

## Cheiloscopy in Downs Syndrome

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**Abstract:** When it was discovered that Down's Syndrome was in fact caused by chromosomal abnormality, research was begun to see how far the hand could be used as a guide to diagnosing other chromosomal defects and dermatoglyphic analysis soon became referred to as 'the poor man's karyotype'. The present study was undertaken to study in depth of the lip prints of different individuals with Down syndrome, to study the lip print pattern of Down's syndrome subjects, their family members, compare the lip print pattern of Down's syndrome subjects and their family members with normal subjects and find any correlation, if any.

Three groups were formed, first comprising of normal subjects as a control group, second of Down's syndrome individuals and third of family members of Down's syndrome individuals each consisting of 31 subjects. A thin layer of lipstick was applied uniformly to the lips and lip prints were obtained separately for upper and lower lips. The lip prints were analyzed using softwares.

Statistical analysis was done using chi square test. Significant differences in the pattern of lip prints are seen in the Down's syndrome individuals and their family members in comparison to normal individuals. Also lip print patterns of the control group had significant findings not related to the study.

**Keywords:** Downs Syndrome, Lip print, Cheiloscopy.

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### I. Introduction

Cheiloscopy is thought of as a method of identification of a person based on the characteristic arrangement of lines appearing on the red part of the lips. The dermatoglyphic features have been well defined in a number of disease entities and syndromes, particularly those associated with chromosomal abnormalities. Down syndrome (Mongolism or Trisomy 21) results from abnormal cell division involving the 21st chromosome.

The first comprehensive attempt to describe the dermatoglyphic patterns in downs syndrome was undertaken by Cummins in 1939. Other investigators have extended his original observations until a fairly discrete pattern of dermatoglyphic findings in downs syndrome has emerged [1]. Abnormalities in these areas are influenced by a combination of hereditary and environmental factors, but only when combined factors exceed a certain level, can these abnormalities be expected to appear. This threshold theory has been advanced by the studies of carter (1969) [2,3] and Mutsunaga (1977) [4] is now generally accepted.

The epidermal ridges of the fingers and palms as well as the facial structures like lip, alveolus and palate are formed from the same embryonic tissues (ectoderm) during the same embryonic period (6-9 weeks). Thus, Nobaru et al stated that the genetic and environmental factors which are responsible for causing deformities of the lips and palate may also cause peculiarities in the dermatoglyphic patterns [5].

The presence or absence of the expected dermatoglyphic findings can be of assistance in supporting or detracting from a considered clinical diagnosis, even though the dermatoglyphic findings by themselves cannot establish or rule out any specific diagnosis [6].

In spite of few studies available the study of Yasuo Tsuchihashi,[4] is giving a standardized classification of his own, for different types of lip print. Keeping this classification as the basis, conducting further studies could give further details. Hence, the present research has been aimed to study in depth of the lip prints of different individuals with Down syndrome, to establish further facts and truths and throw more lights on lip print with an object of providing further information.

### II. Aims And Objectives

- 1) To study the lip print pattern of Down's syndrome subjects.
- 2) To study the lip print pattern of family members of Down's syndrome subjects.
- 3) To compare the lip print pattern of Down's syndrome subjects and their family members with normal subjects and find any correlation, if any.

- 4) To find whether cheiloscopy can be used as marker in Down's syndrome.

### **III. Materials And Methods**

#### **3.1 Selection and Grouping of Patients:**

Three groups were formed, first comprising of normal subjects as a control group, second of Down's syndrome individuals and third of family members of Down's syndrome individuals.

The control group was selected on a random basis in the age range of 10 to 40 years and without any medical disorders. Subjects with inflammation, trauma, malformation, deformity and surgical scars and other abnormalities of the lips were excluded because of their unsuitability for the study. All the groups were studied for variability and differences in their lip print patterns.

The three groups were as follows:

1. Control group: 31 individuals including 18 males and 13 females.
2. Down's syndrome subjects: 31 individuals including 21 males and 10 females.
3. Parents of Down's syndrome subjects: 31 individuals including 13 males and 18 females.

#### **3.2 Method of Collection:**

Several methods of recording lip prints were tried before the method was finally selected. These included the application of lipstick with lips being directly impressed by different techniques on different types of paper, a photographic method, the method of developing latent lip prints using conventional finger print powder, etc. the method of using lipstick and adhesive tape was adopted for the clarity of lip prints obtained, ease of obtaining details and contrast, the protection provided by the scotch tape against damage or distortion of the prints and the ease with which it can be removed after the impressions were taken. Several kinds of lip sticks were tried before a matte finish dark brown colored lipstick was selected for the study. The armamentarium used is shown in figure 1.



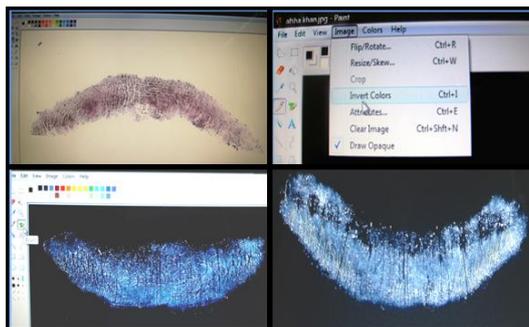
**Figure 1.** Armamentarium

The lips of the subject were first cleaned thoroughly with a piece of sterile gauze moistened with water and allowed to dry. In case lipstick or lip gel was previously applied, they were thoroughly cleaned with deep pore cleansing milk and gauze. Lipstick was then applied to the upper lip starting at the midline and moving laterally, one quadrant at a time. The lipstick applicator brush was moved in light strokes in vertical and horizontal directions till a uniform layer of lipstick was applied over the lip. The lipstick was applied in a similar manner on the lower lip. A clean brush was used every time the brush was applied to the lipstick. The brushes were washed with soap and water and kept in a cold sterilizing solution (Cidex) for a minimum of 30 minutes. They were subsequently rinsed, dried and stored for use.

The lipstick was allowed to dry for 2 minutes after which lip prints were taken. The lip prints of each lip were taken separately using scotch magic tape, with the other lip retracted gently by the subject. The tape was then stuck carefully on an A4 size OHP sheet taking care to avoid stretching or folding of the tape. Multiple lip prints were taken, if necessary, till a lip print of good clarity was achieved. The lips were then cleaned using deep pore cleansing milk and gauze.

#### **3.3 Method for Analysis of Lip Prints:**

The lip prints of each individual were scanned using an image scanner set at a resolution of 600 dpi. The images were stored as Jpeg files. The most legible prints of both lips taken together on scotch tape were used for the study. Adobe Photoshop CS3 and Microsoft Windows Paint 6.0 software were used for imaging applications (Figure 2).

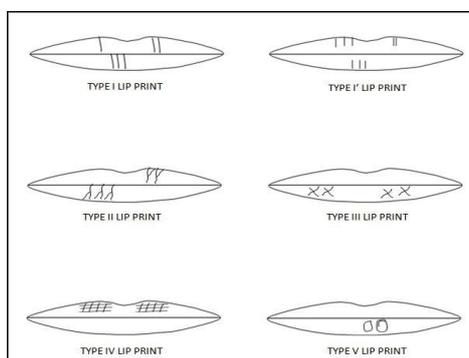


**Figure 2:** a. Lip print after scanning. b. Inverting the colors of the scanned lip print image. c. Image after inverting the colors. d. Marking of the lip patterns with the pencil tool in software.

These software can be used to advantage to sharpen, improve contrast and brightness, magnify, add demarcating lines and perform other editing actions. The scanned images were cropped and vertical lines drawn to divide the left and right sides.

### 3.4 Criteria for Classification of Lip Prints:

The lip prints were classified using the classification given by Suzuki and Tsuchihashi (1970) [7] (Figure 3).

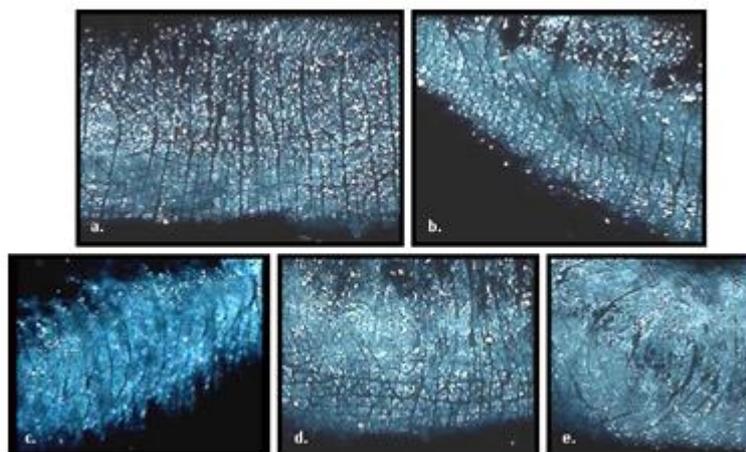


**Figure 3:** Diagrammatic representation of Suzuki and Tsuchihashi (1970) classification for Lip Print patterns.

The type I and type I' patterns were combined into Type I for ease of the study. For this purpose each lip was divided into two quadrants at the midline and each quadrant was further divided into two equal parts, the medial and the lateral. The different quadrants of the lip were named depending on which lip they belonged and the side of the lip as follows: upper right lateral (URL), upper right medial (URM), upper left medial (ULM), upper left lateral (ULL), lower right lateral (LRL), lower right medial (LRM), lower left medial (LLM) and lower left lateral (LLL). The determination of the pattern in each quadrant of the lip was based on the numerical superiority of properties of lines. In case where there were two dominant patterns, the second dominant pattern was noted alongside the most dominant pattern.

The criteria for classification of lip prints in the present study were as follows (Figure 4):

1. Type I: predominance of clear cut lines crossing the lip from the outer border to the mucosal surface of the lip and partial vertical lines not reaching the mucosal surface (Type I'). Vertical lines with intersecting horizontal or oblique lines were not considered.
2. Type II: Branching of lines in the form of "Y" or forking of vertical lines. Very short branches extending for short distances from the vertical lines were also considered.
3. Type III: intersecting lines that crossed each other obliquely.
4. Type IV: lines which predominantly intersected at right angles to each other.
5. Type V: any other patterns (whorls) apart from the above.



**Figure 4:** Suzuki and Tsuchihashi's (1970) lip print classification in patients. a: Type I & I', b: Type II, c: Type III, d: Type IV and e: Type V.

### 3.5 Method for Comparison of Lip Prints:

The lip prints of the individuals of the three groups were recorded in their respective proforma. Comparison of the lip print pattern was made between the Down's syndrome individuals and their family members with the control group. Similar comparison was made between the family members of Down's syndrome individuals and the control group. The comparison was made between the entire upper and lower lip and lateral and medial segments of right and left side combined of the upper and the lower lips.

### 3.6 Statistical Analysis:

Comparison of lip prints between the upper and lower lips as well as the medial and lateral segments was done using the chi-square test between the following:

1. The control group and the down's syndrome group
2. The control group and the family members of down's syndrome individuals

P value was then calculated for the corresponding Chi square values and the significance was seen.

## IV. Results And Discussion

Although hereditary and genetic basis of lip prints has been mentioned, there are no studies which have been done to classify and compare the lip print patterns in genetic abnormalities and disorders.

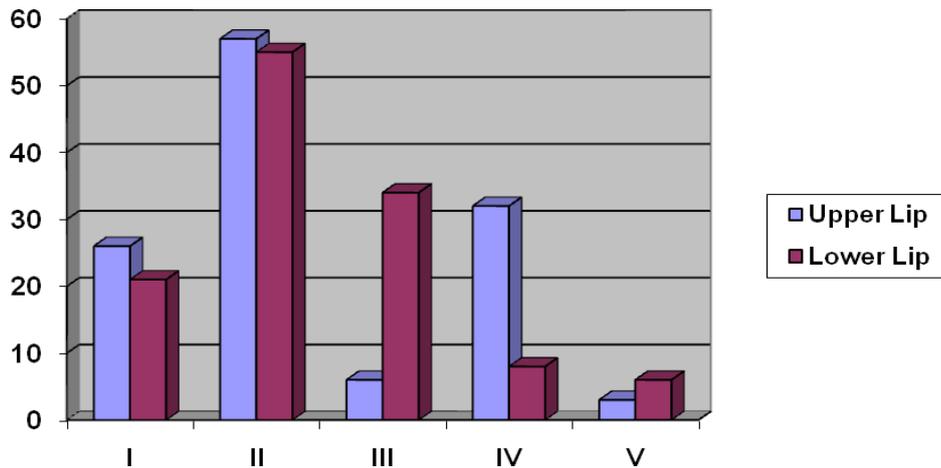
The present study was carried out to classify the lip print patterns, study the common patterns and compare the patterns of Down's syndrome patients and their parents with the normal individuals. A sample of 31 individuals was taken in each of the three groups for the above mentioned purpose. The control group consisted of individuals ranging from 10 to 40 years of age. Age differences in the individuals of the three groups were not taken into consideration as lip prints remain stable throughout life. [4, 8, 9, 10, 11] The control group was initially divided into two sex groups but since no statistical differences were observed between the sexes for lip print pattern (data not shown), the sex groups were pooled.

Several methods of recording lip prints were tried before the method was finally selected. These included a photographic method as described by Suzuki K. and Tsuchihashi Y. (1970), [4, 7, 12, 13] Burns R. W. (1981), [14] Ball J. (2002), [15] Williams T. R. (1991), [16] the method of developing latent lip prints using conventional finger print powder as described by Segui M. A. et al (2000), [17] Williams T. R. (1991), [16] Ball J. (2002) [15] and the method of having the lips impressed on paper after application of lipstick as described by Vahanwala S. P. and Parekh B. K. (2000). [11, 18] Different types of paper including tracing paper and bond paper were tried with the lips being impressed in different ways.

The method of using a thin layer of lipstick applied evenly to the lips and impressed onto the glued side of adhesive tape has been described by Sivapathasundharam B. et al (2000). [19] This method was selected for the accuracy of the details achieved, ease of obtaining the details and contrast, the protection provided by the scotch tape against damage or distortion of the prints, the ease with which it can be removed after the impressions were taken and the reproducibility of the print after sticking on a transparency sheet.

The lip prints then obtained were scanned at 600 ppi, and viewed using Adobe Photoshop software as suggested by Bowers C. M. and Johansen R. J. (2001).[20] These scanned images could be preserved safely, divided into equal parts by using the ruler, adjusted for brightness and contrast and magnified as much as necessary for clear visualization of details. The patterns were then marked by using the pencil tool of the Microsoft paint software and counted manually, further making the procedure of analysis accurate.

In the present study, the most predominant pattern in the control group, taking both the upper and lower lips together, was type II which constituted 45.16% of all patterns (Graph 1).

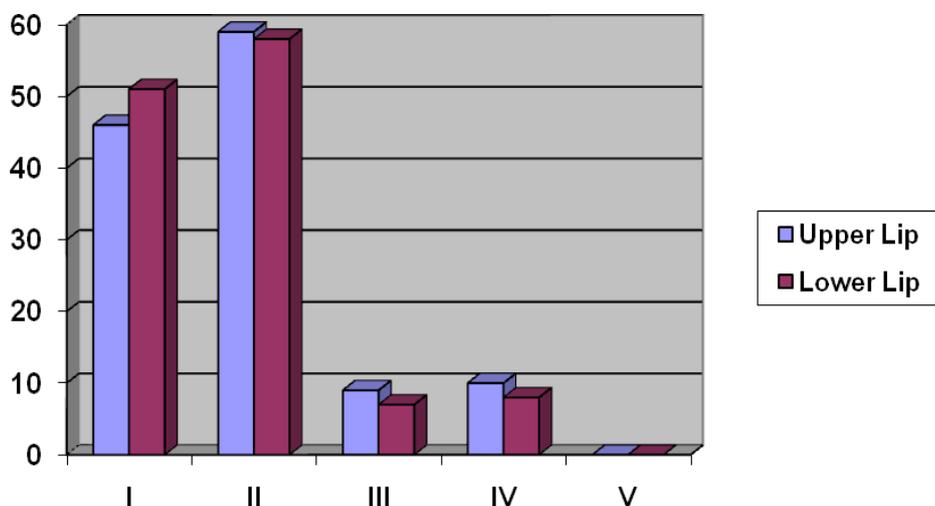


**Graph 1:** Graph showing the lip print pattern in control group.

This was followed by type I (18.95%), type III (16.13%), type IV (16.13%) and type V (3.63%). Similar results have been reported by Vahanwala S. P. and Parekh B. K. (2000) [11,18] who found type I and type II to be the most common in the upper right quadrant. Also, Hirth L. et al (1975) [10] observed that branched pattern was more frequently present in the upper lip and simple pattern in the lower lip. Our results differed from those obtained by Suzuki K. and Tsuchihashi Y. (1970)[7] and Sivapathasundharam B. et al (2000) [19] who found type III to be the most common, followed by type I, type II, type IV and type V.

In the upper lip, type II pattern (59.68%) was found to be more common in the lateral segments than in the medial segments while type IV (50%) was more common in the medial areas than the lateral areas. In the lower lip, type II (66.13%) was more common in the lateral segments whereas type I (33.87%) was frequently seen in the medial segments.

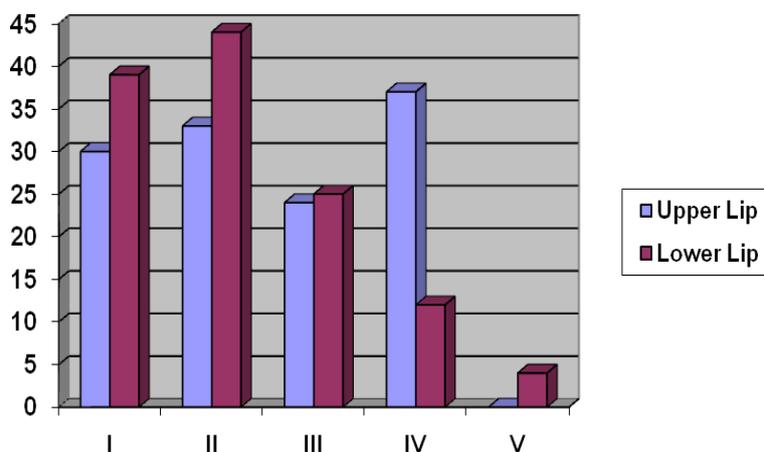
In the Down's syndrome group, the most predominant pattern was found to be type II (47.18%) which was followed by type I (39.11%), type IV (7.26%) and type III (6.45%) (Graph 2).



**Graph 2:** Graph showing the lip print pattern in Downs syndrome group.

It was also observed that the upper lip showed type II (47.58%) to be the most predominant followed by type I (37.10%), type IV (8.07%) and type III (7.26%). In the lower lip, type II (46.77%) was the most common pattern observed followed by type I(45.97%), type IV (6.45%) and type III (5.65%).

In the parents of Down's syndrome individuals, the most predominant pattern was found to be type II (31.05%) which was followed by type I (27.82%), type III (19.76%), type IV (19.76%) and type V (1.61%) (Graph 3).



**Graph 3:** Graph showing the lip print pattern in Parents of Downs syndrome.

The upper lip showed type IV (29.84%) to be the most predominant followed by type II (26.61%), type I (24.19%) and type III (19.36%). In the lower lip, type II (35.48%) was the most common pattern observed followed by type I(31.45%), type III (20.16%), type IV (9.68) and type V (3.23%).

A comparison was first done between the three groups as follows: (Table 1)

Segments of Lips	Groups	LIP PRINT PATTERN				
		I	II	III	IV	V
Upper Lip Medial	Control	7	20	2	31	2
	Downs	26	21	5	10	0
	Parents	15	5	7	35	0
Upper Lip Lateral	Control	21	36	3	1	1
	Downs	20	38	4	0	0
	Parents	15	28	17	2	0
Lower Lip Medial	Control	20	14	14	8	6
	Downs	43	10	1	8	0
	Parents	35	2	9	12	4
Lower Lip Lateral	Control	0	41	21	0	0
	Downs	8	48	6	0	0
	Parents	4	42	16	0	0

**Table 1:** Table showing the distribution of lip print patterns in the three groups.

**1. Comparison between the control group and the Down's syndrome group:**

Type II was the predominant pattern in upper lips of both groups followed by type IV in the control group whereas type I in the Down's syndrome group. Type II was also the predominant pattern observed in the lower lip which was followed by type III in the control group and type I in the Down's syndrome group.

Chi square test was applied to the distribution of patterns in the upper and the lower lip and the lateral and medial segments of both the lips. The test results revealed that the difference was statistically significant in the upper lip (P = 0.0004), lower lip (P < 0.0001), upper medial segment (P < 0.0001), lower lateral (P = 0.0002) and lower medial segments (P < 0.0001). The upper lateral segments (P = 0.6951) showed no significant difference in distribution of lip print pattern.

**2. A comparison was then done between the control group and the parents of Down's syndrome individuals:**

Type II was the predominant pattern in upper lip of control group followed by type IV and type I. Type IV was the predominant pattern in upper lip of parents followed by type II and type I. Type II was also the predominant pattern observed in the lower lip of both groups which was followed by type III in the control group and type I in the Down's syndrome group.

Chi square test was applied to the distribution of the lip patterns. The pattern was statistically significant in the upper lip (P = 0.0003) but not in the lower lip (P = 0.0564). Significance was also seen in the

upper lateral ( $P = 0.0106$ ), upper medial ( $P = 0.0020$ ) patterns and the lower medial segments ( $P = 0.0040$ ) when compared individually.

The following findings, not related to the study, in the lip prints patterns of the control group (normal individuals) were also observed:

- 1) Type II pattern was the most predominant pattern followed by type I, type III, type IV & type V.
- 2) Type III pattern was more frequently observed in the lower lip.
- 3) Type IV pattern was more frequently seen in the upper lip medial segments.
- 4) Statistically significant difference in patterns was observed between the upper and lower lips.

The lip print patterns of males and females in the control group showed no statistically significant differences.

## V. Conclusion

Genes in their optimal state are nearly symmetrical. Asymmetry will be illustrated in various human bilateral structures like eyes, teeth, hands, etc. where genes have been damaged. Thus as genetic damage can also be reflected in the hands through the dermatoglyphic patterns, as well as lip print patterns, this analysis can be an extremely useful diagnostic tool for preliminary investigation into conditions with a suspected genetic base. [21]

With these observations in mind, the following conclusions can be drawn from the present study:

- 1) Significant differences in the pattern of lip prints are seen in the Down's syndrome individuals and their family members in comparison to normal individuals.
- 2) Cheiloscopy can be used as a diagnostic tool in Down's syndrome individuals.
- 3) The study of Lip prints can also be done in various other genetic and chromosomal aberrations and a definitive pattern can be established for different disorders of the oro-facial region.

The range of lip print patterns in the normal population is such that it is impossible to base diagnoses on lip prints findings alone. Neither is it always possible to separate one disease from another just on the strength of such findings. Nevertheless, the simplicity and inexpensiveness of cheiloscopic analysis and the relative constancy of findings within a given disorder, especially the chromosomal aberrations, may establish cheiloscopy as a useful ancillary diagnostic tool.

But further studies have to be done with larger sample size in order to evaluate the significance of these variations in the lip print patterns in Down's syndrome individuals.

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