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Research Article

Closed multiple intramedullary K-wire fixation for humeral shaft fractures in adolescents

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ABSTRACT

Background: Humeral shaft fractures are relatively uncommon injuries in aldolescents and can be managed conservatively in large number of patients. Management becomes easier as there is good potential for remodelling. Problem lies in displaced or unstable fractures, where satisfactory reduction and its maintenance are difficult. In smaller children this can even be managed by closed reduction and cast application. In adults and elderly patients early decision of open or closed reduction and internal fixation with plates and screws or intramedullary device respectively can be taken with some merits and demerits. We land up in dilemma when we have aldolescent patients to deal with.
Methods: Forty adolescents patients with humeral shaft fractures were treated with closed multiple intramedullary K-wire fixations and were followed up. We included patients with displaced fractures, segmental fractures and humeral shaft fractures in polytrauma patients. Multiple intramedullary k-wire were used to stabilize the fracture after closed reduction under image intensifier.
Results: This prospective study included 40 patients of humeral shaft fractures treated by closed K-wiring. All but 1 fracture united with a time span of 5-8 weeks with attainment of full range of movement at shoulder, elbow and wrist. Implant was removed after radiological union as a day care procedure under local anaesthesia, usually 6-8 weeks after surgery. There was 97.5% union rate.
Conclusions: Closed intramedullary k-wire fixation is a minimally invasive procedure with excellent functional outcome.

Keywords: Humeral shaft fracture, Intramedullary K-wire fixation

INTRODUCTION

Fractures of the humeral shaft are uncommon, representing less than 10% of all fractures in children.[1] Excellent results in fractures of humeral shaft can be achieved with non-operative care, with reported union rates of more than 90% and almost full functional recovery.[2] But same is not true for adolescents i.e. 10-18 years of age. Occasionally, reduction cannot be maintained leading to excessive shortening, angulation or malrotation at the fracture site making operative intervention necessary.[3] Long oblique or spiral and segmental fractures are also equally difficult to treat. Non operative treatment includes hanging cast, U-slab, U-cast, shoulder spica, braces etc. Disadvantages in these treatments include shoulder and elbow joint stiffness, mal-union, non-union or at least delayed union. Open reduction internal fixation with narrow/broad DCP (dynamic compression plate) can be done and has its own demerits including excessive soft tissue dissection and periosteal stripping leading to decreased vascularity of fracture fragment and hence delayed or non-union. Also

there is ugly scar and requires second operation for plate removal. Significant blood loss and radial nerve palsy is also a limiting complication of this plating technique. Stress shielding effect may lead to refractor after implant removal.

In the present study we have used intramedullary K-wires to fix humeral shaft fractures in adolescents. K-wires are easily available, cheap implant and closed procedure leaves fracture haematoma intact leading to early bridging callus formation.

METHODS

Forty patients between 13 to 19 years of age with humeral shaft fractures were included in this study. The study was a prospective study conducted at Jawaharlal Nehru Medical College & Hospital, AMU, Aligarh with patients presenting to OPD or respective Emergency unit between 2012 to 2014.

Inclusion criteria

Displaced humeral shaft fractures with-

- Associated failed conservative treatment (fractures were unable to be reduced adequately or maintained in adequate alignment).
- Polytrauma patients with multiple injuries.
- Segmental fractures.
- Long oblique or spiral fracture.
- Injuries in the same extremities e.g., floating elbow.

Pathological fractures or fractures associated with neurovascular compromise were excluded from the study.

Operative technique

Two 45cm long stainless steel K-wires with thickness of 2 or 2.5 mm were used depending upon the intra-medullary canal diameter. The sharp end of the wires was cut to avoid perforation of opposite cortex. Wire was bending to 20-30 degrees 1cm from tip to facilitate proximal entry of wire into cortical window. It also helps in negotiation of wire at fracture site into distal/proximal fragment. It also helped in reduction of the fractures. Opposite end of the wire was bent to 90 degrees as a guide for manipulation of wire and to aid in reduction.

Cortical window entry point was made ½ to 1 inch proximal to olecranon fossa on posterior aspect of arm by posterior approach using 3.2mm drill bit and awl. Prepared wires were gradually advanced using fluoroscopic control past the fracture site using usual closed reduction technique. Wires were engaged in proximal metaphysis and preferably in different directions. This ensured 3 point contact and fixation along with relative rotational stability. Protruding distal end of the wires was cut, bend in hairpin fashion and impacted up to the bone. Closure was done as usual.

Post operatively additional support was given in U-slab and check X-ray was taken next day. Patient was usually discharged 2 days after surgery. Stitches were removed 2 weeks after operation. Patients were followed 4 weeks after surgery for removal of additional support and check X-ray. At this time of follow up slab/cast were removed and full range of movement of shoulder, elbow and wrist were started.

RESULTS

This is a prospective study conducted at Jawaharlal Nehru Medical College & Hospital, AMU, Aligarh between 2012 to 2014. Total of Forty (40) patients with age between 13 to 19 years were treated by closed intramedullary multiple K-wires.

Among these 21 patients sustained injury in road traffic accident. 19 got it when they fell down from roof top or of similar height. In this study all the fractures were closed fractures. 23 patients had midshaft fracture, 13 patients at junction of proximal 2/3rd and distal 1/3rd and 4 patients were having at proximal 1/3rd.

27 patients were operated under brachial block and remaining 13 were operated under general aneaesthesia. 19 patients were operated on the same day of injury. 37 patients were operated 1-3 days after injury when there was gross displacement after initial good reduction when followed up (Figure 1). 3 patients were operated 3-6 days after injury after initial stabilization who were having severe head or chest injury. None of our patients need open reduction. There was no neurovascular compromise either pre or post-operative.

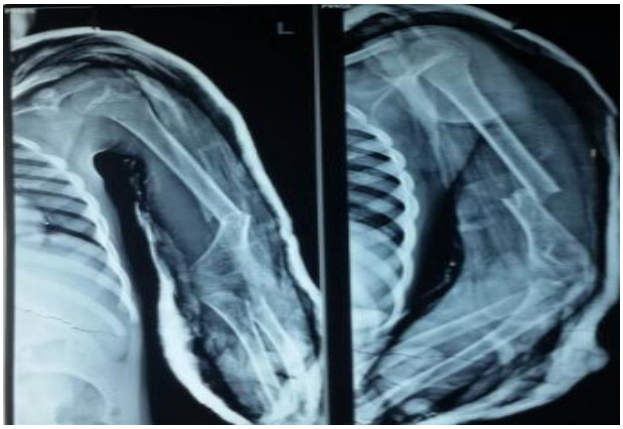

Figure 1: Patient Pooja 14 years old (ckeck X-ray 1 week after closed reduction and U-slab application showing loss of reduction).

Table 1: Patient profile, mode of injury, fracture types, time to operation and union etc.

Sr. no.	Age/sex	Mode of injury	Type of fracture	Time to operation	No. of k-wires used	Time to union	Complications if any
1.	14/M	RTA	transverse	2 days	3	8 weeks	None
2.	13/F	Fall	comminuted	5 days	4	12 weeks	None
3.	19/M	Fall	oblique	1 day	4	20 weeks	None
4.	14/F	RTA	transverse	6 days	3	10 weeks	None
5.	17/M	Fall	oblique	2 days	4	14 weeks	Superficial infection
6.	18/M	RTA	transverse	5 days	4	Non-union at 24 weeks	Wire breakage with nonunion
7.	17/F	RTA	oblique	3 days	3	16 weeks	None
8.	15/F	RTA	comminuted	2 days	3	14 weeks	None
9.	16/M	Fall	transverse	1 day	4	15 weeks	None
10.	19/M	RTA	oblique	1 day	4	20 weeks	None
11.	16/M	Fall	Transverse	1 day	3	17 weeks	None
12.	14/F	RTA	Oblique	1 day	3	13 weeks	None
13.	15/M	Fall	Comminuted	2 days	3	14 weeks	None
14.	17/M	Fall	Transverse	3 days	3	16 weeks	None
15.	19/M	RTA	Transverse	3 days	3	15 weeks	None
16.	13/F	Fall	Comminuted	1 day	2	12 weeks	None
17.	17/M	RTA	Transverse	2 days	3	15 weeks	None
18.	18/M	RTA	Comminuted	1 day	3	20 weeks	None
19.	14/F	RTA	Oblique	2 days	3	19 weeks	None
20.	15/M	RTA	Oblique	2 days	3	15 weeks	None
21.	16/M	RTA	Transverse	1 day	3	16 weeks	None
22.	13/F	RTA	Oblique	2 days	3	14 weeks	None
23.	15/M	RTA	Comminuted	1 day	3	18 weeks	None
24.	14/F	Fall	Oblique	2 days	3	20 weeks	None
25.	16/M	RTA	Transverse	1 day	3	19 weeks	None
26.	19/F	Fall	Oblique	3 days	3	18 weeks	None
27.	18/M	Fall	Oblique	1 day	3	20 weeks	None
28.	19/M	RTA	Comminuted	1 day	3	18 weeks	None
29.	15/M	Fall	Oblique	2 days	3	14 weeks	None
30.	15/F	RTA	Oblique	1 day	3	15 weeks	None
31.	14/M	RTA	Oblique	3 days	3	13 weeks	None
32.	13/M	RTA	Transverse	1 day	3	15 weeks	None
33.	18/M	RTA	Oblique	1 day	3	20 weeks	None
34.	16/M	RTA	Comminuted	2 days	3	18 weeks	None
35.	16/F	RTA	Oblique	1 day	3	19 weeks	None
36.	13/F	Fall	Oblique	2 days	3	18 weeks	None
37.	17/M	RTA	Transverse	1 day	3	20 weeks	None
38.	13/M	RTA	Oblique	2 days	3	13 weeks	None
39.	15/M	RTA	Oblique	1 day	3	15 weeks	None
40.	14/M	RTA	Oblique	1 day	3	16 weeks	None

RTA= Road traffic accident

Clinically union was observed at post-operative 6-18 weeks (average 12 weeks) when patients were able to move their arm without pain (Figure 2). Radiological union was delayed by 1-2 weeks (i.e. 8-20 wks) when there was bridging callus in at least 3 cortices seen in 2 standard antero-posterior and lateral views.

All but 1 fracture united with a time span of 8-20 weeks with attainment of full range of movement at shoulder, elbow and wrist. 1 patient developed skin irritation at entry site because of protruding wire who gets relieved after removal of wire on union.

Implant was removed after radiological union as a day care procedure under local anaesthesia, usually 18-24 weeks after surgery.

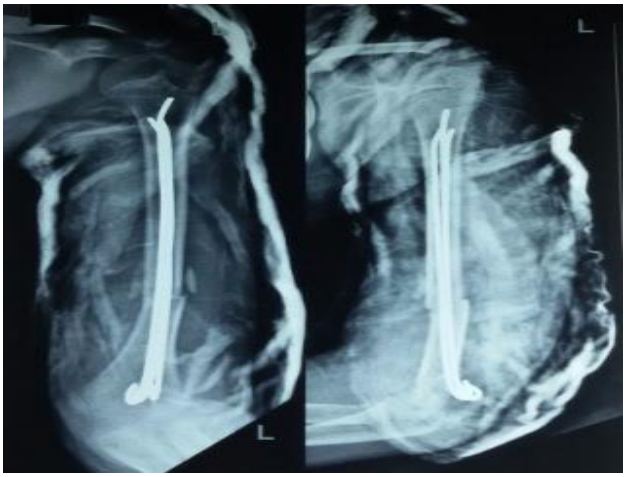

Figure 2: Immediate post-op X-rays.

There was 97.5% union rate with excellent restoration of shoulder and elbow movement in our study. One of our patients landed up in non-union with broken K-wires. This patient was also having significant head injury who returned 10 weeks after surgery as first follow up after stich removal (Figure 3). Non-compliance with the use of arm in heavy work was thought to be the basic reason for implant/surgery failure in this patient. This patient was then managed with K-wire removal and open reduction internal fixation with narrow DCP which united when followed up at 3 months.

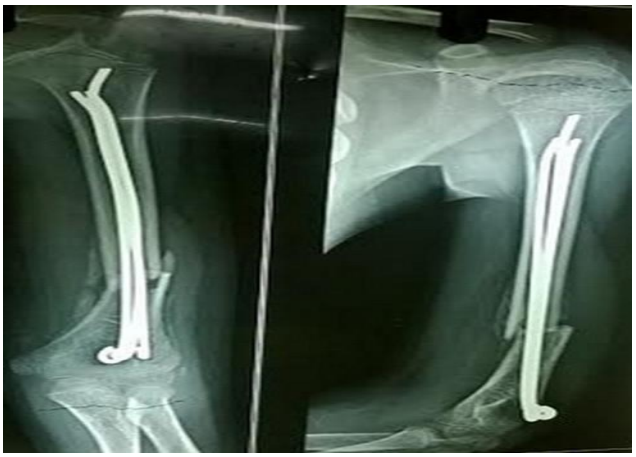

Figure 3: Eight weeks post-operative after immediate removal of slab with check X-ray and clinical union.

Closed intramedullary k-wiring enables us doing almost bloodless surgery. None of our patient developed any peripheral nerve palsy. There was no problem with scar except in one patient with protruding wire who developed superficial infection which subsided with implant removal.

DISCUSSION

Fractures of the humeral shaft are uncommon, representing less than 10% of all fractures in children.[1] Reasonably good results can be achieved with non-operative means, with reported union rates of more than 90% and almost full functional recovery.[2] But same is not true for adolescents where reduction cannot be maintained leading to excessive shortening, angulation or malrotation at the fracture site making operative intervention necessary.[3] Long oblique or spiral and segmental fractures are also equally difficult to treat. Open reduction and internal fixation with plates & screws has its own demerits leading to blood loss, infection and stress shielding effect.

Closed K-wiring under image intensifier is a closed technique without exposing the fracture site. There is minimal blood loss. Stability at the fracture site is not only provided by intramedullary k-wires but also by the cortical contact at the fracture as well as by surrounding soft tissues which act as a guy ropes. Early physiotherapy also prevents joint stiffness and early return to playful activities. Closed technique leaves fracture hematoma intact leading to early bridging callus formation. There is minimal scarring and good cosmetic outcome as compared to plating.

This study gives excellent union and functional result with good cosmetic result. This is also short and simple percutaneous technique with no neurological complication.

Similar results were produced by many authors. Qidwai[4] has produced 93% union rates in humeral shaft fractures treated with K-wire. 91.5% union rate was demonstrated by Shazer, et al using ender nail.[5] Stannard, et al has also reported somewhat similar result.[6]

This study is different from other studies that our study population was only aldoscent and mostly with unstable fracture or failed previous reduction.

CONCLUSION

Intramedullary K-wiring for Humerus is a safe, easy, effective and short procedure. It gives dynamic fixation without compromising stability at the cost of almost nothing. This method of dynamic fixation has advantage of preservation of soft tissue sleeve including muscle and periosteum. Both endosteal and periosteal blood supply is preserved. Fracture haematoma is not disturbed so early bridging callus is seen which along with internal fixation helps us to allow earliest physiotherapy and hence best functional results.

Achieving 97.5% union with almost nil complication in patients with displaced or unstable fracture is much encouraging. In polytraumatized patients or having segmental fracture this closed wiring with minimal blood

loss is a boom. Although sample size is much smaller we strongly believe that this is a simple, easy to learn and promising technique.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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