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Comparison of the therapeutic effects of conservative manual reduction and open reduction on pediatric forearm fracture.

Xu-Fei Zhao, Xing Zhou, Guo-Qiang Zhao, Ye-Feng Dai*

Department of Traumatology, Children's Hospital of Zhejiang University School of Medicine, Hangzhou, Zhejiang, PR China

Abstract

Objective: This study aims to compare the therapeutic effects of conservative manual reduction therapy and open reduction therapy on pediatric forearm fracture.
Methods: A total of 68 patients with pediatric forearm fracture were chosen in our hospital as participants from January 2015 to January 2016. The patients were divided into the observation group (open reduction therapy) and the control group (conservative manual reduction therapy). Each group comprised 34 patients, and the therapeutic effects were compared.
Results: The observation and control groups show statistically significant differences (P<0.05) in terms of length of stay, time of operation, and intraoperative hemorrhage. The healing rates of the observation and control groups are 94.12% and 76.47%, respectively, indicating a statistically significant difference (P<0.05). On the basis of the data obtained from the nine-month follow-up visits to patients, the joint functional recovery rates of the observation and control groups reach 97.06% and 79.41%, respectively, showing a statistically significant difference (P<0.05).
Conclusions: Open reduction therapy to patients with pediatric forearm fracture achieves better therapeutic effect compared with conservative manual reduction therapy and is worthy of application to clinical practices.

Keywords: Pediatric forearm fracture, Conservative manual reduction, Open reduction.

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Introduction

Pediatric forearm fracture is a common clinical type of fracture in orthopedics. It is classified under forearm injuries and is mainly observed in children, which is caused by the high activity and poor self-defensive ability of this population [1]. At present, conservative manual reduction therapy and open reduction therapy are the main treatment options for pediatric forearm fracture in clinics. In this research, 68 patients with pediatric forearm fracture were chosen in our hospital and examined to compare the therapeutic effects of these two therapies. Research results are introduced in the following sections.

General Information and Method

General information

In this study, 68 patients with pediatric forearm fracture were randomly selected in our hospital from January 2015 to January 2016. They were divided into the observation and control groups, with each consisting of 34 patients. The observation group has 20 boys and 14 girls with ages between 5 and 10 years old (average of 7.8 ± 1.4). Among them, 21 patients have fracture at the upper part of the forearm, and 13 patients have fracture at the upper middle portion of the forearm. The control group has 22 boys and 12 girls, with ages between 6 and 11 years old (average of 8.1 ± 1.1). In the control group, 23 patients have fracture at the upper portion of the forearm, and 11 patients have fracture at the upper middle part of the forearm. No statistically significant difference in general information is found between the control and observation groups (P>0.05), indicating that these two groups are comparable.

Inclusion criteria

Child patients were diagnosed with forearm fracture using X-ray images in accordance with the standard of Practical Orthopedics. The injury time before medical treatment is shorter than 3 days. During this period, no examinations and treatments have been given to these child patients. All patients have no previous wrist lesions and forearm fracture. All parents of the patients were well informed of the study content and signed the informed consent.

Treatments

For the observation group, a small incision (approximately 2 cm long) was made under general anesthesia and conventional disinfection procedure with the patients in a supine position to expose the fracture end. Periosteum or muscular tissues that invaded the fracture end were eliminated under direct vision, followed by fracture reduction. The reduction therapy was determined to be successful based on the X-ray perspective of the C-arm machine. An appropriate Kirschner wire was chosen for cross fixation of the fracture end depending on specific conditions, and then the incision was closed. The Kirschner wire was cut outside the skin, and the needle end was bended. A plantlet was used for external fixation [2]. For the control group, the shoulder and elbow joint angles were adjusted with the child patients in a supine position. The shoulder with fracture was extended outward at 90°, and the elbow joint was bent at the same angle. The assistant was asked to hold with two hands the upper part of the elbow and wrist of the patients. The upper 1/3 portion of the fracture was treated using a forearm supination position, whereas the middle-lower 1/3 position was treated using a forearm neutral position. Traction along the fraction direction of child patients was applied, and gentle horizontal rotation was implemented for the sake of reduction. Following successful reduction, a plantlet was utilized for external fixation, and the injured arm was hanged in front of the chest with the aid of a triangular bandage.

Observation indexes

The fracture and joint functional recovery rates after nine-month follow-up visits to the two groups were determined.

The fracture recovery rate can be calculated using the following equation: recovery rate=(clinical healing+delayed healing)/total cases × 100. The clinical healing standard of fracture includes absences of local tenderness, abnormal movement, and pain upon longitudinal percussion. X-ray diagnosis shows a fuzzy fracture line and continuous callus at the position passing through the fracture line. When the external fixation is removed, the injured arm can lift 1 kg loads forward for 1 min. No deformation is observed for two continuous weeks at the fracture. A delayed healing occurs when the fracture fails to completely heal after four months of treatment [3].

For the assessment standard of therapeutic effect, the joint functional recovery of child patients was evaluated in accordance with Anderson scoring standards. The joint functional recovery is tagged as excellent if the joint functional loss is less than 10%, good if the joint functional loss is less than 20%, acceptable if the joint functional loss is higher than 30%, and poor if fracture displays healing failure or malunion. The excellent percentage of the joint functional recovery is determined using the following equation: excellent percentage=(excellent+good) cases/total cases × 100 [4].

Statistical method

Statistical analysis of testing data was accomplished using the statistical software SPSS 18.0. Measurement data were determined through t-test and expressed as $\bar{x} \pm S$. The enumeration data were analysed using χ^2-test and expressed as n%. $P<0.05$ indicates a statistically significant difference.

Results

Comparison of length of stay (LOS), intraoperative hemorrhage, and time of operation

The observation and control groups significantly differ in LOS, time of operation, and intraoperative hemorrhage ($P<0.05$) (Table 1).

Table 1. Comparison of LOS, intraoperative hemorrhage, and time of operation ($\bar{x} \pm s$).

Group	Cases	LOS (days)	Time of operation (min)	Intraoperative hemorrhage (ml)
Observation group	34	6.43 ± 1.50	53.54 ± 30.49	58.34 ± 30.87
Control group	34	7.36 ± 1.82	72.36 ± 35.73	78.05 ± 43.02
t		2.2993	2.3363	2.1705
P		0.0247	0.0225	0.0336

Fracture recovery analysis of two groups

The fracture healing rate of the observation group is 94.12%, which is significantly higher than that of the control group ($P<0.05$). The difference shows statistical significance. Table 2 presents the results.

Table 2. Fracture recovery analysis of two groups (n (%)).

Group	Cases	Clinical healing	Delayed healing	Dislocation of fracture	Bone non-union	Healing rate
Observation group	34	22 (64.71)	4 (11.76)	8 (23.53)	0 (0.00)	26 (76.47)
Control group	34	30 (88.24)	2 (5.88)	2 (5.88)	0 (0.00)	32 (94.12)
χ^2		5.2308	0.7312	4.2207	/	4.2207

P	0.0222	0.3925	0.0399	/	0.0399

Analysis of the joint functional recovery of two groups

On the basis of the data obtained from the nine-month follow-up visits to patients, the excellent percentage of the joint functional recovery of the observation group is 97.06%, whereas that of the control group is 79.41%, showing statistically significant difference (P<0.05). Table 3 lists the results.

Table 3. *Joint functional recovery of two groups (n (%)).*

Group	Cases	Excellent	Good	Acceptable	Poor	Excellent percentage
Observation group	34	14 (41.18)	13 (38.24)	4 (11.76)	3 (8.82)	27 (79.41)
Control group	34	23 (67.65)	10 (29.41)	1 (2.94)	0 (0.00)	33 (97.06)
χ^2		4.8021	0.5913	1.9429	3.1385	5.1000
P		0.0284	0.4419	0.1633	0.0765	0.0239

Discussion

Compared with adults, children have thinner bones and higher water and bone collagen contents. Moreover, children possess several blood vessels, thick periosteum, strong bone toughness, and quick fracture healing ability; thus, healing deformation readily occurs upon poor reduction [5]. Pediatric metaphyseal fractures at the distal radius account for 75% of all forearm fractures. Most pediatric metaphyseal fractures are closed, and fractures with angle ranging from 15° to 25° often require closed reduction and fixation with long-arm gypsum, which easily causes fracture displacement; hence, another closed reduction is needed [6]. Percutaneous Kirschner wire fixation is used after reduction when unstable fracture, neural injuries, large original angle of fracture (>30°), and large fracture displacement (>50%) or a combination of elbow joint fractures occurs. Ulnoradial diaphysis displacement is an unstable fracture that often occurs in older children. Most experts believe that children with ages between 8 and 10 years can tolerate 10° and 50° rotation. Closed reduction therapy is the first choice of treatment for closed injuries. Open reduction therapy is performed for any unsatisfying manual reduction; unstable, open, and multisegment fractures; "floating elbow" injuries; or secondary fracture [7].

Research results demonstrated that appropriate operation indications determine the therapeutic schedule of child patients: open reduction and intramedullary fixation or open reduction and steel plate fixation [8]. Therefore, a high demand exists for pediatric fracture reduction, and one-time correct reduction is needed to achieve the ideal reduction alignment. Having a large angle and rotation displacement at the fracture end is strictly prohibited. Under this circumstance, the first clinical treatment choice is open reduction assisted by a combination of internal fixation with Kirschner wire and plantlet external fixation. Given the continuous medical technology development and progress in the past years, the traditional conservative manual reduction therapy for forearm fracture is gradually replaced with surgical therapy. Internal fixation with Kirschner wire has extensive clinical applications and has the following advantages: it is a minimally invasive surgery and causes minor damages to the child patients, thus preventing serious complications. Child patients can be guided for early exercises after the operation, which can facilitate joint functional recovery. This procedure also strongly immobilizes the fracture end [9]. This study shows that open reduction therapy achieves better therapeutic effects compared with the conventional one. In addition, the fracture recovery rate and excellent percentage of joint functional recovery after nine-month follow-up visits reach 94.12% and 97.06%, respectively, which are significantly higher than those of the conservative manual reduction therapy. This finding reveals that open reduction therapy is a superior clinical treatment for pediatric forearm fracture. Related articles also confirmed the therapeutic effects of open reduction. Furthermore, several similar studies are found in the literature, most of which show consistent conclusions with the present research [10].

Conclusion

Open reduction therapy provides better therapeutic effects to pediatric forearm fracture compared with closed reduction therapy. Thus, open reduction therapy is worthy of extensive application to clinical practices because it can accelerate fracture healing and enhance joint functions of child patients. Moreover, conservative manual reduction therapy is the recommended clinical treatment to child patients with light fracture to reduce economic burdens.

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*Correspondence to

Ye-Feng Dai

Department of Traumatology

Children's Hospital of Zhejiang University School of Medicine

PR China