

Aperture in coronoid-olecranon septum: A radiological evaluation

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ABSTRACT

Background: The humerus bone with coronoid-olecranon septal aperture have very narrow medullary canal and extreme anterolateral bowing proximally and/or extreme anterolateral compressed surface at distal part. Septal perforation might make nailing through a retrograde technique more difficult or possibly with an increased risk of iatrogenic fracture at the site of insertion. Coronoid-olecranon perforation might be very important in preoperative planning for successful nailing. Since the data available has been obtained from the ancient studies using the skeletal material, the present study is aimed at investigating originally the presence of the coronoid-olecranon septum perforation in the living subjects, using a radiographic method.

Materials and Methods: The study was performed on direct radiograms and computed tomography of the elbow obtained from the 709 volunteers (367 males, 342 females).

Results: The incidence of the perforation was found to be 8.6 %. Bilateral occurrence was found to be more common significantly. The highest incidence occurred in second decade.

Conclusion: The present study suggests female prepronounced and left asymmetry in case of septal perforation. Bilateral occurrence from our study might be peculiar to the clinician.

Key words: Coronoid-olecranon septum, aperture, radiological evaluation

INTRODUCTION

In the anthropological literature, the perforation of coronoid-olecranon septum in the humerus has also been called: supratrochlear foramen, intercondylar foramen, septal aperture, etc. Recently, this perforation has been of special interest to clinicians.¹⁻⁴ The significance of the presence of coronoid-olecranon septal perforation was not clinically in atypical fracture pattern of distal humerus in teenaged boys.^{1,3}

During a study performed on the humerus medullary canal for the nailing, Akpınar *et al.* also observed that the humerus with perforation is of different canal from the normal.² The ancient and recent studies reported the variable occurrence

of perforation and to be more common on the left side and in females. Coronoid-olecranon perforation might be important in preoperative planning for successful nailing. To our knowledge, there has been no study regarding coronoid-olecranon septal aperture in the living subjects. To compare with the results obtained from the skeletal material, an extensive work was planned on the plain and computed tomography (CT) radiographs of elbow region from Turkish individuals with known age and sex.

MATERIALS AND METHODS

The Animal Experiments and Ethic committee of our University approved the experiments. This study was carried out over a 4-year period from 2005 through 2009.

Plain radiographs of the elbows were obtained by Multix Pro/Top (Version 0.5, G05OG Type, Siemens, Germany). As stated below, CT (Hitachi Japan) scans with 2 mm cuts were also used for the case needed. Since thin lamellae of bone might have been mistaken for this apertures and vice versa, the voltage and amperage used were balanced by a technical expert, according to the weight and the age of the cases.

The present study reviewed 709 subjects (367 males, 342 females), all of whom were volunteers (university students

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and medical/paramedical staff) possessing no metabolic disease, trauma history, and complaint of upper extremity (pain, paraesthesia etc.). The radiographs showing pathological findings such as tumors or cystic lesions were excluded. The X-rays were evaluated by the authors of this study together with an experienced orthopedic surgeon. When the perforation was discovered or suspected, CT scan of the arm was obtained, since less number of perforation than actual may be scored in the cases where it is small and/or trabecular bone on septa is missed on X-ray. The cases having the coronoid-olecranon perforation were classified according to sex (male-female) and laterality (bilateral, unilateral-right, unilateral-left).

Z test was used in comparison of two sexes (female-male). For age groups, Duncan (multiple comparison) test was then used. *P* value of 0.05 and less was considered as statistically significant for all analyses and comparisons.

RESULTS

There was full agreement on yes/no choice among the observers. Apart from the possibility that our cases having humeral septa less than 2 mm thick mistakenly score perforation, 61 (8.6 %) coronoid-olecranon perforation were found in our series of 709 subjects [Figures 1 and 2]. Bilateral occurrence was found to be more common than both unilateral right and left occurrences [Table 1], which was statistically significant ($P < 0.05$). Our cases with bilateral perforation were found to be 55%. In our study, the greater number of humeri was from the persons in the fourth decade (40-49 ages, 188 humeri) [Table 2]. However, the highest observation ($n=26$) and percentage (15%) of the perforation were found in the 20-29 ages group [Figure 3] [Table 2]. We observed only one perforation ($n=62$, 1.6%) in female aged 16. The lateral column in distal humerus with aperture was observed to be very strong in all cases.

DISCUSSION

To discuss our findings, we failed to find a comparable study performed on the living subjects. In the anthropological literature, the frequency of this perforation has been reported with the sharp differences, as: between 12.6% and 47% in Negroid subjects, 4.3% and 6.1% in the Whites.^{5,6} In Turkish population, an anthropological study with unknown age and sex ($n=114$) reported the prevalence as 12%.⁷

We feel that our data might be compared directly with those obtained from the study with dry bones from our population. Our prevalence ratio is low than that of the study by Cimen *et al.* (8.6% versus 12%).⁷ Simons⁸ stated that focal bony resorption and exposure of trabecular bone

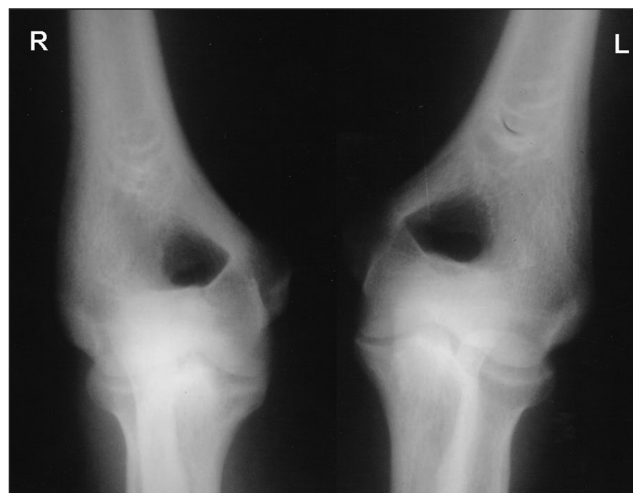


Figure 1: Bilateral coronoid-olecranon perforation of a 25 year old male subject



Figure 2: CT scan of the right humerus in a 25 year old male subject*, coronoid-olecranon perforation

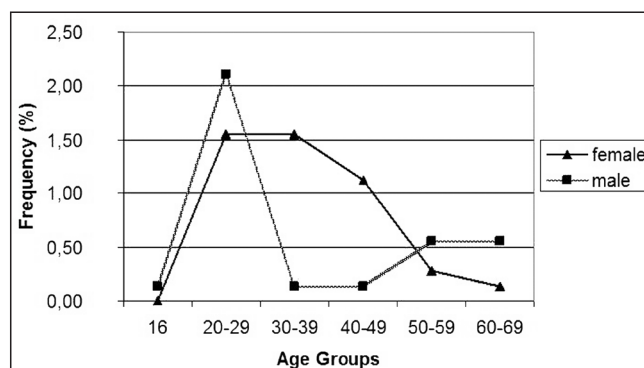


Figure 3: Changes with age in frequency of the coronoid-olecranon perforation of a male and a female

on septa without apertures may occur at the time of death to form an aperture. Similarly, some apertures on fine bony lamella might have occurred after death, artificially deflating its frequency in living subjects.

In the anthropological literature, the female dominance and

Table 1: Distribution of the coronoid-olecranon perforation in our study by sex and side

	General			Bilateral aperture			Right aperture only			Left aperture only		
	N	%	P	N	%	P	N	%	P	N	%	P
Male	26	7.1		12	3.2		4	1.1		10	2.7	NS
Female	35	10.2	NS	22	6.3	S	5	1.4	NS	8	2.3	
Total	61	8.6		34	4.8	*	9	1.2		18	2.3	

S (significant, $P < 0.05$), NS (non significant, $P > 0.05$) indicate sexual asymmetry. Note that bilateral occurrence only shows significant female dominance. * - Significant bilateral asymmetry between sub divisions ($P < 0.05$)

Table 2: Distribution and percentage of the coronoid-olecranon perforation (SA) in the present study, according to sex and age groups

Age groups	Male			Females			Both			p
	n	SA (n)	%	n	SA (n)	%	n	SA (n)	%	
16	55	1	0.14	7	0	0	62	1	0.14	b
20-29	116	15	2.11	57	11	1.55	173	26	3.66	a
30-39	54	4	0.56	104	11	1.55	158	15	2.11	ab
40-49	79	1	0.14	109	8	1.12	188	9	1.26	b
50-59	42	4	0.56	39	2	0.28	81	6	0.84	b
60-69	19	1	0.56	18	1	0.28	37	2	0.28	b
70-79	2	0	0	8	2	*	10	2	*	

* - Percentages in this age group were ignored because of small sample size (see text) The varied lower case in age groups (a, b, c ↓) indicates the differences ($P = 0.03$)

the left asymmetry were commonly observed.^{6,9,10} We found both the sexual asymmetry and the left occurrence to be statistically insignificant, however, bilateral occurrence to be significant [Table 1]. Some of the mechanisms explaining the presence of this perforation in the humerus are: an atavistic character, a mechanical reaction to hyperextension of the elbow, weak development of the bone, and a disturbance in the calcium metabolism. Benfer and McKern¹⁰ correlated the perforation with bone robusticity. Hirdlička¹¹ predicted that the bilateral occurrence might suggest gene differences among different populations, which seems to be an acceptable commentary.

The reason for the high incidence in the second decades and the lowest in the first and the fourth decades from our study are unclear. Trotter proposed that the individuals possessing the aperture die earlier.⁶ If so, the lowest occurrence of the perforation should occur in the later decades. In the present study, the occurrence of the perforation in seventh decade (20%, n=2) was not included in the discussion due to its small sample size.

Clinical implications

An unusual (divergent single-column) fracture pattern seen in the distal part of the humerus with the septal aperture was first reported in few.¹⁻³ The authors pointed out the possible risk for the fracture in the contralateral humerus. It suggests that since the bilateral occurrence is 55% in the living persons (the present study), when a fracture occurs, the risk for the fracture at the other humerus is predicted.

During a morphometric study on the humerus for intramedullary fixation, Akpınar *et al.*² found that the humerus bones with septal aperture have very narrow medullary canal and extreme anterolateral bowing at proximal and/or extreme anterolateral compressed surface

at distal part. It is unclear that the morphology of the distal humerus with septal perforation might make nailing through a retrograde technique more difficult or possibly with an increased risk of iatrogenic fracture at the site of insertion. Glanville⁵ found a relation between the higher frequency of the perforation and a greater range of movement (ROM) at the elbow in African skeletal sample.

Recent evidence indicates that the perforation is a response to hyperflexion, not hyperextension of the elbow. The apertures form predominantly by resorption of the humeral septum at a point at which the coronoid process of the ulna would potentially make contact in full flexion.⁸ Further clinical studies might be needed to explain some clinical questions, for example: a) whether the elbows of these cases have more valgus; b) do they have more ROM? Although previous reports mentioned here, and the present study, confirm the significance of this variation, the clinical bit is yet unclear. We await further clinical studies concerning its clinical significance, which would be of interest.

The present study suggests female preponderance and left asymmetry in case of septal perforation. Bilateral occurrence from our study might be peculiar to the clinician. Although the current study represent original frequency data, future work using CT scans with cuts less than 2 mm would be useful to obtain actual data. It may be worthwhile to investigate this trait in families, in a future view of possibility that it may represent an epigenetic character.

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