

Comparitive Analysis of Lip Prints, Finger Prints, Intercanine Distance Measurement Using Bite Marks and Rugae Pattern in Chhattisgarh Population

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Abstract

Determination of the basic demographic data of the human subject analyzed is often done with the aid of lip prints, finger prints, bite marks and rugae patterns which serve as important & individualistic tools for human identification owing to the uniqueness of these features in presence or absence of teeth. They are individually being used for crime detection and thereby as evidence and as legal documentation in court cases also to solve the cases and to identify the criminals [1].

The dental surgeon is not limited to serve in examination, investigation, diagnosis, and treatment of oral and oro-facial lesions of local origin, but can also serve in other community services and legal matters [2]. The dental identification represents the most useful scientific methods in mass disasters, success rate being 75%. The theory of uniqueness is a strong point used in the analysis of fingerprints and bite marks to convince the court of law [3].

The study was done on 100 adults of Chhattisgarh divided in two age groups of- 18 to 36 years; 37 to 54 years. Analysis was based on the following classifications.

- Lipprint analysis classification - Suzuki and Tsuchihashi Classification 1970
- Fingerprint analysis classification- Henry's Classification System 1899
- Intercanine distance -Maxillary anteriors & Mandibular anteriors
- Palatal Rugae- Thomas and Kotze Classification 1983

Type-I Lipprints & Type -II thumbprints were very common in females whereas, posterior inclined Primary rugae were the common rugae in females irrespective of age & horizontal primary rugae were more prevalent in males. Intercanine distance was more variable in maxilla and more consistent in mandible. It was usually 25 -30 mm in mandible of both sexes. For maxilla it had a broader range from 31 -40 mm due to possible variations in both sexes. Thus a combination of various parameters is more likely to give a clue of gender in forensic investigation. Age of an adult individual did not have a significant influence on type of studied parameters.

Keywords: Lip Prints, Finger Prints, Bite Marks

Introduction

The most challenging task in the scenerio of a mass disaster, identification of significantly decomposed or disfigured bodies, such as that of - drowned persons, fire victims, and victims of motor vehicle accidents and in ethnic studies as well as crime investigation is to be able to identify the required humans or their bodies with scientific authentication by criteria of comparative or reconstructive methods of Forensic dentistry.

In reconstructive identification, determination of the basic demographic data of the human subject analyzed is often done with the aid of lip prints, finger prints, bite marks and rugae patterns which serve as important & individualistic tools for human identification owing to the uniqueness of these features in presence or absence of teeth. They are individually being used for crime detection and thereby as evidence and as legal documentation in court cases also to solve the cases and to identify the criminals [1].

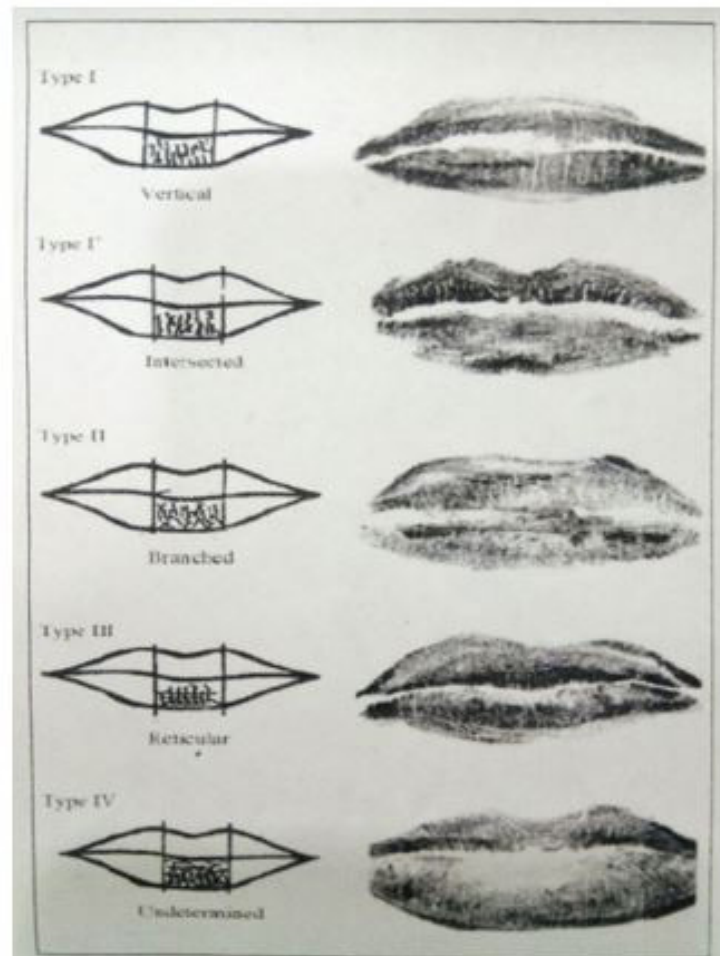
The dental surgeon is not limited to serve in examination, investigation, diagnosis, and treatment of oral and oro-facial lesions of local origin, but can also serve in other community services and legal matters. They can play a vital role in various analysis of forensic dentistry like age and sex determination, personal identification of unknown deceased person, decomposed body, participating in mass disaster, analysis of bite marks as evidence, giving evidence in child abuse, participating in solving the criminal cases on the basis of dental evidence which is very much useful in law and justice [2].

Mutalik VS (2013) in 'Utility of cheiloscopy, rugoscopy, and dactyloscopy for human identification in a defined cohort' had compared cheiloscopy, rugoscopy, and dactyloscopy for human identification. Negi A, Negi A. (2016) in 'The connecting link! Lip prints and fingerprints'. Connect the link between Lip prints and fingerprints. The diversity in fingerprints, lip prints,

and palatal rugae comprises the part of nonlinear geometry in human body. Establishing a person's identity can be a difficult and challenging process in forensic identification. The dental identification represents the most useful scientific methods in mass disasters, success rate being 75%. The theory of uniqueness is a strong point used in the analysis of fingerprints and bite marks to convince the court of law. Likewise, even lip prints and palatal rugae patterns are considered to be unique to an individual, and hence, hold the potential for identification [3].

Lip Prints (Cheiloscopy)

- It is the study of the wrinkles and grooves on labial mucosa, called as sulci labiorum that form a characteristic pattern on any object. They rarely change with time throughout the life, except soft tissue damage. They are referred to as Lip prints.
- Pattern of grooves in lip prints were first describe by R. Fischer in 1902 and more extensive studies on the uniqueness of lip prints was given by two Japanese scientists, Yasuo tsuchihashi and kazuo suzuki in 1970.
- The classification which is most widely used & also used in our study is Suzuki and Tsuchihashi Classification 1970
- **Type Ia:** Clear-cut vertical grooves that run across the entire lips
- **Type Ib:** Similar to type I, but the grooves do not cover the entire lip
- **Type II:** Branched grooves
- **Type III:** Reticular grooves
- **Type IV:** Grooves do not fall into any of the types (undetermined.)

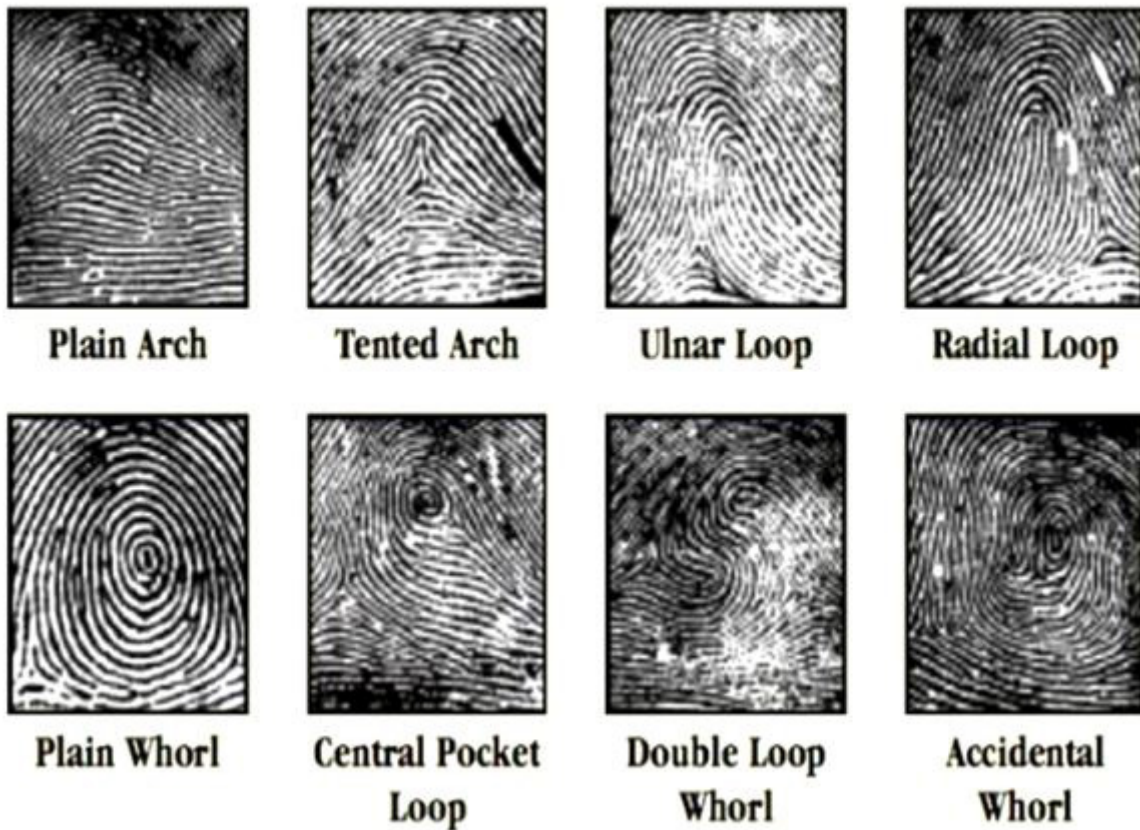


Dactyloscopy or Finger Show

- DACTYLOSCOPY or FINGER SHOW is the method of studying fingerprints to establish identification. Each individual has a unique set of minute raised ridges on volar pads called "Friction Ridge Skin" which are called fingerprints.
- In 1858, an Englishman named Sir William Herschel used it for the first time when signing business documents for authenticity.
- Today, it is based on The Henry Classification System created in 1899

Henry's Classification System 1899

- **TYPE Ia** Plain Arch
- **TYPE Ib** Tented Arch
- **TYPE II** Loop
 - IIa** Right Loop
 - IIb** Left Loop
 - IIc** Central Pocket Loop
- **TYPE III** Whorl
 - IIIa** Plain Whorl
 - IIIb** Open Whorl
- **TYPE IV** Double Loop Whorl
- **TYPE V** Accidental Whorl



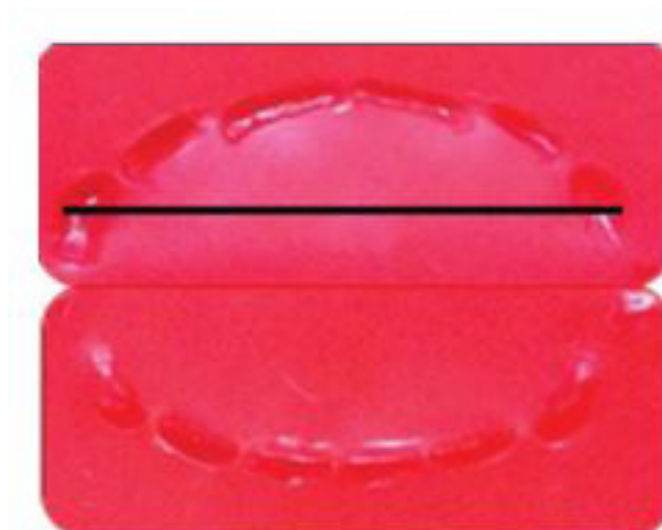
Inter canine distance measurement using bite marks analysis:

- A bite mark is a mark created by teeth either alone or in the combination with other oral structures on an object or tissue by an animal or human.
- It is based on the principle that anatomy and activities of no two mouths are same.

• Bite marks are thus, considered as valuable adjuvant to fingerprinting in forensic examinations.

• Inter canine distance (ICD) of maxillary and mandibular arch is the bitemark parameter used in investigation to identify the individual besides the shape, number and size of bite indentations

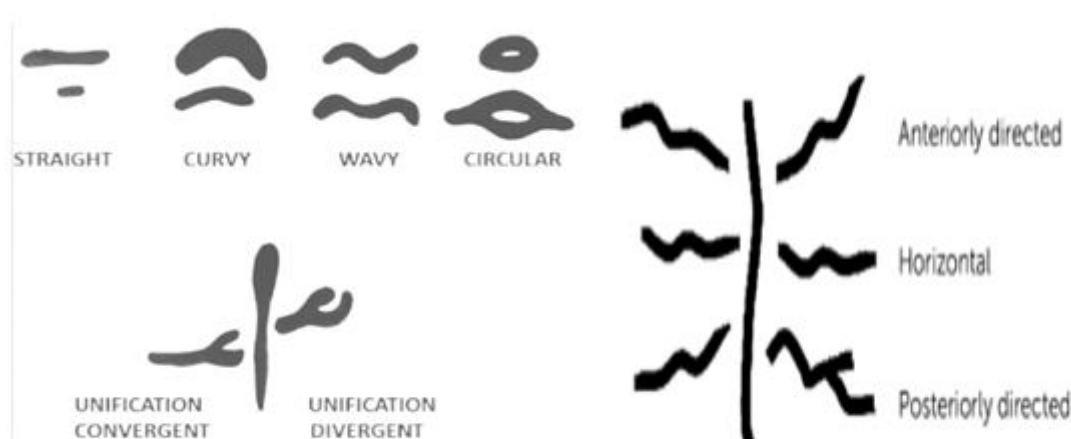
• Average ICD range from 36-42 mm in the maxilla of males and 34-41 mm in females whereas ICD of mandible is 26-33 mm in males and females



Rugae Pattern

• The irregular elevations on the mucosal surface of anterior palate behind the incisive papilla on either side of the mid palatine raphae are called rugae and the study of rugae pattern is called rugoscopy.

- They are of stable anatomy, with unique pattern in each individual and are often preserved by virtue of their location, so, they can be used as a valuable marker in forensic dentistry.
- The anatomical position of the rugae inside the oral cavity (surrounded by cheek, lips, tongue and the buccal pad of fat) also give some protection in cases of trauma or incineration.



Thomas and Kotze Classification 1983

Circular	Straight	Wavy	Curved	Unification

However, the efficacy of chosen parameters in the forensic analysis as a group parameter with certain common or uncommon combinations of their occurrence in individuals of a particular region has not been studied. The uniqueness, structural diversity & differing structural patterns of lipprints, rugae patterns, finger prints, intercanine distance & bite marks require to be verified for different populations in order to know their relatedness.

In this study conducted in Government Dental College, Raipur, we have compared the most common types of the analysed lip prints, finger prints, bite marks and rugae pattern in

Chhattisgarh population in an attempt to analyse a population based prevalence which probably would be beneficial to society and police for identification of the person (victim or accused) and hence aiding in solving complicated cases.

Aim of Study

To determine the common types of lipprints, finger prints, bite marks and rugae pattern in 100 subjects in age 18-54 years. two groups were formed:

Objectives of study

To analyse the lipprints, finger print, inter canine distance and rugae pattern in the 2 adult groups

To find common types of these parameters.

To find the common types of each parameter in chhattisgarh population

Material and Methods

Sample Size- 100 adults from different districts of state Chhattisgarh

Group I: 18-36 Years

Group II: 37-54 Years

Methodology

For Cheiloscopy: Application of brown colour lipstick applied on lips.

For recording the lip prints, lips were initially wiped clean using tissue paper following which the lipstick was applied gently using a lipstick applicator from the central to the lateral portion of the upper lip with a single stroke. The subjects were then asked to clutch both the lips to ensure that the lipstick application was uniform. Following 2 min of waiting, the glue portion of the cellophane tape was used to obtain the impression of the lip. This record was immediately transferred on to a white bond paper by gently sticking the cellophane tape [4-6]. This method, besides serving as patient's permanent lip record could also be safely preserved for subsequent analysis. For analysis, each lip print was topographically divided into six areas, and only the central portion of the lower lip was considered. The analysis of the prints was based on the numerical superiority of the patterns of the line visible in the area of study [7].

For Finger Print

The record of finger print impressions was obtained using printer's black ink, white bond paper, and magnifying glass. The subjects included were all healthy, and individuals. The imprint obtained from the left thumb using printer's black ink was transferred on to a white bond paper and analyzed using magnification lens. Analysis of finger print was carried out using the most widely accepted. The imprint obtained from the left & right thumb using printer's black ink was transferred on to a white bond paper and analyzed using magnification lens. Analysis of finger print was carried out using the most widely accepted Henry classification [7].

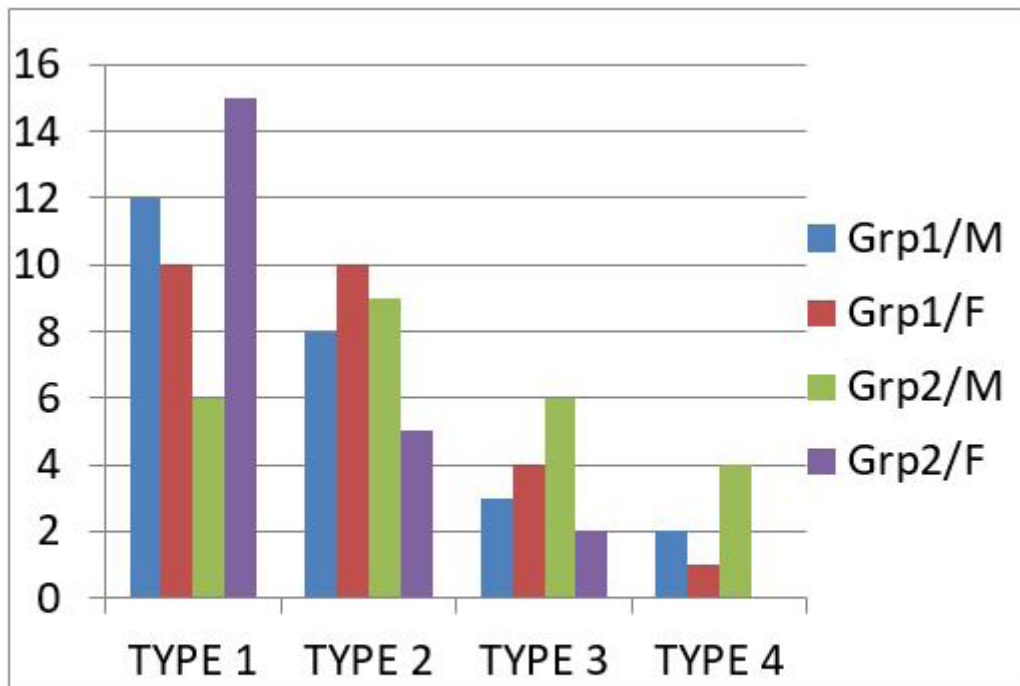
For Bite Marks

Modelling wax sheet was folded in half & kept between the maxillary and mandibular arches and patient is asked to bite in wax sheet and the intercanine distance was measured. Measurements were taken with a caliper, noting the distances in mm between the tips of the right and left canine (as measured in a straight line) imprinted in the wax plate in the maxilla and mandible separately, and the values were recorded on separate sheets [8,9].

For Rugae Pattern

For analysis of palatal rugae, the materials used were the upper impression trays, alginate impression material, dental stone (Denstone), graphite lead black pencil, and magnifying glass. Besides fulfilling the criteria of having the full complement of teeth, abnormalities like severe malocclusion, palatal pathologies, denture wearers, and tobacco-associated and parafunctional habits were excluded. To record palatal rugae, alginate impression of the maxillary arch was obtained and the cast made with dental stone. A plaster base was positioned for each cast for preservation of cast model and easier tracing for interpretation. The outline of rugae was traced on these casts using a sharp graphite pencil under adequate light. The palatal rugae pattern was then analyzed on these casts using the magnifying glass [7]. Our objective was to analyze the pattern of rugae on left & right side and identify the most common pattern. The classification we used for the purpose was that of Thomas & Kotze.

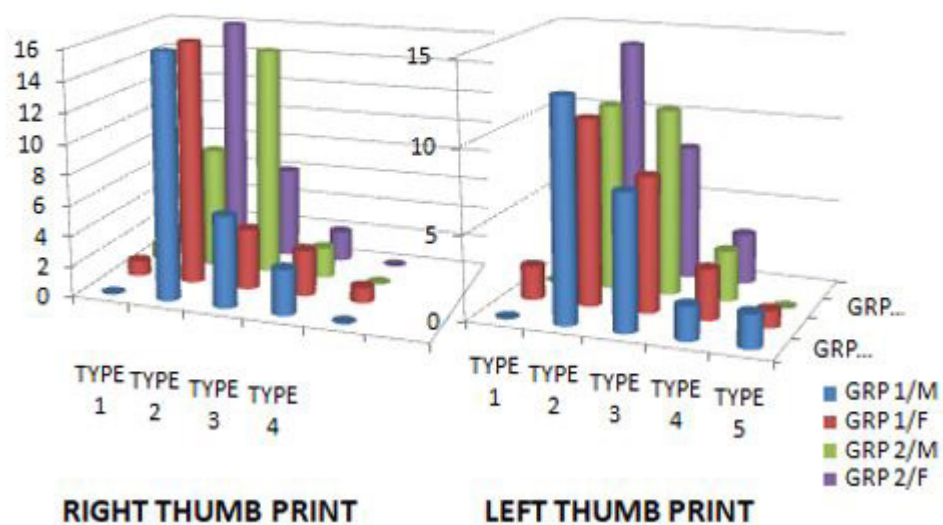
Results and Analysis



GROUP 1 FEMALE TYPE 2 – BRANCHED IS MORE COMMON
 GROUP 2 FEMALE TYPE 1- VERTICAL IS MORE COMMON
 GROUP 1 MALE TYPE 1 – VERTICAL IS MORE COMMON
 GROUP 2 MALE TYPE 2 – BRANCHED IS MORE COMMON

Comparison of Types of Lip Print Between Male and Female of Two Groups

Comparison of right and left thumb print of both groups in male and female

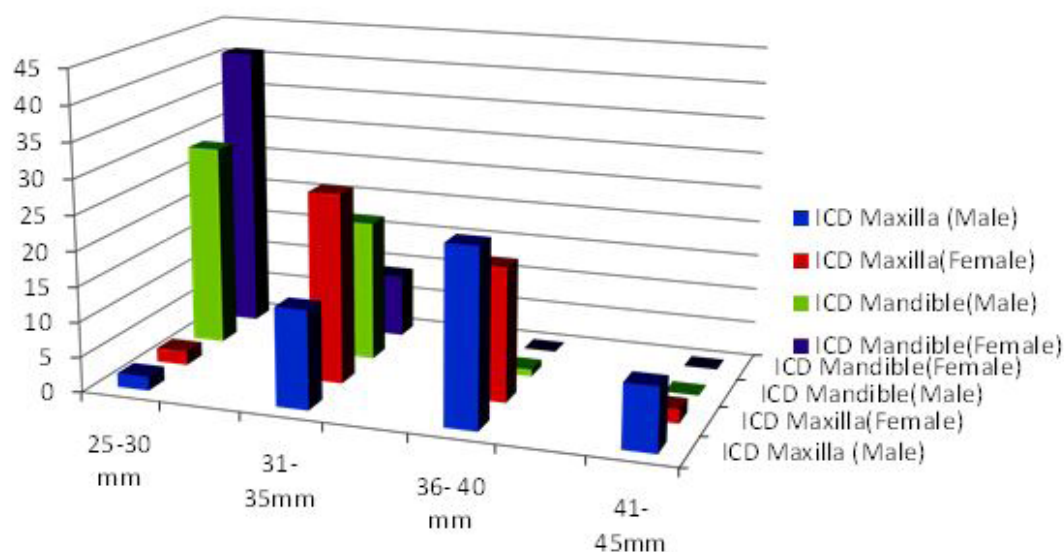


Result of Thumb Prints

In left thumb print type 2 (loop pattern) is more common in group 1 male and female of both groups so the age is not

bringing difference in female whereas type 3 (whorl pattern) is more common in right thumb print group 2 male.

COMPARISON OF INTERCANINE DISTANCE OF BOTH GROUPS OF MALE AND FEMALE

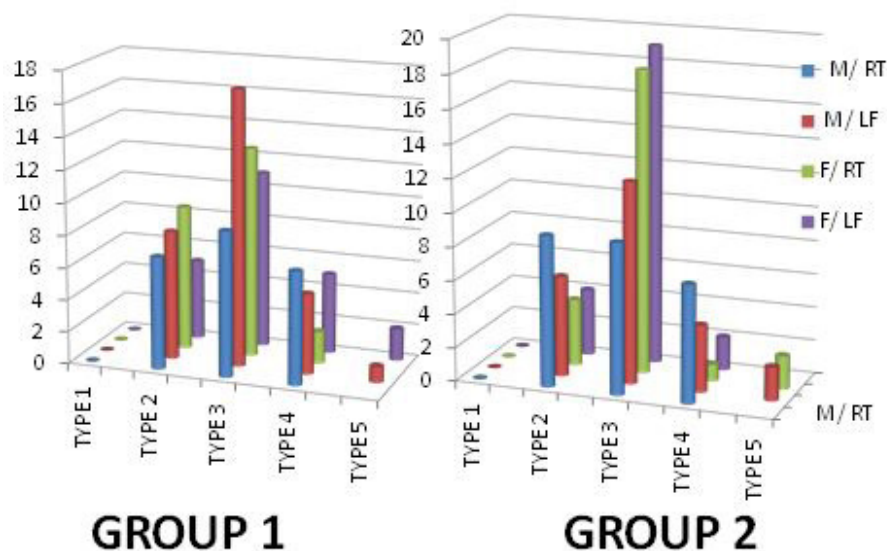


Result of Intercanine Distance

male the ICD of maxilla is 36-40 mm

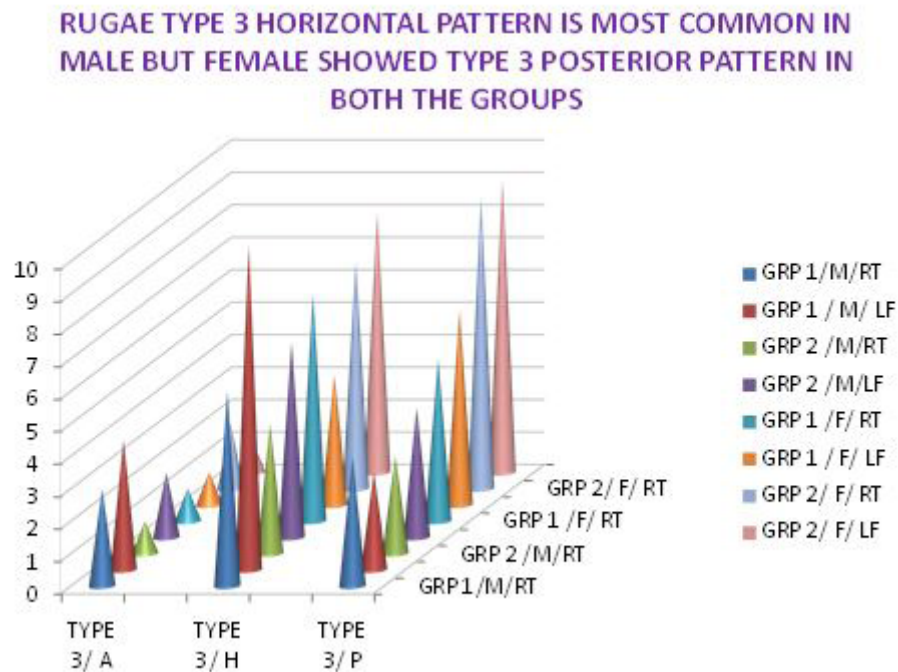
- In female the ICD of maxilla is between 31 – 35 mm whereas in
- The mandibular ICD in male and female both shows between 25- 30mm

COMPARISON OF RUGAE PATTERN IN BOTH GROUPS OF MALE AND FEMALE

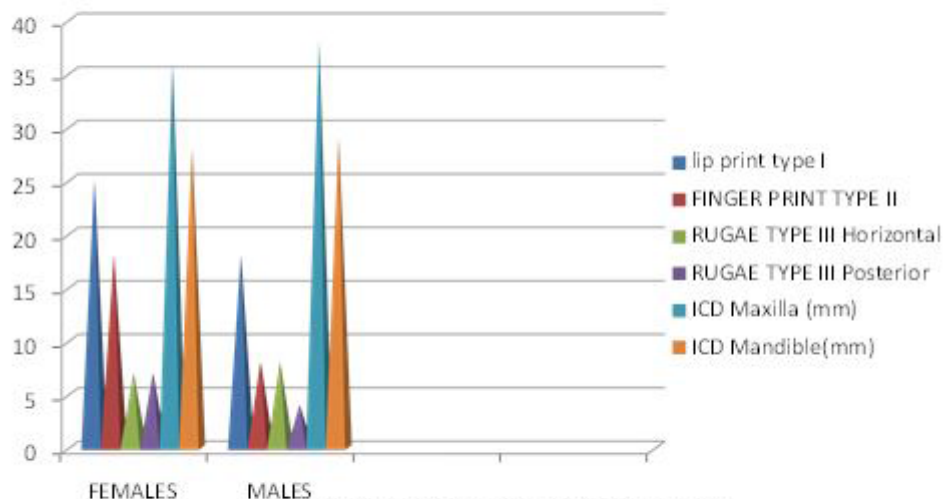


Result of Rugae Pattern:

- Rugae pattern showed type 3 wavy pattern in right and left side is most common in both age groups of male and female.



ANALYSIS OF COMMON TYPES OF FP,PR,ICD IN LIP PRINT –TYPE I



- 25 FEMALE AND 18 MALES HAD TYPE 1 LIPPRINT.
- In them: FINGER PRINT TYPE 2 WAS SEEN IN 18 FEMALE AND 8 MALE ,
- TYPE 3 (WAVY) HORIZONTAL RUGAE PATTERN IN MALE AND POSTERIOR DIRECTION IN FEMALE
- ICD AV. MORE IN MALE COMPARE TO FEMALE .

Interpretation of Results-

- a) Lip print type 1 (vertical) & type 2 (branched) is common for both male and female but type 1 is more common in female
- b) Type 2 Finger Print (Loop Pattern) Common in Both Gender.
- c) Rugae pattern type 3 (wavy) is common in both sexes but horizontal pattern in male and posterior in female but horizontal in type 2 lip print female.
- d) Average ICD in Female Maxilla 36mm and in Mandible 28 mm Whereas in Male Average Maxillary ICD is 38 mm and Mandible 29 mm
- e) P value was most significant for-

Comparison of common combinations

- In male type 3 (reticular) & type 4 (undetermined) lip print were with type 3 (whorl) finger print with type 2 (straight) anterior rugae pattern which was not found in female, were same as type 1 lip print.
- Average ICD in male maxilla 39mm & in mandible 30mm whereas in female ICD in maxilla 37mm & in mandible 30mm.
- Type 3 lip print subjects had maximum ICD in both arches 50

Discussion

Personal identification is very much necessary for unknown deceased person in homicide, suicide, mass disasters, accidents etc. It is also necessary for living individuals like missing person due to amnesia and culprits hiding his/her identity. In dead persons, usually the personal identification is made by comparing an already existing ante mortem record with that of post mortem records whose identity is required. [6] In live persons if the patterns bank is available where the data is collected and recorded, it will be useful for identifying the individual. In order to direct the investigations into bite marks one attempts to observe if the dimensions and configuration of the lesion allow an identification of whether they were produced by humans or animals, and the intercanine distance is one of the parameters that is used by several authors. It is important to note that humans have four incisors per dental arch. However, the marks

left behind do not always show the full arch and the distortions produced by the elasticity and retractibility of tissues, movement and amount of contact can lead to misinterpretation. If one only considers the morphology and anatomy of the teeth of humans, there would certainly be no difficulty in differentiating the markings. Given the dynamics imposed during the biting act and the reaction of the victim, what is observed is not a simple impression of teeth on a substrate. Where the biting injury quality allows the identification of puncturing lesions, suggestive of penetration of canine teeth, the distance between these marks is measured in an attempt to aid the identification of the concerned individual. Inter canine distances measuring between 25.0mm to 35.0mm, suggesting a significant individual variation, which may help identify the biter, and distinguish the impression left by the bite. In our study, the intercanine distance as measured in a bitemark impression for maxillary teeth of females was lower than that of males whereas for mandibular teeth it ranges between 25-30 mm in both males & females. The values of our sample had a statistically significant p value for both jaws but the maxillary intercanine distance values had a more significant p value of 0.017 as compared to that of mandibular teeth which was 0.001 [9].

The soft tissues of oral cavity may help for personal identification. Among the soft tissues, lip prints can be recorded and used as evidence in personal identification and criminal investigation. If the lip print is identified and traced from the material during investigation, it can be compared with the suspected persons. In deceased persons, lip prints have to be obtained within 24 hours to prevent them from post mortem changes. The vermilion border has minor salivary glands and the edges of the lips have sebaceous and sweat glands. The secretions of oil and moisture from these enable development of latent lip prints in most crime scenes, analogous to latent finger prints, where there was a close contact between the victim and culprit.

Various studies have been done till now on lip prints for gender identification. Sharma et al. had concluded that undetermined lip pattern (27.5%) in males, vertical and partial vertical lip patterns in females (25%), are common. Saraswathi et al. reported that intersecting pattern was most common both in males (39.5%) and females (36.5%) and their finding is similar to that of Sivapathasundharam et al. In the study of Gondivkar et al. criss cross lip pattern was reported in 51.05% males and 37.06% branched lip pattern in females [2].

In our study, the Vertical groove pattern of lip prints was most common in both sexes followed by Branched type groove pattern. We thus, found that lip print analysis did not show statistical significance between the genders.

Similar to presentation of lip prints, the palatal rugae has much to offer as a useful forensic tool. It was first discovered as a method of identification by Harrison Allen in 1889. The rugae are protected from trauma, insulated by heat of the tongue, and hence survive postmortem insults. Taking this into account, analysis of palatal rugae was carried out by only taking the shape or pattern of rugae into consideration. The rugae also provide sufficient information to validate identity beyond reasonable doubt and would serve in any forensic investigation. The most predominant pattern noted was wavy pattern, which is in accordance with the other studies followed by horizontal pattern [7].

The use of finger prints in personal identification is very much popular in criminal investigations. The analysis of finger prints as a form of identification has been used since time immemorial. No two finger prints even in a given individual have been found to have the same ridge pattern and this remains unchanged throughout life. This uniqueness in its presentation is the very fact that the analysis of finger print offers an excellent means of forensic investigations. In our observation, loop pattern of fingerprint was the most common [7].

When Inter canine distance was measured from bite marks, it was noted in our study that, it averaged to 36-38 mm for maxillary & 28-29 mm for mandibular teeth in both sexes.

Therefore, we noted from the study of lip with finger prints, rugae pattern & IC distance of bite marks that, gender identification was not possible with individual criteria analyzed as same types were often common in both genders. However, Type-I Lipprints & Type -II thumbprints were very common in females whereas, posterior inclined Primary rugae were the common rugae in females irrespective of age & horizontal primary rugae were more prevalent in males. Inter canine distance was more variable in maxilla and more consistent in mandible. It was usually 25 - 30 mm in mandible of both sexes. For maxilla it had a broader range from 31-40 mm due to possible variations in both sexes. Thus a combination of various parameters is more likely to give a clue of gender in forensic investigation. Age of an adult individual did not have a significant influence on type of studied parameters.

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