



## A comparative study of four methods in treatment of pin tract infection in children supracondylar humerus fractures

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The purpose of this study was to compare prospectively the incidence of pin tract infection in children supracondylar fractures of humerus managed by different frequency of pin care. From April 2004 to February 2014, one hundred and eighty supracondylar humerus fractures in children were randomized to postoperative pin care by no pin tracts cleaning (Group A, 45 cases) or cleaning pin tracts daily (Group B, 45 cases) or cleaning every other day (Group C, 45 cases) or cleaning weekly (Group D, 45 cases). The patient demographics and fracture characteristics of the four groups were comparable. Perioperative care was standardized. The data of pin retention time, union time and the rate of pin tract infection were recorded.

The average follow-up time was 5.7±1.6 months in Group A, 6.0±1.5 months in Group B and 5.8±1.4 months in Group C and 6.3±1.5 months in Group D. There was no significant difference in union time and pin retention time between the four groups. 72 cases (40%) had pin tract infection. Among them, the rate of grade 1 infection occurred about 20% and grade 2 about 11.1% and grade 3 about 5.6%. No significant difference was found between four groups in frequency and severity of pin tract infection (both  $P>0.05$ ). However, complain of pain was more frequent in Group B than other three groups ( $P<0.05$ ). Our results indicated that the four methods were effective in treatment of pin tract infection of children supracondylar humerus fractures. However, excessive frequent care caused more fear and anxiety in the mood of children and parents.

**Keywords:** Children ; supracondylar humerus fracture ; closed reduction ; Kirschner wire ; pin-tract infection.

### INTRODUCTION

Closed reduction and percutaneous pinning fixation has become the preferred method in the treatment of supracondylar humeral fractures in children (3,12). The advantages of it include better blood supply protecting, shorter operative time and hospital stay, lower risk of infection. However, infection at the pin tracts frequently occurs, which leads to pin loosening, chronic osteomyelitis, delayed union and even nonunion (8,9,15). The rate of pin tract infection has been reported as ranging from less than 3% to about 46% (4,5,8-11,14,15,18). Some authors believed that careful pin

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tract care was an important measure to prevent pin tract infection (1,11,14,17). However, there were also authors believed that pin tract care was not effective in preventing pin tract infection (5,8,11,14). Therefore, there was still many controversy about whether it was necessary to do pin tract care, and what was the frequency of pin tract care.

The purpose of this study was to compare the incidence of pin tract infection in children supracondylar humerus fractures managed by no pin care, pin care daily or every other day or weekly. We hypothesized that the incidence of infection would be more frequent in no pin care group, whereas pin care daily achieved the best clinical results and it would decrease healing time and pins removal time.

## MATERIALS AND METHODS

After approval from Institutional Review Board of our hospital, in accordance with the inclusion criteria and exclusion criteria, 180 consecutive children with supracondylar humerus fractures were treated with closed reduction and percutaneous pinning fixation between April 2004 and February 2014. The inclusion criteria were: (1) age from 3.0 to 10.0 years, (2) fresh closed fractures (within one weeks after injury), (3) unstable Gartland type II and Gartland type III fractures whose displacement were greater than 2 mm in the coronal and(or) sagittal plane, (4) treated by closed reduction and percutaneous pinning fixation. The following patients were excluded: (1) chronic, recurrent, inflammatory dermatosis, (2) open fractures, (3) fracture requiring open reduction, (4) associated with nerve or vascular injury requiring repair or exploration, (5) combined with severe vital organs and brain injuries. The parents of the children were informed of the study, and an informed consent was obtained from each of them before the operation. At admission, type of pin tract care was chosen at random by drawing from the box containing an equal number of envelopes with among of the four methods.

All the operations were performed by the same group of surgeons (ZJ, ZYQ and ZSJ). Surgical techniques were standardized in terms of the pin location, the pin size, the incision and position of the elbow used for medial pin placement,

and the postoperative course. Closed reduction and percutaneous pinning fixation were performed under the guidance of fluoroscopy. The patients were treated with lateral entry pin fixation. Two pins were used and they were bent outside the skin. A long arm cast was applied with approximately 70° to 90° of elbow flexion and neutral forearm rotation. Prophylactic antibiotics (Cefazolin 30mg/kg) were only performed within half-hour before the surgery. No antibiotic was administered after the surgery. After surgery, the patients were randomized to one of the four groups (45 cases in each group). Pin tract care was implemented before the patient was discharged from our hospital. Group A took the method of no pin care, and Group B took daily pin care, and Group C took pin care every other day and Group D took weekly pin care. All patient took pin tract care in outpatient clinic dressing room of our hospital. Two registered independent nurses participated in the changing dressing. The criteria procedure of pin tract care were as follows: (1) sterile saline irrigation, (2) drying with sterile swabs, (3) crusts around pin were removed, (4) sterile gauze was placed on to each pin tract, (5) fixing with a soft dressing.

The children's parents were given information about how to observe signs of infection. The patients and the nurses also received instructions about finger motion, circulation observation and pain management. Parents could call of advisory outpatient clinic dressing room if they had any questions or concerns. The number of consultation calls was recorded by the registered nurses. The nurses recorded finger function, circulatory function, pain management, signs of infection and parents' complaint and reported them to us.

The patients were asked for clinical and radiographic follow-up at 2, 4 and 6 weeks postoperatively and each month thereafter. According to postoperative clinically and radiographically healed fracture, the cast and K-wires were removed in the clinic after 4–6 weeks. Pin sites were inspected and graded on the scale of 0 to 5 according to slight modification of the system of Dahl described by Gordon et al (10) during outpatient visits. A trained examiner (YY) blindly reviewed all patients. Grade 0 was normal skin,

grade 1 was pain or erythema without discharge, grade 2 was serous discharge, grade 3 was purulent discharge, grade 4 was radiographic osteolysis and grade 5 was ring sequestrum or osteomyelitis. Fracture union was defined as the absence of pain and the presence of bridging callus seen on the radiographic views of the humerus. We also recorded number of intraoperative percutaneous pinning, pin retention time and parents' complaint.

All statistical analyses were performed with SPSS version 17.0 software (SPSS Inc, Chicago, Illinois). The patient demographics (sex, injury side, fracture type, complain of pain, pin tract infection and condition) of the three groups were compared using the Pearson's chi-square test for nonparametric categorical variables. Independent sample t test was used to compare the patients' age, BMI (Body Mass Index), time of injury to surgery, number of intraoperative percutaneous pinning, duration of follow-up, bone healing time, and pin retention time. The level of significance was set at  $P < 0.05$ .

## RESULTS

The study population consisted of 180 children (81 girls and 99 boys). The mean age at the time of the operation was 6.4 years (range 3.5–10.0 years). There were 37 Gartland type II fractures and 143 Gartland type III fractures. There were no significant differences in age, gender, BMI, injured side, fracture type, injury to surgery time, number of pins or duration of pin retention, follow-up time between the two groups (Table I). No significant difference between the four groups was found in union time ( $5.8 \pm 1.3$  weeks vs.  $5.8 \pm 1.6$  weeks vs.  $5.7 \pm 1.5$  vs.  $5.9 \pm 1.5$ ). When comparing complain of pain, statistical difference existed between the groups ( $P < 0.05$ ). Parents whose children took pin sites cleaning every day had more anxiety and their children were more scared than the contrasts.

Using the system of Dahl, the conditions of infection were grade 0 at 228 pin sites, grade 1 at 72 pin sites, grade 2 at 40 pin sites and grade 3 at 20 pin sites. No grade 4 and 5 infection occurred. Pin site infection occurred in 20 of 45 patients in the group A and in 14 of 45 patients in group B and in 14 of 45 patients in group C and in 24 of 45 patients

in group D. There was no significant difference in the infection rate among the 4 groups. Of the 360 pin sites, infection occurred at 40 of 90 pin sites in group A and at 28 of 90 pin sites in group B and at 28 of 90 pin sites in group C and at 36 of 90 pin sites in group D. No pin was removed before the fracture union because of infection. No local, oral or parenteral antibiotics were prescribed during the follow-up period. Table II lists the distribution of the pin site condition.

## DISCUSSION

Pin track infections were the most common complications in pediatric supracondylar humerus fractures treated with closed reduction and percutaneous K-wires fixation (15,20). One of the most important factors supposed to influence the occurrence of infections was pin tract care (13,15,17). However, The frequency of pin site care was also a controversial issue in clinical practice (6,8,13,14). Patterson et al. (17) demonstrated that dressing twice daily could reduce the incidence of infection. Davies et al. (8) reported a good result in a group of patients with weekly pin tracts care. As a result, we conducted a prospective study to validate the therapeutic efficacy of four different pin site care protocols.

An important finding of the present study was that four methods were effective in treatment of pin tract infection of children supracondylar humerus fractures. Although more children in no pin care group suffered infection, there was no significant difference in the infection rate among the 4 groups ( $P > 0.05$ ). Interestingly, we observed more child's fear and parental anxiety in the daily pin cleaning group.

The reported frequency of pin site infections ranged greatly from 3.6% to 77.0% (2,6,7,11,14,15,18,19). In our study, the overall incidence of infection was 40.0%. In this series, 20 patients (44.4%) suffered infection in Group A and 14 cases (31.1%) in Group B and 14 cases (31.1%) in Group C and 24 cases (55.6%) in Group D. From another point of view, infection occurred at 40 (grade 1 in 22.2% and grade 2 in 13.3% and grade 3 in 8.9%) of 90 pin tracts in Group A and 28 (grade 1 in 17.8% and grade 2 in

Table I. — Baseline characteristics between the three groups

| Characteristics                                   | Group A   |          | Group B  | Group C  | *P <sub>2</sub> |
|---|-----------|----------|----------|----------|-----------------|
| No. of patients                                   | 45        | 45       | 45       | 45       | /               |
| Age (y) <sup>a</sup>                              | 6.0±2.2   | 6.5±2.0  | 6.6±2.4  | 6.4±1.8  | 0.555           |
| Sex (male: female, n) <sup>b</sup>                | 25:20     | 26:19    | 23:22    | 25:20    | 0.935           |
| BMI (kg/m <sup>2</sup> ) <sup>a</sup>             | 18.1±3.5  | 18.0±3.3 | 17.8±3.6 | 17.6±3.0 | 0.899           |
| Fracture side (left: right, n) <sup>b</sup>       | 20:25     | 17:28    | 19:26    | 20:25    | 0.909           |
| Fracture type (II: III, n) <sup>b</sup>           | 8:37      | 10:35    | 8:37     | 11:34    | 0.821           |
| Injury to surgery time (d) <sup>a</sup>           | 1.5±0.3   | 1.4±0.5  | 1.6±0.4  | 1.5±0.4  | 0.146           |
| No. of pins                                       | 90        | 90       | 90       | 90       | /               |
| Number of pinning during surgery (n) <sup>a</sup> | 10.2±5.3  | 9.8±5.8  | 11.1±4.7 | 10.6±4.3 | 0.354           |
| Pin removal time (d) <sup>a</sup>                 | 30.9±10.6 | 32.0±8.2 | 33.2±8.8 | 31.8±9.1 | 0.417           |
| Union time(w) <sup>a</sup>                        | 5.8±1.3   | 5.8±1.6  | 5.7±1.5  | 5.9±1.5  | 0.938           |
| Follow-up time(m) <sup>a</sup>                    | 5.7±1.6   | 6.0±1.5  | 5.8±1.4  | 6.3±1.5  | 0.245           |

<sup>a</sup>Student's t test; <sup>b</sup> Chi-squared test; *P*<0.05 is considered statistically significant.

6.7% and grade 3 in 6.7%) of 90 pin tracts in Group B and 28 (grade 1 in 16.7% and grade 2 in 10.0% and grade 3 in 4.4%) of 90 pin tracts in Group C and 36 (grade 1 in 23.3% and grade 2 in 14.4% and grade 3 in 2.2%) of 90 pin tracts in Group D. Grade 1 infection showed signs of erythema, and whether inflammation or real infection existed was

debatable. When excluding grade 1, the incidence of pin site infections decreased to 22.22% in Group A and to 13.3% in Group B and to 13.3% in Group C and to 16.7% in Group D. We also found no significant difference was observed among the groups (*P*>0.05).

There are many reasons leading to the infection.

Table II. — Pin-tract infection and pin-tract condition

|                                  | Group A | Group B | Group C | Group D | *P    |
|----------------------------------|---------|---------|---------|---------|-------|
| Pin-tract infection <sup>a</sup> |         |         |         |         |       |
| Yes                              | 20      | 14      | 14      | 24      |       |
| No                               | 25      | 31      | 31      | 21      |       |
| Total                            | 45      | 45      | 45      | 45      | 0.083 |
| Pin-tract condition <sup>a</sup> |         |         |         |         |       |
| Grade 0                          | 50      | 62      | 62      | 54      |       |
| Grade 1                          | 20      | 16      | 15      | 21      |       |
| Grade 2                          | 12      | 6       | 9       | 13      |       |
| Grade 3                          | 8       | 6       | 4       | 2       |       |
| Total                            | 90      | 90      | 90      | 90      | 0.323 |
|                                  |         | .94     | .94     |         |       |

<sup>a</sup>Chi-squared test; *P*<0.05 is considered statistically significant.

First, repeatedly percutaneous pinning during surgery may be a factor causing pin site infection. Due to fracture pattern and surgeon's subjective decision, some fractures are often required to place the pins many times to achieve stable reduction. In our institution, five patients who were recorded to insert pins several times (>20) suffered pin track infection. Second, removal of crusts would lead to pin site infection. Kao et al. (11) reported that scraping away crusts could traumatize marginal tissue and break the pin-skin barrier. Dahl et al. (1) also found that pain during the removal of crusts was associated with more pin site infection. Third, pin site infection was related to the type of implant being used, definition of infection used in the study, and pin site care protocol used postoperatively.

Several limitations existed in our study. First, this was a single center study which enrolled only a small number of patients. To further convince these results, high quality randomized controlled trials with larger sample size are still needed. Second, although patients were allocated randomly to either surgical group, it was impossible to perform blindness to both the surgeon and patients, which might influence the results. Third, this study only included lateral entry pinning while medial entry pinning and cross pinning were not included. Therefore, further research is needed.

## CONCLUSIONS

Our results indicated that the four methods were effective in treatment of pin tract infection of children supracondylar humerus fractures. However, excessive frequent care caused more fear and anxiety in the mood of children and parents.

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