ARTICLE

SIGNIFICANCE OF USING THE MANDIBULAR CANINE INDEX IN GENDER DETERMINATION

Christy Jacob[*], **Elham Izadpanahian, Madhura Jadhav, Amol Patil**

Dept. of Orthodontics and Dentofacial Orthopedics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Pune, Maharashtra, INDIA

ABSTRACT

A study was conducted using the mandibular canine index to evaluate its significance in gender determination. 1000 casts were measured and the index calculated in the Maharashtrian population aged 18-25 years. The study showed to have 40.6% accuracy in males and 70.2% accuracy in females. Therefore proving that MCI can be used as a supplemental tool in forensic odontology and should not be relied on solely for gender determination.

INTRODUCTION

Forensic dentistry is an important field in dentistry, especially in aiding post mortem reports to determine cause of death by studying the bite marks etc. Along with it, forensic odontology can also be used in gender determination using cranium remains. This study is done to see the usefulness of using the mandibular canine index to find the gender of the individual.

Enamel being the hardest substance of the human body make teeth a very invaluable material to be used for genetic, forensic and other purposes. Especially in the case of forensic odontology when the body has undergone decomposition, the enamel being the most durable and stable tissue in the body will present as a key to investigation [1, 2].

Canines are considered to be the longest permanent teeth in the mouth. They are also called 'corner stone' in the dentition. The mean age of eruption of mandibular canines is 10.87 years [3]. Canines are used in forensic studies due to (i) its durability in the mouth, (ii) they are the last teeth to be extracted with respect to age (iii)it is the tooth which is least affected by calculus or caries, thus won't be subject to gross deformity or periodontal diseases (iv)They are very durable to various natural calamities [4].

Although DNA tests provide the most accurate information in regard to gender identification, the purpose of this study is to check the reliability using the mandibular canine index to determine the gender and to provide additional information on the sex identification.

MATERIALS AND METHODS

One thousand mandibular casts were recorded for this study, out of which five hundred casts were of females and five hundred of male individuals from a majority of Maharashtrian population, within the age group of 18-25 years. Patients were informed about using their casts for study purposes and written consent was taken. Ethical approval was taken from respective authorities. The inclusion criteria of the casts used in this study were fully erupted, non carious and non-worn out mandibular permanent canines in the lower arch, permanent dentition with normal occlusion. The exclusion criteria involved casts with congenitally missing canines, presence of prosthesis, patients with history of orthodontic treatment and malformed canines or canines with developmental defects.

Each parameter of this study was measured separately and independently by two investigators and later values compared to avoid any error. All measurements of the teeth were taken using vernier callipers. The measurements taken were [1] the greatest mesio-distal crown width: - this was measured between the contact points of the tooth on either side of the jaw. Most of the cases showed a bilateral symmetry with this parameter [2], the mandibular canine arch width: this was measured between the tips of both canines in the lower jaw' [4]. There is no statistically significant difference between the right and left mandibular canines amongst males or females so the maximum crown width was considered. Observer error was minimal. In any case if the values differed, a fresh reading was taken by the investigators to ensure accuracy.

The Mandibular Canine Index (MCI) is derived as a ratio between two parameters of permanent mandibular canine teeth, namely the maximum crown width and canine arch width (measured in mm1 and is calculated as follows:

MCI = <u>Mesiodistal crown width of mandibular canine</u>
            Mandibular canine arch width

*Corresponding Author
Email:
christy.e.jacob@gmail.com
Tel.: +91 844 681 0239

DENTAL SCIENCE

RESULTS

The MCI for each subject was calculated as per the formula given above.
The MCI for males have a mean value of 0.284 and for females it is 0.279. Based on these values method of sex predictation from standard value of MCI was derived as follows :

Formula : $\dfrac{\text{(Mean Male MCI – SD) + (Mean Female MCI + SD)}}{2}$

$= \dfrac{(0.284 - 0.023) + (0.279 + 0.022)}{2}$ =0.281

Standard MCI value obtained : 0.281

This standard value was used and reporting of sex was. All Mandibular Canine Index values up to the limit of the Standard MCI value (0.281) were reported as female. Those values above this limit were reported as male.

The standard value was a base line on which the results were crosschecked and seen if the study proved to be true to determine gender based on the readings.

The accuracy of the method was counter-checked in the graph plotted. The values obtained are presented graphically. A graph was plotted sensitivity vs. specificity and the following reading was obtained. Sensitivity is a reflection of the population number with the expected result and specificity is the measure of the false positive rate.

Variable : MCI Calculated

Disease prevalence unknown.

Area under the ROC curve = 0.556
Standard error   = 0.018
95% Confidence interval = 0.525 to 0.587

Table 1: Summarizes the result of sensitivity and specificity obtained from the ROC curve graphically

Criterion	Sens 95% C.I	Spec 95% C.I	+L.R	-L.R
.288	40.6 (36.3-45.0)	70.2 (66.0 – 74.2)	1.36	0.85

Key : Sens   = Sensitivity : Sensitivity is the probability that a test will indicate 'disease' among those with the disease[5]
        Spec   = Specificity: Specificity is the fraction of those without disease who will have a negative test result[5]
        +LR   = Positive likelihood ratio
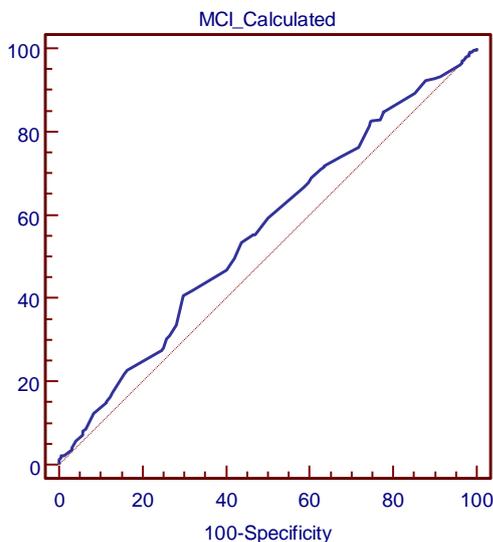   -LR   = Negative likelihood ratio

Fig. 1: The data from the table above has been summed in the line graph of specificity vs sensitivity.
....

Percentage accuracy was then recorded. The percentages were 40.6% in males and 70.2% in females. This proves that males exhibited low accuracy in gender determination using the MCI when compared to females. A wide variation in the percentage was seen between males and females making this index only applicable in females, through this study.

DISCUSSION

Various studies state that the mandibular canine index is an useful and accurate tool in determining the sex of an individual [4-8]. According to a study by Kaushal et al [6], whenever the width of either canine was more than 7 mm, the probability of sex being male was 100. It was seen that with standard MCI, it was possible to detect sex in a North Indian population to as high as 75%. Reddy et al [7] studied the percentage accuracy of sex determination in western Uttar Pradesh and found that males could be predicted correctly in 78% of cases and in females, the accuracy was 66%, so total percentage accuracy was 72%.

However in contradiction few studies state that the mandibular canine index is not an accurate tool for gender determination. The poor ability of the MCI in sex assessment is attributed to it being a relative value–it is obtained as the ratio of two absolute measurements (MD dimension of canines and inter-canine arch width) and does not reflect sex differences that exist in the absolute measurements per say [9,10].

This study done further proves that the MCI is not a reliable source since the values obtained, using the formula and graphically, shows a huge variance and thus cannot be used in the effective determination of sex. Different individuals have different genetic makeup, some females tend to have a larger frame than the others. The same applies with males. Therefore generalizing the overall population and drawing conclusions based on just the width of the canine may not prove to be that accurate a study.

Although, gender determination can be easily done in cases where the cranium is intact. The notable difference between canine in determining sex was noted to be due to the influence of the Y chromosome which was not uniform in all teeth. On the other hand the X-linked genetic influence on tooth width was rather uniform for all teeth [7].

As humans keep on evolving with time, environmental factors play an important role in this evolution. Constantly changing lifestyle, different patterns in diet and early occurrences of growth spurts the results may vary now [10]. Kaushal et al [6] conducted a study back in 1988, stating that the MCI is an important tool for gender determination. But as time progresses, humans evolve, and so does their growth and development. Based on current statistics and casts used for study, we prove that the MCI was more accurate in females who exhibited 70.2%, than males who only exhibited 40.6% accuracy.

Although this method is simple, inexpensive and can be carried out easily, in accordance to our observation, the ability to determine sex is 70.2% in females and 40.6% in males. By comparing the MCI with the standard MCI value will be a profound result found in fragmented female human remains. This method is more accurate and reliable in females due to the percentage of accuracy, when in comparison to males; it did not exhibit even 50% accuracy. But such a method of sex determination has its limitations due to variations of this parameter with geographic distribution. This implies that it is necessary to make up a random sample of the population from this geographical area to calculate the corresponding standard MCI.[11] It can be used just as a supplemental tool in determining the gender of an individual.

CONCLUSION

As it currently stands, MCI does not carry much predictability in the male population as compared to the female. Therefore it may be used as a supplemental tool but it does not carry much relevance to determine the gender. Gender of an individual cannot be estimated if the fragment of the mandible is from the different geographical area unless random sampling of the population of that area has been done to calculate the corresponding MCIs [11]. However, it is not a confirmatory test and is done as an adjunct with other tests for gender identification. Alternative methods should be adopted for gender determination.

DENTAL SCIENCE

11

REFERENCES

[1]   Girish K, Rahman FS, Tippu SR. [2010] Dental DNA fingerprinting in identification of human remains. J Forensic Dent Sci. 2(2):63-68.

[2]   Shamim T. [2012] Forensic odontology. J Coll Physicians Surg Pak. 22(4):240-245.

[3]   Vishwakarma N, Guha R. [2011] A study of sexual dimorphism in permanent mandibular canines and its implications in forensic investigations, Nepal Med Coll J. 13(2) : 96-99

[4]   Rao NG, Rao NN, Pai ML, Kotian MS. [1989] Mandibular canine index – a clue for establishing sex identity. Forensic Sci Int. 1989, 42(3):249-54.

[5]   Lengerich E. STAT 507, Epidemological Research Methods, PennState Eberly College of Science, Pennsylvania, USA (Accessed on May, 2018: https://onlinecourses.science.psu.edu/stat507/)

[6]   Kaushal S, Patnaik VV, Agnihotri G. [2003] Mandibular canines in sex determination. J Anat Soc India; 52:119-24

[7]   Reddy VM, Saxena S, Bansal P. [2008] Mandibular canine index as a sex determinant: A study on the population of western Uttar Pradesh, J Oral Maxillofac Pathol. 12:56-59.

[8]   Singh J, Gupta KD, Sardana V, Balappanavar AY, Malhotra G. [2012] Sex determination using cheiloscopy and mandibular canine index as a tool in forensic dentistry. J Forensic Dent Sci, 4(2):70-74.

[9]   Acharya AB, Mainali S. [2009] Limitations of the mandibular canine index in sex assessment. J Forensic Leg Med. 16 (2): 67- 69.

[10] Silva AM, Pereira ML, Gouveia S, Tavares JN, Azevedo Á, Caldas IM. [2016] A new approach to sex estimation using the mandibular canine index. Med Sci Law,56(1):7-12.

[11] Singh SK, Gupta A, Padmavathi B, Kumar S, Roy S, Kumar A. [2015] Mandibular canine index: A reliable predictor for gender identification using study cast in Indian population. Indian J Dent Res, 26:396-399.