COMPARING THE RELIABILITY OF BARR BODIES, PALATAL RUGAE & MESIO- DISTAL DIMENSION OF MAXILLARY CANINE & CENTRAL INCISORS IN DETERMINATION OF SEX.

DISSERTATION

Submitted to The Tamil Nadu Dr. M.G.R Medical University in partial fulfillment of the requirement for the degree of

MASTER OF DENTAL SURGERY

BRANCH VI

ORAL PATHOLOGY AND MICROBIOLOGY

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CERTIFICATE

This is to certify that this dissertation titled **"Comparing the reliability of barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors in determination of sex.**" is a bonafide research work done by **Dr. K.U Goma Kumar** under our guidance during his post graduate study during the period of 2012-2015 under THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI, in partial fulfillment for the degree of MASTER OF DENTAL SURGERY IN ORAL PATHOLOGY AND MICROBIOLOGY , BRANCH VI . It has not been submitted (partial or full) for the award of any other degree or diploma.

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LIST OF ABBREVIATIONS USED

11/T 11	Maxillary Right Central Incisors
21/ T 21	Maxillary Left Central Incisors
13/T 13	Maxillary Right Canine
23/T 23	Maxillary Left Canine
AO	Aceto Orcerin
BB	Barr Bodies
BL	Bucco Lingual
CRL	Crown-rump length
CV	Coefficient of Variation
CI	Canine Index
DB	Disto Buccal
DPX	Di-Butyl Phthalate Xylene
H&E	Haematoxylin and Eosin
MD	Mesio-Distal
ML	Mesio-lingual
MM	Millimetres
MSP	Methylation Specific protein

PAP	Papanicalou Stain
PMN	Poly Morphonuclear Neutrophils
OG -6	Orange G - 6
ROC	Regenerative Characteristic Observational Curve
RME	Rapid Maxillary Expansion
SSE	Stratified Squamous Epithelium
X	Haploid Chromosome
XX	Chromosomal Representation of Female
Xic	X Chromosome inactivation Centre
XY	Chromosomal Representation of Male

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ABSTRACT

COMPARING THE RELIABILITY OF BARR BODIES, PALATAL RUGAE AND MESIO- DISTAL DIMENSION OF MAXILLARY CANINE & CENTRAL INCISORS IN DETERMINATION OF SEX

ABSTRACT

BACKGROUND:

One of the main used of forensic odontology is sex determination in cases where traditional methods are not feasible. Although newer advances including genetic studies form a fool proof methodology. Some times odontometric methods are preferred. Amongst these the mesio-distal dimension of certain teeth and rugae characteristics were widely used .Barr body estimation is yet another method commonly used, most effective method of sex determination .

AIM OF THE STUDY:

To compare the reliability of sex determination methodologies using Barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors

OBJECTIVES OF THE STUDY:

1. To investigate the mesio distal width of maxillary central incisor and maxillary canine from the master cast obtained from both the sex
2. To investigate the rugae pattern in maxillary master cast in both the sex
3. To investigate the presence of Barr bodies from the buccal smear by exfoliative cytology

MATERIALS AND METHODS:

In this comparative study a sample of 100 individuals (50 males and 50 females) of age group 18-30 yrs were selected from Sree Mookambika Institute of Dental Sciences, Kulasekharam. Maxillary impression and buccal smear were collected from each individual. The rugae were classified using Thomas kotze et al 1983 while the mesio-distal width and rugae length are measured on master cast of the impression obtained using digital vernier calliper. The Barr bodies were analysed using oil immersion light microscope.

RESULTS:

The mesio distal odontometric data showed that maxillary central incisors and maxillary canine showed a significant dimorphism between the sexes. The rugal characteristics proved insignificant in sexual dimorphism. Barr bodies showed a greater significance in both the sexes. On comparing the values with regenerative observational characteristic curve (ROC curve) data Barr bodies have a greater diagnostic accuracy than maxillary central incisor, maxillary canine and the rugae pattern in that order

CONCLUSION:

In our study, we conclude that Barr bodies are more reliable in determination of sex while the rugae are the least reliable. In our study the diagnostic accuracy of the study was done in a small group of individuals. As these values vary in different

population and hereditary factors do found to play a role, larger trials in more cosmopolitan population are necessary to confirm these findings

KEY WORDS: Sex determination, Central Incisor, Canine, Rugae, Barr Bodies

INTRODUCTION

Forensic odontology is the application of knowledge of dentistry to the law. This specialized area of dentistry includes the gathering and interpretation of dental and related evidence within the overall field of criminalistics[1]

Gender determination is one of the important aspects of human identification as it helps in building the biological profile of unidentified human remains. One of the important method of assessing gender is anthropometry of face and intraoral regions. It includes measurement of arch length, palatal rugae pattern and measurement of facial height[2]

Determination of sex from the dead remains as in case of major disasters where bodies cannot be identified and damaged beyond recognition in which only fragments of bone are obtained. It is a great problem for the forensic experts to identify the sex and individual from that data. Forensic dentists can assist other experts to determine sex of the remains by using teeth and skull. Various details like the morphology, crown size, root length etc, That are obtained from the dental and related structures act as adjunct to the determination of sex. The forensic details can be obtained as 1. Visual method or clinical method. 2. Microscopic methods.3.Advanced method.[1, 3,4]

The identification of sex preceeds over age because identification of sex of the missing person of one sex is to be considered for exclusion and inclusion of the suspects[3,4] Identification of sex also is important in living individual for various aspects like in case of trans genders who poses both the features of primary sex organs . These auxillary methods helps in exercise certain civil rights reserved for one sex and for deciding questions relating to legitimacy, divorce, paternity, affiliation and also for some criminal offences.[5]

Various studies are going on to determine the sex of an individual using the dental and supporting structures in metric and nonmetric scales like morphology of the teeth , mesiodistal width intercanine width , rugaes shape, pattern, microscopic analysis using sex chromosome X &Y , Barr bodies , F bodies[5], recently molecular analysis are done using the PCR mehods , amelogenin protein , and radiographic methods [3,4,6]While not as accurate as the skeleton, tooth crown dimensions are reasonably accurate predictors of sex and are useful adjuncts in sex assessment.[7,8]

The dental structures are preferred due to its resistant and preservation to the humiliation during the disasters and the post mortem examination procedure . Teeth are hardest and chemically stable structure in the body and are preserved in fossils and lead a path to identify the evolutionary change [9].

The rugae are soft tissue structures formed at the early stage of embryogenesis it retains its shape and form throughout life and their location makes it preserved by the tongue from the external environmental changes like trauma and thermal effects[10].

Barr bodies are the chromosomal changes seen in the individual by the inactivation of the X chromosome by a procedure called lyonisation which are seen in the interphase cells (or) cells of resting stages which can be obtained through a non invasive procedures like smearing of the exfoliated cells [5]

In this study we assess the sexual dimorphism seen in the individuals by collecting details from four structures namely palatal rugae where we noted the rugae type & pattern, measuring the mesiodistal width of the Maxillary central incisors, measuring the mesiodistal width Maxillary canine and also checked the presence of Barr bodies in the exfolliative cytology buccal smear

REVIEW OF LITERATURE

PALATAL RUGAE:

Palatal rugae are also called as 'plicae palatinae transversae' and 'rugae palatine 'which refer to the epithelial ridges on the anterior part of palatal mucosa, present on each side of the median palatal raphe and behind the incisive papilla. They are also known as transverse palatine folds, refers to the irregular elevations of the mucosa seen on the anterior third of the palate. This projection runs in a transverse direction from the palatine raphe located on the mid-sagital plane. These rugae have significant characteristics features and they are unique patterns in each individual and remain stable from the time of development until death. [11, 12, 13]

Anatomically, the rugae consist of around 37 ridge and oblique ridges that radiate out tangentially from the incisive papillae. Winslow was the first person to describe rugae. The study of palatal rugae is called as Rugoscopy and it is applied in the fields of dentistry like forensic odontology, prosthodontics and orthodontics[11, 13,14,15]

DEVELOPMENT: [16]

The palatal rugae appear towards the third month of intrauterine life, from the covering connective tissue in the palatine process of maxillary bone. Its development and growth are mutually controlled by epithelial-mesenchymal interactions, where specific extracellular matrix molecules are spatiotemporally expressed during development. [17, 18]

The first rugae can be distinguished in human embryos of 32 mm CRL (Crown-rump length) next to the incisive papilla. Then, in the prenatal stage they are relatively prominent. The palatal rugae are well organized at birth with a typical

orientation and pattern. During adolescence they acquire the final shape in each individual. Once they are formed they may experience changes in their size due to growth of the palate, but its shape is maintained even after the growth was completed .[18, 19]

At the 550 mm stage of embryonic development, there are five to seven rather symmetrically disposed ridges, with the anterior ones beginning at the raphe, the others more laterally, towards the end of intra‑uterine life the pattern of rugae becomes less regular, posterior ones disappearing and those anterior become considerably more pronounced and compressed [20] According to Carrea (1937) the rugae pattern is formed by the 12th to 14th week of prenatal life, and it remains stable throughout the person's life [21, 22]

HISTOLOGY:

The rugae are formed of parakeratinised stratified squamous epithelium with a connective tissue base similar to that of the adjacent tissue of the palate. In embryology the differentiation of rugae cores were observed in human embryo over a period of 20 weeks. [21] Thomas et al in 1983 found that, the reticulin fibre content in connective tissue of rugae was very delicate and the fibroblasts are different in amount and size from the adjacent palatal tissue.[20, 21,23]

The core within the palatal rugae of humans contains certain elements that are believed to contribute to the maintenance of its shape. The main structural element contains glycosaminoglycans which by its hydrophilic nature causes the tissues to swell and maintain the shape of rugae throughout life. Fibroblasts and collagen fibres beneath the thickened epithelium also contribute to the stability of palatal rugae[24]

PHYSIOLOGY:

Physiologically the palatal rugae are involved in the oral phase of swallowing and help to improve the relationship between food and the taste receptors in the dorsal surface of the tongue. It also have a significant role in speech and in the suckling in children.[18, 19, 22]

The number of rugae on each side of the palate varies between 3-5 and the rugae donot extend to the posterior palatal half the hard palate .They never cross the midline. The anterior rugae usually are more prominent than the posterior rugae. Most of the rugae are curved and the rest are angular and the last rugae has the higher probability of division where the medial and lateral parts are not connected and do not continue in their axial orientation. Fragmentary rugae frequently are present, particularly in the posterior half of the rugae territory. The shape, length, width, prominence, number and orientation of palatine rugae vary considerably among people. Variation exists in a lesser extent in the left and right sides of the same person. The inclination of the rugae to the sagittal plane also shows marked differences on both sides. Bilateral symmetry also exists in the rugae pattern.[17]

VARIOUS APPLICATIONS OF PALATAL RUGAE:

In Orthodontics:

Palatal rugae is being used in orthodontics as a suitable soft tissue reference points. It does not change in the adult hood after the complete eruption of teeth and no significant alteration in length occurs. They serve as a suitable reference points from which the clinician can derive the reference planes

necessary for longitudinal cast analysis. Positional changes of posterior teeth in the antero-posterior direction are relevant to the diagnosis and correction of sagittal occlusal abnormalities and arch length discrepancies **.**The maximum mean change in distance between the rugae in the antero-posterior plane was 0.41 mm[25, 26.]The palatine rugae can be used as reference points for measuring tooth movement in a manner comparable with cephalometric superimpositions.[25]

Palatine rugae in speech and palatal prostheses:

In prosthesis, when there is a changed relationship of the tongue to a palate the speech is altered, Speech may require surface texture to orient the tongue. The palatine rugae often can serve as a cue for pronunciation of certain letters like S,Sh which requires contact of the tongue to palatal rugae. Palatography served as a basis for determining the shape of the anterior palatal vault to determine the contact position of the tongue to the palate for specific sounds. The re-creation of the palatal rugae does not completely eliminate the speech problems[20, 25, 27].

Palatal rugae in cleft palate

The early detection of the sub mucosal cleft- palate is necessary in children as the diagnosis depends on the patient's clinical history and intraoral examination. Rugae are used to measure the distances on the cleft palate from the period of birth to the time of early mixed dentition. These distance of the cleft are measured by using the fixed reference points of the palatal rugae to estimate the changes that occurred in the anterior palate during various stages of orthodontic therapy and growth.[25]

APPLICATION OF RUGAE PATTERN IN FORENSIC ODONTOLOGY

Rugae patterns contribute reliable details to forensic odontology in identification of the deceased. Even in extreme cases of trauma or incineration the rugae remains protected due to its anatomic position. Rugae are well protected from heat as the lips, tongue and the buccal fat pads act as insulators and remain undisturbed. Palatoscopy or Rugoscopy is the name given to the study of palatal rugae in order to establish a person's identity.[26]

Rugae do not change throughout early childhood and adolescence. Changes that occur in rugae are related only to their length which helps to compare the ante-mortem data to the post mortem data [27]

The rugae have been successfully identified in severely burnt edentulous body and by comparing the pattern on the victim's old denture this indicates that rugae are stable in adult life. Thus, palatal rugae appear to possess the features of an ideal forensic identification parameter due to its uniqueness, post-mortem resistance, and stability .[23]

Palatoscopy used in necro-identification holds good enough due to its resistance to decomposition up to 7 days. Therefore, anatomical structures such as palatal rugae may assume more importance in the future[14]

History:

Rugae were first described by Winslow in 1732. The earliest illustration of Palatal rugae was probably by Santorini in 1775, wherein he put a drawing depicting 3 wavy lines crossing the midline of palate.[25,27] The application of

palatal rugae patterns for personal identification was first suggested by Allen' in 1889[10 11,22]. The first palatal classification system was put forth by Goria in 1911 in two ways: by specifying the number of rugae and specifying the extent of the rugal zone relative to the teeth. Palatal rugoscopy was first proposed in 1932, by a Spanish investigator named Trobo Hermosa. In 1937, Carrea conducted a detailed study and established a method to classify palatal rugae.[20, 25]

1955, Lysell suggested that the palatine rugae might possess unique characteristics that could be used in pattern identification. In 1983, Brinon, following the studies of Carrea, divided palatal rugae into two groups (fundamental and specific) in a similar way to that done with fingerprints.[17, 21]

Sassouni (1957) stated that it is possible to devise a classification based on the symmetry, number and shape of papillae. When Sassouni (1957) tested the classification, he was able to identify a person without difficulty. The palatal rugae can be used in the same way as fingerprints; however, as the rugae are composed only of soft tissue, they are not present in skeletons and stated that no palatal rugae are alike in their configuration and does not change during growth.[28] Fiene (1958) discovered that the palatal rugae could be helpful in anthropological paternity investigations. [21]

CLASSIFICATION: [20,25]

1. The first system of classification was developed by Goria (1911)

   Rugae pattern was divided into two types-

   - Specifying the number of rugae
   - Specifying the extent of rugal zone relative to the teeth

He further distinguished rugae into 2 types-

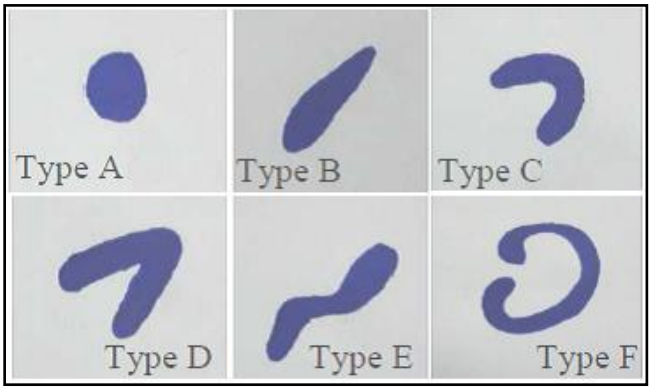
- Simple or Primitive
- More developed

2. Trobo (1932) divided Palatal rugae into two groups:

- **Simple rugae:** Where rugae shapes are well defined and divided further as Type A, B, C, D, E, F

Simple rugae

1. Type A point
2. Type B Line
3. Type C curve
4. Type D angle
5. Type E sinuous
6. Type F circle



- **Compound rugae:** Rugae are formed by the union of two or more simple rugae and were classified as "Type X" or Polymorphic type.

3. According to Lysell (1955):[20,22,25]

   Palatal rugae were classified depending on its length

   - Primary: 5mm or more
   - Secondary: 3-5mm
   - Fragmentary: 2-3mm
   - Rugae smaller than 2mm are disregarded

4. By Kapali et al (1997): [24, 29]

   Based on shape of Palatal rugae

   - Curved
   - Wavy
   - Straight
   - Circular

   Modification of Kapali's classification

   - Converging
   - Curved
   - Wavy
   - Straight
   - Circular
   - Furcated

According to Vilvanathan et al this classification stands good as a early and reliable method [30]

5. Carrea classification: based on form of the palatal rugae[20]

    - Type I: Posterior-Anterior directed rugae
    - Type II: Rugae perpendicular to raphe
    - Type III: Anterior-Posterior directed rugae
    - Type IV: Rugae directed in several directions

6. Martin's dos santos classification:[10,20]

Based on form and Position of each palatal rugae

- **One initial rugae;** The most anterior one on the right side is represented by a capital letter
- **Several complementary rugae;** The other right rugae are represented by numbers
- **One sub initial rugae;** The most anterior one on the left side is represented by a capital letter
- **Several sub complementary rugae;** The other left rugae are represented by numbers

Based upon the height of palatal vault at the deepest point: [19]

- palatal shapes are classified as
- medium (Type I),
- high/ steep (Type II)
- Low/flat (Type III).

7. **DA SILVA CLASSIFICATION: BASED ON SHAPE**

Palatal rugae classified into two types-

- Simple: Numbered from 1-6
- Composed: Resulting from combination of 2 or more rugae pattern

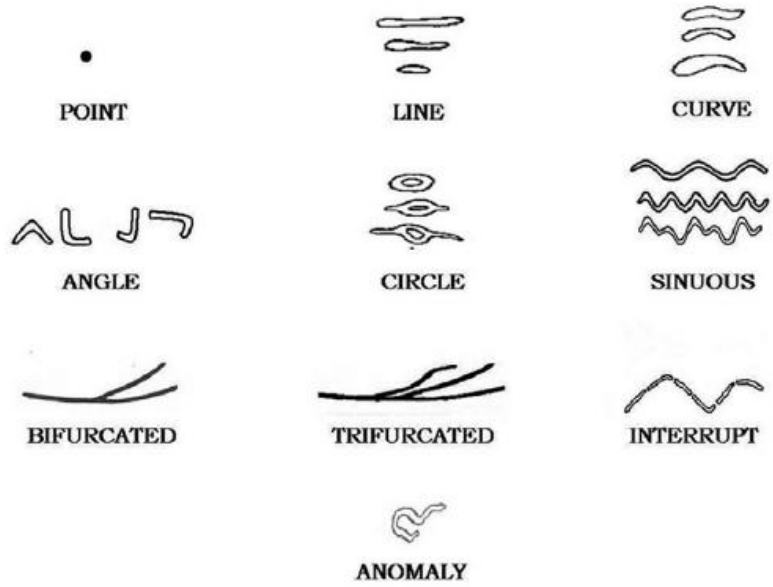
8. **BASAURI CLASSIFICATION:**[25]

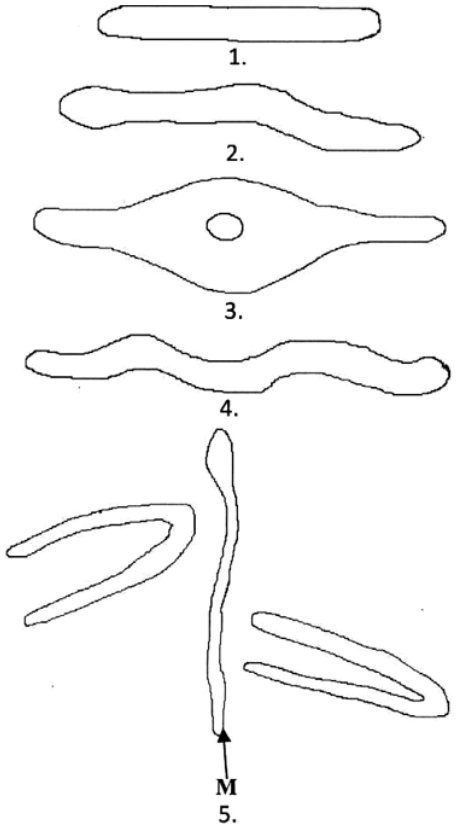
- It differentiates between the principal rugae, which is the more anterior one and the accessory rugae, which consists of all the remaining rugae The rugogram is elaborated beginning from the right side of the palate.

9. **THOMAS AND KOTZE CLASSIFICATION** (Most accepted classification) (1983): Proposed detailed classification consisting of the following[10,25]

- Rugae dimension and Prevalence-
  - **LENGTH-**
  - determined according to the latest rugal dimension and is classified as Primary, Secondary and Fragmentary rugae.
  - Prevalence- Rugae is determined by counting and recording the number in each category (Primary, Secondary and fragmentary) and not the total number on each side.
  - Area- determination of the surface area of primary rugae
- Primary rugae details-
  - These can be described as annular, papillary, crosslink, branches, unification, breaks, unification with non-primary rugae

- Rugae pattern dimensions-
  - Distance between most anterior point on incisive papilla and most anterior point on rugae pattern regardless of the side.
  - Distance between incisive papilla to posterior border of last primary or secondary rugae. · Distance between incisive papilla to posterior border of last rugae (including fragmentary).
  - .
- Angle of Divergence-
  - Measured in degree between the line formed by the medial palatal raphe and line joining incisive papilla with the origin of most posterior primary or secondary rugae on one side of the palate.
  - .
- Dental arch and palate dimensions-
  - Width- Line joining the tips of mesiopalatal cusp of permanent maxillary first molar or the deciduous second molar is used to project a point below and perpendicular to it on the gingival margin to determine thewidth.
  - Depth- point below and perpendicular to line joining the tips of mesiopalatal cusp of maxillary permanent first molar or the deciduous second molar on the mid-palatal raphe is used to determine the depth.
  - Centre- Perpendicular distance between the line joining the tips of mesiopalatal cusp of maxillary permanent first molar or the deciduous second molar and the point on the midpalatal raphe determines the centre.





1. STRAIGHT RUGAE
2. CURVED
3. CIRCULAR
4. WAVY

5. FROM MIDLINE

a. DIVERGENT (LEFT SIDE)

b. CONVERGENT (RIGHT SIDE)

10. **Position analysis**: [18]

- Transverse line passing through the palatal cervical third of the central incisors.
- Transversal line that goes from the mesial side of the right lateral incisor to the mesial side of the left lateral incisor.
- Transverse line through the mesial side of the right canine and reaches to the mesial side of the left canine.
- Transverse line through the mesial side of the right first premolar and reaching to the mesial side of the left first premolar.
- Transverse line through the mesial side of the right second premolar and reaching to the mesial side of the left second premolar.
- Transverse line through the distal side of the second premolar and reaching to the right side of the distal left second premolar.

Based on these lines between the areas they were named as follows:

- Between lines I and II.
- Between lines II and III.
- Between lines III and IV.
- Between lines IV and V.
- Between lines V and VI.

12. Classification based on orientation of rugae in relation to mid palatal raphe

- Forward
- Right angle
- Backward

SOME STUDIES ON PALATAL RUGAE:

Van der Linde et al in (1978) proved that the anterior rugae do not increase in length after 10 years of age. Also the qualitative characteristics such as shape, direction and unification remain stable throughout.[12]

Sunita Kapali et al (1997) did a longitudinal study on serial dental casts of ten Aborigines, from 6 to 20 years. They examined rugae patterns and compared it between different ethnic groups of 100 dental casts of Australian Aborigines and 200 casts of Caucasians, ranging in age from 13 to 17 years and observed features like number, length, shape, direction and unification of rugae. According to their study the most common shapes in both ethnic groups were wavy and curved forms, whereas straight and circular types were least common. There was a statistically significant association between rugae forms and ethnicity, straight forms being more common in Caucasians whereas wavy forms were more common in Aborigines[24]

Faisal M. Fahmi et al (2001) did a study to identify and compare the rugae pattern in Saudi males and females from 120 samples using Thomas kotze et al classification . They identified that female had a significant difference in the converge type while the male had a significant difference in the circular type and suggested rugae can be used as an adjunct tool in determination of sex in Saudi population [32]

Ismar Eduardo Martins Filhoet al (2009) checked the method of identification of palatal rugae together with the incisive papilla using study models and comparing with photographs. The analysis of non coincident

points, led to a 100% percentage certainty on the identification. The identification of all individuals through the method proposed was possible. They concluded that it is possible to achieve the human identification by means of palatal rugae provided that it has a previous database [28]

Valeria Hermosilla Venegas et al (2009) analyzed 120 subjects of both sexes, between 15 to 20 years old and fully dentated, using rugoscopy to determine the shape, size, number and position of the palatal rugae. They stated that most prevalent palatal rugae shape was sinuous (43%) followed by curve (27%), line (15%), point (11%), and polymorphic varieties (4%). The average number of rugae was 12.27, being higher in male than female. The palatal rugae that are larger were the sinuous (mean 9.58 mm). 40% of the rugae were found in the E quadrant, followed by D (30%), the rest was distributed among the other regions. They concluded that the analysis of the palatal rugae and their features can be used as a reliable guide to the forensic identification[18]

Janalt Damstra et al (2009) on a study of Rapid maxillary expansion (RME) to fixed appliance therapy checked the usage of rugae as a land mark in orthodontics .they observed that the rapid maxillary expansion caused change of length in transverse direction between the medial aspects of the bilateral rugae .They also suggested that there is no change in antero-posterior measurements. The transverse changes were more marked for the third reference and less for the second rugae. No changes were reported in the first rugae. They concluded that medial aspects of the third rugae cannot be

considered as stable reference landmarks for dental cast analysis when RME is performed in addition to fixed appliance therapy[26]

For identifying the predominant pattern of rugae in Indian population from Madhya Pradesh and Kerala groups , a study was conducted by Aparna Paliwal et al (2010) using 60 maxillary cast with an age group 17- 23 in both sexes. The results showed that straight rugae pattern on the right side of the palate were more in the male subjects and found to be significantly predominant in the Madhya Pradesh population, whereas wavy shape was predominant in Keralites; However, rugae patterns on the right side of the palate in female subjects exhibited no significant difference[33].

Mahabalesh Shetty et al in 2011 did a study where they randomly selected sample group of 100 subjects comprising 50 males and 50 females of age ranging from 17 to 25 years. They clearly demonstrated the uniqueness of rugae pattern in different individuals and suggested that it is an effective & reliable source of identification when an ante mortem record of palatal rugae is available.[29]

Sreenivasa T bharath et al (2011) studied the differences of palatal rugae patterns in males and females by a cross sectional study in a hospital based coastal Andhra population. 100 pre orthodontic model cast were studied and Thomas classification was adopted for analysis. Discriminant analysis showed 78% accuracy with the actual data[11]

Kamala R et al did a study in (2011) by comparing the rugae in size and length in males and females observed that the proportion of unification converging rugae was found to be 136 in females which was (6.3%) and 98 (4.5%) in males. In their study the proportion of unification converging rugae was significantly higher among females as compared with males. There was no significant difference in the size of the palatal rugae between the two genders. They suggested that the mean number of rugae showed a slight decreasing trend with increasing age. [34]

Chandrasekhar Gandikota et al in 2012 did a study to use palatal rugae as an aid to classify malocclusion in untreated class II div 1 malocclusions in comparison to normal class I occlusions. They observed that there was a significant constriction of the palatal rugae in class II div 1 than the class I individuals and that there was a distinct pattern of palatal rugae between the two groups[16]

Bakannavar M Shankar et al (2012) did a study to analyse the differences in the rugae pattern among the Indian males and females in a small portion of a population with 63 subjects of which 32 were males are 31 females of age group 17-25 years. They found that the females had more number of rugae in the right side and showed increased in number of curved and straight shapes rugae pattern than the males. [15]

Shankar Shunmugam et al (2013) suggested that Palatal rugae can be used to differentiate the population among north Indians and south Indians. They did a study using 940 individuals of 18-23 yrs of age. They observed that

the wavy and curved are more common in both groups. On applying chi square evaluation found that classification had a of accuracy 87.8% [35]

Madhankumar et al (2013) did a cross sectional study of 135 students aged 17-25 yrs to evaluate the gender differences with regard to the shape of the palatal rugae and to identify the most predominant pattern. In that study they confirmed that straight and curve forms were most prevalent rugae shapes in both the genders. Chi-square analysis showed that there was an association between rugae shape and gender with significant differences in total number of rugae and unification pattern of rugae.[12]

Shubha C et al (2013) did a study with a sample size of 150 students by random sample selection from the study population of age group 17-23 years. The study revealed that the analysis by Chi-square test where the P-value with respect to shape, direction for the sex wise distribution were significant. Thus they concluded that the palatal rugae pattern of an individual may be considered as a viable alternative for identification purpose.[16]

Vilvanathan Prabu Rajan et al (2013) did a study to assess the morphology of rugae pattern in 5-15 year old children with gender dimorphism. He observed that there was an increased female prediction in the total count and primary rugae pattern. On comparing the shapes of rugae in male and female the study models showed a predominance of wave shape followed by cuvred. Circular pattern was not seen in the study population. There was no significant statistical difference in the direction and unification of rugae among males and females were reported.[30]

Chopra et al in (2013) did a study to investigate differences in the palatal rugae patterns and maxillary arch length in male and female patient within the age group of 18-30 years with 100 models of equal sex distribution. The study reported that the arch lengths at all dimension were higher for males than females. While females showed a higher curved and diverging rugae type and the males had a higher number of circular and converging type of rugae. They concluded that palatal rugae pattern and maxillary arch length can be used as an additional method in differentiating gender between human populations [20]

Dipshikha Bajracharya et al (2013) conducted a study on 200 Nepalese (100 male and 100 female) to determine the number and pattern of palatal rugae. They observed that the number of primary rugae did not show any statistical significant difference between the gender groups while a wavy pattern was predominant followed by curved, straight, branched and circular in their population.[13]

BARR BODIES

The human cell contains 46 chromosomes of which females have two X chromosomes and males (XY) have only one X chromosome. The X chromosomes contain many important protein-coding genes. In early 1917 Weiman, and later Painter showed that sex chromosomes in the developing human male germ cell tend to remain compact with deep staining properties during the nuclear interphase. This is in contrast to other chromosomes which become so diffuse that it is difficult to identify them.[36]

The cytogenetic studies in 1940 had shown that the interphase cells contained a densely stained chromatin mass in their nuclei. Murray Barr and Ewart Bertram provided some of the first images of the inactive X in 1949 these are called as These Barr bodies named after the scientist Murray Barr[37]

Barr body, is also known as a nucleolar satellite, because it was frequently located next to the nucleolus and they showed that the Barr body was well developed in females but poorly developed in males. Thus, the duo hypothesized that "the nucleolar satellite may be derived from the heterochromatin of the sex chromosomes[38]

Susumu Ohno and colleagues provided more definitive evidence that the Barr body was an X chromosome. By systematically comparing female and male liver cells at various points in the cell cycle, they observed that female cells contained a highly condensed chromosome that was absent in chromosome spreads of male cells. [38,39]

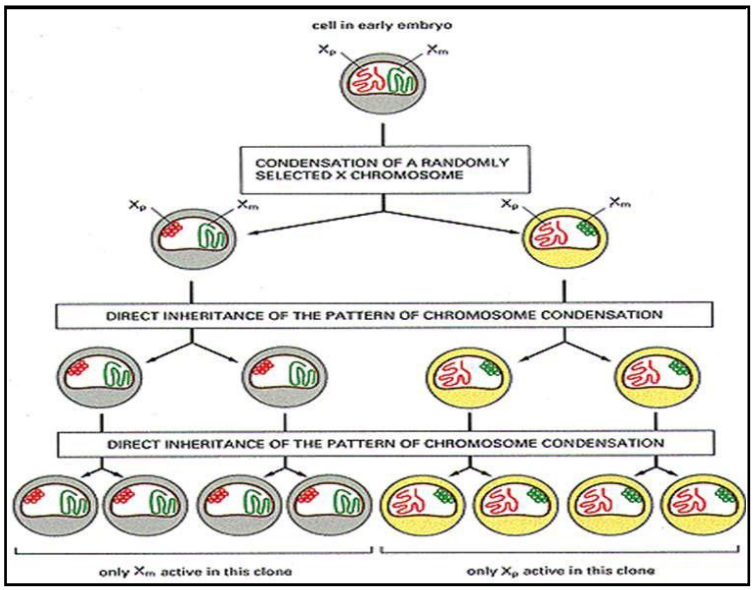
FORMATION OF BARR BODIES:

Lyon (1961) interpreted "sex chromatin" to be a manifestation of a genetically inactive X chromosome. "It is here suggested that this mosaic phenotype is due to the inactivation of one or the other X chromosome early in embryonic development. If this is true, pigment cells descended from cells in which the chromosome carrying the mutant gene was inactivated will give rise to a normal-coloured patch and those in which the chromosome carrying the normal gene was inactivated will give rise to a mutant-coloured patch" this Inactivation of the x chromosomes is called lyonisation[38]

Lyonisation can occur in randomly and affect any one of the paternally derived and maternally derived X chromosomes. Once lyonization has taken place

the X chromosome remains inactive in all the descendants of the cell.[37] Only one of the X chromosomes is genetically active. The other X of either maternal or paternal origin undergoes heteropyknosis and is rendered inactive. Inactivation of either the maternal or paternal X occurs at random among all the cells of the blastocyst on or about the 16th day of embryonic life. Inactivation of the same X chromosome persists in all the cells derived from each precursor cell. Thus, the great preponderance of normal women are in reality mosaics and have two populations of cells, one with an inactivated maternal X and the other with a inactivated paternal X. Herein lies the explanation of why women have the same dosage of X-linked active genes as have men. The molecular basis of X inactivation is just beginning to be understood. It involves a unique gene called Xist, whose product is a non-coding RNA that is retained in the nucleus, where it "coats" the inactive X chromosome and initiates a gene-silencing process by chromatin modification and DNA methylation. the Xist allele is turned off in the active X.[5]

BARR BODIES FORMATION



Gene responsible for lyonisation :

Cytogenetic studies of mouse and human cells with deleted or rearranged X chromosomes pointed to the existence of a unique region of the X chromosome, called the X-inactivation center (abbreviated XIC or Xic in humans and mice, respectively), which was crucial for the X-inactivation process to occur (Rastan & Robertson, 1985).[5, 40]

Identification of barr bodies:

Barr body can be seen in any female cell with large, open nuclei. It is commonly seen in buccal smear (6), pulp tissue (7), hair follicle (8), and vaginal smears. In a smear, only 30 percent of the cells show Barrbodies[37, 41]

Barr body can be seen as a heteropyknotic, basophilic, intra-nuclear structure adjacent to the nuclear membrane in the resting stage of a cell in a karyotypical female. It can also be seen adjacent to the nucleolus or be free in the nucleoplasm. The Barr body generally has a plano-convex, biconvex, triangular, spherical or rectangular morphology when observed under 40 X or oil immersion objeitives. It resembles the letter V W S' or X under electron microscope. It measures0 .8 x 1.1 microns in its greatest diameter.[37]

Alterations in sex chromatin size:

The alteration in size is seen due to variation in the cell source (buccal, vaginal) or the staining procedure. Pathologically, enlargement is seen in iso-chromosomes of X and diminution in size is seen in deletions of X. Significant alteration in the size of chromatin masses will be paralleled by similar alteration of PMN drumsticks.[37]

STAINING:

All nuclear stains can be used to identify the Barr bodies in the cellsof resting phase . Commonly used stains and eosin, are haematoxylin Papanicolau stain, aceto-orcein, Feulgen and geimsa stains, cresyl vioiet and carbol fuchsin, and fluorescent staining. The disadvantages of the hematoxytin and eosin , Orcein and Papanicolau stains was the heavy staining ability towards bacteria . Hence, the Barr bodies are difficult to identify. Acid hydrolysis and thionine staining can be used to reduce the bacterial staining. Ideal stains for Barr bodies are Feulgen and guard stains which need a standardized method. Cresyl violet and carbol fuchsin also stain barr bodies prominently. Fluorescent stains are confirmatory stains for both X & Y chromosome. Study of X and Y chromosomes in the dental pulp cells, which are not undergoing active division is an easily accessible, less expensive and reliable method.[38,42,43,44,45]

Human specimens and remnants such as blood, semen, hair, and saliva containing buccal mucosal cells obtained from the crime scene can be used for solving criminal cases such as sexual offences. Studies have shown that the epithelial cells from the cigarette bud and salivary stains in cups and glasses in disasters were used to identify the sex and identity .[37, 45]

In many forensic cases, sex identification is absolutely essential and hence the inclusion of Barr bodies for gender identification to further strengthen the evidence is made .[46]

- In a somatic cell the number of Barr bodies is always one less than the number of X chromosomes. The normal females of (XX) pattern have one Barr bodes -in each somatic cell while a normal male (XY) donot have any.
- Limitations of this method are the alterations at the chromosomal level because patients with abnormalities can yield false negatives or false positives
- Numerical artefacts are seen in maternal post partum state, first three postpartum days (Infant), steroid and hormone therapy.
- Pathologically, an increase in males (XXY or Klinefelter's), an increase in females (XXX, XXXX) or defects in females (X" or Turners) is seen

VARIOUS STUDIES IN BARR BODIES:

Wienmann et al (1955) suggested that the appearance of a sex chromatin-like particle in the nuclei of epidermal structures of male patients does not represent a sex reversal but is due to an alteration in the chromatin associated with the development of basal cell carcinomas[47]

Dixon,et al in (1956) conducted a study with 260 individuals, of whom 98 were female and 162 male among that the 162 male smears showed no sex chromatin, whereas, th 95 female smears showed between 30% and 50% of the sex chromatin mass.[48]

George D. Wilbanks et al (1967) did an invitro study in cervical epithelium of adult human by doing a biopsy and culturing the epithelium. They observed the cells in phase contrast microscope and opined that persistence of barr bodies were seen in cells of inter phase [49]

R. H Messler et al (1967) conducted a study on 30 pregnant women suggested that barr bodies presence can be altered by the external factors like corticosteroids like oestrogen. They reported that there is difference of Barr bodies' expression in menstrual cycle. New born babies tend to have a reduced Barr bodies count for the first 3- 4 days [50]

Hellen Gardner (1976) conducted a study over a period of 7-year on 43 patients who underwent sex-chromatin and cytogenetic studies in the investigation of a disorder related to reproductive function . According to their opinion, abnormalities of sex or autosomal chromosomes could not be detected by routine buccal smear. They suggested that testing for sex chromatin is of no value to the clinician, because full chromosome analysis must be performed irrespective of the findings from the buccal smear. The sex-chromatin test is an aid to the cytogeneticist in interpreting the chromosome analysis. In addition to those with amenorrhea and oligospermia or aspermia, persons with hypospadius and those to be treated with fertility drugs should undergo cytogenetic studies.[51]

According to Duffy at el (1991) count of Barr bodies in females was 9% - 28% and in males 0% - 6%[52]

Bo Hong et al in (2001) did a study in serum auto immune –antiserum containing antibodies specifically for Xist mRNA in 154 samples for examining the molecular basis for Barr body formation and established the locus of a gene XISt for maintaining X chromosome inactivation. They concluded that anti serum can be used as a tool for the identification and characterization of molecular components of the Barr body[53]

Brain .P Chadwick (2003) found the silencing histone protein location and explained that Barr body represents a discrete sub-nuclear compartment that is not freely accessible to most chromatin proteins. They observed a dichotomous pattern of association or exclusion for the spatial relationship of a number of specific histone methylation patterns in relation to the Barr body. [54]

According Sergio D. J. Pena (2003) that the evaluation of Barr body analysis in detection of klinfelter syndrome can be replaced by highly sensitive molecular test based on methylation-specific PCR (MSP) of the human X-linked FMR-1 gene. which can replace with enormous advantage over the morphological Barr body analysis [55]

Nirmal das et al in (2004) made a study in determining the effect of temperature and humidity on Barr bodies pulp tissue after the extraction of teeth. Mean Percentage of Barr bodies in females was found to be 24.92% +/- 3.74% and the F-bodies to be 2.27% +/- 1.30%.and the sex chromatin could be detected up to 75°C. But above this75 deg temperature, sex chromatin was destroyed and could not be detected [52]

In a study of Sex determination from buccal mucosa scrapes Tushar Mital et al (2009) found to have 1.14% positivity for males and 39.29% positivity for females. Positivity for Barr body in males is due to the inheritance of males to carry primary sex organs of both the sexes. But the range of positivity differed when compared with males, which is more significant in females. The Papanicolaou staining is the gold standard staining method for cervical cancers smears because of its excellent staining capacity of nuclear substances [42]

Ivan Suazo Galdames, et al (2010) conducted a study consisting of 20 men and 20 women between the ages of 24 and45 years. Their results were 100% positive for females and 100 % negative for males .This correlated with the literature, that sex determination from dental pulp depending on different geographic location and its influence on obtained specimens its varies[56]

Ivan Suazo Galdames et al (2011) opined that Barr bodies were positive for females in the tooth subjected to temperature until 400°C; In tooth which was subjected to further high temperature, it was not possible to find any viable tissue for analysis. This correlates to the fact that tooth is well preserved within oral cavity so that only minimum heat dissipates to the tooth which makes dental pulp tissue to withstand and helps for the diagnosis of sex in forensic medicine[57]

D.Shyam Prasad et al (2012) studied 40 samples using acridine orange in confocal microscopy and found that sex determination by the presence of barr bodies in buccal mucosa can be done accurately and rapidly [5]

Bodal Vijay Kumar et al (2014) conducted a study to understand understanding the breast cancer prognosis in a correlation between the sex chromatin status in female breast tumours using paraffin sections, buccal smears and peripheral blood films . They concluded that tumours having low counts of sex chromatin are more likely to have advanced lesion and it is associated with poor histological markers. In correlation to that of higher microscopic grade and skin involvement are likely to have a poor prognosis and high sex chromatin

count are associated with good prognosis. Thus sex chromatin evaluation can help to determine prognosis in a given case of carcinoma breast.[58]

Uma Datar et al (2013) did a study on (60 males and 60 females) 120 individuals of which they contain equal distribution of both the sexes. The buccal mucosal smear was taken and stained using Aceto Orcerin(AO) stain and Papanicalou stain(PAP) . This study showed that the percentage of Barr bodies in AO-stained slides ranged from 5 to 32 among females and from 0 to 8 in males, while with PAP the ranges recorded were 4–20 in females and 0–5 in males ($p < 0.001$). The sensitivity and specificity of AO for detecting sex accurately was around 98.3 and 95% for PAP[44]

Manisha M. Khorate (2014) did a study on gender determination in pulp tissue using 100 teeth (50 male and 50 female), which were indicated for extraction. The teeth were sectioned at various intervals (within 12 h to 49 days post‐extraction), and the pulpal tissue was obtained and they suggested that Gender determination from human pulp is possible up to 7 weeks. Barr bodies decrease gradually as the time interval increases and concluded as Chromosome is a reliable and cost‐effective technique [45]

Harpreet Singh, et al in 2011 did a study on barr bodies from hair follicle from 50 female cadavers. The collected samples of 9 hair follicles were stained using aceto orcerin stain and the percentage of barr bodies was found to be 28-49 %. [59]

Prasanth E.Natekar et al did a study in 100 females to estimate the Barr body seen in the buccal mucosa and the results showed that the X chromosome inactivation in breast cancer is significantly low by $P < 0.001$[60]

Usha Verma et al in 2013 did a study on sex chromatin positive cells in the buccal smear from 100 new born female and stained the smear using carbol fuchsin. Tshey reported that the frequencies of positive cells are 3-11% with an average of 6.4 +/- 0.25 % [61]

TEETH IN FORENSIC ODONTOLOGY

Teeth are the hardest mineralized tissue in the human body, which makes them resistant to mechanical, chemical and thermal effects.[62] In 1990 Kessler, stated that among skeletal parameters, the pelvic and skull bones are known to produce approximately 100% success in sex identification. While teeth are not as accurate as skeletal parameters. The odontometric measurements can be considered as an useful adjunct in sex assessment. It has been studied that the determination of sex and ancestry can be accessed from skull shape and forms. Nowadays studies support that appearance of teeth can be used by forensic dentists to determine race within the three major groups: Caucasoid, Mongoloid and Negroid [63, 64]

Dental identifications have always played a key role in identification of an individual and sex in natural and man made disaster .Those situations particularly when there was mass casualties and charred corpse were obtained like aviation disasters[63]. The major advantage of using dentition in identification was its ability of preservation and high resistance to the insults occurring in accidents. Teeth are better than any other skeletal structure because the bony structures of the body are destroyed

due to its physical characteristics and the teeth are protected by the jaw bone and withstand the post mortem insults too. For these reasons, the use of dental morphology to determine sexual dimorphism was established in the aspects of anthropological and biological studies [62,63].

Kondo and Townsen (2004) Moorrees et al (1957) advised that the existence of sexual dimorphism in permanent teeth is a well known phenomenon. This behaviour is morpho-genetically determined . The shape and dimensions of the tooth are fairly stable extreme environments and applied as a determining factor in providing sexual dimorphism in skeletal remains, which is required for forensic identification purposes. According to Schwartz and Dean et al (2005) various studies have shown that there is a varying degree of sexual dimorphism in human dentition[63]

Few Theories of sexual dimorphism in teeth:

1. According to Garn et al (1966) that teeth have behaved in many ways through the course of evolution, ranging from reduction of the entire dentition to reduction of one group of teeth in relation to another. They suggested that tooth crown size is mediated partly by X or Y chromosome or both, remains obscure; females show greater variability as crown size is mediated by X chromosome in diploid females as compared to haploid male [65,]
2. Alvesalo and Tammisalo (1981), Alvesalo et al. (1985, 1987) found that the Y chromosome increases the mitotic potential of the tooth germ. It induces dentinogenesis, while the X chromosome induces amelogenesis.[62]

3. Stroud et al. (1994) showed that males have larger mesio-distal diameters of single teeth, which is due to a thicker dentin layer [63]
4. According to Moss(1997) the greater thickness of enamel in males due to the long period of amelogenesis when compared to females[65]
5. Y chromosomes producing slower male maturation and the variation in the magnitude of dimorphism can be a result of various factors[65]
6. Boaz et al (2009) have opined that tooth crowns being larger in males than in females, may be because of longer period of amelogenesis for both temporary and permanent dentitions in males [4]
7. Acharya et al commented that various authors have explained that such variation could be due to environmental influences on tooth size. Variation in food resources exploited by different populations has been explained as one such environmental cause. The interference of cultural factors with biological forces. There can be a complex interaction between a variety of genetic and environmental factors that are responsible for the variation in the magnitude of dimorphism. [66]
8. In canine sex dimorphism, Emirel and Devore et al postulated that in the evolution of primates there was a transfer of aggressiveness from canine in apes to fingers in human until this the survival was dependent on the canine later transferred to fingers especially in males the notable difference between canine in determining sex was noted to be due to the influence of Y chromosome .On the other hand the X linked genetic influence on tooth width was rather uniform for all teeth [65]

Methods of sexual dimorphism assessment:

Dental features in sex identification can be broadly grouped into non-metrical and metrical methods.

Non- metrical features are based on the presence or absence of a particular morphological feature. The non metric features are crown and root, features such as upper incisor shoveling, cusp of Carabelli, hypocone, and protostylid, are heritable, and therefore, help establish population group or ethnicity.[7]

Metric features are based on tooth measurements. The use of metrical approach in sex estimation is more structured, less subjective and furthermore, it can be repeated to validate the obtained results. The bucco-lingual (BL) and mesiodistal (MD) tooth dimensions, termed linear measurements may be used for determining sex based on the differences in tooth size and tooth proportions. In addition to linear measurements, diagonal measurements are useful in measuring rotated, crowded and proximally restored teeth. The tooth is measured 'corner to corner', viz, MB-DL and DB-ML[7, 67]

HISTORY:

Black, 1902 was the first to establish the mesio distal diameter of the teeth in North American white population, later Nelson (1938) Ballard (1944) and Wheelar (1961) conducted studies to find out the mesiodistal crown width in a particular population[66]

Garn et al (1966) stated that males tendto have more square dimensions of teeth that females show greater size reduction bucco-lingualy than mesiodistally. [62]

In 1972 Ditch and Rose were the first to prove that teeth diameters can be successfully used in determining sex in poorly preserved and fragmentary skeletal remains in archaeology[68]

Scott and Turner (1997) showed that many non-metric dental traits are highly positive correlated with tooth size because they are both genetically determined [63]

Dentition should be treated as a unit, considering the correlation among all teeth, to determine the difference between sexes. Teeth must have a context of other measurements from the same individual with which to be evaluated. This implied that sex dimorphism is more correctly illustrated when the whole male dentition was compared to the whole female dentition [63]

Various odontometric studies:

Hashim and Murshid (1993) studied 720 teeth of age group 13- 20 yrs (1993), identified that canine is the only teeth that exhibited dimorphism[69]

Mohammed Q. Al-Rifaiy (1997) did a Study to investigate whether dimorphism of permanent mandibular canine, maxillary canine and intercanine distance play a role in establishing sex identity. They observed that the mean values for left and right mandibular and maxillary canine widths were less for females than for males and the differences were not statistically significant. The mean value for both the arches inter-canine distances for females were less than males, a statistically significant increase in inter-canines distance was observed in both aches in males. The analysis using the canine width and intercanine distance

of the mandible and maxilla showed 55.07% and 65.48% was accuracy for the classification of sex.[70]

Yuen et al(1997) conducted a study on mesiodistal dimension of deciduous and permanent teeth of the Southern Chinese population and found that none of the primary teeth nor three of the permanent teeth were found to have significant sex differences in size. Percentage of sexual dimorphism ranged from 0.06% to 1.97% for the primary teeth and 0.36% to 5.27% for the permanent teeth[71]

Nair et al (1999) checked an ability to determine the gender in south Indian population of an age group 15-21 year by comparing the observed mean canine index MCI with standard MCI value they stated that accuracy for sexual identification was 84.3 %in males and 87.5% in females [72]

Kaushal et al (2003) did a study using manibular canine and found a statistically significant dimorphism in the mandibular canines. A sample of 60 subjects from North Indian population was selected for the study. The mandibular left canine exhibit greater sexual dimorphism and they concluded that if the width of the canine is greater than 7 mm, the probability of the sex of the person under consideration being male was 100%.[73]

Singh s. et al did a study (2006) on 110 individuals, (40 males and 70 females) from the age range of 12-18 years. They identified that the mesio distal crown width of males was found to be more than that of the females and the ratio of the mesio-distal crown dimension of the maxillary lateral incisors to the maxillary central incisors was 80% in females and 78% in males. The total arch

length in males was 117.77 mm in maxilla and 111.60 mm in mandible, while in females, the values were 113.98 mm in maxilla and 107.10 mm in the mandible.[74]

Acharya and Mainali (2007) found reverse dimorphism (where females showed larger teeth than males) in the mesiodistal dimension of mandibular second premolars in a Nepalese population. The finding could be attributable to evolution resulting in a reduction in sexual dimorphism, causing an overlap of tooth dimensions in modern males and females [75]

Acharya and Mainali (2007) indicated that assessment mesio distal (MD) dimension was better suited for discriminating sexes than BL .Larger jaws in males may account for a larger MD dimension, of the teeth in them [69].

Ivan Suazo Galdames (2008) investigated sexual dimorphism in the size of the permanent teeth among Chilean population using Mesiodistal and bucolingual diameters. The values were larger in males..A significant difference in mean BL diameter was observed from the right maxillary central ,lateral, canine , molar.O value < 0.05%. Mandibular left central, lateral, Mandibular canine exhibited more significant sexual dimorphism with P value 0.01.the result showed that sexual dimorphism can be foun d in all group of teeth [76]

Prabhu and Acharya (2009) reported a comparative low sexual dimorphism of 37.5% in the south asian population .[77]

Karen boaz (2009) on reported that the mean values of the buccolingual and mesiodistal dimensions of the mandibular left canine were greater in females. These finding could be attributable to evolution resulting in a

reduction in sexual dimorphism, causing an overlap of tooth dimensions in modern males and females.[4]

Thais Maria Freire Fernandes et al (2009) did a study to observe the presence of sexual dimorphism and to compare the mesiodistal width of the teeth in various ethinic orgins Caucasian, African and Japanese individuals with Brazilian ancestry. They found that Sexual dimorphism occurred on the three evaluated groups, and the highest mesiodistal widths were found in males . There was statistically significant difference between the racial groups They concluded that Africans had a greater mesio distal width followed by Japanese and Caucasians, respectively.[78]

Raj bir khangura et al (2011) showed the mesio distal width of permanent maxillary incisors and canines showing that the mesio distal values of all maxillary incisors and canines exhibited larger mean values comparison in males but only canine values were found to be statistically significant for sexual dimorphism[65]

Sittiporn Ruengdit (2011) did a study on sexual dimorphism in teeth Thailand population They observed sex identification from teeth size had an accuracy is relatively of 70%.[63]

Navreet Sandhu et al (2011) did a study to evaluate a relationship existing between the width of philtrum and mesio-distal width of maxillary central incisors in males .They reported that the Width of philtrum was relatively less in females as compared to males. The combined mesio distal width of maxillary

central incisors was always greater than the width of philtrum in both the sex. The mean mesio-distal width of maxillary central incisor was more in [79]

Saeed Hossain Khan et al (2011) did a study for identifying mesiodistal crown dimensions of permanent teeth in Bangladeshi Population .They Identified that males had significantly larger maxillary central incisors & mandibular second premolar with P values are ($p < 0.05$), ($p < 0.001$) respectively .In both sexes, the maxillary lateral incisors showed the greatest variability coefficient of variation (CV) 10.7% and the maxillary canines the least (CV 6.9%) in mesiodistal crown dimension. Among the teeth, mandibular canines displayed greater sexual dimorphism in mesiodistal crown size[80]

Pooja Ahluwalia et al (2011) evaluated the applicability of the Tanaka-Johnston method of prediction of mesiodistal widths of permanent canines and premolars in North Indian population. The study revealed that the differences between the actual and predicted values of permanent canines and premolars were statistically significant in maxilla and mandible in both sexes ($p<0.05$). [81]

Ibrahim H. Al-Fahdawi (2011) did a study to identify gender using the mesiodistal crown diameter of the teeth with 40 students within the age group 13-19 years old. The study showed that half of the teeth on the maxilla and the mandible are significantly different with respect to sex. Moreover, only molar and first premolar teeth on the maxilla showing significant intersex difference with respect to the side of the tooth.[67]

Sonal Pamecha et al (2012)did a study on Rajasthan population and observed that there is a variation in mesio-distal width of right and left sides

signifying that the anterior teeth are not mirror images of one another. Mesio distal width was greater on right side than on left side in most of the cases . Male subjects had teeth with greater mesiodistal width than female subjects showing evident sexual dimorphism .[82]

Dr. Dhara H. Parekh (2012) showed that the sexual dimorphism in mesio-distal diameter is more in right maxillary canine (8.87%) than the left maxillary canine (7.26%). Sexual dimorphism in canine index is more in right maxillary canine (1.93%) than the left maxillary canine t (0.61%). [83]

Talat Al-Gunaid (2012) conducted a study in Yemeni population and they observed that males had slight larger teeth than females and there is no significant discrepencies was observed between the right and left side. [84]

J.V. Zirahei et al (2013) conducted a study on sexual dimorphism maxillary canine teeth among Nigerian students. They reported that there is a significant sexual dimorphism in maxillary canines. The mesiodistal width of the maxillary canine teeth was slightly larger in males than in females.A significant increase in the intercanine distance of the maxilla was observed in males than in females [85]

Shalini Gupta et al (2014) showed that MD of maxillary canines was significantly greater in males than females. They concluded that Sexual dimorphism was more on right permanent maxillary canine than left. Increased inter-canine width in males favours the teeth in sex identification [68]

Ayesha Shireen (2014) did a study to know sex determination potential from mesiodistal dimensions of permanent canines. The mesiodistal widths measurements of all canines were studied on the dental casts of 600 subjects. The mean maxillary and mandibular canine width was found to be less in South Indian population as compared to Central Indian population. The study also showed that the mean maxillary and mandibular canine width in South India Population as was less than the values of Wheelers and equal to the mean values of Saudi population[86]

Geetha Paramkusam, (2014) did a study by measuring the Mesio-distal (MD) widths of maxillary and mandibular right and left canines and inter-canine distance of both arches know the effectiveness of the canine tooth for predicting the sex of an individual. The study showed a significant sexual dimorphism and the standard mandibular canine index (CI) was found to be more reliable in gender estimation than the MD width of canine and CI values. [87]

Srivastava R et al (2014) did a study to evaluate and estimate the accuracy of sex determination in permanent teeth using maxillary central incisor and canine. Results showed that the maxillary central incisors and canines revealed a statistically highly significant sexual dimorphism [88]

MATERIALS & METHODS

This study to compare the reliability of determination of sex using barr bodies, palatal rugae, maxillary central incisor and maxillary canine was conducted in the Sree Mookambika Institute of Dental Sciences, Kulasekaram with a total sample size of 100 who were the students of the same institution with 50 males and 50 females of age group between 18-30 yrs

MATERIALS AND METHODS:

Study design : **Descriptive study**

Study Setting : Department Of Oral and MaxilloFacial Pathology,

Sree Mookambika Institute of Dental Sciences

Kulasekaram

Total duration of the study : 1 year

Number of groups studied : 2 Groups

Detailed description of the groups:

Group 1 – Adult healthy females between of age 18-30 years

Group 2 – Adult healthy males between of age 18-30 years

SAMPLING:

Sample size of each group : 50

Total sample size of the study: 100

Sample size determined using the formula :

$$SS = Z^2 x (P) x (1-P) / C^2$$

SS = sample size

Z = Z value percent confidence level

C = Confidence interval expressed

Inclusion criteria:

- Subject of chronological age between 18 – 30 years with fully erupted maxillary incisors and canine from amongst students of Sree Mookambika Institute of Dental Science , Kulasekharam

Exclusion criteria:

- Patient with dental caries in evaluating teeth
- Patient undergone teeth extraction for prosthetic and esthetic concern in evaluating teeth
- Subjects with Klinfelter syndrome ,Turners syndrome,
- Subjects having oral ulceration with viral infection
- Carcinoma: breast cancer, Oral cancer and any pathology of Head and neck region
- Surgical and clinical pathology in relation to maxilla and buccal mucosa
- Cleft palate

Parameters studied

- Identification of inactivated X chromosome as condensation in nucleus under 100X oil immersion Light microscope and counted

- Using digital vernier caliper & divider Measurements in millimetres for mesio-distal width of maxillary central incisors & maxillary canines
- Rugae Pattern are identified as per the classification established by Thomas et al in 1983 according to the number ,type and length of rugae are measured using venire calliper

Method/Technique/instruments/Reagents/Kit:

The detailed descriptive informed consent was explained to the volunteer in their mother tongue and samples were selected according to the inclusion and exclusion criteria of this study

Barr bodies sample collection

Collection kit

- Adelta Light Microscope
- Lab tech Microscopic glass slides
- Diamond marker
- Label
- Cytospray of ethanol (bio fix spray)
- Wodden spatula
- Coverslip (Lab tech)
- Bio Lab Diagnostics ,Rapid PAP kit for staining
    - Distilled water (NICE)
    - Dehydrant 100% (Propanol)
    - Scott tap water

- Harris haematoxylin- Nuclear stain
- OG -6 } Cytoplasmic stain
- EA- 36
- Xylene – clearing agent
- DPX- mountant

RUGAE & CANINE, CENTRAL INCISOR:

- Perforated stainless steel Stock tray (Atico medical)
- Aliginate powder- (Zhermack ,Algitex
- Disposable rubber Gloves (MS. Surgicals)
- Rubber bowl (Surbhi Chem)
- Curved spatula (Vijay dental depot)
- Straight spatula (Vijay dental depot)
- Dental stone type III (Gold Stone)
- HB pencil (Apsara)
- Digital Vernier Caliper 0.01 m resolution (Mitotoyo)

Procedure in brief:

100 subjects were selected systematic randomly from amongst the students of Sree Mookambika Institute of Dental Science, Kulasekharam, fulfilling the inclusion and exclusion criteria. The scope of the study and procedures involved were explained to them in detail and informed consent will be obtained willingly under no compulsion. Data will be collected on a pre designed Proforma.

Collection of samples:

For Barr Bodies:

Individual detailed proforma were recorded. The patient was asked to rinse the oral cavity using water to remove the debris. Smear was obtained using wooden spatula on the right and left buccal mucosa by scraping. The smear was smeared on a separately labelled glass slide for each individuals, and fixed by ethanol available as cytospray .

The staining was done using the protocol mentioned in the rapid PAP kit

The steps of staining are

- Rehydration of the smear using distilled water for 3 min and blot out the excess water from the slide
- Nucleus was stained using the Haematoxylin for 30 seconds
- Three drops of Scotte,s tap water was added to the slide
- Washed in distilled water after 10 seconds
- Remove the excess water by blotting
- The slide was then dehydrated using Propanol for two changes
- After dehydration the slides are stained with cytoplasmic stain for 45 seconds
- Wash the slides in running tap water and blot out excess water
- The slide dehydrated using Propanolfor 30 seconds
- Clearing was done by diping it in Xylene
- Mounted with DPX using a covers lip

The slides are viewed under 100x oil, immersion light microscope and 100 intact and clear cells were checked for the presence of Barr bodies

For Maxillary Central Incisor & Canine Mesio-distal width and Rugae:

After the smearing procedure, The individual maxillary alveolar and palate were recorded. Sterilised perforated stock tray was selected for each individual and the impression was made using irreversible hydrocolloid impression material Alginate. Impression was selected by discarding the voids and distortion. Master cast was made without porosity using the type III dental stone.

Evaluating the master cast:

For central incisor and canine

As mentioned in the text book of wheeler's dental anatomy, physiology and occlusion 9th edition.yhe contact points of the teeth 11, 21 and 13, 23 were marked .The values are measured using the digital vernier calliper of 0.01 resolutions. The measurement is repeated for three times and the average was selected as the value. Measurements are recorded in millimetres.

For palatal rugae:

In the master cast the excluding the incisive papilla the palatal rugae were outlined using the lead HB pencils to delineate the palatal rugae. Digital vernier caliper was used to measure the length of the rugae and they are classified according to the Thomas et al 1983 classification. The rugae of different pattern are also noted

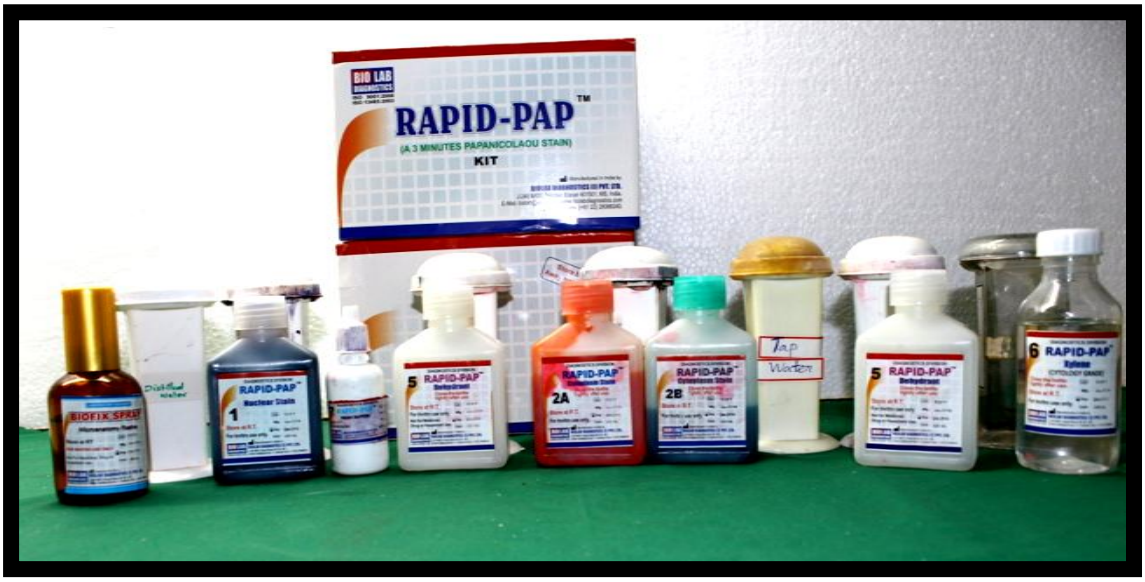
Statistical method of analysis

Analysis done using statistical package SPSS 17 using the parameters like mean, median mode, standard deviation was calculated. T test analyses with regenerative observational curve were plotted.

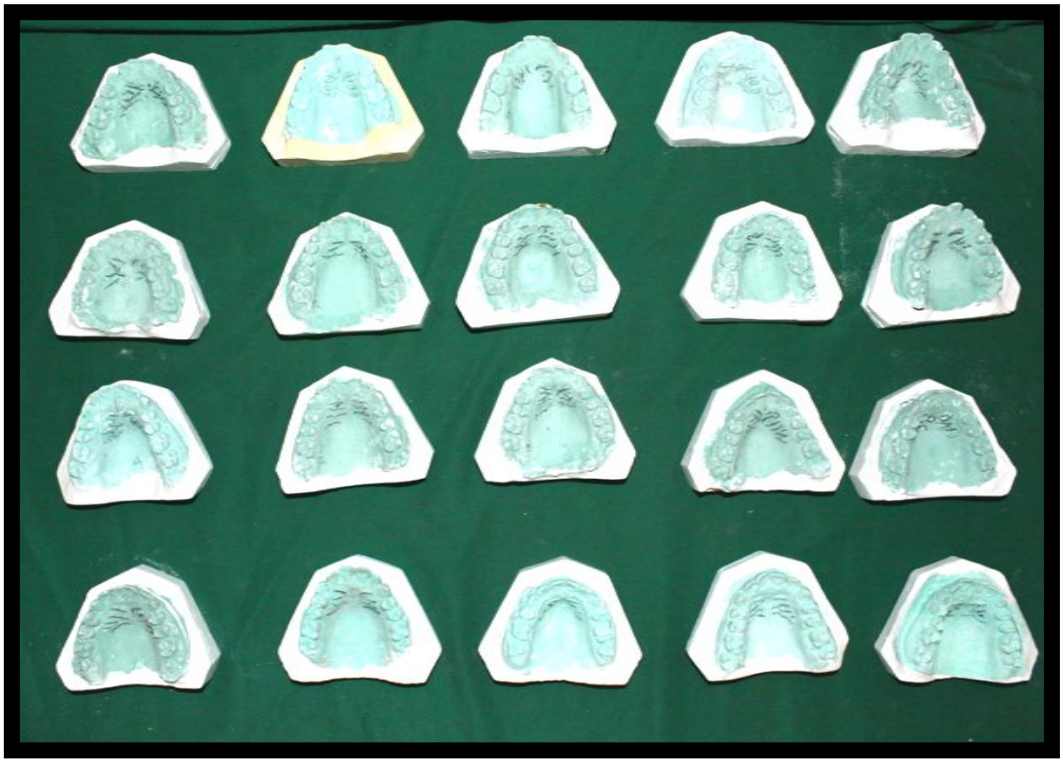
COLOUR PLATES

CP: 1 SAMPLE COLLECTION MATERIALS

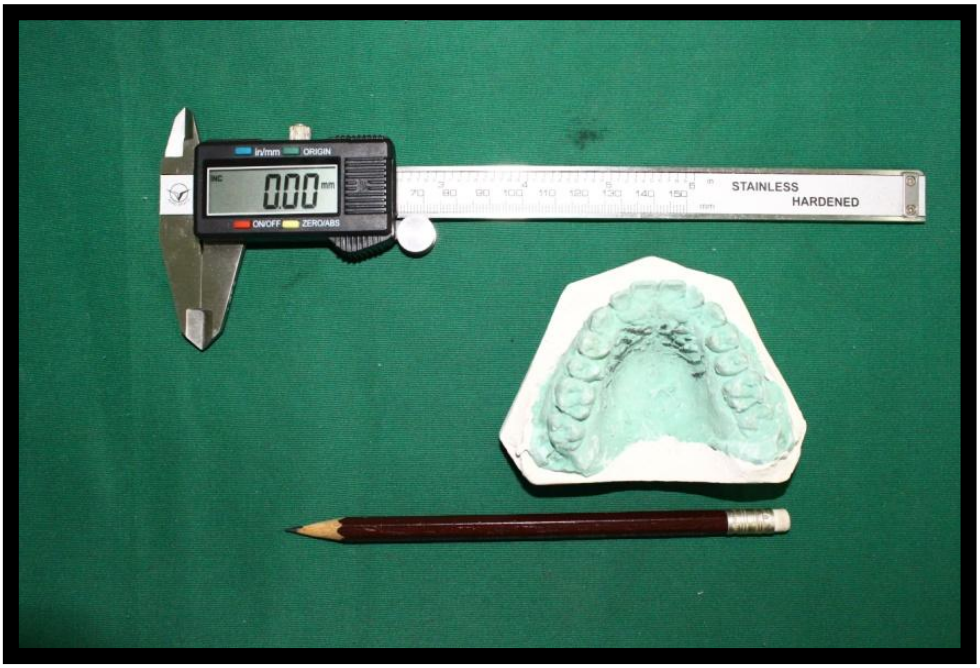
CP: 2 RAPID PAP KIT



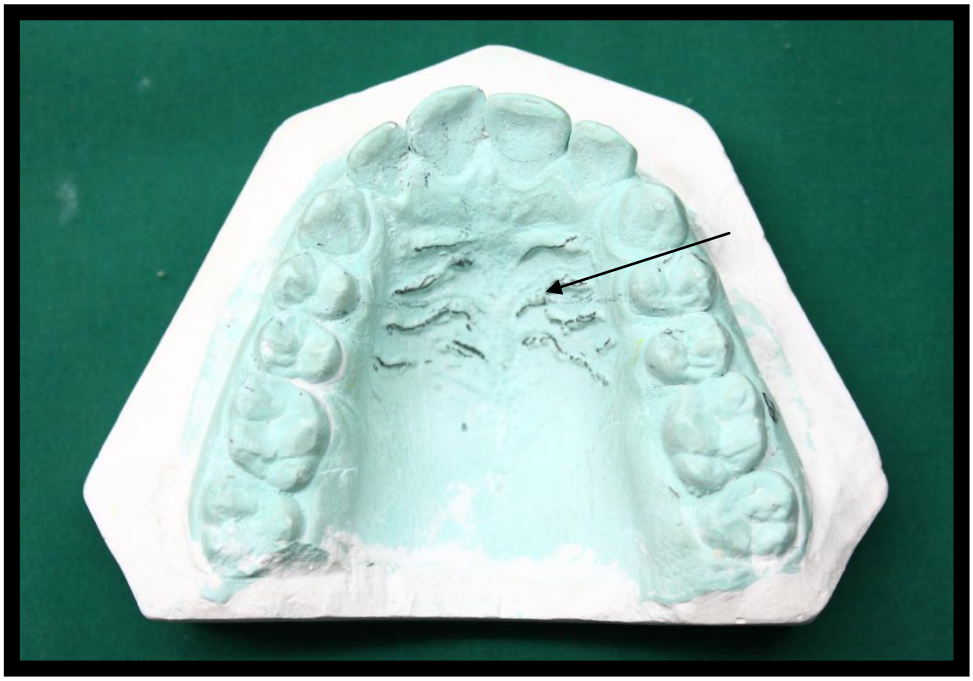
CP : 3 MOODELS OF SAMPLES



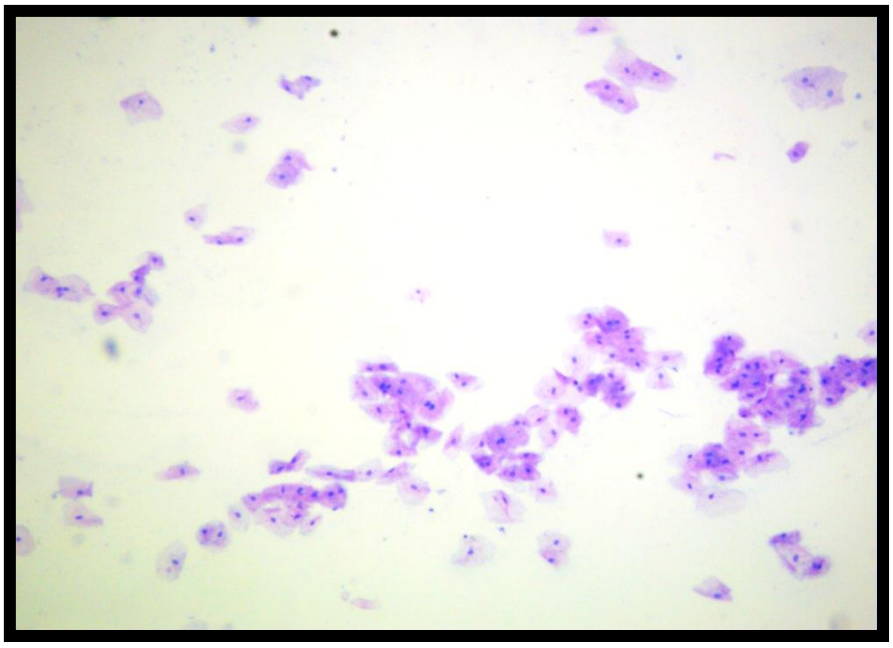
CP: 4 MEASURING MESIODISTAL WIDTH OF TEETH



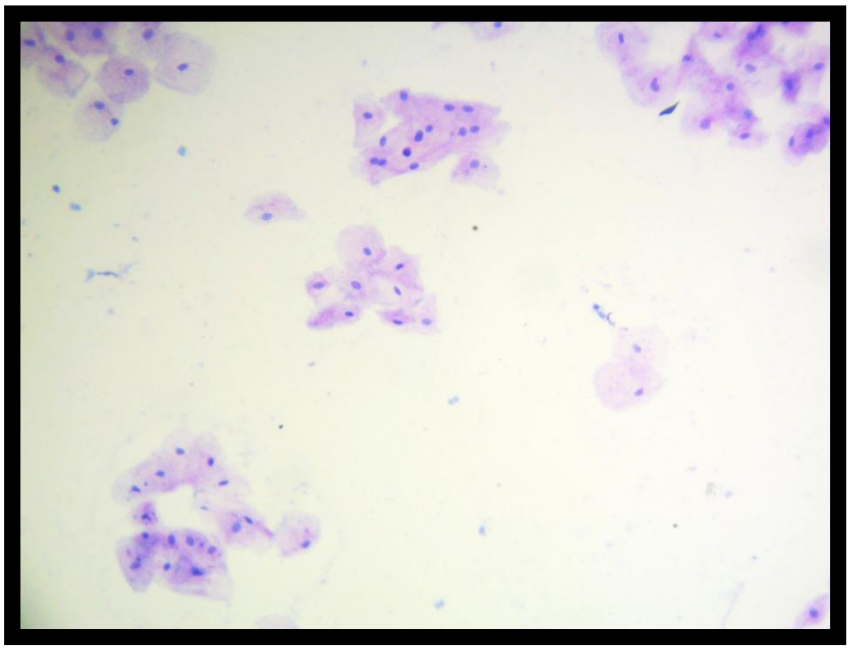
CP: 5 RUGAE PATTERN OUTLINED USING PENCIL



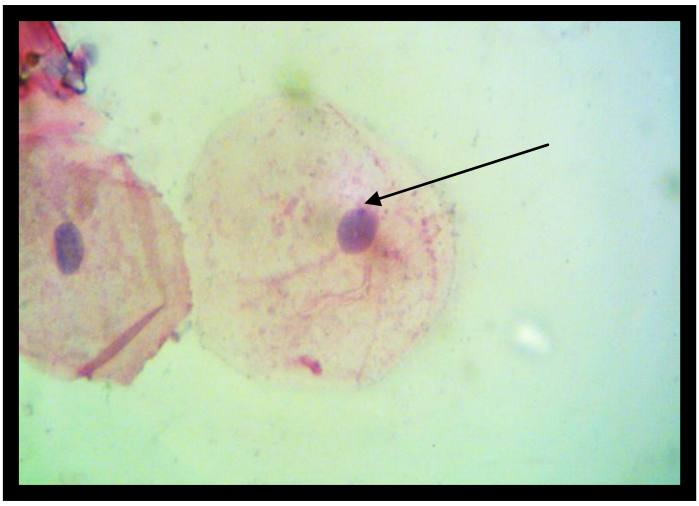
CP 6: BUCCAL SMEAR CYTOLOGY STAI NED WITH PAP 4X



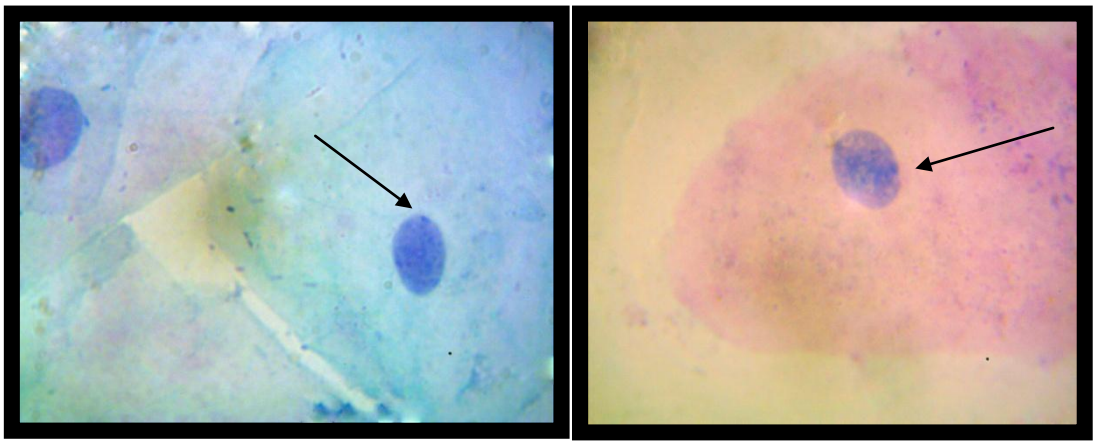
CP 7.BUCCAL SMEAR CYTOLOGY 10 X



CP 8.BUCCAL SMEAR CYTOLOGY 40 X



CP 10. BUCCAL SMEAR CYTOLOGY 100X (BARR BODIES)



RESULTS & OBSERVATIONS

In our study we compared the reliability of sex determination in a sample group of 100 within an age limit of 18 yrs to 30 yrs using the mesio-distal width of maxillary central incisor, maxillary canine, palatal rugae and Barr bodies as the parameters.

Statistical analysis was done by T test and Chi square test using the SPS software of version 17.0

Comparison done on the age group using T test analysis showed a significant P value less than 0.01 with a mean value of 21.36 in male and 20.32 in female.

Teeth measurements:

On analysing the mesio distal width of maxillary central incisor 11, 21 the mean values were 8.95 mm and 8.91mm in males. The females had a mean value of 8.36 mm and 8.33mm respectively. The percentage of sexual dimorphism expressed in our using garn et al formula showed 7% in 11 and 6.9% in 21

The average mean value of maxillary central incisor was 8.6 mm . The inter sex difference were 0.04in male and 0.03 in females. T test analysis showed a highly significant P value<0.001

The maxillary canine of male 13, 23 had a mean value 7.99 mm, 7.95 mm. This also showed a difference of 0.04 mm in the intersex .In female sex the mean were 7.54mm,7.52 mm, with a mean difference of 0.02mm .T test analysis showed a highly significant P value <0.001 for both 13, 23. The average mean of the maxillary canine was 7.75 mm

According to the Garn et al formula of dimorphism, the sexual dimorphism exhibited by 11 is 7%and 21 is 6.9%. Similarly the Garn et al formula for maxillary canine it is 13 is 5.9%and 23 is 5.7%.

Regenerative characteristic curve (ROC) analysis was done to find best cut-off value for the teeth mesio-distal width to classify between Male and Female.

The ROC showed that 11 that maxillary right central incisor having a value greater than 8.49 was had a higher chance of being a male and the diagnostic accuracy was 75%

The ROC analysis graph for 21 showed that those left central incisor having a value greater than 8.79 was had a higher chance of being a male and the diagnostic accuracy is 78%

The ROC analysis graph for 13 showed that maxillary right canine having a value greater than 7.84mm had a higher chance of being a male and the diagnostic accuracy was 74%.

The ROC analysis graph for the 23 showed that those maxillary left central incisor having a value greater than 7.54 had a higher chance of being a male and the diagnostic accuracy is 69%

Rugae Analysis:

The rugae pattern in both the sex shows an increased total rugae count in females with a mean of 9.56 and a P value of 0.53. The primary rugae count was more in males with a mean of 8.68 which is also insignificant with a P value of 0.058.

The secondary rugae and fragmentary count was more in females with a P value of 0.04 and 0.4 respectively. These values shows that, in ROC curve analysis the primary rugae count greater than 9 have a higher chance to be male with a diagnostic accuracy of 59 %. The secondary rugae count greater than 1 will have a stronger female predilection with a diagnostic accuracy of 65%.

On analysis the sequence of rugae occurrence wavy, followed by curved, straight and circular in that order .showing the type of rugae, the males had a higher mean value of 3.26 wavy, 1.92 straight, 2.52 curved, 0.18 convergent.

In females rugae pattern had higher mean values of 0.14 in circular and 0.68 in divergent. The p values are in significant in both the sexes

Barr body:

In Barr body analysis they showed a higher mean vale of 22.22 in females and 4.32 in males the roc curve analysis shows that the Barr bodies count greater than 10 will be females and the diagnostic accuracy was 99%

TABLES & GRAPHS

TABLE: 1

Table for T Test Analysis in Age Group

Variable	Gender	N	Mean	Std. Dev	t-Value	P-Value
Age	Male	50	21.36	1.382	4.205	< 0.001
	Female	50	20.22	1.329		

P value less than 0.05 is significant

Graph: 1 Bar diagram between the groups in relation to age groups

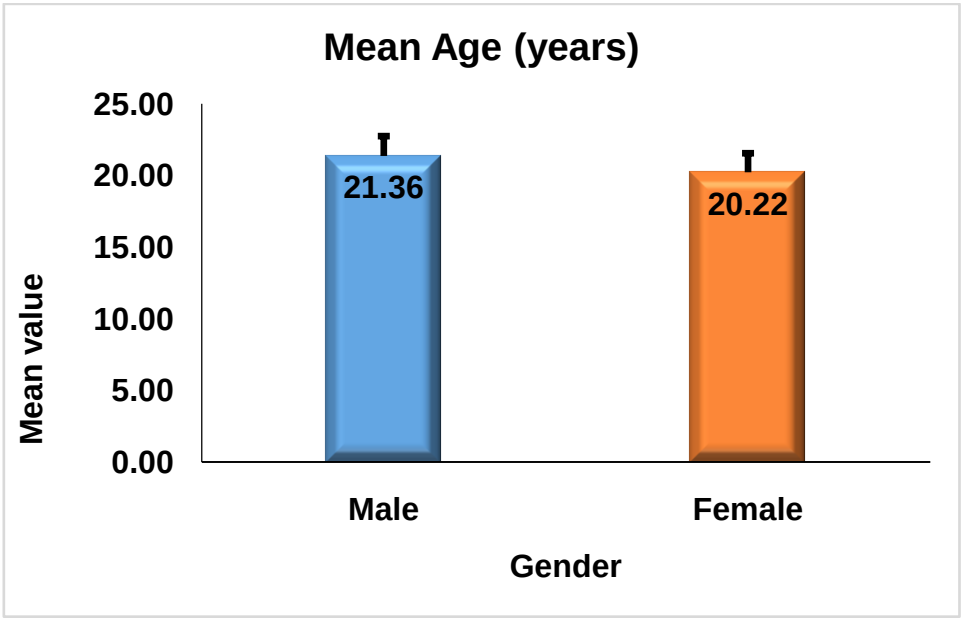


TABLE: 2

Distribution of mesio-distal width of maxillary central incisors 11 and 21 between the male and female sexes

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
11	8.95±0.66	8.36± 0.45	.000
21	8.92±64	8.34 ±0. 42	.000

Table : 3

Distribution of mesio-distal width of maxillary canine 13 and 23 between the male and female sexes

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
13	7.99± 0.52	7.54±0.39	.000
23	7.95±0.57	7.52±0.42	.000

Graph 2: Barr diagrammatic representation of mesiodistal width of 11,21,13,23 in both sex

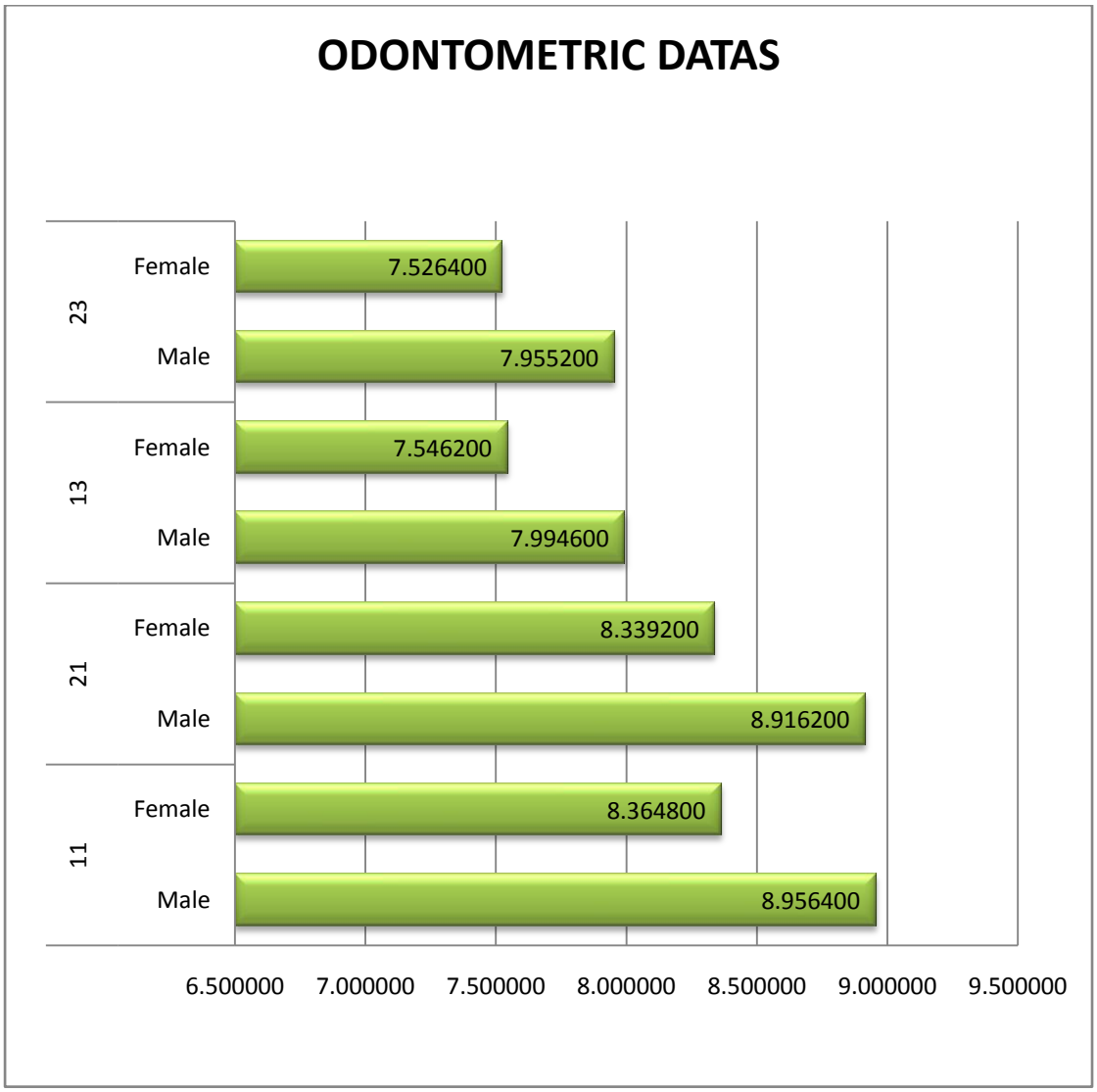


Table: 4 Distribution of total number of rugae between the male and female sexes

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
Total numbers of rugae	9.36±1.65	9.56±1.54	0.53

Table: 5 Distribution of types of rugae based on length between the male and female sexes

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
Primary	8.68±1.64	8.10±1.35	0.50
Secondary	0.64±0.9	1.28±1.24	0.004
Fragmentary	0.1±0.36	0.18±.56	0.40

Graph 3: Barr diagrammatic representation of total rugae, primary , secondary and fragmentary on both sex

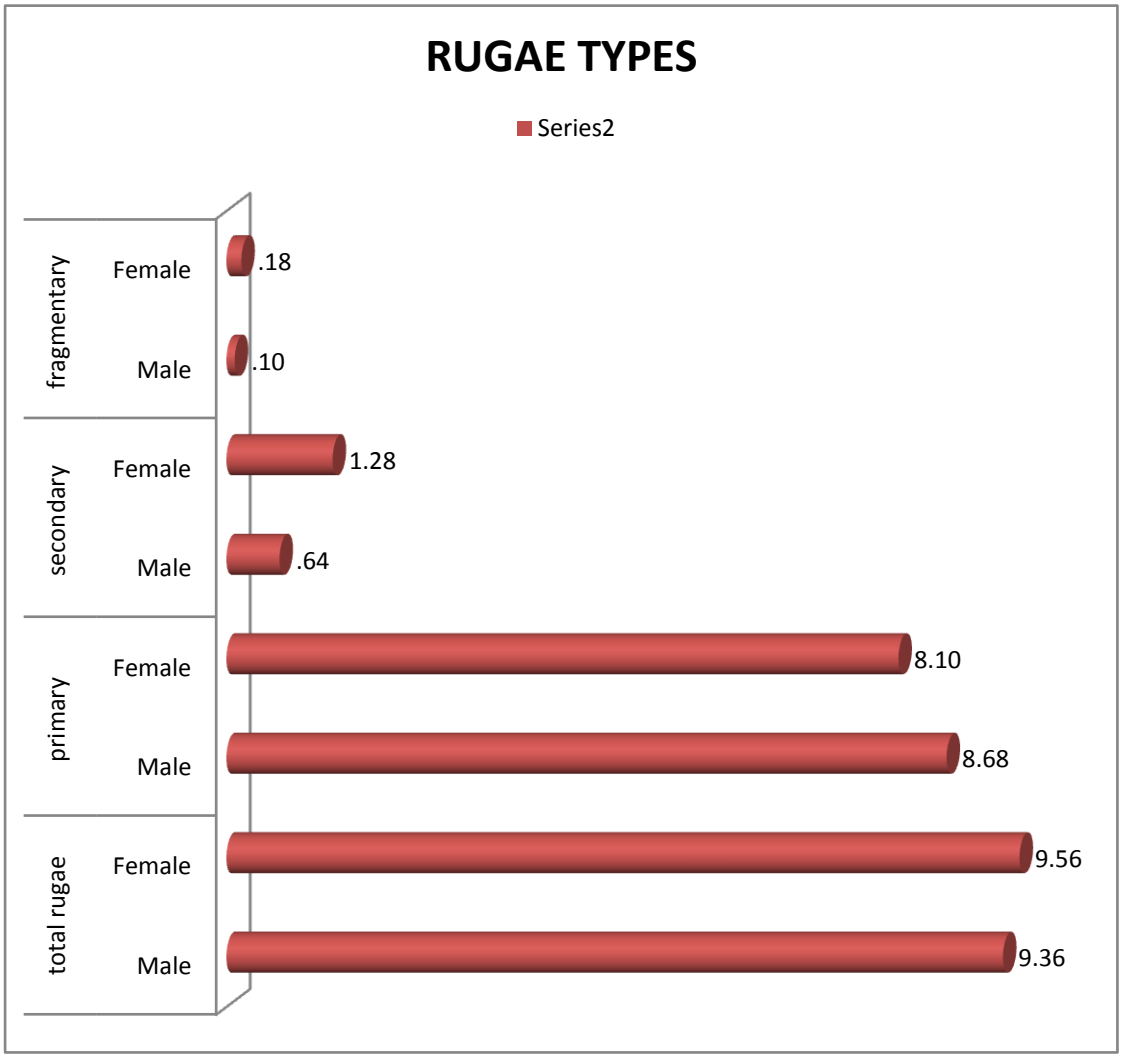
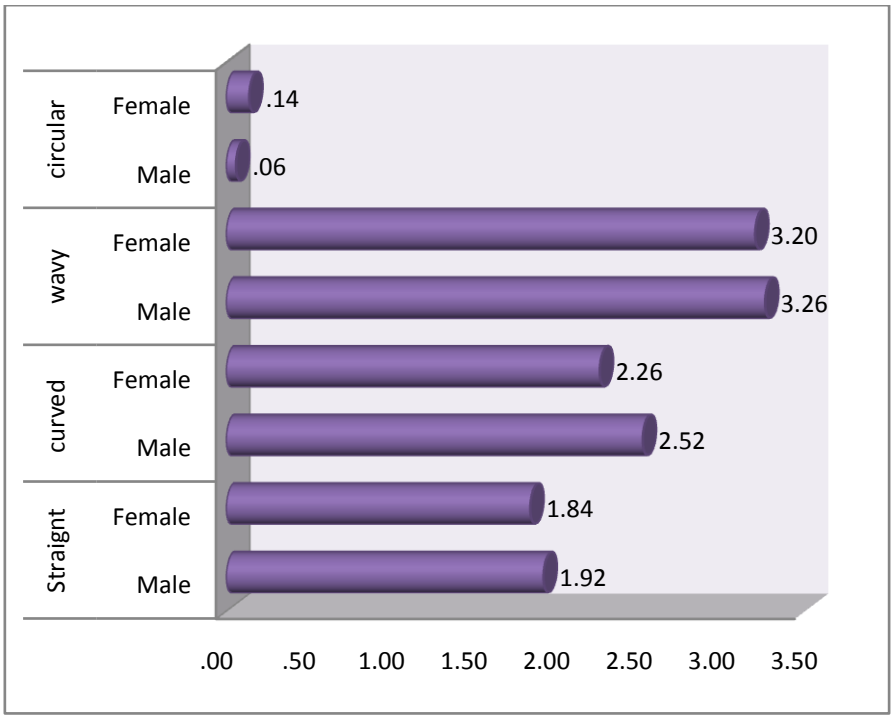


Table: 6 Distribution of types of rugae based on the pattern in the male and female sex groups

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
straight	1.92±1.58	1.84±1.26	0.78
Curved	2.52±1.70	2.26±1.192	0.37
wavy	3.26±1.306	3.20±2.06	0.862
Circular	0.06±0.24	0.14±0,41	0.233
Convergent	0,18±0.44	0.16±0.42	0.816
Divergent	0.62±0.75	0.68±0.680.677	0.677

Graph : 4 .Bar diagrammatic representation of straight , curved ,wavy, circular pattern in both the sex



Graph: 5 .Bar diagrammatic representation of convergebt and divergent pattern in both the sex

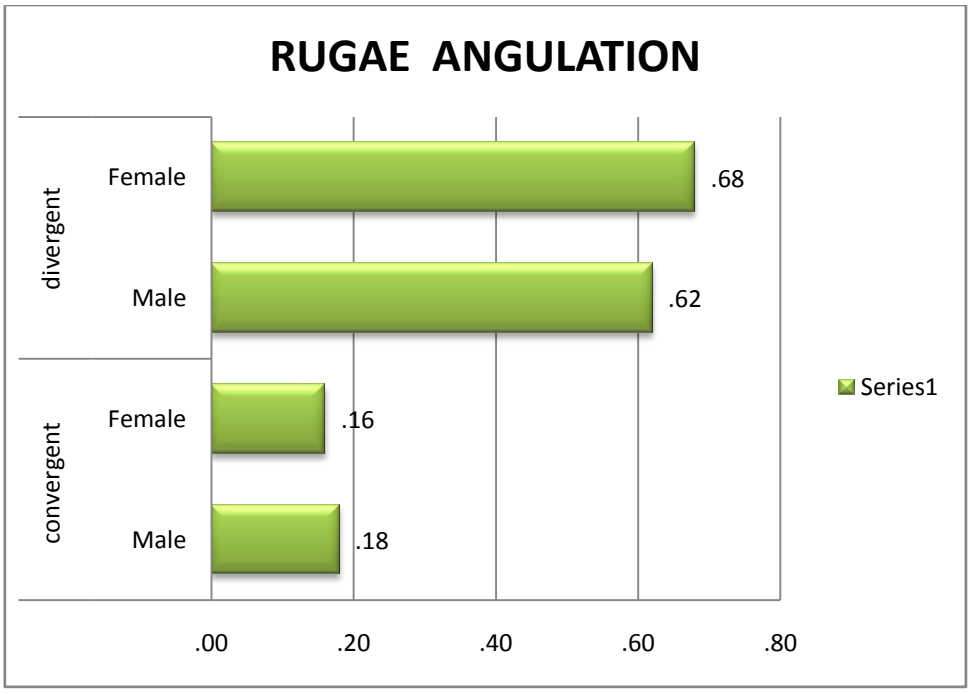


Table: 7 Distribution of Barr bodies in the male and female sex groups

Groups	Sex		P Value
	Male (n= 50) Mean ±SD	Female(n= 50) Mean ±SD	
Barr Bodies	4.32±1.93	22.22± 5.79	0.00

Graph: 6.Bar diagrammatic representation of Barr bodies distribution pattern in both the sex

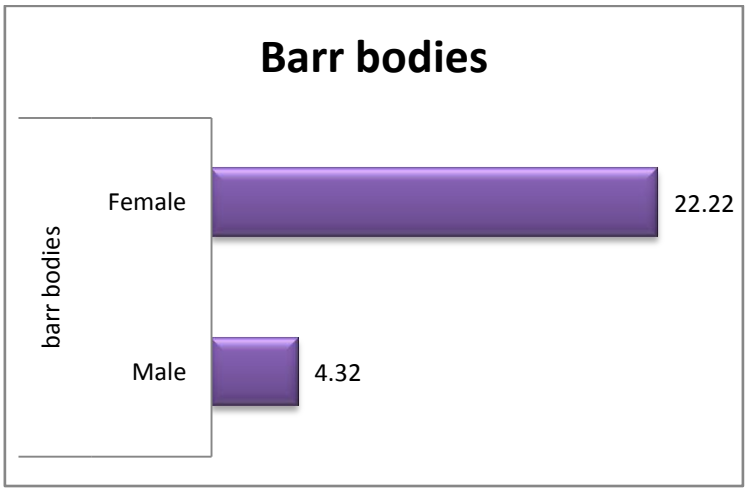
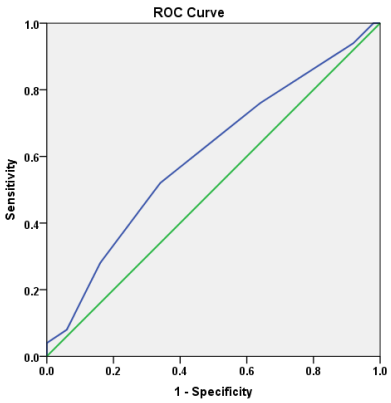


Chart: 7 ROC CURVE –primary rugae

ROC curve analysis is done to find best cut-off value for primary value to classify between Male and Female.



Area under the Curve = 0.602

ROC curve analysis results showed that the best cut off value for Primary value to classify Male is more than or equal to9. That is if the primary value is more than or equal to9, we can classify that there is a high chance of being a Male. If the Primary value is less than 9then there is a high chance of being a Female.

Table : 8 Sensitivity Specificity analysis of primary rugae

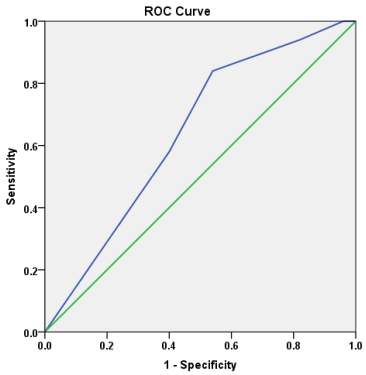
		Gender		Total
		Male	Female	
Primary value	>= 9	26	17	43
	< 9	24	33	57
Total		50	50	100

Table: 8a

Parameter	**Estimate**	**95% CIs**
Sensitivity	52.00%	(38.51, 65.20)
Specificity	66.00%	(52.15, 77.56)
Positive Predictive Value	60.47%	(45.58, 73.63)
Negative Predictive Value	57.89%	(44.98, 69.81)
Diagnostic Accuracy	59.00%	(49.20, 68.13)

Chart: 8 ROC CURVE- secondary rugae

ROC curve analysis is done to find best cut-off value for secondary value to classify between Male and Female.



Area Under the Curve = 0.640

ROC curve analysis results showed that the best cut off value for secondary value to classify Male is less than or equal to 1. That is if the secondary value is less than or equal to 1, we can classify that there is a high chance of being a Male. If the secondary value is more than 1 then there is a high chance of being a Female.

Table 9 : Sensitivity Specificity analysis secondary rugae

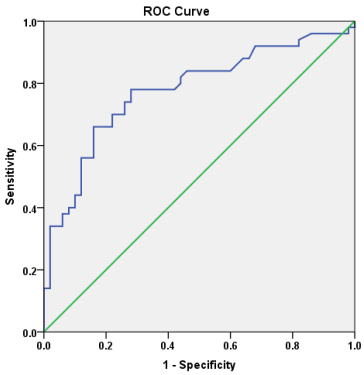
		Gender		Total
		Male	Female	
Secondary value	<= 1	42	27	69
	> 1	8	23	31
Total		50	50	100

Table : 9a

Parameter	**Estimate**	**95% CIs**
Sensitivity	84.00%	(71.49, 91.66)
Specificity	46.00%	(32.97, 59.60)
Positive Predictive Value	60.87%	(49.07, 71.52)
Negative Predictive Value	74.19%	(56.75, 86.30)
Diagnostic Accuracy	65.00%	(55.25, 73.64)

Chart: 9 ROC CURVE –T-11

ROC curve analysis is done to find best cutoff value for T-11 value to classify between Male and Female.



Area Under the Curve = 0.776

ROC curve analysis results showed that the best cut off value for T-11 value to classify Male is more than or equal to 8.49. That is if the T-11 value is more than or equal to 8.49, we can classify that there is a high chance of being a Male. If the T-11 value is less than 8.49 then there is a high chance of being a Female.

Table: 10 Sensitivity Specificity analysis T-11

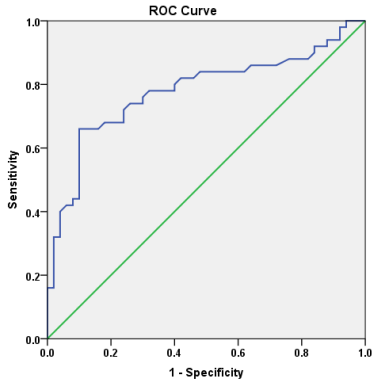
		Gender		Total
		Male	Female	
T-11 Value	>= 8.49	39	14	53
	< 8.49	11	36	47
Total		50	50	100

Table 10 a

Parameter	**Estimate**	**95% CIs**
Sensitivity	78.00%	(64.76, 87.25)
Specificity	72.00%	(58.33, 82.53)
Positive Predictive Value	73.58%	(60.42, 83.56)
Negative Predictive Value	76.60%	(62.78, 86.40)
Diagnostic Accuracy	75.00%	(65.70, 82.45)

Chart: 10 ROC CURVE –T-21

ROC curve analysis is done to find best cutoff value for T-21 value to classify between Male and Female.



Area under the Curve = 0.779

ROC curve analysis results showed that the best cut off value for T-21 value to classify Male is more than or equal to 8.79. That is if the T-21 value is more than or equal to 8.79, we can classify that there is a high chance of being a Male. If the T-21 value is less than 8.79 then there is a high chance of being a Female.

Table: 11 Sensitivity Specificity analysis T-21

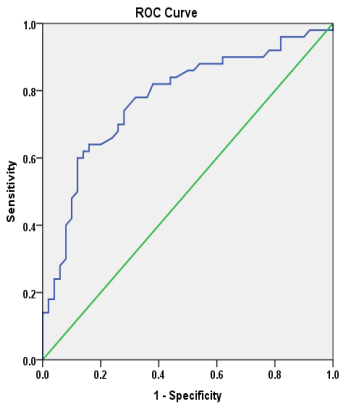
		Gender		Total
		Male	Female	
T-21 Value	>= 8.79	33	5	38
	< 8.79	17	45	62
Total		50	50	100

Table 11 a

Parameter	**Estimate**	**95% CIs**
Sensitivity	66.00%	(52.15, 77.56)
Specificity	90.00%	(78.64, 95.65)
Positive Predictive Value	86.84%	(72.67, 94.25)
Negative Predictive Value	72.58%	(60.41, 82.12)
Diagnostic Accuracy	78.00%	(68.93, 85.00)

Chart: 11 ROC CURVE T-13

ROC curve analysis is done to find best cutoff value for T-13 value to classify between Male and Female.



Area Under the Curve = 0.777

ROC curve analysis results showed that the best cut off value for T-13 value to classify Male is more than or equal to 7.84. That is if the T-13 value is more than or equal to 7.84, we can classify that there is a high chance of being a Male. If the T-13 value is less than 7.84 then there is a high chance of being a Female.

Table 12: Sensitivity Specificity analysis.T-13

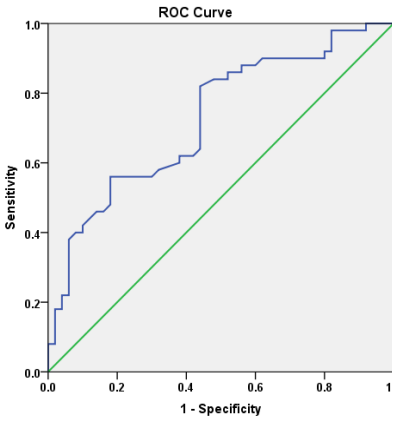
		Gender		Total
		Male	Female	
T-13 Value	>= 7.84	32	8	40
	< 7.84	18	42	60
Total		50	50	100

Table 12 a

Parameter	**Estimate**	**95% CIs**
Sensitivity	64.00%	(50.14, 75.86)
Specificity	84.00%	(71.49, 91.66)
Positive Predictive Value	80.00%	(65.24, 89.50)
Negative Predictive Value	70.00%	(57.49, 80.10)
Diagnostic Accuracy	74.00%	(64.63, 81.60)

Chart:12 ROC T-23

ROC curve analysis is done to find best cutoff value for T-23 value to classify between Male and Female.



Area Under the Curve = 0.726

ROC curve analysis results showed that the best cut off value for T-23 value to classify Male is more than or equal to 7.54. That is if the T-23 value is more than or equal to 7.54, we can classify that there is a high chance of being a Male. If the T-13 value is less than 7.54 then there is a high chance of being a Female.

Table 13: Sensitivity Specificity analysis T-23

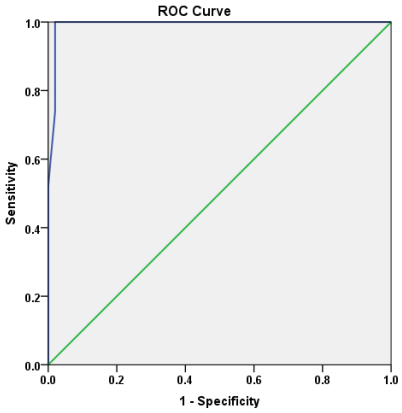
		Gender		Total
		Male	Female	
T-23 Value	>= 7.54	41	22	63
	< 7.54	9	28	37
Total		50	50	100

Table: 13b

Parameter	**Estimate**	**95% CIs**
Sensitivity	82.00%	(69.20, 90.23)
Specificity	56.00%	(42.31, 68.84)
Positive Predictive Value	65.08%	(52.75, 75.67)
Negative Predictive Value	75.68%	(59.88, 86.64)
Diagnostic Accuracy	69.00%	(59.37, 77.22)

Chart 13 ROC – Barr Bodies

ROC curve analysis is done to find best cutoff value for Barr bodies value to classify between Male and Female.



Area under the Curve = 0.993

ROC curve analysis results showed that the best cut off value for Barr bodies value to classify Male is less than or equal to 10. That is if the Barr bodies value is less than or equal to 10, we can classify that there is a high chance of being a Male. If the Barr bodies value is more than 10 then there is a high chance of being a Female.

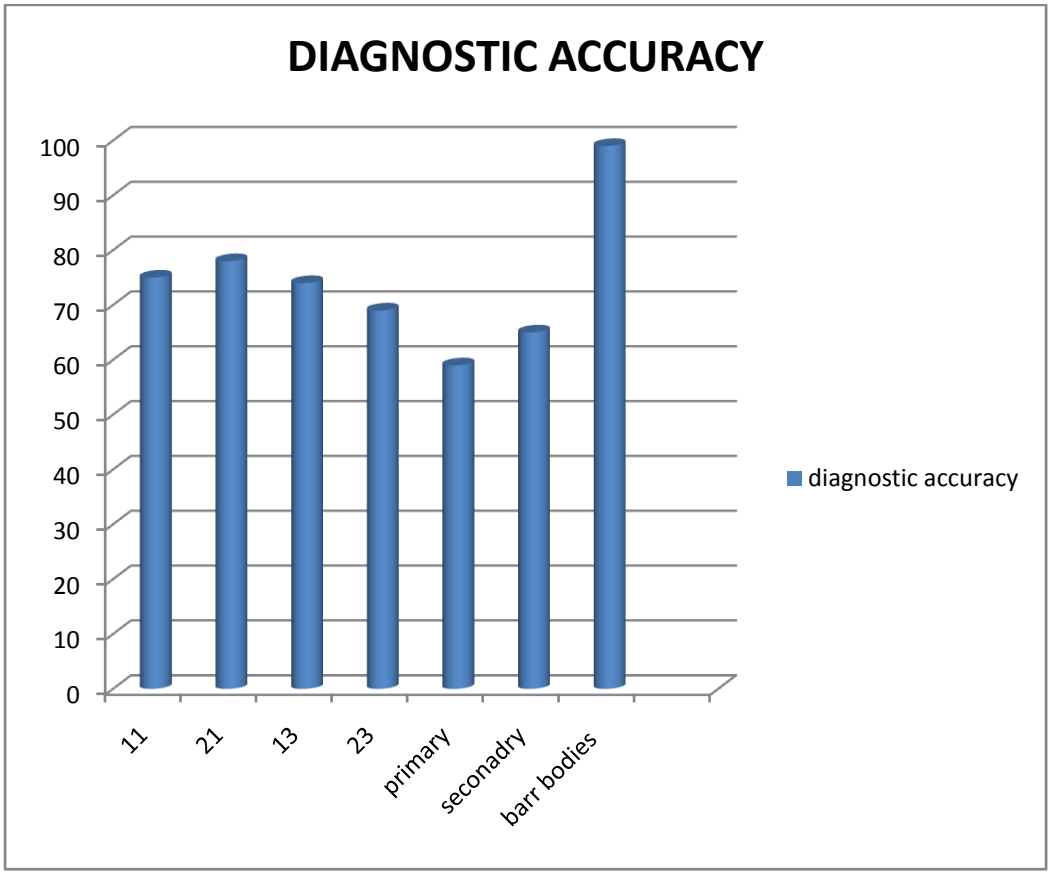
Table 14 Sensitivity Specificity analysis. Barr bodies

		Gender		Total
		Male	Female	
Barr bodies Value	<= 10	50	1	51
	> 10	0	49	49
Total		50	50	100

Table 14 a

Parameter	**Estimate**	**95% CIs**
Sensitivity	100.00%	(92.86, 100.00)
Specificity	98.00%	(89.5, 99.65)
Positive Predictive Value	98.04%	(89.7, 99.65)
Negative Predictive Value	100.00%	(92.73, 100.00)
Diagnostic Accuracy	99.00%	(94.55, 99.82)

PERCENTAGE OF DIAGNOSTIC ACCURACY



DISCUSSION

Sex determination is one of the main applications of forensic odontoogy for reducing the suspects and victims numbers in mass disasters, criminal or civil cases. Sex determination in dead and degenerated bodies can be identified using Conventional methods and advanced methods. The conventional methods are easier and less accurate while the newer advances makes a precise sex identification which is costly and higher degree of technical expertise are needed . To identify the most reasonable and reliable method in conventional technique of sex determination the present study was done.[37]

Various authors had done studies in conventional method using palatal rugae like Kapali et al (1997)[24], Bharath et al (2011)[11], Sathish kumar et al (2012)[22]. In mesio-distal width of teeth studies were done by Kaushal et al (2005)[73], Khangura et al (2011) [65], Yuwanthi et al (2012)[9], Shireen et al (2014) [86]and in Barr bodies Mittal et al (2009)[41], Datar et al (2013)[44].

The present study was done on a sample of 100 individuals with equal sex distribution and mean age of 21. This age group had full complement of permanent teeth, fully erupted and without any physiological changes on the teeth while the rugae were fully matured which were in accordance with the studies done by Mittal et al (2009)[41], Karen boaz et al (2009)[4] , Khangura et al(2011)[65], Sathish Kumar et al (2012)[22].

In the present study average mesio-distal (8.6 mm) of the teeth sample was increased than the established mesiodistal width (8.5 mm) as described Wheelers text book of oral anatomy[93] .

The mean values of 11 and 21 in both the sexes of our study were higher than (0.4 mm in male and 0.03 mm in females) the values reported by Nair et al (1999) in their study on South Indian population[72].

In the present study mesio-distal width values for central incisors were in accordance with the values reported by Kaushal et al (2005) in north Indian population having the mean values 8.94 mm in male and8.61 mm in female. The left side had a mean value of 9.05 mm in male, 8.66mm in females respectively[73].

In this study the mean value and inter arch mean difference (0.04 mm) of both the incisors in males and females were in accordance with the study of Sonal Pamecha et al (2012)[82]

The details obtained from our study shows that the average mesio-distal width of the maxillary central incisor was found to be significantly higher in males compared to the females which was in accordance with Kaushal (2005)[73] et al and Khangura et al (2011)[65]

On comparing the sides, Maxillary left central incisor of our study showed a higher diagnostic accuracy of (78%).Similarly the left central incisor showed an increased sexual dimorphism over the right central incisor on a study done by Kaushal et al in (2005)[73].

In our study the, mesiodistal width of the maxillary canine 13and 23 were 7.99 mm, 7.95 mm in males and the mesio-distal width of 13 and 23 in female were 7.54 mm, 7.52 mm in females respectively . These values were in accordance with the study done by Karen Boaz (2009)[4].

In our study the average MD of the maxillary canine is 0.2mm larger than the established mean value of Wheelers text book of oral anatomy which is of 7.5mm. The inter arch mean difference was 0.04 in males and 0.02 in females which are in accordance with the values of Sonal Pamecha (2012) [82]

In our study the average maxillary canine mesiodistal width was higher in males when compared to females similar to the studies of sharma et al (2010)[90], Khangura et al (2011)[65]. Hashim et al(1993)[69] explained that canines were the only teeth to show sexual dimorphism in the entire jaw.

The mean MD value of the maxillary canine in our study was in accordance with the values expressed by Fernandes et al in (2013)[78] Indian population (7.99± 0.52, 7.54±0.39) for the males and females respectively.

In the present study the right side maxillary canines showed a higher diagnostic accuracy of (74%) in differentiating sex between males and females when compared to the left side which are similar to the studies done by Parekh et al (2012)[83] and Shireen et al (2014)[86] having greater dimorphism in right side maxillary canine when compared to the left canine.

On using rugae pattern and number to differentiate between males and female the total rugae and number of primary rugae, secondary rugae and fragmentary rugae were counted, measured and compared

On comparing the total number of rugae it was found that the females had a slightly more number of rugae (mean 9.56±1.54) when compared to males, but also

this was not statistically significant the measured values were in accordance with the studies of Faisal et al(2001)[32],Shankar et al(2012)[15] and Suresh et al (2013)[91]

In our study males showed a increased primary rugae count with a mean of 8.68±1.64 when compared to that of females .but again the values are not statistically significant. These values were in accordance with the study done by Buhar et al [20] and Fahimi et al (2005)[32] which were also not significant among the sexes.

In the present study the number of secondary rugae proved much more reliable in differentiating between the sexes and it was seen that females had approximately double the number of secondary rugae i.e. (1.28 ± 1.24) when compared to males which was similar to the values found in studies done by Bajacharya et al (2013)[13], Suresh et al (2013)[91], Filipovic et al (2014) [92], Madhankumar et al (2013)[12] and Paliwal(2010)[33] with an inference that secondary rugae was predominating in females . this showed a high statistical significance in the present study .

In our study, although there was an increase in fragmentary rugae number in females (0.18±.56) compared to males (0.1±0.36) this difference was negligible and played no describable part in differentiation of sexes. This was coinciding with the study of Filipovic et al.(2014)[92]

Thomas et al (1983) had commented that secondary and fragmentary rugae do not possess the discriminatory ability in different population. While Shreenivas Kallinapur et al (2011)[93] stated the secondary and tertiary rugae had a more discriminating potential than primary rugae In general population the number of primary rugae was increased and followed by the secondary and fragmentary.

On comparing the types of rugae based on the pattern it was seen that most of the rugae was wavy pattern followed by curved and straight and circular in that order. None of them showed any significant variation between the sexes which was in accordance with the studies of Sreenivas et al (2013)[93], Sarath et al [94], Shetty et al (2011) [29]and Bajacharya et al (2013)[13].

Our study showed that males had a slightly increased number of wavy, curved, and straight patterns whereas females had more circular pattern rugae compared to males which were in accordance with the studies of Kamala et al (2011)[34] and Kumar et al (2012) [22] showing that curved and straight were more prevalent with both the sexes.

In our study the circular pattern was increased in females with a mean of (0.14±0.41) when compared to males which is also in accordance with other studies Bajacharya et al (2013)[13], Madhankumar et al (2013)[12], Kamala et al (2011)[34] which also showed no statistical significance between both the sexes

In the present study Convergent type of rugae were seen to be slightly higher in number with a mean of (0.18) in males where as a divergent type was seen increased in females with a mean of (0.68). No statistically significance was noted. This inference were in accordance with the report of Suresh et al(2013)[91] ,Chopra et al (2013)[95] , Shetty et al (2013) [96] but they were statistically significant in their studies

In our study the diagnostic accuracy of using rugae characteristics was decreased in primary rugae with a 59% than the secondary rugae which had an increased diagnostic accuracy of 65%. This was similar to the values of diagnostic accuracy in palatal rugae done by study Bharath et al (2011) [11]

In our study, Barr bodies were identified using rapid Pap Stain and it showed a mean value of 22..2 in females and 4.3 in males which were in accordance with the study of Datar et al in (2013)[44] showing (4– 20) & (0 – 5) Barr bodies in females and males respectively. Tusar Mittal et al (2009)[41] on study of buccal smear with 200 samples stained with modified PAP stain, the mean values obtained 1.14% positivity for males and 39.29% positivity for females

Duffy et al has stated that in their study the Barr bodies percentage was in range of 0-6% in males and 9.2-45.7% in Females. The study of Nirmal Das (2004) also in accordance with tour study showing Barr body positive cells 24.92 ± 3.74%in haematoxylin and Eosin stain. [52]

In our study, Barr bodies had diagnostic accuracy of 99% which were in accordance with the study of Mittal et al (2009)[41]

The study by Saeed Hussain et al [80] showed that maxillary central incisor showed more sexual dimorphism followed by the mandibular second premolar. Most of the studies done in the rugae showed a reduced statistical significance which was similar to our study.

Based on the diagnostic accuracy our study shows that Barr bodies were found to be most useful and reliable in sex determination followed by the mesio-distal width of central incisor, maxillary canine and rugae characteristics tin that order

SUMMARY & CONCLUSION

The present study was undertaken to compare the reliability of four commonly used, simple methods of sex determination in forensic odontology. In studying the data collected from 100 mutually exclusive subjects, we have concluded that Barr body estimation still remains the most reliable method of sex determination from amongst the one studied here, as has been widely accepted. Mesio-distal width estimation of the maxillary central incisor and canine are also reliable indicators of sexual dimorphism and becomes almost inevitable in conditions where attaining soft tissue samples found impossible. Of the methods studied here palatal rugae turned out to be the least helpful in differentiating between the sexes .although all of the findings in the present study can be correlated by other stand alone studies, a larger scale study using cosmopolitan population may shed more light on the reliability of these findings on universal scale.

In forensic odontology, sex determination is one of the main application, especially in cases where traditional methods are not feasible. Although newer advances including genetic studies form a fool-proof methodology, sometimes odontometric methods are preferred. Amongst these, the mesio-distal dimension of certain teeth and rugae characteristics are widely used methods. Barr body estimation is yet another method commonly used, which has been shown to be the most easier and effective method of sex determination. This study comparing the reliability of Barr bodies, palatal rugae and mesio- distal dimension of maxillary canine & central incisors in determination of sex was done in the Department of Oral Pathology and Microbiology, Sree Mookambika Institute of Dental sciences, Kulasekharam with an aim of comparing the reliability of sex determination methodologies using Barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors. The objectives were to investigate the mesio-distal width of maxillary central incisor, maxillary canine, the rugal pattern and estimation of Barr bodies. Samples were selected according to the inclusion and exclusion criteria as two groups having 50 males and 50 females within the age limits of 18-30 yrs. From these subjects buccal smears and maxillary plaster casts made out of alginate impression were made with full informed consent.

Buccal smear was stained using rapid PAP kit (bio lab tech) and in each slide 100 cells were observed in oil immersion 100X light microscope (Adelta). Rugae pattern was analysed using Thomas Kotze classification (1983) and the mesio-distal measurements of maxillary central incisors and maxillary canines were measured using digital vernier calliper of 0.01 mm resolution.

On statistical analysis this study showed a significant dimorphism in Barr bodies, maxillary central incisor and maxillary canine whereas, evaluation of rugae characteristics proved to be insignificant in sexual dimorphism on T test analysis.

To understand the diagnostic accuracy amongst Barr, bodies, palatal rugae, maxillary central incisor and maxillary canine a Regenerative observational curve was plotted. The ROC curve revealed diagnostic accuracy of 99% in Barr bodies followed by 78 % in maxillary right central incisor, 75% in maxillary left central incisor, 74% in maxillary right canine and 69% in maxillary left canine .In rugae, secondary rugae showed 69% and the primary rugae had a 59% of diagnostic accuracy

This study showed that Barr bodies are more reliable in determination of sex while the rugae are the least reliable.

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ANNEXURES

Sree Mookambika Institute of Medical Sciences
Kulasekharam (K.K District, TN) 629161

Phone No: 04651-280866. Fax No. 04651-280740

Institutional Human Ethics Committee

Ref. No. SMIMS/IHEC/2013/A/12 **Date: 1st July 2013**

Certificate

This is to certify that the Research Protocol Ref. No. **SMIMS/IHEC/2013/A/12,** entitled "Comparing the Reliability of Barr Bodies, Palatal Rugae and Mesio-Distal Dimension of Maxillary Canine and Central Incisors in Determination of Sex" submitted by Dr. Gomakumar K. U, Postgraduate of Department of Oral Pathology, SMIDS has been approved by the Institutional Human Ethics Committee at its meeting held on 30th of May 2013.

[This Institutional Human Ethics Committee is organized and operates according to the requirements of ICH-GCP/GLP guidelines and requirements of the Amended Schedule-Y of Drugs and Cosmetics Act, 1940 and Rules 1945 of Government of India.]

SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES ★ KULASEKHARAM
IHEC
Date 5/7/13

Dr. Rema Menon. N
Member Secretary
Institutional Human Ethics Committee
Professor of Pharmacology and HOD
SMIMS, Kulasekharam (K.K District)
Tamil Nadu -629161

Enroll no: SD0XXX

COMPARING THE RELIABILITY OF BARR BODIES, PALATAL RUGAE & MESIO- DISTAL DIMENSION OF MAXILLARY CANINE & CENTRAL INCISORS IN DETERMINATION OF SEX.

DEPARTMENT OF ORAL AND MAXILLO-FACIAL PATHOLOGY

NAME:

AGE:

SEX:

ADDRESS:

ADVERSE HABITS:

SYSTEMIC ILNESS:

ORAL EXAMINATION:

Mucosa	Labial	Buccal	Palate	Tongue	Gingiva
Pathology ✓ Yes X No					

No. of. Teeth present:

	ERUPTED	CARIES	MISSING	EXTRACTED	FRACTURED / EROSION	ATTRITION
MAXILLARY CENTRAL INCISOR						
MAXILLARY CANINE						

	ESTHECTIC CORRECTION	ESTHECTIC CORRECTION	ESTHECTIC CORRECTION	ESTHECTIC CORRECTION	ESTHECTIC CORRECTION	ESTHECTIC CORRECTION
Yes / No						

SREE MOOKAMBIKA INSTITUTE OF DENTAL SCIENCES

Kulasekharam, Kanyakumari District – 629161.

Department of Oral Pathology & Microbiology

PATIENT INFORMATION SHEET

PART 1 OF 2

Dear Volunteers,

We welcome you and thank you for your keen interest in participation in this research project. Before you participate in this study, it is important for you to understand why this research is being carried out. This form will provide you all the relevant details of this research. It will explain the nature, the purpose, the benefits, the risks, the discomforts, the precautions and the information about how this project will be carried out. It is important that you read and understand the contents of the form carefully. This form may contain certain scientific terms and hence, if you have any doubts or if you want more information, you are free to ask the study personnel or the contact person mentioned below you give your consent and also at any time during the entire course of the project

Name of the inveatigator : K.U Gomakumar

Post graduate student

Department of oral pathology and microbiology

Sree Mookambika Institute of Dental Sciences,

Kulasekharam, KanyaKumari District-629161

Name of the Guide: Dr. Issac joseph
Professor

Department of Oral and maxillofacial pathology .

Sree Mookambika Institute of Dental Sciences.

Kulasekharam, KanyaKumari District-629161

Institute: Sree Mookambika Institute of Dental Sciences,
V.P.M Hospital complex, Padanilam, Kulasekharam,
Kanyakumari – 629161 Tamilnadu

Title of the study:

"Comparing the reliability of barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors in determination of sex.

Background information: Scientific Journals

Aims and Objectives:

- To compare the reliability of sex determination methodologies using Barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors
- To investigate the mesio distal width of maxillary central incisor and maxillary canine from the master cast obtained from both the sex
- To investigate the rugae pattern in maxillary master cast in both the sex
- To investigate the presence of Barr bodies from the buccal smear by exfoliative cytology

Scientific justification of the study:

The necessary of identification of sex in most criminal and accident cases will reduce the confusion. The identification of sex in a charred are decomposed remnants of a individual is difficult through conventional methods. this study will discuss on the easy method to identify the sex and identify the reliable method among the three technique used in forensic odontology .

Procedure for the study:

Once you are enrolled into the study a roll no will be implemented to represent the name. you will be asked to rinse the oral cavity with plain water to remove the remaining food debris.
A wooden spatula is used to take the smear from the right and left buccal mucosa
It is smeared into a glass slab and smeared using cover slip and fixed in ethanol 95% and stained with modified PAP staining
A sterile / disposable stock tray for maxilla is selected according to the patient
A irreversible hydrocolloid Alginate is used to take impression of the upper maxilla
Cast is made using type III dental stone
And you are asked rinse the oral cavity to remove the remnants of impression materials in oral cavity

10. Expected risks for the participants:

Gag reflux during impression procedure

The previous study conducted does not produced any complication or risk other than the gag reflux in rare condition and can be overcome by proper tray ,posture and topical application of local anesthesia.

Expected benefits of research for the participants:

You will not be required to pay for this lab test.

You can enquire about the outcome of the procedures and your details.

Maintenance of confidentiality:

- You have the right to confidentiality regarding the privacy of your medical information (Personal details, results of physical examinations, investigations, and your medical history).
- By signing this document, you will be allowing the research team investigators, other study Personnel, sponsors, institutional ethics committee and any person or agency required by law to view your data, if required.
- The results of clinical tests and therapy performed as part of this research may be included in your medical record.
- The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

Why have I been chosen to be in this study?

- Chosen because of groping under the inclusion and exclusion criteria
- Need of good sampling size
- No invasive procedure that harm your health and helps in diagnosis and helpful for the society

How many people will be in the study?100 individuals

Agreement of compensation to the participants (In case of a study related injury):

Patient will be taken care in case of complication and medical treatment will be provided in the institution.

Anticipated prorated payment, if any, to the participant(s) of the study: No

Can I withdraw from the study at any time during the study period?

The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during the course of the study without giving any reasons. However, it is advisable that you talk to the research team prior to stopping information.

If there is any new findings/information, would I be informed? Yes

Expected duration of the participant's participation in the study: 1 Year

Any other pertinent information: No other information

Whom do I contact for further information

For any study related queries, you are free to contact :

K.U Goma kumar

Post Graduate student.

Department of Oral pathology ,

Sree Mookambika Institute of Dental Sciences,

Kulasekharam, KanyaKumari District-629161.

Mobile No: 09940257313

gomes.k.u@gmail.com@gmail.com

Place:

Date:

Signature of Principal Investigator **Signature of the participant**

SREE MOOKAMBIKA INSTITUTE OF DENTAL SCIENCES
Kulasekharam, Kanyakumari District – 629161.

PART 2 OF 2 PARTICIPANTS CONSENT FORM

The details of the study have been explained to me in writing and the details have been fully explained to me. I am aware that the results of the study may not be directly beneficial to me but will help in the advancement or medical sciences. I confirm that I have understood the study and had the opportunity to ask questions. I understand that my participation in the study is voluntary and that I am free ***to*** withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). I have been given an information sheet giving details of the study. I fully consent to participate in the study titled

"Comparing the reliability of barr bodies, palatal rugae & mesio- distal dimension of maxillary canine & central incisors in determination of sex.

Serial no / Reference no:

Name of the participant:

Address of the participant:

Contact number of the participant:

Signature / thumb impression of the participant / Legal guardian

Witnesses 1. 2.

Place and date

ஒப்புதல் படிவம்

1 - 2

ஆய்வின் தகவல் படிவம்

மதிப்பிற்குரிய தன் ஆர்வலருக்கு!

தாங்கள் இந்த ஆய்வில் பங்குபெற வந்தமைக்கு நன்றி. இந்த ஆய்வில் பங்குபெறுவதற்கு முன் நீங்கள் இந்த ஆய்வின் தன்மை, ஏற்படும் நன்மை, தீமை, எதிர்மறைகள் நலன்கள் எல்லாவற்றையும் அறிதல் முக்கியமாகும். இந்த தகவல் படிவத்தை கவனமாக படித்து புரிந்து கொண்டபின் பங்குபெற வேண்டும். மேலும் இந்த படிவத்தில் சில மருத்துவ அறிவியல் சொற்கள் இருக்கும் அதன் விளக்கத்தையும் இறுதியில் கூறப்பட்டுள்ள நபரிடம் கேட்டு தெளிவு பெறவும். இந்த ஆய்வின் எந்த நேரத்திலும் நீங்கள் அவரிடம் இந்த ஆய்வின் குறைகளையும் கேட்கலாம்.

தகவல் சேகரிப்பாளர் : **மரு. கோமகுமார்**
முதுகலை மாணவர்
ஓரல் பேத்தாலஜி,
ஸ்ரீ மூகாம்பிகை பல் மருத்துவமனை கல்லூரி,
குலசேகரம்.

வழிகாட்டி : **மரு. ஐசக் ஜேகப்**
பேராசிரியர்,
ஓரல் பேத்தாலஜி,
ஸ்ரீ மூகாம்பிகா பல் மருத்துவமனை கல்லூரி,
குலசேகரம்.

ஆய்வின் தலைப்பு :

பார் பாடிஸ், ரூகே, முன்பல் மற்றும் சிங்கபல் ன் தன்மையால் பா னம் அறித ன் ஒப்பிட்டு பார்த்தல்.

குறிக்கோள் :

பார்பாடிஸ், முன்பல், சிங்க பல், ரூகே முத யவற்றை கொண்டு அறியப்படும் பா னத்தின் நம்பகத்தன்மையை ஒப்பிட்டு பார்த்து அறிதல்.

1. பா னம் அறிதல் - பார் பாடிஸ், ரூகே, முன்பல், சிங்கபல் மூலம் அறிதல்.

2. ஒப்பிட்டு பார்த்தல் கிடைக்கும் முடிவுகளை கொண்டு சிறந்த முறையை கண்டறிதல்.

ஆய்வின் அடிப்படை தகவல் :

பார்பாடிஸ் எனப்படும் கட்டுப்படுத்தப்பட்ட (X) எக்ஸ் குரோமசோம்ஸ் ஆண்களை விட அதிகமாக பெண் பா னத்தினரிடம் காணப்படும். மேலும் இரண்டாவது மூளைக்கும் நிஜப்பல்லான மூன் பல் மற்றும் சிங்க பல் ன் பக்கவாட்டு அளவின் மூலம் பா னம் அறிய முடியும் இவை இரண்டும் பெண்களின் பற்களை விட பெரியதாக இருக்கும் என தெரிகிறது. இதைபோல் மேல் அன்னத்தின் திசுகளான ரூகேயிலும் பா ன வித்தியாசத்தை அறியமுடியும்,

செயல்முறை :

- ❖ தகவல் குறிப்பு எண் வழங்கப்படும்
- ❖ வாயை நீரால் சுத்தம் செய்யவும்.
- ❖ மர தட்டையான ஸ்பேட்சுலாவை கொண்டு ஸ்மியர் எடுக்கப்படும்.
- ❖ மேல் அன்னத்தின் அச்சு ஆல்ஜினேட் மூலம் பதிவு செய்யப்படும்.
- ❖ டெண்டல் ஸ்டோன் மூலம் அச்சு, மாதிரி பெறப்படும்.
- ❖ இறுதியில் நீரால் வாயை சுத்தம் செய்யவும்.

விளைவுகள் :

- ➢ சிலருக்கு வாந்தி எடுக்கும் வாய்ப்பு உள்ளது. அவ்வாறு ஏற்பட்டால் டாப்பிகல் அனஸ்திசியா மூலம் சரிசெய்யப்படும்.
- ➢ இதற்கு முன் இந்த ஆய்வில் இதுபோன்று எந்த விளைவுகளும் ஏற்படவில்லை.

தகவல் பாதுகாப்பு :

- உங்களது தகவல் பாதுகாக்கப்படும்.
- தேவை ஏற்பட்டால் உங்களது தகவல்கள் எத்திக்கல் கமிட்டியிடம் காண்பிக்கப்படும்.
- உங்களது அனுமதியுடன் உங்களது தகவல்கள் ஆய்வாளர் மற்றும் ஆய்வின் பங்காளருக்கு காண வாய்ப்பு உள்ளது.
- இந்த ஆய்வு வெளியிடப்படும் போது உங்களது தகவல் பத்திரமான பாதுகாக்கப்படும், வெளியிடப்படாது.
- ஆய்வு தகவல் குறிப்பு சீட்டில் உங்களது தகவல்கள் பதிவு செய்யப்படும்.

இந்த ஆய்வில் தேர்வு செய்ய காரணம் :

- தாங்கள் இந்த ஆய்வின் சேர்ப்பு மட்டும் விடுப்பு கட்டளையின் உள்ள அமைய பெறுவதால்.
- நல்ல சிறந்த முடிவு ஆய்வின் தேவைக்கு
- சமூகத்தின் உதவிக்கு

ஏற்படும் நன்மைகள் :

இந்த ஆய்வின் மூலம் நேரடியாக எந்த நன்மையும் ஏற்படாது. மேலும் அறிவியல் முன்னேற்றத்திற்காக பயன்படும்.

ஆய்வின் மொத்த எண்ணிக்கை : 100

ஏற்படும் விளைவுகள் மற்றும் நஷ்ட ஈடுகள் :

எந்த பொருள் உதவியும் அளிக்கப்படாது எங்களது ஆய்வு நிலையம் எதிர்மறை விளைவுகள் ஏற்பட்டால் அதற்கான சிகிட்சை அளிக்கும்.

நன்கொடைகள் : கிடையாது

ஆய்வில் இருந்து பின்வாங்குதல் :

பங்கு பெறுபவருக்கு முளு உரிமை உள்ளது. எந்த நேரத்திலும் எந்த காரணம் இன்றி பின்வாங்கலாம்.

ஆய்வில் ஏற்படும் முன்னேற்றங்களுக்கு ஏதேனும் தகவல் தெரிவிக்க வேண்டுமாம் : ஆம்

ஆய்வின் கால அவகாசம் : ஒரு நாள்

தொடர்பு கொள்ள

மரு. கோம குமார்
முதுகலை மாணவர்
ஒரல் பேத்தாலஜி
குலசேகரம், கன்னியாகுமரி.
தொலைபேசி எண் : 9940257313
வலைமுகவரி : gomes.k.u@gmai.com

இடம் : ஆய்வாளர்

தேதி : பங்குபெறுபவரின் கையொப்பம்

ஒப்புதல் படிவம்

பாகம் : 2

பங்குபெறுபவரின் ஒப்புதல் படிவம்

இந்த ஆய்வின் முழு விபரங்களும் எழுத்து மூலமாகவும், விரிவாகவும், என்னிடம் கூறப்பட்டது. எனக்கு இந்த ஆய்வின் விளைவுகள் எந்த பயனும் தரவில்லை என்றாலும், மருத்துவ அறிவிய ன் மேம்பாட்டிற்காக பயன்படுத்தப்படும் என்று அறிவேன். நான் இந்த ஆய்வில் எந்த நிர்பந்தமும் இல்லாமல் பங்கு பெறுகிறேன். மேலும் இந்த ஆய்வின் எல்லா விதிகள் மற்றும் விதிமுறைகளையும் அறிவேன். எந்த சந்தேகத்திற்கும் கேள்வி கேட்கவோ அல்லது ஆய்வில் இருந்து விலகவோ எல்லா உரிமைகளும் எனக்கு உண்டு என்று அறிவேன். இந்த ஆய்வின் விளைவுகள் எந்த அறிவியல் பயன்டாட்டிற்கும் பயன்படுத்த எனக்கு தடையில்லை. எனக்கு இதற்கு முன்பாக ஆய்வின் தகவல் படிவம் கொடுக்கப்பட்டது. எனக்கு இந்த ஆய்வில் பங்குபெற முழு சம்மதம்.

ஆய்வின் பெயர் :

பார்பாடிஸ், ரூகே, மற்றும் முன்பல் + சிங்கபல் ன் அளவினால் பா னம் அறித ன் தன்மையை ஒப்பிட்டு பார்த்தல்.

குறிப்பு எண் :

பெயர் :

முகவரி :

தொலைபேசி எண் : கையொப்பம்

சாட்சி : 1

2

இடம் :

தேதி :

ഡിപ്പാർട്ട്മെന്റ് ഓഫ് ഓറൽ ആന്റ് മാക്സിലോഫേഷ്യൽ പതോളജി

പഠനത്തിൽ പങ്കെടുക്കുന്ന വ്യക്തികളുടെ അറിവിലേക്ക്:

പങ്കെടുക്കുന്ന വ്യക്തിയുടെ പേര് :

പഠനവിഷയം : ബാർബോഡികളും, പാലറൽ റൂഗേയും, പല്ലുകളുടെ വീതിയും ഉപയോഗിച്ചുള്ള ലിംഗ നിർണ്ണയം. : ഒരു താരതമ്യ പഠനം

പഠനരീതി :

- താങ്കളെ ഈ പഠനത്തിൽ ഉൾപ്പെടുത്തുമ്പോൾ താങ്കളുടെ പേരിനു പകരമായി ഒരു റോൾനമ്പർ തരുന്നതാണ്.
- പഠനത്തിനു മുമ്പായി വായ് വൃത്തിയായി കഴുകേണ്ടതാണ്.
- കവിളിന്റെ ഉൾവശങ്ങളിൽ നിന്നും ഒരു സ്പാററുല ഉപയോഗിച്ചു സ്മിയർ എടുക്കുകയും അത് ഒരു കവർ സ്ലിപ്പ് ഉപയോഗിച്ചു ഒരു ഗ്ലാസ് സ്ലയിഡിലേക്ക് മാററുകയും അതിനു ശേഷം 95% എത്തനോൾ ഉപയോഗിച്ചു ഫിക്സ് ചെയ്യുകയും പാപ്നിക്കോലൊ സ്റ്റയിൻ ചെയ്യുകയും ചെയ്യുന്നു.
- അതിനു ശേഷം വൃത്തിയുള്ളതും അണുവിമുക്തവുമായ ഒരു ഇംപ്രഷൻ ട്രേയും ആൾജിനേററ് എന്ന മാവും ഉപയോഗിച്ചു മേൽപല്ലുകളുടെ അളവ് എടുക്കുകയും അത് ഉപയോഗിച്ചു മോഡലുകൾ ഉണ്ടാക്കുകയും ചെയ്യുന്നു.

ഈ ഗവേഷണത്തിന്റെ പ്രസക്തി :

ദുരൂഹസാഹചര്യങ്ങളിലും പ്രകൃതിക്ഷോഭങ്ങളലും കൂട്ടമരണങ്ങളിലും മററും ലിംഗ നിർണ്ണയം ശ്രമകരമായേക്കാവുന്ന സാഹചര്യങ്ങളിൽ ഈ പഠനത്തിലൂടെ വിജയകരമായി ലിംഗ നിർണ്ണയം സാധ്യമാകുന്നതാണ്.

നിങ്ങൾക്കുണ്ടായേക്കാവുന്ന പണചിലവുകൾ :

നിങ്ങൾക്കു ലാബ് ടെസ്ററുകൾക്കായി പണം ചിലവഴിക്കേണ്ടതില്ല .

- നിങ്ങൾക്കു ടെസ്ററുകളുടെ ഫലത്തേക്കുറിച്ചു അന്വേഷിക്കാവുന്നതാണ്.
- പഠനം മൂലം നിങ്ങൾക്ക് എന്തെങ്കിലും ദോഷവശങ്ങൾ ഉണ്ടായാൽ ഞങ്ങളുടെ സ്ഥാപനം പരിപൂർണ സൗജന്യ ചികിത്സ നൽകുന്നതാണ്.
- നിങ്ങളുടെ സുരക്ഷയാണ് ഞങ്ങൾക്ക് പ്രധാനം.

- പഠനത്തിന്റെ ഇടയിൽ നിങ്ങൾക്ക് ഉണ്ടായേക്കാവുന്ന ആരോഗ്യ പ്രശ്നങ്ങൾക്ക് പരിഹാരം നിർദ്ദേശിക്കാൻ കഴിയുന്ന വ്യക്തികളുടെ വിവരങ്ങൾ ഈ ഫാറത്തിന്റെ അവസാനം നല്കിയിട്ടുണ്ട്.
- താങ്കളുടെ വ്യക്തിപരമായ വിവരങ്ങൾ വൈദ്യപരിശോധനയുമായി ബന്ധപ്പെട്ട വിവരങ്ങൾ പഠനത്തിനിടയിൽ ലഭിക്കുന്ന ബന്ധപ്പെട്ട മറ്റു വിവരങ്ങളോ പുറത്തു വിടുന്നതല്ല.
- പഠനത്തിലുള്ള പങ്കാളിത്തം നിങ്ങളുടെ സൗകര്യത്തെ മാത്രം അടിസ്ഥാന പ്പെടുത്തിയായിരിക്കും.
- താങ്കൾക്ക് എപ്പോൾ വേണമെങ്കിലും ഈ പഠനത്തിലുള്ള പങ്കാളിത്തം കാരണം കാണിക്കാതെ തന്നെ അവസാനിപ്പിക്കാവുന്നതാണ്.

ബന്ധപ്പെടേണ്ട വ്യക്തികളുടെ പേര് വിവരങ്ങൾ :

ഡോക്ടറുടെ പേര്	:	ഡോ. ഗോമകുമാർ
ഫോൺ	:	09940257313
ഗൈഡിന്റെ പേര്	:	ഡോ. ററി.ഐസക്ക് ജോസഫ്
ഫോൺ	:	09443727835
കോളേജ് വിലാസം	:	ഡിപ്പാർട്ട്മെന്റ് ഓഫ് ഓറൽ ആന്റ് മാക്സില്ലോഫേഷ്യൽ പാത്തോളജി ശ്രി മൂകാംബിക കോളേജ് ഓഫ് ഡെന്റൽ സയൻസസ് കുലശേഖരം .

ഡിപ്പാർട്ട്മെന്റ് ഓഫ് ഓറൽ ആന്റ് മാക്സില്ലോഫേഷ്യൽ പതോളജി

<u>സമ്മതപത്രം</u>

ഞാൻ, ... ശ്രി മൂകാമ്പിക കോളേജ് ഓഫ് ഡെന്റൽ സയൻസിന്റെ ഓറൽ ആന്റ് മാക്സില്ലോഫേഷ്യൽ പതോളജി വിഭാഗത്തിന്റെ കീഴിൽ നടക്കുന്ന ഗവേഷണത്തെപറ്റി പത്രിക വായിച്ചതിൽ നിന്നും ബോധവാനാണ്/ ബോധവതിയാണ്.

വിവരണ പത്രിക വായിച്ചതിൽ നിന്നും ഈ ഗവേഷണത്തിൽ ഞാൻ പങ്കെടുക്കുന്നത് സംബന്ധിച്ച വിവരങ്ങൾ രഹസ്യമായി സൂക്ഷിക്കുന്നതാണെന്നും, താല്പര്യപ്പെടുന്ന പക്ഷം പഠനത്തിന്റെ ഫലം അറിയിക്കുന്നതാണെന്നും ഉറപ്പു നൽകിയിട്ടണ്ട്. ഇതിൽ പങ്കെടുക്കുന്നതിനായി എന്റെ മേൽ യാതൊരു വിധത്തിലുള്ള സമ്മർദ്ദങ്ങളും ഉണ്ടായിട്ടില്ല. ഈ ഗവേഷണ പദ്ധതിയുടെ ഭാഗമാകുന്നതിന് എനിക്ക് പൂർണ്ണസമ്മതമാണ്.

രോഗിയുടെ പേര്	സാക്ഷിയുടെ പേര്
ഒപ്പ്	ഒപ്പ്
വിലാസം	വിലാസം

ഡോക്ടറുടെ പേര് : ഡോ. ഗോമകുമാർ

ഫോൺ : 09940257313

കോളേജ് വിലാസം : ഡിപ്പാർട്ട്മെന്റ് ഓഫ് ഓറൽ ആന്റ് മാക്സില്ലോഫേഷ്യൽ പാത്തോളജി
ശ്രി മൂകാംബിക കോളേജ് ഓഫ് ഡെന്റൽ സയൻസസ്

കുലശേഖരം .

ENROLL NO: SD0XXX

RUGAE:

Type	Numbers	Pattern	Numbers
Primary rugae (5-10)mm		Straight	
Secondary rugae (3-5)mm		Curved	
Fragmentary		Circular	
		Wavy	
		Convergent	
Total no of rugae		Divergent	

TEETH:

Maxillary Central incisor	Mesio distal width (mm)	Maxillary Canine	Mesio distal width (mm)
11		13	
21		23	

BARR BODIES:

Total number of Barr bodies: / 100 cells