

ORIGINAL ARTICLE

Radial head and neck fractures in children[☆]

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KEYWORDS

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Abstract

Objective: To analyse cases of radial head and neck fractures in children and compare them with the literature.

Method: Retrospective and descriptive study of 21 children with radial head and neck fractures. The following parameters were collected: demographics, comorbidity, classification, treatment, need for rehabilitation, lack of range of motion (ROM), time for recovery and complications.

Results: The series included 11 males, and the mean age was 8.3 years. The right side was affected in 14 patients. Twelve cases had an associated ipsilateral elbow injury. According to the Chambers classification, 15 cases belonged to group A, while in the Steele-Graham classification, 12 cases were in group I. Eleven patients were treated with immobilisation only, 4 percutaneously, and 6 by open reduction and internal fixation (ORIF). Eleven of them needed rehabilitation and despite this, 8 did not achieve full mobility. The mean time to obtain the greatest ROM was 4.71 months. Eight patients had complications, with the most common being neuroapraxia and valgus deformity of the elbow.

Discussion and conclusions: Treatment of paediatric radius head and neck fractures must be step-wise, from immobilisation only, manual and/or percutaneous reduction, to ORIF, whichever is less indicated. In this respect, both the transcapital needle and/or removal the radius head should be avoided. The most common complication is lack of supination, especially in cases treated by ORIF. The posterior interosseous neuroapraxia was the most common of the rest of complications.

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PALABRAS CLAVE

Fractura;
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Codo;
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Fracturas pediátricas de cabeza y cuello de radio**Resumen**

Objetivo: Analizar los casos de fractura de cabeza y cuello de radio en pacientes pediátricos y compararlos con los de la bibliografía.

Material y métodos: Estudio retrospectivo y descriptivo de 21 pacientes pediátricos con fractura de cabeza y cuello de radio, en los que se recogieron los siguientes parámetros: datos demográficos, afección asociada, tipo de fractura, tratamiento, necesidad de rehabilitación, déficit de balance articular, tiempo de recuperación y complicaciones.

Resultados: Del total de la serie, 11 eran varones. La edad media fue de 8,3 años. En 14 pacientes el lado lesionado fue el derecho. Doce casos asociaron lesiones en codo ipsilateral. Según la clasificación de Chambers, 15 casos pertenecieron al grupo A, mientras que en la clasificación de Steele-Graham, 12 casos fueron del grupo I. Once pacientes se trataron solo con inmovilización, 4 percutáneamente y 6 mediante reducción abierta y fijación interna (RAFI). Once casos precisaron rehabilitación, de los que 8 no recuperaron movilidad completa. El tiempo medio para obtener el mayor arco de movilidad fue de 4,71 meses. Ocho pacientes presentaron complicaciones, destacando neuroapraxia y la deformidad en valgo del codo.

Discusión y conclusiones: El tratamiento de la fractura de cabeza y cuello de radio en pacientes pediátricos ha de ser escalonado, desde la simple inmovilización, reducción manual y/o percutánea, hasta la RAFI, la cual cada vez está menos indicada. En este aspecto, debe evitarse la colocación de una aguja transcapitelar y/o la exéresis de la cabeza radial. La complicación más frecuente es el déficit de pronosupinación, sobre todo en casos tratados mediante RAFI. Del resto de las complicaciones observadas, la neuroapraxia del interóseo posterior fue la más común.

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Introduction

Radial head and neck fractures make up 1% of all fractures in children and 5–10% of those that affect the elbow.^{1–4} They may be isolated events or associated with another injury in the same area.^{1–5} When 1 occurs, treatment is usually more aggressive, with a consequential increase in morbidity. In this article we review our experience in treating radial head and neck fractures in paediatric patients cared for in our centre over the last 5 years.

Material and methods

In the time between 1 January 1996 and 1 January 2011, data for 21 paediatric patients (younger than 14 years) with a radial head or neck fracture were collected retrospectively. In every case, the following parameters were analysed: demographic data (including the patient's age and gender), laterality of the injury, associated pathology (absence of it, involving the ipsilateral elbow or another location), fracture type according to the classifications from Chambers (Table 1) and Steele-Graham (Table 2), treatment applied (conservative or surgical, including the different surgical techniques), need for rehabilitation after immobilisation period, loss of balanced articulation (BA), time needed to achieve complete BA (or greater range of motion in those cases where a mobility deficit persisted) and complications derived from the fracture and/or treatment.

Table 1 Chambers classification for radial head and neck fractures.

Valgus traumatism

- Type A: Epiphysiolysis Salter Type I & II
- Type B: Epiphysiolysis Salter-Harris Type IV
- Type C: Pure metaphyseal

Elbow Luxation

- Type D: Following the luxation or during luxation reduction
- Type E: During the luxation

Results

The mean age of the population studied was 8.3 years (9.8 years in boys and 6.8 years in girls). There were no gender differences (11 boys and 10 girls). The right elbow was the most affected, making up 2 thirds of the sample.

Table 2 Steele-Graham classification for radial head and neck fractures.

Grade	Angle	Displacement
I	0–30°	0–10%
II	31–60°	11–50%
III	61–90°	51–90%
IV	>90°	>90%



Figure 1 Open reduction and internal AP fixation.

Regarding associated conditions, 7 patients (33.33%) had exclusively a radial head or neck fracture, while 12 cases (57.14%) had another ipsilateral injury of the elbow (6 had an injury in the proximal or middle ulna, 5 presented an olecranon fracture and 1 case was associated with a trochlear injury). Of the cases associated with a proximal ulna fracture, 5 were Monteggia injuries (23.8% of total cases): 4 common Bado type II injuries and 1 Monteggia equivalent. Two patients (9.52%) presented associated injuries in other locations: 1 case of an ipsilateral fracture of the distal radius, and 1 case of an upper jaw fracture with a severe head injury. According to the Chambers classifications, 15 cases (71%) were type A, 1 case (4.7%) was type C, 3 cases (14.28%) were type D and 2 cases (9.5%) were type E. No type B cases were observed. According to the Steele-Graham classification, 12 cases (57.1%) were Level 1 and the remaining levels included 3 cases (14.28%) each. Regarding the treatment applied to the radius (excluding treatment to the ulna), 11 patients (52.38%) were treated conservatively using immobilisation with a splint and/or a sling, no patients underwent closed-reduction by manipulation, 4 patients were treated with percutaneous reduction (3 using the Métaizeau technique and 1 using the Feray technique, with a Kirschner needle as a lever), and 6 patients were treated with open reduction and internal fixation (ORIF) (Figs. 1 and 2). One patient required reoperation, using ORIF with a transcapsular pin, due to secondary displacement of the fracture (Fig. 3). In another case,



Figure 2 Open reduction and fixation with 2 pins: lateral view.

corrective surgery was required for an anterior valgus deformity. Eleven patients (52.38%) required functional rehabilitation after the immobilisation period. Thirteen patients (61.9%) recovered complete mobility, while the other 8 (38.1%) presented some functional deficit. Among the latter group, 1 patient remained limited in all elbow movements. All patients that did not completely recover mobility were treated in rehabilitation. The movement most frequently lost was supination (5 patients), with a mean limitation of 13° (23.8% of all patients and 62.5% of patients with a mobility deficit), followed by extension (4 patients), with a mean limitation of 11.25° (19.04% of all patients and 50% of those with a mobility deficit). Two patients (25% of patients with a mobility deficit, 9.5% of all cases) presented a pronation deficit, 45° being the mean. The mean time needed to achieve complete mobility, or greater range of motion in patients with a mobility deficit, was 4.71 months.

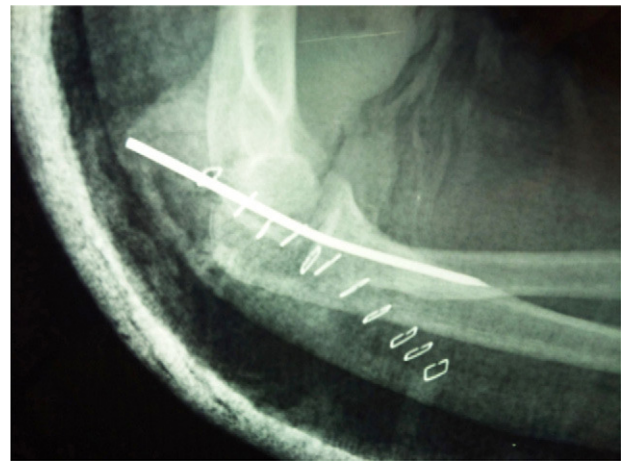


Figure 3 Transcapsular pin.



Figure 4 Avascular necrosis of the radial head.

Thirteen patients (61.9% of the sample) recovered without incident, while the other 8 patients (38.09%) had 1 or more complications. There were no cases of premature physodesis (or there were no clinical repercussions), pseudoarthrosis, radial neck notching or radioulnar synostosis. However, there was 1 case of each of the following complications: radial head overgrowth, ossifying myositis and compartment syndrome. Two patients (9.52% of the total cases) developed avascular necrosis (relative to the most severe cases) (Fig. 4). Also observed were 3 cases of valgus deformity (defined as a carrying angle greater than 15° of physiological valgus^{2,3,6}) and 4 cases (19.04%) of neuropraxia, of which 3 affected the posterior interosseous nerve (1 attributable to surgery) and 1 affected the ulna nerve. In all cases of neuropraxia, the mean duration period observed in the clinic was 8 months after diagnosis. Of the 3 patients with a valgus deformity (14.28% of the total), 1 was slight (22° carrying angle), another will be a candidate for corrective osteotomy once the elbow growth is finished (32° carrying angle) and the last 1 required corrective surgery (35° carrying angle prior to the intervention).

Discussion

Radial head and neck fractures in children make up 1% of all fractures and 5–10% of those which affect the elbow.¹⁻⁷

Regarding the age of onset, the mean age was 8.3 years in our study, with slightly higher incidence in males, a figure similar to results observed in the literature.^{2,3,5-7} Even though we did not find fracture laterality results in the literature mentioned, the right elbow was affected more often in our study. A radial head or neck fracture is rarely an isolated pathological entity. They are often associated with other elbow injuries,^{2,3,5-7} such as olecranon fractures, avulsion of the medial humeral condyle and dislocation of the elbow.^{2,3,5-8} In our study, only 7 cases (33%) had a radial head or neck condition exclusively.

Regarding treatment, these fractures can be treated conservatively with simple immobilisation or using manual closed reduction and surgically with open or percutaneous reduction. The references differ on up to what limit conservative treatment should be permitted. According to Canale,³ conservative treatment is used in fractures with angles up to $30-45^\circ$. For Staheli,⁵ it can be used with fractures at Level 1 of Steele-Graham. In the opinion of Eilert and Erickson,² it can be used on fractures with an angle less than 30° , as an appropriate redesign can be achieved with a functional range of mobility in displacements up to 40%. However, Vocke et al.⁹ proposed a broader limit (with the exception of displacements greater than 60°). In this study, all cases in group I of Steele-Graham except for 1 (12 cases) were treated conservatively, using immobilisation without reduction, with good results. There were no cases in groups II, III or IV in our study treated this way.

Treatment using percutaneous reduction with the Métaizeau technique was reserved for fracture cases in groups II and III of Steele-Graham. In this context, optimal results were obtained by Bernstein et al.^{7,10} (a series of 15 patients), González-Herranz et al.¹¹ (17 patients) and Dendane¹² (5 patients). Staheli⁵ was of the same opinion, proposing this treatment option when the fracture cannot be reduced using manipulation. In the present study, 1 of the 3 cases treated with this technique had to be reoperated due to secondary displacement of the fracture and compartment syndrome. We have not found the combination of these 2 associated complications with this type of treatment in the references. Regarding open reduction (OR) with or without internal fixation, it was reserved for those cases with greater angles and/or displacement. Both Canale³ and Eilert and Erickson² confirmed that displacement fractures with angles greater than 45° , or those of Grade II or higher according to the Steele-Graham classification, require ORIF treatment with oblique needles. However, Staheli⁵ recommended that ORIF be used only in group IV. Other authors proposed OR without internal fixation (given the great stability of the fracture after reduction), which produced equally good results as with internal fixation.^{13,14} In our 6 cases, with fractures in Steele-Graham Grades II, III and/or IV, we always used ORIF. In order to achieve the same, the recommended approach is posterolateral, even though it is sometimes necessary to perform Henry's^{2,3,7,15} anterior approach. Fixation of the fracture with a transcapitellar pin should be avoided at all costs due to the high rate of complications, particularly osteosynthesis material breakage.^{2,7,15-17} The excision of the radial

head is absolutely contraindicated, as a deformity in the valgus elbow is produced with distal migration of the radius (acquired Madelung deformity), which is very difficult to resolve.²

Regarding complications, the loss of mobility is the most frequent, with the others occurring in the following order of frequency: pronation, supination, extension and elbow bending.^{2,3,5-7,9,18,19} In this sense, Vocke et al.⁹ concluded that this functional deficit is associated above all with fractures treated by ORIF. We observed that supination was the most frequent movement affected (38.1% of the total sample and 42.85% of those treated with ORIF). Regarding the mean period of mobility recovery, we did not find any references on this. In our study, 4.71 months was the mean. Other complications described in the references^{2,3,5-7,14-16,19} include neuropraxia, valgus elbow deformity, ossifying myositis, radial head overgrowth, compartmental syndrome, avascular necrosis of the radial head, proximal radioulnar synostosis, premature physodesis, pseudoarthrosis and radial neck notching. Our study confirmed these data with a total of 8 cases (38.09%), albeit with different proportions. Thus, while there are authors² that observed ossifying myositis in up to 32% of cases (generally without functional deficit) and radial head overgrowth in up to 40% (but with generally benign behaviour), we have observed these in only 2 cases, 1 in each complication. Regarding avascular necrosis of the radial head, Eilert and Erickson² concluded that it was intimately related to ORIF, while Young¹⁹ attributed it to the posterior development of a severe valgus elbow and a mobility deficit, as happened with 2 patients in our study (9.52% of the total cases) (Fig. 4). Even though we did not have any radioulnar synostosis cases, it serves to cite the recommendation of Beaty⁶ in order to avoid this complication: perform ORIF on the displaced olecranon fracture and a percutaneous synthesis of the radial head. Finally, neuropraxia is another complication to keep in mind, even though it usually resolves itself spontaneously. In our study, 4 cases were presented, which correspond to 19.04% of the total patients.

Conclusions

Treating radial head and neck fractures in children should be as conservative as possible, leaving OR with or without internal fixation for those cases in which appropriate reduction cannot be achieved with less aggressive measures, such as closed reduction by manipulation or a percutaneous technique. In the case of ORIF, we contraindicate the use of a transcapitellar pin, as well as the removal of the radial head. Regardless, in spite of appropriate treatment, it is common to observe a delay in gaining mobility, even after assisted physical therapy.

Level of evidence

Level of evidence III.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this investigation.

Confidentiality of Data. The authors declare that no patient data appears in this article.

Right to privacy and informed consent. The authors declare that no patient data appears in this article.

Conflict of interest

The authors have no conflicts of interest to declare.

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