Review Article

Dermatoglyphics and orthodontics

ABSTRACT

Dermatoglyphics is the study of fingerprints and skin patterns. These appear at the 12th week of intrauterine life and are completely established by the 24th week of intrauterine life. It is said that thereafter, these configurations remain constant throughout life. It is during the same embryonic period that finger and palm prints, the lip, alveolus, and palate develop. As a result, any factor causing changes in the lip, alveolus, and palate may also cause different patterns in the appearance of finger and palm prints. Hence, fingerprint patterns and other details of dermal ridges may offer distinct advantages and thus may be used as a screening tool, which is easily accessible, economical, and noninvasive marker to detect early malocclusion.

Key words: Dermatoglyphics; malocclusion; orthodontics.

Introduction

The study of epidermal ridges and their patterns is known as "Dermatoglyphics."[1] It is the study of dermal ridge counts and figures on the fingers, palms, and soles.[2] The term was coined by Cummins and Midlo in 1961. The word "Dermatoglyphics" is derived from the Greek word "Derma" meaning skin and "glyphic" meaning carvings.[3] Dermal configurations appear at the 12th week of intrauterine life and they are established by the 24th week. Thereafter, they remain constant, except for the change in their sizes. Embryological development of orodental structures and these dermal patterns occur during the same period.[4]

Genetics and environmental forces play an important role in the development of an individual's fingerprints.[5] The dermal ridges develop in relation to the volar pads, which in turn are formed by the 6th week of gestation and reach a maximum size between 12th and 13th weeks. Thus, the genetic message contained in the genome - normal or abnormal is deciphered during this period and is also reflected by dermatoglyphics.[6] Thus, any environmental or genetic factors affecting the process of development of dental hard tissues might affect and also get recorded in the dermal ridges. This forms the basis of comparison of dental diseases with that of dermatoglyphics.[7]

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It is also said that the ridged skin can be a sensitive indicator of intrauterine dental anomalies. The ridged skin originates from the fetal volar pads as the teeth which also originates from the same ectodermal layer in the 6–7th week of embryonic life. Hence, a tooth anomaly can be expected, when an intrauterine dermal damage occurs.[8]

It is said that the finger ridges are influenced by blood vessel-nerve pairs at the border that exist between the dermis and epidermis during prenatal development. Various factors such as inadequate oxygen supply, unusual distribution of sweat glands, and alterations of epithelial growths could also influence the ridge patterns.[9]

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Sir Francis Galton had put forth a rule called "proof of no change" in the 19th century. It stated that an individual's dermatoglyphics will remain unchanged throughout his/her lifetime. It is said to be unique for each person and is not same even in monozygotic twins. Thus, studying them can determine the number of parameters which could be helpful in diagnosing and in treatment of examined individuals. Hence, it can be considered to be an important tool in various situations such as assessing the genetic trait, evaluation of children with suspected genetic disorders, and also in forensics.[10]

Types of Fingerprint Patterns

In 1892, Sir Francis Galton classified the basic characteristic pattern of fingerprint.[11] He classified mainly into three types: Arches, loops, and whorls. This was mainly based on the degree of curvature of the ridges.[1,11] Arches may be simple or tented, loops may be described as radial or ulnar, and whorls may be spirals or double loop.[1]

Arches

In this type of pattern, the ridges run or flow from one side of the pattern to the other with a slight rise at the center of the pattern without making any backward turn or twist.[1,12]

Loops

In this type, the ridges start from one side of the pattern, continue till the center, and then at least one ridge tends to turn backward around the core. Depending on the direction, they face these are classified as radial or ulnar.[1,12]

Whorls

In this type, the ridges start from one side of the pattern and complete one complete circle [Figure 1].[1,12]

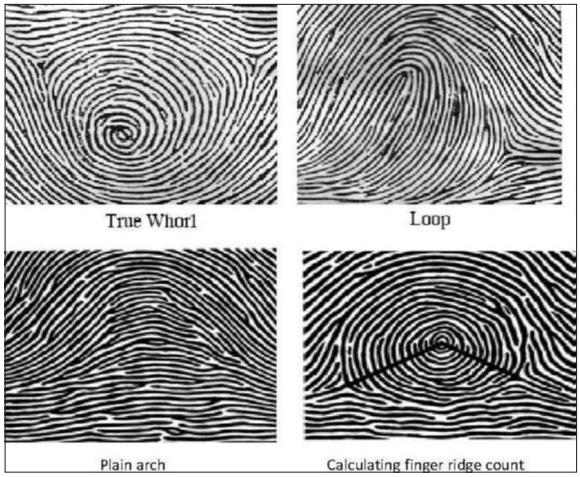

Figure 1: Dermatoglyphic patterns: whorl, loop, and arch

At this point, it is important to know that:[12,13]

- Core: Forms the approximate center of the pattern
- Triradius: Formed due to confluence of three ridge systems.

There is no triradius in a simple arch pattern, one in a loop, and two or more in a whorl.[1]

- Total finger ridge count: A ridge count is determined by drawing a straight line from the core of the pattern to its triradius and counting the number of ridges touched or crossed by the line[1]
- Atd angle: This is estimated in a palm print. This is measured as the angle formed by joining the lines drawn from the digital triradius (a), to the axial triradius (t), and from this triradius to the digital triradius (d) [Figure 2].[14]

Methods of Recording Dermatoglyphics

Ink method

This is one of the most widely used methods. The various required equipments are printer's ink, a roller, a glass or metal inking slab, a sponge rubber, and good quality paper.[15,16]

Faurot inkless method

In this method, commercially available patented solution and specially treated, sensitized paper are used.[15]

Photographic method

It is based on the total internal reflection.[16]

Transparent adhesive tape method

In this method, a dry coloring pigment is applied to the skin and is lifted off with the transparent adhesive tape.[17]

Special methods

This helps in studying the correlation between the epidermal patterns and the underlying bone structures.[17]

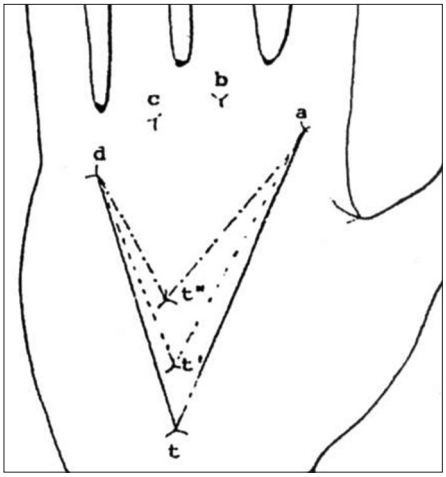

Figure 2: Atd angle

Numerical methods

In this method, an algorithm of images of fingerprints is used.[17]

Dermatoglyphics in Orthodontics

In dentistry, review of literature shows a meager number of studies to establish a relationship between finger patterns and the disease process.

Kharbanda *et al*.,[18] in 1982, conducted a study on 25 North Indian males by with true mandibular prognathism which was confirmed with cephalometric Down's analysis. They compared this with the dermatoglyphic findings of individuals with Class I occlusion and craniofacial pattern. They stated in their study that the craniofacial skeletal Class III pattern was associated with an increase in arches and ulnar loops at the expense of whorls on all digits except digit II, there was an increased frequency of whorls and radial loops, and an increased frequency of carpel loops on interdigital area of palms.

In 1986, Kanematsu *et al*.[19] studied dermatoglyphic patterns in 311 children who were diagnosed with cleft lip, alveolus, and palate without any external malformations. They compared these patterns with those of the normal children. They found that the etiology of the abnormalities in the appearance of finger and palm prints was influenced by genetic factors during the embryonic period.

Lakshmi[20] conducted a study in 1989, where they studied the fingerprint patterns of twenty patients with hypodontia and compared with those of twenty normal males and 20 normal females. The frequency of whorls and arch patterns was more compared to that of the loop patterns in individuals with hypodontia as compared to normal females. An increased frequency of whorls and decreased frequency of loops and arch patterns were found as compared to normal males.

In 1997, the study was conducted by Reddy *et al*.[21] where dermatoglyphics was used to predict and compare Class I, Class II division 1, division 2, and Class III malocclusion. The study revealed that increased frequency of arches and ulnar loops and decreased frequency of whorls were associated with craniofacial Class II division 1, division 2. Class III malocclusion was associated with an increased frequency of arches and radial loops with decreased frequency of ulnar loops.

A study was undertaken by Trehan *et al*.[22] in 2000 to analyze and compare the dermatoglyphic patterns of patients with normal occlusion and various classes of malocclusion. The study showed an association of increased frequency of radical loops and arches with Class I and Class II division 1 malocclusions. Furthermore, an association of an increased frequency of whorls with Class I and Class III malocclusion was seen when compared to normal occlusion.

A study was conducted by Reddy *et al*.[4] in 2013 in an attempt to compare the dermatoglyphic patterns of individuals with normal occlusion and various classes of malocclusions. Particular predictive occurrence of patterns was not found to be associated with each group, but some of the fingerprint patterns such as twinned loops were seen with an increased frequency in Class II malocclusions and radial loops were absent in Class III malocclusions.

Rajput *et al*.[23] conducted a pilot study on 24 patients with ten Class I, eight Class II, and six Class III malocclusion. The dermatoglyphic patterns collected were evaluated quantitatively and qualitatively. The study revealed that there was an increased frequency of whorls in Class I malocclusion patients and an increased frequency of loops in Class II and Class III malocclusion patients.

Conclusion

Dermatoglyphics is an upcoming area of interest. Its use as a marker for various conditions is still in its initial stages. From the above-mentioned studies, it can be said that there is an association between various malocclusions and different dermatoglyphic patterns. However, whether dermatoglyphics alone can be considered as a factor to diagnose malocclusion is still questionable. More studies with larger sample size involving various ethnic and racial backgrounds are required to establish this. If dermatoglyphics are proven to be an acceptable diagnostic tool, it can help in identifying malocclusion at an early age and thus help in preventive and interceptive treatment.

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Conflicts of interest

There are no conflicts of interest.

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