ORIGINAL ARTICLE

Pin tract infection rates between percutaneous and buried K-wires in supracondylar fracture of humerus in children

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Abstract:

Objective: To compare pin tract infection rate between percutaneous and buried Kirschner wires (K-wires) in supracondylar fracture of humerus in children.

Study Design: A retrospective study.

Setting and Duration: Department of orthopaedics, Hamdard College of Medicine and Dentistry, Karachi and department of orthopaedics, Karachi Medical and Dental College, Karachi from January 2005 to October 2009.

Methodology: Out of 154 patients of Gartland type – III, Supracondylar fracture of humerus, 66 patients were treated by percutaneous K-wire fixation and 88 by buried K-wires. The data of above mentioned children was collected on proforma and analyzed.

Results: In this study 13 wires out of 66 wires in percutaneous K-wire group has developed infection in comparison to only 2 wires out of 88 K-wires in buried K-wire group. This difference was statistically significant ($p < 0.001$). Other wound related complications found in this study were overgranulation in 5 patients, hypersensitive scar in 1 patient, neuroparaxia in 1 patient, wire loosening in 16 patients and retromigration in 5 patients. There was no fatal complication resulting from antegrade migration of K-wires.

Conclusion: It is evident from this study that Kirschner wires, that were left exposed percutaneously in the fixation of supracondylar fracture of humerus in children, have a significantly higher pin tract infection rate than those that were buried beneath the skin. The advantages of burying the K-wires are less incidence of infection and lower risk of early removal of an infected K-wire and subsequent displacement of fracture fragments, but the disadvantage of burying K-wires in paediatric population is that it will need to be removed as a day case surgery with considerable financial implications.

Key Words: Pin tract infection, Percutaneous, Buried, K-wire, Supracondylar fracture of humerus in children

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Introduction:

Kirschner wires are extremely useful in fracture fixation in the paediatric population. Complications associated with k-wiring procedure vary minor to life threatening.[1] Although meticulous pin insertion techniques reduces pin tract infection, it can not be eliminated.[2] Pin tract infection is a common and well documented complication which is usually treated with antibiotics and removal of pin.[3] If neglected, it leads to serious complications including osteomyelitis, septic arthritis, early physeal fusion, flexor sheath infection and toxic shock syndrome.[3,4]

Most informations on pin tract infection has been gathered through the use of external fixators, where the pin tract infection can be as high as 33%.[3] The formation of biofilm has been noted on external fixator pin.[5,6] It has been found that, Incidence of infection rate increases with length of time for which Kirschner is left in Situ.[7] A number of strategies have been adopted to reduce the pin tract sepsis. These include pin site cleaning, release of tethered skin, coating pins

with antibacterial substances and application of prophylactic topical antibiotics.[3] However it is not evident that burying of wires under the skin reduces the pin tract infection rate.[3]

The purpose of this study was to determine whether burying the Kirschner wires, as opposed to leaving them percutaneously, reduced the infection rate in the management of supracondylar fracture of humerus in children.

Patients and Methods:

This study was conducted at department of orthopaedics, Hamdard University Hospital, Karachi and department of orthopaedics, Abbasi Shaheed Hospital, Karachi from January, 2005 to October 2009. This was a retrospective study and all the patients included in this study had supracondylar fracture of humerus, Gartland type- III. They have been treated either by open reduction and internal fixation of the fracture by k- wires or closed reduction under C-arm control with percutaneous K-wire fixation. K-wires measuring 1-1.5 mm. in diameter were inserted with power drill while the K-wires used were of different manufacturing companies. At the end of procedure k- wires have either been left percutaneous protruding through the skin with exposed ends acutely bent in 66 (42.8 %) patients or were cut off, bent, buried under the skin and closed with 5/0 prolene in 88 (57.2 %) patients at the end of the operation. Ends of the wires were bent over in all cases to prevent the wire migration. The wounds were dressed with Bactrigras and above elbow plaster of paris posterior slab was applied. The majority of patients were discharged the following day and reviewed at 1,2 and 4 weeks in out patient department .

Table 1: *Modified Openheim classification*[3]

Grades	Clinical findings	Management
1	Slight discharge and redness around pin	Local pin and wound care
2	Redness and tenderness in the soft tissues with or without discharge of pus	Local pin and wound care + oral antibiotics
3	As for grade 2 but with failure to improve with local care and antibiotics	Infected pin removal + oral antibiotics
4	Severe soft tissue involvement affecting more than one pin	Infected pin removal + oral antibiotics
5	As for grade 4 but also with bone involvement visible on x-ray	Infected pin removal + Curettage of bone
6	A sequestrum has formed with in the bone and a persistent sinus has formed	Further surgery required to eradicate infection

Patients with age greater than18 years, open fractures, metabolic bone disease, dysvascular deformity, multiple injuries and ipsilateral upper extremity fractures were excluded from the study. Review assessment consisted of clinical examination and scoring of pin tracts using modified Oppenhiem classification3(Table- I) of pin tract infection. Diagnosis of pin tract infection was made if the pin tract score was tract score was grade 2 or higher. Pus from all discharging wounds were sent for culture and sensitivity examination. If one or more pin tracts were infected, antibiotics were commenced and patients were reviewed during the following week. Pin tract was examined and evaluated for the response of treatment. If the wound condition improved as evidenced by decreased cellulitis and decreased amount of pus discharge. K-wires were left in place and patient was followed twice weekly. If pin tract did not respond to antibiotic, kirschner wires were removed before 4 weeks period of time.

Data were collected on proforma and enterd to SPSS-15 computer software programme. Statistical analysis was performed using Chi- square test. A p-value for the level of significance < 0.05 was considered statistically significant. Statistical analysis also included descriptive statistics including frequencies and measure of central tendency for general data i.e gender, age methods used and infection rates.

Result:

This study comprised 154 patients with displaced supracondylar of humerus

(Gartland type – III) treated with K-wire fixation. Numbers of percutaneous K-wires were 66 while number of buried K-wires were 88. Twenty seven males while 6 females were treated with percutaneous K-wires. On the other hand, 39 males and 5 females were treated with buried

K-wires.

Demographic data of the treatment groups percutaneous & buried K-wires and their results are shown in Table 2. 13 wires out of 66 wires in percutaneous K-wire group has developed infection in comparison to only 2 K-wires out of 88 wires in buried k- wire group. This difference was statistically significant ($p < 0.001$).

Wound related complications are shown in Table 3. Infected wires have caused over granulation in 5 cases and hypersensitive scar in one case. No chronic or deep soft tissue infection was observed. Neuroparaxia affecting ulnar nerve (3 Patients) and superficial branch of radial nerve (5 patients) were detected postoperatively. All neurological complications were resolved over a period of time. 16 cases had wire loosening indicated by the ease of wire removal. Most of the patients of pin loosening were associated with wound related complications. 5 Patients were found to have retrograde wire migration indicated by presence of K-wires in cast or longer protruding part of the k- wire than initial protruding portion.

There were no fatal complications resulting from antegrade wire migration to vital organs. 3 Patients had undergone removal of K-wire, remanipulation of the fracture and above elbow plaster slab application.

Discussion:

Kirschner wire fixation is a common and versatile method of internal fixation in paediatric fractures. This study compared the rate of pin tract infection in patients with supracondylar fracture of humerus in paediatric age group, who were treated with either by burying K-wires under the skin or leaving them protruding percutaneously.

Table 2: *Out come of the treatment between two groups*

	Percutaneous wires (n=66)	**Buried wires (n=88)**	**p-value**
Total number of wires infected	13 (19.69%)	2 (2.27%)	<0.001
Method of reduction open / closed	9 / 57	13 / 75	>.01
Number of wires removed earlier due to infection	5	0	-

Table 3: *Complications related to K-wires*

Overgranulation	5
Hypersensitive scar	1
Neuroparaxia	8
Wire loosening	16
Retrograde migration	5
Remanipulation under general anaesthesia & above elbow plaster slab application	3

It has been observed in this study that rate of infection in percutaneous K-wire group was significantly higher than the buried k- wire group ($p<0.001$). There is no information in local literature regarding incidence of pin tract infection in paediatric poplation. Botte et al[7] reported 10 cases of infection in their retrospective review of Kirschner wire complications in 137 patients, Two of which caused osteomyelitis. It could be possible that pin tract infection develop because of biofilms growing on its surface and tracking down along the kirschner wires. Biofilms have previously been identified on external fixator pins,[6] but Hargreaves et al[3] were unable to identify biofilms on either non-infected Kirschner wires, which had been left in situ for six weeks.

Complication rates in few of the previously published relevant studies such as Stahl and Schwartz[8](15.2%), Botte et al[7].(18%) and Stern & Fulton[9](42%) are all related to adult patients and they have studied hand and wrist region. Lee et al[13] observed 30 patients (18.98%) with unsatisfactory results in a review of 158 Gartland type-III supracondylar fracture of humerus in children. Infection rate in our study is 19.7% in percutaneous group which is similar to the above mentioned study.

Lee et al.[10] reported higher complication rates (33%) in a retrospetctive study of 21 medial condyle fractures. The authors recommended adequate stabilization of the fracture using K-wire and immobilization until there is radiographic evidence of healing. Starker and Eaton[11] observed a low complication rate for K-wires placed in emergency room with no patient developing osteomyelitis, septic arthritis or deep

pin track sepsis. We do not believe that k-wiring in accident and emergency room is a practically feasible option in children.

We observed significant wound related problems in percutaneous K-wire group of patients in the form of pin tract infection in 15 patients, overgranulation in 5 cases and hypersensitive scar in one case. No chronic or deep seated soft tissue infection was seen. Cheng et al.[12]analyzed 403 cases supracondylar fracture of humerus in children. They found two cases of superficial pin tract infection. Botte et al[7] observed infections in 10 patients (7%) and pin loosening without infection in 6(4%) out of 137 patients. Lee et al[13] presented a retrospective review of 158 type- III supracondylar fractures of humerus. They found no correlation between an increase in time to surgical intervention and longer operative time or need to open the fracture site, nor was there an indication that delayed operation resulted in longer hospital stay.

Distal migration of K-wires reported earlier in literature such as distant migration of K-wire in to right ventricle, cardiac arrhythmia, intrathoracic migration into main pulmonary trunk and pericardial tamponade. Haemoptysis due to migration of a fractured K-wire to bronchial tree and Brown-Sequard syndrome are frightening reports with a nearly fatal outcome.[7,9,11,14-20] Lyons and Rockwood[19] described 49 cases of K-wire migration (including 17 to major vascular structures at 8 deaths). The mechanism of this migration was loosening of the K-wire secondary to the movement of shoulder girdle over pin ends. The movement along tissue planes was thought to be due to muscle action and effect of gravity.[19,20] K-wires are prone to migrate due to their smooth nature. Pins are bent to prevent migration and left out side the skin or buried beneath it in all patients in this current series.

We have found 16 cases with wire loosening in this study by the ease of wire removal. 5 patients showed retrograde migration of K-wires by the presence of wires in the plaster cast or longer size of protruding part of the pin. There was no fatal or nearly fatal complication due to antegrade migration of K-wire to vital structures.

Gosens and Bongers[21] reported a 16.5% rate of neurological impairment in a series of 200 patients. All recovered without sequelae except one case with persistent radial nerve palsy, which recovered after interposition grafting of sural nerve. Ikram[22] mentioned four children in his study, who developed ulnar nerve palsy following percutaneous fixation of supracondylar fracture of humerus by K-wires in children. It was observed that the recovery in three patients took an average of 6 weeks after removal K-wires with exploration and adhesiolysis of the ulnar nerve. Rasool[23] described 6 cases of ulnar nerve injury after K-wire fixation of supracondylar fracture of humerus. Full nerve recovery occurred in 3 cases, partial in 2 and no recovery in one case. The author also advised an early exploration rather simple removal of K-wires. Cheng et al.[12] mentioned only one case of ulnar nerve palsy associated with K-wire fixation; however, 10.5% had an initial neuroparaxia. We found 8 cases (5.2%) iatrogenic neuroparaxia in this series affecting superficial branch of radial nerve in 5 patients and ulnar nerve in 3 cases. All patients regained full neurological functions later on with conservative approach.

Conclusion:

It is evident from this study that Kirschner wires that are left percutaneously exposed in the fixation of supracondylar fracture of humerus in children, have a significantly higher pin tract infection rate than those that are buried beneath the skin. The advantages of burying the K-wires are less incidence of infection and lower risk of early removal of an infected wire, which may risk further displacement of fracture fragments. The disadvantage of burying K-wires in paediatric population is that it will need to be removed as a day case surgery under general anaesthesia with considerable financial implications.

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