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Review Article

Role of Dermatoglyphics in Dental Malocclusion. A Review Literature

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Abstract

Dermatoglyphics is the study of dermal ridge configurations on palms, fingers, soles and toes of an individual. Dermal ridges and craniofacial structures are both developed during 6 to 7th week of intra-uterine life. These patterns are individually unique, permanent and remain unchanged throughout life. Dermatoglyphics has been an important and useful tool for foretelling the future and in criminal investigations. These patterns help in understanding basic questions in medicine, genetics, and evolution. Malocclusion is one of the most commonly reported oral conditions and is widely prevalent. There are sparse reports of dermatoglyphic findings in children with malocclusion and some studies have been reported regarding the same. This review focuses briefly on the spectrum of dermatoglyphic history, types of pattern and its relation with dental malocclusion.

Keywords: Dermatoglyphics; Fingerprint Patterns; Dental Malocclusion

Introduction

Many years ago, Aristotle recognizes the potential of the hand. He defined it as an important organ [1]. The study of the hands dates back to several centuries. The features of the hands have fascinated people from all walks of life- be it doctors or scholars. The lines and patterns of hands have been used by palmists to predict the future and in science as a definitive tool for the identification of criminals. The term dermatoglyphics, (derma refers to skin and glyphic refers to carving), as defined by Sir Cummins (Cummins and Midlo 1961) [2] refers to the study of naturally occurring dermal patterns in the surface of the hands and feet. These dermal patterns remain constant throughout life and are not changed by disease or age except in overall size. Fingerprints are unique for each person; even monozygotic twins do not have the same pattern [3,4]. Dermal ridges are usually developed by the sixth week of gestation and these ridges reach their maximum size between the twelfth and thirteenth weeks. They start to appear during the 12th week of intrauterine life and are completed by the 24th week of intrauterine life, thereafter they remain constant [3,5,6].

History

Study of papillary ridges of the hands and feet is attributed as the beginning with the work of Joannes Evangelista Purkinje in 1823 [7]. In India, William Herschel (1858) was the first to experiment with fingerprints [8]. Sir Francis Galton (1892) [9] did extensive research on the importance of skin ridge patterns, demonstrate the hereditary significance of fingerprints and the biological variations of different fingerprint patterns amongst different racial groups. In 1892, he published the book "Fingerprints which was later followed by the book by Sir Edward Henry (1893) [10]. The classification and uses of fingerprints which is now the basis for most of the other classification systems.

Cummins and Midlo [2] (1926) were the first to coin the term 'Dermatoglyphics' (from two Greek words- derma=skin, glyphe=carving). It is the science and art of the study of surface markings /patterns of ridges on the skin of the fingers, palm, toes, and soles. The main thrust of their research was on Down's syndrome and the characteristic hand formations. They showed

that the hand with significant dermatoglyphic configurations would assist the identification of Mongolism in the new-born child. Charles Midlo M D (1929) together with others published one of the most widely referred books "Fingerprints, Palms and soles", a bible in the field of Dermatoglyphics [11].

Types of finger prints

The curved lines in a fingerprint constitute the Ridge. The approximate centre of a pattern is known as a Core. The meeting point of three ridges that form angles of approximately 120 degrees with one another is known as the Triradial point/ Delta. The numerous ridges that enclose the pattern constitute the skeletal framework of the pattern and are called Radiants [12]. Many classifications have been proposed by several investigators to classify these patterns. The most commonly used classification today was given by Sir Francis Galton (1892), who classified fingertip pattern configurations on the distal phalanges into three broad groups- arches, whorls, and loop [13,14]. The arches can be further classified into simple and tented, the loops can be twinned, radial or ulnar and the whorls are further subdivided into the spiral, symmetrical, and double loop.

Ridges are often counted between two digital triradial. a, b, c and d are alphabets ascribed to the triradial point located at the base of the index, middle, ring and little finger respectively. The ridge count most frequently obtained is between triradial a and b, and is referred to as the a-b ridge count. Sometimes, ridge counting is done along a straight line between one tradial point to the core of the pattern. The ridges falling on the core and triradial point are not included in the count. This count is referred to as Total Ridge Count (TRC) [9,14].

Methods of printing

There are a number of methods used for palm printing which are inexpensive and rapid [15].

Ink method

This method is most widely used. The equipment consists of printer's ink, a glass or metal inking slab, a roller, a sponge rubber, and good quality paper preferably with a slightly glazed surface [16,17].

Faurot inkless method

This method is commercially available as a patented solution and specially treated sensitized paper is used in this method [16].

Transparent adhesive tape method

In this method, the print is produced by applying a dry coloring pigment to the skin and lifting it off with the transparent adhesive tape. The coloring agent may be colored chalk, dust, India ink, standard ink, carbon paper, graphite stick or powdered graphite, common oil pastel crayon, etc., The advantage of this method is printing are clear and not smudged and can be preserved for a long period of time.

Photographic method

This method is based on the principles of total internal reflection which occurs when an object is pressed against a prism. The magnified image is photographed by a Polaroid camera [17].

Numerical method

Algorithm of synthesis of images of fingerprints is used and minutiae are created. The model allows looking at digital coding of a fingerprint and also enables mathematical cataloging of minutiae and types of patterns.

Special methods

It allows the study of the correlation between the epidermal patterns and the underlying bone structures (radiodermatography), a study of sweat pores (hygrophotography) or study of the spatial shape of the ridged skin areas, for example in primates (plastic mold method).

Dermatoglyphics in malocclusion

Malocclusion is one of the most common oral conditions. Angle (Edward Angle 1899) [18] classified malocclusion into three types- Class I, II, III. In Class, I malocclusion, mesiobuccal cusp of the upper first permanent molar occludes with the mesiobuccal groove of the lower first molar, but the line of occlusion is incorrect because of malposed teeth, rotations or other discrepancies. In Class II Malocclusion, mesiobuccal cusp of the lower first permanent molar occludes distal to the class I position. Class III Malocclusion involves mesiobuccal cusp of the lower first molar occluding mesial to the class I position. Early diagnosis and correction of deviated growth patterns of the jaws have been among the main goals of orthodontics for many years. Genetic factors are one of the main etiologic factors of malocclusion. Since the late diagnosis of skeletal malocclusions leads patients to orthognathic surgery, many studies have been undertaken to assess the possible association between fingerprint patterns and different types of dental malocclusion.

Kharbanda., *et al* [19]. 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 the interdigital area of palms.

In 1997, the study was conducted by Reddy., *et al*. [20] where dermatoglyphics was used to predict and compare Class I, Class II division 1, division 2, and Class III malocclusion. Subjects were divided into 3 malocclusion groups, in the ages of 12 - 14 years. The dermatoglyphic findings showed that the Class II, Div. 1, div.2 pattern was found with increased frequency of arches and ulnar loops and decreased the frequency of whorls, whereas, in Class III, there was an increased frequency of arches and radial loops with decreased frequency of ulnar loops. 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.

In the study done by Trehan., *et al*. in 2001 [21], correlating the dermatoglyphic patterns and malocclusion among 60 subjects, it was found that the frequency of the whorl pattern was more in number in Class 1 and 3 and the frequency of radial loop and arches were more in number in Class 1 and 2 division 1 cases.

Tikare S., *et al*. in 2010 [22] assessed the relationship between fingerprints and malocclusion among a group of randomly school children aged 12 - 16 years. Fingerprints were registered using duplicating ink and class of malocclusion was clinically assessed using Angle's classification. The study concluded that dermatoglyphics might be a significant marker for malocclusion and further studies are needed to elucidate an association between fingerprint patterns and malocclusion.

A study was conducted by Reddy., *et al*. in 2013 [23] in an attempt to compare the dermatoglyphic patterns of individuals with normal occlusion and various classes of malocclusions. The 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.

According to a study conducted by Jindal G et al in 2015 [24], increased tendencies toward high frequencies of whorls in subjects with class II malocclusion and high frequencies of plain arches in subjects with class III malocclusion plain arches. Ulnar loop pattern was found increased in subjects with all types of malocclusion. Significant differences in atd angle and TRC were also observed among malocclusion types. Asymmetry scores did not differ significantly. Finger and palm prints were collected, and fingertip pattern frequencies, total ridge counts (TRCs), and atd angles were calculated. Dermatoglyphic parameters were assessed and asymmetry analysis was done in subjects with different occlusion patterns.

In 2016 Eslami N., *et al*. [25] compared the characteristics of dermatoglyphic of different malocclusions. Dermal ridges and craniofacial structures develop from the identical embryonic tissues during the same. The subjects were divided into three groups according to Angle's classification. The total ridge counts of each finger (TRC), atd angles, a - b ridge counts, and types of fingerprint patterns. Right, and left-hand asymmetry scores were calculated. Slight differences in dermatoglyphic peculiarities of different skeletal malocclusions were found, however, most of the palm and fingerprint characteristics failed to indicate any significant differences. Significant values were determined between Class I and III patients in terms of left a-b ridge count ($p = 0.049$). Loop was the most frequent pattern in the groups, whereas the arch pattern occurred with the lowest frequency.

Divya., *et al*. 2016 [26] did a study which was designed to analyse the palmar dermatoglyphic patterns in patients with class I and class II malocclusion classified based on Downs and Steiner's analysis and to confirm genetic contribution in the ethology of malocclusion. The pattern distribution was significantly different between both the groups. Increased frequency of whorls was found both in right and left hands in skeletal class I pattern group. Increased frequency of ulnar loops was found in the right hand of skeletal class II pattern group which was in agreement with the study done by Sumedha., *et al*. and Reddy., *et al*. Significantly higher mean ridges were found in class I malocclusion compared to class

II malocclusion. Statistically significant association (p>0.05) was found in the 4th finger of the right hand wherein more lunar loops were found in class II malocclusion.

Charles A., *et al*. 2018 [27] studied to evaluate and compare the dermatoglyphic pattern with various skeletal malocclusions. The study was carried out on outpatients reported with an age group of 18 - 20 years divided into four groups as follows: Group: I - 10 (Class I occlusion), Group: II - 10 (skeletal Class I malocclusion), Group: III - 10 (skeletal Class II malocclusion), and Group: IV - 10 (skeletal Class III malocclusion). The fingerprints were recorded using scanner exclusively designed for diagnostic purpose of the study. Dynamic role of life is performed by Skin, the largest human organ. The ectodermal skin layers found on the palm with intricate lines are stable throughout the life. They have grabbed scientific attention. Disturbances of any type during their development might possibly have the likelihood of a subject developing malocclusion. They concluded that dermatoglyphic pattern remains constant throughout life and it can be used as a non-invasive aid in determining the development of malocclusion at a very early age.

Conclusion

Dermatoglyphics can prove to be overwhelmingly helpful for the easy, accessible, non-invasive and identification of groups at risk of developing malocclusion and for its timely prevention.

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