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Epidemiology of humeral fractures in Malawi

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Abstract We analysed and determined retrospectively the location, age, gender and side of the body of humeral fractures from 258 antero-posterior radiographs of all patients aged 3–81 years over a 5-year period. It was observed that 160 fractures occurred on the left side while 98 were on the right side with 156 occurring in males and 102 in females. Forty-eight percent of the fractures occurred at the lower end of the humerus while 41% occurred at the mid-shaft with only 10% occurring at the upper end. Furthermore, the age group of 3–12 years had the highest incidence of fractures (40.7%) with the age group of 30–39 years the lowest incidence (6.2%). Most supracondylar fractures (75.4%) occurred in children, with teenagers accounting for the majority of mid-shaft fractures (51.9%). However, middle-aged and elderly individuals had the highest incidence of upper humeral fractures (73.1%). There was significant relationship between the site of these fractures, age, gender and body side of the patients studied ($p < 0.001$). These results are, however, not in agreement with some previously documented studies. The importance of epidemiological study of humeral fractures in planning, training and resource management in a given population is therefore stressed.

Résumé Nous avons étudié rétrospectivement 258 radiographies antéropostérieures de toutes les fractures humérales survenues pendant 5 ans chez des patients âgés de 3 à 81 ans en notant l'âge, le sexe, le côté atteint et la localisation fracturaire. Il a été observé que 160 fractures se sont produites du côté gauche et 98 du côté droit, 156 chez des hommes et 102 chez des femmes. 48% des fractures se sont produites à la partie inférieure de l'humérus, 41% à mi-diaphyse et seulement 10% à

l'extrémité supérieure. En outre, la tranche d'âge de 3 à 12 ans avaient la plus haute fréquence de fractures (40.7%), et la tranche d'âge de 30 à 39 ans la plus basse fréquence (6.2%). La plupart des fractures supracondyliennes (75.4%) s'est produite chez les enfants et la majorité des fractures médio-diaphysaires (51.9%) chez les adolescents. Les patients d'âge moyen et les patients âgés avaient la plus haute fréquence de fractures de l'extrémité supérieure de l'humérus (73.1%). Il y avait une relation significative entre le siège de ces fractures, l'âge, le sexe et le côté chez les malades étudiés ($P < 0.001$). Ces résultats ne sont, cependant, pas en accord avec quelques-unes des études précédemment faites. L'importance de l'étude épidémiologique des fractures de l'humérus, pour les prévisions, l'enseignement et la gestion des ressources est donc affirmée.

Introduction

The humerus is the arm bone connecting the shoulder with the elbow joint. Fractures are a common injury sustained with trauma, and the patterns of fractures change as age increases [4]. Furthermore, fractures occurring in children differ from those in adults, with considerable differences in aetiology, incidence, presentation, pattern, types and configuration [2].

Three main areas of the humerus are prone to fracture, and these are at the upper end affecting the head and neck regions of the bone, middle shaft and lower end, with the latter occurring in the supracondylar region. Fractures occurring at the first two sites are usually as a result of direct trauma to the humerus following a collision with an object or a heavy fall directly on the bone. Mid-shaft fractures result from applied bending forces while supracondylar ones are a result of upward transmission of forces along the humerus, such as falling on the tip of the olecranon or on the bulk of the flexed elbow [4].

Fractures are one of the leading causes of morbidity and mortality in children and are probably one of the most reliable parameter of hazards in the lives of children [5].

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Epidemiological data of fractures, however, varies between communities as a result of differences in socio-economic, cultural, degree of urbanisation and other population characteristics [2, 3, 10]. Some authors have reported on trends and patterns of humeral fractures. In a study conducted by Gallagher et al. [3], the incidence of humeral fractures was related to age group, with a significantly higher incidence in those aged between 41 and 70 years compared with those in the younger age group ($p < 0.001$). Furthermore, the fractures occurred significantly more on the right humerus (64.5%) than on the left (35.5%). Hart and Kester [4] also showed that the pattern of fractures changed as a child's age increased, with younger children more prone to supracondylar fractures. The Malaysian study also showed that the non-dominant arm was more often injured while a study conducted among the Scots indicated a higher incidence of fractures on the left humerus, with more women affected than men [1, 9].

The epidemiology of fractures of the humeral shaft has, however, received little attention since there are many inherent difficulties involved [6, 8]. Literature is not available in African subjects, as indicated by Medline search, and none exists in Malawi. Hence the need for this study. Furthermore, the study of orthopaedic epidemiology may be useful in planning, training and resource management.

Materials and methods

We analysed 258 antero-posterior radiographs of all in-patients and out-patients aged 3–81 years with humeral diaphyseal fracture over a 5-year period (1998–2003). A diaphyseal fracture was defined as one occurring between the superior border of the insertion of the pectoralis major and the area immediately above the supracondylar ridge, according to Tytherleigh-Strong et al. [9]. Radiographs were collected from Queen Elizabeth Central, Cure International, Mwaiwathu and Blantyre Adventist Hospitals, all of which are the major referral hospitals dealing with orthopaedic patients in Malawi. We then classified each radiograph on the location of the humeral fracture, age and gender of the individual and the side of the body on which the fracture occurred, as provided on the radiograph jackets. They were also described according to their location in the proximal, middle or distal thirds of the humeral diaphysis. The fracture location distribution was then related to age group, gender and body side distributions for each individual. Data were then analysed using the chi-square and the Z distribution tests, respectively. The relationship between fracture location and the other variables were tested for statistical significance at 95% confidence level.

Results

Table 1 shows the characteristics of humeral fractures in Malawians studied. The five age groups represent patients whose ages range from 3 to 81 years in accordance with the frequency distribution. It was observed that 160 fractures occurred on the left side of the body while 98 were on the right side. Similarly, 156 fractures occurred in males and 102 in females. Frequency distribution of humeral fractures according to the fracture site is also shown. We found 48.8% of the fractures occurred at the lower end of the humerus while 41.1% occurred at the humeral shaft, with only 10.1% of the fractures occurring at the upper end (sites C, B and A, respectively).

Table 2 shows the distribution of fracture sites with age group, body side and gender. The age group of 3–12 years had the highest incidence of humeral fractures (40.7%), with the age group of 30–39 years the lowest incidence (6.2%). Most supracondylar fractures (75.4%) occurred in the age group of 3–12 years (children). Teenagers (13–19 years), on the other hand, accounted for the majority of humeral shaft fractures (51.9%). This was followed by children, with an incidence of 29.2%. However, middle-aged and elderly individuals had the highest incidence of upper humeral fractures (73.1%). There was a significant relationship between the sites of fractures with patient age ($p < 0.001$). There were also significant relationships between the site of fractures, gender and body side (Z transformation, chi-square $p < 0.001$).

Table 1 Characteristics of humeral fractures in Malawians. *A* Fracture at upper end of humerus, *B* fracture of the humeral shaft, *C* fracture at the lower end of humerus (supracondylar)

Age group (years)	Frequency	Percent
3–12	105	40.7
13–19	72	27.9
20–29	37	14.3
30–39	16	6.2
40–81	28	10.9
Total	258	100.0
Body side	Frequency	Percent
Left	160	62.0
Right	98	38.0
Total	258	100.0
Gender	Frequency	Percent
Female	102	39.5
Male	156	60.5
Total	258	100.0
Fracture site	Frequency	Percent
A	26	10.1
B	106	41.1
C	126	48.8
Total	258	100.0

Table 2 Distribution of fracture site with age group, body side and gender in Malawians. *A* Fracture at upper end of humerus, *B* fracture of the humeral shaft, *C* fracture at the lower end of humerus (supracondylar)

Age group (years)	Fracture sites			
	A	B	C	Total
3–12	0	10	95	105
13–19	0	55	17	72
20–29	3	31	3	37
30–39	4	8	4	16
40–81	19	2	7	28
Total	26	106	126	258

Body side	Fracture sites			
	A	B	C	Total
Left	16	65	79	160
Right	10	41	47	98
Total	26	106	126	258

Gender	Fracture sites			
	A	B	C	Total
Female	9	42	51	102
Male	17	64	75	156
Total	26	106	126	258

Discussion

This study documents the epidemiology of humeral fractures in Malawians probably for the first time. We have also demonstrated the relationship between the site of fracture with respect to age, gender and body side in Malawians, indicating that the pattern of humeral fracture site changes as with increasing age.

Our study clearly showed that the majority of supracondylar fractures occurred in children (3–12 years) and that fractures in general were more common in children. This is contrary to a study among Americans [3], which indicated the highest incidence of humeral fractures in individuals aged 41–70 years. Our study also indicated that humeral fractures occur in the age groups younger than 50 years, which is again contrary to a report from Scotland, which indicated the highest incidence in patients aged over 50 years [9]. We also showed that, in elderly patients, most fractures occurred on the proximal part of the humerus, as was indeed also shown by Gallagher et al. [3].

The epidemiological data we present in this study also agrees with other previously published studies. Mast et al. [6], in a retrospective study of 240 humeral shaft fractures, showed that 60% occurred in the under-30 age group and that there was a fairly even distribution of injury within the shaft. This reflects a more violent environment, as 17% of the fractures were the result of gunshot wounds, which illustrates the difficulty of interpreting epidemiological data from a selected population in a level-1 trauma centre. Rose et al. [8], however, reviewed 586 humeral fractures of which 116 (20%) were of the shaft. They also noted a bi-modal distribution for the latter injuries, with nearly 70% of occurring in the under-30 age group and as a result

of severe trauma; just over half were sustained in men. These data were also from a selected population.

Although our series did not show the bimodal distribution of fractures indicated above, it showed that the younger age group is more susceptible to humeral fractures, which were age related. A possible explanation for our observed pattern could be a result of a considerable difference in the bony architecture of the supracondylar area of the humerus between the child and the adult. At the median age of peak incidence for supracondylar fractures (7.5 years), the bone is undergoing remodelling, with a decrease in both antero-posterior and lateral diameters and hence is less cylindrical when compared to that of an adult. With age, and as the humerus matures, the osseous epiphyseal centres fuse with widening of the humeral structures both medially and laterally, increasing the resistance to stress. The increased incidence of upper humeral fractures in old age may be a result of osteoporosis, as in menopause, which increases the vulnerability of the bone to fractures.

We have also shown that relationships exist between fracture site, gender and the side of the body involved: the left hand was more actively involved than the right hand. This could be explained by the fact that about 90% of individuals world wide are right-handed and hence the right hand is more actively involved in physical mechanical action and use, as indeed a Malaysian study has indicated [1]. The overall outcome of this is that the right arm has a greater bone mass than the more sedentary left arm and hence is less prone to fractures.

Analysis of humeral fractures in general in this study in relation to gender showed that males had a 10% higher incidence than females, as had been shown also from the American study [3]. This might be due to the fact that men in this environment are more involved with physically demanding jobs than women. A previous study in this environment also showed that men are more involved in road traffic accidents than women [7].

In conclusion we have presented the epidemiology of humeral fractures in Malawians not previously reported, and this information may be useful in planning, training and resource management in our given population. The differences highlighted in this study when compared to other populations underscore the importance of this study in our studied population.

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