

New Classification of the Styloid Process Length – Clinical Application on the Biological Base

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ABSTRACT

The aim of this study was to evaluate the mean radiographic length of styloid process in a sample of Croatian population, and based on biological basis, to suggest a classification applicable in clinical practice. Two hundred and ninety six panoramic x-rays were examined, out of which 161 from males and 135 from females. The length of the styloid process was measured and age analysis was conducted. The styloid process was observed in approximately three-quarters of the studied sample. The mean length of the styloid process was 21.6 mm for the right side and 21.2 mm for the left side. Statistical analysis of the obtained data shows the existence of three different groups of styloid processes: short (under 21 mm), normal (21–30 mm) and elongated (more than 30 mm) styloid processes. This study explains trimodal distribution as a consequence of developmental changes. This classification is both the biologically based and clinically relevant.

Introduction

The styloid process on temporal bone is a highly variable formation. The normal length of the styloid process ranges from 20 to 30 mm^{1,2}. Despite of it, being normally distributed in the population, styloid processes could be divided in two groups – short styloid processes with less than 20 mm and long styloid processes with more than 20 mm in length³. This finding is supported by embryological evidence but with minor clinical relevance.

Over the years authors have given much pathogenic relevance to the length of styloid process, as well as to the shape and position in suggesting the etiology of painful syndromes¹¹. However, not all elongated styloid processes are symptomatic, since some styloid processes of normal length can also lead to the syndrome⁴. The reported incidence of elongated process is estimated to be 4% by Grossman⁵, 18.2% by Correl⁶, 28% in the study of Kaufman et al.⁷ and 29% by Lengele and Dahm³. Fewer than 4% of those patients ever become symptomatic^{8,9}. Although

bilateral elongation is more common, patients with unilateral elongation are usually more symptomatic.

The purpose of this study was to evaluate the mean radiographic length of styloid process in a sample of Croatian population, and suggest the biological basis that can be used in clinical evaluation.

Material and Methods

The sample consisted of patients from the Clinic for oral and maxillofacial surgery, University hospital »Dubrava«, Zagreb, Croatia hospitalized in the period between 1989 and 1999. Two hundred ninety six panoramic x-rays were examined, of which 161 from males and 135 from females. One hundred and twenty three subjects younger than the age of 20, 100 subjects between 20 and 40 years of age, and 73 older than 40 years of age participated in the study.

All panoramic images have been taken by the same orthopan. Magnification factor was 1.25. The length of the styloid process was measured by scale with incorporated magnification factor. The lengths were evaluated from the mesial side of stylomastoid foramen to the top of the process. Both left and right sides were measured. Age analysis was also conducted.

We used program package »Statistica«, Version 5 (1997) for statistical analyses which was also based on Lengele and Dhem (1988)³. The mean value, standard deviation and statistical dispersion were calculated.

Results

Out of a total of 296 participating subjects, 161 were male and 135 female. Bilateral styloid process was found in 80 male and 51 female subjects participating in this study. Right hand side styloid process was found in 13 male and 13 female subjects, while left hand side styloid

process was found in 10 male and 10 female subjects.

Table 1 depicts the total sum of styloid processes on both sides. Their mean length and standard deviations are also presented. Styloid process was noticed at about three-quarters of the sample. The mean length was 21.6 mm for the right side and 21.2 mm for the left side.

Figure 1 presents styloid processes in different age groups. Longer styloid processes can be found in older age groups on both sides. No significant difference between unilateral and bilateral processes was found within groups (Table 2). Bilateral styloid processes were found in 131 (44.3%) panoramic x-rays.

Figures 2 and 3 depict the statistical distribution of the length of styloid processes on the right and left hand side. Both figures show the existence of three different groups of styloid processes. On the right hand side, styloid process less or equal to 21 mm were recorded in the first

TABLE 1
MEAN LENGTH OF STYLOID PROCESS

	Right	Left
N	157/296 (76%)	151/206 (73%)
Mean	21.64	21.19
SD	7.92	7.84

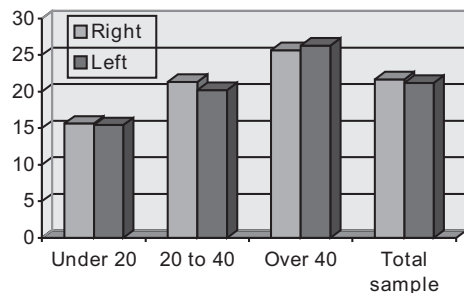


Fig. 1. The length of styloid processes in different age groups.

TABLE 2
SIDE DISTRIBUTION OF STYLOID PROCESSES IN DIFFERENT AGE GROUPS

Age	Position	Right			Left		
		N	X	SD	N	X	SD
< 20	Unilateral	14	14.21	7.01	7	13.71	4.46
	Bilateral	26	16.38	7.65	26	15.88	6.87
20–40	Unilateral	6	22.50	9.52	8	18.00	9.61
	Bilateral	54	21.17	6.54	54	20.56	6.68
> 40	Unilateral	6	21.83	3.31	5	23.00	2.83
	Bilateral	51	26.82	6.39	51	25.92	7.06
Total		157	21.67	7.92	151	21.19	7.84

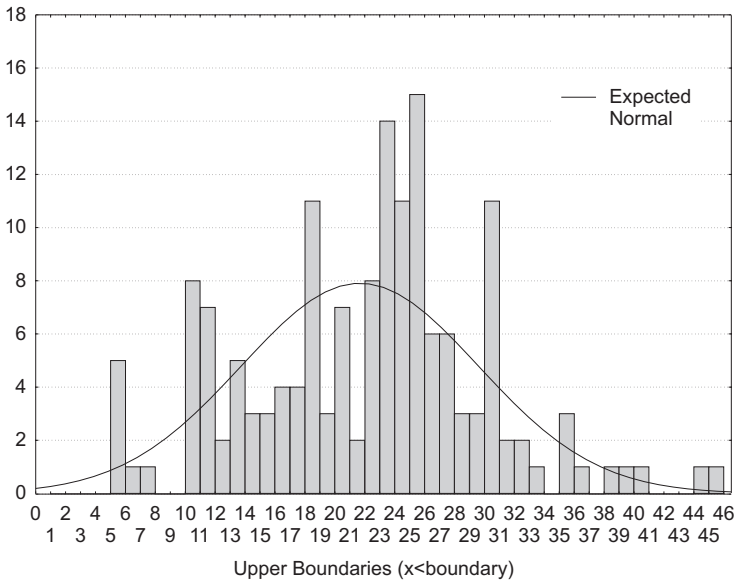


Fig. 2. Statistical dispersion of length of right styloid process.

group, ranging between 21–34 mm in the second group, and larger than 34 mm in the third group (Figure 2). A similar dispersion was recorded on the left side, where styloid processes longer than 29 mm were observed in the third group (Figure 3).

This difference is also evident in the general statistical dispersion (Figure 4)

of both sides. It can be seen that the most common length was 25 mm.

Discussion

Quantitative analysis of the styloid process length can be done using x-ray^{1,7,10} or macerated skulls^{3,11}. Some authors report advantages in evaluating the length

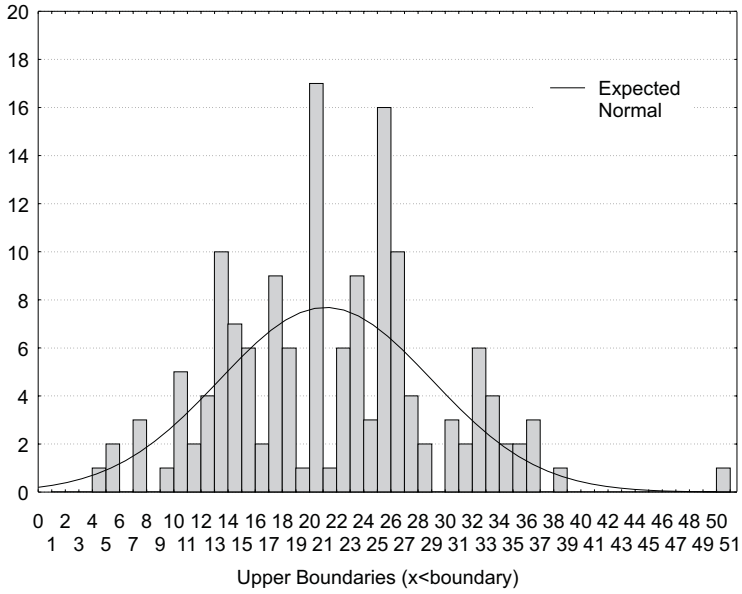


Fig. 3. Statistical dispersion of length of left styloid process.

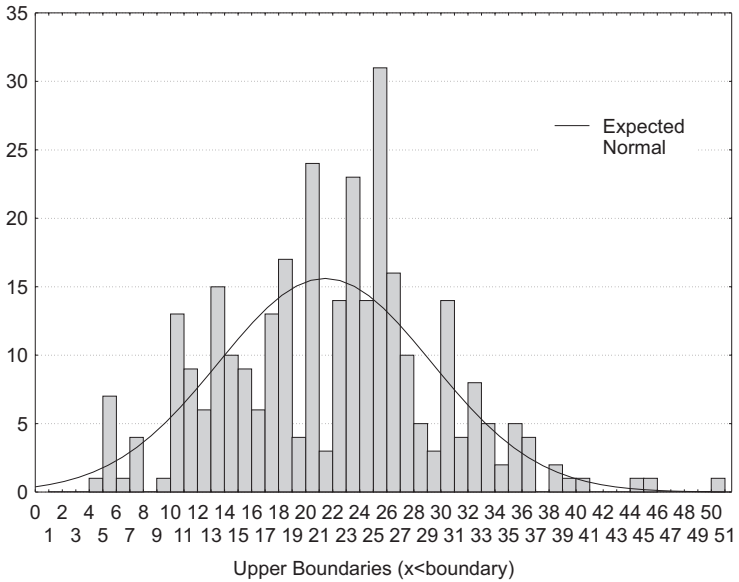


Fig. 4. General aspect of statistical dispersion of length of styloid process.

on the macerated skulls to x-ray measuring³ hence the projection of the styloid process on x-ray is shorter than the real anatomic length. However, Ferario et al. state that panoramic x-rays are especially useful in identifying stylohyoid structures¹². Panoramic x-rays have high sensitivity while in standard macerated skull and cervical column x-rays the styloid process may be overlaid against other structures, creating false negative images in sagittal projections. Finally, two contralateral stylohyoid complexes may appear overlaid. In skeletal series, bilateral asymmetry can be related to unilateral activities¹³.

Lengele states that short styloid processes, deeply inserted into the petrosus part of the temporal bone, dissimulated by the vaginal crest, are generally invisible in standard radiographs³. Such misreading of short styloid process could be confirmed in this study. Only a few styloid processes shorter than 5 mm were recorded in our results. This could offer be the answer as to why the styloid process was found in only about 75% of the subjects.

According to our results the mean length of styloid process in Croatian population is 21 mm. Analysis of styloid processes on macerated skulls in Croatian sample gave similar results. The length is distributed between 9 and 57 mm with the mean length of 24 mm¹¹. There is no unique statement of defining normal length of styloid process. Ogale reports the normal length of styloid process ranging from 2.2 to 4 cm¹⁴. Radiographic studies have shown that a normal styloid process is generally less than one inch (about 2,5 cm) in length^{6,15}. Although the length of the styloid process may vary considerably, most reports cite an average length between 2.0 and 3.0 cm, with an upper limit of normal range of 5.0 cm⁹.

It has been shown that the styloid process increases in length up to the age of

30, reaches a quiescent stage between 30 and 50 years of age, and then undergoes another slight increase in length after the age of 60¹⁶. Dimensional changes in different bones occur with age^{17–19}. Our age analysis confirms the increasing in length of the styloid process with age in younger population. Our findings also confirm that bilateral distribution of long styloid process in all age groups is most common²⁰.

Statistical dispersion in Croatian sample corresponds to the findings of Lengele and Dhem³. The existence of two different groups, long and short was noted in our sample, short styloid processes less than 21 mm, and long styloid processes – over 21 mm. However, in Lengele and Dahm study, 24% of total population was characterized by short styloid process, while in our sample this figure reached 46%. Lengele and Dhem explained the bimodal distribution corresponding to two different transformations of Reichert's cartilage. Short styloid process exists when only timpanohyal cartilaginous fragment of the second branchial cartilage is ossified and stylohyal cartilaginous fragment is not³. However, our data analysis gives yet a third group of the styloid processes that are separately distributed. In statistical dispersion of the left styloid process that group includes processes of over 29 mm. The dispersion of the right styloid process however, suggests larger value (34 mm). Nevertheless, 29 mm should be accepted as the upper limit for normal styloid length. Many authors state that any styloid process exceeding 3.0 cm in length, is considered elongated^{7,21}. Several elongation theories have been proposed but the cause of the elongation of the styloid process has not been fully elucidated²². Ceratohyal degeneration into stylohyoid ligament could be incomplete, if proximal part persists and ossification appears, elongated process could occur. This study suggests trimodal distribu-

tion as the consequence of developmental changes.

The results from this study, as well as findings of Lengele and Dhem, confirmed the existence of »short styloid process« (under 21 mm) that has the embryolo-

gical basis. Additionally, two more groups could be accepted. The group of normal (21–30 mm) and the group of elongated (more than 30 mm) styloid processes. This classification is both biologically based and clinically referent.

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NOVA PODJELA DUŽINA STILOIDNOG NASTAVKA: KLINIČKA PRIMJENA NA BIOLOŠKIM OSNOVAMA

SAŽETAK

Cilj ovoga rada bilo je određivanje prosječne radiografske dužine stiloidnog nastavka u hrvatskoj populaciji i prikaz nove podjele koja je primjenjiva u kliničkoj praksi. Pregledano je 296 ortopana od kojih je 161 bio od muških, a 135 od ženskih ispitanika. Mjerena je dužina stiloidnog nastavka i provedena je analiza prema dobi. Stiloidni nastavak je utvrđen u oko tri četvrtine ispitanika. Prosječna dužina iznosila je 21,6 mm na desnoj strani, odnosno 21,2 mm na lijevoj strani. Statističkom obradom utvrđene su tri grupe stiloidnih nastavaka: kratki (manje od 21 mm), normalni (21–30 mm) i produljeni (dulji od 30 mm). Ovaj rad prikazuje trimodalnu distribuciju duljine stiloidnog

nastavka kao kliničku podjelu na biološkim osnovama