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Research Article

Assessment of Pterygoid Plate Measurements in Internal Derangements of Temporomandibular Joint (TMJ) - A Cone Beam Computed Tomography (CBCT) Study

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Abstract

Objective: Temporomandibular disorder (TMD) is multifactorial in nature and hence one of the most challenging diseases of modern society. The lateral pterygoid muscle (LPM) has been implicated in TMD, i.e. it may become hyperactive, eventually leading to anterior and medial disc displacement. It has been hypothesized that the hyperactivity of LPM can cause asymmetry of the lateral pterygoid plate (LPP). Hence, the present study was undertaken to evaluate a potential relationship between LPP measurements and Internal Derangements of temporomandibular joint (TMJ), using cone-beam computed tomography (CBCT).

Materials and Methods: CBCT images of 20 patients with Internal Derangement of TMJ were evaluated and compared with images of 20 age- and gender-matched controls, without any TMJ disorders. The length of LPP was measured in the axial view of the full skull CBCT images.

Results: The LPP measurements in patients from the study group were increased compared to the control group. Further, in females, the mean LPP length on left side was significantly increased in the study group compared to the control group.

Conclusion: From the results of the present study, we can suggest that evaluating the LPP asymmetry in TMD patients using CBCT could be useful for its diagnosis. However, further studies with larger sample size are recommended in this direction.

Keywords: Temporomandibular Disorders; TMD; Lateral Pterygoid Muscle; Lateral Pterygoid Plate; CBCT

Introduction

Temporomandibular disorder (TMD) is a clinical term used to describe musculoskeletal disorders affecting the temporomandibular joints and their associated musculature [1]. The most frequent cause of temporomandibular joint disorder is internal derangement, which is defined as an abnormal relationship of the disc to the condyle [2]. The lateral pterygoid muscle (LPM) has a close association with the temporomandibular joint (TMJ) and is thought to play a major role in the control of jaw and TMJ function [2]. It has been implicated in TMDs because of its abnormal activity patterns in some TMD patients and it is very tender [3]. In TMD patients, the LPM is thought to become hyperactive [4] and this, in turn, can cause asymmetry on the lateral pterygoid plate (LPP) [5]. The LPP consists of a lateral surface or outer wing (gives attachment to the LPM), a medial surface or inner wing (forms part of pterygoid fossa and gives attachment to medial pterygoid muscle) and a posterior edge (often has a sharp projection called pterygospinous process) [6].

The particularly complex bony anatomy of the skull base makes it an attractive target for high spatial resolution imaging [7]. In CBCT imaging the voxel size is small, thereby offering a good spatial resolution and detailed reconstruction [7].

Purpose of the Study

The purpose of this study was to evaluate a potential relationship between LPP measurements and Internal Derangements of TMJ, using CBCT.

Materials and Methods

Source of data

Prior to starting the research, ethical clearance from the ethical board of the institution was obtained. Informed consent was ob-

tained from the patients. The study consisted of 20 patients with Internal Derangement of TMJ selected from the out-patient department of Oral Medicine and Radiology and 20 age- and gender-matched controls referred by a diagnostic imaging centre in Bengaluru, India. The study duration was one year and six months.

Inclusion criteria

- 20 patients aged 18 to 50 years, clinically diagnosed with internal derangement of TMJ on the basis of DC/TMD (Diagnostic Criteria for TMD) were selected as cases (Study group).
- 20 age- and gender-matched, apparently healthy subjects without any TMD were selected as controls.

Exclusion criteria

The following patients were excluded from this study:

- Patients with history of arthritis, TMJ ankylosis, other joint pains or trauma.
- Patients with history of migraine.
- Patients who had undergone treatment or were undergoing treatment for TMJ disorders.

Materials used

CBCT imaging of full skull (large FOV; 17 cm x 13.5 cm) was performed using Kodak Carestream CS 9300 system machine set at 90 kVp, 10 mA and 11.26 seconds with a typical voxel size of 300 **µm.** CS 3D Imaging software was used for reconstruction and for making the necessary measurements. The slice thickness was 0.9 mm.

Study procedure

Each patient underwent a thorough clinical examination of the TMJ on the basis of DC/TMD (Diagnostic Criteria for TMD) [8]. The DC/TMD guidelines provide standardized criteria for a two-axis diagnosis.

All patients were subjected to CBCT imaging of full skull using the Kodak Carestream CS 9300 system machine set at the operating parameters mentioned above. Measurement tools were used for measuring the lengths of the Lateral Pterygoid Plates (LPPs). Linear measurements of the LPPs were made in an axial view, referring to the coronal and sagittal views (Figure 1 and 2). First, the midsagittal plane and the nasal-cavity-floor plane were selected on the coronal view (Figure 1). Second, the midsagittal plane and the long axis of the palatal plane were selected on the sagittal view, in order to obtain a proper axial view of the outer wings of the bilateral LPPs (Figure 2). Measurement was made from the most concave point on the pterygomaxillary fissure line to the most posterior point of the LPP.

Figure 1: Coronal CBCT image showing intersection of the midsagittal plane with the nasal cavity floor plane.

Figure 2: Sagittal CBCT image showing intersection of the midsagittal plane with the long axis of palatal plane, selected in order to obtain a proper axial view of the outer wings of the bilateral lateral pterygoid plate.

Figure 3: Axial CBCT image showing the measurements of right and left LPPs of a patient with TMD (Study group).

Figure 4: Axial CBCT image showing the measurements of right and left LPPs of a subject from the control group.

Statistical analysis

All the findings were entered in Microsoft Excel. The study data was analyzed using SPSS (Statistical Package for Social Sciences) software v.22, IBM, corp. The mean difference between the right and left sides for the study variables was compared using student paired 't' test, within the study and control group. Student unpaired 't' test was used to compare the mean difference between the study and control groups for the study variables. The level of significance (P-Value) was set at $P < 0.05$.

Results

The study included 40 patients i.e. 20 patients in the study group and 20 age- and gendermatched controls. According to the results, in the age range of 18 - 25 years, the mean LPP length on left side was significantly increased in the study group compared to the control group (P = 0.05) (Table 1). The mean LPP length on left side, in females, was significantly increased in the study group compared to the control group (P = 0.03) (Table 2). In the control group, the mean length of LPP was 11.02 ± 2.58 mm on the right side and 10.99 ± 2.32 mm on the left side (Table 3). The mean LPP length on the right side was increased in patients with right TMD and the mean LPP length on the left side was increased in patients with left TMD; while in patients with bilateral TMD, the mean LPP length on both sides were increased compared to the control group. But these results were not statistically significant (Table 4).

The mean length of LPP on the right side was 12.40 ± 3.17 mm and 11.02 ± 2.58 mm in the study and control group, respectively. The mean LPP length on the left side was 12.31 ± 2.50 mm and 10.99 ± 2.32 mm in the study and control group, respectively. But, these results were not statistically significant (Table 5).

		Right LPP Length				Left LPP Length				
	Study group		Control group		P value	Study group		Control group		P value	
	n		n			n		n			
18 - 25 yrs	Mean (mm)	7	11.64	7	9.91	0.13	7	11.76	7	10.47	0.05*
	SD (+ mm)		4.06		2.90			1.82		2.15	
26 - 35 yrs	Mean (mm)	8	12.51	9	11.10	0.11	8	12.59	9	10.89	0.08
	SD (+ mm)		3.24		2.06			3.34		2.49	
36 - 50 yrs	Mean (mm)	5	13.26	4	12.78	0.50	5	12.62	4	12.13	0.50
	SD (+ mm)		1.61		2.67			2.13		2.41	

Table 1: Comparison of the lateral pterygoid plate (LPP) measurements between subjects from the study group and control group, according to age.

*Statistically significant difference ($p < 0.05$).

	n	Study group		Control group		P-value
		Mean (mm)	SD (± mm)	Mean (mm)	SD (± mm)	
Right Side LPP length						
Male	10	14.02	2.90	11.60	2.68	0.07
Female	10	10.77	2.63	10.44	2.49	0.78
Left Side LPP length						
Male	10	12.42	2.69	12.02	2.40	0.73
Female	10	12.19	2.44	9.96	1.80	0.03*
*Statistically significant difference ($p < 0.05$)						

Table 2: Comparison of the lateral pterygoid plate (LPP) measurements between subjects from the study group and control group, based on gender.

		Right LPP length		Left LPP length		P value
	n	Mean (mm)	SD (+ mm)	Mean (mm)	SD (+ mm)	
Patients without TMD (Control group)	20	11.02	2.58	10.99	2.32	0.97
*Statistically significant difference (p < 0.05)						

Table 3: Comparison of the lateral pterygoid plate (LPP) measurements between right and left side within the control group.

		Right LPP length		Left LPP length		P value
	n	Mean (mm)	SD (+ mm)	Mean (mm)	SD (+ mm)	
Right TMD	12	13.29	3.21	11.91	2.90	0.28
Left TMD	5	10.02	2.96	12.46	2.16	0.18
Bilateral TMD	3	12.76	1.42	13.60	0.72	0.41

Table 4: Comparison of the lateral pterygoid plate (LPP) measurements between right and left side within the study group.

*Statistically significant difference (p < 0.05).

	n	Mean (mm)	SD (+ mm)	P-value
Right Side LPP length				
Study group	20	12.40	3.17	0.14
Control group	20	11.02	2.58	
Left Side LPP length				
Study group	20	12.31	2.50	0.09
Control group	20	10.99	2.32	

Table 5: Comparison of the lateral pterygoid plate (LPP) measurements between subjects from study group and control group.

*Statistically significant difference (p < 0.05).

Discussion

Temporomandibular disorder (TMD) is a common malady that affects almost one third of all the adults [9]. It has been suggested that in TMD patients, the LPM may become hyperactive, eventually leading to anterior and medial disc displacement [10]. Guerrero., *et al*. hypothesized that; the hyperactivity of LPM can cause asymmetry of the LPP (The lateral surface of LPP gives origin to the inferior head of LPM) [5]. The displacement of articular disc can lead to chronic spasm in the LPM. This excessive muscle tension produces a gradual remodeling on the lateral surface of the LPP, which can condition its elongation over an undetermined period of time [5].

The present study showed that the mean length of LPP in patients without TMD (control group) was 11.02 ± 2.58 mm on the right side and 10.99 ± 2.32 mm on the left side (P = 0.97) (Table 3). These results are comparable with those reported by Guerrero., *et al*. [5] and Ueki., *et al* [11]. However, there is no standardized measurement of LPP reported in literature in the general population.

It was observed that the LPP measurements were increased in the study group compared to the control group in all the age ranges, though it was statistically significant only in the age range of 18 - 25 years, on the left side (Table 1). Possibly, a larger sample size would have yielded more significant results. But, in the study by Guerrero., *et al*. statistical significance was found in all the age ranges between patients with TMD and without TMD; except in the patients under 20 years of age who demonstrated no statistical significance on the right side [5].

In this study, it was noted that the LPP measurements in the study group were increased compared to the control group; however, these results were not statistically significant and could be attributed to the small sample size (Table 5). But, the mean LPP length on the left side was closer to the significance compared to the right side (P = 0.09). However, in the study by Guerrero., *et al*. they found statistically significant differences in the LPP measurements between the two groups, on both the right and left sides [5].

When comparing the mean LPP lengths in this study between the two groups according to the gender, in females, the mean LPP length on the left side in the study group was significantly increased compared to the control group (P = 0.03); however, the other results were statistically insignificant (Table 2). This was not reported in the previous study (Guerrero., *et al*.), where there was no significance noted in terms of the gender [5].

When the patients were compared in terms of the side of TMD and length of LPP, in the present study, increased LPP lengths on the same side of the TMD were observed. But this result was not statistically significant (Table 4). Similar results were obtained by Guerrero., *et al*. who found a statistically significant relation between the side of TMD and length of LPP on same side [5].

Limitations of Present Study

- The present study consisted of a small sample size.
- A standardized measurement of LPP has not been reported in literature, in the general population.

Future Recommendations

- This was a primitive study in evaluating a potential relationship between the LPP measurements and Internal Derangements of TMJ. Further studies with larger sample size are recommended.
- This was a case-control study. Prospective longitudinal observational studies are recommended to test the hypothesis that, hyperactivity of LPM can cause asymmetry of the LPP.

Conclusion

The present study was an attempt to study the effect of internal derangements of TMJ on the LPM, by evaluating its potential effect on the LPP. We suggest that CBCT can be used as a diagnostic tool for assessing the asymmetry of LPP in patients with internal derangements of TMJ. The asymmetry of LPP may imply the hyperactivity of LPM, due to the TMJ internal derangement; hence, presence of the LPP asymmetry can help us in the diagnosis of internal derangements of TMJ. However, further studies with larger sample size are recommended in this direction.

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