ORIGINAL RESEARCH

Assessment of Most Complex Anatomical Structure On Cone Beam Computed Tomography: A Guide For Surgical Intervention On Posterior Aspect Of Maxilla

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ABSTRACT
In this article, we recorded the length and width of pterygopalatine fossa and its morphological variations using CBCT images. Being familiar with its anatomy on advance radiolographic modality such as CBCT will overcome diagnostic and surgical difficulties. Type II pterygopalatine fossa was most commonly seen males and females (53% and 58 %). There was a significant difference found in type I and Type III between genders. The mean widths of pterygopalatine fossa at various heights (upper (A) middle (B) and lower third (C)) were calculated in both the gender and sides but the results were statistically insignificant. A detailed anatomy of pterygopalatine fossa on CBCT helps to make diagnostic as well as surgical procedures possible as these are complex anatomical structures.
Keywords: pterygopalatine fossa, the Piccadilly Circus of the face and cluster headache.

INTRODUCTION

Craniofacial structures such as mandible, maxilla, temporomandibular joint, cranial base, paranasal sinuses etc have complex anatomy and each of them offers valuables paradigms for studying morphology, development and functions. One of these complex structure is pterygopalatine fossa (PPF) which is also called ‘the Piccadilly Circus of the face’ (Wentges, 1975) because many important anatomical structures are crammed together inside it.[1]Itis abony space which is located in the skull base immediately posterior to the maxilla and orbit bounded by the junction of the maxilla, palatine, and sphenoid bones, giving as an “inverse pyramid “shaped bony cavity (FIG 1). Pterygopalatine fossa comprises of neurovascular structures such as:-

- The pterygopalatine ganglion.
- The maxillary division of the trigeminal nerve and its branches
- The Vidian (pterygoid) nerve.
- The distal branches of the maxillary artery
- Emissary veins.[2]

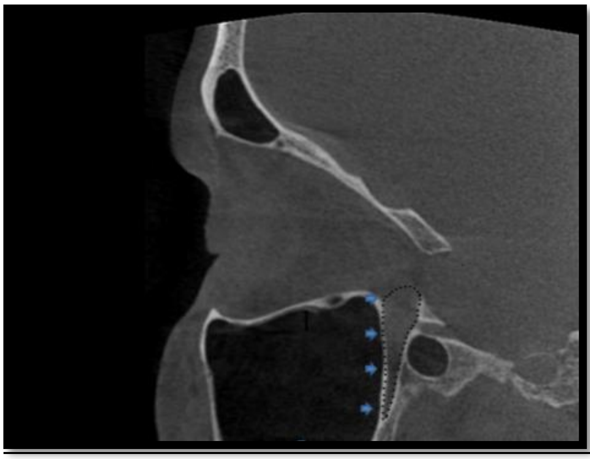

Figure 1: Pterygoplalatine Fossa

There are number of craniofacial structures which shows sexual dimorphism (males usually have larger bone size than females) which is helpful in forensic /medicolegal cases.Pathological conditions like infective, inflammatory, and neoplastic conditions that originate from the fossa can cause local regional spread of diseases to the deep neck area. Due to its deep seated position, it is difficult to examine clinically. Radiographic evaluation provides the valuable information for the diagnosis and treatment of such conditions.

The pterygopalatine ganglion (PPG) is associated with autonomic symptoms such as cluster headaches, which result from the activation of the trigeminal autonomic reflex (Lainez et al. 2014)[3]. Borsody & Sacristan (2016) suggested the possibility of neuromodulation to treat cluster headaches and facial nerve stimulation as treatment for cerebral stroke.[4]

Understanding this three-dimensional space is challenging because cadaveric dissection and two-dimensional (2D) textbook schematics do not allow full appreciation of its structure and communicating channels.[5]

Forensic maxillofacial radiology encompasses the performance, interpretation, and reporting of radiological examinations and procedures connected to the courts and the law.On High resolution CT and Cone Beam Computed Tomography (CBCT), the pterygopalatine fossa is best evaluated in sagittal section between the posterior wall of maxillary sinus and anterior cortex of pterygoid plates.

AIM

This radiographic study conducted in order to estimate the width and length of pterygopalatine fossa and morphological variations of the PPF using CBCT images.

MATERIALS AND METHODS

This retrospective study was conducted in the post graduate department of Oral Medicine and Radiology, Government Dental College and Hospital Srinagar(J&K)in the year of 2022. CBCT scans of patients who had been recommended for their respective dental and maxillofacial complaints were collected and analyzed properly. Only those patients scans were included in the study which fulfilled the inclusion criteria such as CBCT scans with complete visualization of pterygopalatine fossa area bilaterally in superioinferior, anterioposterior and mediolatral aspect patients without any pathological lesions (tumors, carcinomatous, metastatic lesions) involving pterygopalatine fossa region. The Care Stream 3D Imaging software were used to analyzed the study data with tube voltage- 74Kvp, tube Current (mA)- 10mA and field of view-8×8cm.

Total number of 56 patients (31 males and 25 females) were included in the study. Both right and left sided pterygopalatine fossa were thoroughly examined. Therefore a total 112 pterygopalatine fossa were examined (62 from males and 50 from females) with age ranges from 20-85 yrs. In the coronal scan, the axial and sagittal axes were crossed over at the foramen rotundum. Then, on the axial scan, the sagittal axis was displaced laterally (right and left) until the pterygopalatine fossa was visible on sagittal scan. PMF width was measured on the parasagittal plane at three different levels. The total PPF length was evaluated and then divided into three equal parts that is superior (A) , middle (B) and inferior (C) part. At the middle of every portion, we recorded the measurements from the anterior boundary of fossa to the posterior boundary in order to estimate the width at different levels of pterygopalatine fossa. This protocol of assessing the shape of pterygopalatine fossa was adopted by the method of tracing and classification given by M. Puche-Torres et al(2017) [1] (FIG 2,3,4,5).

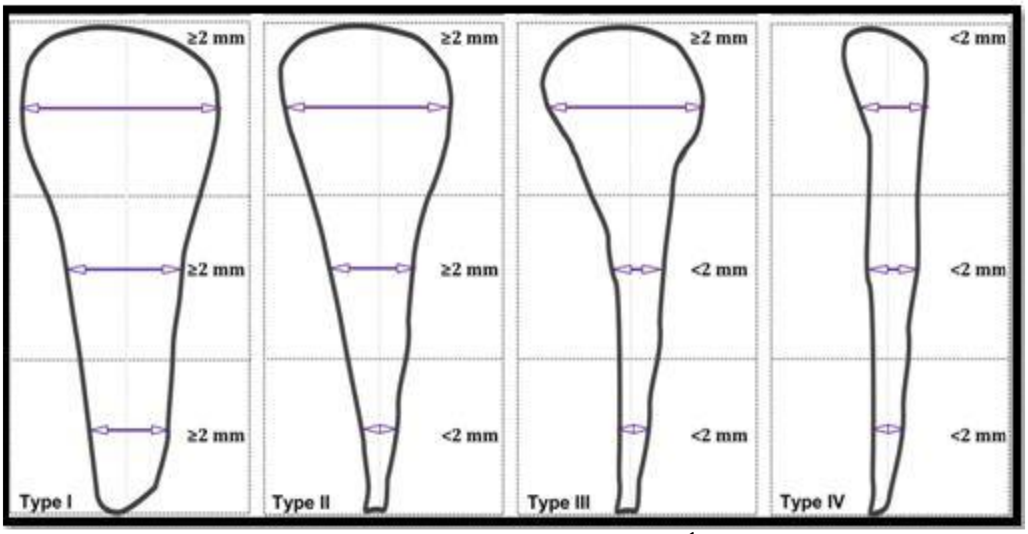

Figure 2: morphological variation in the size of pterygoplatine fossa.[1]

Figure 3: measurement of width of pterygoplalatine fossa at superior(A), middle(B) and inferoir (C)level

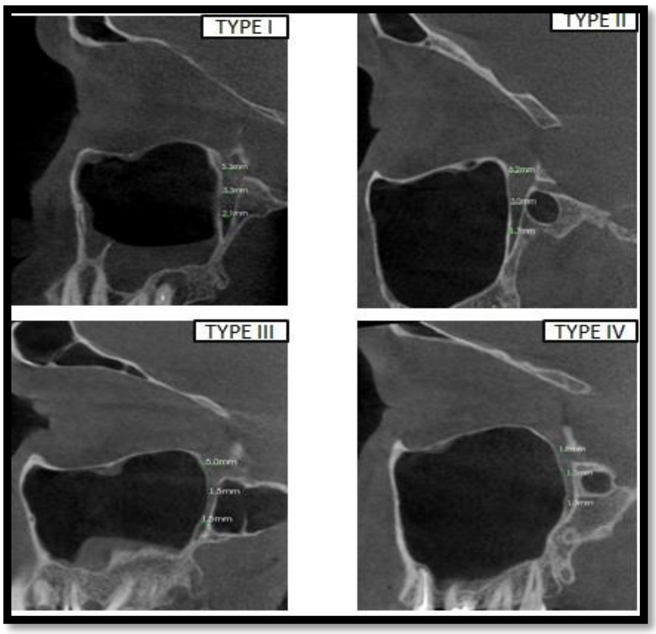

Figure 4: cone beam computed tomography images of all 4 tpyes of pterygopalatine fossa

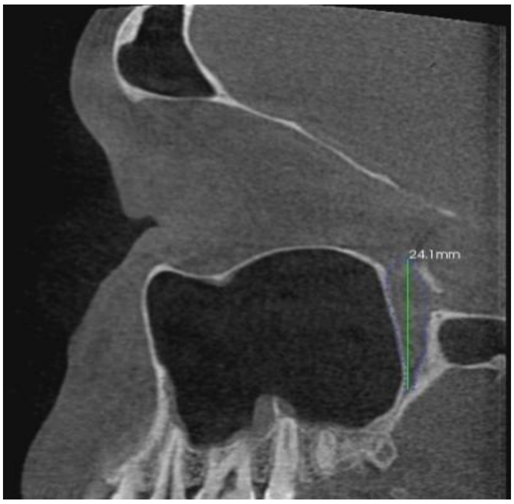

Figure 5: craniocaudal length of pterygopalatine fossa

Descriptive statistics of width and length of the PPF according to gender and side were calculated. Chi-square test of association was used to test the statistical difference. The SPSS statistics 22.0.0.2 was used to carry out all the statistical analyses. Statistical significance was set at 0.05.

RESULTS

Total study sample included 56 patients in which males and females were 31and 25 in numbers respectively as shown in table 1.

Table 1: Distribution of no. of patient and pterygopalatine Fossa

Gender	Males	Females	total
No. of patients	31	25	56
No. of pterygopalatine fossa(right+left)	62	50	112

Type II pterygopalatine fossa is most commonly seen followed by Type I. Type III and IV pterygopalatine fossa are seen in 16% and 1.7% respectively. There was significant difference found between gender in type I and Type III($p<0.05$) as shown in table2.

Table 2: Types of pterygopalatine fossa among males and females.

Classification	Males	Females	Total	χ^2 value	P value
Type I	24 (39%)	6 (12%)	30(27%)	10.8	**0.001***
TYPE II	33 (53%)	29 (58%)	62(55.3%)	0.38	>0.05
TYPE III	5 (8%)	13 (26%)	18(16%)	4.76	**0.025***
TYPE IV	0	2 (4%)	2(1.7%)	2.0	0.1

The mean width of pterygopalatine fossa at various heights (upper (A), middle (B) and lower third (C))were calculated in both the gender females as shown in table 3. There was no statistical significant difference found.

Table 3: Descriptive statistics of width of pterygopalatine fossa between genders.

<table>
<tr><th rowspan="2">Measurement (mm)</th><th colspan="3">Males</th><th colspan="3">Females</th></tr>
<tr><th>Mean(SD)</th><th>Minimum</th><th>Maximum</th><th>Mean(SD)</th><th>Minimum</th><th>Maximum</th></tr>
<tr><td>A</td><td>5.7±1.2</td><td>2.9</td><td>7.8</td><td>4.4±1.0</td><td>1.8</td><td>6.6</td></tr>
<tr><td>B</td><td>2.9±0.9</td><td>1.9</td><td>4.9</td><td>2.5±0.7</td><td>1.7</td><td>4.1</td></tr>
<tr><td>C</td><td>2.2±0.9</td><td>1.7</td><td>3.8</td><td>1.8±0.7</td><td>1.6</td><td>2.6</td></tr>
<tr><td colspan="4">χ² value-(between gender)
A=0.167
B=0.02
C=0.04</td><td colspan="3">P value >0.05
Non significant</td></tr>
</table>

Comparison of width between right and left side were also carried out at Point A,B and C as shown in table 4.

Table 4: Descriptive statistics of width of pterygopalatine fossa among sides.

Measurement (mm)	Right side Mean(SD)	Left side Mean(SD)
A	5.5±1.3	5.1±1.1
B	2.9±1.2	2.6±0.7
C	2.1±0.9	1.9±0.7
χ^2 value-(between sides) A=0.015 B=0.019 C=0.010		P value (>0.05) Non significant

The total mean length in males was 22.64mm and 21.29mm in females with right side length founded slightly larger than left side. The results were not statistically significant between gender and sides as given in table 5.

Table 5: craniocauidal length of pterygopalatine fossa.

Gender	No.	Right side (mean in mm)	Left side (mean in mm)	Total (mean in mm)	P value
Males	62	22.75	22.59	22.64	>0.5
Females	50	21.34	21.27	21.29	

DISCUSSION

In our study, 112 pterygopalatine fossa were evaluated, out of which 62 are from males and 50 from females. Type II pterygopalatine fossa is most commonly seen in both the males and females (53% and 58 % respectively) followed by type I in males (39%) and Type III in females (26%). Type IV seen in females only(4%). Statistical significant difference found in type I and Type III($p<0.05$) among the gender. M. Puche-Torres et al(2017)[1] also recorded that type II pterygopalatine fossa is most commonly seen in both gender (51.24% in males and 57.02% in females), Type III represented more in females(10.75%) than males (1.66%) and Type IV case were only seen in Females. Their results were consistent with our study but statistically significant differences between males and females were not present.

The mean width at upper, middle and lower third of PPF in males and females were 5.7mm and 4.4 mm, 2.9 mm and 2.5 mm and 2.2mm and 1.8 mm respectively. Similar results were founded in a study done by M. Puche-Torres et al(2017)[1] in which upper, middle and lower third of fossa in both gender (males and females) were (5.3mm and 4.7mm), (3.5mm and 2.9mm) and (2.0 and 1.8 mm) respectively. Stojcev Stajcic et al (2010)[6] found 8.18% of narrow pterygopalatine fossa out of 159 intact PPFs, the results were in contrast to our study in which narrow PPF (type III and type IV) seen in 17.8% of cases. Kim et al. 1996; Erdogan et al. 2003; Derinkuyu et al. 2017 Chen et al. 2010; Rusu et al. 2012 and Aoun et al. 2016 carried out radiological studies in order to estimate the anatomy of PPF and its communications.[(7-12)]. Assaf et al. 2016 elaorated and emphasized on the importance of width of PPF as a minimum width of ≥ 1.2 mm is necessary for surgical accessibility in cases of cluster headache. Moreover an implanted SPG stimulator (neurostimulator) has diameter of 1 mm.[13]

CONCLUSION

Our study is one of the initial studies performed on PPF on CBCT which provides an elaborative approach on type and width of pterygopalatine fossa among Indian population. The resultant data can be further used for the forensic purpose especially for gender determination (type I and type III showed significant difference) as well as presurgical assessment because any morphological variations of this structure will lead to altered surgical approach. The PPF is situated in the deep facial structures where various neurovascular communications exists.

There is possibility of spread of inflammation ,tumor and infection towards deep structures of neck and cranium.

However, high-resolution CT or CBCT provides third dimensional view of fossa that facilitates learning, teaching and endoscopic surgical procedures of these types of complex anatomical structures.

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