

Styloid process elongation and temporomandibular disorders: a pilot study in the Albanian population

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Abstract

Introduction. Patients with an elongated styloid process (SP) presented related symptoms as deep neck pain, foreign body sensation in the throat, pain on turning the head, and odynophagia. These symptoms are the source of misdiagnosis of this syndrome since these clinical manifestations are like those of temporomandibular disorders (TMD). This study aimed to investigate a possible correlation between the TMD and elongation of the SP.

Materials and methods. The case-control study included 60 participants between 25-60 years of age and was carried out at University Dental Clinic, Department of Maxillo-Facial Surgery, Tirana, Albania during the period November 2020 – March 2021. The study group consisted of 30 patients diagnosed with TMD (21 females and 9 males) and the control group consisted of 30 individuals without TMD (18 females and 12 males). The diagnosis of TMD was performed according to Research Diagnostic Criteria for Temporomandibular Disorders axis I and the SP measurement was performed by a single experienced examiner. The normal range of SP length was considered 20-30 mm.

Results. SP >30mm was found in 86.67% of patients with TMD group and 43.33% of individuals of the control group. There was a significant difference between the TMD group and the control group in regards to SP length ($p < 0.001$).

Conclusions. There is a significant association between the elongation of the SP and TMD. Dental clinicians should recognize the morphological changes in the length of SP on the panoramic radiographs, which could be a hint in the proper diagnosis of TMD.

Key words

- temporomandibular disorders
- styloid process
- masticatory muscles

INTRODUCTION

The styloid process (SP), an integral part of the styloid complex chain is derived from the second pharyngeal arch (Reichert's cartilage). The tip of SP is positioned between the internal carotid artery, internal jugular vein, and cranial nerves V, IX. With this critical anatomical location, variations in the length of SP, which according to Langlais *et al.* [1, 2] results from ossification in the stylohyoid ligament, may be associated with a group of clinical symptoms that require surgical intervention [3]. O'Carroll reported that 8 of 103 (8%) patients with an elongated SP presented with related symptoms of deep neck pain, foreign body sensation in the throat, pain on turning the head, and odynophagia which are the source of misdiagnosis of this syndrome

since these clinical manifestations are like those of Temporomandibular disorders (TMD) [4].

TMD encompasses many clinical problems involving the masticatory muscles, the temporomandibular joint and associated structures or both [5]. An elongated SP is present in 2% to 30% of adults and the prevalence among patients with classic TMD pain symptoms is unknown.

This study aimed to investigate a possible correlation between the TMD and elongation of SP in the Albanian population.

MATERIALS AND METHODS

The study protocol consisted of a pilot case-control study carried out at University Dental Clinic, Depart-

ment of Maxillo-Facial Surgery, Tirana, Albania during the period November 2020 – March 2021. The study was approved by the Bioethical Commission of the Medical University of Tirana [Protocol no: 2020/11-16]. From each patient enrolled in this study informed consent was obtained before the beginning of the study.

Cases group (n = 30) included patients diagnosed with TMD and the control group (n = 30) with no history of TMD.

Subjects who do not have reached skeletal maturity (<25 years old), pregnant women, and individuals who have undergone radiation treatment were not allowed to participate in the study.

The diagnosis of TMD was performed according to Research Diagnostic Criteria for Temporomandibular Disorders axis I [6], with the symptoms lasting at the last 3 months.

For both groups in the study, the SP length was assessed bilaterally from the digital panoramic images [7], and only the side with a higher length of SP was taken into consideration. The digital panoramic radiographs evaluated in this study were taken using 2D Units Dentsply Sirona at the Faculty of Dental Medicine, Tirana, Albania. To have a good visualization and accurate measurements, the images were calibrated properly by adjusting the contrast and brightness. The length of SP from 20-30 mm is considered normal, and the length longer than 30 mm is considered elongated SP [8-10]. To obtain high reproducibility and reliability of the data and to reduce bias the clinical and radiographic examinations were done by a single trained examiner. Digital measurement calibration was performed before each radiographic measurement.

Reporting of this observational case-control study was conforming with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [11].

STATISTICAL ANALYSIS

To test whether the relationship between a categorical variable (control and TMD subjects) and a continuous numerical variable (SP length) is statistically significant, we used the Mann-Whitney non-parametric test.

Fisher's exact test was used to test whether the differences between the control and TMD subjects and the elongated and normal SP variables are statistically significant or not. A p-value <0.05 was the criteria for considering the result statistically significant.

To test whether there were any differences in the length of the SP between different ages and genders in the TMD group and control group, a two-way ANOVA without replication test was used.

The statistical analysis has been performed using BioStat 4.0.

RESULTS

The sample size consisted of 60 individuals (40 females and 20 males), with an average age of 42.53 years. The gender ratio in TMD cases (female:male) was 2.3:1. A gender ratio in favor of the females was found also in control group (1.5:1). The higher participation of the female gender, perhaps, is related to the fact that females are more concerned about oral health and oral esthetics, and hence had more frequent dental controls. The average SP length was statistically significantly higher in TMD cases (mean = 35.7) compared to controls (mean = 30.73) (p-value <0.001 using Mann-Whitney nonparametric test) (Table 1).

There was a significant difference for the SP length between cases and controls subjects (p value = 0.009). In particular, the TMD group has a higher percentage of SP length (>30 mm) compared to the control group (87% versus 43% respectively) (Table 2).

The Table 3 shows the results of two-way ANOVA without replication test, in order to describe the effect

Table 1
Demographic characteristics of the subjects included in our study

Variable	Controls (n=30)	TMD (n=30)	P-value *
Sex			
Male (n, %)	12 (40%)	9 (30%)	
Female (n, %)	18 (60%)	21 (70%)	
Age in years (mean, SD)	42.3 (12.15)	42.76 (11.64)	
SP length (mean, SD)	30.73 (3.54) †	35.7 (4.12)	<0.001

* P value using Mann-Whitney nonparametric test.

Table 2
Distribution of cases and controls by selected variables and Fisher's Exact Test between case and control subjects

Variable	Controls (n=30)	TMD (n=30)	P-value*
SP length			
> 30 mm (n, %)	13 (43%)	26 (87%)	0.009
≤ 30 mm (n, %)	17 (57%)	4 (13%)	

*P value using Fisher's Exact Test (2-sided).

Table 3

Results of two-way ANOVA without replication test; the effect of age and gender in the length of the SP in the TMD and control group respectively

Source of Variation	SS	df	MS	F	P-value	F crit
TMD group						
Age	2490.30933	29	85.8727356	1.28683792	0.25068731	1.86081144
Gender	747.654	1	747.654	11.2038997	0.00227172	4.18296429
Error	1935.216	29	66.7315862			
Total	5173.17933	59				
Control group						
Age	2363.51483	29	81.5005115	1.01627929	0.48280813	1.86081144
Gender	1984.90017	1	1984.90017	24.7509235	2.7189E-05	4.18296429
Error	2325.65483	29	80.1949943			
Total	6674.06983	59				

SS: sum of squares; Df: degrees of freedom; MS: mean squares; F crit: critical value for F score.

of gender and age in the length of the SP in the TMD and control group respectively (Table 3).

The results of two-way ANOVA without replication test, show that, in the TMD group, there is a significant effect of the gender variable in the length of the SP (p-value = 0.002), and no discernible effect of the age variable in the length of the SP (p-value = 0.25). In the control group, the results show that there is a discernible effect of the gender variable in the length of the SP (p-value = 2.7189E-05) and no effect of the age variable in the length of the SP (p-value = 0.48).

DISCUSSION

The etiology of elongated SP under the current knowledge is unknown, even though this condition has a prevalence in the range of 1.4-83.6% [7-9].

The percentage of female gender in controls was 60% and in cases it was 70%. The gender ratio is shown to be 2:1 with female risk three times greater compared with male in development of TMD [6]. In literature, the relationship between gender and SP length has shown controversial results. Some studies report that there is no association [12, 13] between gender and SP length, and others report that there is an association [14, 15].

The mean lengths of SP were 35.7 and 30.73 mm in TMD and control groups respectively. These values are higher than those reported by Andrade *et al.* 2012 [8]. This difference could be explained by the small sample size, which could bias to some extent the results of this study. The current study was limited by its non-randomized nature, as well as the small number of patients.

In our study, we found that there is an association between gender and elongation of SP in both groups (p-value = 0.002 and 0.003 in TMD and control group respectively).

Also, in our study we found that there is no association between age and elongation of SP, which is consistent with the results of studies of Rizzatti-Barbosa *et al.* 2005; Okabe *et al.* 2006 [14, 15].

The relationship between TMD and elongated SP is

poorly investigated in epidemiological studies. Existing studies again offer controversial results. In 2013 Sancio-Gonçalves *et al.* [13] reported no significant relationship between TMD and SP length. But other studies [16, 17] reported a significant association between the length of the SP and TMD. In our study, we found that 87.7% of patients with TMD had elongated SP, *versus* 13.33% with normal SP. In the control group, 43.3% had elongated SP, *versus* 56.7% with normal SP. This data clearly showed a significant association between the elongation of the SP and TMD in the Albanian population.

CONCLUSIONS

The present study attempts to investigate a possible correlation between the TMD and elongation of SP. Although the results are interesting and show a significant association between TMD and elongation of SP, a possible bias to our result is the fact that we considered as the normal range of length of SP from 20-30 mm and elongated SP when the length was >30 mm, but we do not have data that show the normal range of length of SP in Albanian ethnic group. Further investigations must be conducted to examine the normal range of length of SP in Albanian ethnic groups to clarify if there are differences in the morphology of SP with other ethnic groups and the prevalence of elongation of SP in Albanian ethnic groups.

There is a significant association between the elongation of the SP and TMD. Dental clinicians should recognize the morphological changes in the length of SP on the panoramic radiographs, which could be a hint in the proper diagnosis of TMDs. Further follow-up studies are necessary to confirm this evidence.

Conflict of interest statement

The Authors declare that there is no conflict of interest.

Received on 7 October 2021.

Accepted on 22 December 2021.

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