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TECHNIQUE OF PERCUTANEOUS SCREW FIXATION OF SCAPHOID FRACTURES

Orthopaedics

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ABSTRACT

Aim of this study is to describe the technique of percutaneous screw fixation of scaphoid fracture through both volar and dorsal approach. Percutaneous screw fixation is one of the well-known methods for fixation of undisplaced scaphoid fracture. Displaced fractures /comminuted fractures are best delt with open techniques through either volar or dorsal approach

KEYWORDS

INTRODUCTION:-

Fractures of the scaphoid bone are common but the management is Controversial (1). For displaced fractures, Herbert screw fixation is an accepted method of treatment (2), but for minimally or undisplaced fractures the role of surgery remains controversial(3). The scaphoid bone is a boat shaped bone in the human wrist and is the largest bone of the proximal row of the carpus on the lateral (radial) side, articulating with the radius, lunate, capitate, trapezium, and trapezoid. The scaphoid is surrounded on 80% of its surface by joint fluid containing fibrinolysin, a substance that dissolves blood clots. Because blood clots are necessary for healing of bone fractures, the substantial presence of fibrinolysin around the scaphoid inhibits healing of the fracture of that bone unless the fracture fragments are fixed in sufficiently good apposition such that joint fluid is prevented from entering the fracture site(4). Failure to properly fix the bone fragments into apposition will result in a non-union because of the presence in the fracture site of joint fluid (5).In addition to an undesirable non-union resulting from poor apposition, a fracture of the scaphoid through its waist often leads to avascular necrosis or death of the proximal pole of the bone. This is because the blood supply to the bone is chiefly through the distal pole and an unhealed fracture at the bone waist cuts off the blood supply to the proximal pole, resulting eventually in severe arthritis and deformity of the wrist. The closed (cast) treatment of acute scaphoid fractures generally has good outcome(6), with bony union; however, closed treatment can result in delayed union, non-union, malunion, cast-induced joint stiffness, and lost time from employment and avocations.

The traditional conservative treatment of a fractured scaphoid includes the application of a cast to the hand and thumb with the hand in radial deviation in an effort to oppose the fracture ends of the bone. Surgical intervention to fix the scaphoid bone typically includes the use of a Herbert screw(7). Current techniques include treatment with short arm wrist cast, short arm thumb spica cast, long arm thumb spica cast, open reduction and pin or screw fixation, and closed percutaneous screw fixation. Without adequate treatment, there is a risk of scaphoid nonunion or malunion, both of which subsequently can result in arthritis. Even with treatment, however, complications can result from both cast immobilization and internal fixation. Despite appropriate cast treatment, some scaphoid fractures carry a risk of nonunion of 5% to 55%, depending on the fracture type. Also, fractures treated to successful union with a cast can result in wrist pain secondary to arthritis(8-12). Moreover, acute scaphoid fractures typically occur in a young, working population (average age, 25years) at an incidence of 23 to 43 per 100,000 persons per year; thus, the morbidity of the treatment itself in terms of time off work and activities is significant(13,14).These young, active patients prefer not to spend prolonged periods of time in a cast; their preference is to undergo a single course of definitive treatment.

Percutaneous fixation of scaphoid fractures with headed cannulated screws was first performed in Germany by Streli(15), beginning in 1962, as a modification of the technique of open reduction with solid bone screws of McLaughlin(16). A series of more than 200 cases treated using the Streli traction-assisted volar technique and headed cannulated screw was subsequently reported by Wozasek and Moser(17) in 1991 to have an 89% union rate for acute fractures. The development of the headless cannulated compression screw has led to greater ease of screw insertion and has resulted in recent reports of acute percutaneous fixation of scaphoid fractures with union rates in some series of 100%(2-25).

Nondisplaced scaphoid waist fractures are a primary indication for percutaneous screw fixation. For these stable fractures, the methods of percutaneous fixation described above work well. In all patients with rigid internal fixation, early postoperative mobilization with a removable splint is recommended. In the patient with nondisplaced scaphoid fracture, deciding between surgery and closed (cast) treatment is based on patient age, handedness, type of work, and the patient's personal preference. Acute unstable scaphoid waist fractures are a second indication for primary internal fixation of the scaphoid and a relative indication for percutaneous fixation. With unstable fractures, internal fixation must be performed on a reduced and aligned fracture. When this cannot be achieved closed, open reduction is needed. For fractures without a gap or malalignment, all of the methods of percutaneous screw fixation are acceptable. For scaphoid fractures that require reduction, the surgeon may choose the volar traction-assisted approach; the dorsal minimal incision approach, with manual reduction as the guidewire is advanced; or the dorsal approach with arthroscopy-assisted reduction.

When significant comminution is encountered, percutaneous bone grafting with placement of bone down the drilled passageway can be performed(26). Complications of percutaneous fixation of the scaphoid include failure to achieve anatomic reduction, scaphoid subsidence or shortening with secondary screw penetration, injuries to soft tissue (e.g., cutaneous nerves, tendons, radial artery), incorrect placement of fixation screw, and failure to recognize concomitant injuries. Accurate fracture reduction is paramount. When reduction cannot be achieved or confirmed in a closed manner, conversion to a standard volar or dorsal approach is needed(27). A valuable technique is that of Haddad and Goddard: choosing the correct starting point and then tapping a 12- or 14-gauge angiocatheter needle into the scaphoid as a drilling guide for the wire(28). With this wire guide in place, even if the wire has to be re aimed, a new starting point is not needed. Alternatively, a minimal access dorsal incision can be used so that the starting point is always under direct visualization (29).

The most common errors of screw placement include using too long a screw or too eccentric a screw. Internal fixation must be placed down the central axis of the scaphoid, not only to achieve the best strength but also to avoid penetrating the scaphocapitate joint. Double checking of the guide wire position with multiple radiographic views is required before drilling or screw insertion. The screw length should be sufficiently shorter than the measured length of the scaphoid to allow for complete implantation of the screw in the bone. When measuring

against the curved articular surface of the proximal scaphoid, a screw that is 3 to 4 mm shorter than the measured scaphoid length should be used. From distally, where the surface is less curved at the point of measurement, a screw that is 2 to 3 mm shorter than the scaphoid should be adequately buried. Use of a screw that is available in 1mm increments of length may help with selecting the correct screw length. Here we will be describing the technique of percutaneous screw fixation of scaphoid fractures through both volar and dorsal approach.

Surgical Technique:-

A) Dorsal Approach:-

Patients is to be placed in a supine position after either regional block or general anesthesia. First the dorsal scapholunate joint is to be marked under fluoroscope. The direction of the screw is to be marked starting from the scapholunate joint. Then the wrist is to be pronated and flexed so that the scaphoid is seen as a circle on fluoroscope (ring sign). The centre of the circle is to be chosen as the landmark for the insertion of the guide wire into the proximal pole of the scaphoid. A small stab incision (3 mm) over the centre of the circle (usually over the scapholunate joint) is to be made. With a small haemostat the stab was carefully developed until a bony landmark will be felt. This is a very useful measure to avoid injury to the extensor tendons and superficial branch of the radial nerve which is one of the major concerns while using this approach. Then the guide wire is to be driven dorsal to palmar to exit at the radial base of the thumb. The reduction and placement of the guide wire is to be confirmed under an image intensifier. A hole is to be drilled over the guide wire.

A Herbert–Whipple screw is to be inserted under image intensifier control over the guidewire. After fixation, the position of the screw is to be verified using an image intensifier. The limb is to be immobilised in short arm/scaphoid for 10-14 days.

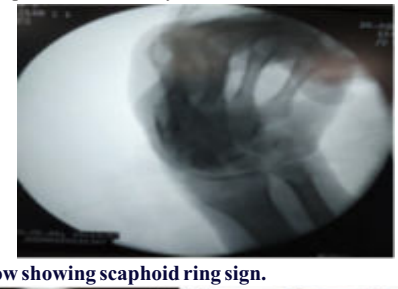

Fig 1:-Arrow showing scaphoid ring sign.

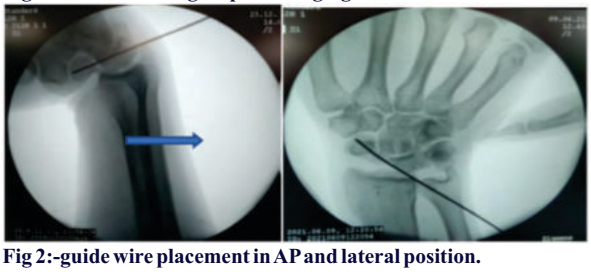

Fig 2:-guide wire placement in AP and lateral position.

Fig 3:-placement of screw through dorsal approach.

B) Volar Approach:-

Hyperextension and ulnar deviation of the wrist facilitated any necessary reduction of the fracture. A short stab incision is to be made distal to the scaphotrapezial joint. Hypodermic needle is to be used to determine the insertion point radiologically before inserting 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 then is to be inserted at the confirmed entry point. The guide wire track is to be angled 45 degrees dorsally, and 45 degrees medially, along the mid axis of the scaphoid.

To measure the length of the screw to be placed take another guide wire of the same length and place its tip on to 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 2mm to determine the screw length. Use only the dedicated drill bit with the help of power drill to drill over the guide wire. Insert the screw manually over the guidewire. It is vital that the threaded section of the tip of the screw pass completely beyond the fracture plane, if inter fragmentary compression is to be achieved. Before final tightening, remove the guidewire. Check the final position of the screw and the scaphoid stability using image intensification. The limb is to be placed in short arm/scaphoid cast for a period of 10-14 days.

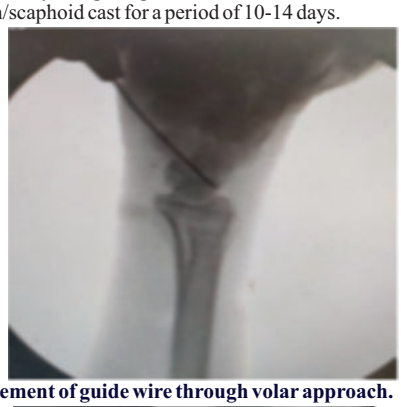

Fig 4:-placement of guide wire through volar approach.

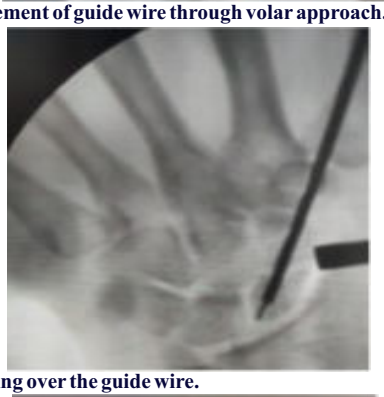

Fig 5:-drilling over the guide wire.

Fig 6:-placing the screw by volar approach.

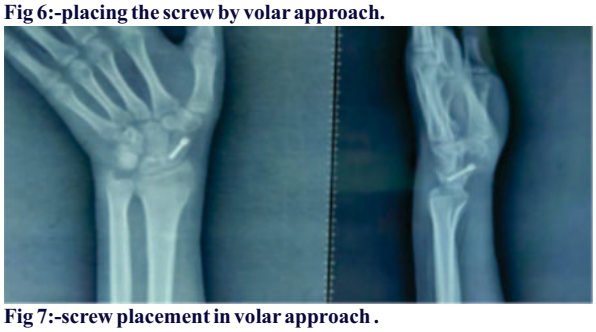

Fig 7:-screw placement in volar approach .

Post Operative Management

The wrist is to be supported in a scaphoid cast for two weeks. Active and assisted finger exercises are to be encouraged immediately after surgery.

- Patients were given 1 dose of i/vv antibiotic postoperatively.
- Postoperative PA view, lateral view radiographs are to be obtained on the next day of surgery
- Most of the patients may be discharged within two days of surgery.

DISCUSSION:-

Nondisplaced scaphoid fractures treated with prolonged cast immobilization may result in temporary joint stiffness and muscle weakness in addition to a delay in return to sports or work. Fixation of scaphoid fractures with a percutaneous cannulated screw has resulted in a shorter time to union and to return to work or sports.

The average time to fracture union in the screw fixation group is around seven to eight weeks as shown by various studies compared with twelve to fourteen weeks in the cast immobilization group as shown by various studies.

The average time until the patients return to work is around eight to nine weeks compared with fifteen to sixteen weeks in the cast immobilization group as show in various studies.

There is no significant difference in the range of motion of the wrist or in grip strength at long term follow-up evaluation done by various study groups. Overall patient satisfaction is high in both groups.

CONCLUSION:-

Percutaneous cannulated screw fixation of nondisplaced scaphoid fractures results in faster radiographic union and return to activity compared with cast immobilization. The specific indications for and the risks and benefits of percutaneous screw fixation of such fractures must be determined in larger randomized, prospective studies.

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