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ORIGINAL ARTICLE

The incidence of associated fractures of the upper limb in fractures of the radial head

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Abstract Radial head fractures are common injuries. In American publications, one-third of the patients with these fractures have been shown to have associated injuries. The aim of this retrospective study is to describe the epidemiology of radial head fractures and associated fractures of the ipsilateral upper extremity in a European population. This study describes the epidemiology of radial head and associated fractures of the upper extremity in a Dutch population by a retrospective radiographic review of all patients with a radial head fracture between 1 January 2006 and 1 July 2007. A total of 147 radial head fractures were diagnosed in 145 patients. The incidence in the general population was 2.5 per 10.000 per year. The average age was 45.9 (SD 17.3) years and male–female ratio was 2:3. The mean age of males was significantly lower (37.1, SD 14.2 years) than of women (53.9, SD 16.4 years). Associated fracture of the upper extremity was found in 10.2%. Coronoid fractures were most common (4.1%). Associated upper limb fractures in patients with a radial head fracture are common in the European population. It is of clinical importance to suspect associated lesions and to perform a thorough physical examination and additional radiological examination on demand.

Keywords Radial head fracture · Associated injury · Epidemiology

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Introduction

Radial head fractures are common and account for one-third of all fractures of the elbow and approximately 1.7–5.4% of all fractures in adults [1, 2]. Eighty-five percentage of radial head fractures occur in patients between 20 and 60 years of age and approximately one-third of the patients have associated injuries, such as a fracture or ligamentous injury of the hand, wrist, forearm, humerus or shoulder [1, 3, 4]. Radial head fractures usually result from a fall on an outstretched arm with the elbow in pronation and partial flexion or, in rare cases, direct trauma [5, 6].

Radial head fractures can be classified according to the Mason–Johnston classification, based on 100 cases (see Table 1) [7]. Mason type 1 fractures are treated conservatively with early mobilisation. Type 2 fractures (with over 2 mm dislocation or over one-third of the articular surface) are treated with open reduction and internal fixation (ORIF). Type 3 and 4 fractures can be treated with ORIF or excision of the radial head and ligamentous repair or reconstruction, usually followed by prosthetic replacement [2, 8, 9].

The Mason–Johnston classification does not consider soft-tissue injury or associated elbow and forearm injuries. More recent classifications do consider these types of injury as recent literature shows the importance of associated injury, such as coronoid fractures, for an adequate treatment of radial head fractures [2, 10, 11]. Based on 372

Table 1 The Mason–Johnston classification of radial head fractures [7]

Mason type	Description
1	Non-displaced fracture
2	Minimal displacement with angulation or impression (>2 mm)
3	Comminuted fracture with dislocation
4	Radial head fracture with luxation of the elbow

reviewed cases, van Riet and Morrey [12] recently published their modification of the Mason classification (Table 2). Radial head fractures are classified according to their type (I–III) and a suffix is added for articular or ligamentous injuries when they occur. A "c" is added for coronoid fractures and an "o" for an olecranon fracture. Ligamentous injuries are noted as "m", "l," or "d" for medial collateral ligament, lateral collateral ligament or distal radio-ulnar joint lesions. Coronoid fractures are common associated injuries in radial head fractures and can be classified by the Regan and Morrey classification: type 1 is an avulsion fracture, a fracture of <50% of the coronoid is a type 2 and >50% of the coronoid process is a type 3 fracture (see Table 3) [4, 10].

Little is known about the incidence of radial head fractures and associated injuries in the European population. The goal of this retrospective study is to describe the epidemiology of radial head fractures and associated fractures of the ipsilateral upper extremity in a Dutch population.

Methods

A retrospective database search was performed to identify all patients with radial head fractures who visited the Emergency Department (ED) of the Amphia Hospital (Breda, The Netherlands) in the period between 1 January 2006 and 1 July 2007. This ED provides a region of 400.000 inhabitants of acute medical care. In this period, about 66.000 patients visited the ED. Radiographs of patients with radial head fractures were reviewed by LK and RvR, and gender, age, side, type of radial head fracture according to the Mason–Johnston classification and associated osseous injuries were documented.

Table 2 Van Riet and Morrey classification of radial head fractures and their associated injuries

Type of radial head fracture	Associated injury	Suffix
I	Articular	c, o
II	Ligamentous	m, l, d
III		

c Coronoid process, *o* olecranon, *m* medial collateral ligament, *l* lateral collateral ligament, *d* distal radio-ulnar joint [12]

Table 3 The Regan and Morrey classification of coronoid fractures [10]

Type of coronoid fracture	Description
1	Avulsion fracture
2	Fracture of <50% of the coronoid
3	Fracture of >50% of the coronoid

Coronoid fractures were classified according to the Regan and Morrey classification (see Table 3). The Student's *t* test was used to analyse the significance in age between men and women. The Chi-square test was used to statistically analyse differences between men and women for type of fracture. A *P* value smaller than 0.05 was considered as statistically significant.

Results

A total of 147 fractures of the radial head were diagnosed in 145 patients in the period between 1 January 2006 and 1 July 2007; an incidence in the general population of 2.5 per 10.000 per year. Two patients (1.4%) had bilateral radial head fractures. Seventy-eight patients presented with a radial head fracture on the left side (53.8%) and 65 patients had right sided fractures (44.5%). The male–female ratio was 2:3; 58 males (40%) and 87 females (60%). The mean age was 45.9 (range 15–87, SD: 17.3) years. The mean age of men (37.1, SD 14.2, range 15–73 years) was significantly ($P < 0.05$) lower than the mean age of women (53.9, SD 16.4, range 15–87 years).

A total of 50.3% ($n = 74$) of the radial head fractures were a Mason type 1, of which 5.3% ($n = 4$) had an associated fracture; 36.1% ($n = 53$) were Mason type 2 fractures, of which 7.5% ($n = 4$) had associated fractures; 8.8% ($n = 13$) of the patients had a Mason type 3 fracture, of which 15.4% ($n = 2$) had associated fractures; 71.4% ($n = 5$) of the patients with a Mason type 4 fracture (4.8%, $n = 7$) had associated fractures (see Table 4). There was no significant difference between men and women for type of fracture ($P = 0.997$). A total of 15 patients (10.2%) had at least one associated fracture.

Thirteen associated fractures were located in the elbow and six associated fractures occurred in the hand, wrist or forearm. Six coronoid fractures were found (4.1%). Four of these were a type 1 fracture, according to the Regan and Morrey classification. Two patients had a type 2 coronoid fracture. Five coronoid fractures were diagnosed with Mason type 4 radial head fractures. One coronoid fracture

Table 4 Number of radial head fractures, mean age and associated fractures divided by Mason–Johnston classification

Mason type	1	2	3	4
Number (%)	74 (50.3%)	53 (36.1%)	13 (8.8%)	7 (4.8%)
Male	28	22	5	3
Female	46	31	8	4
Associated fractures in % (*n*)	5.4% (4)	7.5% (4)	15.4% (2)	71.4% (5)
Mean age (SD)	42.2 (18.2)	49.8 (13.7)	50.5 (22.8)	52.9 (11.3)

SD standard deviation

Table 5 Associated fractures with radial head fractures

Associated fractures	Number	% of total	% of fractures
Coronoid process	6	4.1	32
Scaphoïd fracture	4	2.7	21
Olecranon fracture	1	0.7	5
Radial diaphysis fracture	1	0.7	5
Proximal ulna fracture	1	0.7	5
Capitulum fracture	1	0.7	5
Triquetrum avulsion fracture	1	0.7	5
Radial head luxation	1	0.7	5
Essex-Lopresti injury	1	0.7	5
Medial epicondyl fracture of the humerus	1	0.7	5
Dorsal avulsion fracture of the distal humerus	1	0.7	5
Total	19	10.2%	100%

was seen with a Mason type 1 fracture. Four (2.7%) scaphoid fractures were diagnosed. Olecranon fractures, radial diaphysis fractures, capitulum fractures, triquetrum avulsion fractures and medial epicondyl fractures of the humerus were seen in 0.7% ($n = 1$) of the patients. One (0.7%) Essex-Lopresti injury and one (0.7%) radial head luxation were diagnosed (see Table 5). A 'terrible triad' of the elbow (a medial collateral ligament tear, radial head fracture and a coronoid fracture) was seen in five patients (3.4%). No osseous injuries were found proximal to the elbow.

Discussion

In the period between 1 January 2006 and 1 July 2007 the incidence of radial head fractures in this general Dutch population was 2.5 per 10.000 per year. The mean age was 45.9 years. On average, men sustained a radial head fracture at a significantly younger age (37.1 years) than women (53.9 years). The male–female ratio in this study was 2:3. Previous publications show male–female ratios varying between 1:1 and 3:2 [1, 4, 13, 14].

In 2005, van Riet et al. [4] described in a similar study of an American population associated fractures in 23% of 333 radial head fractures, compared to 10.2% in this study. This difference may be explained because relatively more Mason type 3 fractures were diagnosed in the population of van Riet et al. (19.2% compared to 13.6%, Mason type 3 and 4). This could be due to the expertise function of the hospital the patients were referred to and Mason type 4 fractures were regarded as Mason type 3 fractures with dislocation.

Coronoid fractures were also the most common associated fractures in the study of van Riet et al. [4]: 16% of all patients, compared to 4.1% in this study. These fractures are common with dislocations of the elbow and can be part of a 'terrible triad' of the elbow [15]. Certain types of coronoid fractures are an indication for operative treatment. Inadequately treated coronoid fractures can lead to persistent posterolateral instability and an increased risk of early degeneration of the ulnohumeral joint [10, 16, 17]. In the current study, scaphoid fractures were in this study diagnosed in 2.7% of all patients, which is similar to the approximately 2% found by van Riet et al. [4].

Associated soft tissue injuries, such as of ligaments and cartilage, can also occur in radial head fractures [4, 18]. The medial collateral ligament (MCL), especially the anterior band, functions as a major primary stabiliser of the elbow, with the radial head as a secondary stabiliser. Injuries to these structures may result in valgus instability of the elbow. If the MCL is ruptured, the radial head becomes the primary valgus stabiliser. Therefore, the radial head should not be resected in case of MCL injury [19, 20]. So ligamentous instability is of clinical importance, but usually cannot be diagnosed with routine radiographic examination and was therefore not reviewed in this study.

The incidence of associated, osseous injuries of the upper limb in radial head fractures is high. The treating physician should be aware of this and should apply thorough physical examination of the upper limb in every patient with radial head fracture; additional radiological examination can be indicated.

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