

## Artikel Asli/Original Articles

# Digital Approach for Lip Prints Analysis in Malaysian Malay Population (Klang Valley): Photograph on Lipstick-Cellophane Tape Technique (Analisis Cap Bibir Populasi Melayu di Lembah Klang secara Digital: Teknik Fotografi ke Atas Gincu-Pita Selofan)

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### ABSTRACT

*Personal identification in forensic investigation is not an easy process. Lip print analysis is one of the techniques that can be used to assist in human identification. This study was conducted to investigate the sex based on lip print pattern among Malaysian Malay population in Klang Valley, using photograph on lipstick-cellophane tape technique and the Suzuki and Tsuchihashi classification. A total of 360 subjects (180 males and 180 females) aged 15 and above were included in this study. The lip print was taken by pressing a cellophane tape to the lipstick applied on lip, pasted it onto a plain A4 paper and then photographed using a smart phone camera (OPPO F1). The images were then analysed using Adobe Photoshop software. A lip print image were divided into six sections: upper left, upper middle, upper right, lower right, lower middle and lower left. The Pearson chi-square test showed that there are significant differences between sexes in each section except for the upper middle section. Type V (irregular pattern) was the dominant pattern for the upper left, upper right, lower right and lower left sections (ranging from 71.1% to 86.7% for males and 80.6% to 83.9% for females) while type IV (reticular pattern) was mostly found in upper middle and lower middle section. Malaysian female displayed type V as the dominant lip print pattern in every section (ranging from 39.4% to 83.9%) except upper middle section and for Malaysian male, type V dominated the lip print pattern in all section (ranging from 71.1% to 86.7%) except for the upper and lower middle section. The result of this study can be applied in assisting the human identification for forensic science investigation.*

*Keywords: Suzuki and Tsuchihashi classification; sex determination; lip print; digital approach; Malaysian Malay population; Klang Valley*

### ABSTRAK

*Identifikasi peribadi dalam penyiasatan forensik bukan satu proses yang mudah. Analisis cap bibir adalah salah satu teknik yang boleh digunakan untuk membantu identifikasi manusia. Kajian ini dijalankan untuk mengkaji jantina berdasarkan corak cap bibir pada setiap bahagian bibir dalam kalangan populasi Melayu Malaysia di Lembah Klang, menggunakan teknik fotografi pada gincu-pita selofan dengan merujuk kepada klasifikasi Suzuki dan Tsuchihashi. Seramai 360 subjek (180 lelaki dan 180 perempuan) berumur 15 tahun dan keatas telah terlibat dalam kajian ini. Cap bibir telah diambil dengan menekan pita selofan pada gincu di bibir, ditampal atas kertas kosong A4 dan kemudian gambar diambil menggunakan kamera telefon pintar (OPPO F1). Gambar tersebut dianalisis dengan menggunakan perisian "Adobe Photoshop". Cap bibir dibahagikan kepada enam bahagian: kiri atas, tengah atas, kanan atas, kanan bawah, tengah bawah dan kiri bawah. Ujian khi-square Pearson menyatakan terdapat perbezaan yang signifikan antara jantina pada setiap bahagian bibir kecuali bahagian tengah atas. Jenis V (corak tidak teratur) adalah yang paling dominan dijumpai pada bahagian kiri atas, kanan atas, kanan bawah dan kiri bawah bibir (71.1% ke 86.7% untuk lelaki dan 80.6% ke 83.9% untuk perempuan) sementara jenis IV (corak retikular) kebanyakannya dijumpai pada tengah atas dan tengah bawah bibir. Perempuan Melayu mempamerkan cap bibir jenis V yang dominan pada setiap bahagian bibir (39.4% ke 83.9%) kecuali bahagian tengah. Cap bibir jenis V mendominasi cap bibir lelaki Melayu pada setiap bahagian (71.1% ke 86.7%) kecuali bahagian tengah atas dan bawah. Hasil kajian ini boleh diaplikasikan untuk membantu identifikasi manusia dalam penyiasatan sains forensik.*

*Kata kunci: Klasifikasi Suzuki dan Tsuchihashi; penentuan jantina, cap bibir; digital; populasi Melayu Malaysia; Lembah Klang*

## INTRODUCTION

Personal identification is important in forensic science investigation, either in homicide or suicide cases. It aids in finding missing person or perpetrator (Saraswathi et al. 2009) and crime and suspect detection based on trace evidence from a crime scene. Construction and building an individual's identity was a very arduous and complicated process (Caldas et al. 2007).

Lip prints has been used in forensic science as an identification technique similar to fingerprints and palm prints (Augustine et al. 2008). Cheiloscopy is a study of lip prints, whereby the wrinkles and lines arrangement that appears on the red part of lips can be used for human identification (Prabhu et al. 2013). The uniqueness of lip prints makes cheiloscopy an effective identification method, which can be found on cups, glasses or skin at a crime scene (Porwik & Orczyk 2012). Lip print is unique, has its own individual characteristic for every human being (Saraswathi et al. 2009) and do not change in life (Gondivkar et al. 2009) unless major trauma or disease occurs. Even in twins, lip prints may be similar, but it will not be absolutely identical as proven by Jaishankar (Jaishankar et al. 2010).

Based on previous researches, the centre of a lip is the most important part as compared to the peripheral because it is the most common part that can be found in a crime scene without smudging and distortion, if it comes into contact with any surface (Prabhu, Rachana V. et al. 2012). Every quadrant on the lip does not have only one type of pattern but there will be a mixture of varying patterns (Jaishankar et al. 2010). Suzuki and Tsuchihashi classified lip prints into six types as shown in Figure 1 (Tsuchihashi 1974). Many researchers had published data on lip print analysis, however, most of them are for Indian population, as shown in Table 1. For Malaysian Malay population, Neo (Neo et al. 2012) and Wan Rafiuddin (Wan Rafiuddin et al. 2018) had discovered interesting facts about lip print pattern, using lipstick-cellophane tape technique (Table 1). Neo noted that type I' was the dominant lip print pattern found in Malaysian Malays (from 88 subjects) while Wan

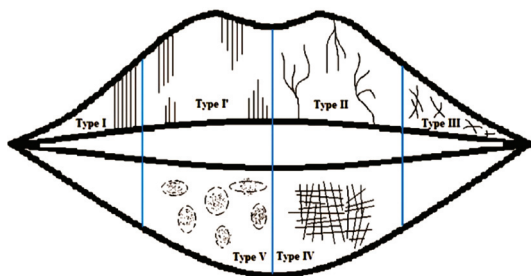


FIGURE 1. Suzuki and Tsuchihashi classification of a lip print. Type I is a complete vertical, type I' is an incomplete vertical, type II is branched, type III is intersected, type IV is a reticular pattern and type V is an irregular pattern (Jeergal et al. 2016)

Rafiuddin noted that type II was the dominant pattern in Malaysian Malays (from 360 subjects).

Digital approach, using a camera of a smartphone was chosen as suggested by previous studies (Margot 2011; National Academy of Sciences 2009). This study is carried out to determine the lip print pattern in Malaysian Malay populations, males and females, using a digital approach, a photograph on lipstick-cellophane tape technique. The result of the current study will hopefully be useful in future for human identification and sex determination.

## METHODOLOGY

A total of 360 convenient subjects aged 15 years old and above were selected (180 Malay males and 180 Malay females). Sample size was selected based on arbitrary decision. Previous study by Neo et al. (2012) only used 88 Malay subjects, hence, for the current study, 360 Malaysian Malay population in Klang Valley was chosen. Ethic approval code for this study was UKM PPI/111/8/JEP-2018-133. Inclusive criteria was Malaysian Malay population (for three consecutive generation), females and males. 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). Consent was taken for every subject. Wet tissues were given to subject to clean the lips for hygiene purpose. Lipstick was applied to whole lip using a lip brush. Lip brush was cleaned prior to application to a new subject. The lipstick used (Silkygirl) was less greasy, non-glossy and red colour (Siren Red code 03) for optimum visibility (Neo et al. 2012). A 45mm cellophane tape was pressed on the subject's lip with gentle pressure (using one finger) as human lips are so mobile, the strength and pressure applied even at minimal movement can affect the print on the cellophane tape (Prabhu, R. V. et al. 2012). Subject was advised to be at ease so that the lip print could be taken in its original position. The cellophane tape was then pasted on a plain A4 paper and this step was repeated three times. The lip print was then captured using a smartphone camera (OPPO F1, 13 mega pixels front camera) and then analysed using Adobe Photoshop software. The brightness and contrast level of pixels of the images was increased to get a clear image of each line that appears on the lip print (Wrobel K. et al. 2015). Adobe Photoshop applications was used to trace each line on the lip print and all the patterns were classified based on Suzuki and Tsuchihashi classification (Tsuchihashi 1974). The whole lip was divided into six sections (Figure 2) which are upper left (UL), upper middle (UM), upper right (UR), lower right (LR), lower middle (LM) and lower left (LL) and the dominant pattern at each section was identified. The data collected were analysed using Statistical Package Social Sciences (SPSS) and Pearson chi-square test was selected to determine whether there are significant differences in lip prints between Malaysian Malay males and females population.

TABLE 1. Comparison of cheiloscopy studies from previous researches and the result from the current study

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
Kumar A et al. (Kumar et al. 2016)	Indian	90 (45 males + 45 females)	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 & Badiye 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	50 Indian + 50 Indian + 50 Chinese	Not Available	Not Available	II
Gondivkar et al. (Gondivkar et al. 2009)	Indian	140 (70 males + 70 females)	Bond paper technique	4 quadrants	II
Nagrале et al. (Nagrале et al. 2014)	Indian	500 (250 males + 250 females)	Bond paper technique	4 quadrants	III
Prabhu RV et al. (Prabhu, R. V. et al. 2012)	Indian dental students	100	Lipstick cellophane tape – scanning technique	4 quadrants	V
Durbakula et al. (Durbakula et al. 2015)	Indian and Malaysian dental students	64 (Indian: 16 males + 16 females, Malaysian: 16 males + 16 females)	Lipstick cellophane tape technique-bond paper	4 quadrants	II (Indians) I' (Malaysians)
Neo et al. (Neo et al. 2012)	Malays	88 (44 males + 44 females)	Lipstick cellophane tape technique	4 quadrants	I'
Wan Rafiuddin et al. (Wan Rafiuddin et al. 2018)	Malaysian Malays	360 (180 males + 180 females)	Lipstick cellophane tape technique	6 sections	II
Current study	Malaysian Malays	360 (180 males + 180 females)	Photograph on lipstick cellophane technique	6 sections	V

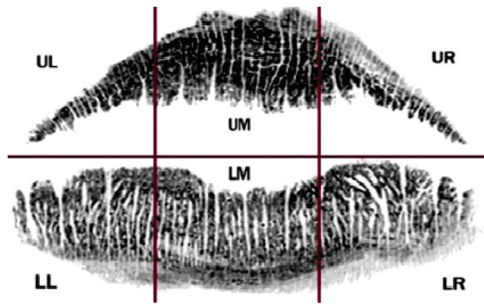


FIGURE 2. Each section of lips was named accordingly from left to right as upper left section (UL), upper middle section (UM), upper right section (UR), lower right section (LR), followed by lower middle section (LM) and finally lower left section (LL) following a clockwise rotation for whole lips

## RESULTS AND DISCUSSION

Table 2 showed the percentage of lip print pattern distribution in each section for Malaysian Malay males and females population. Type V is the most dominant pattern for the upper left, upper right, lower right and lower left sections (ranging from 71.1% to 86.7% for males and 80.6% to 83.9% for females) except for the upper middle and lower middle section. These two sections have Type IV as the dominant pattern (58.9% and 65.6% for males, 46.7% and 38.3% for females, respectively). Pearson chi-square test showed a significant statistical difference between male and female with a significant  $p < 0.05$  for all sections except for the upper middle section, as shown in Table 3. The results agreed with previous researchers who noted that there was significant difference between males and females lip print patterns, as shown in Table 1. However, most of them divided the lip prints into 4 quadrants (Bindal et al. 2009; Durbakula et al. 2015; Gondivkar et al. 2009; Kapoor & Badiye 2017; Koneru et al. 2013; Nagrale et al. 2014; Neo et al. 2012; Prabhu, R. V. et al. 2012), whole

lips (Ishaq et al. 2018; Kautilya et al. 2013; Kumar et al. 2016) and even only the middle part of the lips (Kinra et al. 2014; Multani et al. 2014; Remya et al. 2016). Only Wan Rafiuddin (Wan Rafiuddin et al. 2018) used 6 sections, similar to the current study.

TABLE 3. Pearson chi-square test result

Section of lips	Significant value ( $p$ )	
Upper left	$p < 0.05$	Significant
Upper middle	$p = 0.100$	Not significant
Upper right	$p = 0.017$	Significant
Lower right	$p = 0.017$	Significant
Lower middle	$p < 0.05$	Significant
Lower left	$p = 0.004$	Significant

Neo noted that type III was the dominant lip print pattern for Malaysian males and type I and type I' were the dominant for females in all quadrants (Neo et al. 2012). This result was from 88 subjects (44 males and 44 females) and the lip print was divided into 4 quadrants. Wan Rafiuddin found that type II was the dominant lip print pattern for both sexes (Malaysian Malays) in 4 sections: upper left, upper right, lower right and lower left while type IV was the dominant for the upper middle and lower middle section, for males and females (Wan Rafiuddin et al. 2018). Wan Rafiuddin analysed 360 subjects (180 males and 180 females) and the lip print was divided into 6 sections. Durbakula analysed 32 Malaysian students (16 males and 16 females) and divided the lip print into 4 quadrants (Durbakula et al. 2015). The result showed that type I' was the dominant for males (all quadrants) and for females, type I' was the dominant for three quadrants: I, II and IV while type II was the dominant for quadrant III. All these researchers analysed lip prints from the lipstick-cellophane technique, unlike the present study, the results were analysed using digital approached, images were captured with a 13 mega pixel smartphone camera and analysed using a software. This suggested that clearer lip print

TABLE 2. 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	UL	2.2	11.7	0.0	0.0	15.0	71.1	100
	UM	0.6	1.7	3.3	0.6	58.9	35.0	100
	UR	3.3	1.1	11.7	0.0	11.7	72.2	100
	LR	0.0	0.6	8.3	0.0	4.4	86.7	100
	LM	1.1	5.0	11.1	0.0	65.6	17.2	100
	LL	0.0	0.6	8.9	0.0	4.4	86.1	100
Female	UL	1.7	3.3	8.9	0.6	3.3	82.2	100
	UM	0.0	1.1	6.7	0.0	46.7	45.6	100
	UR	0.6	2.8	6.7	0.0	6.1	83.9	100
	LR	0.0	2.2	16.1	0.0	1.1	80.6	100
	LM	0.6	12.8	8.9	0.0	38.3	39.4	100
	LL	0.0	1.1	17.2	0.0	0.0	81.7	100

patterns were able to be visualised digitally. Furthermore, the current study had 380 subjects, as compared to 88 subjects from Neo and 32 subjects from Durbakula. The vast difference of the number of subjects involved might have contributed in the disagreement of findings.

For digital approach comparison, only Remya (Remya et al. 2016) analysed 200 subjects with scanned (a HP flatbed scanner) lower middle part of lip print (after applying a dark-coloured lipstick) and Kapoor (Kapoor & Badiye 2017) who captured the lip print digitally, with no lipstick, and divided the lip print into 4 quadrants. There was no mentioning how the images were analysed, either manually by visual comparison using magnifying glass or digitally using any software, for both researches and the subjects were Indian. Remya noted that, for the lower middle part of 200 subjects, type IV was the dominant lip print pattern, while type II belonged to females and type IV belonged to males. Kapoor used a 14.2MP Nikon D3100 camera and published that type I were the dominant lip print pattern among 200 subjects, while type I dominated the males and type III was mostly seen in females. The current study agreed with Remya because type IV prevailed the lower middle section of the lip print, however, disagreed with Kapoor's. This was probably because of the difference in the sample size, the current study had more subjects (380) as compared to Kapoor's (200).

In the meantime, the top three highest percentage of lip print patterns for both gender in each section was displayed in Table 4. Each sections showed different combination of the three highest percentage of lip print pattern among male and female subjects. The upper middle section was excluded because the result was insignificant, based on the chi-square test. This result was never before explored in previous studies, especially when it involved a Malaysian Malay population. Based on Table 2, it seemed difficult to distinguish between males and females because both genders displayed type V and IV as the dominant patterns. However, the present of second and third

TABLE 4. Top three highest percentage of lip print pattern in different sections between male and female

		Dominant lip print pattern		
		Most dominant	Second	Third
Upper Left (UL)	Male	V	IV	I'
	Female	V	II	IV & I'
Upper Right (UR)	Male	V	IV & II	I
	Female	V	II	IV
Lower Right (LR)	Male	V	II	IV
	Female	V	II	I'
Lower Middle (LM)	Male	IV	V	II
	Female	V	IV	I'
Lower Left (LL)	Male	V	II	IV
	Female	V	II	I'

highest percentage of lip print pattern could be useful in differentiating both sexes.

Table 5 showed frequency of lip print patterns recorded in each lip section that represented males and females. For the upper left section, females showed higher percentage of possible gender (85.7%) if type I' lip print pattern was found at the crime scene, unless type IV was found, which suggestive of males (81.8%). Males again dominated the upper right section with type I lip print pattern (85.7%). For the lower right section, if type I' was found at the crime scene, female is the possible gender (80%), and if type IV was found, male is the possible gender (88.9%). For the lower middle section, females had the higher percentage for type I' (71.9%) and type V (69.6%). The result also suggested that, for the lower left section, male could be the possible gender, if type IV was recovered from a lip print at the crime scene. Overall, Table 5 can be used as a suggestion to identify the gender of the lip print's owner if lip print evidence was found at the crime scene.

## CONCLUSION

Lip print analysis can be used as personal identification and sex differentiation. The current study could be useful in assisting the human identification for forensic science investigation and had a potential for improvement such as having a bigger sample size of subjects, which can represent the whole Malaysian Malay population in Malaysia and possibility for lip print classification for other races in Malaysia.

TABLE 5. Frequency of respondents with specified lip print pattern in certain lip section

Lip Section	Type	Frequency			Possible Gender
		Male	Female	Total	
UL	I'	1	6	7	Female (85.7%)
	II	20	16	36	Male (55.6%)
	IV	27	6	33	Male (81.8%)
	V	128	148	276	Female (53.6%)
UR	I	6	1	7	Male (85.7%)
	II	22	12	34	Male (64.7%)
	IV	20	11	31	Male (64.5%)
	V	130	151	281	Female (53.7%)
LR	I'	1	4	5	Female (80.0%)
	II	15	30	45	Female (66.7%)
	IV	8	1	9	Male (88.9%)
	V	156	145	301	Male (51.8%)
LM	I'	9	23	32	Female (71.9%)
	II	20	16	36	Male (55.6%)
	IV	118	69	187	Male (63.1%)
	V	31	71	102	Female (69.6%)
LL	I'	1	2	3	Female (66.7%)
	II	16	31	47	Female (44.7%)
	IV	8	0	8	Male (100.0%)
	V	155	147	302	Male (51.3%)

#### ACKNOWLEDGEMENT

This study was fully funded by Faculty of Health Sciences, Universiti Kebangsaan Malaysia, project code GGPM-2017-064.

#### REFERENCES

- Augustine, J., Barpande, S. R. & Tupkari, J. V. 2008. Cheiloscopy as an adjunct to forensic identification: a study of 600 individuals. *J Forensic Odontostomatol* 26(2): 44-52.
- 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.
- Caldas, I. M., Magalhaes, T. & Afonso, A. 2007. Establishing identity using cheiloscopy and palatoscopy. *Forensic Sci Int* 165(1): 1-9.
- 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.
- Gondivkar, S., Indurkar, A., Degwekar, S. & Bhowate, R. 2009. Cheiloscopy for sex determination. *Journal of Forensic Dental Sciences* 1(2): 56-60.
- 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).
- Jaishankar, S., Jaishankar, N. & Shanmugam, S. 2010. Lip Prints in Personal Identification. *Journal of Indian Academy of Dental Specialist Researchers* 1(4): 23-26.
- 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.
- 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.
- Margot, P. 2011. Commentary on the Need for a Research Culture in the Forensic Sciences. 58: 795-801. <http://www.uclalawreview.org/pdf/58-3-6.pdf>
- 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.
- Nagrare, 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.
- National Academy of Sciences. 2009. *Strengthening Forensic Science in the United States: A Path Forward*. National Academies Press.
- Neo, X. X., Osman, K., Amir Hamzah, S. P. A. & Noor Hazfalinda, H. 2012. Lip Prints in Sex and Race Determination. *Jurnal Sains Kesihatan Malaysia* 10(1): 29-33.
- Porwik, P. & Orczyk, T. 2012. *DTW and Voting-Based Lip Print Recognition System*, Berlin, Heidelberg.
- Prabhu, R. V., Dinkar, A. & Prabhu, V. 2012. 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. 2012. Cheiloscopy: Revisited. *Journal of Forensic Dental Sciences* 4(1): 47-52.
- 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.
- Tsuchihashi, Y. 1974. Studies on personal identification by means of lip prints. *Forensic Science* 3: 233-248.
- 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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Received : December 2018  
Accepted for publication : February 2019

