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Percentage of failure in identifying gender: A comparative study combining mandibular canine index, rugae pattern and lip prints.

[1]Dr Sandhya Jain, Professor and Head, Department of Orthodontics and Dentofacial orthopedics, Government college of Dentistry, Indore, Madhya Pradesh, India-452001

[2]Dr Merin Kuriakose, Post Graduate Student, Department of Orthodontics and Dentofacial orthopedics, Government college of Dentistry, Indore, Madhya Pradesh, India-452001

[3]Dr Divya Bharathi, Post Graduate Student, Department of Orthodontics and Dentofacial orthopedics, Government college of Dentistry, Indore, Madhya Pradesh, India-452001

[4]Dr.Shristi Jain, Post Graduate Student, Department of Orthodontics and Dentofacial orthopedics, Government college of Dentistry, Indore, Madhya Pradesh, India-452001

Corresponding Author: Dr Divya Bharathi, Post Graduate Student, Department of Orthodontics and Dentofacial orthopedics, Government college of Dentistry, Indore, Madhya Pradesh, India-452001

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Abstract

Identifying a person's gender is one of the important and foremost tasks in Forensic odontology. Various methods have been used for Gender identification. Mandibular canine index, rugoscopy and cheiloscopy are some of the commonly used methods. Many studies have been conducted to find out the predictability of each method in gender identification. Relying on a single method for gender identification may give false results as no method is 100% accurate in predicting gender. In this present study, we calculated the failure percentage of the above mentioned 3 methods in identifying gender individually and when combining together. When mandibular canine index, rugoscopy and cheiloscopy are combined together, the failure percentage in identifying gender was found to be 0% which shows that 100% predictability.

Keywords: Gender Identification, Mandibular Canine Index, Rugoscopy, Cheiloscopy

Introduction

Gender identification is an important task in forensic investigation for identifying the victim or the criminal in cases of crimes and also for victim identification during mass disasters or calamities.[1] The individual set of teeth which can be traced back to established dental records existing with the dental specialists are the highlight of forensic odontology as this can be helpful in

finding missing individuals.[2] Various methods have been implicated for gender identification. Some of them are mandibular canine index, rugae pattern and lip prints. Various studies have been conducted previously for finding the accuracy of these methods in determining gender. Most of them concluded that these methods are accurate enough and are used routinely.

The accuracy of lip prints in identifying gender by various studies are Sharma et al[3] 78.44%, Gondivkar et al[4] 94.2% and Bhagyashree et al[5] 55%.

The accuracy of mandibular canine index in identifying gender by various studies are Bakkannavar et al[6] 75%, Kaushal et al[7] 75%, Mughal et al[8] 76% and Muller et al[9] 59.57%.

The accuracy of rugae pattern in identifying gender by various studies are Saraf et al[10] 99.2% and Sunita Prashant Kulkarni et al[11] 36%.

However, if we see individually, these methods have got considerable amount of failure percentage also in identifying the gender. To the best of our knowledge, in previous literature, we could not find any study which calculated and compared the failure percentage in identifying gender by various methods when combined together.

Thus, this study aims to find out and compare the failure percentage of MCI, rugoscopy and cheiloscopy, individually and in combination, in identifying gender.

Aims and objectives

This study aims to find out and compare the failure percentage of MCI, rugae pattern and lip prints, individually and in combination, in identifying gender.

To find out the predictability and advantages of combining various methods together.

Materials and methods

The study sample consisted of 60 patients, 30 males and 30 females between age group of 15-40 years reporting to the department of Orthodontics and Dentofacial orthopaedics, Government College of dentistry Indore. Patients were explained about the nature of the study and informed consent was taken.

Inclusion Criteria

- Age group between 15 and 40 years
- Patients with all fully erupted teeth
- Healthy periodontium
- Non attrited teeth
- No caries

Exclusion criteria

- Developmental anomalies
- History of trauma or orthognathic surgeries
- Partially erupted and ectopically erupted teeth
- Teeth showing wear and tear (e.g. attrition, abrasion, abfraction, erosion)
- Patients with oral habits (e.g. bruxism)
- Restorated teeth
- Trauma
- Carious teeth

From each participants, the lip prints were recorded, maxillary and mandibular arch impressions were taken using alginate impression material and casts poured so as to study the palatal rugae patterns and to determine the mandibular canine index.

Determination of mandibular canine index

Mesio distal diameter of right and left mandibular canines were measured from mesial contact point to distal contact point with the help of digital Vernier calipers accurate to 0.01 mm and read. Intercanine distance was measured between tips of both the canines.

The Mandibular Canine Index (MCI)[12] is derived as a ratio between canine crown width and canine

arch width (measured in mm and is calculated as follows:

$$MCI = \frac{\text{Mesio distal crown width of mandibular canine}}{\text{Mandibular canine arch width}}$$

The standard MCI value was used as a reference to differentiate males from females, which is obtained by applying following formula: Standard MCI (MCIs) = (mean male MCI − SD) + (mean female MCI + SD)/2

sexual dimorphism can be calculated by using the formula given by Garn et al[13].

Sexual dimorphism in mesio distal width = [(Xm/Xf)-1] ×100

Xm = Mean value of canine width in males

Xf = Mean value of canine width in females.

Determination of Rugae pattern

The Rugae patterns were analysed from the maxillary cast based on the classification given by Thomas & Kotze and Kapali et al[14-15]. These classifications include number, shape length and unification of rugae. The Rugae were highlighted by a black permanent marker on the cast. A brass wire was adapted over the Rugae and the length of wire was measured using a digital vernier caliper.

Based on length rugae can be classified as:

- Primary- >5mm.
- Secondary- 3 to 5mm.
- Fragmentary-<3mm.

Only primary rugae were considered in this study. Secondary and fragmentary rugae were eliminated.

Based on the shape, rugae can be classified into 4 types:

- Curved: crescent shape.
- Wavy: serpentine shape.
- Straight: They run directly from their origin to termination.
- Circular: Rugae that display a definite continuous ring

Unification occurs when two rugae are joined at their origin or termination.

- Diverging: when two rugae had the same origin from the midline but immediately branched laterally.
- Converging: Rugae with different origins from midline, but are joined laterally.

Determination of lip prints

Lip prints were taken using dark coloured, non glossy, non metallic lipsticks. The lips of the patients were cleaned using wet tissue paper and allowed to dry. An impression of the lips was made on a clear cellophane tape and it is transferred to white A4 bond paper.

Lip prints were classified based on modified Suzuki and Tsuchihashi'[16]s classification proposed by Sandhya Jain et al[17] . In this method, the lip was divided in two parts – upper and lower lip. The upper lip was divided in three parts by vertical lines passing through midline and sides.(figure1). Similarly, lower lip was divided. Each of the segment was then evaluated for lip patterns. The pattern which was existing in more than 75% of lip was taken as the predominant lip print pattern of that individual.

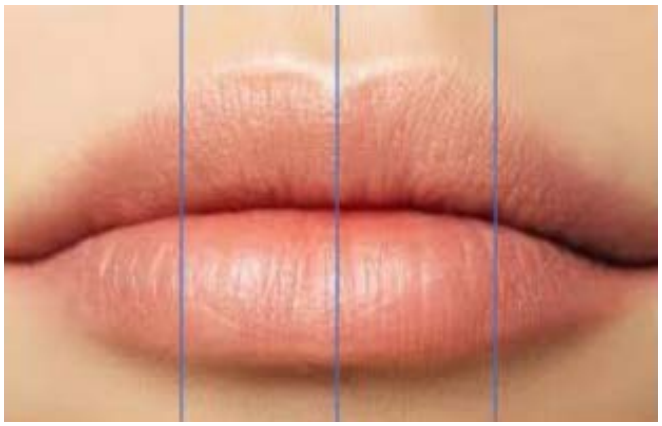

Fig.1: Division of lips into 8 zones

Type I: Straight vertical grooves that run across the entire lips.

Type I': Vertical grooves similar to Type I that do not run across the entire lip.

Type II: Branched Y pattern.

Type III: Intersected grooves.

Type IV: Reticular grooves.

Type V: Undetermined.

Results

The predictability and percentage of failure in identifying gender by the various methods individually and in combination are analysed in this study. Table 1 Shows the success and failure percentage in predicting gender by various methods.

Table 1: Shows the success and failure percentage in predicting gender by various methods

VARIABLE	SUCCESS RATE		FAILURE RATE	
	MALE n=30	FEMALE n=30	MALE n=30	FEMALE n=30
MCI	24/30 =80%	19/30 =63%	6/30 =20%	11/30 =37%
RUGAE	26/30 =86.6%	16/30 =53%	4/30 =13.4%	14/30 =47%
LIPPRINT	24/30 =80%	26/30 =86.6%	6/30 =20%	4/30 =13.4%

Table 2 : Shows the success and failure percentage in predicting gender by combining various methods. (The sample size was selected based on, if the values obtained were either correct or wrong for all the variables in the combination. For example, MCI+ RUGAE combination for females, 13 samples showed all correct values for females or all wrong values for females in which 9 out of 13 were correctly predicted as females and 4 out 13 were wrongly predicted as males.)

COMBINED VARIABLES	SUCCESS RATE		FAILURE RATE	
	MALE	FEMALE	MALE	FEMALE
MCI+ RUGAE	20/20 = 100%	9/13 = 70%	0/20 = 0%	4/13 = 30%
LIPPRINT + RUGAE	20/20 = 100%	12/13 = 92.4%	0/20 = 0%	1/13 = 7.6%
LIP PRINT + MCI	20/22 = 91%	15/15 = 100%	2/22 = 9%	0/15= 0%
LIP PRINT + MCI+ RUGAE	15/15 = 100%	7/7 = 100%	0/15 = 0%	0/7 = 0%

Table 3: Shows the overall failure percentage in identifying gender by various methods.

Method	Failure percentage (%)
MCI	57
RUGAE PATTERN	60.4
LIP PRINT	33.4
MCI+ RUGAE	30
LIP PRINT + RUGAE	7.6
LIP PRINT + MCI	9
LIP PRINT + MCI+ RUGAE	0

When we assess the failure percentage of various methods and its combination in identifying gender, combined method is more reliable as the failure percentage in identifying gender is less when compared to individual methods. Failure percentage of combined MCI+ rugaue + lipprints is 0%. Failure percentage of MCI+ rugae is 30% and lipprint + rugae is 7.6% and lipprint + MCI is 9%.

If we see individually, rugae has got highest failure percentage (60.4%), followed by MCI (57%) and least is lip prints (33.4%).

Discussion

Various methods have been used for Gender identification. Many studies have been conducted to find out the predictability of each method in gender identification. In our study, we have compared the predictability as well as failure percentage of three methods, MCI, rugae pattern and lip prints individually and in combination in identifying gender.

When we combine 3 methods together for identifying gender and if all the 3 methods are showing a pattern of particular gender for example, MCI, rugae pattern and lip prints are exhibiting characteristics of male gender, then the probability of that individual actually being male is 100% which is a very good accurate prediction. The failure percentage of 3 combined method was 0%. Likewise, if we combine MCI+ rugae, the probability of identifying the gender correctly is 70%, Lip print + rugae is 92.4% and Lip print + MCI is 91%.

When we combine MCI with rugae and lip print with rugae it showed 100% accuracy in predicting male

gender. Combining lip print with rugae showed 100% accuracy in predicting female gender. From our study, it is evident that combining various methods together increases the accuracy in gender prediction.

It was found that lip prints have got highest predictability when compared to MCI and rugae. These findings agree with some previous studies.[18-19] Our previous study for gender identification using MCI in Malwa population showed overall 65.52% prediction accuracy[20].

Combining 3 methods together i.e, MCI, lip print and rugae together will give most reliable method for gender identification. When 2 methods are combined together for gender identification, the most reliable is MCI + lip print and least reliable is MCI + rugae. During forensic investigation, it is always better to examine all the 3 methods together if it is available from the crime or disaster scene rather than relying on single method for gender identification. The previous dental records such as dental cast and intraoral photographs can give information about the palatal rugae and mandibular canine index. Lip prints can be retrieved from the surface of cigarette ends, plastic bags, paintings, doors and windows.

Studies with larger sample size are needed to authenticate the present findings.

Conclusion

This study concluded that it is always better to combine various methods for identification of gender rather than relying on a single method. We found that failure percentage in identifying gender when MCI, lip prints and rugae pattern combined together is 0%.

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