RESEARCH ARTICLE

CONE-BEAM COMPUTED TOMOGRAPHY STUDY OF MORPHOMETRIC EVALUATION OF PTERYGOIDHAMULUS

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ABSTRACT

aim: The aim of the study was morphometric evaluation of pterygoidhamulus using CBCT.

Material and Methods: CBCT images of 40 males and 40 females with age >20 years were evaluated. The length, width, inclination, and incidence of shape of PH was evaluated with respect to side and gender. Independent t-test was used for statistical analysis.

Results: The mean length of PH of both sides in males and females was found to be 11.5±0.75 and 10.09±0.45 mm, inclinations in sagittal plane was 12.74°±30.45 and 15.22°±30.65 in anterior direction, inclinations in coronal plane was 11.5°±31.05 and 19.70°±39.15 in medial direction whereas, it was 79.13°±30.4 and 71.5°±38.7 in lateral direction. Incidence of shapes of PH was 2.6, 2.4 for triangle 1.7 and 2.2 for slender respectively with statistically significant difference. Mean width values in males & females was found to be (left) 3.04±0.6, 3.06±0.5 and (right) 2.01±0.4 and 2.02±0.3 mm, inclination in sagittal plane (left) was 47.2°±20.1 and (right) 47.28°±22.1, 47°±20.1 and 47.1°±22.1 in posterior direction respectively with statistically insignificant difference. No statistically significant difference was found between left and right side except the inclination in coronal plane was more in left as compared to right side. Inclination in coronal and sagittal plane was more on lateral and posterior side respectively.

Conclusion: Appraisal of the morphology of PH is helpful as it provides insight for differential diagnosis of the imperceptible pain in oral cavity and pharynx.

INTRODUCTION

Tracing an unusual pain in the soft palate and pharyngeal region has been a diagnostic dilemma since years. Symptoms in this area forms a complex, which can include hearing disorders, TMD’s, uncontrolled movements of facial muscles, stylo-hyoid ligament calcification or stylo-mandibular ligament inflammation (Eyrich et al., 1997; Shankland, 1996; Ramirez et al., 2006). Also any of the following factors may be responsible such as bursitis or an osteophyte in the tensor velipalatini, elongation of the Pterygoidhamulus (PH), consistent repetition of minimal trauma to the overlying soft tissue and of PH, hyper awareness of the PH, muscular discoordination, or fracture of the PH after extensive and repeated manipulation (Eyrich et al., 1997). PH is a structure beneath the skull base, which has been scarcely described till now. It is biomechanically unique in its position (Putz Kroyer, 1999). The position, length, and inclination of PH are of great importance for the function of several muscles: tensor velipalatini, palatopharyngeus, and upper part of the upper pharyngeal constrictor. These muscles contribute to the separation of the oral from the nasal cavity during sucking and swallowing during growth and development and into adulthood (Hjørting-Hansen and Louis, 1987). Anatomically, the PH and the edge of the medial pterygoid plate give rise to the origin of the superior constrictor muscle of the pharynx. The palate pharyngeus muscle originates in layers from the PH as well as from the border of the hard palate and from the fibers of the levatorvelipalatini (LVP) muscle. It is generally considered that the lowest and most anterior fibers of the LVP arise from the base of the pterygoid process and reach up to and a little beyond the base of the PH (Orhan et al., 2011; Krmpoti et al., 2006). According to Krmpoti c-Nemani et al., 2006 if the PH remains short, as it is in newborns, thencephalopharyngeus does not have firm support and its contraction will lead to uncontrolled narrowing of the upper pharynx, causing problems such as snoring or sleep apnea (Krmpoti et al., 2006; Jo, 2006). Variations in the distance between the left and right PH influence the volume of the epipharynx (Krmpoti et al., 2006; Jo, 2006). Ulas et al. (2016) has shown in his study that the PH length is inversely associated with sleep apnea severity. He concluded that the size of PH seems to play an important function in affecting the level of muscle activity and thereby the airway collapse. (Hjørting- Hansen and Louis (Hjørting-Hansen and Louis, 1987) were the first to coin the term pterygoidhamulus syndrome which described pain in the palate and pharyngeal area as a result of an abnormal growth of a pterygoidhamulus.

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Also the present study states the clinical importance of pterygoid hamulus which can help in

- In locating hamular notch (between tuberosity & pterygoid hamulus), required for fabrication of maxillary denture (Posterior, 2014).
- In knowing the anatomy with exact dimensions which are required prior to lefort 1 osteotomy surgery (EdwardBuchanan, 2013).
- For placement of pterygoïd implants (Pterygoïdimplants for rehabilitation of a patient with a bilateral maxillectomy defect).
- Length of PH influences the procedure selection and objective treatment in patients with Obstructive sleep apnea (Ulás et al., 2016).
- Excessive length and improper inclination increases the chances of pterygoidhamulus syndrome (Morphological features of pterygoidhamulus and its clinical significance). Recently cone beam computed tomography (CBCT) is introduced in dental imaging which provides three dimensional evaluations of dental and maxillofacial structures. CBCT explains the internal structure of object as a cone shaped beam of radiations, which acquires data in a single 360° degree rotation. When CBCT compared with conventional periapical radiograph it has combination of axial, coronal and sagittal sections & as a result it minimizes distortion and overlapping of anatomical structures. When CBCT is compared with conventional computed tomography (CT), it provides less radiation dose, over scan time and it also increases accuracy and resolution (Scarfé, 2005). The aim of the present study was morphometric evaluation of pterygoid hamulus using CBCT. The objectives of the study was to evaluate the length, width, inclination, incidence of shape with respect to side and gender.

MATERIALS AND METHODS

The study was conducted in Oral medicine and radiology department in MGV’S Dental college and Hospital, Nasik, India. Protocol of the study was approved from authorized ethical committee. The CBCT dental imaging system (SIRONA, Germany) operating at 85 kVp and 6mA and FOV used was 8 × 8 cm with 14 second of exposure time. Total 80 patient’s scan of age > 20 years were evaluated by selecting them randomly. (As the ossification age of PH is estimated to be 18-20 years). Both sides (Right and left) and gender (40 males & 40 females) correlation was evaluated with respect to each parameter. Following parameters were noted:

- **Length of PH:** junction of medial pterygoid plate and PH through the tip. First a line was drawn from the junction of medial pterygoid plate and PH parallel to the horizontal plane. Following the identification of the midpoint of this line, the length was measured starting from this point to the tip of the PH.
- **Width of PH:** the distance between the most thickest portion of the PH in the coronal plane.
- **Inclination of PH:** Inclination of PH along its long axis in sagittal and coronal plane.
- **Types of inclination:**
  - i) Sagittal section
  - a) Anterior,
  - b) Posterior
  - ii) Coronal section
    - a) Medial,
    - b) Lateral,
  - Shapes of PH
    - a) Triangle type
    - b) Slender type.

Independent t-test was used for statistical analysis. p value <0.05 was considered as significant.

RESULTS

The CBCT images of 40 males and 40 females were studied. The mean length of PH (left side) in males and females was found to be 7.72 ±0.5, 6.78±0.3 mm. Inclination in coronal plane was found to be 53.01°±20.3°, 47.95°±26.18° (lateral) and 7.26°±20.7°, 13.91°±26.1° (medial) and that in sagittal plane was found to be 8.46°±20.3°, 10.17°±21.1° (anterior). The incidence of shape in left side of PH was 1.8, 1.5 (Triangle) and 1.2, 1.5 (slender) respectively. Independent t-test stated significant difference of this parameters with p value > 0.05. The mean width value in males and females were found to be 2.04±0.4, 2.05±0.4 mm and inclination in sagittal plane 47.22°±20.1°, 47.28°±22.1° (posterior) respectively with statistically insignificant (Table 1). The mean length of PH (right side) in males and females was found to be 7.56±0.5, 6.62±0.3. Inclination in coronal plane was found to be 52.24°±20.3°, 47.23°±25.18° (lateral) and 7.6°±20.7°, 13.03°±26.1° (medial) and that in sagittal plane was found to be 8.56°±20.3°, 10.01°±20.1° (anterior). The incidence of shape in right side of PH 1.7, 1.4 (triangle) and 1.1, 1.5 (slender) respectively. Independent t-test stated significant difference in this parameters with p value > 0.05. The mean width value in males and females were found to be 2.01±0.4, 2.02±0.3 and inclination in sagittal plane 47°±20.1°, 47.12°±22.1° (posterior) respectively with statistically insignificant (Table 2).
No significant difference was found between right and left side except the coronal plane inclination (posterior) was greater of left side as compared to right side. Also, in coronal and sagittal plane inclination, lateral and posterior inclination was seen more and among shapes more incidence of triangular shape PH were found.

**DISCUSSION**

IfPH plays the etiological role, deviant or uncharacteristic pain is caused. Common symptoms include sharp or burning pain in the palatal and pharyngeal region that may remain localized or refer to the ipsilateral ear or temporomandibular joint. This may occur spontaneously or elicited by touch or eating and drinking (Naidoo et al., 2014). Firm swelling, erythema and sometimes ulceration of the palatal mucosa over the hamulus are also common signs (Sasaki et al., 2001; Shankland, 1996). Occasional soreness upon swallowing and while manipulating the area with the tongue or finger are seen. After several months of elapsation, their may be history of occasional exacerbations and remissions of swelling and discomfort (Charbeneau and...
Blanton, 1981). The following symptoms present are not always associated with elevation in the soft palate. Although an excessively long hamulus could have been present in such cases, it is conceivable that one of the three other relationships could have existed, the medial pterygoid plate (and the PH) may have been situated in more inferior position than normal or the soft palate mucosa may have been situated more closer than normal or soft palate would have been thinner than usual in thickness (Charbeneau and Blanton, 1981). Several studies describe the morphology of PH in different populations. Eyrich et al. 1997 found the mean length of the left hamulus to be 5 mm and the right to be 4.9 mm. But, the present study showed mean length in left and right side in males and females as 7.726, 6.78, 7.56 and 6.62 mm respectively. Putz and Kroyer (1999) reported the average length to be 7.2 mm and the sagittal and transverse diameter to be 1.4 mm and 2.3 mm, respectively. Whereas in present study the mean width values found were 2.04, 2.05, 2.01 and 2.02 mm respectively. Sasaki et al. 2001 reported an elongated PH case of 13 mm. Also they found the mean length of PH to be 6.8 mm. In the present study, an elongated PH of 10.53 mm in a young female patient (Figure 4) and shortest PH found of 6.63 mm was reported. The inclination of PH in Putz and Kroyer’s (1999) study was found to be 75° in the sagittal plane and 58° in the coronal plane. Whereas, in the present study, it was found to be 47° and 53° in sagittal and coronal plane respectively. Also as per their findings of Putz and Kroyer’s study, all the hamulus found were inclined dorsolaterally. Similar to this study, the present study findings showed more number of scans with dorsolateral inclination but few scans with ventromedial inclination were also noted. The incidence of shape of PH of triangle shape in present study was found to be 30.43%, which was not in accordance with the percentage found to be 12% in NIOSang et al (2005). Incidence of 28.12% of slender shape PH was found in present study which was in accordance to Nio sang et al study, which found it to be 29.33%.

Orhan et al. in 2011 showed the mean length of PHs for left and right sides were 5.48 (SD 1.94) and 5.40 (SD 2.0) mm, respectively with no significant difference according to gender and location. They reported an elongated PH (10.9 mm) in a young female. Whereas in present study, comparing gender wise, males had greater degree of inclination in both the planes than females But with respect to location all the parameters were almost of same value for both the sides (left and right) except the coronal inclination, which was found to be more in left side as compared to right side. The strength of the present study is use of CBCT which provides high-resolution images of high diagnostic quality with significantly reduced acquisition time and radiation burden. Reformatted from CBCT imaging data have been shown to have measurement accuracy equivalent to MDCT imaging data (2014). However, limitation of this study is that this is a retrospective study which was conducted in limited geographic areas.

Conclusion

The length, width, inclination in coronal and sagittal plane of PH is greater in males as compared to females. The inclination in coronal plane is more of lateral than medial and that of sagittal plane is more of posterior than anterior. There was no difference in the metric measurements of left side when compared with right side, except the inclination in coronal plane. (Left side>Right side) The triangular shape of PH shows higher incidence than slender shape in both the genders. CBCT is an excellent imaging modality for the identification of PH. The morphometric evaluation of PH helps us to trace and manage obscure and conflicting symptoms related to its morphology. So henceforth; consideration of the PH as a pain inducing factor should be included in the diagnosis list.

REFERENCES


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