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Rare Cases of Humerus Septal Apertures in Greeks

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ABSTRACT

The purpose of this study was to determine the incidence of humerus septal apertures among the Greek population. The presence of supratrochlear foramen was studied using 656 human humeri (304 male and 352 female). Out of the 656 pairs of humeri, we detected two female pairs of humerus bones with bilateral, equal size and shape, septal apertures. This is a rare finding. The overall frequency of septal apertures among the Greek population appears to be as low as 0.304% in the general population, with a marked absence among males and a 0.568% incidence for females.

Key words: Septal aperture, olecranon, humerus

INTRODUCTION

The olecranon and the coronoid fossa at the distal humerus are usually separated by a thin, transparent laminal bone lined by a synovial membrane. In certain bones that thin plate may become perforated, thereby giving rise to an opening above the epiphyseal line and in the intra-articular part of the olecranon fossa called the septal aperture or, more commonly, the supratrochlear foramen (Hirsh, 1927).

The humerus septal apertures were first described around two hundred years ago by Meckel (1816). Following his observation several other reports by other authors were published on the subject, pointing out that these 'perforations' were found not only in man but also in other mammals (Lamb, 1890; Trotter, 1934; Benfer and Tappen, 1968).

Several studies have examined the frequency of septal apertures among human populations, as well as numerous mammalian species, finding that the percentage of its occurrence can vary greatly. It appears to be more frequent in females and on the left side of the humerus, but can vary significantly between ethnic groups, as well as individuals of the same ethnic group with similar habits and occupation (Macalister, 1990; Hirsh, 1927; Trotter, 1934; Benfer and Tappen, 1968).

The side of the perforation may be unilateral or bilateral. However, as it was established by Warren (1897) and Hirsh (1927), if the perforation was unilateral it was more frequent at the left side and when it was bilateral it was larger on the left side.

Lamb (1890), described the differences in size of the humerus septal apertures, and reports on the same subject followed by Hrdlicka (1932), who noted that the distribution of the septal apertures between left and right side show little difference in size and only the multiple openings are more common on the left side.

Studies have shown that the humerus is not perforated in the embryonal stage. The foramen usually develops during adolescence, or more frequently adulthood due to incomplete ossification, due to intralamellar space enlargement and gradual septum absorption (Hirsh, 1927; Ming-Tzu, 1935).

Greece is a modern European country and its individuals have nowadays, similar habits, occupation and social behaviour with central Europeans. Their origin though is different and this is why the present study was undertaken. The objective of this study was to examine the incidence of supratrochlear foramen in the modern Greek population.

MATERIALS AND METHODS

After the authorization of the Athenian University and the Municipality of Athens, access to the ossuary of the 3rd Athenian cemetery was allowed for carrying out research studies on human remains.

A total of 656 humerus pairs, 304 male and 352 female were examined in order to detect the presence of septal apertures. The age for males was ranging from 24 to 92 years with an average 67 years and for the females 22 to 87 years with an average 68 years.

The remains used for this study belonged to individuals that passed away over the last 40 years. All remains belonged to individuals of Greek origin-at least as it could be ascertained by their names as well as the names and place of birth of their parents. Partial or damaged or remains with obvious skeletal abnormalities were excluded from the study.

The possibility of the apertures being a post-mortem artifact (Finnegan, 1978; White and Folkens, 2005), should rather be excluded as the remains were kept in special metallic boxes in a well organized warehouse.

RESULTS

Out of the 656 humerus pairs (304 male and 352 female), only two pairs, both belonging to females demonstrated septal apertures. These were bilateral, symmetrical and of equal size (Fig. 1, 2). Further examination of the rest of the skeleton did not reveal any other skeletal abnormalities.

One female was 72 years old at death and died of cardiac arrest in 1987 while the other was 57 years old and died of pneumonia in 1986. No aperture was detected among the 304 pairs (608 humeri) of male specimens. The overall incidence of septal apertures for both males and



Fig. 1: The right and left humerus of the first case, showing the bilateral appearance of the equal size and shape septal apertures in both sides (the asymmetry also between right and left humerus is obvious)



Fig. 2: The right and left humerus of the second case showing the bilateral appearance of the equal size and shape septal apertures in both sides

females of Greek origin in this series was 0.304%. Among the males it was 0% and among the females 0.568%.

DISCUSSION

The frequency of the humerus septal apertures in human populations varies, in general, from close to zero to almost 60% (Glanville, 1967). Macalister (1990) had noted in bones from Libyan graves a frequency of 57,2%.

However, a few general conclusions based on data from a number of studies could be drawn. Overall, studies have shown that septal apertures were more common among ancient human populations and less frequent in modern populations, specially in late Europeans. The frequency of humerus septal apertures appears to have decreased considerably since the paleolithic and even the neolithic times (Hirsh, 1927). Hrdlicka (1932) reported that it was more common in the Australians, the yellow-browns in general (exclusive of the Lapps), and in the Negro, than it is in the European whites.

They also seem to be more often present on the left side and in females (Hirsh, 1927; Benfer and McKern, 1966). Finally, septal apertures have not been observed only in humans but in most mammalian species, with a slightly greater prevalence amongst the old and new world apes (Benfer and Tappen, 1968).

Anatomy books, Palastanga *et al.* (2002), Gray and Standring (2005), Schunke *et al.* (2006) and Human Bone Manuals (White and Folkens, 2005) simply give a bare mention of the subject.

Many theories and speculations have been expressed in order to explain the septal apertures of the humerus.

Being hereditary and phylogenetically significant. A number of studies have suggested that it may be a hereditary phylogenetic trait, associate with an evolutionary significance (Scheuer and Black, 2000). The robusticity of the humerus has, probably, an inhibitory effect on the expression of the trait (Benfer and McKern, 1966; Scheuer and Black, 2000). However, till to date there have been identified no genes or pathological abnormalities associated with the incidence of supratrochlear foramen. With no other obvious cause, the observed communication between the

olecranon fossa and coronoid fossa seems to be a rather unusual congenital irregularity. Congenital deformities of bilateral occurrence might reflect the presence of a particular, though very rare genetic defect, since an OMIM database search (Online Mendelian Inheritance in Man) did not reveal any disorder with a clinical evaluation corresponding to distal upper limb communication. Such congenital deformity might be due to an overgrown olecranon or coronoid process, or it could be related to collagen fiber elasticity causing loose joints. Loose joints commonly overextend and this could cause an erosion of the thin bone septum between the fossae. In this way joint laxity, which is more often associated with women, may justify this kind of bilateral “trauma” as well as its increased occurrence in females.

Since pressure from the olecranon should act as a strengthening factor it has also been suggested that it may be caused by insufficient blood supply (Hirsh, 1927).

Another cause may be osteoporosis or a degenerative joint disease like osteoarthritis or rheumatoid arthritis. These diseases affect the structure and the quality of the bone and appear more often in females than in males (White and Folkens, 2005). Poor bone quality could justify our observation if similar findings in other areas of thin bone tissue were detected. In our cases though, the rest of the bones did not exhibit any particular irregularities while other skeletons, even when showing degenerative or thinning changes did not have the supratrochlear aperture.

A more solid hypothesis suggests that the septal apertures are purely mechanically induced (overgrown olecranon or coronoid process, a wider range of flexion and extension at the elbow joint) (Mall, 1905; Glanville, 1967; Benfer and Tappen, 1968; Scheuer and Black, 2000) and is acquired (Macalister, 1990; Hiramoto, 1993) and it may be worth viewing it as part of the anatomical and mechanical relationship between humerus and ulna during normal flexion and extension of the elbow (Glanville, 1967).

This theory is also supported by the views of some researchers that statistical data that humerus septal apertures were commonly presented in the neolithic and prehistoric types but are relatively rare in late Europeans. And Hirsh (1927) predicted: ‘If it can be proven that there is any relationship between the presence of the foramen and an increase in the flexion and extension amplitude at the elbow joint, its significance would be apparent. It would then mean that there has been an adaptation to functional needs and that, on the whole modern man has lost to a certain degree the range of these particular motions possessed by his prehistoric ancestors and animals in whom this foramen is more or less constant finding and that this character is in recession and will eventually disappear’.

The low incidence of humerus septal apertures found in Greeks in our series, in comparison with other Europeans, was an interesting finding. The incidence of humerus septal aperture was: in Greeks 0.304%, in Italians 9.4% in Germans 8.8% in all other European groups 7.6% (Hrdlicka 1932).

According to sex, in Greeks it was nil for males and 0.568% for females. In Italians it was 5.10% for males and 13.79% for females in Germans 7.48% for males and 10.19% for females and for Irish it was 1.60% for males and 7.37% for females (Hrdlicka, 1932).

Another interesting finding in the present study, noticed apparently for the first time was of the bilateral apertures being of equal size and shape (Fig. 1, 2) excluding handedness as a possible factor. In these figures also, the asymmetry between the right and left humerus described by Hiramoto (1993), Scheuer and Black (2000) and Papaloucas *et al.* (2008) is obvious.

Present results are generally in agreement with several other studies, demonstrating a low percentage of septal apertures among the modern Greeks with a higher prevalence among females.

In addition, our data suggest that Greeks, so far are among the late European populations with the lowest incidence of septal apertures.

The low frequency of observed cases, together with the lack of extensive information regarding the phenotype of the individuals and their family history, does not allow the association of that particular incidence with any characterized pathology. However, it raises a number of questions regarding its' clinical relevance.

Anyway, for the time being, we must admit that despite the large number of humeri examined and the search in the extensive literature of the last two hundred years we are still not able to give any plausible explanation, for the aetiology, the formation and the higher incidence of humerus septal apertures in females, considering the phenomenon as an 'enigma' (Hrdlicka, 1932), waiting for its future solution. It is still unclear as to why certain individuals carry septal apertures. Both genetic and environmental factors may be implicated, but it's still not well defined as to what degree the thickness of the septum may be modified by nutritional, working or other cultural conditions and to what extent it is a genetic characteristic which reflects gene frequencies within populations. So even if all the theories are scientifically sound in trying to explain the phenomenon, the lack of information can be a problem. It is very difficult to collect information on every individual on genetic profile, origin, details on growing up, handedness, profession, medical history etc. Hopefully future data integration will help solving this problem.

CONCLUSION

The incidence of the phenomenon of septal apertures in Europeans varies in different populations. It is higher in Italians and smaller in Irish and Greeks, but it is always greater in females than in males.

However, although the large number of pair humeri have been examined by many authors, we are of the impression that much greater number of humeri should be elaborated in order to allow us a precise answer, at least as far as the incidence of the phenomenon concerns, keeping always in mind the prediction of Hirsh (1927) 'that this character is in recession and will eventually disappear'.

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