Dermatoglyphics and Rugoscopy: A Diagnostic Tool for Periodontal disease or just a Forensic Aid?

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Abstract: Background: Forensic sciences, a well-established branch in the field of medicine and dentistry always aids in uncovering individual personality by different strategies. Each person has unique set of fingerprints and palatal rugae patterns which is characteristic and may be used to identify them. Periodontal disease initiation and propagation is through an imbalance of the commensal oral micro biota but can also occur due to environmental factors as well as due to genetic susceptibility of the individual. Aim: To determine the uniqueness of fingerprint pattern and palatal rugae pattern in Greater Noida population and to assess the relationship between finger prints, rugae pattern and periodontal diseases among males and females. Materials & Methods: 120 patients with age group between 20-50 years were equally divided into 4 groups of 30 patients each. Groups were characterised based on diagnosis of Group 1: periodontally health group, Group 2: gingivitis, Group 3: chronic periodontitis, Group 4: aggressive periodontitis. The fingerprint patterns of the participants were recorded with a rolling impression technique using duplicating ink on A4 sheet paper. Maxillary impressions cast in dental stone were made. Results: Among the fingerprint pattern arch pattern was found to be more common among Group 1, radial pattern among group 2, whorl pattern among group 4 and ulnar pattern among group 4. The most prevalent rugae shape among group 1 was point, in group 2 was sinuous and among group 3 was sinuous and among group 4 was angle. Mean rugae pattern was more prevalent in group 1 as compared to other groups. Conclusion: Dermatoglyphics and rugae pattern may act as prognostic and diagnostic tools for early prevention & intervention of periodontal diseases.[Abrol S A Natl J Integr Res Med, 2020; 11(2):51-59]

Key Words: Forensic science, Dermatoglyphics, Palatal Rugae, Periodontal disease

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Introduction: Periodontal diseases have multi-factorial pathogenesis caused by specific periopathogenic microorganisms and their metabolic products but can also occur due to environmental factors as well as due to genetic susceptibility of the individual. There is some literature pointing toward the genetic etiology of periodontal disease.

Twin study by Michalowicz et al. 1991 studied dizygous twins reared together (dizygous T) and apart (dizygous A) and monozygous twins reared together (monozygous T) and apart (monozygous A) Concluded that genetics seems to form the basis for the familial aggregation of periodontitis. Hassell & Harris 1995 - German studies of familial nature within the early 20th century have shown aggregation of chronic forms of periodontitis in families which strongly suggests genetic predisposition.[1]

Human distinguishing proof, which is a backbone of progress, has gotten a basic in all parts of human relationship both as social and lawful levels. For recognizing an individual, different techniques have been proposed.[2]

Dermatoglyphics comes from two Greek words (Derma= skin;Glyphe=carve). The term was coined by Cummins and Midlo in 1926, and Harold Cummins is considered to be the father of dermatoglyphic. Dermatoglyphs are the patterns of the skin ridges on pads of fingers which constitutes a person's fingerprints.[1] These are also present on palms, soles, and toes. Each person has a unique set of fingerprints which helps to identify them. The development of dermatoglyphic patterns begins with the appearance of fetal pads in the 6th week of gestation and ends with the appearance of finished patterns on the surface of the skin in the 24th week of gestation. These patterns once developed are unaffected by the environment, and this explains their unique role, as a marker for individual identification.[3]

The basic patterns are whorls, arches and loops, however the size, spacing and shape give them their distinct personality. These factors seem to be influenced by genetic factors. Other than genetic factors the skin ridges are also influenced by environment in the womb. Thus, identical twins who have same DNA have different

fingerprints.[4] The ridged skin is considered to be a sensitive indicator of intrauterine dental anomalies because it originates from the same ectodermal layer as the teeth. Hence when an intrauterine dental damage occurs, a tooth anomaly can be expected.[1,3,4]

Disturbance in the ectodermal layer may manifest itself in both the development of skin ridges and the tooth with its periodontium and create a link between dermatoglyphics and anomalies of tooth and periodontium.[3]

Filho et al[5] in 2009 stated that the rugae pattern is as unique to humans as are his or her fingerprints and it retain its shape throughout life, hence can be useful for forensic identification. Allen[6] in 1889 was the one who first used palatal rugae for personal identification.

The anatomical position of the rugae inside the mouth-surrounded by cheeks, tongue, lips, buccal pad of fat, teeth & bone—keeps them well shielded from trauma & high temperatures. Palatal rugae are transversely running crests which are formed by the mucosa of the hard palate except where an ossified base can be distinguished and formed in the third month in utero from the hard connective tissue covering bone. The pattern orientation is formed by about 12th to 14th week of prenatal life.[7]

Literature search revealed no study in relation to fingerprints and rugae pattern together in periodontal patients. Hence, the aim of the present study was to determine the uniqueness of fingerprint pattern and palatal rugae pattern in Greater Noida population and to assess the relationship between finger prints, rugae pattern and periodontal diseases among males and females.

Material and Methods: Study Design: 120 patients (60 males and 60 females) with age group between 20-50 years reporting to the Out Patient Department of Periodontics were equally divided into 4 groups of 30 patients each. Groups were characterised based on diagnosis of Group 1: Periodontally healthy group, Group 2: Gingivitis, Group 3: Chronic periodontitis, Group 4: Aggressive periodontitis.

Exclusion Criteria: Absence of a digit. Patient with conditions/abnormities that did not allow accurate recording of finger prints or rugae. History of surgery of the palate or trauma. Smokers. Pregnant females.On antibiotics or other medications.

Figure 1: Brief Study Outline

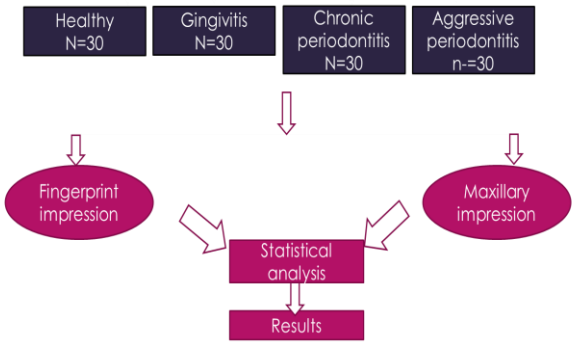


Table 1.Patients Were Categorized Into Chronic And Aggressive Periodontitis According To AAP Classification 2017-18

	Slight (Mild)	Moderate	Severe (Advanced)
Probing Depth	>3≤5 mm	≥5mm &<7mm	≥7mm
Bleeding On Probing	Yes	Yes	Yes
Radiographic Bone Loss	Up to 15% of root length or ≥2 mm & ≤3mm	16% to 30% or 3 mm & ≤5mm	>30% or >5 mm
Clinical Attachment Loss	1 to 2 mm	3 to 4 mm	≥5mm

Table 2.Diagnostic Criteria To Distinguish Chronic And Aggressive Periodontitis9

Criterion	Aggressive Periodontitis	Chronic Periodontitis
Rate Of Progression	Rapid	Slow but rapid episodes are possible
Familial Aggregation	Typical	Can be present when families share imperfect oral hygiene habits
Presence Of Etiological Factors Like Plaque,	Often Minimal	Often commensurate with observed periodontal

Calculus		destruction
Age	Often in young patients i.e.<35 years but can be found in all age groups	Often in older patients but can be found in all age groups
Clinical Inflammation Signs	Sometimes lacking	Commensurate with number of etiological factors present

Periodontal status was recorded using plaque index, gingival index and bleeding on probing.

Dermatoglyphic Pattern Recording: The ink and roller method: Reported by Cummins and Midlo10, utilises printer's ink commonly known as duplicating ink. to determine fingerprint patterns of the participants. All the participants were asked to clean their hands to remove impurities. The ink smeared hands are then transferred on white A4 sheet and studied with the help of magnifying lens. Fingerprint patterns were categorized as per the criteria of Sir Richard Henry11 into three forms as follows:

- Whorls (ridges make a turn through one complete circuit),
- Loops (ridges run from one side to another with a backwards turn)
  a. Radial loop- the pattern area recurves and exit from the thumb side
  b. Ulnar: the pattern area recurves and exit from the little finger side.
- Arches (ridges run from one side to another making no backward turn).

Figure 2: Fingerprint Patterns As Per The Criteria Of Sir Richard Henry[11]

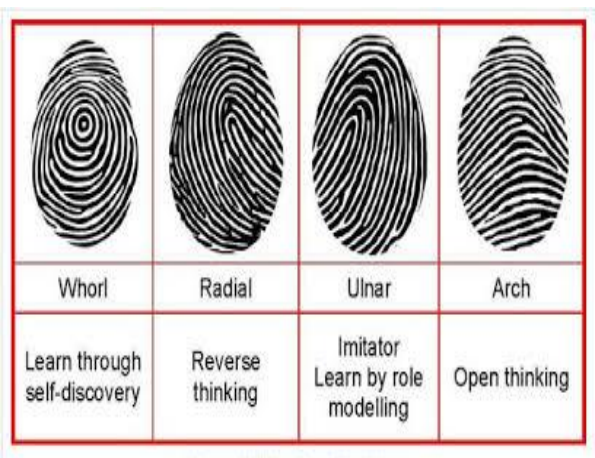
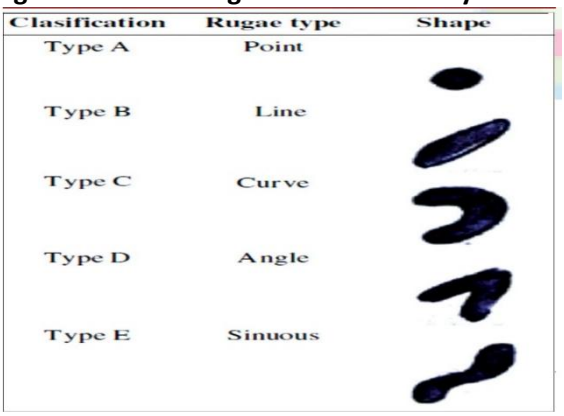


Figure 3: Fingerprint Patterns Of The Participants Recorded With Rolling Impression Technique Using Duplicating Ink On A4 Sheet

Rugae Pattern Determination: Alginate impressions of the maxillary arch of the participants were made in stock trays and poured in Type III dental stone according to the manufacturer's instructions. The rugae pattern was seen as elevated impressions and then marked on these casts using lead pencil.

The rugae pattern was classified according to Trobo classification[12] for shape analysis as follows:

Figure 4: Palatal Rugae Classification By Trobo12



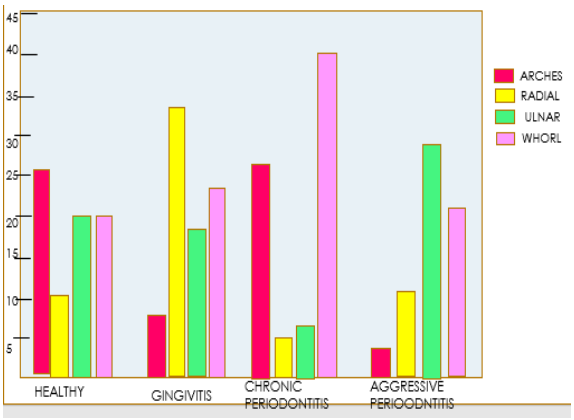
This was double blinded study and the data thus obtained were subjected to statistical analysis.

Statistical Analysis: Data analysis was performed using tables in Microsoft Excel 2010 and SPSS version 24. The difference in the mean parameter values across groups was tested for statistical significance using One-way ANOVA and comparisons of dermatoglyphic pattern and rugae pattern across groups was performed using Chi-square test. P value of less than 0.05 was considered to be statistically significant.

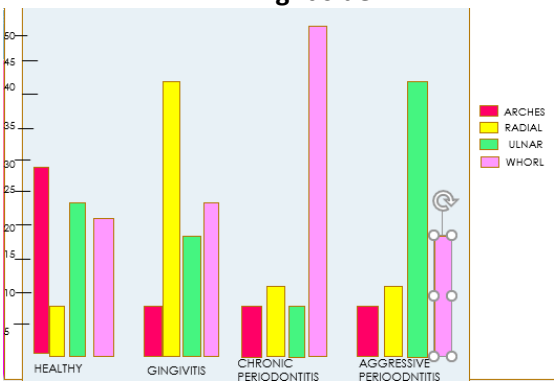
Results: The present study assessment revealed an increased frequency of whorl pattern of fingerprints in patients with Chronic periodontitis in both right and left hands of both males and females. Frequency of radial loop was found to be increased among patients with gingivitis in both left and right hands. There was increased frequency of sinuous pattern of rugae in patients with gingivitis and chronic periodontitis. The most prevalent palatal rugae shape in patients with aggressive periodontitis was found to be angle. Our study revealed that mean rugae number was more in healthy followed by gingivitis, chronic periodontitis and least in patients with aggressive periodontitis.

Graph 1: Frequency Of Different Fingerprint Pattern Seen Among Males

A: Left side

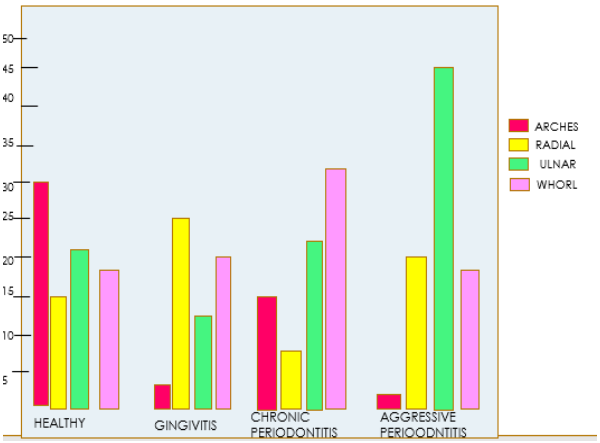


B: Right side

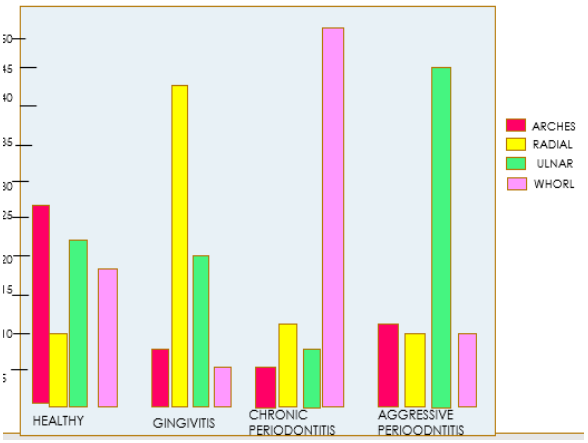


Graph 2: Fequency Of Different Fingerprint Pattern Seen Among Females

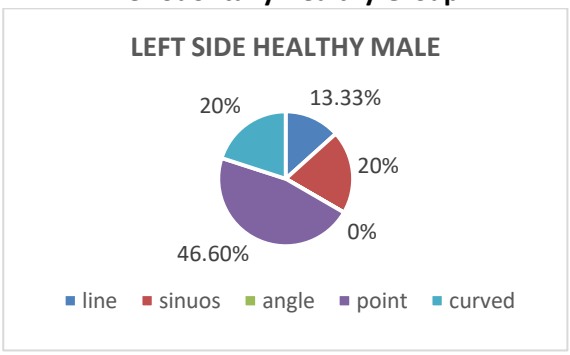
A: Left side

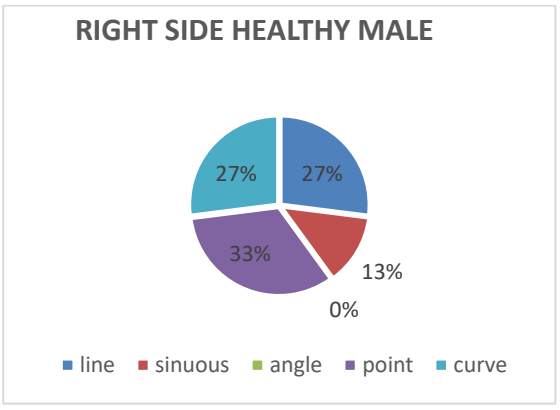


B: Right side

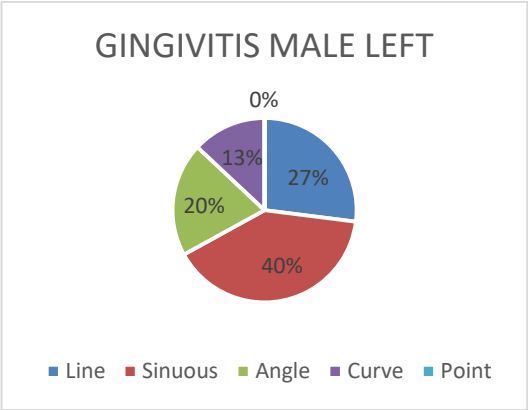


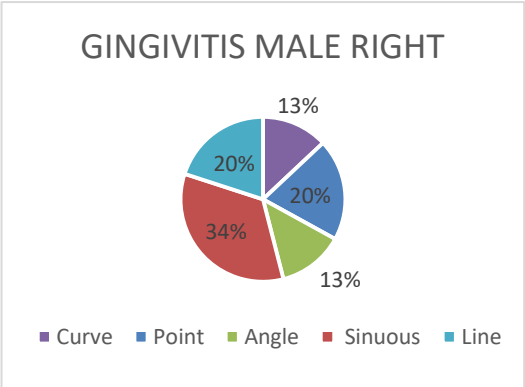
Graph 3: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Males In Periodontally Healthy Group



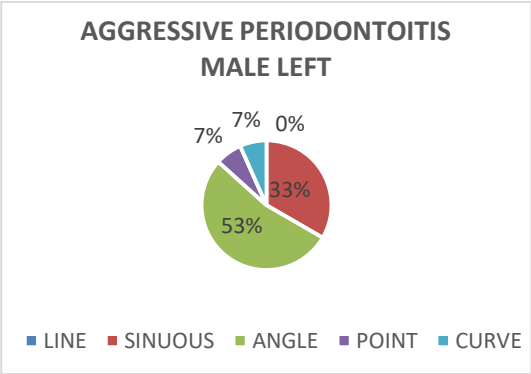


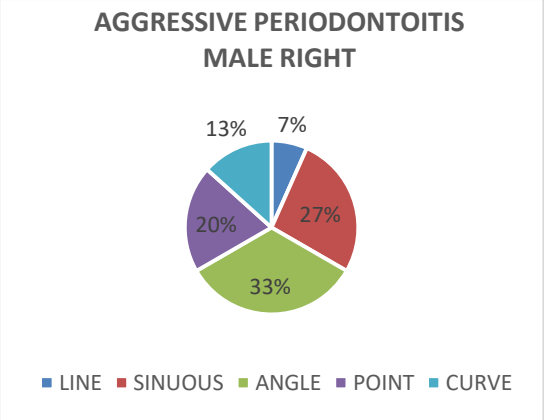
Graph 4: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Males In Gingivitis Group



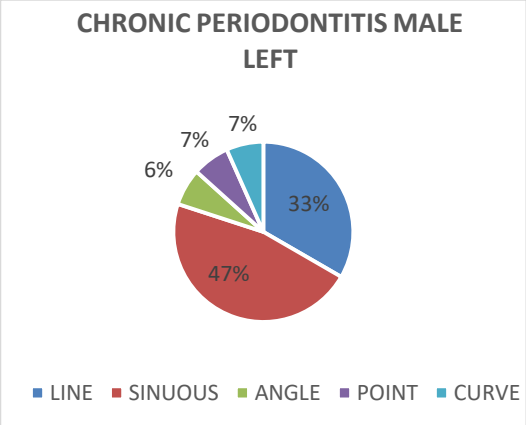


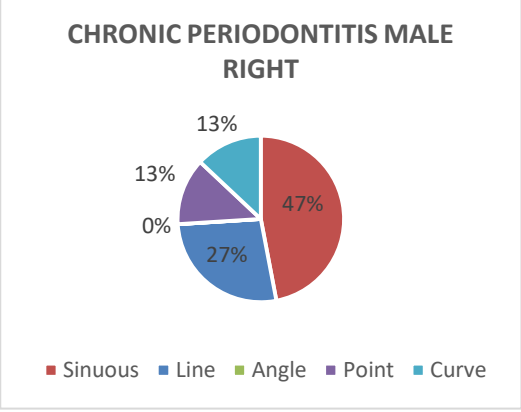
Graph 5: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Males In Aggressive Periodontitis Group



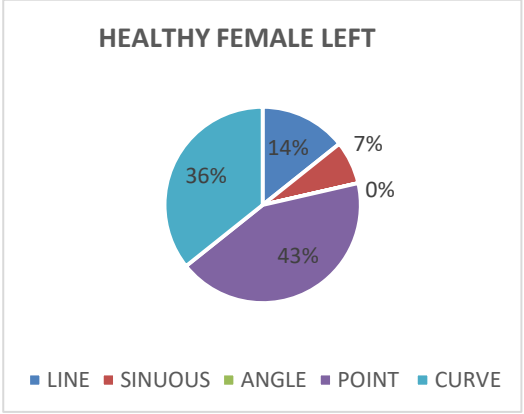


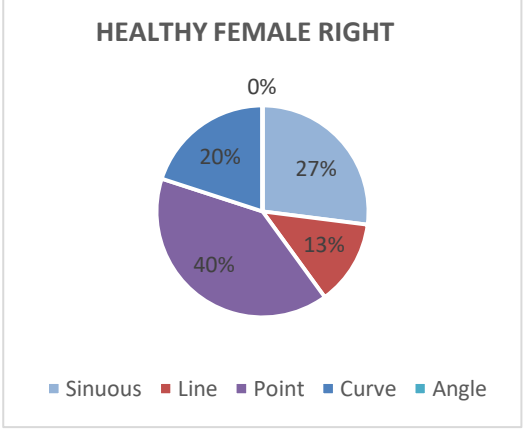
Graph 3: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Males In Chronic Periodontitis Group



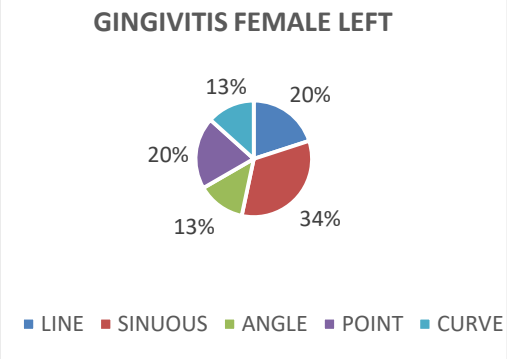


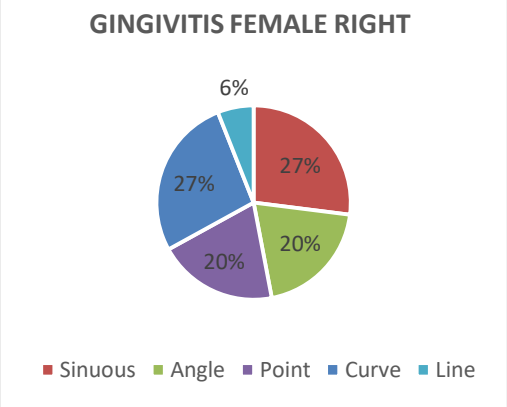
Graph 6: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Females In Periodontally Healthy Group



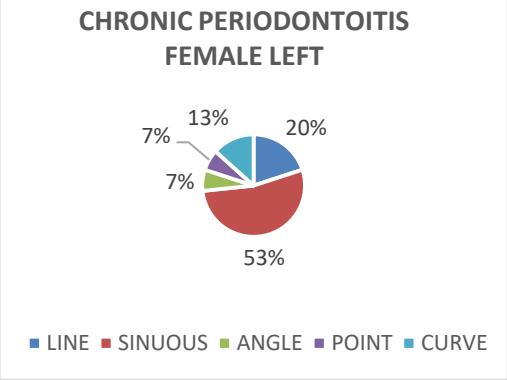


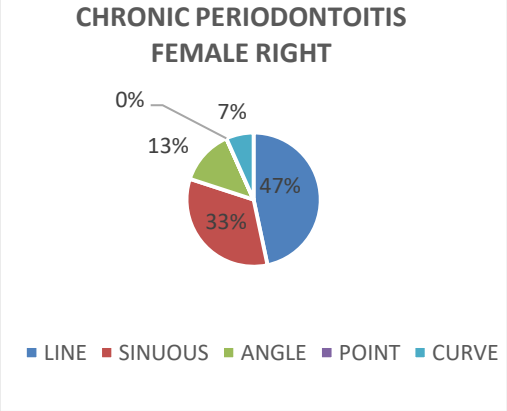
Graph 7: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Females In Gingivitis Group



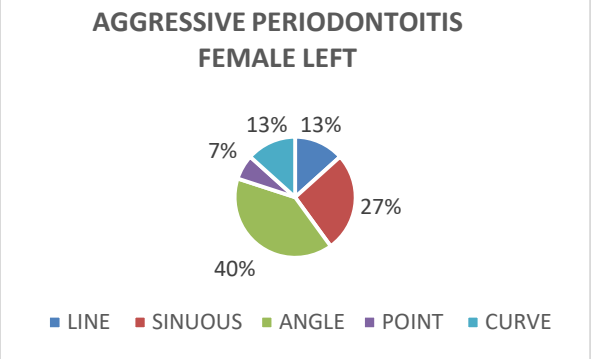


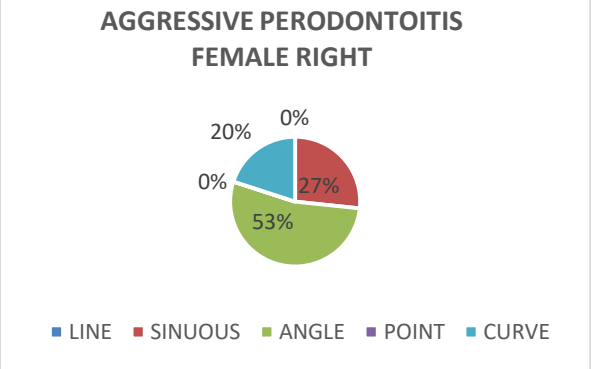
Graph 8: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Females In Chronic Periodontitis Group



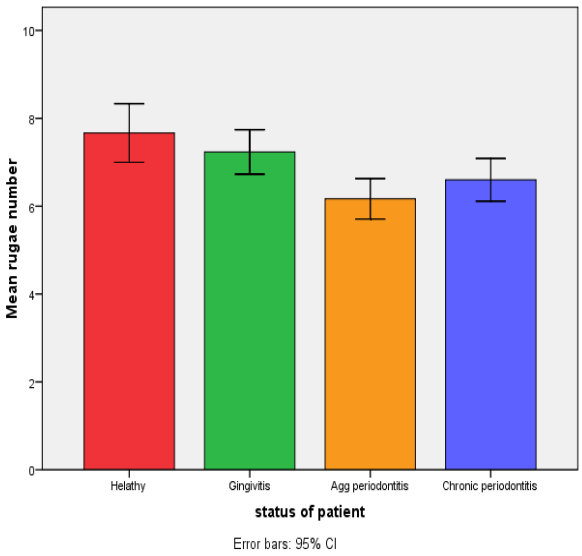


Graph 9: Frequency Percentage Of Different Palatal Rugae Pattern Seen Among Females In Aggressive Periodontitis Group





Graph 10: Mean Rugae Number Among 4 Groups



Discussion: Fingerprint and rugae pattern analysis for personal identification, through decades of scientific research has come to be recognized as a powerful tool in the diagnosis of psychological, medical and genetic conditions.[3]

As the fingerprint patterns are unique to all individuals and remain unchanged over the lifetime, they can be used for the study of

chirology. Dermatoglyphic and rugae patterns can be recorded rapidly with ease, with minimum equipment. It is an economical and non-invasive method without causing any trauma to the patient. Data collected can be preserved for long duration for future references.[4]

Rugae shape analyses is a subjective method, but it is as compared to other methods are easy to record and also there is no need of complex instrumentation. Rugae shape is better suited which is a discrete variable than the length which is a continuous variable. So, in our study we used shape and number analysis. [12]

Periodontitis have multifactorial etiology such as smoking, poor oral hygiene, stress and immunosuppression, familial influence and gene polymorphism.

In the present study, there was increased frequency of arches pattern of fingerprint.
The present study assessment revealed an increased frequency of whorl pattern of fingerprints in patients with Chronic periodontitis in both right and left hands of both males and females which is in accordance to the study conducted by Atasu et al[13], Babitha et al[14] and Vaidya P et al[4] who concluded that there were more whorls and less arches in both left and right hands in patients with chronic periodontitis. The results were dissimilar to the study conducted by Kochhar et al who found no significant relation of whorl pattern with chronic periodontitis.

Harikrishna et al[15] 2017 described an increased frequency of ulnar loops on all fingers of patients with aggressive periodontitis. These results are similar with the present study in which among the loop pattern, there was increased frequency of ulnar loop among both males and females in both left and right hands with aggressive periodontitis.

Devishree et al[16] compared the dermatoglyphic features in aggressive periodontitis patients and periodontally healthy individuals and found significantly increased frequency of ulnar loop on all fingers of patients with aggressive periodontitis.

In the present study frequency of radial loop was found to be increased among patients with gingivitis in both left and right hands which is in accordance to the study done by Chatterjee et al (2017)[17] in which there was increased frequency of radial loops in Gingivitis and higher frequency of ulnar loop in Chronic periodontitis patients.

Our study revealed increased frequency of sinuous pattern of rugae in patients with gingivitis and chronic periodontitis. This is in accordance to the study conducted by Hermosilla et al[12] and Jindal V et al 2016[18].

The most prevalent palatal rugae shape in patients with aggressive periodontitis was found to be angle which is in accordance to the study done by Jindal et al[18] and point pattern of rugae in periodontally healthy patients.

Our study revealed that mean rugae number was more in healthy followed by gingivitis, chronic periodontitis and least in patients with aggressive periodontitis. This is in accordance to the study conducted by Sindgi et al[19] 2018 who found that number of rugae was more in normal healthy individuals as compared to those with periodontitis. Circular pattern and wavy pattern was more prevalent in healthy and periodontitis respectively.

Our study revealed that males had more number of rugae as compared to females which is parallel to the study conducted by Sindgi et al[19] 2018 and Osato et al 1994[20].

Our study correlates the studies done by Kapali et al[21] according to which denture wear, tooth malposition and palatal pathology could cause alterations in rugae pattern. Similarly, Peavy and Kendrick also stated that tooth extraction may sometimes slightly change the position of palatal rugae adjacent to the alveolar arch. Limson and Jullian 2004[22], stated that extractions can produce a local effect on the direction of the palatal rugae. Hence, may be change in shape in rugae pattern in diseases conditions such as aggressive periodontitis and chronic periodontitis was the cause of it.

According to El-Fotoh MM (1998)[23], palatal rugae pattern are sufficiently characteristic to discriminate between individuals. It was stated that rugae pattern was absolutely unique to an individual and could be used for identification (Lysell L 1995)[24].but this was contraindicated to our study as the rugae pattern may be changed after the disease progression as chronic periodontitis and aggressive periodontitis were

inflammatory conditions and may damage the rugae pattern identification.

Dematoglyphics and rugoscopy could be used together with the other diagnostic methods like clinical and radiographical investigations in identifying patients with periodontal disease. Early detection can lead to early prevention in young age. Thus, the participants of the healthy group that showed similar frequency of dermatoglyphic patterns as that of patients with periodontal disease can be considered susceptible to the disease in the future and can take preventive measures as prevention is better that cure.

Further studies with larger sample size should be done to make dermatoglyphics and ruguscopy reliable diagnostic and screening tool and detection of the patterns could be subjective to manual errors so the fingerprint analysis with the help of automated fingerprint identification system in large scale would overcome such limitation.

Conclusion: This short term study just adds a cornerstone to the existing research work. It's not the end but an opening to a new arena, where in near future detecting these diseases at an early stage will be possible using dermatoglyphics and rugoscopy as a diagnostic and prognostic tool. This study would be helpful in formulating counselling messages based on dermatoglyphic and rugae pattern prevalent among young generation and their possible stimulation to determine the young people's likelihood to develop periodontal diseases in their later age.

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