

RESEARCH ARTICLE

SHORT TERM FUNCTIONAL OUTCOME OF CLOSED REDUCTION AND FIXATION OF COLLE'S FRACTURE USING MODIFIED-JOSHI'S EXTERNAL STABALIZATION SYSTEM - A PROSPECTIVE STUDY

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Manuscript Info	Abstract
Manuscript History	Colle's fracture is the most common fracture seen in adult population. It is never an isolated fracture of the distal radius, but is associated
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with; fracture of ulna styloid which may be displaced or undisplaced; instability of the distal radio-ulnar joint complex and; may be associated with injury to triangular fibro cartilaginous complex. The aim of study was to determine functional outcome of management of closed reduction and fixation of comminuted colle's fracture using a rigid and stable "modified-Joshi's External Stabalisation System" as soon as possible. In our study we have tried to bring associated soft tissue and bony injuries around the wrist joint as a highlighter and focused on fixation and restoration of anatomy to near normal with fixation of all the above mentioned injuries without exposing the joint, and as an immediate and definative management. Out of a total of 30 patients included, 26 patients had an excellent outcome as measured using quick-disability arm shoulder hand score and modified-mayo wrist scoring system. One patient had a superficial pin tract infection and was managed with oral antibiotics. The patients were able to resume the activities of daily living by end of eight weeks. It can be concluded that this method can be employed in immediate and definative management of comminuted colle's fractures as it leads to a better functional outcome, lesser hospital stay, early mobilization of the joint, lesser exposure to radiation, avoids joint exposure, has a low learning curve, early resumption of activities of daily living and avoids re-surgery at a later date for implant removal.

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Introduction:-

The Colle's fracture is a very common fracture seen due to a fall on an outstretched hand.^[1] It leads to an immediate development of swelling, deformity and patient is unable to move the wrist due to pain and swelling.^[1,2] An isolated distal end radius fracture is a myth as it is associated with other soft tissue and/or bony injuries such as, an ulnar styloid fracture; Distal Radio-Ulnar Joint (DRUJ) disruption and; disruption of the Triangular Fibro-Cartilagenous Complex(TFCC) near its attachment. Its mentioned in literature for the need to give an ulnar styloid block along with a haematoma block for external fixation of distal end radius comminuted fracture.^[3] This is interpreted as there is an associated ulna styloid injury and an injury to the attachment of TFCC. This has been confirmed on MRI and CT scan studies of distal end radius comminuted closed fracture.^[1,2,3]

There is no evidence for a generalized immediate and definitive management of colle's fracture surgically, due to presence of swelling over the wrist. Various open reduction and surgical fixation options for the colle's fracture are fragment specific plate fixation and anatomical volar plate fixation.^[4,5,6] These fixation devices may not be suitable in cases of an osteoporotic bone and surgeon may encounter a lot of technical difficulty in securing the fragments together.^[2,7] The ultimate result expected from a surgical management is anatomical reduction of fracture fragment and a low profile fixation that makes fracture stable.^[2,8,9]

The objective of our study was fixation of colle's fracture along with associated injuries by using rigid and stable modified-Joshi's External Stabalisation System (m-JESS) and to determine its functional acceptance and outcome. This method can be used immediately following the trauma, unlike open reduction and fixation where there is a wait till the swelling subsides.^[10,11] By re-alignment of the fragments to their near anatomical position, the swelling around the wrist reduces.^[12,13] It is also essential to fix the ulnar styloid fragment as it is invariably fractured in comminuted distal end radius fracture. The DRUJ needs to be reduced to its anatomical position for the normal functioning of the joint.^[6,14] By early fixation of distal end radius fracture, DRUJ reduction, ulnar styloid fixation and re-alignment of the TFCC, we ensure early stabilization and fixation of the fracture and hence permit early mobilization of the joint allowing the early free flow of the blood components and lymphatic drainage, thus enhancing the reparitive and healing process.^[15] It is also known in the literature that early joint mobility leads to production of synovial fluid in the joint which further aids in enhanced healing of the cartilage and soft tissues due to mobilization of the nutrients and mesenchymal stromal cells that naturally aid in repairative process.^[16]

Materials And Methods:-

This study was carried out at Suvidha Hospital and Research Center Pvt. Ltd., Jabalpur, M.P., India, which included a total of 30 patients. Inclusion criteria included patients who presented within 12 hours of injury and were aged between 25 years and 65 years. Exclusion criteria were open fractures, previously operated on the same limb for same fracture and patients who presented after 12 hours of injury. After written informed consent and the preanesthetic checkup, patients were shifted to the operation theater and were given general anesthesia. One dose of intravenous antibiotic ceftriaxone was given pre-operatively and two doses post-operatively. Patient was positioned supine. Under the guidance of C-Arm, one 3.5mm x 6" schanz screw was passed on the radial shaft vertically, that held both the cortices. Another schanz screw, 2.5mm x 6'' was passed over the base of second metacarpal crossing the third and fourth metacarpal base. Two medium sized clamps were put in these schanz screws and then a connecting rod was inserted. The clamp over the metacarpal schanz screw was tightened and traction was given by pulling the thumb, and index and middle finger, and along with it, an assisted traction was given over the schanz screw and then the clamp over the radial shaft schanz screw was tightened. This acted as an external fixator. Once the distraction was achieved, and confirmed under C-arm, a 3mm x 6" k wire is passed from the medial aspect of ulna styloid, horizontally towards the radial styloid, thus securing and correcting the DRUJ instability. Then, a 3.5mm x 9" k wire is passed from the dorsal aspect, between the 1^{st} and 2^{nd} extensor dorsal compartment of the wrist, through the radial styloid and passed through the fragment into the shaft of radius, crossing the schanz screw over the radius shaft. A 3.5mm x 9" k-wire was passed from the dorsal aspect of wrist, medial to the 6th external dorsal compartment at wrist, over the ulna styloid, catching the styloid fragment and locking the k-wire in the ulnar shaft. Another 3.5mm x 9" k-wire was passed from the ulnar side of the radius, between the 4th and 5th extensor dorsal compartment of wrist, that holds the lower end radius fragment, and locks in the shaft of the radius. The wire from the ulna styloid and from the radial styloid are pulled apart and secured with small clamps over a connecting rod, which is also a 1mm x 9" k-wire. These two clamps are tightened and the reduction is confirmed. The remaining clamps over the k-wires are tightened. Following this, the initial distraction achieved over the fragment by the schanz screws was loosened by loosening the clamps and the clamps were tightened back. Dressing of the pin tracts was done and the frame was covered with sterile bandage. A below elbow Plaster of Paris (POP) slab was given on discharge to the patient for immobilizing the limb. After two weeks patients were reviewed and the external fixator was removed under local anesthesia. The patients were given the slab back secured with crepe bandage. They were taught to remove the slab and practice wrist dorsi-flexion and palmar-flexion, along with the free finger movements for about four to six times a day. Four weeks following this, the patients were reviewed and the m-JESS was removed. Patients were given a below elbow POP cast for another two weeks. The cast was removed on the 15th day and patients were advised for wrist mobilisation with hot water fomentation. Follow-up xrays were done at two weeks, six weeks, 12 weeks and six months post operatively. Functional outcome was evaluated using quick Disability Arm Shoulder Hand scoring and Modified Mayo Wrist Scoring System.

Results:-

66.67 % (20 patients) were above 40 years of age and mean age of study population was 43.63 years (range 25 years to 65 years). 66.67 % (20 patients) were males and 33.33% (10 patients) were females. Right upper limb was involved in 56.67% (17 patients) and 43.33% (13 patients) sustained injury over left upper limb. Mode of injury in 40% (12 patients) was road traffic trauma and 60% (18 patients) had fall by self. One patient had developed a superficial pin tract infection on the 14th day, which was managed with pus culture sample and report and oral antibiotics according to the culture report. One patient had an extensor tendon injury, which was repaired following the removal of the dorsal k-wire. A plain radiograph was done at two weeks, six weeks, 12 weeks and six months. In 66.67 % (20 patients), radiological union was seen at six weeks. Functional outcome was evaluated using the quick Disability Arm Shoulder Hand scoring system which showed that 76.67 % cases (23 patients) had an excellent result, 16.67 % (5 patients) showed good to fair result. Modified wrist scoring system showed that 86.67 % patients (26 patients) had a good range of motion by the end of eight weeks. Patients were followed for six months where they had resumed all their normal activities like before.

Discussion:-

Colle's fracture is the commonest fracture that is seen amongst population and the usual mechanism is fall on an outstretched hand.^[1,3] Our aim in these injuries was to bring into account the associated injuries with the colle's fracture and to restore the near normal anatomical reduction and a better functional outcome. Taking into consideration the age of patient, mechanism of injury, the quality of the bone and the health condition of the patient, the treatment options should be considered.^[5]

An important factor that aids in the union and long term results is the near normal anatomical restoration of the bone and soft tissues along with early mobilization of the joints to prevent them from becoming stiff and allivate pain.^[17,18,19] The movement of a synovial joint causes production and movement of the synovial fluid in the joint which causes the secretion of mesenchymal stromal cells that attach to the cartilages and soft tissues and start the repairative mechanism. This helps in early healing of the soft tissues and cartilages.^[17,18] Early mobilization also allows for movement of blood and blood components hence providing nutritional support to the joint and aid in healing. Early mobilization leads to lessen the chances of development of stiffness.^[19]

External fixation has been used since the past 80 years with different combinations and permutations so as to suit the pattern and nature of injury and the surgeon's experience. The use of external fixation for distal radius fracture was first described by Ombredanne (1929).^[20] Narendre et al. compared and found the use of JESS as a better and cost effective method in treatment of distal end radius fractures.^[111] Melendez et al. showed good results in 13 cases,^[21] Krishnan et al. showed good results in 22 cases^[22] and Fischer et al. showed good results in 17 patients.^[23] Chan BK et al. and McKenna J et al. conducted a study which concluded good results in external fixation of lower third intraarticular radius fractures.^[24,25] The study conducted by Rajeev et al. showed excellent results in 77.8% of cases operated with JESS for undisplaced distal radius fractures.^[10] Wei DH et al. found that there was a better functional outcome of the patients with an improved grip strength and wrist range of motion in external fixation of distal radius fractures and concluded it to be an alternative surgical method.^[26] Shukla et al., Kreder et al. and Saving et al. found the superiority in using external fixation over internal fixation.^[27,28,29] Kreder et al. concluded a better restoration of functional outcome and early return to activities of daily living in a two year follow up with the use of external fixation method.^[28] Saving et al. did a study in 118 patients where they concluded the incidence of re-operation and atherosis more in the use of volar locking plates than in the external fixation system.^[29] Kapoor et al. also concluded that there was more incidence of instability and a poorer functional outcome in intra articular distal radius fracture management by volar locking plate groups. They concluded in such cases, external fixation system can be used that uses the principle of ligamentotaxis for restoration of the length of fracture fragment.^[30]

In our study we carried out the surgery within 12 hours of injury, irrespective of the swelling around the wrist. We evidenced that once the fracture was fixed and re-aligned back to near anatomical configuration, the swelling subsided. The construct was rigid and was holding the fragments and the soft tissues well in place. The two schanz screws placed at the start of the surgery provided ligamentotaxis around the radio-carpal joint while they dis-impacted the distal end radius fragment.^[31] This maneover was done as it is practically impossible to maintain the distraction physically by pull, throughout the procedure. After the construct was completed and secured with clamps and connecting rods, the external fixator was loosened so as to allow the release the distraction and re-align the fragments in the direction of K- wire reduction. It is known to all that external fixator is known for causing non-

union,^[32] this step prevents the distal radius fracture to remain distracted. This external fixator is applied to provide an additional support to the m-JESS construct.^[12,13,33]

Our experience in the study showed that, specially in the osteoporotic bones, the hold of the k-wires and the reduction to near normal anatomical alignment was good and there was an immediate relief of pain and swelling in the post operative period. The patients returned to their work within two months of the surgery and resumed their near normal functioning and fine movements of the fingers and hand by three months of the surgery.

Huard et al. compared the use of k-wires and volar non locking plate for the treatment of lower third radius fractures in patients over 70 years of age and found that secondary displacements were found in both the comparison groups.^[34] Study by Voigt and Lill included 89 lower third radius fractures in elderly population and compared treatment between a volar non locking plate and k-wire fixation and came to the conclusion that there was reduction loss in both the groups^[35], that was not seen in our study. In a study by Arora et al. they compared volar locking plates and conservative casting method and found that there was 13% complications in the locking plate group of patients and there was no difference in the functional outcome between the two groups.^[36]

In our study, we treated 30 patients and found that there was a low complication (0.66 %) and a high level of satisfactory outcome (86.6%) rate. There was an immediate relief to the pain and subside the swelling over the wrist. This helped the patients in early mobilization of the joint, lesser stay at the hospital and early return to activities of daily living. A study conducted by Hull et al. had not observed any clinical advantage by using volar locking plates over using k-wires for treatment of lower end radius fractures. They observed that the fixation by the k-wires was strong enough to hold the fragments in their place of near anatomical reduction.^[37,38,39]

We have taken into consideration the bony fracture as well as associated injury to the soft tissues. The learning curve required for this method is also less as compared to various other surgical methods. Our method also prevented a re-surgery where there is a need of implant removal by opening up of the wrist joint.

The limitations of our study were; a small sample size, limited followup period and surgery was performed by two different surgeons that could cause a bias due to experience of the surgeons. We were not able to perform an ultrasound of the wrist to confirm the re-alignment of TFCC.

This procedure is seen to be well tolerated by the patients and also leads to lesser hospital stay, lesser use of antibiotics, since its a closed procedure, and hence lesser cost of surgery to the patient.

Concluding the discussion we found our method to be much more effective, immediate with a small learning curve, having a lesser soft tissue damage, lesser radiation exposure and having good functional outcome with a low complication rate.

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