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Kertas Asli/*Original Articles*

A Preliminary Study of Malay and Chinese Bite Mark in UKM Using Dental Wax

(Kajian Preliminari Tanda Gigitan Melayu dan Cina di UKM Menggunakan Lilin Dental)

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ABSTRACT

Identification of unknown suspect through bite marks has always been challenging. Narrowing list of suspects through sex and race markers is always recommend but rarely utilized due to limited publication in this area. Thus, this preliminary research was aimed to study the difference of bite mark made on dental wax between sex and race. A sample size of 40 UKM undergraduates comprising of Malay (male = 10, female = 10) and Chinese (male = 10, female = 10) were used in this study. Bite mark of subject was obtained through dental wax, digitally scanned and analyzed using Image-J software. Parameters measured were anterior teeth size, intercanine width and anterior teeth relative rotation. Result indicated that mandible left canine tooth size had significant sexual dimorphism ($p < 0.05$) in differentiating sex. The means for male and female measured were 4.63 ± 1.05 mm and 5.35 ± 0.87 mm respectively. In addition to the result, tooth size of maxillary left canine and mandible left lateral incisor were significantly different ($p < 0.05$) between races. Means for mandible left canine Malay and Chinese were 5.27 ± 1.01 mm and 4.50 ± 1.22 mm respectively. Furthermore, left lateral incisor mandible had means of 5.15 ± 0.87 mm and 4.60 ± 0.74 mm for Malay and Chinese respectively. Unfortunately, there were no significant differences for intercanine width and anterior teeth relative rotation between the two major races in Malaysia. In conclusion, this research has demonstrated the possibility of using tooth size of mandible left canine, maxillary left canine and mandible left lateral discriminate sex and race.

Keywords: Bite mark; tooth size; arch width; tooth relative rotation; ethnic; sex

ABSTRAK

Pengenalpastian suspek yang tidak diketahui melalui tanda gigitan merupakan satu teknik yang amat mencabar. Pengecilan senarai suspek menggunakan penanda jantian dan kaum amat galak digunakan, tetapi kaedah ini jarang digunakan kerana kajian yang terhad dalam bidang ini. Oleh itu, kajian preliminari ini bertujuan untuk mengkaji perbezaan antara tanda gigitan pada lilin dental antara jantian dan kaum. Saiz sampel seramai 40 pelajar sarjana muda UKM yang terdiri daripada Melayu (lelaki = 10, perempuan = 10) dan Cina (lelaki = 10, perempuan = 10) telah digunakan dalam kajian ini. Tanda digital subjek yang telah diperolehi menggunakan lilin dental, diimbas secara digital dan dianalisis menggunalan perisian Image-J. Parameter yang diukur meruapakan saiz gigi anterior, kelebaran intercanine dan putaran relatif gigi anterior. Keputusan kajian menunjukkan bahawa saiz mendibel kiri kanan mempunyai dimorfisme seksual yang paling bererti ($p < 0.05$) dalm keupayaan untuk membezakan gigitan berdasarkan jantina. Nilai purata untuk parameter ini bagi lelaki dan wanita adalah 4.63 ± 1.05 mm dan 5.35 ± 0.87 mm masing-masing. Selain daripada itu, saiz gigi maksilari canine kanan dan mandibel lateral insisor didapati berbeza secara bererti ($p < 005$) anatra kaum. Nilai purata mendibel kanan canine Melayu dan Cina adalah 5.27 ± 1.01 mm dan 4.50 ± 1.22 mm masing-masing. Tambahan pula, mandibel lateral insisor kanan mempunyai purata 5.15 ± 0.87 mm dan 4.60 ± 0.74 mm untuk Melayu dan Cina masing-masing. Walau bagaimanapun, tidak terdapat sebarang perbezaan bermakna antara kelebaran intra-canine dan putaran relatif gigi anterior antara dua kaum utama di Malaysia itu. Kesimpulannya, kajian ini telah membuktikan keupayaan menggunakan saiz gigi mandibel canine kiri, maksilari canine kiri dan mandibel lateral kiri untuk menentukan jantina dan kaum.

Kata kunci: Kesan gigitan; saiz gigi; kelebaran arkus; putaran relatif gigi; kaum; jantina

INTRODUCTION

American Board of Forensic Odontology (ABFO 2012) defines bite marks as i) a pattern left on an object or tissue by dental structure of a human or animal and ii) a physical alteration in a medium caused by contact of teeth. Study conducted by Perry (2003) had proven that 91% forensic odontologist agree that human dentition is quite unique among individuals. In specific, some factors that attribute to this uniqueness are the numbers of teeth, damaged teeth, malposition teeth, malrotation teeth and teeth restoration. Further study by Kieser et al. (2007) further found that incisor surface of anterior tooth had unique characteristics thus allowing investigators identify the biter confidently.

In sexual assault cases, bite mark can be found on the body of a victim. Past report have also proven that bite mark can also be found on a suspect body as a result of self-defense (Fonseca et al. 2009). A recent study by Pretty and Sweet (2000) had proven that the probability of a women getting bitten is four times higher than a man. Further study on the common sites of bite on victim indicated 33% are found on the chest while 19% were on the arm (Pretty & Sweet 2000). Apart from bite marks on victim, these marks have been known to be found on various foods and inanimate object at the crime scene. Items include cheese (Bernitz & Kloppers 2002), chocolate (McKenna et al. 2000), bread, apple and bullet.

A study on the structure of bite mark clearly proves that an elliptical or circular injury is characteristic of a human bite. The injury may also be shaped like a doughnut with characteristics recorded around the perimeter of the mark. Bite mark will appear as a circular or oval patterned injury consisting of two opposing symmetrical, U-shaped arches separated at their bases by open spaces. The diameter of this injury typically ranges from 25-40 mm (Stavrianos et al. 2011).

Although a suspect can be linked physically to a crime scene or be exonerated through fingerprints and DNA samples, the validity of DNA evidence is regularly challenged. Supporting evidence in the form of bite marks would be useful to strengthen a case (Bernitz et al. 2006).

Identification of perpetrator's gender has been highlighted to be useful but specific association between bite marks and gender has still eluded forensic researchers. Despite this, some progress have been made by recent research which had indicated that mandible canine teeth has the highest evidential value in showing the greatest sexual dimorphism (Vandana et al. 2008). To compound to the lack of reliable data, variation of teeth crown for different populations have been reported. Several factors that contribute to this phenomenon include genetics, epigenetics and environmental influences. Further study conducted by Hanihara and Ishida (2005) had found that population in Australia, Melanesia, Micronesians, sub-Sahara Africa and American natives had the biggest teeth compared to other known population. On the other hand, population with the smallest teeth belongs to the Philippine Negrito, Jomon and the Western Eurasian.

Malaysia is a country composed of different ethnics. Malay, Chinese and Indian are the dominant race in Malaysia with a ratio of 67.0, 24.3 and 7.4 respectively (Jabatan Perangkaan Malaysia 2010). Despite some studies on bite marks around the world, unfortunately no study of this nature has been done in Malaysian population. Thus, the aim of this study was to determine the differences of tooth structure between two afore mentioned ethnics and gender.

MATERIALS AND METHODS

This preliminary study was conducted among students in Universiti Kebangsaan Malaysia Bangi (UKM). Randomly chosen subjects with unhealthy dentition, loss of teeth, damaged teeth and those who are currently undergoing or have underwent orthodontic treatment was not included in the study. Final sample size for this study was 40. The selected sample was further divided equally among Malays and Chinese. No sample from Indian population was taken due to the small population of this race in UKM. Thus, ethnic comprising of Malay and Chinese with each consists of 10 male and 10 female were used. Age range of the subjects was between 17-20 years old.

Bite mark was taken from subjects by using base plate wax class 3. The base plate wax containing the bite mark was then kept in plastic bag and labeled with the subject's information. Photo was taken of subject's maxillary and mandible. Image of the bite mark was later produced by scanning the dental wax. Actual dimension of the bite marks was determined by scanning the dental wax with a ruler. The bite mark was then analysed using Image J.

The parameters measured were teeth size, distance between canine teeth and relative rotation. The data for each measurement collected was analysed by statistical test using Statistical Package Social Sciences (SPSS) for Windows version 20.0. Independent t-test was conducted to determine differences in teeth size between sexes. Independent t-test was performed to determine presence of differences in mesio-distal width of anterior teeth, inter-canine arch width and relative rotation of anterior teeth within ethnics. A $p < 0.05$ was used to indicate the result was statistically significant.

RESULTS

There was significant difference for the mesio-distal width of mandibular left canine between sexes ($p < 0.05$). On the other hand, there was no significant difference existed for mesio-distal width of mandibular right canine between sexes ($p = 0.182$). In addition, the mean value of mandibular left canine width in female was 5.35 ± 0.87 mm while male was 4.63 ± 1.05 mm. For average mandibular right canine width of female and male were 5.03 ± 1.21 mm 4.51 ± 2.24 mm respectively (Table 1).

TABLE 1. Differences in tooth size of mandibular canine (cm) between sexes

	Male (n = 20)		Female (n = 20)		Independent t test
	Mean	S.D.	Mean	S.D.	p
Mandibular left canine	0.46	0.11	0.54	0.09	0.023
Mandibular right canine	0.45	0.12	0.50	0.12	0.182

Maxillary left canine and mandibular left lateral incisor showed significant difference between ethnic ($p < 0.05$). However, there was no significant difference for the rest of other anterior teeth ($p > 0.05$). Overall, the anterior teeth width were wider in Malay than Chinese except upper left central incisor, lower left central incisor and lower right central incisor (Table 2).

TABLE 2. Differences in tooth size (cm) between ethnics

	Malay (n = 20)		Chinese (n = 20)		Independent t test
	Mean	S.D.	Mean	S.D.	p
Upper left central incisor	0.64	0.12	0.65	0.10	0.608
Upper left lateral incisor	0.50	0.12	0.49	0.12	0.803
Upper left canine	0.53	0.10	0.45	0.12	0.038
Upper right central incisor	0.68	0.12	0.62	0.06	0.115
Upper right lateral incisor	0.53	0.13	0.51	0.12	0.574
Upper right canine	0.52	0.17	0.46	0.14	0.227
Lower left central incisor	0.48	0.06	0.50	0.06	0.394
Lower left lateral incisor	0.51	0.09	0.46	0.07	0.039
Lower left canine	0.52	0.08	0.48	0.12	0.193
Lower right central incisor	0.46	0.05	0.48	0.05	0.202
Lower right lateral incisor	0.47	0.07	0.46	0.07	0.419
Lower right canine	0.52	0.06	0.45	0.15	0.620

The inter-canine arch width revealed no significant ethnic difference for maxillary inter-canine distance ($p = 0.698$) and mandibular inter-canine distance ($p = 0.668$). The mean inter-canine distance for maxillary was wider in Chinese (3.50 ± 0.16 cm) than Malay (3.48 ± 0.20 cm). Inter-canine distance for mandibular was also wider in Chinese (2.81 ± 0.14 cm) than Malay (2.79 ± 0.14 cm). In addition, relative rotation of anterior teeth were also showed no significant difference ($p > 0.05$) (Table 3 and 4).

TABLE 3. Differences in inter-canine arch width (cm) between ethnics

Inter-canine arch width	Male (n = 20)		Female (n = 20)		Independent t test
	Mean	S.D.	Mean	S.D.	p
Maxillary	3.48	0.20	3.50	0.16	0.698
Mandible	2.79	0.14	2.81	0.14	0.668

TABLE 4. Differences in relative rotation (degree) between ethnics

	Malay (n = 20)		Chinese (n = 20)		Independent t test
	Mean	S.D.	Mean	S.D.	p
Upper left central incisor	85.82	12.05	85.25	11.47	0.878
Upper left lateral incisor	56.47	12.74	55.74	12.14	0.856
Upper left canine	30.11	8.38	27.80	18.09	0.628
Upper right central incisor	86.54	10.11	88.25	14.33	0.665
Upper right lateral incisor	64.85	13.58	58.19	10.73	0.105
Upper right canine	28.03	12.60	32.64	18.01	0.367
Lower left central incisor	93.50	12.86	94.64	10.12	0.758
Lower left lateral incisor	67.74	17.33	63.77	14.49	0.437
Lower left canine	35.18	10.63	36.71	13.34	0.695
Lower right central incisor	89.48	14.96	90.72	15.92	0.802
Lower right lateral incisor	65.27	13.09	60.74	7.33	0.196
Lower right canine	32.46	11.66	35.61	10.03	0.365

DISCUSSION

It was found that the mandibular left canine width had statistically significant differences between sexes. Unfortunately, no significant differences for mandibular right canine width were noted. These finding was similar with previous study done by Vishwakarma and Guha (2011), Kaushal et al. (2004) and Srivastava which had looked at a few selcted Indian population in India (2010).

Moreover, this study had observed reverse sexual dimorphism where the mean canine width was wider in female than male. Similar result was also seen in study of South Indian by Boaz and Gupta (2009). It is felt that the reverse sexual dimorphism could have been caused by evolution although conformation of this hypothesis is beyond the scope of this study (Acharya & Mainali 2007).

Our research finding of mesio-distal anterior teeth width indicates the presence of variation in tooth sizes between ethnic. This result was similar to that reported by Paredes et al. (2011) and Brook et al. (2009). Factors that can lead to this phenomenon are likely genetic, epigenetic and environmental influences.

Past study had found 300 genes involved in the development of tooth from bud to its complete development (Galluccio et al. 2012). This also implies that teeth size variation seen in this study could also be due to heredity.

Previous research has also indicated that epigenetic could have played an important influence in the odontogenesis. This was further supported by Townsend and Brook (2008) where they had noted epigenetic can happened at a much rudimentary level of tissue.

The role of environmental towards teeth variation can be seen through human's habits and diet. For example, malnutrition can lead to variation in teeth size. This was supported by Townsend and Brook (2008) where they noted a reduction of mesio-distal width of desiduous teeth in low birth weight.

We noted that there was no significant inter-canine arch width difference between ethnicity. This is contrary to a few reports by Kook et al. (2004), Radmer and Johnson (2008) and Nojima et al. (2001) where they all had found significant differences inter-canine arch width between Korean, North American white, Afro-American, Caucasian residing in Japan and Japanese. Latest study by Othman et al. (2012) had strongly suggested that different race group should have some basic difference on arch width and shape. Unfortunately, this was not seen in this study.

A contradicting result seen in this study could be due to the selection of the study's target group. We would like to stress that, this study had exclusively used Malay and Chinese as the study group. As these two ethnics belong to the Mongoloid cluster, hence it is logical to assume that there should not be any significance inter-canine arch width difference observed within the ethnic.

The study had also not seen any significant relative rotational of anterior teeth between ethnicity. This study's result differ with result reported by (Bernitz et al. 2006) where there was significant teeth rotation found between races of Caucasian and Negroid for upper right and lower left incisor. Thus, we conclude that relative rotation of teeth is not suitable in determining ethnicity.

CONCLUSION

Sex can be determined through mandibular left canine as it established significant difference. The upper left central incisor and lower left lateral incisor had significance mesio-distal width difference between ethnic. On the other hand, inter-canine arch width and relative rotation of anterior teeth showed no significant difference. Therefore, upper left central incisor and lower left lateral incisor can be take into account for the determination of ethnic Malay and Chinese.

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