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Cheiloscopic pattern in relation to gender and blood groups: A cross sectional study

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Abstract: Introduction: Cheiloscopy is the study of furrows and grooves present on the red part, or the vermilion border of the human lips. The type of grooves is unique to an individual and can be used for person identification.
Aim: The aim of this study is to ascertain whether the uniqueness of lip print (LP) can help in identifying a person. In addition, we aimed to evaluate whether there is any correlation between LP types and blood groups.
Materials and Methods: A cross-sectional study was conducted on 100 participants (51 males and 49 females), aged between 18 and 50 years, to determine any correlation between LP types and blood groups. These lip patterns were analyzed and interpreted using Tsuchihashi's classification, and later, associated blood group matching was performed to determine the predominant LP type with the ABO and Rh blood grouping system.
Results: The present study showed a positive correlation between LP pattern and blood group among males and females. Thus, the distribution of LP patterns and ABO blood groups might help in the identification of an individual.
Conclusion: Since LP and blood group are unique to a person, cheiloscopy, along with blood group, can play a vital role in person identification.

Keywords: Blood group; Cheiloscopy; Identification; Lip prints.

1. Introduction

Forensic science refers to the areas of endeavor that can be used in a judicial setting and accepted by the court and the general scientific community to distinguish truth from untruth [1]. Apart from the routine professional obligation of a dental surgeon to examine, investigate, diagnose, and treat oral and oro-facial lesions, sometimes their services are required in community services and legal matters. In forensic identification, the mouth allows for a myriad of possibilities. Hence, the role played by a dental surgeon in the discipline of forensics is significant in terms of age and sex determination, personal identification of unknown deceased persons, analyzing bite marks as evidence, participating in mass disasters, giving evidence in child abuse, etc. [2]. Due to the distinctive features of teeth, dental identification is one of the most popular ways to positively identify an individual. In fact, teeth are known to have singular features and possess extraordinary resistance to extreme conditions. These properties enable fast and secure identification processes [3].

Cheiloscopy (from the Greek words, Cheilos = lips, Skopein = see) or the study of lip prints is the forensic investigation technique that deals with the identification of humans based on lip traces [4]. It can act as an indispensable tool in forensic odontology. The wrinkles and grooves on the labial mucosa, called sulci labiorum, form the characteristic lip print pattern [5]. Lip patterns can be recognized as early as the 6th week of intrauterine life and do not alter over time [3]. They are unique in all individuals, even in twins and family members. Hence, they can be used to explore personal identity as it has been proved that they recover after

minor trauma, inflammation, and can resist even herpetic infections [6,7]. Lip prints (LPs) can act as vital proof in authenticating a person's individuality in medico-legal cases like sexual assault, murders, or rape, etc. Sometimes the participant unknowingly leaves evidence on clothes, cups, glasses, cigarette butts, or on the skin [8]. Thus LPs can build up a sequence in linking crime, suspect, and the crime scene.

Another biological record that remains unchanged throughout a person's life is the blood group and Rh factor. Collecting the blood sample of a person from the site of a crime helps in identifying a person. Hence, blood itself and along with LPs can play a significant role in unfolding different medico-legal practices. Landsteiner classified blood groups under the ABO blood group system [9].

The applicability of cheiloscopy in individual identification has been an area of extensive research in recent years. Lip prints can be silent important evidence in the scene of crime to identify the culprit.

Objective of the study: The present study was performed to determine whether the configuration of Lip Prints has the potential to determine sexual dimorphism and to identify any correlation between blood groups and Lip Prints.

2. Materials and methods

The present cross-sectional study was conducted in the Department of Dentistry, Lakhimpur Medical College and Hospital after obtaining approval from the Institutional Ethical Committee. All participants were informed about the intention and objective of the study, and written consent was obtained prior to taking their lip prints. A total of 100 healthy voluntary participants (51 males and 49 females) between the ages of 18 and 50 were randomly selected for the study, and lip impressions were collected.

2.1. Materials

- Dark pink-colored lipstick.
- Lipstick applicator.
- Cellophane tape (2 inches wide).
- Executive bond paper.
- Magnifying lens.
- Lipstick remover liquid.
- Cotton balls.
- Scissors.
- For identifying blood group, a glass slide, anti-A and anti-B sera, lancets, and alcohol swabs were used.

2.2. Inclusion criteria

Individuals between the ages of 18 and 50 with lips free from any pathology, and having a normal transition zone between the mucosa and skin, were included in the study after giving informed consent.

2.3. Exclusion criteria

Individuals with known allergy to lipstick, inflammation of lips, trauma, malformation, deformity, surgical scars, facial palsy, and active lesions of the lips were excluded.

2.4. Data collection methodology

2.4.1. Collecting lip prints

Bright pink non-glossy lipstick, transparent cellophane tape (2 inches wide) with glue on one side, scissors, white paper, magnifying glass, swabs, soap, soft towels, and cleansing milk were used. The lips of each participant were cleaned with soap and water and then dried with a soft towel. The lipstick was applied uniformly, starting at the middle of the lips and moving laterally. The subject was asked to roll both lips inwards on each other to ensure even spread of lipstick. The applied lipstick was allowed to dry for about 2 minutes. A strip of cellophane tape, 10 cm long, was cut with scissors. Keeping the oral fissure closed in a normal resting position, the glued portion of the cellophane tape was placed on the closed lips. It was held in place by dabbing in the center initially and later towards the corners of the lips. The tape was carefully lifted

from the lips to avoid smudging. This strip was then stuck to a white paper. The lips were then cleaned with a cotton swab dabbed in cleansing milk.

Each lip print was divided into four quadrants, and each quadrant was examined using a magnifying glass. The classification proposed by Suzuki and Tsuchihashi was used to classify the lip prints. The blood group of the individual was noted by questioning, and in case of people who were unaware, tests were done to determine their blood group. Recording of lip prints is shown in Figure 1. Lip prints collected on cellophane tape and then stuck to a thin bond paper are shown in Figure 2. The pattern of lip prints as suggested by Suzuki and Tsuchihashi is shown in Figure 3. Type I lip print pattern is shown in Figure 4, Type II lip print pattern is shown in Figure 5, Type III lip print pattern is shown in Figure 6, and Type IV lip print pattern is shown in Figure 7.

Figure 1. Recording of lip prints

Figure 2. Lip print collected on cellophane tape and then stuck to a thin bond paper

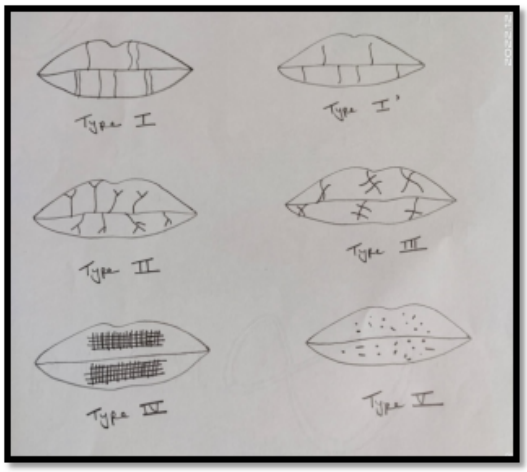


Figure 3. The pattern of lip prints as suggested by Suzuki and Tsuchihashi

Figure 4. Type I lip print pattern

Figure 5. Type II lip print pattern

Figure 6. Type III lip print pattern

Figure 7. Type IV lip print pattern

2.4.2. Recording of the Blood Groups of the Study Population

The subjects will be asked to wash their hands with soap and water and pat them dry. The pulp of their middle finger will be cleaned with a spirit swab and pricked with the help of a lancet. Two drops of blood will be squeezed onto a glass slide. It will then be treated with anti-A and anti-B sera. A positive agglutination with anti-A serum shows 'A' blood group; with anti-B serum, 'B' group; agglutination with both sera is 'AB' blood group, and no agglutination with any sera is 'O' group. Agglutination with Rh antigen is 'Rh positive,' and the absence of agglutination is 'Rh negative.' The blood slide, anti-A, and anti-B sera are shown in Figure 8.

2.5. Statistical analysis

The data obtained were entered into Microsoft Excel and analyzed using the SPSS package version 24. The predominant lip patterns for the different groups were calculated using the percentage method. The chi-square test was used to analyze and compare the lip print patterns with gender and blood groups. The level of significance was set at $P < 0.05$.

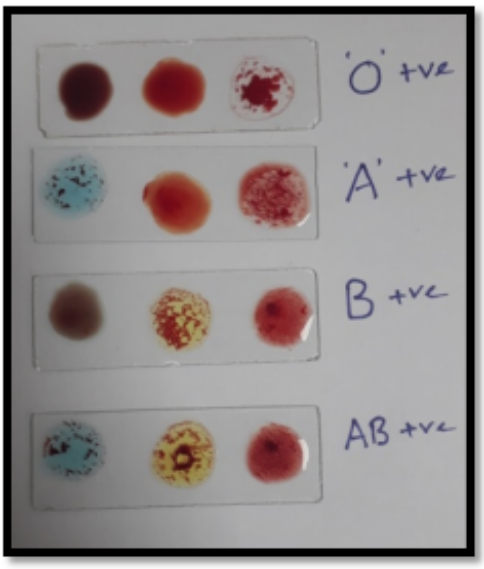


Figure 8. Blood slide, anti-A and anti-B sera

3. Observation and Results

There were a total of 100 voluntary subjects in this study, comprising 51 males and 49 females. The following interpretations were drawn from the present study. First, all LPs were unique, and no two lip patterns were alike to each other. Second, the most common LP pattern was Type II (43%), followed by Type III (31%), Type I (13%), Type IV (11%), Type V (2%), and Type I' (0%) [Table 1 and Figure 9]. Third, the most common blood group found in this study was O+ (35%), followed by A+ (27%), B+ (24%), AB+ (10%), O- (2%), A- (2%), AB- (0%), and B- (0%) [Table 2 and Figure 10]. Type III lip pattern was predominantly found in male participants, and Type II lip pattern was the most common among female participants. On correlating ABO blood group with lip pattern results, were significant with $\chi 2 = 66.22$ and $P < 0.001$ [Table 3 and Figure 11].

On comparing lip pattern with gender and ABO blood group, a positive correlation was reported as $\chi 2 = 32.62$ and $P = 0.0371$ [Table 4 and Figure 12] and $\chi 2 = 75.53$, $P < 0.001$ [Table 5 and Figure 13] in male and female participants, respectively.

Table 1. Distribution of lip patterns among the study population

Type	Frequency	Percentage
I	**13**	13.0%
II	**43**	43.0%
III	**31**	31.0%
IV	**11**	11.0%
V	**2**	2.0%
Total	100	100.0%

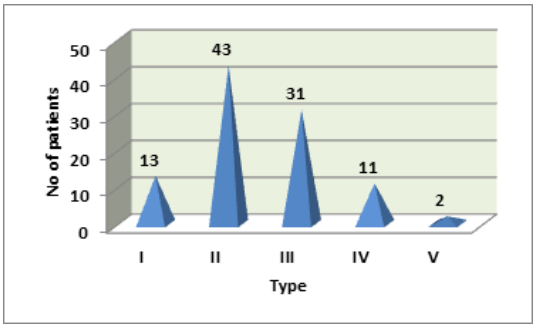


Figure 9. Lip pattern among study population

Table 2. Distribution of blood groups among the study population

	Frequency	Percentage
A+	27	27.0%
AB+	10	10.0%
B+	24	24.0%
O+	35	35.0%
O-	2	2.0%
A-	2	2.0%
AB-	0	0.0%
B-	0	0.0%
Total	100	100.0%

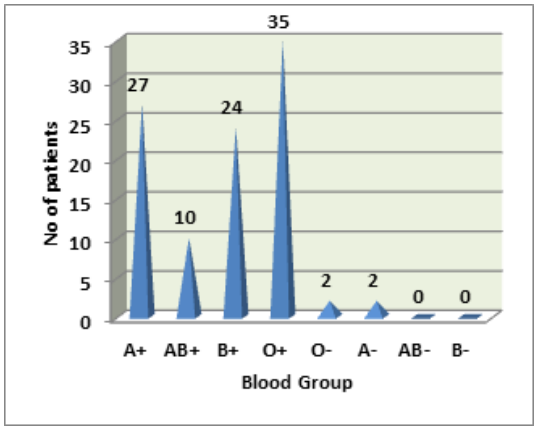


Figure 10. Blood groups among study population

Table 3. Association between blood groups and lip pattern

Overall	A+	AB+	B+	O+	O-	A-	Total	chi, df	p value
I	1(3.7%)	2(20%)	4(16.7%)	6(17.1%)	0(0%)	0(0%)	13(13%)	"66.22, 20"	**<0.001**
II	18(66.7%)	6(60%)	4(16.7%)	15(42.9%)	0(0%)	0(0%)	43(43%)		
III	7(25.9%)	1(10%)	7(29.2%)	14(40%)	1(50%)	1(50%)	31(31%)		
IV	0(0%)	1(10%)	9(37.5%)	0(0%)	0(0%)	1(50%)	11(11%)		
V	1(3.7%)	0(0%)	0(0%)	0(0%)	1(50%)	0(0%)	2(2%)		
Total	27(100%)	10(100%)	24(100%)	35(100%)	2(100%)	2(100%)	100(100%)		

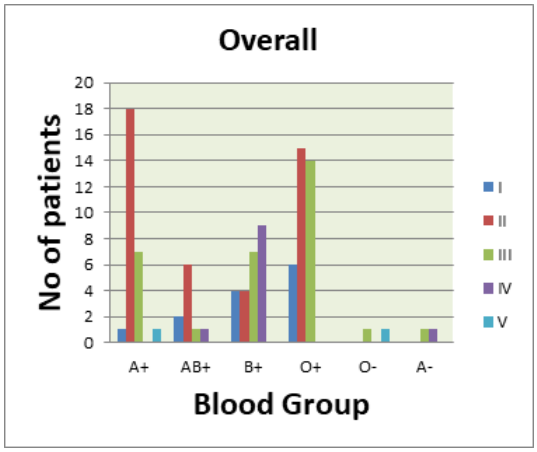


Figure 11. Blood group and lip pattern

Table 4. Association between blood groups and lip pattern: Males

Overall	A+	AB+	B+	O+	O-	A-	Total	chi, df	p value
I	1(3.7%)	2(20%)	4(16.7%)	6(17.1%)	0(0%)	0(0%)	13(13%)	"66.22, 20"	**<0.001**
II	18(66.7%)	6(60%)	4(16.7%)	15(42.9%)	0(0%)	0(0%)	43(43%)		
III	7(25.9%)	1(10%)	7(29.2%)	14(40%)	1(50%)	1(50%)	31(31%)		
IV	0(0%)	1(10%)	9(37.5%)	0(0%)	0(0%)	1(50%)	11(11%)		
V	1(3.7%)	0(0%)	0(0%)	0(0%)	1(50%)	0(0%)	2(2%)		
Total	27(100%)	10(100%)	24(100%)	35(100%)	2(100%)	2(100%)	100(100%)		

Table 5. Association between blood groups and lip pattern: Females

Female	A+	AB+	B+	O+	O-	A-	Total	chi, df	p value
I	0(0%)	2(25%)	1(7.7%)	3(21.4%)	0(0%)	0(0%)	6(12.2%)	"75.53, 20"	**<0.001**
II	10(83.3%)	5(62.5%)	4(30.8%)	8(57.1%)	0(0%)	0(0%)	27(55.1%)		
III	2(16.7%)	0(0%)	2(15.4%)	3(21.4%)	0(0%)	1(100%)	8(16.3%)		
IV	0(0%)	1(12.5%)	6(46.2%)	0(0%)	0(0%)	0(0%)	7(14.3%)		
V	0(0%)	0(0%)	0(0%)	0(0%)	1(100%)	0(0%)	1(2%)		
Total	12(100%)	8(100%)	13(100%)	14(100%)	1(100%)	1(100%)	49(100%)		

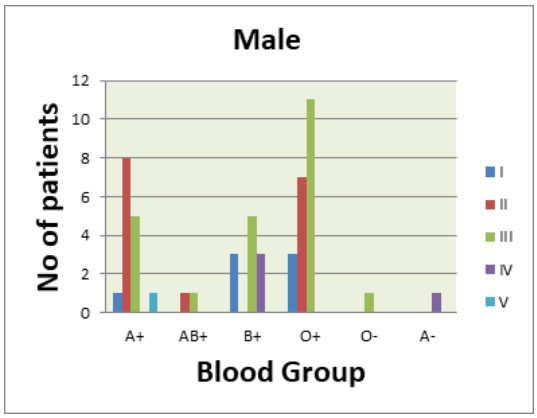


Figure 12. Blood group and lip pattern: Male

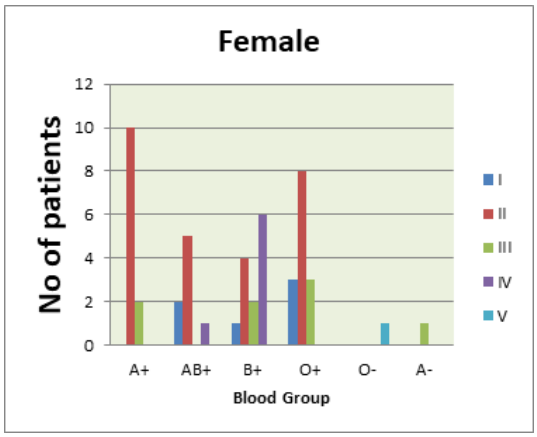


Figure 13. Blood group and lip pattern: Females

4. Discussion

Forensic science plays a major role in both civil and criminal investigations for identifying missing persons, victims, or culprits hiding their identity. Cheiloscopy is a forensic technique used to identify individuals based on their distinctive lip traces [10,11]. A well-known lip print (LP) pattern develops as early as the 6th week of intrauterine life. The presence of grooves and furrows on the red portion of the human lip

was first described by Fisher in 1902 [12]. The LP pattern was first recommended by the French criminologist Edmond Locard (1932), and later Dr. Martins Santos classified LP based on the pattern of lip grooves in 1967 [13]. He classified it into four types: (1) Straight line, (2) Curved line, (3) Angled line, and (4) Sine-shaped curve. Another widely accepted classification of LP was proposed by a Japanese doctor Suzuki in 1970, who classified it into five types [9].

Type I: Complete vertical pattern. (Clear-cut grooves running vertically across the lip).

Type I': Incomplete vertical pattern. (The grooves are straight but they disappear halfway).

Type II: Branching, Y-shaped pattern. (The grooves fork in their way).

Type III: Criss-cross pattern. (The grooves intersect).

Type IV: Reticular pattern.

Type V: Undetermined. (The grooves do not fall in any of the types from I to IV).

The present study was conducted on 100 randomly selected volunteering subjects visiting Lakhimpur Medical College and hospital, of which 51 were male and 49 were female. It was undertaken to evaluate the relationship of LP with gender and ABO blood group. The study aimed to analyze whether LP and blood group hold the potential for the determination of sex and identity of an individual. The classification proposed by Suzuki and Tsuchihashi of lip pattern was used as it is the most widely followed globally and encompasses all types of lip patterns. To study the lip prints, each individual's lips were divided into four compartments, two compartments on the lower lip and two on the upper lip, following the method advocated by Vahanwala [14] and used by Saraswathi *et al.,* [15]. Each compartment was studied, and the overall type of groove patterns was recorded as the lip print.

The most predominant pattern in the entire study population, taking both the upper and lower lips together, was Type II (43%). This was followed, in order, by Type III (31%), Type I (13%), Type IV (11%), Type V (2%), and I' (0%). The result was similar to the studies done by Gondivkar *et al.,* [16] and Pallavi Kesarwani *et al.,* [17], where Type II was a major pattern in the study population. Type II lip print pattern was also the most predominant pattern reported in the studies conducted by Verma P *et al.,* Kataria *et al.,* Karki RK, *et al.,* respectively [18–20]. Further, our study results were partially in accordance with a study done by S Surya *et al.,* [21] and a study done in North Kerala by Basheer *et al.,* [22]. On the contrary, Verghese *et al.,* in their study on the Kerala population found Type IV to be the most common pattern [23]. Another study done by Gupta P *et al.,* found that Type I was the most common lip print type in both males and females [24]. Sivapathasundharam *et al.,* in their study on 200 Indo-Dravidian persons, stated that Type III was a leading pattern [25] and Multani *et al.,* found Type I pattern as the predominant LP pattern [26]. Which is also not in support of our study. Lip prints are unique and are associated with the race and ethnic origin of a person [23]. Previous studies have reported that the LP patterns forms revealed a population-wise dominance that is a particularlip pattern predominance in a specific group of population [9,18].

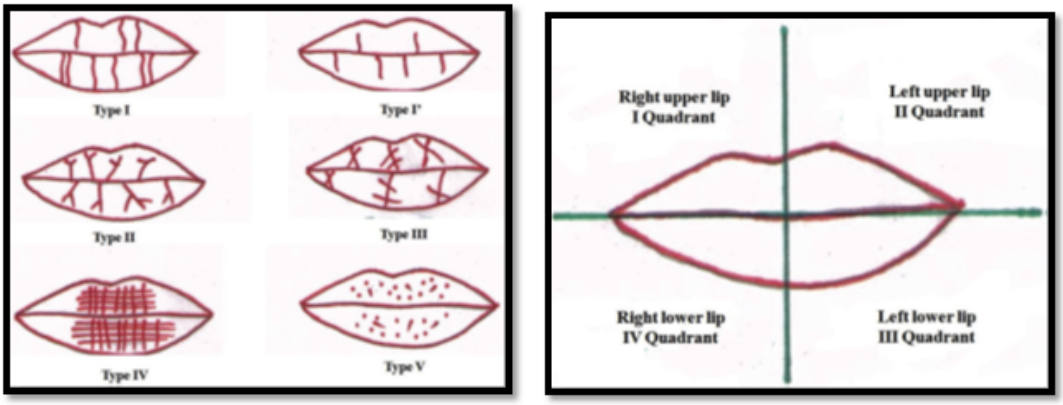
On further analysis, the results showed that the most common lip print type found in males was Type III (45.1%) whereas in females it was Type II(55.1%).The study done by Multani *et al.,* [26] found that Type III was a major pattern prevalent among male and Type I among female. Patel *et al.,*[6]. Reported Type I as the most well-known pattern among male participants and Type II among female participants. Both the studies are partially in accordance with our study. Sharma *et al.,* concluded in his study that Type I and Type I' lip patterns were most frequently seen in female while Type IV was most commonly found in males [12]. Srilekha *et al.,* in their study showed that Type I was predominant among females and Types I and IV lip pattern were predominant among males [8]. This variation may occur due to inter-observer variability in the classification of reticular and intersecting types.

Blood groups

The most common blood groups found in the study population was O Positive followed by A Positive. Type II was the predominant lip print found in both the blood groups analysed. Srilekha *et al.,* in their study found O +ve as the most common blood group type, followed by B +ve [8] while Verma *et al.,* reported B +ve blood group as a principal one in their study [18]. In our study, O +ve, followedby A +ve were the predominant blood groups, which was partially in accordance with the study conducted by Raloti *et al.,* in Gujarat [27].

The results revealed a significant correlation between LP patterns and ABO blood group and also in the sex-wise distribution of the LPs and ABO blood group. Not much previous literature has compared blood

groups and LPs but Suzuki and Tsuchihashi have reported that there is some correlation between heredity and LP and that the LP types are inherited in a manner similar as heredity of blood groups [5,7]. Sandhu H *et al.*, in their study founda correlation between lip prints and blood group except Type 1 [28]. The results of the present study are not in support of the studies done by Karim B *et al.*, which showed no correlation between lip prints andblood groups [29].



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5. Conclusion

The present study confirms the distinctiveness of Cheiloscopy and its potential usefulness in Forensic Medicine. It analyzed the lip print patterns with blood groups of individuals and found a significant association between gender, lip prints, and blood groups. Thus, the study suggests that the association of lip prints with blood groups holds the potential to recognize the sex and identity of an individual. Although the present study has certain limitations, such as a small sample size, the results obtained in the present study open a window for similar studies in larger cohorts.

6. Limitations of Cheiloscopy

The lip print is produced by a substantially mobile portion of the lip. This fact alone explains why the same person can produce different lip prints, depending on the pressure, direction, and method used to take the print. If lipstick is used, the amount can also affect the print. Smudging of lip prints is one of the major limitations of using lipsticks, as in the present study. Manual registration of the overlay is another problem, due to the possibility of subjectivity.

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: "The authors declare that they do not have conflict of interests."

Ethical Clearance: Obtained from the appropriate ethics committee/institutional review board.

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