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EVALUACIJA STILOIDNOG PROCESUSA KOD POREMEĆAJA TEMPOROMANDIBULARNIH ZGLOBOVA

EVALUATION OF THE STYLOID PRECUSSUS IN TEMPOROMANDIBULAR JOINT DISORDERS

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Sažetak

Cilj *studije bila je procena stiloidnog procesusa kod različitih oboljenja zgloba.*
Materijali i metode: *Istraživanje je obuhvatilo 150 ispitanika, 50 ispitanika sa dijagnozom I grupe istraživačkih dijagnostičkih kriterijuma (RDC/TMD), 50 ispitanika sa dijagnozom II grupe i 50 ispitanika bez TMD kao kontrolne grupe. Izvršen je klinički pregled praćen radiografskim pregledom digitalnim panoramskim rendgenskim snimkom. Radiografije su procenjene i analizirane u pogledu dužine i vrste stiloidnog nastavka.*
Rezultati: *Srednja dužina stiloidnog nastavka bila je 32,33 ± 4,14 mm u RDC/TMD I grupi, 29,08 ± 5,26 mm u RDC/TMD II grupi i 29,94 ± 7,02 u kontrolnoj grupi. Dužina stiloidnog nastavka kod RDC/TMD I bila je veća, a zatim kod kontrolne i RDC/TMD grupe II. Razlika između grupa je bila značajna (p < 0,05). U grupi RDC/TMD I najviše je dominirao stiloidni proces tipa II, zatim tip I i tip III. U grupi RDC/TMD II najviše je dominirao stiloidni nastavak tip I, zatim tip II, tip III. Dalje, u kontrolnoj grupi, stiloidni nastavak tip I bio je najistaknutiji, zatim tip II i tip III. Utvrđena je značajna povezanost između grupa i tipa stiloidnog nastavka (p = 0,000).*
Zaključak: *Izduženje stiloidnog nastavka se češće javlja kod poremećaja temporomandibularnog zgloba kod RDC/TMD I dijagnoze nego kod RDC/TMD II dijagnoze. Studija predlaže procenu stiloidnih procesa kod pacijenata sa TMD.*

Ključne reči: *Orlov sindrom, izduženi stiloidni proces, panoramska radiografija, poremećaji temporomandibularnog zgloba*

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Abstract

Aim *The present study was undertaken with the aim of evaluating the styloid process in various TMD.*
Materials and Methods: *The study included 150 subjects, 50 subjects with Research Diagnostic Criteria (RDC/TMD) group I diagnosis, 50 subjects with group II diagnosis and 50 subjects without TMD as a control group. Clinical examination followed by radiographic examination using digital panoramic radiograph was carried out. The radiographs were evaluated and analysed for the length and type of the styloid process.*
Results: *The mean length of the styloid process was 32.33 ± 4.14 mm in the RDC/TMD I group, 29.08 ± 5.26 mm in RDC/TMD II group and 29.94 ± 7.02 in the control group. The length of the styloid process in RDC/TMD I was higher followed by the control and RDC/TMD group II. The difference between the groups was significant (p < 0.05). Styloid process type II was the most predominant in the RDC/TMD I group, followed by type I, and type III. In RDC/TMD II group, styloid process type I was the most predominant, followed by type II, type III. Further, in the control group, styloid process type I was the most prominent, followed by type II and type III. A significant association between the groups and the type of styloid process was found (p = 0.000).*
Conclusion: *Elongation of the styloid process is more predominantly found in temporomandibular joint disorders RDC/TMD I diagnoses than RDC/TMD II diagnoses. The study suggests evaluating the styloid processes in TMD patients.*

Key words: *Eagle syndrome, elongated styloid process, panoramic radiography, temporomandibular joint disorders*

Introduction

Temporomandibular joint (TMJ) is one of the most complex bilateral synovial joints present in the human body. It plays a crucial role in managing the mandibular movements and regulating the major functions of the stomatognathic system such as speech and mastication[1]. World Health Organization (WHO) report refers to temporomandibular joint disorders (TMD) as the third most predominant stomatological problem after dental caries and periodontal diseases, under the category of population diseases[2]. The global prevalence of TMDs in adults is estimated to be about 31%[3]. The etiology of TMD is multifactorial and the pathogenesis remains to be diverse and poorly understood. Pain in the TMJ region and restriction of mandibular movements were reported to be the most common clinical presentation of TMDs[4]. The presentation of pain in the TMJ and jaws region may be a common presentation of various other disorders as well, such as referred odontogenic pain, otologic pain, and pain due to the elongated styloid process. It is clinically difficult to delineate the pain related to TMD from that due to an elongated styloid, without the aid of radiographic investigations[5]. The anatomical proximity of the styloid process to the TMJ is also a major reason that could lead to misperception of the symptoms. The average length of styloid process is about 20–30 mm, when their length exceeds 30 mm it is said to be elongated leading to Eagle syndrome[6,7]. The evidence exploring the association between the styloid process and temporomandibular joint disorders are scanty in the literature. Hence, present study was undertaken to evaluate the styloid process in various temporomandibular joint disorders.

Material and methods

The study was conducted after the institutional research and ethical committee approval. A total of 150 subjects attending the outpatient Clinic of Oral Medicine and Radiology were involved in the study. All subjects were within the age group of 18–40 years. Study subjects were divided into three groups based on the clinical findings. Study groups 1 and 2 consisted of 50 subjects each with pain in the TMJ region and were diagnosed with TMD falling under the Research Diagnostic Criteria (RDC/TMD) group I and II respectively. Study group 3 included 50 control subjects without TMD and required panoramic radiographs for diagnosis and treatment planning. Subjects who had TMJ pain for a period less than 3 months or pure arthrogenic pain (RDC/TMD group III), history of systemic disorders and syndromes, history of craniofacial trauma or any history of head and neck surgery were excluded from the study.

The study subjects who fulfilled the inclusion criteria were given explanations about the study procedures in detail and written informed consents were signed by the subjects who were willing to take part in the study. A well-trained oral medicine specialist carried out the complete clinical TMJ assessment by abiding to the clinical diagnostic criteria for diagnosing TMD[8]. The study subjects were divided into three groups, group 1 comprised 50 subjects with myogenic pain (RDC/TMD I), group 2 comprised 50 subjects who had disc displacements (RDC/TMD II) and group 3 was the control group. The radiographic investigation with digital orthopantomogram (OPG) was done for the preliminary evaluation of the dentition, TMJ and styloid complex. The digital radiographs were procured using Planmeca ProMax S2-2D (Helsinki, Finland, 2008) under standard exposure parameters (average exposure of 64–70 kV; 8–13 mA). Radiographic imaging was undertaken by a well-trained radiographer and the radiographic images were assessed in full-screen monitor using Planmeca Romexis software (version 4.6.2) by two independent maxillofacial radiologists who were blinded about the clinical group of the subjects. Maxillofacial radiologists were trained and calibrated for the measurements. The radiographic evaluation assessed the morphology of the condylar head, the extent of movement of the condylar head, and the length and type of the styloid process. The measurement of the styloid process was recorded using the measurement tool from the point where the styloid exits the tympanic plate to the tip of the styloid process[9]. The classification system of the styloid complex that was put forth by Langlais was followed to categorize the type of styloid (Figure 1)[10].

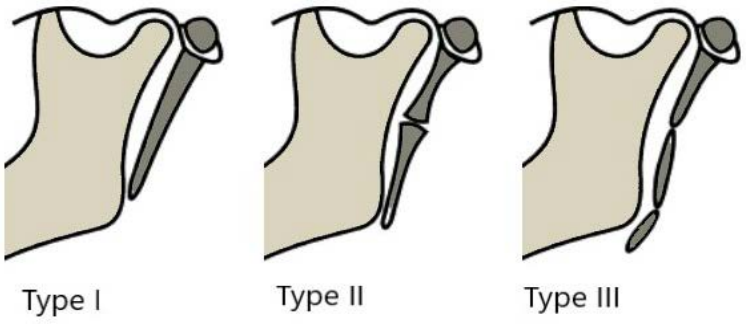

Figure 1. Classification of styloid process[10]

Statistical analysis

The data obtained from the study were tabulated and subjected to statistical analysis using Statistical Package for the Social Sciences software version 26 (SPSS Inc., Chicago, IL, USA). The comparison between the lengths of the styloid process between the three groups was done using ANOVA followed by Tukey post hoc analysis, while Chi-square test was used to compare the distribution of various types of styloid processes among the study subjects. P-value < 0.05 was considered to be statistically significant.

Results

Our study included a total of 150 subjects (98 females and 52 males), the clinical details of the subjects included in the study are given in Table 1. The mean age of the study subjects in the myogenic and disc displacement groups was 30.32 ± 4.78 and 25.84 ± 6.27 years, respectively and the mean age of subjects in the control group was 25.92 ± 6.07. The mean length of the styloid process in the RDC/TMD I/myogenic group was 32.34 ± 4.14 mm and in the RDC/TMD II/disc displacement group, it was 29.08 ± 5.26 mm. The mean length of the styloid process in the control group was 29.94 ± 7.02. The length of the styloid process in RDC/TMD I was higher than in the RDC/TMD II group and it was statistically significant with a p-value of 0.012 (Table 2). On assessment of the type of styloid process in the study groups, type II was the most predominant in the RDC/TMD I group, followed by type I and type III. In the RDC/TMD II group, type I was the most predominant type, followed by type II, and type III. A significant association (p = 0.000) between the groups and the type of styloid process was found (Table 3, Figure 2). Panoramic radiographs of our study samples representing different type of styloid processes are shown in the figures, styloid process type I (Figure 3), styloid process type II (Figure 4) and styloid process type III (Figure 5).

Table 1. Characteristics of the study subjects

	RDC/TMD I	RDC/TMD II	CONTROL
Number (n)	50	50	50
Gender n (%)	Males = 17 (34%)	Males = 14 (28%)	Males = 21 (42%)
	Females = 33 (66%)	Females = 36 (72%)	Females = 29 (58%)
Mean age (in years)	30.32 ± 4.78	25.84 ± 6.27	25.92 ± 6.07
Mean duration of Pain (in months)	4 ± 0.23	4 ± 1.82	No Pain
Visual Analogue Scale for pain (Out of 10)	7 ± 0.96	6 ± 1.07	Not applicable

Table 2. Comparison of length of styloid process between the 3 groups

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Sum of Squares	F	Sig.
					Lower Bound	Upper Bound			
RDC/TMD I	50	32.33	4.145	0.58627	31.15	33.50	283.570	4.518	0.012*
RDC/TMD II	50	29.08	5.260	0.74389	27.58	30.57			
Control	50	29.94	7.021	0.99298	27.94	31.93			

Table 3. Comparison of type of styloid process between the three groups

		Styloid process		
		I	II	III
Groups	RDC/TMD I	19	24	7
	RDC/TMD II	31	17	2
	Control	43	6	1

$X^2 = 26.001$, p = 0.000*

Chi-square test was used. A significant association between the groups and the type of styloid process was found (p = 0.000)

Table 4. Multiple Group Comparisons

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
RDC/TMD I	RDC/TMD II	3.25000*	1.12044	0.012*	0.5971	5.9029
	Control	2.39000	1.12044	0.087	-0.2629	5.0429
RDC/TMD II	RDC/TMD I	-3.25000*	1.12044	0.012*	-5.9029	-0.5971
	Control	-0.86000	1.12044	0.723	-3.5129	1.7929
* The mean difference is significant at the 0.05 level						

The comparison between the lengths of the styloid process between the three groups was done using ANOVA followed by Tukey post hoc analysis. The length of the styloid process was highest in the RDC/TMD I group followed by the control and RDC/TMD II group. The difference between the groups was significant (p < 0.05). Post hoc analysis confirmed that the difference between RDC/TMD I and RDC/TMD II groups was significant (p = 0.012)

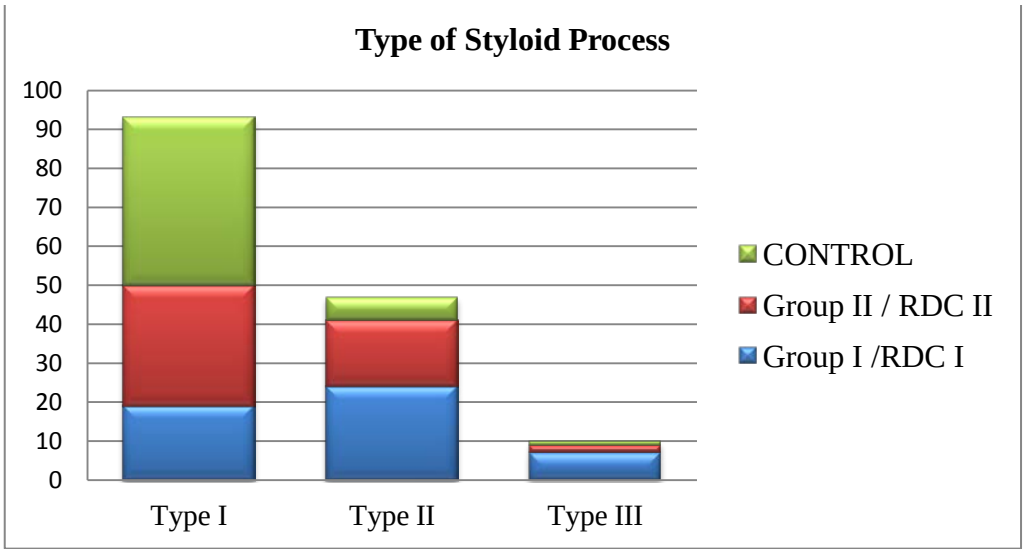

Figure 2. Distribution of various types of styloid process in the study subjects

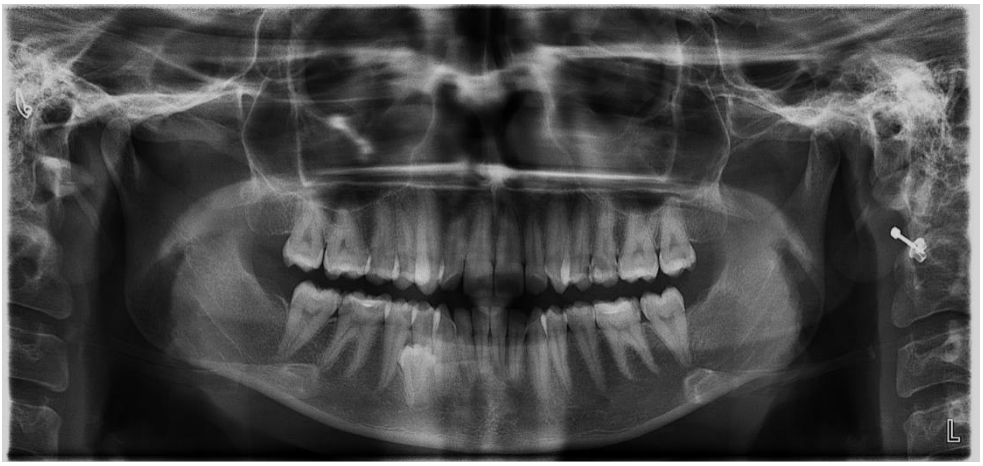

Figure 3. Panoramic radiograph showing styloid process type I

Figure 4. Panoramic radiograph showing styloid process type II

Figure 5. Panoramic radiograph showing styloid process type III

Discussion

Temporomandibular joint diseases are commonly encountered in women, especially among young adults[11]. Pain and functional limitation are the most common features of TMD. Pain associated with TMDs may radiate to the dental arches, ears, forehead, occipital and cervical spine region, or even to the shoulder girdle. Despite the high prevalence of TMD globally, relatively only a few patients seek treatment[12].

Myofascial TMD pain is associated with the masticatory muscles and gets aggravated by jaw movements, by provocation testing of the masticatory muscles or in the region within the border of the muscle. Myofascial pain is reported to be the most common cause of orofacial pain[13]. The medical literature reports that the pain associated with TMD is the most pronounced in the neck region, where the lack of lateral support balance can cause the neck to bend to the affected side[12]. Among disc displacements of the TMJ, disc displacement with reduction is the most frequently reported type with a prevalence up to 41%[14,15]. The initial stages of disc displacement with reduction may not exhibit any pain or functional limitation because of the ability of the joint to adapt to various disc positions however, in time the clinical symptoms develop due to the progression of the condition[16].

The clinical assessment of TMJ and establishment of relevant diagnosis is complex and requires expertise because of the anatomy of the joint and its close proximity to other anatomically significant structures[1]. The RDC/TMD diagnostic algorithm is a reliable and widely accepted criteria for the diagnosis of TMD[8]. In this study, the subjects were categorized based on the RDC/TMD criteria as RDC/TMD I/myogenic group and RDC/TMD II/disc displacement group. Literature evidence reports TMDs to be more prevalent in the age group of 20–40 years with a strong female predilection[17,18]. In the present study, 69% of the respondents were females, and the female predilection for TMDs can be attributed to various factors including psychological and hormonal influences[17,19]. In most instances, radiographic evaluation of the joint is vital for establishing a diagnosis of TMD. Various conventional and advanced modalities aid in the imaging of the TMJ. Panoramic radiography is useful only in gross morphological evaluation of the joint. However, panoramic radiography provides visualization of the lateral view of the condyles in comparatively low radiation exposures. Panoramic radiographs can serve as a preliminary radiographic tool to rule out significant changes in the osseous morphology of the joint[20,21].

The styloid process is located in the temporal bone adjacent to the stylomastoid foramen. The morphology of the styloid process appears as a cylindrical structure tapering at the end, with stylohyoid ligament attaching at its tip. Various vital structures such as the carotid arteries are in the close proximity of the styloid process, making it clinically important[22]. Anatomical alterations in the styloid process or stylohyoid ligament may manifest clinically as features similar to TMD. Eagle syndrome is a well-known phenomenon

characterized by the extension of styloid apophysis[23]. Elongation of the styloid process demands radiographic examination to determine the extent of the abnormality and for treatment planning. Bruno et al. conducted a systematic review to evaluate the validity of panoramic radiographs in the elongated styloid process. They reported panoramic radiography a valuable modality in the diagnosis of elongated styloid process (ESP). Panoramic radiography can serve as a primary radiographic modality for the evaluation of styloid in symptomatic individuals and to differentiate ESP from other painful orofacial conditions[24].

According to the literature reports, a styloid process that exceeds 30 mm in length is said to be elongated[7]. Generally, the mean length of the styloid process is reported to be within the range of 20–25 mm[25,26]. However, the average length of the styloid process differs widely in the observations of various authors. The mean length of the styloid process in the control group of our study was 29.94 ± 7.02. This variation is due to the population studied. In the present study, the styloid process length in RDC/TMD I (32.33 ± 4.145 mm) was higher than in the RDC/TMD II group (29.08 ± 5.26mm). Yavuz et al. in their study, reported individuals with TMD to have longer styloid processes with a mean length of 32.65 mm, which is similar to our findings[27]. However, the report of Yavuz et al. assessed the length of the styloid process in TMD as a single entity, without categorizing the type of TMD. Krohn et al. reported elongated styloid processes in individuals with TMD, but they did not find any significant difference in the association between the styloid process and specific RDC/TMD diagnoses[7].

Though evidence is supporting the association between the elongated styloid process and TMD, Sancio-Goncalves et al. reported a lack of association among the two conditions[28]. We observed an association between the elongated styloid process and the TMD—the RDC/TMD I group rather than the RDC/TMD II group. Our observation of the association between the elongated styloid and myogenic TMD could be related to various factors. Siéssere et al. in their clinical trial demonstrated hyperactive masticatory muscles in subjects with Eagle syndrome[29]. The hyperactive state of the masticatory musculature may result in myogenic pain. The mechanical irritation to mechanoreceptors due to an elongated styloid may alter their discharge in the area of cranial nerve endings of the 5th, 7th, 9th and 10th nerves[30]. The abnormal discharge in the mechanoreceptors can affect the neurological impulses to the TMJ region and the adjacent masticatory muscles leading to co-occurrence of TMD. Hormonal influence is also known to exert a direct effect on styloid chain calcification and elongation, similarly, hormones such as oestrogen were reported to be a major etiological factor in the development of TMD, especially in females[31–33].

We observed altered ESP (Styloid > 30 mm) in 62% of the study subjects in the RDC/TMD I group, 38% of the RDC/TMD II group and 36% of the control group. Yavuz et al.[27] and Mathew et al.[34] have also reported a similarly high prevalence of ESP in TMD, whereas Zaki et al.[35] and Guimarães et al.[36] have reported a comparatively lesser prevalence of ESP in TMD. The variations in the prevalence can be attributed to various factors such as the characteristics of the studied population, design of the study, presence of other systemic factors in the population studied etc. On analysis of the morphological type of the styloid process, we found type II to be the most predominant in the RDC/TMD I group, while type I was the most predominant type in the RDC/TMD II group and type I was more prominent type in control group. A significant association between the groups and the type of styloid process was found. Our study findings are in line with those of Andrade et al., where styloid type I was found to be the most common type in subjects with temporomandibular joint disorders[23]. Reddy et al. have reported styloid type I to be more prevalent in the South Indian population in general[37]. Hence, we did not find any specific attribute to the finding of styloid process type I in our study subjects with TMD.

Our study was an attempt to evaluate the styloid process in various types of TMD using panoramic radiography. This process involves a two-dimensional radiographic technique, which has its limitations. Therefore, further prospective large-scale studies are needed to evaluate the styloid process using 3-dimensional modality such as cone beam computed tomography (CBCT), particularly in specific types of TMD. Such studies will help provide an in-depth understanding of the association between these two conditions.

Conclusion

Elongation of the styloid process is associated with temporomandibular joint disorders, predominantly with RDC/TMD I diagnosis rather than RDC/TMD II diagnosis. Hence, clinicians must carefully evaluate the styloid processes in all cases of

temporomandibular joint disorders before establishing the diagnosis and developing the treatment plan.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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