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Study of Lip Conditions Associated with Lip Print Patterns: A New Perspective on Cheiloscopy

Estudio de Afecciones Labiales Asociadas a sus Patrones de Huellas: Una Nueva Perspectiva en Queiloscopía

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SUMMARY: Although almost all studies exclude lip conditions because they would affect furrow patterns, some authors maintain that they should be considered temporary or permanent disabilities, all of which require further research in this context.We present a study in which we associate lip conditions with lip print patterns to associate both morphological elements for fieldwork purposes. Fifty-seven women and 48 men aged between 19 and 38 years who resided in Temuco (Chile) were included. The lip conditions and their prints were recorded, and an analysis, comparison, evaluation, and verification protocol (ACE-V) for lip prints was applied. Of the participants, 27.4 % had healthy lips, while 71.7 % had some type of condition. Although patterns related to temporary and permanent lip conditions were recognized in the lip prints in a non-significant way, the diagnosis of "healthy" or "altered" lip status could be made significantly by a calibrated examiner. Although these conditions do not represent identifying variables without empirical studies to validate them, they can affect the quality of the evaluated lip print; therefore, they should be recognized during the analyses considering the prevalence of these conditions.

KEY WORDS: Cheiloscopy; Lip prints; Lip conditions; Forensic identification; Fingerprints.

INTRODUCTION

Cheiloscopy defines lip print studies and has been proposed as a way of making individual identifications based on the supposed uniqueness of lip prints and labial grooves being permanent and not changing over time. Although certain lip conditions could assume statistical significance in enabling the creation of a biological profile and thus the identification of the bearer of the lip print, almost all studies that have addressed these lip conditions must be excluded, as they would affect furrow patterns, invalidating the cheiloscopic identification process (Caldas *et al*., 2007; Coward, 2007; Kavitha *et al*., 2009; Fonseca *et al*., 2013; Moshfeghi *et al*., 2016; Borase *et al*., 2017).

It has been stated that pathology is based on lesions as morphological manifestations, which can be evidenced in the oral cavity as an expression of the context or behavior of the individual (Fonseca *et al*., 2013). Considering that to date no lip conditions have been associated with lip print patterns, a study is presented with the objective of associating both morphological elements for fieldwork purposes in the forensic field.

MATERIAL AND METHOD

This study was approved by the Scientific Ethics Committee of the University of La Frontera (Act No. 35/2013). Through non-probabilistic sampling and for convenience, individuals of both sexes between 19 and 38 years of age, all residing in Temuco (Chile), were selected. Individuals without distinction of their lip condition were included, excluding those with a history of allergy to lipsticks.

Clinical assessment of the lip condition. This was carried out by two examiners calibrated and trained in clinical diagnosis using procedures based on the WHO Guide (Kramer *et al*., 1980), one of the most used today for this purpose (Kansky *et al*., 2018):

a. The lips were examined with open and closed mouths to evaluate color, texture, and abnormalities on the vermilion margin.
b. The identified conditions were recorded according to the concepts defined in the literature (Kramer *et al*., 1980; Neiswanger *et al*., 2009; Fonseca *et al*., 2013; Hitz Lindenmüller *et al*., 2014; Bruch & Treister, 2017;

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Greenberg *et al*., 2017; Lighthall & Fedok, 2017; Poitevin *et al*., 2017; Zuckerman, 2017; Nanci, 2018; Fonseca *et al*., 2020; Tamura *et al*., 2020). Malformative, inflammatory, degenerative and/or neoplastic labial conditions were included. The diagnoses were made by a calibrated examiner (J.O.C.). In cases of discrepancy, the diagnoses were confirmed by another examiner (G.M.F.). The lip conditions were categorized as "temporary" or "permanent" according to the characteristics of these disturbances, and adapting this categorization to the guidelines established by the Federal Bureau of Investigation (FBI) (2019) for fingerprint disabilities.

c. Only the lesions present during the examination were recorded; however, additional information was requested on conditions that involved defined periods of time (e.g., herpes virus lesions).
d. The lip conditions detected were revealed to the patients, providing them with indications for treatment or referral to specialized centers as the case may be.

Immediately after identification of the clinical condition, each of the sampled subjects was enrolled in an ad-hoc spreadsheet, and photographic records were made following Ahmad (2009) for close-up photographs of the lips, with natural light, in the labial rest position, visibly referencing their corresponding code number.

Cheiloscopic record. After the clinical examination, each individual was invited to register their lip prints following Gupta *et al*. (2011). Indelible brown lipsticks were used for men and red for women to allow for subsequent categorization of the prints. After cleaning their lips, the subjects were asked to open their mouths and apply the lipstick in one motion. They were then asked to carefully rub their lips together to evenly spread the tint. Immediately afterwards, they were asked to make a first impression of eliminating excess pigment, following Caldas *et al*. (2007), to print their lips on a white sheet (smooth, matte, not textured), placing their mouth in a relaxed position. The lips were placed in their central portion, pressing them uniformly towards the corners and with passive application of a polyurethane foam pad behind the white sheet to achieve an impression without lip deformation, avoiding finger pressure or a hard surface. These cheiloscopic records were digitized using a PIXMA MX431 multifunctional printer unit with a flatbed scanner (Canon Inc., Tokyo, Japan) at a 1:1 ratio, color, and resolution of 600 dpi.

Image analysis. This was performed using Adobe® Photoshop® v. 19.1.3 (Adobe Systems Inc., San José, California, USA), with a display on a 32" LG Brand Smart TV Led monitor at HD resolution (1366x768). The cheiloscopic records were rotated horizontally for comparison and superimposed on the clinical records to corroborate the presence/absence of individual and/or population identifying signs. The obtained information was processed using Microsoft Excel.

Analysis, comparison, evaluation and verification (ACE-V) of lip prints. ACE-V is the process designed for fingerprint analysis, by which the examiner conducts a comparison and identification, arriving at a conclusion (Hawthorne *et al*., 2021). Although this methodology is based on the comparison of two impressions by observing the ridge characteristics of similar shapes that occupy the same relative positions in both patterns (Hawthorne *et al*., 2021), in our study, ACE-V was adapted to: 1) Analyze preliminary factors such as quality of the lip print, deposition pressure, pressure distortion, and anatomical aspects; 2) Compare the lip print with the clinical information, determining which variables are contained within the print (e.g. pattern, friction ridges, flexion creases, deviations, interruptions, superpositions); 3) Evaluate the information contained in the latent lip print, specifically configuration and details related to the possible manifestations of lip conditions; 4) Verify the opinion of the original examiner through a review and consultation with the other researchers and reach a consensus.

In cases where an individual presented more than one temporary condition, only the most individualizing one was considered; the same criterion was followed if the individual presented more than one permanent condition. If the subject presented transient and permanent conditions simultaneously, only the permanent condition was considered. All the characteristics of the lip conditions that could be evaluated in the lip prints were defined or contrasted with the descriptions already mentioned in the literature, in cases where there were reports.

For verification process, two observations of the lip prints were made with a one-month difference between the two observations. In cases of discrepancies, a third observation was carried out seeking consensus one month later. To evaluate the agreement between the observations, Cohen's kappa coefficient was calculated, categorizing the results according to the agreement measures for categorical data by Landis & Koch (1977): Poor (< 0.00); Slight (0.00–0.20); Fair (0.21–0.40); Moderate (0.41–0.60); Substantial (0.61–0.80); and Almost Perfect (0.81–1.00).

Statistical analysis. A descriptive analysis of the data was performed, and the means and their respective standard deviations were determined. Independent samples t-tests, one-factor ANOVA, and Pearson's chi-square tests were performed. The IBM SPSS Statistics program (version 23.0) was used for data analysis. A value of $p < 0.05$ was chosen as the threshold of significance.

Table I. Lip conditions and their clinical and print characteristics.

Lip condition	Character	Clinical characteristics	Lip print characteristics	Number of subjects (%)
Desquamative lip	Temporary	A lip with discontinued vermilion and partial superficial tissue loss due to dehydration. The concept of "desquamation" applies to the detachment of squamas (Nanci, 2018; Tamura *et al*., 2020).	A lip print with oval areas corresponding to accumulations of lipstick on its margins, which are superimposed on the image.	30 (28.3)
Healthy lip	-	A pristine lip, free of conditions	A lip print with clear distinction of lines and grooves.	29 (27.4)
Dry lip	Temporary	A dehydrated lip with the formation of dry oval areas, continuous with the lip vermilion. The concept of "squama" defines the thickening of the labial tissue surface but without visible detachments (Nanci, 2018; Tamura *et al*., 2020).	A lip print with presence of oval areas corresponding to accumulations of lipstick on its margins. The squama facilitates the accumulation of lipstick.	22 (20.8)
Eroded lip	Temporary	A lip with discontinued vermilion and areas of total superficial tissue loss due to dehydration. Erosion is the "loss or thinning of superficial epithelial layers not extending through the full thickness of epithelium, typically secondary to inflammation (Bruch & Treister, 2017).	A lip print with oval areas corresponding to accumulations of lipstick in its internal portions.	8 (7.5)
Scars	Permanent	Scars arise from a variety of etiologies in the perioral region; the mouth and lips are integral to production of facial expressions, and scars may be minor or severely contracted with volume and lip height discrepancies, distort key landmarks and even alopecic in males (Lighthall & Fedok, 2017).	Lip print with the presence of a usually linear morphological pattern, with blurring of the lipstick pigment (Coward, 2007; Jurczyk-Romanowska, 2014).	8 (7.5)
Cheilophagia	Temporary	Cheilophagia is defined as a "mechanical damage to the lips due to repeated chewing on the upper of lower lip" (Hitz Lindenmüller *et al*., 2014). This condition is usually considered as a bad habit and may be evidence of stress or a compulsive disorder (Fonseca *et al*., 2013; Greenberg *et al*., 2017).	Lip print with demarcation of elongated areas not pigmented by lipstick on the lower lip, corresponding to the imprint of the incisal edges of the upper incisors (Fonseca *et al*., 2013).	5 (4.7)
Fordyce's Granules	Permanent	A collection of ectopic sebaceous glands, visible through transparent oral epithelium. They can be commonly seen in the vermilion border of the upper lip and the buccal mucosa. Clinical findings are pinpoint yellow or white papules, not associated with hair follicles (Greenberg *et al*., 2017; Regezi *et al*., 2017).	Expressions of Fordyce spots on lip prints have not been previously reported.	3 (2.8)
Cracked lip	Temporary	A lip with discontinuity of its vermilion in the form of perpendicular lines. Dry, cracked lips can be fissured depending on severity, and are usual consequence of dry climates, habitual lip-licking or irritant exposures (Fonseca et al., 2020).	A lip print with presence of linear areas that cross it perpendicularly and accumulations of lipstick inside.	1 (0.9)
Herpes labialis	Temporary	Vesicles are defined as fluid-filled blisters <0.5 in diameter that often develop in clusters and eventually break down to form coalescing, shallow, irregularly shaped ulcerations. They are characteristics of herpes simplex virus and the clinical course is typically no more than 14 days with complete resolution (Kramer et al., 1980; Coward, 2007; Bruch & Treister, 2017; Greenberg *et al*., 2017).	Lip print with pattern of multiple and small spaces without lipstick pigmentation, grouped in clusters, corresponding to the arrangement of herpetic vesicles (Jurczyk-Romanowska, 2014).	0 (0)
Cheilitis	Temporary	An inflammatory condition of the lips, and on physical examination, there may be slight edema to complete loss of the normal lip markings (Greenberg *et al*., 2017). Beyond its multifactorial and nonspecific nature, we have preferred to include as "cheilitis" only the edematous ones and not the advanced inflammatory ones that are accompanied by exfoliation, dry scale or fissuring, which are included in the categories already described.	Lip print with loss of lip lines and furrows and pigment blurring.	0 (0)
Labial pigmentary nevus	Permanent	Nevi, sometimes referred to as "moles", are pigmented macules which may appear on vermilion, among other areas of the buccal mucosa (Greenberg *et al*., 2017). Lesions can present as either flat or raised (Bruch & Treister, 2017), and only in the latter case could they be represented in the lip print (Coward, 2007).	Lip print with a rounded and circumscribed area, with absence of lipstick pigment (Coward, 2007).	0 (0)
Warts	Permanent	Warts are extremely common benign epidermal neoplasm caused by human papilloma virus (HPV) (Drahansky *et al*., 2012).	Lip print with presence of a rounded and circumscribed area, not pigmented with lipstick (Drahansky *et al*., 2012).	0 (0)
Neoplasms	Permanent	Neoplastic processes of the lips are usually characterized by an asymptomatic growth, with presence of infiltration, nodularity, or ulceration (Greenberg *et al*., 2017).	Expressions of neoplasms on lip prints have not been previously reported.	0 (0)
Cleft lip(s)	Permanent	The cleft lips result from the interruption of the normal fusion of the embryologic plates that form the lips during embryogenesis. They are usually unilateral, and in rare instances they may be bilateral (Greenberg *et al*., 2017).	Lip print with a linear interruption pattern between defined lip mamelons. A repaired cleft lip may show a characteristic whorled pattern (Neiswanger *et al*., 2009; Zuckerman, 2017).	0 (0)
Total				106 (100)

RESULTS

Table I shows all lip conditions considered in this study, the clinical characteristics or those of their lip prints, their categorization as temporary or permanent, and the number of subjects who presented them. A total of 106 subjects were included: 57 women (53.8 %) and 48 men (46.2 %) aged between 19 and 38 years (mean 22.8 years). Of the sample, 27.4 % had healthy lips, whereas the remaining 71.7 % had some type of condition. The most frequent conditions were desquamative lips (28.3 %), dry lips (20.8 %), eroded lips (7.5 %), and cheilophagia (4.7 %). Among the 76 subjects with some lip condition, 59 (77.63 %) had the condition exclusively on the lower lip, 5 (6.58 %) exclusively on the upper lip, and 12 (15.79 %) on both lips. Fig. 1 and Fig. 2 show the identified patterns of lip conditions comparing the clinical images with those of the lip prints.

Fig. 1. Some of the patterns of lip conditions identified in this study, comparing the clinical images with their respective lip prints. Lip prints have been mirrored to aid comparisons. A: Healthy lips, male; B: Dry lip, female; C: Dry lip, male; D: Desquamative lip, female; E: Desquamative lip, male.

Fig. 2. Other patterns of lip conditions identified in this study, comparing the clinical images with their respective lip prints. Lip prints have been mirrored to aid comparisons. A: Eroded lip, female; B: Eroded lip, male; C: Cracked lip, male; D: Fordyce's granules in the upper lip and signs of cheilophagia in the lower lip, male, smoker; E: Scar in the midline lower lip.

Clinical assessment of the lip condition. Considering all the lip conditions studied, a statistically significant relationship was found between the clinical diagnosis and the first and second observations, as well as with the consensus (p=0.001), which indicated that a diagnosis of the condition cannot be made only by evaluating the lip print. Considering the lip conditions included in this study, the kappa coefficient revealed a fair level of agreement (k = 0.377) (Table II). When the kappa coefficient was applied to each diagnostic group separately, the levels of agreement were slight to fair (k = 0.111 to 0.357) (Table III).

To simplify the diagnoses, all lip conditions were grouped as a category "healthy lip" versus "altered lip", which showed a statistically significant relationship between the clinical diagnosis and the first and second observations, as well as the consensus (p =0.001). This indicated that it was possible to diagnose "healthy" or "altered" lip status by

only evaluating the lip print. The concordance obtained from the results of these simplified diagnoses improved substantially (k = 0.679) (Table II). When all conditions were incorporated into the group, intraobserver agreement improved substantially. The same result was observed for the simplified diagnosis, with almost perfect concordance (Table IV).

Table II. Intra-rater reliability considering all lip conditions.

1st vs. 2nd observation	Kappa	Agreement measure
All lip conditions	0.377	Fair
Health lip / Altered lip	0.679	Substantial

Table III. Intra-rater reliability considering each of the lip conditions.

1st vs. 2nd observation		Kappa	Agreement measure
Clinical diagnosis	Healthy lip	0.259	Fair
	Dry lip	0.137	Slight
	Desquamative lip	0.357	Fair
	Eroded lip	0.111	Slight
	Cheilophagia	0.02	Slight
	Fordyce spots	0.167	Slight

Table IV. Intra-rater reliability (v. consensus) considering all.

	Variables	Kappa	Agreement measure
All lip conditions	1st observation vs. consensus	0.747	Substantial
	2nd observation vs. consensus	0.623	Substantial
Healthy lip / Altered lip	1st observation vs. consensus	0.821	Almost perfect
	2nd observation vs. consensus	0.850	Almost perfect

DISCUSSION

The change in the paradigm of forensic identification and the lack of validation for cheiloscopic evidence have led to skepticism in its use in the field and loss of interest in the scientific community (Fonseca *et al*., 2019). The analysis of lip prints has risen that the subjectivity of the analysis and the existence of some conditions on the lips are problems that can invalidate cheiloscopic studies (2007). To our knowledge, these two problems have rarely been addressed in the literature and with pessimistic results (Furnari & Janal, 2017; Fonseca *et al*., 2019). Our study sought to involve both variables, trying to offer a technical solution to specific situations in the field: lip conditions are common (Greenberg *et al*., 2017), but they have not been addressed in the diagnosis and evaluation of their possible prints. In fingerprint research (comparable to lip prints in characteristics and analysis techniques) (Caldas *et al*., 2007), skin conditions have already been the object of study because of the problems they cause in correctly recording fingerprints. Different authors assert that 20-25 % of individuals have some type of condition that, owing to its temporary or permanent characteristics, can condition fingerprint studies (Drahansky *et al*., 2012; Lee *et al*., 2013).

The first problem: existence of lip conditions. In 2007, Coward analyzed 326 lip prints over six months, including lips with conditions (to our knowledge, this is the only published study with these characteristics). However, the author mentions that evaluating the lip conditions in these prints "proved a very unrewarding area with almost no pathologies visible in the vermilion region or surrounding tissue". In one case, he was only able to identify a "mole" (nevus) adjacent to the edge of the lower lip (a condition which he described as permanent and unalterable throughout the study), and in another case, two varicosities in the lip center were "surprisingly" not recorded on the contact lip prints (Coward, 2007). Likewise, the author states that the rare circumstance of identifying visible conditions in the prints "would assume great statistical significance" for personal identification. In our study, by opening the spectrum of diagnosable lip conditions in prints, 71.7 % of the subjects showed some type of condition. Subtle, temporary, or permanent conditions of the labial surface can be visible in lip prints; however, intensive training is required for their diagnosis.

Cheilitis results from exposure to environmental factors that can cause the prevalence rates to vary in specific populations and ages. In Chile, there are reports that differ in their prevalence depending on the city sampled, and different authors (Espinoza *et al*., 2003; Aitken-Saavedra *et al*., 2017) have reported a prevalence of actinic cheilitis between 0.9 % and 1.8 % in Santiago City. Orozco *et al*. (2013) reported that 16.6 % of the individuals in Talca had actinic cheilitis. In a similar study in Valdivia, Ríos *et al*. (2017) reported that 38.8 % of the subjects had actinic cheilitis. All authors agree that exposure to environmental factors from an early age favors susceptibility to cheilitis. In 2016, Hameed & Vaswani (2016) evaluated the possible seasonal impacts on the patterns of lip prints and concluded that they did not change with the climatic conditions. These authors specifically studied groove patterns according to the classic Suzuki & Tsuchihashi classification (Suzuki & Tsuchihashi , 1970), and only included healthy lips in their sample. On the other hand, Borase *et al*. (2017) evaluated lip prints of 100 subjects at two different times of the year and found that lip prints were affected by seasonal changes in 23 % of subjects due to low temperatures. These affections were only temporary because the conditions were only on

the labial surface; however, these authors stated that deeper injuries could produce permanent distortion of the grooves. Borase *et al*. (2017) agree with Hameed & Vaswani (2016) that groove patterns do not change seasonally, but the presence of lip changes (particularly chapped lips), healing patterns and the effect of deep injuries over these groove pattern need further research. During the study period, June to August 2013 had a temperature range of -5 ºC to 16.8 ºC, and an average ambient humidity of 87.4 %. These climatic conditions, added to a declared environmental pollution among the highest in the world during winter periods (Aguilar Córdoba, 2020) (as in our study), could explain the high prevalence of cheilitis observed in this research. The higher prevalence of lip conditions in the lower lip was attributed to its greater exposure to environmental conditions (Orozco *et al*., 2013; Hitz Lindenmüller *et al*., 2014; Greenberg *et al*., 2017; Regezi *et al*., 2017; Ríos *et al*., 2017), a situation we detected in our study. It is a future challenge to be able to evaluate lip behavior as a response not only to these harsh environmental conditions, but also in periods of less aggressive environment, information not only relevant for the study of lip prints, but also to evaluate appropriate and specific health policies for these conditions. Although Fordyce's granules are of no clinical interest due to their malformative (and permanent) nature (Bruch & Treister, 2017), they are interesting to mention because of their almost exclusive presence on the upper lip in our study (which has also been mentioned in the literature) (Regezi *et al*., 2017) and because of their subtle appearance in lip prints (Fig. 2d), which could justify their evaluation and matching in lip print analysis.

Integuments have more features than friction ridges: scars, cuts, warts, blisters, healing processes, or other conditions that may also be part of the body surface, which scientists should not ignore, understand, and use as features that can provide clarity and detail to the source of prints (Vanderkolk, 2009). Vanderkolk (2009) suggest using the term "persistent" rather than "permanent" when describing skin patterns, and that regardless of which skin it is, "[t]he significance of the conclusion relies on the sufficiency of details of the persistent unique features of the skin and the ability of the substrates to capture sufficient details in the impressions". Patterns must be recorded at three levels within the scope of the prints. The first-level describes the general appearance and location of the features that are visible to the naked eye. The second-level describes local characteristics and the third-level describes contours and textures at a microscopic level (Vanderkolk, 2009; Hildebrandt *et al*., 2017). Vanderkolk (2009) refers to this protocol when describing the identifiable patterns in lip prints: general appearance (first-level), specific paths of creases (second-level) and textures (third-level), emphasizing that the standards must be captured in a similar expression as the evidence was recorded, since relaxation or lip puckering can give different images, even in the same person. For that author, conditions (scars, warts, blisters, etc.) can be recorded as first, second or third level details, in conjunction with the ridges. According to Vanderkolk (2009), there are always variations in appearance, and it is not expected that a perfect match will be found among impressions, prints, or images from the same source. Therefore, the value of the morphology and its conditions depend on the persistence between the time of deposition at the scene and recording as a standard.

In a recent Interpol review of fingerprints and other body impressions, Bécue *et al*. (2020), reported that among the different topics addressed in the literature, wound healing and scar formation have received little attention in the fingerprint identification process. Similarly, the authors cite a study on the weight assigned by examiners to the recognition of such conditions and, therefore, establish the clarity of the print for its processing. For these authors, the quality of the known impressions is a deciding factor, as is the risk of producing artifacts that could be mistaken for additional scars or ridges. Our results showed that lip conditions comprise entities that can be visualized in lip prints that can temporarily or permanently affect the pattern of lip grooves, which must be recognized by the examiner. Although permanent ones can eventually help with personal identification, temporary ones can acquire value in the analysis depending on the persistence between the time of deposition at the scene and the record as a standard (Vanderkolk, 2009). We believe that it is necessary to expand this line of research.

The second problem: subjectivity of the analysis. Only 36 % of studies evaluating lip prints have used some type of control strategy for calibration and/or intra-/inter-rater reliability with very dissimilar results (Fonseca *et al*., 2019). Furnari & Janal (2017) exposed 13 sets of lip prints to 20 untrained forensic odontologists to assess the inter-rater reliability. The authors reported a "poor to fair" level of agreement between raters (k= 0.15 to 0.25) and confirmed that there is little evidence to support inter-rater reliability. We agree that calibration exercises, experience, and further research on the topic are necessary to solve the dilemma of using lip prints for identification. Our study demonstrates that training, calibration, and the use of proper techniques for examining lip prints and their alterations are basic for developing a usable protocol in the field, as well as recommendations for all areas of forensic identification based on pattern matching.

ACE-V has been described as a technique for examining prints using friction ridge skin since 1959.

Among the factors that can affect the quality and quantity of detail in a latent print, the examiner must consider the condition of the skin (National Research Council, 2009). If the latent print does not have sufficient detail for either identification or exclusion, it is often called "not suitable" for comparison. Although some systems have succeeded in automating the identification of fingerprint records, the evaluation of latent prints relies heavily on human interpretation; therefore, ACE-V is usually performed by examiners performing subjective evaluations (National Research Council, 2009). This subjectivity is intrinsic to friction ridge analysis, and because a useful feature in a previous comparison may not be present or may not have been recorded in the latent impression, the process does not allow prior establishment of the specific features to be compared depending on the subjective judgments of the examiner. The friction ridge identification process works best when a careful examiner works with good-quality latent prints (National Research Council, 2009). Thus, the examiner must possess not only the skill to discern the identifying characteristics but also sufficient visual experience to judge whether that print is "suitable" for comparison (National Research Council, 2009). This judgment is generally based on "common sense" or information passed down through oral tradition from one examiner to another, so the literature recommends formal research to provide additional tools to support those explanations (National Research Council, 2009). The same situations have been described for lip print comparison, in which lip mobility, lipstick use, recording and comparison methods, and the existence of some lip conditions represent circumstances potentially affecting judgment of the examiner (Caldas *et al*., 2007), problems that, to date, have not been addressed or resolved.

Considering that even qualified examiners make mistakes (Thompson *et al*., 2013) and that claims that friction ridge analysis has zero error rates "are not scientifically plausible" (Hawthorne *et al*., 2021), research in the field of cheiloscopy has assimilated methodological assumptions that, for the most part, have not been properly validated (Liukkonen *et al*. 1996; Fonseca & Cantín, 2014; Fonseca *et al*., 2019). In cheiloscopy, there is a paucity of reported instances of research collaboration between scientists and technicians; therefore, the particular perspectives and knowledge of each of them fail to obtain the necessary synergy required by the current standards (Bonfigli *et al*., 2010; Fonseca *et al*., 2019). On the one hand, scientists remain almost entirely "speculative" without transferring the specific findings of their research to the field; on the other hand, the personnel at the scene do not have the knowledge to understand (and validate) what needs to be analyzed (Fonseca *et al*., 2019).

Lip print identification in the field. Lip print patterns altered by different lip conditions can be found in real cases and need to be studied further (Fig. 3). The major limitation of this study was that it intentionally distanced itself from the protocols reported in almost all cheiloscopic investigations. This study generated results that were not in contrast with previous research that sampled subjects exclusively with healthy lips, focusing on identifying the value of ridge patterns. However, our study revealed one of the biggest problems: once in the field, the scant 27.4 % of individuals with healthy lips identified in this study undermines the real value of published research to date. This study proposes to further push the limits of lip print research: forensic identification does not demonstrate the supposed uniqueness of lip prints, nor about estimating sex or ethnicity by evaluating their patterns, nor about continuing citing literature whose methodologies today do not meet minimum quality standards (Page *et al*., 2011; Fonseca *et al*., 2019; Franco *et al*., 2021; Pausic *et al*., 2021). Mannering *et al*. (2021) state that in fingerprint and most of the disciplines that compare patterns, there are no standards for what constitutes sufficient evidence to reach a conclusion. They added that individualization is the decision that there are enough matches to conclude that two prints originated from the same source and that the probability that they were produced by a different source is remote and practically impossible. Ultimately, it comes down to being able to find and properly process the print (partial or total, with intact or affected patterns), to have a suspect, identify sufficient elements of comparison, and to take responsibility for the conclusions. "Only comparisons involving 'individual' characteristics could lead to an identification conclusion"

Fig. 3. Lip print recovered from a picture of the Virgin Mary in a high-profile case of theft with burglary in 1987 (Fingerprint Department of the Central Forensic Laboratory of Police in Warsaw, Poland). The wide lines showed signs of cheilitis, which was confirmed after the suspect was arrested. For diagnosis at that time, the author (J.K.) collaborated with the prestigious Polish dermatologist, Prof. Franciszek Miedzinski .

say Champod *et al*. (2016), and they propose that, since specificity is difficult to reduce to just two categories, it should be studied considering the complete spectrum of feature specificity, which ranges from low to high. Vanderkolk (2009) states that "the sufficiency and persistency of the repeatable and unique features must be considered when determining the judgment of conclusion", and he concludes: "determinations of agreement and disagreement rest upon the quality and quantity of three levels of details of the persistent unique features of the source(s) as recorded in the substrates". Reality states that favorable conditions are never frequent, adequate technical training is essential, and the circumstances of experimental evaluation should reproduce this reality as faithfully as possible (Fig. 4).

Lip conditions should be considered as much as possible during cheiloscopic analysis in the field; therefore, the examiner should be trained in their recognition. Kaushal & Kaushal (2011) assert that, beyond the fact that the identification decision can only be made if there is a match between the latent and known fingerprints, it is accepted that "[d]ue to the pliability of the friction skin, and other environmental factors, friction ridge impressions of the same finger will never look exactly alike". Drahansky *et al*. (2017), highlighted that both skin diseases and environmental factors are of great importance but usually neglected during the acquisition of fingerprints. Some authors have emphasized that the greatest importance lies in establishing the appropriate time to perform the registration, considering the possibility of a successful recovery from these altered, often temporary conditions (Champod *et al*., 2016; Drahansky *et al*., 2017).

We believe that a new perspective is necessary for the analysis of lip prints, which includes interdisciplinary technical and scientific views of professionals and examiners, appropriate calibrations, evaluation of real conditions in the field, and empirical validation of the methodologies used.

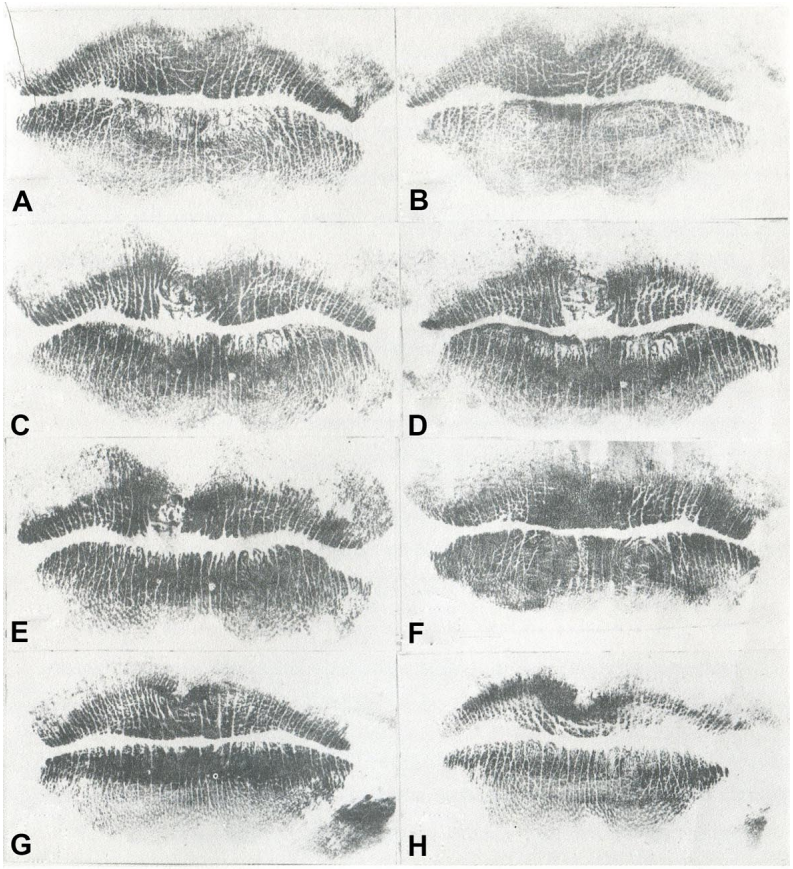

Fig. 4. Experimental model with lip prints taken every two weeks from one of the study participants. The images show the lesions on the individual's upper lip. After the lesions disappeared, the line pattern returned to its previous state. The research was conducted at the MP Training Center in Min´sk Mazowiecki (Poland)

CONCLUSIONS

Of the sampled subjects, 27.4 % had healthy lips, while 71.7 % had some form of lip condition. Although not significant, patterns related to temporary lip conditions, such as healthy, dry, desquamative, eroded, cracked, labial effects of cheilophagia, and permanent conditions, such as scars and Fordyce's granules, were recognized in the lip prints obtained from the sampled subjects. The diagnosis of the lip condition could not be made only by evaluating the lip print (k= 0.111 to 0.357); however, simplifying diagnoses such as "healthy" or "altered" lip status significantly improved the agreement, so the diagnosis could be made by a calibrated examiner (k= 0.679). Although these conditions do not represent identifying variables without empirical studies that validate them, they can affect the quality of the evaluated lip print, so they should be recognized during the analyses considering the prevalence of these conditions with respect to environmental irritants, malformations, or neoplastic factors. It is proposed that lines of research be developed with the participation of both scientists and technicians, which address this perspective not only for training recognition of lip patterns and lip conditions, but also for evaluating the cheiloscopic techniques that examiners can utilize in the field.

ORTIZ CONTRERAS, J.; NAVARRO CÁCERES, P.; KASPRZAK, J. & FONSECA, G. M. Estudio de afecciones labiales asociadas a sus patrones de huellas: una nueva perspectiva en queiloscopia. *Int. J. Morphol., 42(3)*:567-576, 2024.

RESUMEN: Aunque casi todos los estudios excluyen las afecciones labiales pues afectarían los patrones de sus surcos y huellas, algunos autores sostienen que deben ser consideradas alteraciones temporales o permanentes, por lo que se requiere mayor investigación en este aspecto. Se presenta un estudio en el que se asocian afecciones labiales con sus patrones de huellas para evaluar conjuntamente ambos elementos morfológicos con fines de trabajo forense de campo. Se incluyeron 57 mujeres y 48 hombres con edades entre 19 y 38 años residentes en Temuco (Chile). Se registraron las afecciones de los labios y sus huellas, y se aplicó un protocolo de análisis, comparación, evaluación y verificación (ACE-V) para las huellas labiales. De los participantes, el 27,4 % tenía labios sanos, mientras que el 71,7 % presentaba algún tipo de afección. Aunque los patrones relacionados con afecciones labiales temporales y permanentes se reconocieron en las huellas labiales de manera no significativa, un examinador calibrado podría realizar significativamente el diagnóstico de estado labial "sano" o "alterado". Si bien estas condiciones no representan variables de identificación sin estudios empíricos que las validen, pueden afectar la calidad de la impresión labial evaluada; por lo tanto, deben ser reconocidos durante los análisis considerando la prevalencia de estas condiciones.

PALABRAS CLAVE: Queiloscopía; Huellas labiales; Afecciones labiales; Identificación forense; Huellas dactilares.

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