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BRIEF ARTICLE

Incidence and analysis of radial head and neck fractures

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Abstract

AIM: To investigate several complications like persistent radial head dislocation, forearm deformity, elbow stiffness and nerve palsies, associated with radial head fractures.

METHODS: This study reviewed the clinical records and trauma database of this level Ⅰ Trauma Center and identified all patients with fractures of the radial head and neck who where admitted between 2000 and 2010. An analysis of clinical records revealed 1047 patients suffering from fractures of the radial head or neck classified according to Mason. For clinical examination, range of motion, local pain and overall outcome were assessed.

RESULTS: The incidence of one-sided fractures was 99.2% and for simultaneous bilateral fractures 0.8%. Non-operative treatment was performed in 90.4% (*n* = 947) of the cases, surgery in 9.6% (*n* = 100). Bony union was achieved in 99.8% (*n* = 1045) patients. Full satisfaction was achieved in 59% (*n* = 615) of the patients. A gender related significant difference (*P* = 0.035) in Mason type distribution-type Ⅲ fractures were more prominent in male patients *vs* type Ⅳ fractures in female patients-was observed in our study population.

CONCLUSION: Mason type Ⅰ fractures can be treated safe conservatively with good results. In type Ⅱ to Ⅳ surgical intervention is usually considered to be indicated.

Key words: Elbow; Radial head; Radial neck; Fracture; Children; Adult

Core tip: To investigate several complications like persistent radial head dislocation, forearm deformity, elbow stiffness and nerve palsies, associated with radial head fractures. An analysis of clinical records revealed 1047 patients suffering from fractures of the radial head or neck classified according to Mason. Non-operative treatment was performed in 90.4% (*n* = 947) of the cases, surgery in 9.6% (*n* = 100). Full satisfaction was achieved in 59% (*n* = 615) of the patients. A gender related significant difference (*P* = 0.035) in Mason type distribution-type Ⅲ fractures were more prominent in male patients *vs* type Ⅳ fractures in female patients-was observed in our study population.

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INTRODUCTION

Fractures of the radial head are common and account for one third of all fractures of the elbow and approximately 1.5%-4% of all fractures in adults[1-3]. As much as 85% of these fractures occur between the third and sixth decade of age. According to the literature the mean age is between 45 and 45.9 years, and in an average, female patients are 7 to 16.8 years older than male patients[4-8]. Injury mechanism is a fall on the outstretched arm with the elbow in pronation and partial flexion, or in a rare case, direct trauma[1,6,7,9]. In children the incidence for radial head and neck fractures is up to 1.3%[10].

Radial fractures can be classified by the Mason-Johnston classification[11,12]. According to this classification, radial head fractures can be divided in to 3 types: a type I fracture is a nondisplaced fracture, a type Ⅱ fracture is a displaced fracture, and a type Ⅲ fracture is a comminuted fracture. Johnston added a fourth type: a radial head fracture with dislocation of the elbow[7,11,12].

Thus, the aim of this study was to analyze the epidemiology of radial head and neck fractures, specifically to describe age distribution, male female ratio, and the influence of fracture types and stabilization technique on the overall outcome, seen in this Level I Trauma Center between 2000 and 2010.

MATERIALS AND METHODS

Study population

In a ten year period, 1047 non-selected trauma patients where included in our study at a Level I Trauma Center, Department auf Trauma Surgery, Medical University of Vienna, Austria. Data were collected prospectively and evaluated retrospectively, in our computerized patient record's database. We collected data on all victims admitted to the hospital with diagnosed radial head and neck factures, but only patients with complete data and follow up have been included into the present study.

Members of the Department of Trauma Surgery did data collection and an independent member of the Department not involved in the study did a random cross check to exclude possible errors. Internal revision board (IRB) approval was not requested due to the fact that it is a retrospective data study only. The study was conducted according to the principles of Good Clinical Practice (GCP) and Good Laboratory Practice (GLP) to the best of our knowledge. Collected data included variables such as age, gender, mechanism of injury, method of treatment, and clinical and radiological outcome after treatment. We generated two subgroups, juvenile fractures of the radial head and neck (< 18 years), and fractures in adults. Exclusion criteria for this study were missing pertinent clinical or radiographic data of follow-up monitoring leading to incomplete dataset. Treatment methods were depending on the fracture type and the physicians' choice. Radial head prosthesis was implanted in patients with comminuted fractures, if the salvage of the radial head was not possible. For clinical examination, range of motion, local pain, and bony union were assessed routinely.

Table 1 Description of studypopulation *n* (%)

Total	1047 (100)
Male	499 (47.7)
Female	548 (52.3)
Age (range), yr	36 (2-95)
Follow up (wk)	3 (0-350)
Children	77 (7.4)
Adults	970 (92.6)
Left	501 (47.9)
Right	538 (51.4)
Utriusque	8 (0.8)

Clinical and radiographic examination

For analysis of incidence and outcome of radial head a neck fractures, all records of follow-up monitoring were meticulously reviewed for each patient. Follow-up monitoring included patient's accurate clinical and radiographic examination in our outpatient clinic at admittance and at each follow-up visit. Radiographic assessment included standard radiographs (antero-posterior and lateral view). Additional radiocapitellar views or computer tomography (CT) scans were performed if the standard finding was doubtful. Radiologic scoring was performed according to Johnston's modification of the Mason classification[11,12].

Statistical analysis

For statistical analyses we used the SPSS software package (SPSS, Chicago, IL, United States). Medians and Interquartile rages are shown for continuous variables unless otherwise stated. Discrete variables are presented as counts and percentages. The nonparametric Mann-Whitney *U* test was used for continuous variables and the χ^2 test for discrete variables. A two-tailed *P* value less than 0.05 was considered statistically significant.

RESULTS

During the ten-year study period, 1047 trauma patients met the inclusion criteria. The mean age was 36 years (range 2 to 95), 499 (47.7%) were males and 548 (52.3%) were females, 970 (92.6%) patients were adults, 77 (7.4%) were children. (Table 1) In our study population a total of 859 (82.1%) fractures type I, 149 (14.2%) type Ⅱ, 28 (2.7%) type Ⅲ and 11 (1.1%) type Ⅳ have been observed. (Table 2) In 538 patients (51.4%) the radial head fracture or neck fracture was on the right side, and 501 cases (47.9%) had the fracture on the left side. In 8 cases (0.8%) a simultaneous bilateral fracture was observed. Mean follow up was 3 wk (range 0 to 350). 71 (6.6%) had follow-up less than one week, 267 (25.5%) had follow-up of exactly one week.

We divide our total patient population in two subgroups: adults and children to analyse our treatment results. In the children group 69 (90%) cases were treated

Table 2 Distribution of fracture types I-IV in our study population *n* (%)

Mason		Male	Female
Type Ⅰ	859 (82.1)	409 (47.6)	450 (52.5)
Type Ⅱ	149 (14.2)	67 (45.0)	82 (55)
Type Ⅲ	28 (2.7)	20 (71.4)	8 (28.6)
Type Ⅳ	11 (1.1)	3 (27.3)	8 (72.7)

conservatively compared to 8 (10%) cases treated with surgery. In comparison to those findings, in the adult group 91% (n = 880) cases were treated conservative compared to 9% (n = 90) cases treated with surgery.

In the total study population, 11 prostheses (1%) were implanted. In seven cases cemented radial head prostheses, in three cases bio prostheses and in one case total elbow prosthesis were implanted.

In eight cases sensitivity impairment was observed in type Ⅰ fractures, treated conservatively. Those patients were from the geriatric study pool and had full function on the affected extremity. Two patients, both type Ⅲ, developed a non-union, one after stabilization with a T-plate, and one after open reduction in the first procedure and transfixation during the revision surgery. In one case, type Ⅲ, a palsy of the ulna nerve occurred after closed reduction. Synostosis was observed in a type Ⅲ fracture, treated with a prosthesis. Re-osteosynthesis was indicated in one case, because the primary screw fixation was locking the range of motion (ROM) in the elbow joint. After re-osteosynthesis the patient gained full ROM without pain. Luxation after initial treatment occurred in two cases, one in a type Ⅰ fracture, stabilized with a T-plate, and in the second case, a type Ⅲ fracture, treated with a prosthesis of the radial head. No death or amputation occurred in our study population.

A gender related significant difference (P = 0.035) in Mason type distribution was observed in our study population. type Ⅲ fractures were more prominent in male patients (n = 20, 71.4%) *vs* type Ⅳ fractures in female patients (n = 8, 72.7%).

A significant difference in type Ⅱ distribution was observed between children and adults. While 26% of the children (n = 20) type Ⅱ fracture, only 13% of the adult subgroup (n = 129) suffered from the same fracture type (P = 0.004). Correlating with age revealed that within children younger than ten years, only half of the patients suffered from type Ⅰ (53%, n = 17), and type Ⅱ (40.6%, n = 13) (P < 0.001). In the children older than ten years, and adults, type Ⅰ was predominant. 84% (n = 38) in children from 11 till 18 years, and 83% (n = 804) in the adult subgroup (P < 0.001).

Median ROM (flexion/extension) according to Mason classification was: type Ⅰ 135 [interquatile range (IQR) 105-150], type Ⅱ 130 (IQR 108-150), type Ⅲ 130 (IQR 108-150) and type Ⅳ 140 (IQR 110-150). For the total study population 77% (n = 802) gained ROM > 100°, 22% (n = 225) ROM 50°-100°, and 2 (n = 20) < 50°. Median ROM (internal/external rotation) was 94% (n = 985) > 100°, 4% (n = 43) 50°-100°, and 2% (n = 19) < 50°. Total pain distribution at the end of follow up was non 59.3% (n = 621), mild 37.6% (n = 394) and severe in 3.1% (n = 32) (P = 0.031).

Different forms of conservative treatment did not influenced time of immobilization and pain at the end of follow-up. (Table 3) 75% of patients treated with surgery reported no pain at the end of follow-up compared to 57% of patients, treated conservatively (P = 0.03) (Table 4). No influence according to Mason classification could be observed.

DISCUSSION

In our study, we aimed to investigate the effect of fracture type and stabilization technique on overall outcome. Additionally we also looked at possible gender related influences. Due to the limited range of follow up, we believe that the total number of 1047 included cases over a period of ten years allows a warrantable analysis of our study population.

Incidence of fracture types according to Mason was comparable to findings in the already published literature[7,13]. The average age in years for specific fracture types (Ⅰ-Ⅳ) in the adult subgroup was similar to those numbers published by Duckworth *et al*[13]. For the distribution of fracture types in the children subgroup, we could detect similar results compared to Kaas *et al*[7]. The number of observed simultaneous bilateral fractures during an inclusion period of ten years is in accordance with previous published data[14]. Haematoma aspiration was performed in a total of 23 cases (2%), but no significant influence on pain and functionality could be observed. This is in contrast to the finding by Ditsios *et al*[1], postulating that haematoma aspiration leads to a imminent decrease in pain for the patient.

Our results demonstrate a statistical significance for the male female ratio in both subgroups. In current publications male-female ratio of 2:3, with female patients being significantly older is reported[4]. We found a full satisfactionary outcome after 3 wk on average in 59% (n = 615) of the patients, after radial head and neck fractures.

The assessment of longitudinal stability is a basic step before deciding the most suitable surgical option and to avoid complications[15]. If open reduction and internal fixation fails to achieve a satisfactory result, resection arthroplasty and radial head prosthesis are additional options, but both are linked with poorer outcome results[3,15-17]. Despite the fact that numerous papers have been published dealing with the optimal treatment of radial head fractures, no consensus or general accepted guideline exists[16,18-23].

There are several limitations of the current study we have to mention in relation to our results. The first and most gravid is the fact that the study was retrospectively performed. Also some critical readers may esteem the long inclusion duration of ten years as limitation. The fact that the study population represents a wide range of

Table 3 Immobilization time in conservative treatment

	Type Ⅰ				Type Ⅱ				Type Ⅲ				Type Ⅳ
	n	Median	Min	Max	*n*	Median	Min	Max	*n*	Median	Min	Max	*n*
Cast upper arm	256	1	1	6	51	2	1	6	0				0
Cast lower arm	7	2	2	4	1	2	2	2	0				0
Dorsale splint	7	4	1	4	1	1	1	1	0				0
Elastic bandage	3	1	1	3	4	2	1	3	0				0
Filmulin bandage	526	1	1	12	34	1	1	8	1	3	3	3	0
Gilchrist	0	0			1	2	2	2	0				0
Cork splint upper arm	0	0			1	3	3	3	0				0
Cork splint lower arm	1	1	1	1	0				1	1	1	1	0
Mitella	8	1	1	1	0				0				0
Non	9	0	0	0	3	0	0	0					0
Surgery	10				53				26				11

Table 4 Summary treatment strategies and pain *n* (%)

	Total	Surgery	Pain non	Pain mild	Pain severe
Type Ⅰ	859 (82.1)	10	3 (30)	7 (70)	0
Type Ⅱ	149 (14.2)	53	41 (77.4)	10 (18.9)	2 (3.8)
Type Ⅲ	28 (2.7)	26	21 (80.8)	4 (15.4)	1 (3.8)
Type Ⅳ	11 (1.1)	11	10 (90.9)	1 (9.1)	
		Conservative			
Type Ⅰ		849	488 (57.5)	335 (39.5)	26 (3.1)
Type Ⅱ		96	57 (59.4)	36 (37.5)	3 (3.1)
Type Ⅲ		2	1 (50)	1 (50)	
Type Ⅳ		0			

age and heterogeneity in the accident cause and fracture type may also be seen as a disadvantage. Several surgeons, attendings and residents, performing the surgeries might also influence the results. We also want to mention the special patient population when it comes to suicidal jumps and motor vehicle accidents, with people of challenging social background that might have an influence on the outcome, compliance and follow up. Also the inclusion of extreme fracture cases with severe soft tissue trauma may have an influence on our results. Despite these limitations we believe that the results justify our conclusion, even if further prospective clinical trials have to be conducted to approve our findings.

Conservative treatment is the primary goal. Mason type I fractures can be treated safe conservatively with good results[1,12,24]. In type Ⅱ to Ⅳ surgical intervention is usually considered to be indicated[23]. A gender related significant difference ($P = 0.035$) in Mason type distribution was observed in our study population. type Ⅲ fractures were more prominent in male patients ($n = 20$, 71.4%) *vs* type Ⅳ fractures in female patients ($n = 8$, 72.7%). Different forms of conservative treatment did not influence the pain at the end of follow-up. 75% of patients treated with surgery reported no pain at the end of follow-up compared to 57% of patients, treated conservatively ($P = 0.03$).

The decision which of the described techniques should be used in a patient can still be considered a fine line, and has to be based on the individual case and surgeons experience.

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COMMENTS

Background

To investigate several complications like persistent radial head dislocation, forearm deformity, elbow stiffness and nerve palsies, associated with radial head fractures.

Research frontiers

Radial fractures can be classified by the Mason-Johnston classification.

Innovations and breakthroughs

Fractures of the radial head are common and account for one third of all fractures of the elbow and approximately 1.5%-4% of all fractures in adults. As much as 85% of these fractures occur between the third and sixth decade of age. According to the literature the mean age is between 45 and 45.9 years, and in an average, female patients are 7 to 16.8 years older than male patients. Injury mechanism is a fall on the outstretched arm with the elbow in pronation and partial flexion, or in a rare case, direct trauma. In children the incidence for radial head and neck fractures is up to 1.3%.

Applications

An accurate classification of radial head fractures is the first step in successful treatment.

Peer review

The manuscript is an interesting one. It summaries a 10 year prospective study related to an important population suffering radial head and neck fractures.

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