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Evaluation of the Association between Dermatoglyphic Patterns and Dental Malocclusion. – A Clinico - Demographic Study.

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Abstract

Objectives: To evaluate the association between dermatoglyphic patterns and different types of dental malocclusion.

Materials & methods: A sample of 200 subjects with all permanent teeth erupted up to the second molar and in the age range of 15-25 years of both genders, were divided into 4 groups of 50 each (25 males, 25 females).

Group 1: (control group): Subjects with Angle's Class I Ideal molar relationship with good occlusion.

Group 2:(Case group) : Subjects with Angle's Class I molar relationship with malocclusion.

Group 3: (Case group)**:** Subjects with Angle's Class II (No subdivision) molar relationship with malocclusion.

Group 4: (Case group)**:** Subjects with Angle's Class III molar relationship with malocclusion. Malocclusion was assessed by clinical examination (Angles Classification). Dermatoglyphic patterns of the patients were recorded for all 10 digits of the hand using Green Bit Dactyscan 84 C fingerprint reader and categorized into the arch, loops, and whorl. The Total Finger Fridge Count (TFRC) is indicative of the pattern size. The TFRC represents the sum of the ridge counts of all ten fingers.

Result: Data pertaining to the fingerprints were obtained and entered into an excel spreadsheet and analyzed by using chi-square tests. There was an increased distribution of arch pattern in Class III malocclusion ($p<0.05$) .The frequency distribution of radial loops in Class III malocclusion outnumbered ideal occlusion ($p<0.05$) followed by Class II and then Class I malocclusion .Total ridge count showed that the ridge count could be considered for predicting class II and class I malocclusion ($p<0.05$)

Conclusion: Dermatoglyphics could be used as a cost-effective tool for the preliminary investigation of malocclusion and could also strengthen the diagnosis and prediction of malocclusion. Identifying these problems at an early age by the utilization of dermatoglyphic information could eventually lead to formulating an efficient treatment plan.

Key words: Dermatoglyphics, Malocclusion, Total Finger Fridge Count (TFRC)

Introduction

Many years ago, Aristotle defined hand as an important organ. The lines and patterns have been used to predict the future and in science as a definitive tool for the

identifying criminals.[1] The term dermatoglyphics, (derma refers to skin and glyphic refers to carving), as defined by Sir Cummins (Cummins & Midlo 1926) refers to the study of naturally occurring dermal patterns in the surface of the hands and feet[2-4]. 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. Various studies have reported specific variations in fingerprints and palm prints of patients with dental caries, periodontal diseases, cleft lip and palate and malocclusion.[5-8] Since craniofacial characteristics and dermal ridge patterns are mainly, but not exclusively genetically-governed structures, it has been seen that genetic and environmental factors that cause changes in the alveolar bone may also lead to appearance of fingerprints and palm prints. [9-10]

Malocclusion is one of the most common oral conditions. Angle (Edward Angle 1899) classified malocclusion into three types- Class I, II, III.[11] Early diagnosis and correction of deviated growth patterns of the jaws have been among the main goals of orthodontics for many years. One of the main etiologic factors of malocclusion are genetic factors. Since the late diagnosis of malocclusions leads patients to orthognathic surgery, this study was undertaken to assess the possible association between fingerprint patterns and different types of dental malocclusion. Dermatoglyphics can prove to be overwhelmingly helpful for the easy, accessible, noninvasive and identification of groups at risk of developing malocclusion and for its timely prevention.

Materials & Methods

This study was conducted among the population of Jammu & Kashmir, India. A sample of 200 subjects with all permanent teeth erupted up to the second molar and in the age range of 15-25 years of both genders, were divided into 4 groups of 50 each (25 males ,25 females).

- **Group 1** (Control group)**:** Consists of subjects with Angle's Class I(Ideal) molar relationship with good occlusions.(Fig1.1).
- **Group 2**: (Case group): Subjects with Angle's Class I molar relationship with malocclusions. (Fig1.2).
- **Group 3**(Case group)**:** Subjects with Angle's Class II (No subdivision) molar relationship with malocclusion. (Fig1.3).
- **Group 4** (Case group)**:** Subjects with Angle's Class III molar relationship with malocclusion. (Fig1.4).

Exclusion Criteria

- Patients having major craniofacial anomalies, such as cleft lip and palate or any syndrome.
- Patients with orthodontic treatment or those who were undergoing orthodontic treatment.
- Patients with a history of trauma or surgical procedures done in the orofacial region.
- Congenital Or Acquired Deformities Of The Fingers, Amputated Fingers, Patients With Skin Diseases, With Wound Or Scars On The Fingers.

Techniques of Research

Ethical committee clearance was obtained at organizational level, as most of the procedures involved were carried out as a part of the diagnostic evaluation in treating malocclusion and were harmless to the participants. Written consent was obtained from all the participants. Confidentiality of the participant's identity was strictly maintained. Malocclusion was assessed by clinical examination (Angles Classification).

Methods for obtaining and analyzing fingerprints.

The subject's hand were first cleaned with soap and water prior to the recording of prints, so as to remove dirt, oily secretions, sweat and then dried with a towel. Dermatoglyphic patterns of the patients were recorded for

all 10 digits of the hand (Fig1.5) using Green Bit Dactyscan 84 C fingerprint reader (Fulcrum Biometrics, India) (Fig1.6) and categorized into the arch, loops, and whorl with their subtypes based on the classification as follows :

Arches: Ridges entering from one side and exiting from the other side with a distally bowed sweep are called Arches. Arch does not have a delta and lacks a triradius.

Loop: In a loop, the curve of the ridge around only one extremity of the pattern and flow to the margin of the digit. The loop possesses only one delta/ triradial point. The loops can be twinned, radial or ulnar. If the loop opens towards the ulna bone, it is known as Ulnar loop and if it opens towards the radial bone, it is known as Radial loop. Thus, the ulnar and radial loops differ in both the hands. For example, on the left hand, a loop that opens to the left would be an ulnar loop, while the one that opens to the right would be a radial loop.

Whorls: Ridge configuration with two or more triradii are termed as Whorls . One of the triradius is on ulnar side and the other on the radial side of the pattern. Whorl may be simple, double looped, central-pocketed, or accidental, depending upon the internal structure of the whorl pattern and have two triradius.

Ridge counting was done along a straight line between one tradial point to the center of the pattern and determining the number of intersected ridges between these two points The ridges which falls on the center and triradial point are not included in the count. This count is referred to as **Total Ridge Count(TRFC).** The Total Finger Fridge Count (TFRC) is indicative of the pattern size. The TFRC represents the sum of the ridge counts of all ten fingers.

Result and Observation

Data pertaining to the fingerprints were obtained and entered into an excel spreadsheet 2007 and imported to statistical software SPSS version 16.0.The values were statistically analyzed by using chi-square tests for correlating Ideal occlusion with different types of malocclusion.

Frequency percentage of Patterns.

The total percentage frequency of occurrence of different patterns in Ideal occlusion , Class I, Class II and Class III malocclusion was separately noted for both hands and then combined figures were recorded. The overall percentage frequency showed the distribution of loops, whorls and arches approximately 65%, 25%, and 7% respectively.(Tab 2.1)

There was an increased distribution of arch pattern in the Class III malocclusion cases (3.9 %) followed by Class 1 and then Class II malocclusion .An increased distribution of ulnar loop pattern was found in Class II (25.5 %) followed by class I ideal occlusion and then class III malocclusion. As far as the whorl pattern is concerned the distribution was found to be Class I malocclusion (9.8 %) > Class I ideal occlusion (9.15 %) > Class II malocclusion (8.3 %), and finally class III malocclusion (7.2 %) . The frequency distribution of radial loops in Class III malocclusion (3.2 %) outnumbered ideal occlusion (1.6 %) followed by class II malocclusion (1.4 %) and then class I malocclusion (1.1 %) . Whereas the twinned loops were more frequent (2.1 %) in Class I malocclusion. (Tab 2.2)

Total finger ridge count (TFRC)

The mean of the total finger ridge count of the dermatoglyphic patterns was also assessed for the ten fingers of the right and left hands in the all study groups. The average Total finger ridge count (TFRC) in the ideal group was 103 (SD =6.94). The average TFRC was highest in Class II malocclusion 119.92 (SD=7.52) followed by Class I malocclusion 112.18 (SD=7.39) and

the class III malocclusion 106.56 (SD=7.65), both in the left and the right hand. (Tab 2.5&2.6)

Discussion

Dermatoglyphics, as a means of identification, has been used by man from ancient times, but the use of dermatoglyphic features in the diagnosis of various diseases has received attention from the 17th century.

Once the dermatoglyphic characters are formed, they remain unchanged throughout the life of an individual except in size. (Mulvihill [4] and Smith, 1969; Cummins and Midlo, 1961) They exhibit a wide range of variations in both qualitative and quantitative features in the finger and palmar regions. Thus the ridge pattern is genetically determined and is affected by various environmental factors like external pressure on foetal pads and embryonic foetal finger movements.[12]

It has been seen that though a person may have the same pattern on all ten fingers, various patterns often can occur on different digits. In our study, loops were the most common pattern on the fingertips of which ulnar loops comprised of the major chunk in both genders. The whorls were the second most prominent patterns in our study. These results were in similar to ones by Nithin et al [13] who reported the most common occurrence of ulnar loops (52.3%) followed by whorl pattern (28.74%). Study conducted by Jaga and Igbigbi in Ijaw subjects of Southern Nigerians, Igbigbi and Msamati in Kenyan and Tanzanian subjects and by Eboh in Anioma and Urhobo population of Southern Nigeria had similar results as our study with predominance of ulnar loops followed by whorls and arches patterns .[14] Even the worldwide percentage was in conformity with our study which showed the distribution of loops, whorls and arches approximately 65%, 25% and 7% respectively.

However, the results of current study wherein contrast with the studies conducted by Ching Cho in New Zealand Samoans who reported the predominance of whorls (60.6%) followed by ulnar loops (38.65%). Banik et. al. among Rengma Nagas of Nagaland [15] , Biswas among Dhimals of North Bengal [16] and Tiwari et. al. among Tibetans [17] reported whorls to be the most common pattern, followed by loops and arches in both hands of male and females. Karmakar et al among Muzziena Bedouin [18] alongwith Ghosh et al [19] in Sunni Muslim males of West Bengal also found whorls to be the most common pattern, followed by loops and arches. This could be attributed to the differing ethnicity i.e J&K population where this study was carried out.

The current study of fingerprint patterns on individual digits revealed that majority of ulnar loops were found on middle fingers whereas whorls were mostly found on the thumb and the index finger. Arches though less numerous were most commonly found on the little and ring finger. This result almost coincides with the a study done on British subjects and some medical students with a little difference that there was a preponderance of loops on the little finger as well and whorls on the ring finger. Twinned loops were less numerous but whenever present were mostly found on little fingers mostly so in class I ideal cases.

However, in current study distribution of arches on the index finger was similar, that of whorls higher and loops on the lower side when compared to the British population. Men out numbered the females in all the three types of loops whereas the reverse was true in case of arches and whorl pattern.(Tab2.3) This was, in contrast, to study done in British population where more frequently encountered patterns in females were on the left side while whorls were more common in males and on the right side. In our study variation of gender difference between different patterns or between right or left hands was statistically insignificant Same results were obtained in

indigenous black Zimbabweans.[14] However, the frequency of loops among Zimbabweans was significantly higher when compared to other studies.

According to current study, there was an increased distribution of arch pattern in Class III malocclusion cases followed by Class I and Class II malocclusion. An increased distribution of ulnar loop pattern was found in Class II malocclusion followed by Class I ideal occlusion and Class III malocclusion. As far as the whorl pattern were concerned the distribution was found to be Class I malocclusion > Class I ideal occlusion, >Class II malocclusion and finally class III malocclusion. The frequency distribution of radial loops in Class III malocclusion outnumbered ideal occlusion followed by Class II and then Class I malocclusion in that order.

Intergroup comparison between ideal occlusion and other malocclusion showed that figures of various patterns were statistically insignificant. However, when ideal occlusion was compared with class III malocclusion the figures were statistically significant in terms of the frequency of the arch and the radial loop pattern which meant that increased frequency of radial loops and arches can be a good predictor for class III malocclusion.

Our results were similar in certain ways to a few studies but also differed in certain aspects with other studies. In one of the previous studies, Class II malocclusion had increased frequency of whorl pattern especially on the thumb, while subjects with Class III malocclusion showed an increased frequency of plain arches [20] while our study also added that radial loops can be good predictors of Class III malocclusion. One of the previous studies showed an increased frequency of arches and ulnar loops and a decreased frequency of whorls in Class III malocclusion.[7] Only the statement about arches stands the same in our study whereas the latter part is in total contradiction. Our study was in conformity to a study where there was no major overall statistical association observed between fingerprint patterns and malocclusion, except in Class III malocclusion.[9]

The Chi-square analysis of the association between fingerprint patterns and malocclusion among study subjects showed that there was no statistically significant difference between presence or absence of a pattern when various malocclusions were compared with each other. However, the presence of twinned loops in various malocclusion was found to be statistically significant.(Tab2.4) Multinomial regression predicting malocclusion with respect to the frequency of twinned loops showed that it could be considered for predicting Class II and Class I malocclusion.

The mean of the total ridge count of the dermatoglyphic patterns was also assessed for the ten fingers of the right and left hands in all four study groups. The average total finger ridge count (TFRC) was highest in class II malocclusion followed by Class I and the Class III, both in the left and the right hand. On comparing the ideal occlusion with malocclusion the TFRC showed statistically significant result except when ideal occlusion was compared with class III malocclusion. The chi-square analysis tests showed that the total ridge count was higher in Class II and Class I malocclusion and the difference was statistically significant when compared to ideal occlusion. Multinomial regression predicting malocclusion with respect to total ridge count showed that the ridge count could be considered for predicting class II and class I malocclusion. Similar results were obtained by Jindal et al, where he showed that TFRC increase in class II malocclusion.[20] However according to Reddy et al no significance was seen when comparing TFRC among various classes of malocclusion.[7]

Based on our study, it can be concluded that there is a significant association between dermatoglyphic patterns

and malocclusion particularly with an increased frequency of radial loops and arches in Class III malocclusion and significant increase in total finger ridge count for predicting Class II and Class I malocclusion. Dermatoglyphics can be used as a cost-effective tool for the preliminary investigation of malocclusion. It can also strengthen the diagnosis and prediction of malocclusion. Identifying these problems at an early age can eventually lead to early and timely orthodontic interception.

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Legends Figure and Table

Table 2.1: Percentage frequency of finger patterns in various classes of malocclusion among study subjects

Type of Pattern	Class	Frequency									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Arches	Ideal	68	26	6	0	0	0	0	0	0	0
	C-1	58	30	6	6	0	0	0	0	0	0
	C-2	54	38	8	0	0	0	0	0	0	0
	C-3	44	34	22	0	0	0	0	0	0	0
Whorls	Ideal	0	8	18	22	24	14	8	6	0	0
	C-1	0	4	12	20	28	26	8	2	0	0
	C-2	0	10	20	26	24	12	8	0	0	0
	C-3	0	12	26	36	18	6	0	2	0	0
Ulnar Loops	Ideal	0	0	4	4	14	26	30	16	4	2
	C-1	0	0	4	6	30	34	14	10	2	0
	C-2	0	0	0	4	14	28	20	26	8	0
	C-3	0	2	0	12	12	20	32	20	2	0
Twinned Loops	Ideal	78	20	2	0	0	0	0	0	0	0
	C-1	66	28	4	2	0	0	0	0	0	0
	C-2	90	10	0	0	0	0	0	0	0	0
	C-3	70	30	0	0	0	0	0	0	0	0
Radial Loops	Ideal	70	28	2	0	0	0	0	0	0	0
	C-1	78	22	0	0	0	0	0	0	0	0
	C-2	74	24	2	0	0	0	0	0	0	0
	C-3	54	32	10	4	0	0	0	0	0	0

Table 2.2: Chi-square analysis of comparison of patterns between ideal occlusion and other classes of malocclusion among study subjects

Fingerprint pattern	Ideal vs C-1	Ideal vs C-2	Ideal vs C-3
Arches	0.316	0.355	0.021*
Whorls	0.641	0.756	0.131
Ulnar loops	0.285	0.552	0.531
Twinned loops	0.475	0.213	0.331
Radial loops	0.596	0.499	0.045*

***Statistically Significant Difference (P-value<0.05)**

Table 2.3- showing gender distribution of patterns in different forms of malocclusion

Ideal	**Arches**	**Whorls**	**Ulnar loops**	**Twinned loops**	**Radial loops**
Male	8	87	142	7	7
Female	11	96	138	5	8
Class I	**Arches**	**Whorls**	**Ulnar loops**	**Twinned loops**	**Radial loops**
Male	14	88	128	12	9
Female	16	108	115	9	2
Class II	**Arches**	**Whorls**	**Ulnar loops**	**Twinned loops**	**Radial loops**
Male	12	82	147	2	6
Female	15	84	140	3	8
Class III	**Arches**	**Whorls**	**Ulnar loops**	**Twinned loops**	**Radial loops**
Male	22	70	134	7	14
Female	17	74	133	8	18

Table 2.4: Chi-square analysis of association between presence/absence fingerprint patterns and malocclusion among study subjects

Type of Pattern	Class	Ideal	C-1	C-2	C-3
Arches	No arch	34	29	27	22
	Atleast 1 arch	16	21	23	28
	Total	50	50	50	50
	P-value	**0.112 (Statistically Not Significant)**			

Whorls	No whorl	0	0	0	0
	Atleast 1 whorl	50	50	50	50
	Total	50	50	50	50
	P-value	**1 (Statistically Not Significant)**			
Ulnar Loops	No ulnar loop	0	0	0	0
	Atleast 1 ulnar loop	50	50	50	50
	Total	50	50	50	50
	P-value	**1 (Statistically Not Significant)-**			
Twinned Loops	No twinned loop	39	33	45	35
	Atleast 1 twinned loop	11	17	5	15
	Total	50	50	50	50
	P-value	**0.026 (Statistically Significant)**			
Radial Loops	No radial loop	35	39	37	27
	Atleast 1 radial loop	15	11	13	23
	Total	50	50	50	50
	P-value	**0.051 (Statistically Not Significant)**			

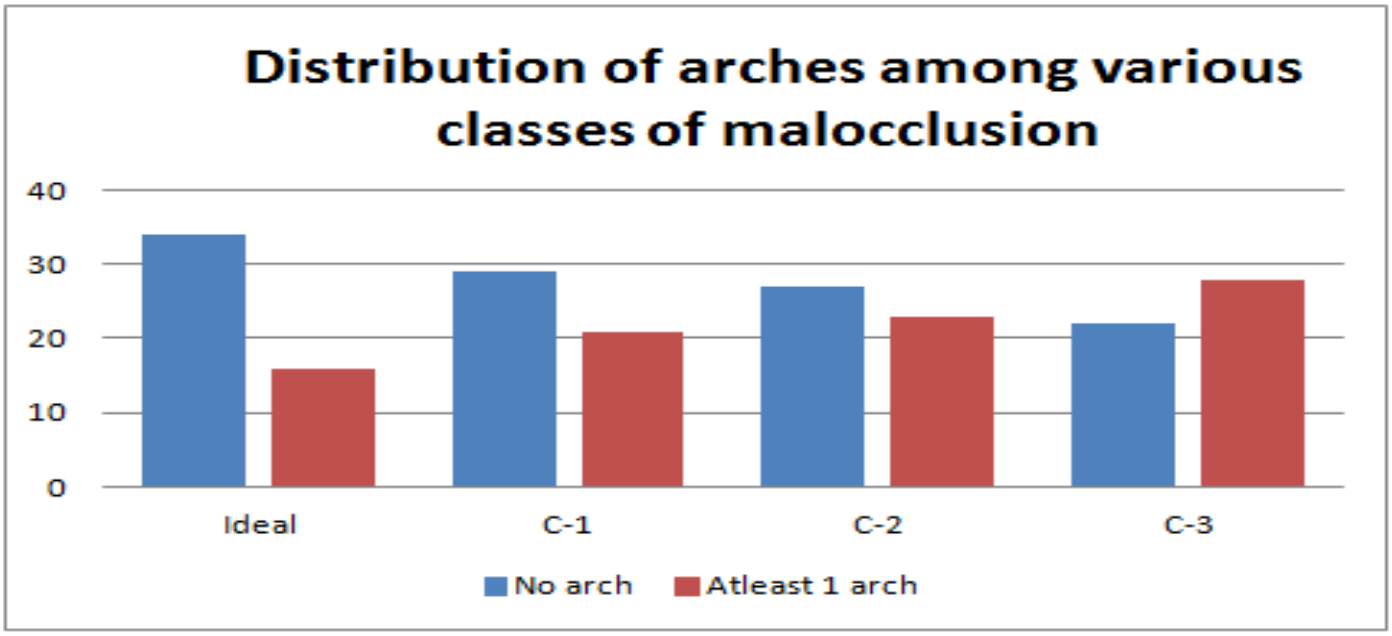
Table 2.5: Showing average total finger ridge counts in various classes of malocclusion

Class	Right Hand		Left Hand		Total	
	Mean	SD	Mean	SD	Mean	SD
Ideal	51.20	6.11	52.22	6.39	103.42	6.94
Class I	54.94	4.93	57.24	3.86	112.18	7.39
Class II	59.72	4.04	60.20	5.99	119.92	7.52
Class III	52.28	5.36	54.28	6.62	106.56	7.65

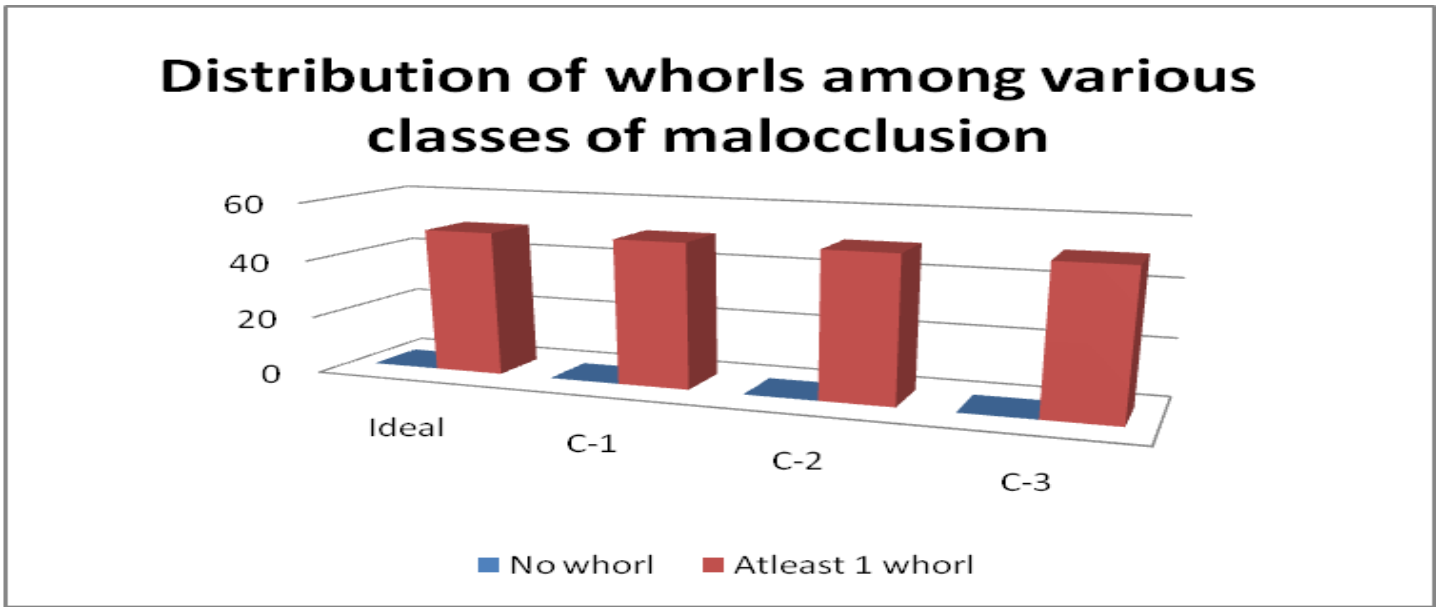
Table 2.6: Inter-group comparison based on total finger ridge counts in various classes of malocclusion			
	Ideal vs C-1	**Ideal vs C-2**	**Ideal vs C-3**
Right Hand	<0.001*	<0.001*	0.297
Left Hand	<0.001*	<0.001*	0.078
Total	<0.001*	<0.001*	0.053

***Statistically Significant Difference (P-value<0.05)**

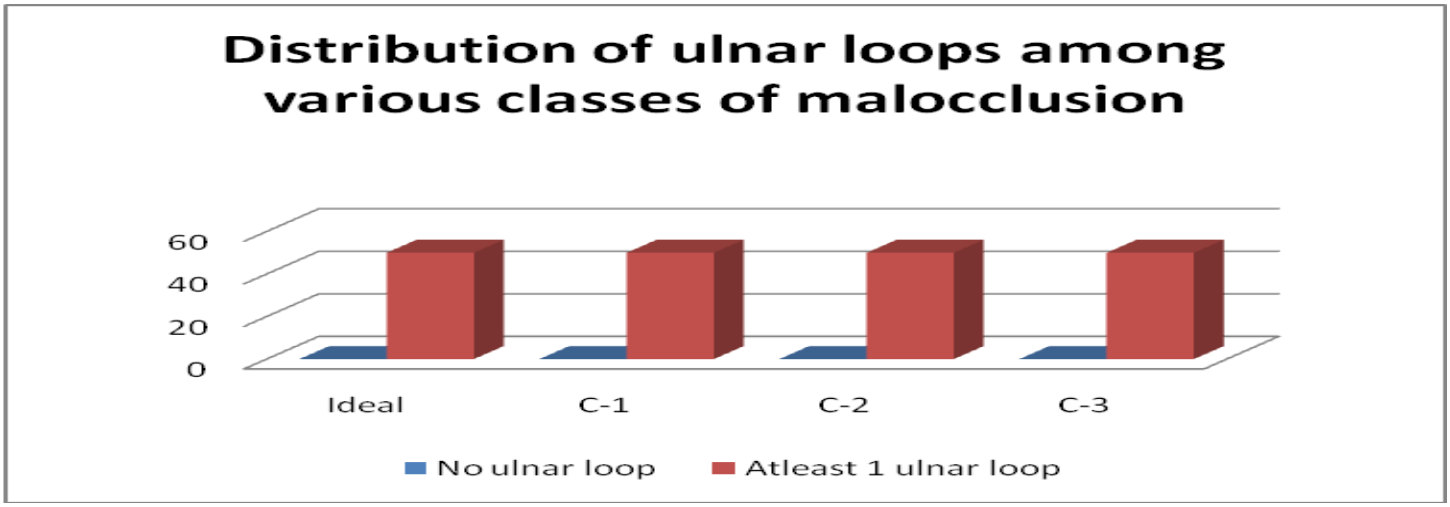
Graph 3.1



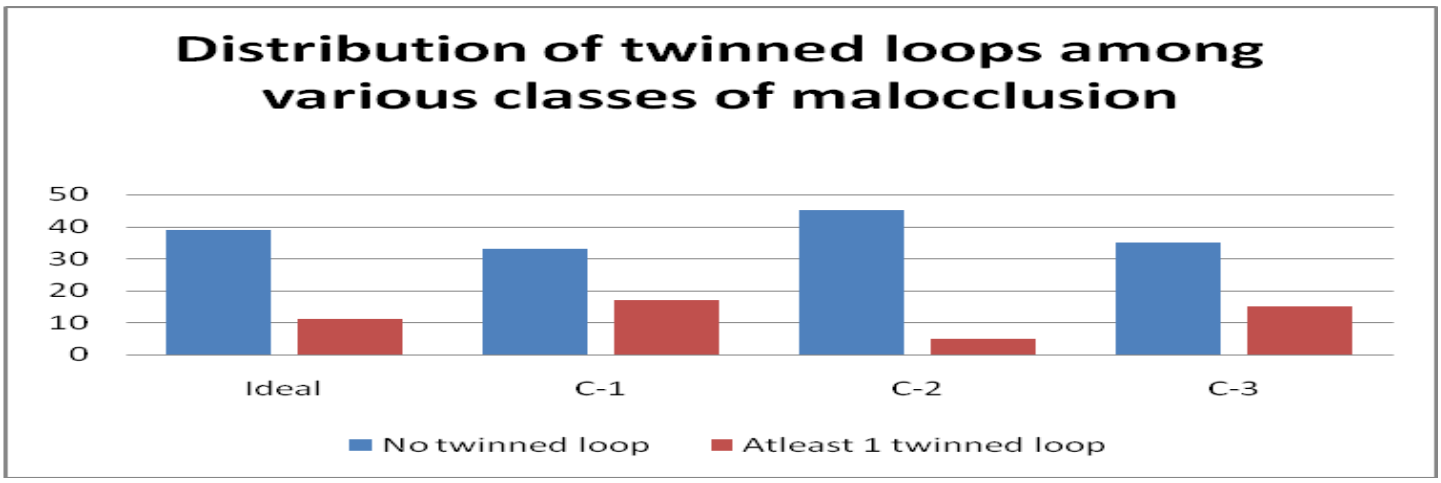
Graph 3.2



Graph 3.3



Graph 3.4



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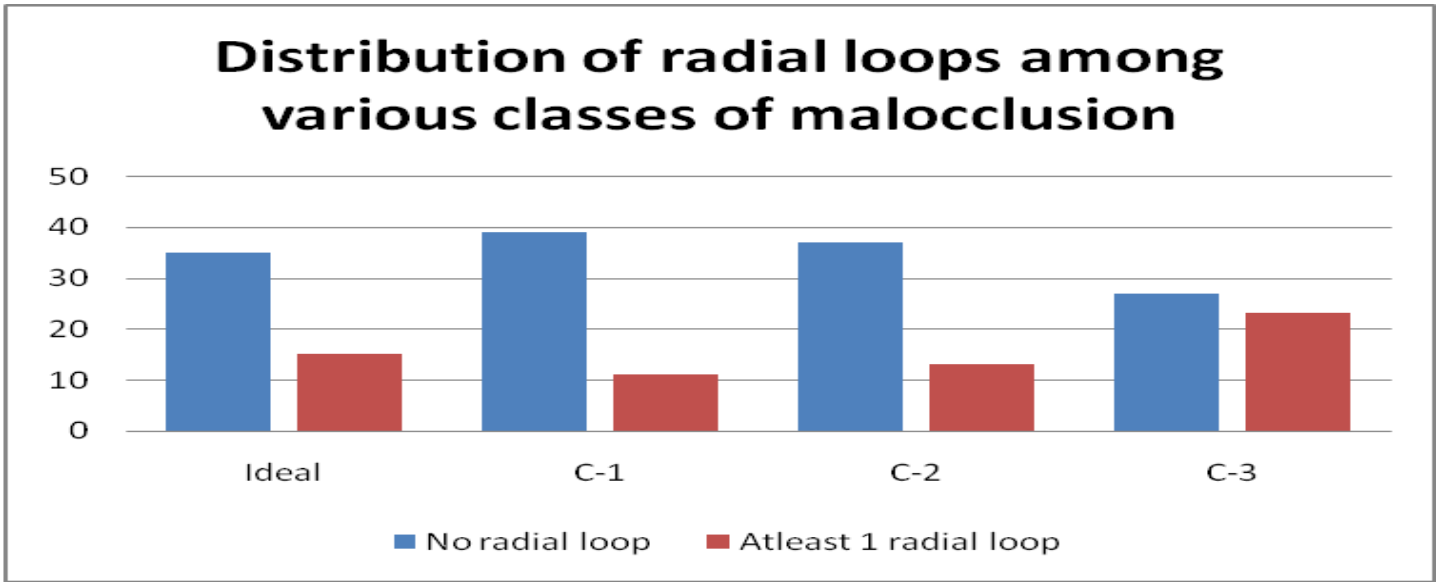

Graph 3.6

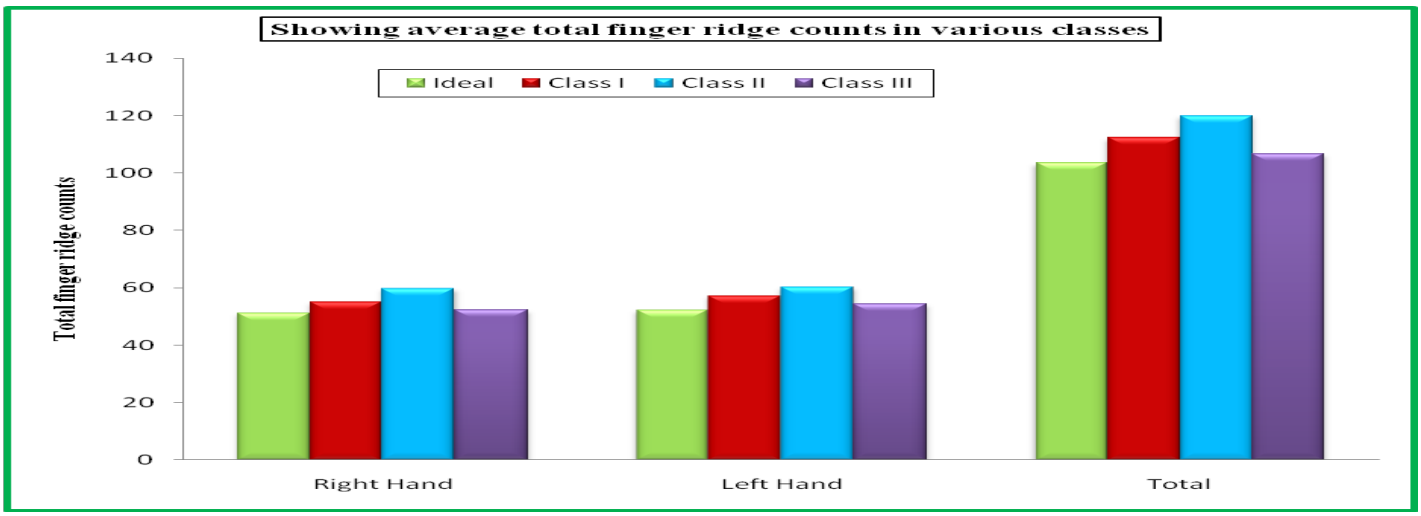

FIG. 1.1: Ideal occlusion

FIG.1.2: Class I malocclusion.

FIG. 1.3: Class II malocclusion.

FIG 1.4: Class III malocclusion

FIG.1.5: Finger and thumb prints

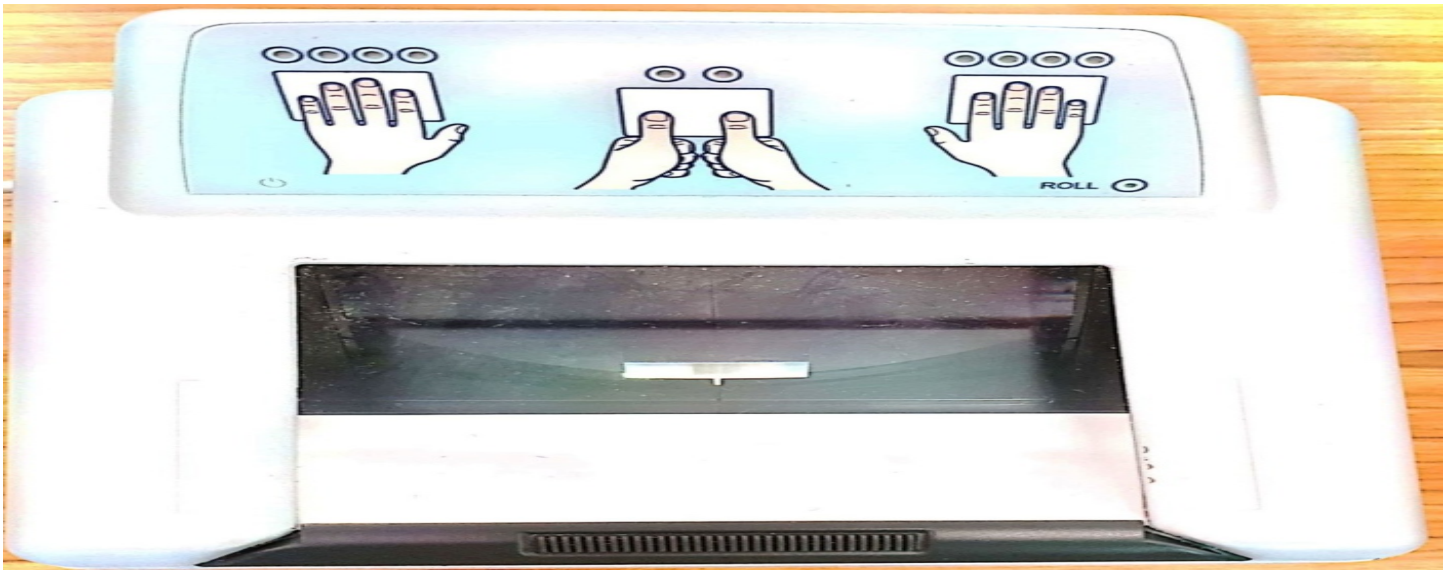

Fig 1.6- Green Bit Dactyscan 84 C fingerprint reader