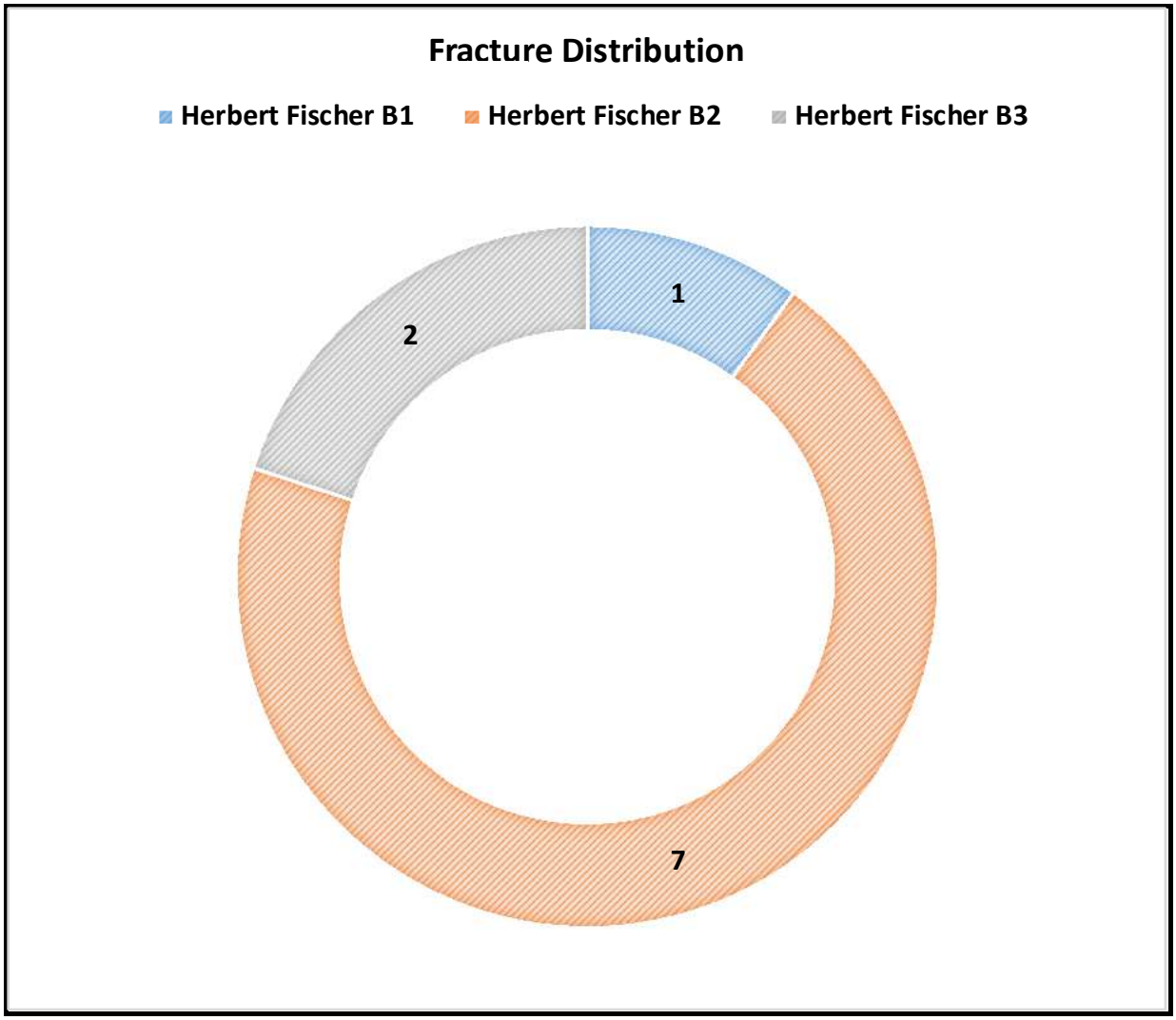
All the patients were Right hand dominant but injury occurred in both the hands with slight preponderance to the dominant side.



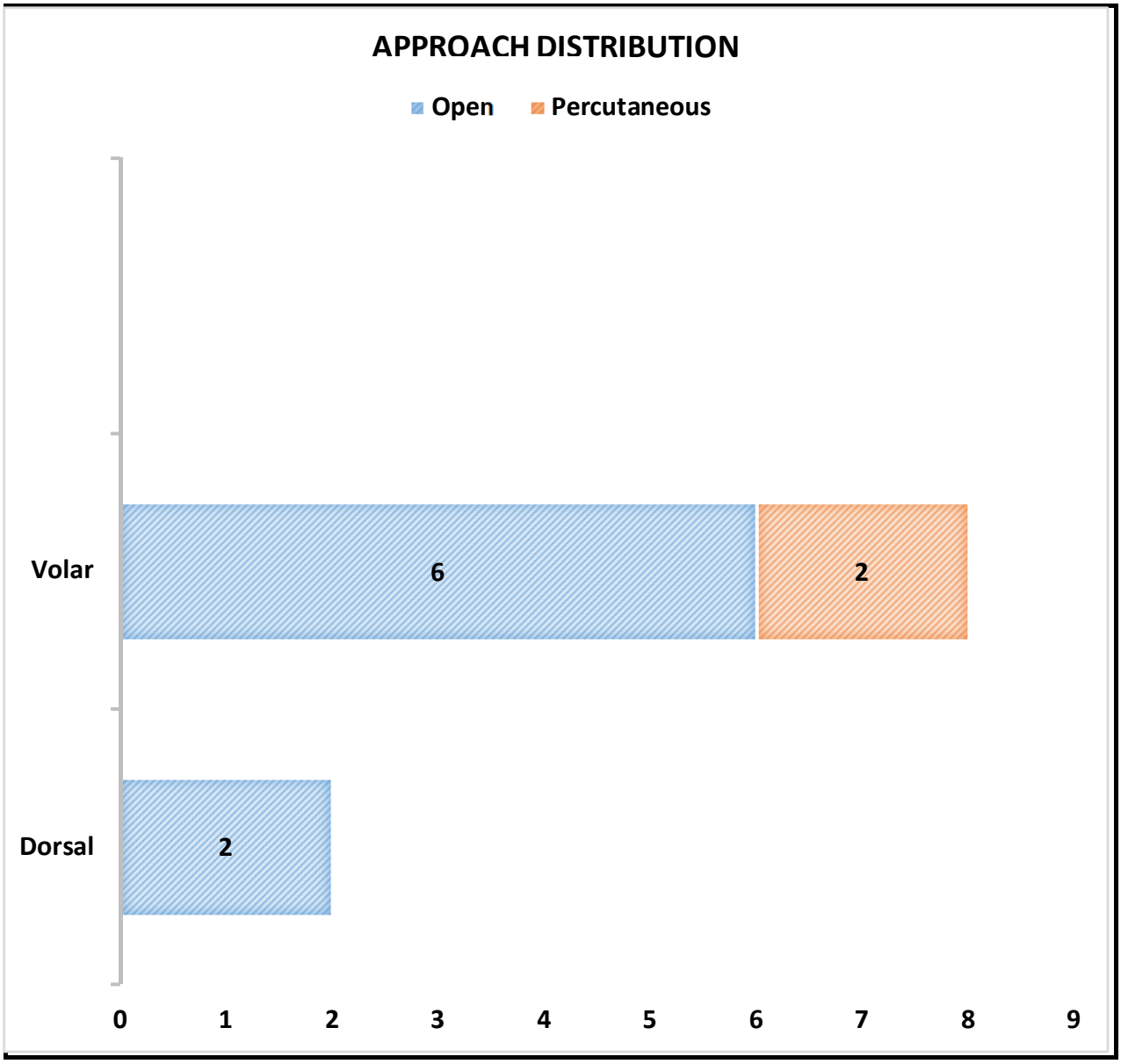
Above histogram shows that the majority of the patients affected with scaphoid fracture were of the young adult age group of 23-32 who were the major the working population of the society.



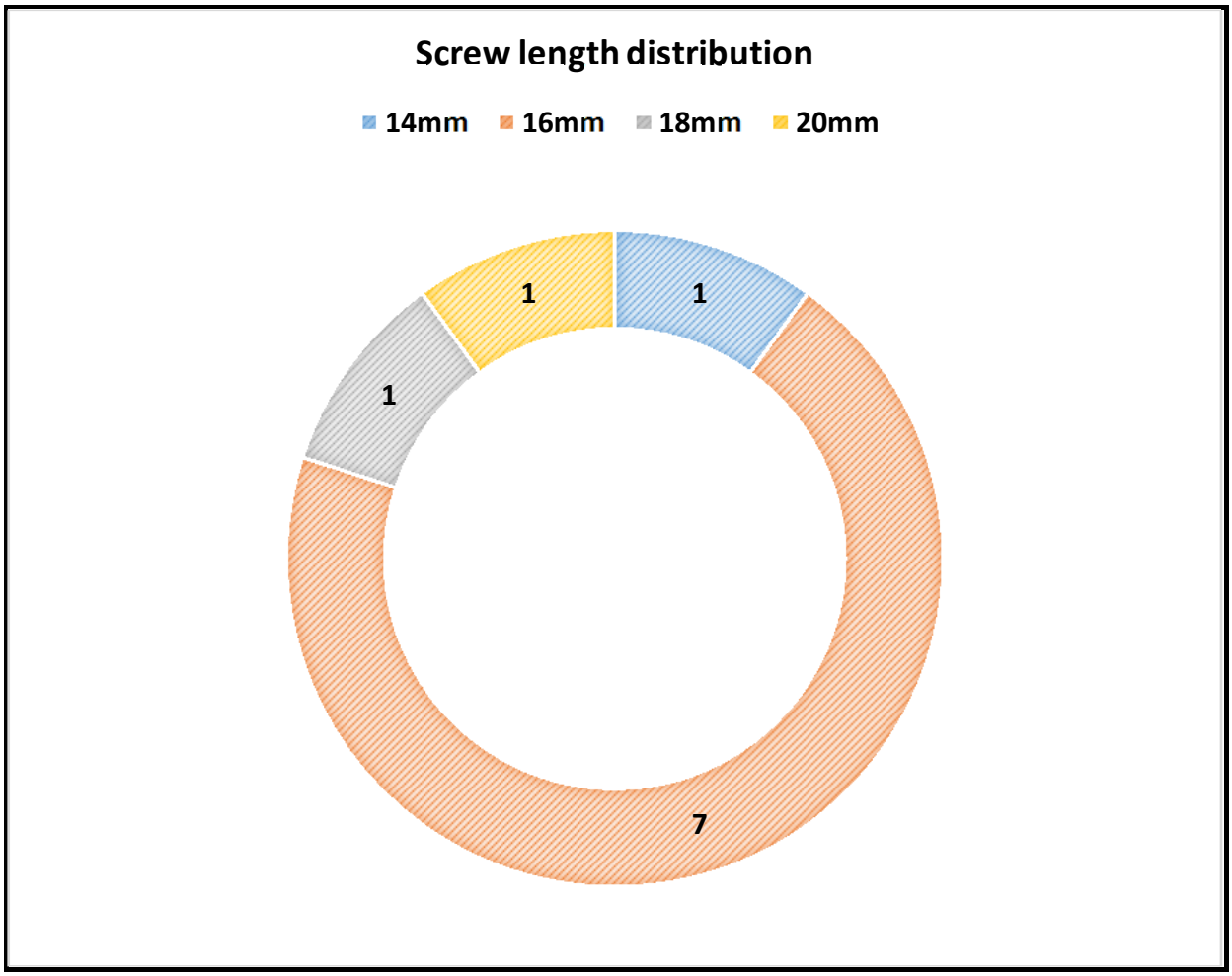
The mode of injury in the patients that resulted in these fractures when analysed showed that 6 patients sustained their injury from road traffic accident with fall on an outstretched hand with axial load and hyperextension injury. 3 patients had accidental fall on floor with outstretched hyperextended hand while one patient sustained injury from assault by direct injury over the wrist.



The duration when patients presented to us after injury ranged from immediate post injury to 17 days. The average duration at which the patient was operated post injury ranged from 10 days to 21 days at an average of 15.25 days. All the fractures were classified by Herbert Fischer classification and out of 10 cases, 1 case of B1 type and 7 cases of B2 type and 2 case of B3 type was found showing a predominance of complete displaced waist fracture of the scaphoid as the predominant type involved in the study.



5 waist fractures and 1 distal pole fractures of the scaphoid were addressed through volar approach and 2 cases of proximal pole fracture of the scaphoid was addressed by dorsal approach to scaphoid while 2 cases were fixed by percutaneous volar screw fixation.



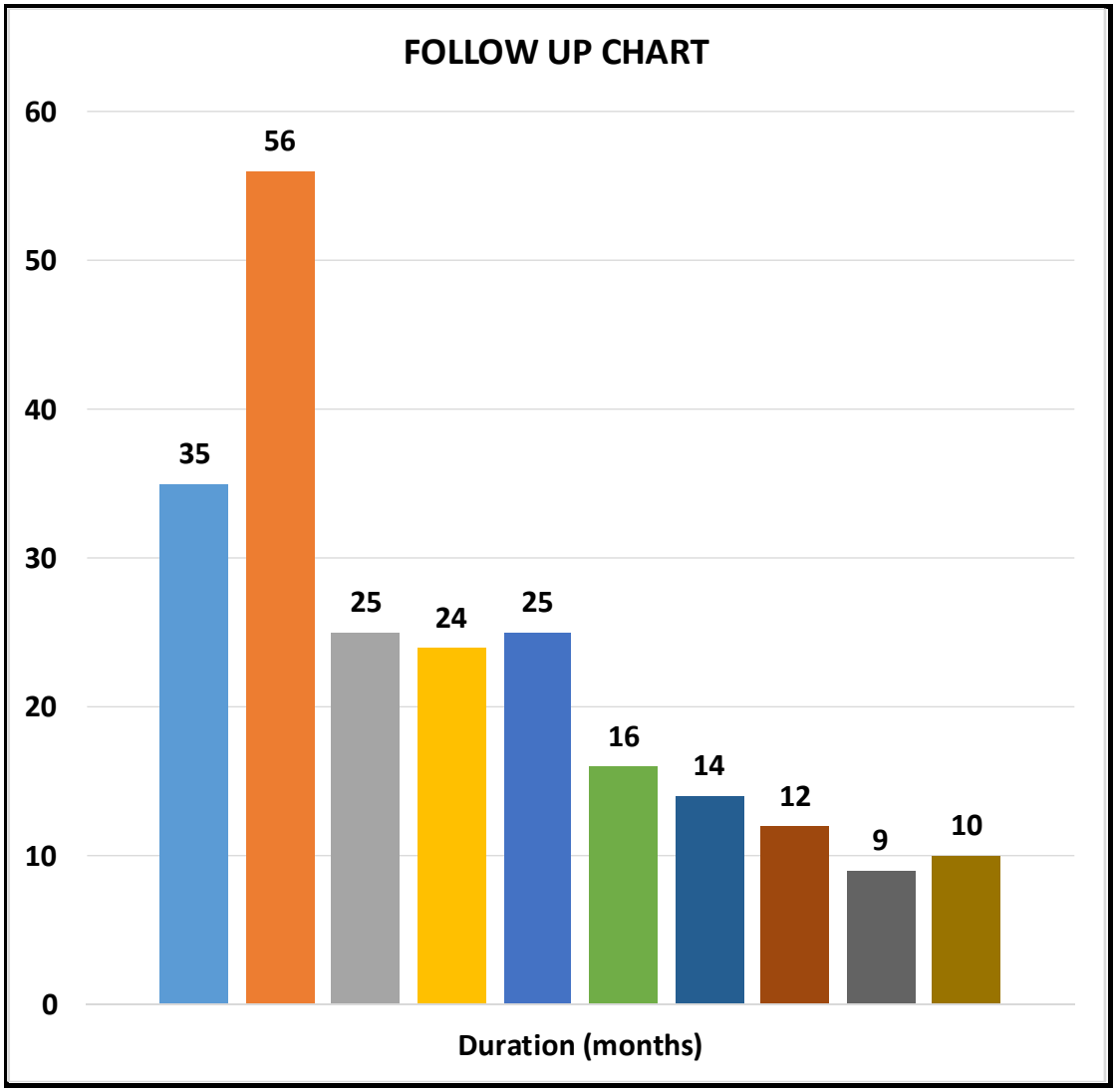
We used Herbert screws of length 14mm in 1 case, 16mm in 7 of the cases and 18mm in 1case and 20mm in 1 case.

Results were analysed both clinically and radiologically. Time of clinical union was defined as the period between operation and full weight bearing without external support along with radiographically healed fracture. Union was achieved in all the cases at a mean duration of 7.2 weeks with a range of 6-10 weeks.

Out of the 10 cases 5 cases were retrospective follow-up while remaining 5 were prospective cases done during the study period.

UNOIN TIME AND FUNCTIONAL SCORES:

There was a no statistically significant relationship between the duration of union and the functional results at 1 year, and it was noted that all cases that united had better comparable functional results at 1 year followup irrespective of the rate of union of individual fractures types.



Average duration of follow-up obtained in our study was 22.4 months with a range from 9 – 56 months. Wrist flexion averaged 66.81 (range 50 to 75) and wrist extension averaged 57.5 (range 40 to 65). According to Modified Mayo wrist score (MMWS); the mean pain score was 21.3 (range 15 to 25), mean range of motion score was 23.3 (range

15 to 25), mean grip strength score was 24.6 (range 20 to 25) and satisfaction score was 23.3 (range 15 to 25). The mean MMWS score was 87 .5(range 75 to 95).

FRACTURE TYPE & FINAL OUTCOME:

Fracture Type	Number of cases	Approach		Excellent	%	Good	%	Fair	%
		Volar	Dorsal						
B1	1	1	0	0	0	0	0	1	10
B2	7	7	0	6	60	1	10	0	0
B3	2	0	2	1	10	1	10	0	0
Total	**10**	**8**	**2**	**7**	**70**	**2**	**20**	**1**	**10**

Accordingly, seven patients (70%) had excellent results, two patients (20%) had good results and one patient (10%) had fair result and none of the patient had poor result.

There were associated injuries noted in 2 of the patients which were addressed along with the scaphoid fracture management. Both the patients had rib fracture with haemothorax which was managed with chest tube drainage.

COMPLICATIONS:

Complications noted in our study were stiffness of the wrist in the initial post-operative period in 3 cases which later subsided with wax bath mobilisation and wrist pain in 2 cases due to arthritic changes in the scaphoid-trapezoid articulation being violated for screw placement in the volar approach on one case and due to screw protrusion in one case. None of the patient had non-union. Two patients had scar sensitivity which subsided with physiotherapy.

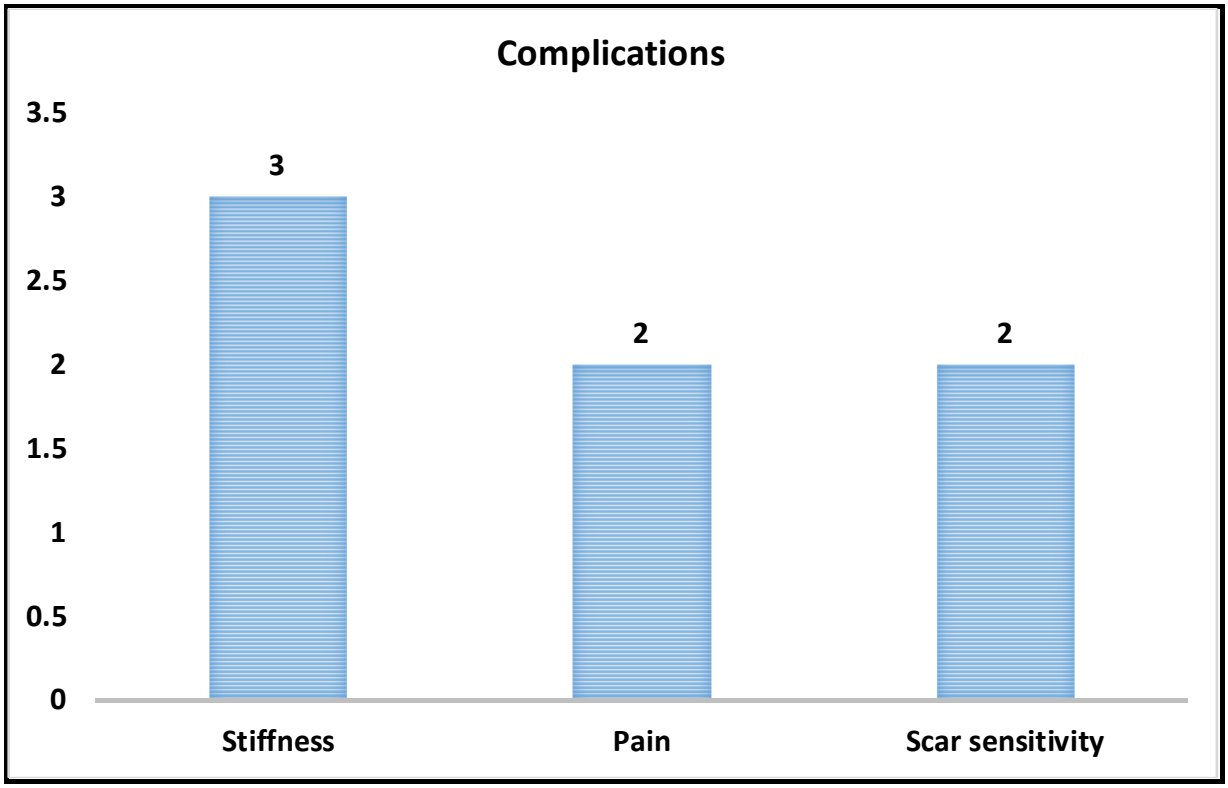


Figure shows screw protrusion in one of our case leading to wrist pain.

Wrist pain noted in one of our cases was due to the screw protrusion. Although fracture union was achieved in him patient was advised for implant exit but patient deferred any surgery to manage the wrist pain which did not affect his activities of daily living and so he is managed on close monitoring for signs of advanced arthritis in future. Hence length of the screw is of paramount importance in prevention of complications like post-operative arthritis.

DISCUSSION

Fractures of scaphoid are common, and many times are difficult to diagnose and treat. Fracture scaphoid can cause prolonged morbidity and absences from work in young adults in which they are most common. [90] In our series only two patients (20%) was above 30 years, rest 8 (80%) patients were below 30 years. This finding suggests that scaphoid fracture is common in young adults.

Open reduction and internal fixation of acute fracture of the scaphoid using a compression lag screw was recommended by McLaughlin and Maudsley and Chen to allow early mobilization of wrist. [91,92] Herbert and Fischer first described the technique in 1984, since then the Herbert screw has become widely accepted as a mode of treatment. [93]

Rettig ME et al [94] evaluated 14 patients with acute displaced scaphoid waist fractures treated by open reduction and internal fixation with Herbert screw and K wires using either volar approach or dorsal approach. Out of 14; eight were treated with Herbert screw fixation. Thirteen (93%) out of 14 got united within 11.5 weeks (range 8 – 20 weeks) with good function. Undisplaced (<1 mm displacement), stable fractures of distal and middle 1/3rd of scaphoid were treated conservatively.

Saeden B et al [95] in a prospective study compared Herbert screw fixation versus short arm cast for acute scaphoid fracture in 61 patients with 62 fractures and found that the operative group returned to work in a shorter period of time. Hence there has been a trend towards surgical fixation of these fractures.

In a study done by Davis EN et al [18], 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. When considering only direct costs, open reduction and internal fixation is cost effective relative to other widely accepted interventions.

Herbert screw can be inserted through both palmar and dorsal approach. Palmar approach is useful in waist as well as distal pole fractures and preserves the important dorsal blood supply; however, it disrupts the volar carpal ligaments and gives poor exposure of proximal pole. Dorsal approach provides exposure of the proximal pole but can disrupt the tenuous blood supply. [96,97]

In our study we have used open volar approaches in 6 cases and dorsal approach in two case. We did not encounter any complications or difficulties peroperatively using those approaches. We used percutaneous volar approach in 2 cases with waist fractures which are minimally displaced and presented early. Filan and Herbert [9] achieved 88% union rate with displaced or mobile fracture of scaphoid waist that had early surgical intervention with screw fixation.

Various authors have recommended Herbert screw fixation of scaphoid fracture by percutaneous technique. Naranje S et al [98] reported 100% union rate with Percutaneous Herbert screw fixation in 32 patients involving both fresh and late scaphoid fracture presentations with dorsal approach. We 2 cases by percutaneous technique and achieved union in both of them too.

Similarly Shin AY et al [99] 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. Reported union rates and complication rates with the percutaneous technique ranged from 94% to 100% and 0% to 30%, respectively which seem to be comparable with those of the open technique. [88]

In our series we achieved 100% union rate, minimal complication and an early return of wrist function with open reduction and internal fixation with Herbert screw irrespective of type of fracture. Though significant complications have been reported with open technique, it is mainly due to significant soft tissue dissection and violation of the extrinsic volar and dorsal ligaments. [94]

From our study we found that the average size of the screw used in our population was 16mm. The most common complication seen in various studies were; problem with scar (Hypertrophied scar), screw protrusion, osteoarthritic changes in scaphotrapezial joint after volar approach and post-operative instability. [9] Another common complication following Herbert screw fixation is non-union. In our study we faced with complications like sensitive scar, stiffness and pain. Review of literature, however, shows that the most common reason for failure in Herbert screw procedure is improper screw placement.

Several authors have stressed that, important consideration during Herbert screw fixation is that the screw should be placed within the centre of the scaphoid perpendicular to the plane of the fracture. A high successful union rate of approximately 95% can be achieved after adequate screw fixation; however, malpositioning can result in non-union of scaphoid fractures. [96,98,100]

Non-union may occur in 5% to 10% of all cases, with an even higher incidence in displaced fracture and proximal pole fracture. The reason behind such high incidence is attributed to the tenuous blood supply of the scaphoid. None of our patients had such complications.

Violation of the scapho-trapezial articulation for screw placement in volar approach, which is widely used for the waist and distal pole fractures resulted in the development of arthritic changes and pain in the wrist in late postoperative follow-up and hence as far as possible for minimally displaced fractures percutaneous approach is advocated since it is minimally invasive and does not violate the ligaments and inter-carpal articulation for the purpose of screw placement. We faced such complication in one of our cases.

Although many studies have reported good results, others have described difficulties with correct positioning of the screw. We feel that certain technical points are worth re-emphasising:

(i) Handling of the ligaments and capsule is of paramount importance to prevent any future instability due to the surgical procedure. The ligament and capsule must be repaired after the fracture has been fixed.

(ii) Length and position of the screw dictates the outcome of the surgical procedure and any compromise in the either the length or the position leads to failure and catastrophic results far worse than conservative management of these fractures.

(iii) Excision of fibrotic and necrotic tissue must be aggressive. Evidence of vascularity should be seen in both fracture ends before insertion of screw.

By attention to these technical points, screw malposition was avoided in all patients. However, if there is any doubt about the position of the screw then intra-operative radiography is always recommended.

There are several limitations in our study. This study is not a comparative study between other methods of treatment, so a similar study with a nonoperative control group or a comparative study with another operative technique would be ideal. A long term follow up is necessary to find out its long term functional outcome and complications like avascular necrosis of proximal fragment, osteoarthritis and carpal instability.

CONCLUSION

Our study has shown that internal fixation using the Herbert screw results in rapid symptomatic relief and functional recovery. Review of these cases shows that the screw provides sufficient stability to allow normal use of the wrist. Functional recovery is much quicker after internal fixation and most patients can return to work within a few weeks.

Orientation of the screw and length of the screw plays a major role in preventing the late complications like arthritis and wrist pain.

CASE ILLUSTRATION: 1

Name: Mr. A

Age/Sex: 25/M

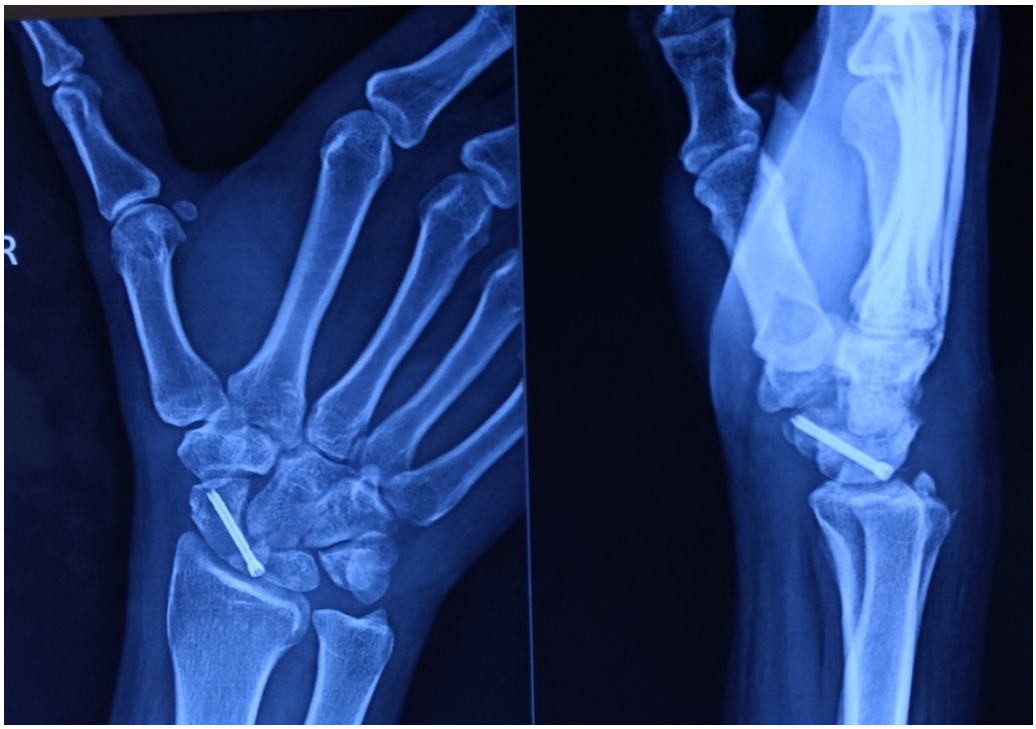
IP No: 70468

Diagnosis: Herbert Type B3 Right Scaphoid Fracture

PREOP X RAY

POST OP X RAY

6 WEEKS POST OP



1 YEAR POST OP

CLINICAL OUTCOME

CASE ILLUSTRATION: 2

Name: Mr. B

Age/Sex: 26/M

IP No: 20883

Diagnosis: Herbert Type B1 Left Scaphoid Fracture

PREOP X RAY

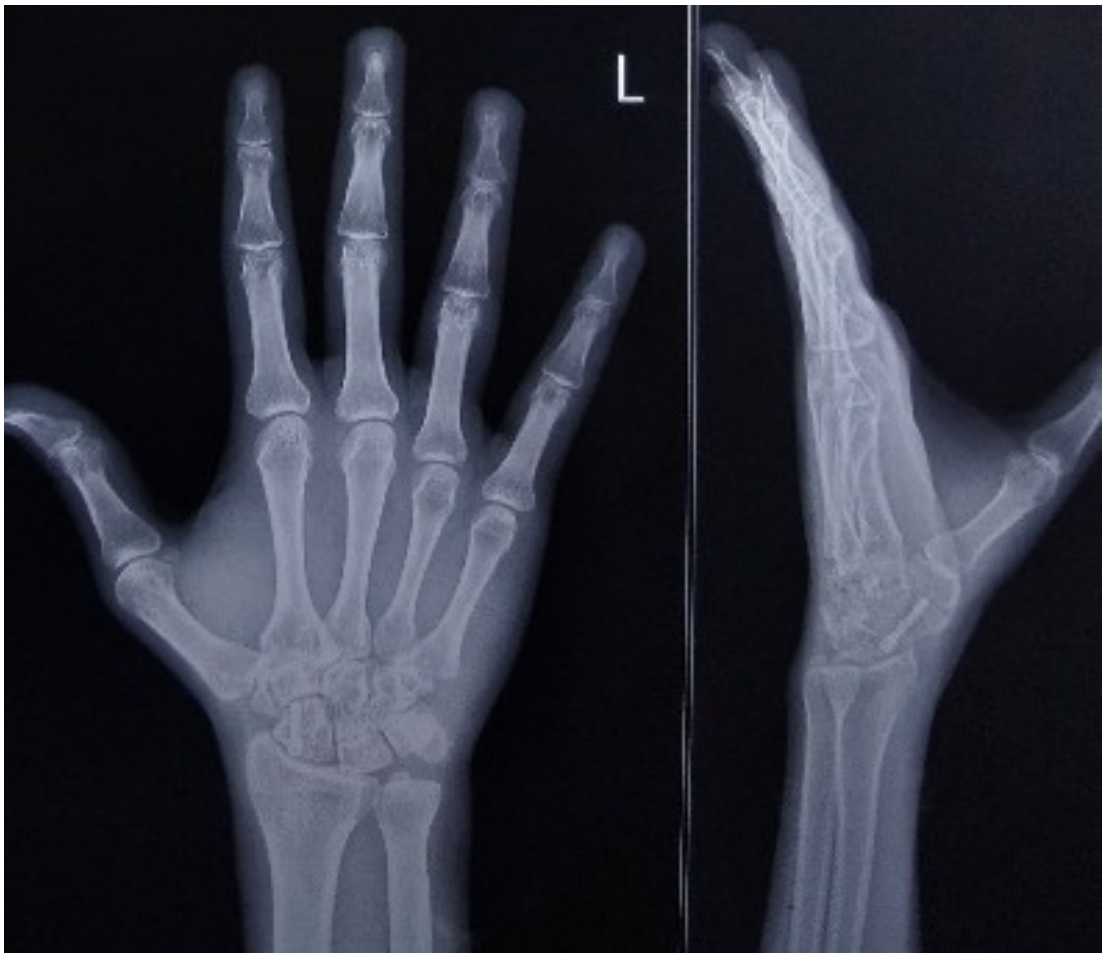
PREOP CT

INTRA OP IMAGES



POST OP X RAY


FINAL FOLLOW UP X RAY



CLINICAL OUTCOME

CASE ILLUSTRATION: 3

Name: Mr. C

Age/Sex: 27/M

IP No: 66431

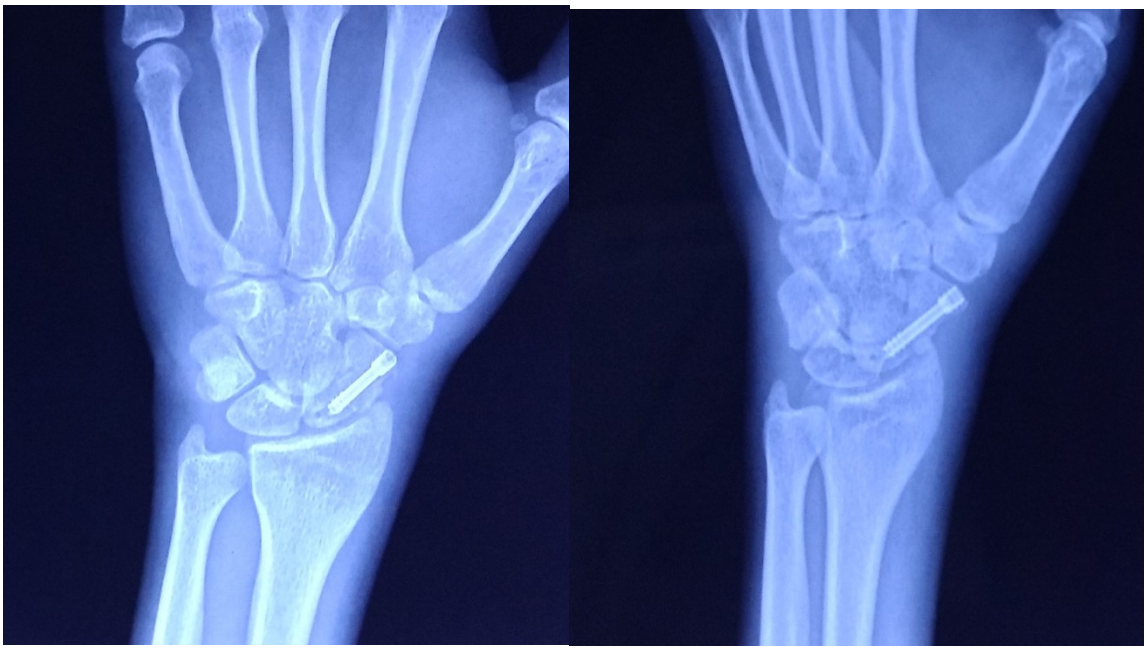
Diagnosis: Herbert Type B2 Left Scaphoid Fracture

PREOP X RAY

PREOP CT

POST OP X RAY

FINAL FOLLOW UP X RAY



CLINICAL OUTCOME

CASE ILLUSTRATION: 4

Name: Mr. D

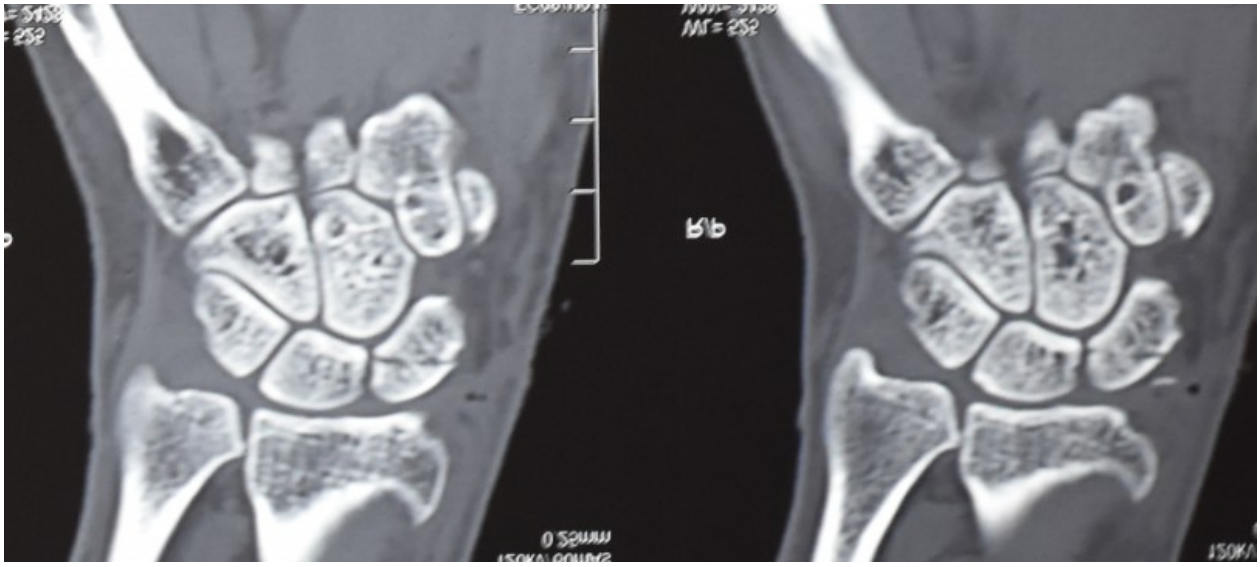
Age/Sex: 32/M

IP No: 42785

Diagnosis: Herbert Type B3 Left Scaphoid Fracture

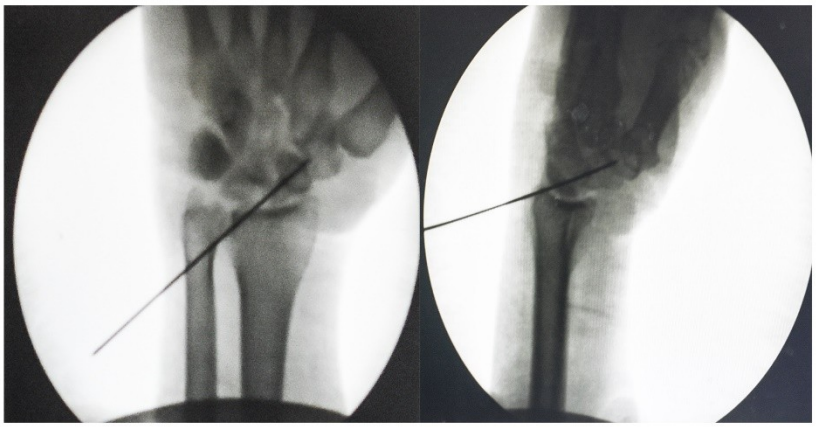
PREOP X RAY

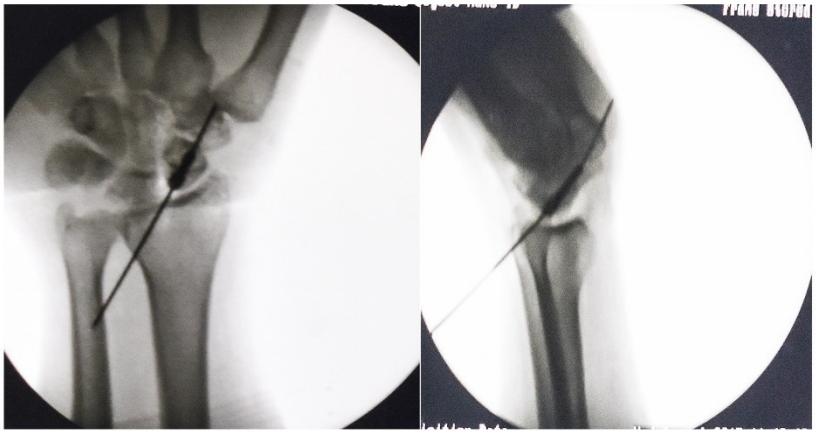
PREOP 2D-CT



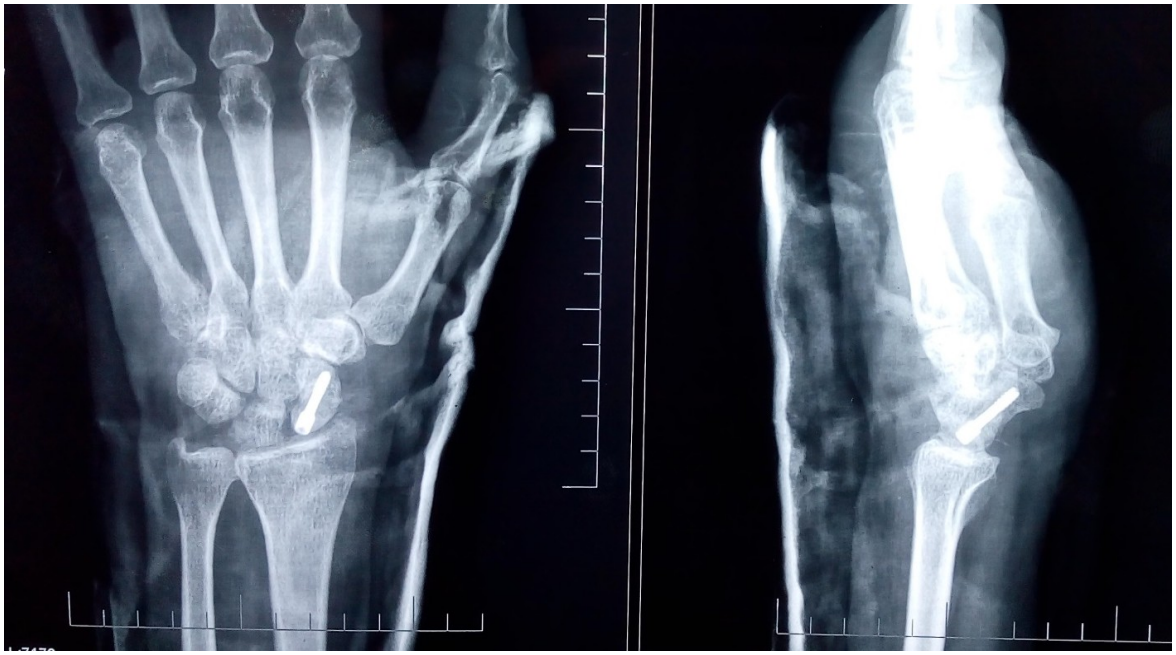
PREOP 3D-CT

INTRAOP IMAGES:

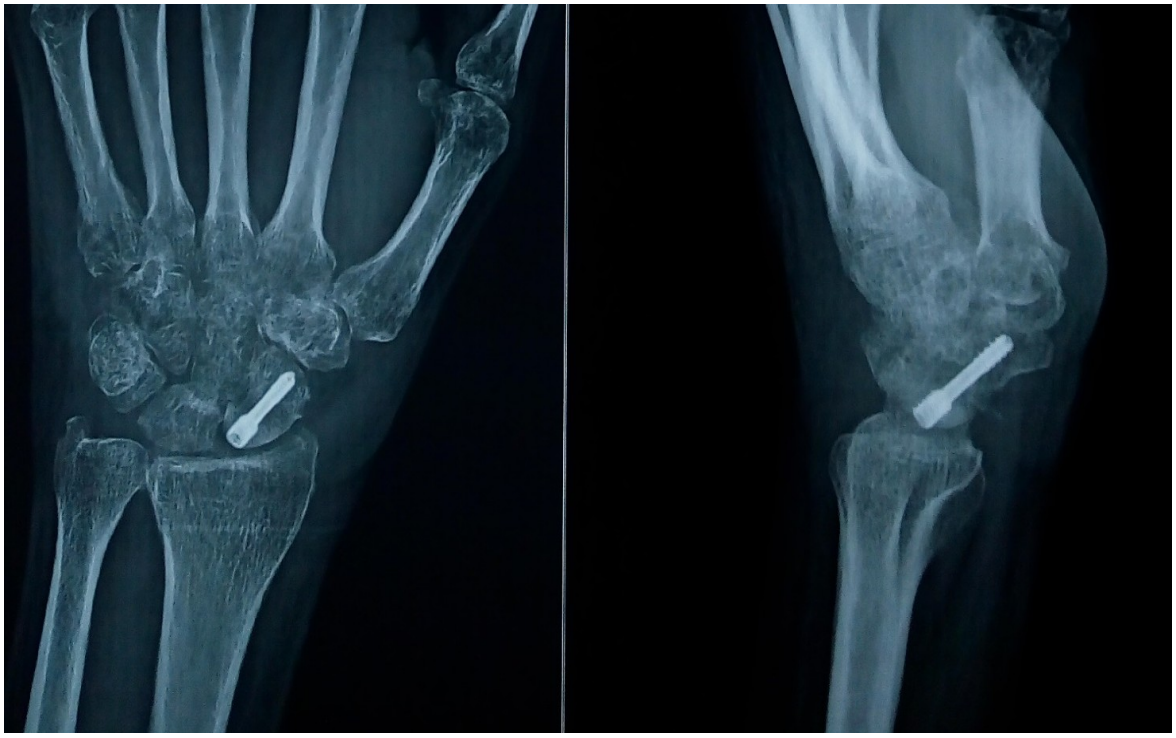




IMMEDIATE POST OP



FINAL FOLLOW UP X RAY



CLINICAL OUTCOME

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PROFORMA

Name :

Age :

Sex :

IP No :

Date of Admission :

Duration of Illness :

Diagnosis :

Procedure done :

Date of Surgery :

Date of Discharge :

Follow Up	Range of Movements		Modified Mayo Score	Complication (if any)
	Flexion	Extension		
4 weeks				
8 weeks				
3 months				
6 months				
1 year				
Final follow up				

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013
Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To
Dr.M.Sathish
Post Graduate in M.S. Orthopaedic Surgery
Institute of Orthopaedics & Traumatology
Madras Medical College
Chennai 600 003

Dear Dr.M.Sathish,

The Institutional Ethics Committee has considered your request and approved your study titled **"PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION " - NO.01012017 (IV).**

The following members of Ethics Committee were present in the meeting hold on **31.01.2017** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4.Prof.B.Vasanthi,MD., Prof.of Pharmacology.,MMC,Ch-3	: Member
5.Prof.S.Suresh,MS, Prof. of Surgery,MMC,Ch-3	: Member
6.Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
7.Prof.S.Mayilvahanan,MD,Director, Inst. of Int.Med,MMC, Ch-3	: Member
8.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
9.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary - Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

ஆராய்ச்சி ஒப்புதல் கடிதம்

ஆராய்ச்சி தலைப்பு : **ஹெர்பர்ட் திருகு பொருத்துதல் கொண்டு படகு வடிவு முறிவு மேலாண்மை விளைவு வருங்கால மற்றும் பின்னோக்கிய பகுப்பாய்வு.**

இராஜீவ் காந்தி அரசு பொது மருத்துவமனைக்கு வரும் நோயாளிகளிடம் ஹெர்பர்ட் திருகு பொருத்துதல் கொண்டு படகு வடிவு முறிவு மேலாண்மை விளைவு வருங்கால மற்றும் பின்னோக்கிய பகுப்பாய்வு குறித்த ஆய்வு.

பெயர் : **தேதி :**

வயது : **உள்நோயாளி எண் :**

பால் : **ஆராய்ச்சி சேர்க்கை எண்:**

இந்த ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கமும் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது.

எனக்கு விளக்கப்பட்ட விஷயங்களை நான் புரிந்துக் கொண்டு எனது சம்மதத்தை தெரிவிக்கிறேன்.

இந்த ஆராய்ச்சியில் பிறரின் நிர்பந்தமின்றி எந்த சொந்த விருப்பத்தின் பேரில் நான் பங்குபெற சம்மதிக்கிறேன் மற்றும் நான் இந்த ஆராய்ச்சியில் இருந்து எந்நேரமும் பின் வாங்கலாம் என்பதையும் அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் நான் புரிந்துக் கொண்டேன்.

இந்த ஆராய்ச்சியினால் ஏற்படும் நன்மைகளையும், சில பக்க விளைவுகளையும் பற்றி தெளிவாக மருத்துவர் மூலம் தெரிந்து கொண்டேன்.

நான் என்னுடைய சுயநினைவுடன் மற்றும் முழு சுதந்திரத்துடன் இந்த மருத்துவ ஆராய்ச்சியில் சேர்த்துக் கொள்ள சம்மதிக்கிறேன்.

ஆராய்ச்சியாளர் கையொப்பம் **பங்கேற்பாளர் கையொப்பம்**

நாள் :

இடம் :

PATIENT CONSENT FORM

STUDY TITLE: PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION

A Short Term Prospective Cum Retrospective Study

Study Centre: **Institute of Orthopaedics and Traumatology, Madras Medical College, Rajiv Gandhi Govt. General Hospital, Chennai-03**

Patient's Name :_____
Patient's Age :_____
Identification Number :_____

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction.

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms.

e) I hereby consent to participate in this study of **"**PROSPECTIVE AND RETROSPECTIVE ANALYSIS OF OUTCOME IN MANAGEMENT OF SCAPHOID FRACTURE WITH HERBERT SCREW FIXATION"

f) I hereby give permission to undergo detailed clinical examination, radiographs, diagnostic tests including hematological, biochemical and surgical procedure as required.

Signature / Thumb impression _____ Place_____ Date _____
of the patient.

Patient's Name &Address: _____
_____

Signature of the Investigator: _____ Place_____Date _____

Study Investigator's Name: **Dr.Sathish M**

URKUND

Urkund Analysis Result

Analysed Document: Scaphoid Thesis FInal.docx (D42512674)
Submitted: 10/13/2018 6:55:00 PM
Submitted By: drsathishmuthu@gmail.com
Significance: 0 %

Sources included in the report:

Instances where selected sources appear:

0

MASTER CHART

Sl no	Age	Sex	Side	Duration of illness	Fracture type	Open/ percutaneous	Approach	Follow up period (months)	Time to union (weeks)	Complication	Final mayo score
1	23	Male	Right	10	B2	Percutaneous	Volar	35	6	Nil	95
2	39	Male	Right	19	B2	Percutaneous	Volar	56	6	Nil	90
3	27	Male	Left	12	B2	Open	Volar	25	8	Stiffness	85
4	25	Male	Right	14	B2	Open	Volar	24	8	Pain	90
5	25	Male	Right	10	B3	Open	Dorsal	25	6	Scar Sensitivity	90
6	26	Male	Left	21	B1	Open	Volar	16	10	Pain	75
7	35	Male	Right	12	B2	Open	Volar	14	8	Stiffness	80
8	32	Male	Left	12	B3	Open	Dorsal	12	6	Scar Sensitivity	90
9	24	Male	Right	21	B2	Open	Volar	9	8	Stiffness	90
10	36	Male	Left	14	B2	Open	Volar	10	6	Nil	90