A Study Of Palatal Indices And Bony Prominences And Grooves In The Hard Palate Of Adult Human Skulls

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Abstracts Objectives: The present study was aimed to provide data on palatal indices, and to describe the osteological and morphological variations in the grooves and bony prominences of the hard palate, and thus to compare the same with the work of other authors. Methods: 100 dry, sexed, adult human skulls were studied from sources in various Medical Colleges of Gujarat, and palatal indices were measured with Vernier callipers to the nearest 0.1 mm. The percentage frequencies of spines, crests, variant sutures, and longitudinal grooves were determined. Results: The values for Palatine index showed that 63% of the total sample of skulls had narrow (leptostaphyline), 24% had intermediate (mesostaphyline), and 13% had wide (brachystaphyline) palates; while the Palatine height index showed that 42% of the total sample had low (chamestaphyline), 54% had intermediate (orthostaphyline), and 4% had deep (hypsistaphyline) palates. Longitudinal palatal grooves were found bilaterally in all the palates, with 86.5% having crests along their length. Incisive suture was seen in 8% of the adult skulls studied. Conclusion: A knowledge of Palatal indices would be helpful to the surgeons during repair of the cleft palate and/or lip, and to anthropologists. Further, the anatomical variations in the grooves, crests and spines on the hard palate may be of clinical significance in the administration of local anaesthesia, and in palatal surgery and prosthetic dentistry. [Dave M et al NJIRM 2013; 4(1) : 7-11]

Key Words: Palatal indices, Hard palate, Crests, Grooves, Cleft palate.

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Introduction: The bony palate on the base of the skull is formed by alveolar arch and hard palate. Alveolar arch bears the sockets for the roots of the upper tooth. Hard palate is formed by the palatine process of maxilla in its anterior two-third, and the horizontal plates of palatine bone in its posterior one-third. These four processes meet at the cruciform suture, which is made up of intermaxillary, interpalatine and palatomaxillary sutures[1].

It is arched in all directions and shows pits for the palatine glands. The greater palatine foramen, one on each side, is situated near the lateral palatal border behind the palatomaxillary suture. A vascular longitudinal groove leads from the foramen forwards to the incisive fossa.

The posterior border of hard palate is free and presents the posterior nasal spine in the median plane. The palatine crest is a curved ridge near the posterior border, begins behind the greater palatine foramen and runs medially. There is presence of occasional incisive suture which separates the premaxilla from the palatine process of maxilla[2].

The osteological and some morphological variations in the hard palate, and the frequency of grooves and bony prominences may be of clinical importance in the administration of local anesthesia and in palatal surgery. A knowledge of the development of hard palate is of importance in surgical repair of cleft palate.

The embryological basis of cleft palate is the failure of the mesenchymal masses in the lateral palatine processes to meet and fuse with each other, with the nasal septum, and/or with the posterior margin of the median palatine process[2].

Material and Methods: The present study materials comprised of 100 dry sexed, adult human skulls from sources in Medical Colleges of Gujarat. Out of 100 skulls, 60 were males, 39 were females, and 1 was of unknown sex.

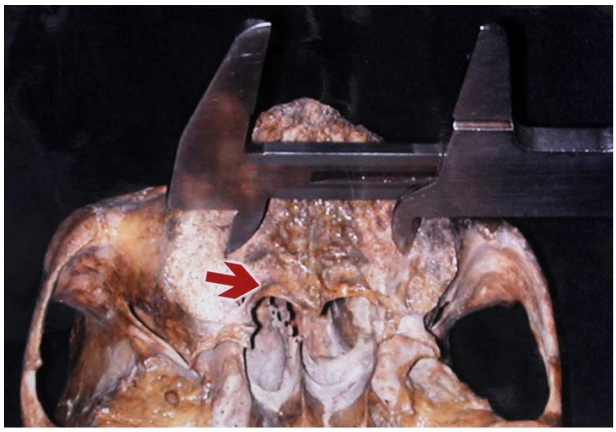
Male skulls were larger, heavier, with more prominent muscular markings especially superciliary arches, external occipital protuberance, nuchal lines, and muscular ridges on mastoid process. Female skulls were relatively smaller, lighter, with less prominent muscular

markings especially rounded superciliary arches, blunted and rounded external occipital protuberance, less marked nuchal lines, and smoother mastoid process.

Keeping in view the aim of the study, following parameters were measured in mm, using a pair of Vernier callipers:

(1) Palatine Breadth (PB): the fixed end of calliper compass was placed at the inner border of the socket of one side maxillary second molar, and the movable point at the opposite inner border of the socket of the maxillary second molar (Fig 1). The distance between compass arm points was then measured in mm to the nearest 0.1 mm.

Fig 1 – Illustrates measurement of Palatine breadth (PB) with Vernier Caliper; arrow shows Palatine crest.



(2) Palatine Height (PH): the distance of the maximum arching of the palate from the line connecting the two sides' inner border of the socket of maxillary second molar, was measured to the nearest 0.1 mm.

(3) Palatine Length (PL): the fixed end of the calliper compass was placed in the anterior border of incisive fossa, and the movable point was placed at the posterior nasal spine, and the distance measured to the nearest 0.1 mm (Fig 2).

(4) Longitudinal palatal grooves: the fixed end of the calliper compass was placed in the anterior margin of the greater palatine foramen, and the movable point was placed at the anterior distinct end of the groove, and distance measured to the nearest 0.1 mm (Fig 3).

Fig 2 – Illustrates measurement of Palatine length (PL) with Vernier Caliper; arrows on each side show palatine crest along Longitudinal palatal groove.

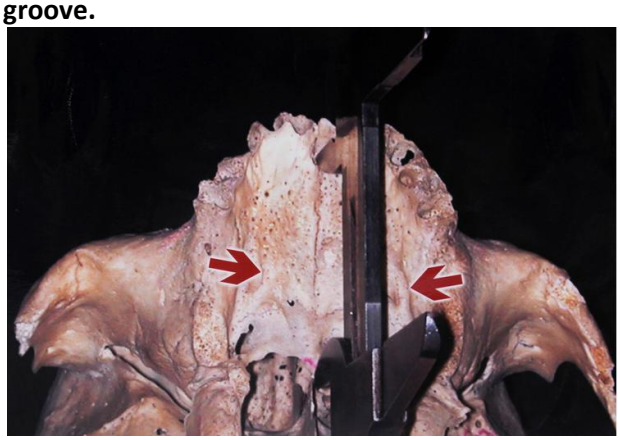
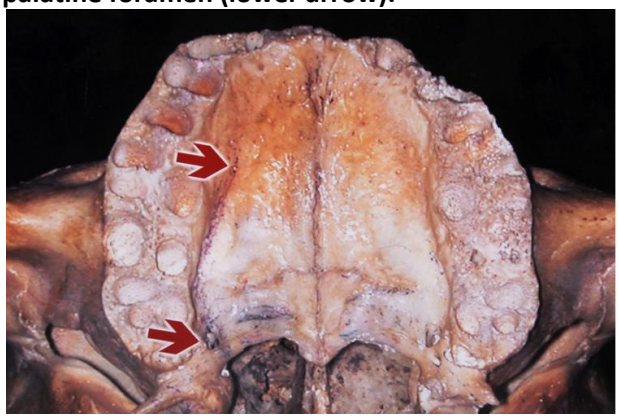


Fig 3 – Illustrates the extent of Longitudinal palatal groove (upper arrow) from the greater palatine foramen (lower arrow).



The observations thus made were compiled and tabulated, and the following indices were calculated:

1. Palatine Index (PI): {Palatine Breadth (PB)/Palatine Length (PL)} * 100
2. Palatine Height Index (PHI): {Palatine Height (PH)/Palatine Breadth (PB)} * 100
3. Frequency of PI and PHI within the various range of palatal types were calculated for the total sample, for males and females.
4. Mean values and Standard deviation for the PL, PB, PH, PI and PHI were calculated for the total sample.

5. Percentage frequencies for the data on longitudinal palatal grooves, spines, crests, and bridges were determined for the total sample and tabulated.

Results: The following observations were tabulated:

Table 1: Palatine Index frequency in different types of palate for the total sample, and for the males and females

Type	Range	Total sample (100)		Male skulls (60)		Female skulls (39)		U
		N	%	N	%	N	%	N
Leptostaphyline	<79.9	63	63	38	63.3	24	61.5	1
Mesostaphyline	80-84.9	24	24	12	20.0	12	30.8	-
Brachystaphyline	>85	13	13	10	16.7	3	7.7	-

U=Skull of unknown sex (1); N=Number of skulls

Table 2: Palatine Height Index frequency in different types of palate for the total sample, males and females

Type	Range	Total sample (100)		Male skulls (60)		Female skulls (39)		U
		N	%	N	%	N	%	N
Chamestaphyline	<27.9	42	42	26	43.3	15	38.5	1
Orthostaphyline	28-39.9	54	54	30	50	24	61.5	-
Hypsistaphyline	>40	4	4	4	6.7	0	0	-

U=Skull of unknown sex (1); N=Number of skulls

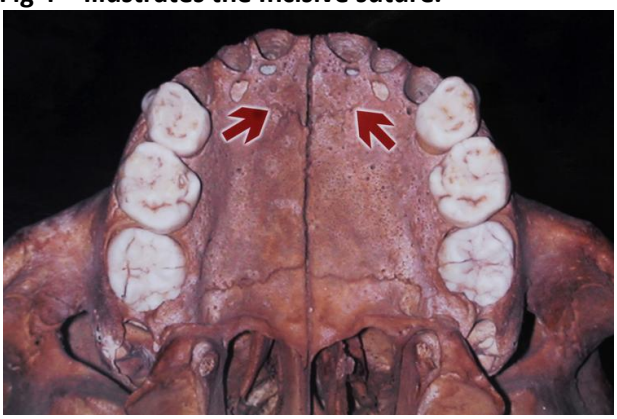
Table 3: Mean values(M) in mm and Standard deviation(SD) of various parameters

	M	SD
PL	43.54	0.28
PB	33.83	0.20
PH	9.87	0.23
PI	77.97	7.02
PHI	29.23	2.54

Longitudinal grooves: Mean length of the groove from the anterior margin of greater palatine foramen to its distinct end was 45.08 mm (Fig 3). Also, 5.5% of the grooves were divided.

Incisive suture: This suture was observed in 8% of the skulls studied (Fig 4).

Fig 4 – Illustrates the Incisive suture.



Incidence of Spines and Crest: Palatine crest was seen in 6.5%, whereas crests & spine associated with longitudinal groove & foramina were observed in 59% of the skulls studied (Figs 1 & 2).

Presence of a bony projection along the posterior border of greater palatine foramen was observed in 62% on right side, and 55% on left side.

Discussion: Cleft palate, with or without cleft lip, occurs about once in 2500 births, and is more common in females than in males[3]. While most clefts result from multiple factors (multifactorial inheritance), some clefts of the palate and/or lip appear as part of syndromes determined by single mutant genes. Surgical repair of cleft palate demands mobilization of the periosteum and mucosa on the palate, so that this can be moved to the midline and sutured to its fellow from the opposite side.

In modern day practice, Veau-Wardill-Kilner Palatoplasty (V.W.K. repair) is performed. In this, the mucoperiosteum of either the nasal or buccal surface of the palate is sutured to that of the nasal septum[4].

Hassanali J. et al had studied 125 hard palates of Kenyan African dry skulls. According to their study, the palatine index showed that 43.2% of the total sample of skulls had narrow (leptostaphyline), 23.7% intermediate (mesostaphyline), and 33.1% wide (brachystaphyline) palates. The palatine height index showed that 40% skulls had low (chamestaphyline), 57% intermediate (orthostaphyline), and 3.0% deep (hypsistaphyline) palates. Mean palatal length, breadth, and height for the total sample was 4.92 cm, 4.02 cm, and 1.22 cm, respectively. Extensive longitudinal palatal grooves were found bilaterally in all the palates, 70% showed divisions of the grooves, 63.2% had crests along the border of the grooves, and 19.2% had bridges in the posterior part of the groove near the opening of the greater palatine foramen. The incisive suture was present in 6.4% of the adult palates[5].

Khatri K. et al reported palatal spine in relation to the groove for the greater palatine nerves and vessels in 90% of skulls, just anterior to the foramen[6], while a bony bridge connecting the palatal spines in front of the greater palatine foramen in 17.1% of edenticulus human skulls[7].

Westmoreland EE. et al studied three hundred dry, adult human skulls, of East Indian ethnic background, and homogenous in arch form and full eruption of third molars, wherein they reported a bony projection, similar to the mandibular lingula, extending from the posterior margin of the greater palatine foramen in 16% of the skulls studied[8].

Ajmani ML. observed a bilaterally symmetric bony projection extending from the posterior margin of the greater palatine foramen in 24.6% of the Nigerian and 35.3% of Indian skulls. The palatal vault was of U-shaped in all instances, its height varying from flat to 0.3-0.8 cm[9].

The osteological and morphological variations of the prominences in the bony palate of 160 Korean skulls studied by Lee SP. et al showed that the frequency of the occurrence of the posterior palatine crest, located on the posterior border of the greater palatine foramen, was 13.8%. Palatal ridges were observed commonly in the skulls; however, the smooth type, which has no palatal ridges in the palate, was shown in 14.7% of cases, and palatal spines were observed in 33.8%[10].

In the present study, the values for Palatine index, which indicate the width of the palate, showed that 61.5% female and 63.3% male skulls had narrow (leptostaphyline) palates; 30.8% female and 20% male skulls had intermediate (mesostaphyline) palates; 7.7% female and 16.7% male skulls had wide (brachystaphyline) palates.

The Palatine height index, which indicates the characteristic arching of the palate, showed that 38.5% female and 43.3% male skulls had low (chamestaphyline) palates; 61.5% female and 50% male skulls had intermediate (orthostaphyline) palates; while 6.7% males had deep (hypsistaphyline) palates.

Further, a bony projection was found along the posterior border of greater palatine foramen in 62% on right, and 55% on left side of the skulls.
Longitudinal palatal grooves were common feature found bilaterally in all the palates. The grooves were extensive, 5.5% showing divisions; 86.5% had crests along its length. Bennett RC (1978) states that it will be advantageous to insert the needle and deposit the solution so that the anterior palatine nerve will be anaesthetised anterior to the foramen. Clinically, the presence of crests and bridges along the grooves and particularly at the opening of the greater palatine foramen may present problems in administration of local anaesthesia[11]. The high prevalence of the spines and crests may also present a problem in prosthetic dentistry, although the bony prominences are not generally palpable due to the thickened loosely attached mucosa in the posterior part of the hard palate.

Persistence of the incisive suture in 8% of the adult skulls is rather unusual as the suture is said to be ossified at a young age[12].

All these observations may be of help to the dental surgeon during the peripheral block of maxillary nerve for the maxillo-facial surgery[13].

Conclusion: A knowledge of the morphological variations in the hard palate may be helpful in the surgical repair of cleft palates, and the data on palatine index and palatine height index will also be helpful in comparing the Indian skulls with those from various other regions as well as skulls of different races.

Clinically, the presence of crests and spines along the grooves and foramina may present problems in the administration of local anaesthesia, and during prosthetic dentistry.

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