CHAPTER- IV
MATERIALS & METHODS

Any research takes place in context of the major aims and objectives. Following a methodology commencing from selection of universe of study, unit of study, sampling, parameters of data collection, techniques of the same are all methods involving depth of deliberations and requirements. This chapter discusses in detail the methodology followed for collection of relevant data for the study. The present study was conducted on Ad-Dharmi population of Doaba region of Punjab for studying morphological characters of teeth and palatal rugae. The sample for the present study consists of 300 subjects (150 males and 150 females) aged between 18 and 40 years.

The data were collected from among the Ad-Dharmi population of Doaba region of Punjab. Ad-Dharmi population was 11% of the total population of Doaba region. Four districts of Doaba region of Punjab namely Jalandhar, Hoshiarpur, Kapurthala and Nawashehar (SBS Nagar) (Figure 3.1) which were included in the study.

The subjects with abnormalities of palate and lips such as the cleft palate and cleft lip, and the subjects who were wearing partial dentures and braces were excluded from sample selection.

4.1 Anthropometric measurements on the subjects

A total of 9 anthropometric measurements were taken on face and head of each subject. Along with these, stature and body weight of each subject were also recorded. While taking the measurements, the anatomical
landmarks were located with the help of skin marking pencil and were identified keeping the head in Frankfurt Horizontal (FH) plane. All the measurements were taken in a properly well lit room. The measurements were taken using standard anthropometric instruments in centimetres to the nearest millimetres according to the techniques described by Vallois (1965). All the instruments were regularly checked for their accuracy. Some general information of the subjects such as age, sex, caste, was also recorded.

**Anthropometric measurements:**

1. Morphological facial length (n-gn)
2. Mouth breadth (ch-ch)
3. Nasal depth (prn-sn)
4. Nasal breadth (al-al)
5. Nasal height (n-sn)
6. Bigonial breadth (go-go)
7. Bizygomatic diameter (zy-zy)
8. Head breadth (eu-eu)
9. Head length (g-op)
10. Height vertex
11. Body weight
Techniques and Landmarks

1. **Morphological facial length (n-gn)** – It measures the straight distance between nasion (n) and gnathion (gn).

**Landmarks**

**Nasion (n)** – It is the point on the nasal root intersected by mid-sagittal plane.
Nasal root is not the depression on the nose but at the naso-frontal suture which can be felt by slightly probing the root of the nose.

**Gnathion (gn)** – It is the lowest point on the lower margin of the lower jaw intersected by the mid-sagittal plane. This point can be palpated on the lower jaw from behind and slightly anterior to chin.

**Instrument used** - Sliding calliper.

**Technique**: The instrument was held in right hand and the nasion point was found out by palpation with the fingers. It appeared as transverse groove above the fronto-nasal suture. After determination of nasion point, the moveable cross-bar was placed on the gnathion point for taking the measurement.

2. **Mouth breadth (ch-ch)** – It measures the straight distance between two chelion (ch) i.e., corners of the mouth.

**Landmark**

**Chelion (ch)** – It is the point on the mouth opening where the lateral margins of the upper and lower lips meet i.e., corner of the mouth.

**Instrument used** - Spreading calliper.
**Technique:** The calliper was placed firmly on the jaws of the subject which was closed and the facial muscles were relaxed at the time of taking the measurement.

3. **Nasal depth (prn-sn)** – It measures the projective distance between tip of the nose and hind most point of the nasal septum.

**Landmarks**

**Pronasale (prn)** – It is the most anteriorly placed point on the tip of the nose when the head is held in mid-sagittal plane.

**Subnasal (sn)** – It is a point between the lower surface of nasal septum and the upper lip.

**Instrument used**- Sliding calliper.

**Technique:** The instrument was held in the right hand. Upper cross-bar of the calliper was placed at the root of the nasal septum and lower moveable cross-bar was kept on the other side to bring it in-touch of the tip of the nose. The main bar of the calliper remained parallel to the median line at the time of taking measurement.

4. **Nasal breadth (al-al)** – It measures the straight distance between the two alaria (al) i.e., the most laterally placed points on the nasal wings.

**Landmark**

**Alare (al)** – It is the most laterally placed points on the nasal wing. This point is determined by measuring nasal breadth.

**Instrument used**- Sliding calliper.
**Technique**: The upper cross-bar was placed against the right alare of the nose and moveable cross-bar was adjusted on the other alare to take the measurement. Even a slight pressure on the nasal wings was avoided for getting accurate measurement.

5. **Nasal length (n-sn)** – It measure the straight distance between nasion (n) and subnasale (sn).

**Landmarks**

**Subnasale (sn)** – It is a point between the lower surface of nasal septum and the upper lip.

**Nasion (n)** – It is the point on the nasal root intersected by mid-sagittal plane. Nasal root is not the depression on the nose but at the naso-frontal suture which can be felt by slightly probing the root of the nose.

**Instrument used** - Sliding calliper.

**Technique**: The instrument was held by right hand and upper cross-bar was made fixed against the nasion point whereas the lower cross-bar touched the sub nasale point, at the lower border of the nasal septum. For accurate measurement, the calliper has to be kept sideways, leaving the middle line of the nasal bridge.

6. **Bigonial breadth (go-go)** – It measures the straight distance between two gonia (go).

**Landmark**

**Gonion (go)** – It is the lowest posterior and most lateral point on the angle of the lower jaw. The point lies on the lateral side of the angle.
**Instrument used**: Spreading calliper.

**Technique**: The tip of the spreading calliper was held with the thumb and forefinger and 2 gonion points were searched by index fingers, the measurement was taken properly and it is never taken on the lower side of gonion.

7. **Bizygomatic diameter (zy-zy)** – It measures the straight distance between the two zygia (zy) i.e., the most lateral points on the zygomatic arch.

**Landmark**

**Zygion (zy)** – It is the most laterally placed point on the zygomatic arch. These points are determined by taking bizygomatic breadth.

**Instrument used**: Spreading calliper.

**Technique**: The tips of the calliper were held between the thumb and the first finger, and applied on the zygomatic arches. Maximum breadth was noted by trial, sliding the hands of the calliper, backward and forward. This maximum breadth is usually obtained from a place near the ear, not on the cheek. Special attention is kept in the process of operation, because skin may displace at the time of recording the measurement. The joint of the spreading must lie on the mid-sagittal plane of the head for a correct reading.

8. **Head breadth (eu-eu)** – It measure the straight distance between the two eurya (eu) i.e., maximum breadth taken at right angle to mid-sagittal plane wherever found.
Landmark

**Euryon (eu)** – It is the most laterally placed point on the side of the head. This point can only be determined by measuring the maximum head breadth.

**Instrument used** - Spreading calliper.

**Technique**: Hold the spreading calliper in such a manner either behind or in front of the subject that the joint of the calliper is in the mid-sagittal plane of the head. Now slide the tips of the calliper from forward to backward and vice versa in zig-zag manner. Take the maximum reading. Note that the line joining the two tips of the calliper must be at right angles to the mid-sagittal plane.

9. **Head length (g-op)** – It measures the straight distance between glabella (g) and opisthocranion (op) i.e., the most projecting point on the dorsal surface of the head in the mid-sagittal plane.

Landmarks

**Glabella (g)** – It is the point on the protuberance of the lower forehead above the nasal root and between the eyebrow ridges intersected by mid-sagittal plane.

**Opisthocranion (op)** – It is the most posterior point on the posterior protuberance of the head in the mid-sagittal plane. This point is determined by measuring maximum head breadth.

**Instrument used** - Spreading calliper.
**Technique:** The instrument should be held in such a manner that the tips of the calliper are free to touch the head. Undue pressure should not be applied while taking the measurement.

10. **Height vertex** – It measures the vertical distance from vertex to floor.

**Landmark**

**Vertex** – It is the highest point on the head when head is held in F.H. plane. This is not an anatomically determined point and is dependent on the orientation of the head.

**Instrument used**- Anthropometric rod.

**Technique:** The subject stands erect on a horizontal and resistant plane surface; the upper limbs are pendent, the palms of the hands turned inwards and finger pointing downwards, heels touching – military position of attention. It seems preferable that the subject should be placed against the vertical plane, heels, buttocks, and shoulders touching it slightly, but not the occipital. The head is balanced on the spine, a position more easily attained when the demo graph draw on the left cheek a line from the tragion to the lower point of the orbital border. This line, which closely corresponds to the auriculo-orbital plane of the skeleton, must be horizontal. The height of the vertex above the ground is to be measured in this position.

11. **Body weight** – Body weight is to be taken with the subject unclothed or wearing minimum clothing.

**Instrument used**- Weighing machine.
Technique: It should be taken by means of standard weighing machine with fine accuracy. The reading of the pointer of machine was zero before taking measurement. The figures obtained will be recorded in kilograms to 1 decimal place (hectograms). The method consisting of guessing the weight of the clothes worn by a subject has no scientific value. Owing to the large daily variations in weight, the weight should be checked at approximately the same time for all the subjects in one group.

4.2 Measurements on the Dental Cast

1. Arch height of dental cast- Dental arch height was determined by measuring the perpendicular distance from the occlusal plane constructed from the second primary premolars/permanent first molars. Through a space in a plastic square set, the end of the digital calliper was pressed to the palatal contour, this distance minus the thickness of the square set (2 mm) represented dental arch height.

Figure 4.1: ‘Arch height’ on a dental cast
2. **Inter-canine distance**- Distance between the cusp tips of the maxillary right and left permanent canines with the help of digital calliper.

![Image of dental cast measurement](image1)

**Figure 4.2: Measurement of ‘inter-canine distance’ on a dental cast**

3. **Incisor-incisor distance**- It is the distance between the centre points of maxillary left and right lateral incisors with the help of digital calliper.

![Image of dental cast measurement with calliper](image2)

**Figure 4.3: Measurement of ‘incisor-incisor distance’ on a dental cast**
4.3 Morphological Characteristics of the Teeth

Dental cast

Impression of the teeth of the subjects was made with the help of alginate material dust free class A type II of Marieflex make –normal setting in the ratio 7.5g of powder to a half-measure of water 20.5ml. The powder and water were mixed for 45 seconds. Cast was prepared with the help of dental stone of Gypstone make green in colour of compressive strength 600Kg/cm² and linear expansion 0.25% (Maximum) in the ratio of water 30CC and plaster 100gms. Its mixing time was 30 to 60 seconds and setting time was 8 minutes, hard setting time 30 minutes and full setting time 2 hours. It was mixed mechanically with the help of spatula to obtain uniform mixture and it was vibrated into the impression to exclude air bubbles. Perforated metal maxillary and mandibular impression tray, mixing bowl and spatula were used to made dental casts.

The dental casts were studied for morphological characters of teeth and classification of palatal rugae according to Thomas and Kotze (1983).

Morphological characters were studied by assigning number system i.e. 1 if morphological feature found to be present and 0 if absent. Following morphological characteristics of teeth were studied (Kapali et al.1997):

1. **Shovel shaped tooth** - The presence of lingual marginal ridges on the upper incisors and canines.
2. **Carabelli’s cusp**—A groove, pit, depression, or cusp can appear on the lingual surface of the mesiolingual cusp of the upper molars.
   
a. Single-cusped
   
b. Bicuspids
   
c. Multi-cuspid
3. **Occlusion**-Occlusion can be defined very simply: it means the contacts between teeth.

   a. Normal bite

   b. Open bite

![Figure 4.6: Open bite on a dental cast.](image1)

![Figure 4.7: ‘Class I occlusion’ on a dental cast.](image2)
Figure 4.8: ‘Class II occlusion’ on a dental cast.

4. **Anterior cross bite**- An abnormal relation of one or more teeth of one arch to the opposing tooth or teeth of the other arch, caused by deviation of tooth position or abnormal jaw position.

Figure 4.9: ‘Anterior cross bite’ on a dental cast.

5. **Posterior cross bite**- Mandibular premolars or molars are buccal to their opposing teeth.
6. **Crowding**- Dental crowding is asymmetry between tooth size and jaw size.

7. **Supernumerary teeth** - A supernumerary tooth is one that is additional to the normal series and can be found in almost any region of the dental arch.
8. **Diastema**- A diastema is defined as a space greater than 0.5 millimeter between the proximal surfaces of adjacent teeth.

9. **Caries**- Dental caries (caries is Latin for "rottenness"), also known as tooth decay, cavities, or caries, is breakdown of teeth due to the activities of bacteria.
10. **Fracture**-A tooth fracture is a break or crack in the hard shell of the tooth.

**Figure 4.14**: ‘Caries’ on a dental cast.

**Figure 4.15**: ‘Fractured tooth’ on a dental cast.
11. **Peg shaped lateral incisors**- The lateral incisors can be reduced in size or take on a peg shape.

![Figure 4.16: ‘Peg shaped lateral incisors’ on a dental cast.](image)

12. **Grooves pattern**- it is the shallow linear depression on the surface of tooth.

![Figure 4.17: ‘Groove pattern’ on a dental cast.](image)
13. **Hypocone**- The size of the distolinguinal cusp. Cusp 5: A fifth cusp can appear in the distal fovea of the upper molars between the metacone and the hypocone.

![Hypocone](image)

**Figure 4.18: ‘Hypocone’ on a dental cast**

14. **Central ridge**- Ridge of Enamel Bridge that connects the buccal cusp with meso-lingual cusp.

![Central ridge](image)

**Figure 4.19: Central ridge on a dental cast**
15. **Hypoconulid**- Cusp 5 or the hypoconulid occurs on the distal occlusal aspect of the lower molars.

![Hypoconulid on a dental cast](image)

**Figure 4.20: Hypoconulid on a dental cast**

### 4.4 Palatal Rugae

According to Thomas and Kotze, (1983), palatal rugae classification is based on their length, shape, direction and unification. The rugae impressions were marked with the help of lead pencil on the casts.

The parameters are as follows:

1. Total number of rugae
2. Numbering of primary rugae
3. Predominant shape
4. Predominant direction
5. Unification of rugae
Figure 4.21: A diagram representing Classification of palatal rugae (based on Unification. a-Converging, b-Diverging, Classified on the basis of Direction. c-Forward, d-Backward, Rugae classified on the basis of shape. e-Circular, f-Straight, g-Curved, h-Wavy).

On the basis of length, rugae were classified as:

1. Primary - > 5mm

2. Secondary - 3 to 5 mm

3. Fragmentary - <3 mm

According to Thomas and Kotze (1983), less than 2 mm rugae were disregarded. Measurements were taken using a plastic ruler in millimeters.
The rugae were divided into four types based on their shapes as:

1. **Curved**: They had a crescent shape and curved gently.

2. **Wavy**: If there was a slight curve at the origin or termination of curved rugae.

3. **Straight**: They run directly from their origin to termination.

4. **Circular**: Rugae that form a definite continuous ring were classified as circular.

On the basis of direction, the rugae were determined by measuring the angle formed by the line joining its origin and termination and the line perpendicular to the median line:

1. **Forwardly directed rugae**: associated with positive angles.

2. **Backwardly directed rugae**: associated with negative angles.

3. **Perpendicular rugae**: associated with zero angles.

On the basis of unification, rugae were as follow: Unification was said to have occurred when two rugae joined at their origin or termination.

1. **Diverging**: If two rugae had the same origin from the midline but immediately branched.

2. **Converging**: Rugae with different origins from midline, but which joined on their lateral portions.
Figure 4.22: Rugae pattern on a dental cast.

All the morphological features of teeth were noted, anthropometric measurements were taken and palatal rugae classification was done by the researcher herself to avoid any inter-personal error on a specifically designed proforma for the research purpose. A format of proforma is given as Appendix-I.

While conducting the present study, a new type of ruga was observed in Ad-Dharmi population of Doaba region of Punjab, which has been named as H-Shaped (the name after its shape) (Figure 4.23).

Figure 4.23: H-shaped palatal rugae pattern on a dental cast
4.5 Analysis of the Data

1. STATISTICAL ANALYSIS

Data collected was entered into the MS-Excel program of the computer and appropriate statistical tools were applied to the data pertaining to the morphological variations of the teeth, anthropometry of the face and palatal rugae using SPSS (Statistical Package for Social Sciences, version 11.0) computer software (Chicago; IL, USA).

Microsoft word and Microsoft excel programmes have been used to make graphs and tables. Statistical analysis of the data of the present study was based on the following two parts.

1. Analysis of data based on anthropometric measurements and palatal rugae study used are as follow:

   a) Arithmetic mean: Arithmetic mean of a group is the sum of all the values divided by the number items /observations in the group. It is a single value within the range of given data which is used to represent all the values in series.

      It can be mathematically expressed as under: -

      \[ \bar{X} = \frac{\sum X}{N} \]

      Where,

      \( \bar{X} \) = Arithmetic mean

      \( \sum X \) = sum of all the values in the group

      \( N \) = Total number of observations
b) **Standard Deviation (S.D):** it is the square root of the mean of the squares of the deviations of individual items from their arithmetic mean.

Formula for calculating standard deviation is as follows:

\[
\sigma = \sqrt{\frac{(x-x)^2}{N-1}}
\]

Where,

\(\sigma = \) Standard deviation

\(x = \) Mean value

\(x = \) Individual value

\(N = \) Total number of individuals

c) **Paired t-test:** The paired t-test is used when there is one measurement variable and two nominal variables.

d) **ROC curve:** The ROC curve is a fundamental tool for diagnostic test evaluation. In a ROC curve the true positive rate (Sensitivity) is plotted in function of the false positive rate (100-Specificity) for different cut-off points of a parameter.

e) **Correlation:** It is a statistical technique that can show whether and how strongly pairs of variables are related.

2. **Analysis of data based on morphological features of teeth:**

**Frequency:** The rate at which something occurs or is repeated after a particular period of time in a given sample.
Morphological features of teeth and palatal rugae classification were done by calculating the frequencies of occurrence in males and females of Ad-Dharmi population of Doaba region of Punjab. This chapter provided a detailed account of the methods and techniques through which raw data were collected from the sample of 300 hundred subjects and subsequent measurements that were made directly on the people and on the dental casts. Detailed analysis of the data were made according to the variables and measurements described here.