Brief Communication

Percutaneous multiple K-wire fixation for humeral shaft fractures

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Humeral shaft fractures are one of the common injuries, following Musculo-skeletal trauma. Being the most important bone of the upper extremity involved in the skilled movements, the appropriate management of the humeral shaft fractures is very important. There are various modalities of management for the humeral shaft fractures ranging from non-operative to operative. Non-operative management techniques include; hanging cast, U-slab, U-cast, shoulder spica, braces, and so on. Disadvantages of these non-operative methods are stiffness of the shoulder and elbow joints, non-union, delayed union due to distraction, and mal-union. Open reduction and internal fixation with narrow/broad dynamic compression plate (DCP) and screws has its own demerits, such as, extensive soft tissue dissection, significant blood loss, risk of intra operative radial nerve injury, impaired periosteal vascular supply to the fracture fragment, leading to delayed union/non-union, implant failure due to osteoporosis. Intramedullary stabilization of humeral shaft fractures avoids these disadvantages, but the nails are not without complications. Unlocked nails have fallen out of favor due to failure to provide good rotational stability and frequent slipping, thus, causing irritation to the joint. However, locked nails provide a good rotational stability, but a potential risk of radial nerve injury remains, due to the distal locking screws.

In the present study, Kirschner wires (K-wires) have been used to achieve closed intramedullary fixation. The K-wires are less expensive, universally available, and more flexible than the Hackethal nails, as they allow smoother introduction into the medullary cavity and provide a dynamic fixation without compromising stability. This prospective study was conducted at the Department of Orthopedic Surgery, Jawaharlal Nehru Medical College and Hospital, Aligarh Muslim University, Aligarh. The study included 86 cases of the diaphyseal humerus fractures, which were treated with closed intramedullary K-wire fixation. Patients of all age groups were included in this study, ranging from 8-65 years.

We included polytrauma patients, displaced fractures in adults, not amenable to closed reduction. In children, only those cases, in which closed reduction failed or the fractures re-displaced after initial successful reduction.

Preoperative management. Careful examination of the patient was performed to rule out any emergent systemic problem, and if present were taken care of. After ruling out the other serious medical complications, attention was paid to the upper extremity diaphyseal fractures.

Operative technique. *Preparation of the Kirschner Wire.* The K-wires of 50 cm length were chosen with the thickness according to the age of the patient and width of the intramedullary canal. Two to 4 K-wires of 2-3 mm thicknesses were inserted. The K-wires were bent to 30°-40° at a point of 1-1.5 cm from the tip, which helped in the progress of the wire across the fracture, as well as in reduction of the fracture. Tips of the wires were made blunt to avoid perforation of the cortex. The opposite end of the wire was bent at an angle of 90°, around 8-10 cm from the other end, opposite to the initial bend. This helped in easy maneuvering of wire and controlling the direction of the tip of the K-wire passing through the intramedullary canal.

Steps of surgery. The reduction of the fracture was checked under the image intensifier. For achieving reduction, manual traction, and fracture site manipulation was carried out. A window of 0.5 x 0.5 cm diameter was made in the posterior cortex, approximately 1.5-2.5 cm proximal to olecranon fossa, by using drill bit and later enlarging the hole with the help of bone awl. Bent-tip wires were introduced into the medullary canal of the bone, through the prepared hole under the image intensifier control. Wires were gradually advanced in the medullary canal by rotation or by hammering with pliers and mallet, until it reached the fracture site. At this point, reduction was carried out under the image control, and the wire negotiated into the second fragment. Wires were then engaged in the metaphyseal region of the second fragment (**Figures 1a & 1b**). The tips of wires were embedded in different directions, so as to give better stability and hold. Protruding distal end of the wires were cut, bent into "hairpin bend" and buried under the soft tissues and the skin.

Majorities of the patients were males (69.4%). Mean age of the patients was 31 years. The most common mode of injury was fall from height, accounting for nearly 45.8% of all cases. In our study, road traffic accident was the second most frequent cause (43%) of fractures. Among these, 4 patients had associated fracture shaft of femur and 3 patients had associated head injury. In this study, out of 86 fractures, majority (78.95%) were simple fractures, 14 fractures were of compound Grade I, only one case of each compound, Grade II and III, were included in this study. Most of the humeral shaft fractures were located in the region of

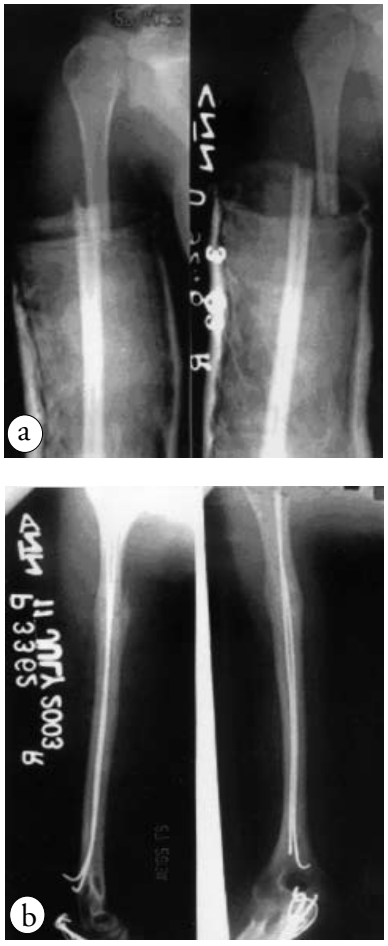

Figure 1 - Radiographic image **a**) on the day of trauma (fracture shaft of humerus at the junction of proximal approximately one-third and distal of two-thirds) **b**) on the 16 weeks after the operation (fracture was united with k-wires in situ).

the middle of one-third (64.5%). The next common site of fractures was the lower third accounting for 11.8% of all fractures. The mean interval between trauma and operation was 8 days. In humeral shaft fractures, majority of cases were treated with 2 K-wires. Three K-wires were used to stabilize the diaphyseal fractures in 13 humeri. In this study, most often portal of entry of K-wires in humeral shaft fractures was just proximal to olecranon fossa. However, in 4 polytrauma patients, the site of entry was just medial to the tip of the greater tuberosity. The mean follow up in this study was 14 months. One patient was lost to follow up, who was having fracture shaft of humerus in a polio limb.

Union Rates. Radiologically, the union was defined by the bridging callus in both antero-posterior and lateral views, with partial obliteration of the fracture line. Clinically, union was defined as the absence of tenderness and lack of abnormal mobility at fracture site in any plane. In our study, most of the humeral shaft fractures (93%) united between 8-12 weeks, time after the operation. In our study, the average time to union was 10 weeks. There were 5 fractures, which had delayed union. Two fractures went into non-union. None of the fracture took more than 24 weeks to unite.

All the cases were given some type of support postoperatively; this immobilization was continued until the early signs of union were identified on the x-rays in follow-ups. When good quality of bridging callus was visible on x-rays, these supports were discarded and patient was advised to initiate physiotherapy of involved joints. In this study, we had performed closed reduction under image intensifier and internal fixation with intramedullary K-wires. Recently, there has been growing trend towards the flexible intramedullary nailing for pediatric diaphyseal long bone fractures. However, this study included all the age groups, so as to evaluate the effectiveness of this method, even in adults. Union rates in our study were 93%. Majority of fractures united in less than 16 weeks. Five cases took longer period to unite and went into delayed union. Two fractures had gone into non-union. These fractures were later re-operated and open reduction, and internal fixation with Narrow DCP and cancellous bone grafting was performed. The average time to union of humeral shaft fractures was 10 weeks in our study. Union rates of humeral shaft fractures in our series are comparable to other studies. Qidwai[1] has reported the union rates of 93% using K-wires in humerus. Shazor et al[2] reported approximately 91.5% union rates using retrograde Ender nailing. Other studies using humeral interlocking nails for fixation, such as Stannard et al,[3] have also reported similar union rates in their series. Skin irritation and pain by the protruding distal ends of wires at the portal of entry was the most common complication (15.79%). This complication was encountered in other studies also.[1,4,5] This problem of irritation by protruding wire tips was overcome by bending the tips of the wire in a U-shape or hairpin bend, and embedding the end of wire deep under the skin with the help of K-wire punch. These minimizes the irritation by the protruding wire tips.

Flexible intramedullary nailing of humerus is an easy, safe, and effective method. Flexible intramedullary nails (Ender or Hackethal nails) have given satisfactory results, however, K-wires are more flexible, less expensive, and universally available, and provide a dynamic fixation without compromising stability. Closed intramedullary K-wiring is a dynamic biological method of fixation with less damage to the muscles or the periosteum, leaving fracture hematoma intact, thus, leading to early bridging callus formation.

There is no interference with endosteal or periosteal blood supply. Micro movements at the fracture site stimulate early bridging callus by converting shearing into compression forces. In this technique, cosmetic damage is minimal, with minimal scarring at the entry points of the K-wires. This technique is cost-effective, as there is reduced hospital stay as compared to other methods; also implant is very cheap and easily available. Intramedullary K-wires provide a combination of elastic mobility and stability. In contrast with the techniques involving rigid fixation, stability is not only ensured by intramedullary K-wires, but also by the bone and the surrounding soft tissues. The K-wires provide internal elastic support, channeling forces, and preventing excessive displacement by automatic adjustment of bone fragments. The muscles acting as guy-ropes, help in spontaneous postoperative correction of slight angular deviation and retention of normal curvature of long bones. Living tissue provides stability and aids in rapid healing, and there is minimal disturbance of bone growth, thus, leading to rapid return of function. Hence, it is a physiological method of treatment. Axial stability is provided by 3-point fixation of bones by the K-wires, and rotational stability is achieved by angled wire tips, anchoring at different points inside the metaphyseal end of bones. Percutaneous closed K-wire fixation of diaphyseal fractures of the humerus is a safe, reliable, and effective method of fixation, and is recommended for all fresh fractures where internal fixation is indicated.

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Negative suction versus non-negative suction after coronary surgery

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There is a controversy whether the institution of negative suction for cases of coronary artery bypass surgery (CABG) affect the rate of Mediastinal bleeding. It has largely been based on non-scientific principles whether to use negative suction of 20 cm of water or not. This paper helps to answer this question. The Pubmed and Medline searches revealed no study that addresses this question. Consecutive cases of CABG were studied accordingly, whether negative suction was applied (Group A) or not (Group B) from October 2003 until May 2004; and chest tube drainage over the first 24 hours postoperative, the mortality rates, re-opening for bleeding, and postoperative pericardial effusions were analyzed. **Table 1** showed the cases performed in each group. Approximately 281 consecutive cases of CABG alone or in combination with other procedures were studied. Negative suction was applied in 78 cases (28%). The male to female ratio was 3.2:1. Pure CABG was carried out in 258 cases (92%). Concomitant procedures included Mitral valve repair and replacement and aortic valve replacement. Redo surgery was performed in 16 cases (5.6%). Left internal thoracic artery was utilized in 81%. Average blood loss in group A was 870 ± 270 ml, and group B was 630 ± 215 ml giving a $p<0.05$. Overall, the re-opening rate was 19 cases, re-opening for bleeding occurred in 10 cases in group A, and 9 cases in group B (**Table 1**). Overall, there were 11 deaths (**Table 1**). Pure CABG had 7 deaths from a total of 258 cases, giving first time coronary mortality rate of 2.7%. A pericardial effusion occurred in 2 cases in group A, and 9 in group B (**Table 1**). Drainage of the pleura and mediastinum after cardiac surgery is usually achieved with plastic drains.[1] Due to the nature of coronary artery bypass surgery, there is a great potential for bleeding postoperatively. Negative suction applied to the chest drains to facilitate their drainage capacity and prevent the drains from clotting off. Clotting off from the drains can lead to hemodynamic instability, cardiac tamponade, closure of grafts, and development of pericardial efussions.[2-5] There was no paper on Pubmed or Medline searches, that specifically looked at the effect of negative suction on drainage post coronary artery surgery or the effect on residual pericardial and pleural effusions. Our study demonstrated an increase in total drainage with the use of negative suction; however, there were no effects