Gender Discrimination Based on Lip Prints Analysis in Malaysian Chinese Population (Klang Valley): Photograph on Lipstick-Cellophane Tape Technique

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ABSTRACT

Lip print pattern is different and unique in every human. It consists of indented pattern from fissures and grooves that appear on the red part of the lips. Cheiloscopy, the study of lip print, proves that it has individual characteristic and has been widely used for identification purpose. It can be an important method for gender determination and individual identification. Therefore, this study aimed to discriminate gender among Malaysian Chinese population based on lip prints using photograph on lipstick-cellophane tape technique. Suzuki and Tsuchihashi lip print pattern classification was referred to. A total 412 subjects (203 males, 209 females) were selected conveniently. Lipstick was applied on lips and lip print was lifted using a cellophane tape, pasted onto an A4 paper and photographed. Lip print image was divided into six topography areas which were upper left, upper middle, upper right, lower left, lower middle and lower right. Photoshop was used to analyse all images. A Pearson chi-square test showed significant differences between male and female in two sections which were upper left and upper right ($p < 0.05$). Type II and type IV dominated both females and males. Type II and IV dominated the upper left section (45.6%) while type III was noted in the lower right section (30.8%). Type IV was the dominant pattern for both upper middle and lower middle sections (75.2% and 73.8%) while type II occupied the upper right (45.6%) and lower left sections (55.8%). This finding is useful in aiding forensic investigation and criminalistics involving lip print analysis.

Keywords: Cheiloscopy, digital technique, gender determination, Malaysian Chinese population, Suzuki and Tsuchihashi

INTRODUCTION

Lip print is one of useful criterion in forensic investigation (Eldomiaty et al. 2014). A lip print at a crime scene can provide important information such as pathological changes of the lips (Gondivkar et al. 2009). Apart from identification and evidential use, lip-prints may also be used in gender determination (Ghimire et al. 2014; Kasprzak 1990; Neo et al. 2012; Nur Sabrina Sarah et al. 2019; Wan Rafiuddin et al. 2018) hence, leading to acceptance of this technique as evidence in the Polish criminal justice system (Utsuno et al. 2005). Lip print pattern is unique in every human being, even for a set of twins (Saraswathi et al. 2009) and cheiloscopy, a study of a lip print, has been accepted as a method in forensic investigation for gender determination (Sharma et al. 2009; Wrobel K. et al. 2015) and personal identification (Remya et al. 2016). Lip print consists of furrows and grooves on the red part or the vermilion border of human lips (Jeergal et al. 2016; Prabhu et al. 2012b). A single lip print contains, on average, 1145 individual features forming a unique pattern, different for each person, in which approximately 100 individual features can be identified (Wrobel K. et al. 2015). It does not change with time, however, any surgery or disease, or trauma can change the lip print pattern of a person (Bindal et al. 2009; Venkatesh et al. 2011). Various studies of lip prints were published using various methods of lifting and analysing the lip prints, however, majority are from Indian population in India (Fonseca et al. 2019), as shown in Table 1.

TABLE 1. Cheiloscopy studies from previous researches (Nur Sabrina Sarah et al. 2019)

Authors	Population	No. of subject	Lifting technique	Area of study	Dominant pattern found
Multani S et al. (Multani et al. 2014)	Indian	200 (100 males+100 females)	Lipstick-cellophane tape technique	Middle part only	I
Kinra M et al. (Kinra et al. 2014)	Indian	40 (20 males+20 females)	Lipstick-cellophane tape technique-bond paper	Middle part only	III
Remya S et al. (Remya et al. 2016)	Indian	200 (100 males+100 females)	Lipstick-cellophane tape technique – scanning technique	Middle part only (lower)	IV
Verghese AJ et al. (Verghese et al. 2010)	Indian	100 (50 males+50 females)	Lipstick-cellophane tape technique-bond paper	Middle part only (lower)	IV
Karim and Gupta (Karim et al. 2014)	Indian	122 (62 males+60 females)	Lipstick-cellophane tape technique	Middle part only (lower)	I (males) III (females)
Rao et al. (Rao et al. 2014)	Indian, Chinese, Malay (Melaka Manipal Medical College)	185 (61 Chinese, 63 Malay, 61 Indian)	Lipstick-cellophane tape technique-bond paper	Middle part only (lower)	V (Chinese) V (Malay) III (Indian)
Kumar A et al. (Kumar et al. 2016)	Indian	90 (45 males+45 females)	Lipstick-bond paper technique	Whole lips	IV
Vijay Kautilya D et al. (Kautilya et al. 2013)	Indian	100 (50 males+50 females)	Lipstick-cellophane tape technique-bond paper	Whole lips	I
Ishaq et al. (Ishaq et al. 2018)	Pakistan	250 (125 males+125 females)	Lipstick-cellophane tape technique-bond paper	Whole lips	I
Koneru et al. (Koneru et al. 2013)	Indian	60 (30 males+30 females)	Lipstick-cellophane tape technique	4 quadrants	I
Kapoor N et al. (Kapoor et al. 2017)	Indian	200 (100 males+100 females)	Direct photography technique (Nikon D3100 14.2 MP)	4 quadrants	I
Bindal U et al. (Bindal et al. 2009)	Indian	50 (25 males+25 females)	Lipstick-bond paper technique	4 quadrants	II
Manipady (Manipady 2001-2002)	Indian and Chinese origin students in Manipal India	50 Indian + 50 Chinese	Not Available	Not Available	II
Gondivkar et al. (Gondivkar et al. 2009)	Indian	140 (70 males+70 females)	Lipstick-bond paper technique	4 quadrants	II
Nagrale et al. (Nagrale et al. 2014)	Indian	500 (250 males+250 females)	Lipstick-bond paper technique	4 quadrants	III

Prabhu RV et al. (Prabhu et al. 2012a)	Indian dental students	100	Lipstick-cellophane tape technique–scanning technique (300dpi scanner)	4 quadrants	V
Durbakula et al. (Durbakula et al. 2015)	Indian and Malaysian dental students in Mangalore India	64 (Indian: 16 males+16 females, Malaysian: 16 males+16 females)	Lipstick-cellophane tape technique-bond paper technique	4 quadrants	II (Indians) I' (Malaysians)
Neo et al. (Neo et al. 2012)	Malaysian Malays	88 (44 males+44 females)	Lipstick-cellophane tape technique	4 quadrants	I'
Neo et al. (Neo et al. 2012)	Malaysian Chinese	36 (18 males+18 females)	Lipstick-cellophane tape technique	4 quadrants	I
Abdel Aziz et al. (Abdel Aziz et al. 2016)	Malaysian and Egyptian	120 (Egyptian: 30 males+30 females, Malaysian: 30 males+30 females	Lipstick-paper technique	4 quadrant	III in both Malaysian and Egyptian
Alzapur et al. (Alzapur et al. 2017)	Hyderabad, India	100 (50 males+50 females)	Lipstick-cellophane tape technique-bond paper technique	4 quadrant	I
Peeran et al. (Peeran et al. 2015)	Sebha city, Libya	104 (37 males+67 females)	Lipstick-paper technique	4 quadrant	I
Ragab et al. 2013	Egyptian population	955 (235 males+720 females)	Lipstick-paper technique and scanning technique (Canon Pixma 495MP, 300dpi scanner)	6 sections	I – complete vertical (Renaud classification)
Moshfeghi et al. (Moshfeghi et al. 2016)	Iranian population	96 (22 males+74 females)	Lipstick-paper technique	6 sections	V
George et al. (George et al. 2016)	Malaysian Malays	124 (from 31 families)	Lipstick-paper technique and scanning technique	6 sections	I
Wan Rafiuddin et al. (Wan Rafiuddin et al. 2018)	Malaysian Malays	360 (180 males+180 females)	Lipstick-cellophane tape technique	6 sections	II
Nur Sabrina et al. (Nur Sabrina Sarah et al. 2019)	Malaysian Malays	360 (180 males+ 180 females)	Photograph on lipstick- cellophane tape technique (13MP mobile phone camera)	6 sections	V
Mohd Seliman et al. (Mohd Seliman et al. 2020)	Malaysian Chinese	412 (203 males+209 females)	Lipstick-cellophane tape technique	6 sections	II

Based on Table 1, majority of the lip print studies comes from India for Indian population. There were a number of researchers who were interested with Malaysian lip print pattern and only four studies were done exclusively for Chinese. Rao et al. (Rao et al. 2014) noted that type V was the dominant

pattern for Malaysian Malay and Chinese from the Melaka Manipal Medical College, while Manipady (Manipady 2001-2002) found that type II was the dominant pattern for Indian and Chinese origin students in Manipal India, India. Durbakula et al. (Durbakula et al. 2015) studied Indian (from India) and Malaysian dental students at Mangalore, India and that type I' was the dominant pattern for Malaysian. Neo et al. (Neo et al. 2012) studied 88 Malaysian Malays and 36 Malaysian Chinese. The results showed that type I' and I were the dominant pattern for Malays, Chinese, respectively. George et al. (George et al. 2016) found type I was dominant among 124 Malaysian Malays family members while Wan Rafiuddin et al (Wan Rafiuddin et al. 2018) and Nur Sabrina Sarah et al. (Nur Sabrina Sarah et al. 2019) noted that type II and type V were the dominant pattern for Malaysian Malays, respectively. Mohd Seliman et al. (Mohd Seliman et al. 2020) analysed 412 Malaysian Chinese and type II was the dominant pattern. Only two from these researchers use digital method for lip print acquisition: George et al. used lipstick-paper technique and scanning technique and Nur Sabrina Sarah et al. used photograph on lipstick- cellophane tape technique (13MP mobile phone camera). Therefore, the aimed of our study was to discriminate gender of Malaysian Chinese population in Klang Valley based on lip prints analysis using digital approach, photograph on lipstick-cellophane tape technique. Suzuki and Tsuchihashi classification (Tsuchihashi 1974) was used for lip print pattern classification: type I complete vertical, type I' incomplete vertical, type II branched, type III intersected, type IV reticular pattern and type V irregular pattern.

MATERIALS AND METHODS

A total of 412 convenient subjects (n=412) were involved in the research, 203 males (n=203) and 209 females (n=209), from Malaysian Chinese population, of which at least three consecutive generations with no mixed race. Subjects who were hypersensitive to lipstick, with defects or scars on lips, or previously underwent lip surgery, had dried or chapped lips and had piercings on lips were excluded from this study (Neo et al. 2012). Subjects were then asked to complete a consent form. Ethic approval code for this study was UKM PPI/111/8/JEP-2018-133. Wet tissues were given to the subject to clean the upper and lower lip for hygiene purpose. A non-glossy and red colour lipstick was used (Silkygirl, Siren Red code 3) for optimum visibility of the pattern on the lip. Lipstick was applied uniformly to the whole lip using a lip brush in a single direction (Karim & Gupta 2014). The subject was asked to rub the lips together gently to spread the lipstick evenly (Verghese et al. 2011). Subjects were then asked to close their mouths in a stationary and relaxed manner for one minute. As human lips are mobile, the strength and pressure applied even at minimal movement can affect the print on the cellophane tape (Prabhu et al. 2013). Subject was strictly advised not to move the lips and avoid movement that can affect the lip print while the lip print was taken.

A 45mm cellophane tape (Sheng Leong and LTi Material, 45 mm width) was pressed against the subject's lip with gentle pressure for ten seconds. The tape was then carefully lifted from the subject's lip and then pasted onto a plain A4 paper. These steps were repeated three times without reapplying lipstick. The A4 paper with the subject's lip print was labelled with subject's details for record purposes. The lip prints obtained on a plain A4 paper were captured using a digital camera Canon Power Shot (14MP) for digital analysis. Lip print images were viewed and analysed using Adobe Photoshop 7, for better visualisation, recording and identification of the lip print pattern. It also served as an ideal method of permanently storing data which helped in keeping ante-mortem record of subjects.

Lip print image was divided into six sections: upper left (UL), upper middle (UM), upper right (UR), lower right (LR), lower middle (LM) and lower left (LL) sections. Figure 1 shows the six topography areas of the lip, as suggested by Nur Sabrina Sarah et al. (Nur Sabrina Sarah et al. 2019).

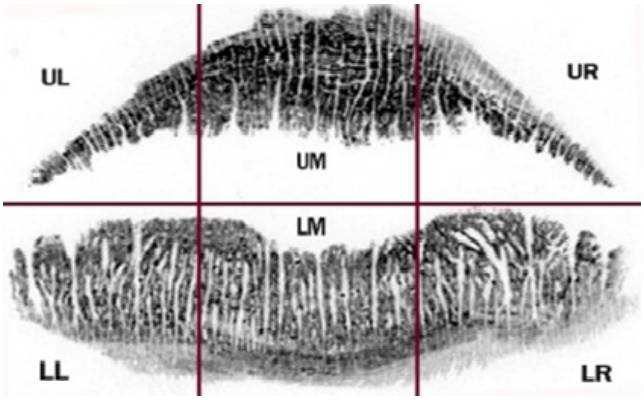

FIGURE 1. Six topography areas of the lips, upper left (UL), upper middle (UM), upper right (UR), lower right (LR), lower middle (LM) and lower left (LL) sections (Nur Sabrina Sarah et al. 2019)

The dominant pattern in each quadrant were recorded. In order to obtain optimum visibility image of each line on the lip print, the brightness and contrast level of pixels of the images was increased (Wrobel K. et al. 2015). Each type of lip print pattern was given a color code for identification purpose, based on Suzuki and Tsuchihashi classification (Tsuchihashi 1974): yellow (Type I), red (Type I'), blue (Type II), green (Type III), purple (Type IV) and orange (Type V). Dominant pattern of each section on lip was identified and further analysed using Pearson Chi Square test.

RESULTS AND DISCUSSIONS

Table 2 shows the percentage distribution of lip print pattern of Malaysian Chinese population in each lip section.

TABLE 2. Percentage of lip print pattern distribution in each section

Lip section	Upper Left	Upper Middle	Upper Right	Lower Right	Lower Middle	Lower Left
Type I	1.9	0.2	3.4	0.0	0.2	0.0
Type I'	1.0	1.0	1.5	0.2	0.7	0.2
Type II	45.6	21.3	45.6	28.6	20.9	55.8
Type III	4.9	1.7	4.4	30.8	2.7	5.1
Type IV	45.6	75.2	44.9	21.8	73.8	38.1
Type V	1.0	0.5	0.2	18.4	1.7	0.7

Based on Table 2, type II and IV dominated the upper left section (45.6%), type IV again were dominant in another two sections, upper middle and lower middle (75.2% and 73.8% respectively), type II were dominant in two sections, upper right (45.6%) and lower left (55.8%), while type III dominated the lower right section with 30.8%. Neo et al. (Neo et al. 2012), Mohd Seliman et al. (Mohd Seliman et al. 2020), Rao et al. (Rao et al. 2014) and Manipady (Manipady 2001-2002) studied Chinese lip print patterns using Suzuki and Tsichihachi's classification. Neo et al. used lipstick-cellophane tape technique and analysed 36 Malaysian Chinese students at Universiti Kebangsaan Malaysia, based on 4 quadrant of lips. Their results showed that type I was the dominant pattern. Mohd Seliman et al. had 412 Malaysian Chinese subjects, they used similar method which was lipstick-cellophane tape technique and lip print pattern was analysed based on 6 sections. The dominant lip print pattern was type II. Manipady analysed 50 Chinese origin students from Manipal India and the results agreed with Mohd Seliman et al. (Mohd Seliman et al. 2020). Rao et al. (Rao et al. 2014) studied 61

Chinese students' lip prints pattern (middle part only) from Melaka Manipal Medical College, Malaysia, using lipstick-cellophane tape and bond paper technique. The result showed that type V was the dominant pattern. All these four researchers did not use digital approach for lip print analysis, and other than Mohd Seliman et al. (Mohd Seliman et al. 2020), the other three researchers had less than 100 subjects. The current study divided the lip print into 6 sections so that the dominant pattern for each section can be determined. Based on Table 1, Kapoor N et al. (Kapoor & Badiye 2017), Prabhu RV et al. (Prabhu et al. 2012a) and Nur Sabrina Sarah et al. (Nur Sabrina Sarah et al. 2019) used digital method for lip print analysis. Kapoor N et al. (Kapoor & Badiye 2017) used a 14.2 MP digital camera to capture 200 Indian lip prints and noted that type I was the dominant lip print pattern (4 quadrant of lip print), while Prabhu RV et al. (Prabhu et al. 2012a) used a 300dpi scanner to scan 100 Indian dental students. The result showed type V was the dominant lip print pattern (4 quadrant of lip print). Nur Sabrina Sarah et al. (Nur Sabrina Sarah et al. 2019) took photograph of lip print images pasted onto an A4 paper with a 13MP mobile phone camera from 360 Malaysian Malay subjects. The result showed that the dominant lip print pattern was type V, from 6 section of lip prints. The current study noted that type II and IV dominated most of 6 sections of lip prints, and these results agreed with Mohd Seliman et al. (Mohd Seliman et al. 2020) who noted that type II was the dominant pattern for Malaysian Chinese. Such variance in outcomes was predicted because different groups or races have different anatomies of lip print and lip print can be categorised according to their thickness (Gunasekaran et al. 2018). In the European and Caucasian, thin lips are most prevalent, thick or very thick lips are usually seen in Negros, mixed lips are usually seen in Orientals and medium lips (about 8-10 mm thickness) are seen in Indians. In addition, genetic influences (Ahmed et al. 2018) and geographical distribution of subjects may be linked to variance in lip print patterns (Prabhu et al. 2012a). Pattern distribution in each section between male and female is shown in Table 3.

TABLE 3. Percentage of lip print pattern distribution in each section between male and female

Lip print pattern		Type I	Type I'	**Type II**	Type III	**Type IV**	Type V	Total (%)
Male	Upper Left	2.0	1.5	**53.2**	3.0	**38.9**	1.5	100
	Upper Middle	0.5	1.0	**22.7**	2.5	**72.4**	1.0	100
	Upper Right	3.9	2.0	**52.2**	2.0	**39.4**	0.5	100
	Lower Right	0.0	0.5	**58.1**	4.4	**36.5**	0.5	100
	Lower Middle	0.0	0.5	**20.2**	1.5	**74.9**	3.0	100
	Lower Left	0.0	0.5	**56.7**	3.0	**38.4**	1.5	100
Female	Upper Left	1.9	0.5	**38.3**	6.7	**52.2**	0.5	100
	Upper Middle	0.0	1.0	**20.1**	1.0	**78.0**	0.0	100
	Upper Right	2.9	1.0	**39.2**	6.7	**50.2**	0.0	100
	Lower Right	0.0	0.0	**56.5**	7.7	**35.9**	0.0	100
	Lower Middle	0.5	1.0	**21.5**	3.8	**72.7**	0.5	100
	Lower Left	0.0	0.0	**55.0**	7.2	**37.8**	0.0	100

Type II and type IV were dominant for both males and females (Table 3). For males, type II was the dominant pattern found in upper left, upper right, lower right and lower left, ranging from 52.2% to 58.1%, while type IV dominated the upper middle and lower middle section with 72.4% and 74.9%, respectively. For females, type IV dominating four out of six sections, upper left (52.2%), upper middle (78.0%), upper right (50.2%) and lower middle (72.7%), while Type II was the dominant pattern for lower right (56.5%) and lower left (55.0%).

Results also showed that only upper right and upper left sections were statistically significant ($p < 0.05$, Table 4).

TABLE 4. Pearson chi-square test result of lip print pattern

Section of lips	*p* value	
Upper Left	$p < 0.015$	Significant
Upper Middle	$p < 0.391$	Not Significant
Upper Right	$p < 0.016$	Significant
Lower Right	$p < 0.422$	Not Significant
Lower Middle	$p < 0.201$	Not Significant
Lower Left	$p < 0.100$	Not Significant

Table 5 showed frequency of lip print patterns recorded in each lip section for both males and females. For the upper left section, type I, type I', type III and type V were highest in males ranging from 51.3% to 75%, while type III and type IV were highest in females (69.1% and 56.7%, respectively). These results could be used as a suggestion to identify a gender of the lip print's owner, for example, if type I, I', III or V found at the crime scene, there is a possibility that it comes from a male. Interestingly, the upper middle section, type I and V were exclusively for males (100%). Whilst, type V was the only lip print pattern found in males, which is at upper right section (100%). For the lower right and lower left sections, type I' and type V were only found in males, but type I was exclusively for females in the lower middle section. These results also could be used as a guide for gender determination, if a lip print is one of the evidences found at the crime scene.

CONCLUSION

Lip print identification has been proposed as a tool for forensic science investigation, however, evaluation of concepts and designs need to be done for lip print identification. This current study introduced digital approach in analysing the lip print pattern and the results suggested that it is useful for lip print identification among Malaysian Chinese population in Klang Valley especially in gender discrimination. The findings indicate that females dominated type III and IV in the upper left and upper right section while type I, I', II and V were dominant in males for both section. These results can be suggested for gender discrimination in Malaysian Chinese population in Klang Valley based on lip print patterns and of course more research may be carried out to strengthen the findings, such as using larger sample sizes to reflect certain ethnicity in a country or involving different ethnicity studies.

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TABLE 5. Frequency of subjects with specified lip print pattern

Lip Section	Type	Frequency			Possible gender
		Male	Female	Total	
UL	I	2.0	1.9	3.9	Male (51.3%)
	I'	1.5	0.5	2.0	Male (75.0%)
	II	53.2	38.3	91.5	Male (58.1%)
	III	3.0	6.7	9.7	Female (69.1%)
	IV	38.9	52.2	91.1	Female (56.7%)
	V	1.5	0.5	2.0	Male (75.0%)
UM	I	0.5	0.0	0.5	Male (100.0%)
	I'	1.0	1.0	2.0	Both (50.0%)
	II	22.7	20.1	42.8	Male (53.1%)
	III	2.5	1.0	3.5	Male (71.5%)
	IV	72.4	78.0	150.4	Female (52.9%)
	V	1.0	0.0	1.0	Male (100.0%)
UR	I	3.9	2.9	6.8	Male (57.4%)
	I'	2.0	1.0	3.0	Male (66.7%)
	II	52.2	39.2	91.4	Male (57.1)
	III	2.0	6.7	8.7	Female (77.0%)
	IV	39.4	50.2	89.6	Female (56.1%)
	V	0.5	0.0	0.5	Male (100.0%)
LR	I	0.0	0.0	0.0	Both (0.0%)
	I'	0.5	0.0	0.5	Male (100.0%)
	II	58.1	56.5	114.6	Male (50.7%)
	III	4.4	7.7	12.1	Female (63.6)
	IV	36.5	35.9	72.4	Male (50.4%)
	V	0.5	0.0	0.5	Male (100.0%)
LM	I	0.0	0.5	0.5	Female (100.0%)
	I'	0.5	1.0	1.5	Female (66.7%)
	II	20.2	21.5	41.7	Female (51.6%)
	III	1.5	3.8	5.3	Female (71.7%)
	IV	74.9	72.7	147.6	Male (50.8%)
	V	3.0	0.5	3.5	Male (85.7%)
LL	I	0.0	0.0	0.0	Both (0.0%)
	I'	0.5	0.0	0.5	Male (100.0%)
	II	56.7	55.0	111.7	Male (50.8%)
	III	3.0	7.2	10.3	Female (69.9%)
	IV	38.4	37.8	76.2	Male (50.4%)
	V	1.5	0.0	1.5	Male (100.0%)

REFERENCES

Abdel Aziz, M.H., Badr El Dine, F.M.M. & Saeed, N.M.M. 2016. Regression equations for sex and population detection using the lip print pattern among Egyptian and Malaysian adult. *Journal of Forensic and Legal Medicine* 44: 103-110.

Ahmed, S.A., Salem, H.E. & Fawzy, M.M. 2018. Forensic dissection of lip print as an investigative tool in a mixed Egyptian population. *Alexandria Journal of Medicine* 54(3): 235-239.

Alzapur, A., Nagothu, R.S. & Nalluri, H.B. 2017. Lip prints-A study of its uniqueness among students of MediCiti Medical College. *Indian journal of clinical anatomy and physiology* 4(1): 68-70.

Bindal, U., Jethani, S.L., Mehrotra, N., Rohatgi, R.K., Arora, M. & Sinha, P. 2009. Lip prints as a method of identification in human beings. *Journal of the Anatomical Society of India* 58(2): 152-155.

Durbakula, K., Kulkarni, S., Prabhu, V., Jose, M. & Prabhu, R. 2015. Study and comparison of lip print patterns among Indian and Malaysian dental students. *Journal of Cranio-Maxillary Diseases* 4(1): 5.

Eldomiaty, M.A., Anwar, R.I. & Algaidi, S.A. 2014. Stability of lip-print patterns: a longitudinal study of Saudi females. *J Forensic Leg Med* 22: 154-158.

Fonseca, G.M., Ortíz-Contreras, J., Ramírez-Lagos, C. & López-Lázaro, S. 2019. Lip print identification: Current perspectives. *Journal of Forensic and Legal Medicine* 65: 32-38.

George, R., Nora Afandi, N.S., Zainal Abidin, S.N., Binti Ishak, N.I., Soe, H.H. & Ismail, A.R. 2016. Inheritance pattern of lip prints among Malay population: A pilot study. *J Forensic Leg Med* 39: 156-160.

Ghimire, N., Ghimire, N., Nepal, P., Upadhyay, S., Budhathoki, S.S., Subba, A. & Kharel, B. 2014. Lip print pattern: an identification tool. 2014 11(3): 5.

Gondivkar, S., Indurkar, A., Degwekar, S. & Bhowate, R. 2009. Cheiloscopy for sex determination. *Journal of Forensic Dental Sciences* 1(2): 56-60.

Gunasekaran, S., Mahabob, N., Elangovan, S., Lakshmi, S., Balasubramaniam, S. & Rajendran, D. 2018. Comparative evaluation of lip prints among Indian and African students. *The Saudi Journal of Forensic Medicine and Sciences* 1(1): 14-18.

Ishaq, N., Malik, A.R., Ahmad, Z. & Ullah, S.E. 2018. Determination of Sex by Cheiloscopy as an Aid to Establish Personal Identity. *Annals of King Edward Medical University* 24(1).

Jeergal, P.A., Pandit, S., Desai, D., Surekha, R. & Jeergal, V.A. 2016. Morphological patterns of lip prints in Mangaloreans based on Suzuki and Tsuchihashi classification. *J Oral Maxillofac Pathol* 20(2): 320-327.

Kapoor, N. & Badiye, A. 2017. A study of distribution, sex differences and stability of lip print patterns in an Indian population. *Saudi Journal of Biological Sciences* 24(6): 1149-1154.

Karim, B. & Gupta, D. 2014. Cheiloscopy and blood groups: Aid in forensic identification. *Saudi Dent J* 26(4): 176-180.

Kasprzak, J. 1990. Possibilities of cheiloscopy. *Forensic Science International* 46(1): 145-151.

Kautilya, D.V., Bodkha, P. & Rajamohan, N. 2013. Efficacy of Cheiloscopy in Determination of Sex Among South Indians. Journal of Clinical and Diagnostic Research : *JCDR* 7(10): 2193-2196.

Kinra, M., Ramalingam, K., Sethuraman, S., Rehman, F., Lalawat, G. & Pandey, A. 2014. Cheiloscopy for Sex Determination: A Study. *Journal of Dentistry* 4(1): 48-51.

Koneru, A., Surekha, R., Nellithady, G.S., Vanishree, M., Ramesh, D. & Patil, R.S. 2013. Comparison of lip prints in two different populations of India: Reflections based on a preliminary examination. *Journal of Forensic Dental Sciences* 5(1): 11-15.

Kumar, A., Prasad, S.N., Kamal, V., Priya, S., Kumar, M. & Kumar, A. 2016. Importance of Cheiloscopy. *Int J Oral Care Res* 4(1): 48-52.

Manipady, S. (2001-2002). A comparative study of lip print patterns among Indians and Chinese in Manipal (Dissertation), *Manipal Academy of Higher Education*, Manipal, India.

Mohd Seliman, A.F.F., Noor Hazfalinda, H., Gabriel, G.F. & Osman, K. 2020. Lip Print Analysis in Malaysian Chinese Population (Klang Valley): Lipstick-Cellophane Tape Technique. *Jurnal Sains Kesihatan Malaysia* 18(2): 31-38.

Moshfeghi, M., Beglou, A., Mortazavi, H. & Bahrololumi, N. 2016. Morphological patterns of lip prints in an Iranian population. *Journal of clinical and experimental dentistry* 8(5): e550-e555.

Multani, S., Thombre, V., Thombre, A. & Surana, P. 2014. Assessment of lip print patterns and its use for personal identification among the populations of Rajnandgaon, Chhattisgarh, India. *J Int Soc Prev Community Dent* 4(3): 170-174.

Nagrale, N., Bipinchandratirpude, Murkey, P. & Patond, S. 2014. Establishing Cheiloscopy as a Tool for Identification: An Assessment on 500 Subjects

In Central India. *Al Ameen Journal of Medical Sciences* 7(3): 201-206.

Neo, X.X., Noor Hazfalinda, H., Osman, K. & Amir Hamzah, S.P.A. 2012. Lip Prints in Sex and Race Determination. *Jurnal Sains Kesihatan Malaysia* 10(1): 29-33.

Nur Sabrina Sarah, A.R., Noor Hazfalinda, H., Nur Hamizah, M.U. & Gabriel, G.F. 2019. Digital Approach for Lip Prints Analysis in Malaysian Malay Population (Klang Valley): Photograph on Lipstick-Cellophane Tape Technique. *Jurnal Sains Kesihatan Malaysia* 17(2): 43-49.

Peeran, S.W., Kumar, P.G.N., Abdalla, K.A., Azaruk, F.A.A., Manipady, S. & Alsaid, F.M. 2015. A study of lip print patterns among adults of Sebha city, Libya. *Journal of Forensic Dental Sciences* 7(1): 67-70.

Prabhu, R.V., Dinkar, A. & Prabhu, V. 2012a. A study of lip print pattern in Goan dental students - A digital approach. *J Forensic Leg Med* 19(7): 390-395.

Prabhu, R.V., Dinkar, A. & Prabhu, V. 2013. Digital method for lip print analysis: A New approach. *Journal of Forensic Dental Sciences* 5(2): 96-105.

Prabhu, R.V., Dinkar, A.D., Prabhu, V.D. & Rao, P.K. 2012b. Cheiloscopy: Revisited. *Journal of Forensic Dental Sciences* 4(1): 47-52.

Rao, B., Srinivasan, S.R. & Natarajan, M. (2014). Evaluation and comparison of lip print patterns among indians, Chinese and malay. *Oral Pathology*. 2019, from https://www.researchgate.net/publication/262647142_Evaluation_and_comparison_of_lip_print_patterns_among_indians_chinese_and_malay

Remya, S., Priyadarshini, T., Umadethan, B., Gopalan, M. & Jeyaseelan, N. 2016. Cheiloscopy – A Study of Lip Prints for Personal Identification. *IOSR Journal of Dental and Medical Sciences* 15(2): 101-103.

Saraswathi, T.R., Mishra, G. & Ranganathan, K. 2009. Study of lip prints. *J Forensic Dent Sci* 1(1): 28-31.

Sharma, P., Saxena, S. & Rathod, V. 2009. Cheiloscopy: The study of lip prints in sex identification. *Journal of Forensic Dental Sciences* 1(1): 24-27.

Tsuchihashi, Y. 1974. Studies on personal identification by means of lip prints. *Forensic Science* 3: 233-248.

Utsuno, H., Kanoh, T., Tadokoro, O. & Inoue, K. 2005. Preliminary study of post mortem identification using lip prints. *Forensic Sci Int* 149(2-3): 129-132.

Venkatesh, R. & David, M.P. 2011. Cheiloscopy: An aid for personal identification. *J Forensic Dent Sci* 3(2): 67-70.

Verghese, A.J. & Mestri, S.C. 2011. A Study of Efficacy of Lip Prints as an Identification Tool among the People of Karnataka in India. *J Indian Acad Forensic Med* 33(3): 200-203.

Verghese, A.J., Somasekar, M. & Umesh Babu, R. 2010. A Study on Lip Print Types among the People of Kerala. *Journal of Indian Academic of Forensic Medicine* 32(1): 6-7.

Wan Rafiuddin, W.A., Sri Pawita Albakri, A.H. & Noor Hazfalinda, H. 2018. Sex Differentiation by Lip Print Analysis in Malays: Lipstick-Cellophane Tape Techniques. *ARC Journal of Forensic Science* 3(1): 18-21.

Wrobel K., Doroz R. & M., P. 2015. Lip Print Recognition Method Using Bifurcations Analysis. In Nguyen N., Trawiński B., & R., K. (Eds.), *Lecture Notes in Computer Science* (Vol. 9012): Springer, Cham.

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