ISSN No:-2456-2165

Assessment of Palatine Rugae Stability as a Landmark for Analysis of Orthodontic Treatment Changes in Extraction Cases

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ABSTRACT:

INTRODUCTION: Palatine rugae are anatomical folds or wrinkles of irregular fibrous connective tissue located on the anterior third of the palate behind the incisive papilla. These rugae patterns have been widely studied for various purposes, mainly in the fields of anthropology, genetics, orthodontics, prosthodontics and forensic science.

AIM: The study aims to assess the palatine rugae stability as a landmark for analysis of orthodontic treatment changes.

OBJECTIVES: This study was designed to investigate the stability of palatine rugae before and after orthodontic treatment and to explore the potential of the palatine rugae area to be used as an adjunctive aid for superimposition in cast analysis of orthodontic treatment changes.

MATERIALS & METHODS: The pre and post-dental casts of 50 orthodontically treated adult patients were selected from the Department of Orthodontics, Tamilnadu Government Dental College and Hospital. All patients were indicated to have symmetrical extraction of the maxillary first premolars followed by retraction of the anterior teeth& space closure.All casts were analyzed and measurements done. Comparing the pre and post orthodontic treatment position of the rugae points transversely, antero-posteriorly and in relation to the median palatal plane.

RESULTS: Findings concludes that the most stable rugae points were the points of the third rugae and this may be due to their presence away from the extraction position. Thus, they were the least affected by the distal retraction of the anterior teeth. Hence, it could be used as reference points for cast superimposition.

CONCLUSION: Palatine rugae showed stability following orthodontic treatment and tooth movement which presented no statistically significant effect on the position of the palatine rugae area. Hence,it could be used for cast analysis and superimposition.

DISCUSSION: In the present study, the rugae points in all the measurements in relation to the median palatine raphe revealed stability except for a slight decrease in the values of the right second rugae which was statistically non-significant. From these findings and the whole results, it was concluded that the most stable rugae points were the points of the third rugae and this may be due to their presence away from the extraction position.

Keywords:- *Palatal rugae,Rugae pattern, Cast Analysis, Orthodontic Superimposition.*

I. INTRODUCTION

Palatal Rugae (PR) or transverse palatine folds are asymmetrical and irregular elevations of the mucosa located in the anterior third of the palate, made from the lateral membrane of the incisive papilla, arranged in transverse direction from palatine raphe located in the midsagittal plane. They are also called "PlicaPalatinae" or "Rugae Palatine".[1]

Winslow was the first person to describe them. These formations have been used in medicolegal identification processes because of their individual morphological characteristics and stability overtime.[2]

The earliest illustration of palatal rugae was probably by Santorini in 1775, wherein he put a drawing depicting 3 wavy lines crossing the midline of palate. The first palatal classification system was put forth by Goria in 1911.[3]The first suggestion for the use of palatal rugae as a method of personal identification was suggested by Harrison Allen in 1889. The term "Palatal rugoscopy" was proposed in 1932, by a Spanish investigator named Trobo Hermosa.[4]

"In the social jungle of human existence, there is no feeling of being alive without a sense of identity"[5]
- Erik Erikson

"Identity" is a set of physical characteristics, functional or psychic, normal or pathological that define an individual. It is the mainstay of civilization, and the identification of unknown individuals has always been of paramount importance to society. [6]

Not only is it important to identify the deceased to ensure appropriate obsequies, but there are also issues such as criminal investigations, insurance settlements, and military proceedings that can be resolved only with positive identification.[8]

Overall, in world-wide scenario, forensic dentists are playing an important role in human identification, bite mark analysis, maxillofacial trauma, and malpractices.

ISSN No:-2456-2165

Although teeth are more durable than other parts of the body, identification via dental records also may prove to be inconclusive, because dental treatment might have been performed between the creation of a dental record and the person's death.It is a well established fact that rugae retains its shape throughout life and resists decomposition.[7]

Personal identification is based on the rugae pattern since the palate would remain intact when most other anatomical structures are destroyed, burned or dehydrated and also in situations where there are no finger prints.Thus, in forensic dentistry, the unique characteristic pattern of palatal rugae can be used as an identification tool. Rugae are not damaged from trauma due to their internal position in the oral cavity and are insulated from heat by tongue and buccal fat pads. The anatomical location of the palatal rugae inside the oral cavity–within the blanket of cheeks, lips, buccal pad of fat, dento alveolar apparatus keeps them protected from trauma and temperature changes.[9]

As it does not change in the adult hood after the complete eruption of teeth and no significant alteration in length occurs. Hence aim of our study is to assess the palatine rugae stability as a landmark for analysis of orthodontic treatment changes in extraction cases.[10]

II. MATERIALS & METHODS

A. *TYPE OF STUDY*

Experimental study – Invitro study.

B. *MATERIALS AND METHODS*

- This study includes study of dental casts of orthodontically treated 50 adult patients aged 18-30 years.
- Dental casts are collected from patients visiting the Department of Orthodontics, Tamilnadu Government Dental College and Hospital, Chennai-600 003 for treatment purpose.
- Subjects are included in the study as per the inclusion and exclusion criteria.

C. *INCLUSION CRITERIA*

- Patients with Angle's class I malocclusion.
- Extraction cases only.
- Pre and Post treatment models.
- Maxillary cast with symmetrical extraction of first premolars are selected followed by retraction of anterior teeth & space closure.
- Full set of Permanent Dentition (with or without third molars).
- Models poured from alginate impressions will be selected.
- Individuals between 18-30 years.

D. *EXCLUSION CRITERIA*

- Previous orthodontic treatment.
- Edentulous spaces,history of trauma.
- Significant cuspal wear.
- Extensive restoration or prosthesis.
- Anterior or posterior cross bite.
- Severe crowding (>9mm) or severe spacing (>9mm).

E. *METHOD OF COLLECTION OF DATA*

Study cast are collected from patients visiting Department of Orthodontics, Tamilnadu Government Dental College and Hospital, Chennai-600 003 for treatment purpose.

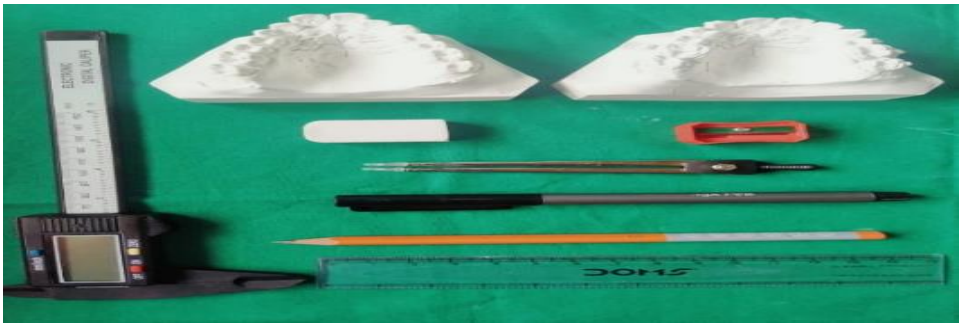

Fig. 1: Utensils used for dental cast analysis

F. *DENTAL CAST ANALYSIS*

- Upper dental cast are collected (Pre& Post treatment following extraction of 1st premolar).
- Measurements are made using a digital Vernier calliper.
- Landmarks on palatal raphae& palatal rugae are marked on maxillary casts
- Medial and lateral points are marked on medial and lateral ends of 1st, 2nd, 3rd rugae.
- Each cast is photographed.
- The median palatal plane is constructed on the median palatal raphe.

G. *THREE MAIN GROUPS OF MEASUREMENTS TAKEN ARE*

- Transverse linear distances between medial and lateral points of the right and left rugae.
- Anteroposterior linear distances between the first and second medial and lateral points of both the right and left rugae as well as the second and third ones.
- Vertical distances from the median palatal plane to the rugae medial and lateral points for right and left sides on each cast.

ISSN No:-2456-2165

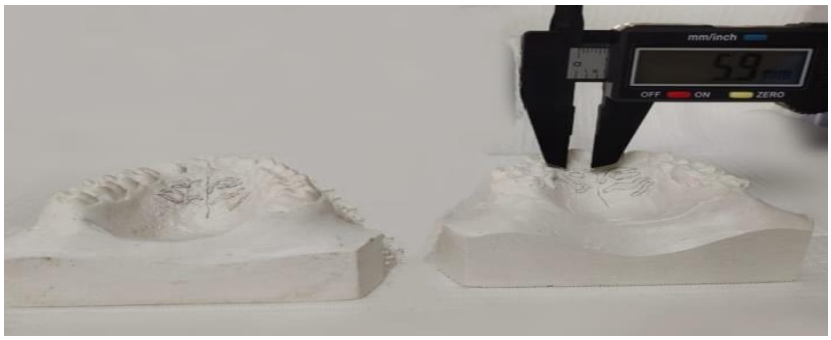

Fig. 2: Dental cast analysis using digital verniercaliper

III. RESULTS

VARIABLE		MEAN	SD	MIN	MAX	SIG
Right 1st rugae	Pre	9.16	.943	8	11	.279
	post	7.80	.756	6	9	
Left 1st rugae	Pre	10.10	.789	8	12	.171
	post	10.76	1.685	1	13	
Right 2nd rugae	Pre	12.58	.702	11	13	.233
	post	10.76	1.685	1	13	
Left 2nd rugae	Pre	8.66	.626	7	9	
	post	10.76	1.685	1	13	.886
Left 3rd rugae	Pre	11.58	.702	10	12	.937
	post	9.46	.862	8	10	
Right3rdrugae	Pre	9.50	.839	8	10	1.000
	post	7.80	.756	6	9	

Table 1: Descriptive statistic and paired t test between the pre- and post- transverse changes of the rugae points in 50 patients.

Comparing the pre- and post-orthodontic treatment position of the rugae points transversely, anteroposteriorly and in relation to the median palatal plane, although there was a slight decrease in the measurements of limited points which was insignificant, yet, the difference was statistically nonsignificant for all other points in different directions.

The pre-and post-transverse dimensions were compared and we found a slight decrease in the distance between pre and post treatment right rugae, but this difference was statistically insignificant (Table1).

VARIABLE		MEAN	SD	MIN	MAX	SIG
1st-2nd Lateral left rugae	Pre	3.16	.584	2	4	.000∗
	post	3.68	.587	2	4	
1st-2nd Medial left rugae	Pre	4.94	.586	4	6	.821
	post	4.96	.570	4	6	
1st-2nd Lateral right rugae	Pre	6.60	.670	5	7	.642
	post	6.56	.705	5	7	
1st-2nd Medial right rugae	Pre	3.70	.544	2	4	.766
	post	3.68	.587	2	4	
2nd-3rd Lateral left rugae	Pre	3.00	.728	1	4	.000∗
	post	3.68	.587	2	4	
2nd-3rd Medial left rugae	Pre	7.82	.748	6	9	.837
	post	7.80	.756	6	9	
2nd-3rd Lateral right rugae	Pre	2.94	.712	1	4	.000∗
	post	3.68	.587	2	4	
2nd-3rd Medial right rugae	Pre	6.56	.837	5	8	.000∗
	post	5.52	.614	4	6	

Table 2: Descriptive statistic and paired t test between the pre- and post- anteroposterior changes of the rugae points in 50 patients.

∗Significant - < 0.05

ISSN No:-2456-2165

The pre-and post-anteroposterior dimensions were compared and we found statistical significant difference between the 1st-2nd Lateral left rugae, 2nd-3rd Lateral left rugae, 2nd-3rd Lateral right rugae, 2nd-3rd Medial right rugae points. Slight decrease was observed in the other measurements but it was statistically insignificant (Table.2).

Variable		mean	sd	Sig
1st Lateral left rugae	Pre	9.34	1.479	0.772
	post	11.58	.702	
1st Medial left rugae	Pre	1.52	.735	0.004∗
	post	1.72	.573	
1st Lateral right rugae	Pre	1.52	.735	0.004∗
	post	1.72	.573	
1st Medial right rugae	Pre	10.72	1.679	0.238
	post	8.66	.626	

Table 3: Descriptive statistic and paired t test between the pre- and post- treatment changes of the First palatal rugae points in relation to the medial palatal plane in 50 patients.

∗Significant - < 0.05

Variable		mean	sd	Sig
2nd Lateral left rugae	Pre	10.98	.915	.232
	post	11.58	.702	
2nd Medial left rugae	Pre	1.84	.584	.012∗
	post	1.72	.573	
2nd Lateral right rugae	Pre	12.64	.663	.964
	post	13.62	.753	
2nd Medial right rugae	Pre	2.90	.707	.635
	post	3.68	.587	

Table 4: Descriptive statistic and paired t test between the pre- and post- treatment changes of the second palatal rugae points in relation to the medial palatal plane in 50 patients.

∗Significant - < 0.05

Variable		mean	sd	Sig.
3rd Lateral left rugae	Pre	13.60	.728	.158
	post	12.64	.663	
3rd Medial left rugae	Pre	4.94	.586	.002∗
	post	4.96	.570	
3rd Lateral right rugae	Pre	14.56	.787	.948
	post	12.64	.663	
3rd Medial right rugae	Pre	4.90	.614	.804
	post	6.56	.705	

Table 5: Descriptive statistic and paired t test between the pre- and post- treatment changes of the third palatal rugae points in relation to the medial palatal plane in 50 patients

∗Significant - < 0.05

The medial and lateral points of the palatine rugae in both right and left sides were compared in relation to the median palatine raphe in pre-and post-treatment and there was statistical significant difference in the first palatal rugae points - 1st Medial left rugae, and 1st Lateral right rugae (Table.3), significant difference in 2nd Medial left rugae of lateral and medial left, right second rugae (Table.4) and significant difference in 3rd Medial left rugae of lateral and medial left , right third rugae points (Table5).

Findings concludes that the most stable rugae points were the points of the third rugae and this may be due to their presence away from the extraction position. Thus, they were the least affected by the distal retraction of the anterior teeth. Hence, it could be used as reference points for cast superimposition.

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IV. DISCUSSION

The evaluation of palatine rugae stability and the ability of using it in cast superimposition has a great help for a better orthodontic treatment outcome. This study was designed to investigate the stability of palatine rugae and the possibility of their use of cast super imposition. Upper dental cast of patients are collected (Pre & Post treatment following extraction of 1st premolar).Cast analysis was performed usingdigital Verniercaliper.

In this study, transverse dimensions were compared and a slight decrease in the distance between pre and post treatment right rugae, but this difference was statistically insignificant.(Table 1).

Anteroposterior dimensions were compared and a statistical significant difference between the 1st- 2nd lateral left rugae,2nd -3rd lateral left rugae,2nd-3rd lateral right rugae, 2nd-3rd medial right rugae points was seen.Slight decrease was observed in the other measurements but it was statistically insignificant.(Table 2).

The medial and lateral points of the palatine rugae in both right and left sides were compared in relation to the median palatine raphe in pre-and post-treatment and there was statistical significant difference in the first palatal rugae points-1st medial left rugae,and 1st lateral right rugae (Table 3), significant difference in 2nd medial left rugae of lateral and medial left, right second rugae (Table 4) and significant difference in 3rd medial left rugae of lateral and medial left ,right third rugae points (Table 5).From these findings and the whole results it concludes that the most stable rugae points were the points of the third rugae and this may be due to their presence away from the extraction position.

Thus, they were the least affected by the distal retraction of the anterior teeth.Hence,it could be used as reference points for cast superimposition.

These findings supports the results of Peavy and Kendrick (1967) who found that the third rugae are not markedly affected by the orthodontic treatment.

Also, other studies proved that the posterior rugea are less affected by anterior teeth movement since they are away from it and the most stable rugae points to be used as a reference points are the third rugae points (Lysell, 1955; Abdel-Aziz and Sabet, 2001).

This study was designed to investigate the stability of palatine rugae before and after orthodontic treatment and to explore the potential of the palatine rugae area to be used as an adjunctive aid for superimposition in cast analysis of orthodontic treatment changes.

V. LIMITATIONS

Though we studied the various rugae points for stability, no specific gender discrimination was done to see rugae points in different gender. The sample size was very to generalize our results, hence future endeavours are necessary to generalize our results. No specific age categories or range was done, to generalize which age group need what rugae to be calculated. Manual entries during our data collection, introduced us to observers bias. Similarly no independent factors influence was found, to remove confounding bias.

VI. CONCLUSION

Findings concludes that the most stable rugae points were the points of the third rugae and this may be due to their presence away from the extraction position.Thus, they were the least affected by the distal retraction of the anterior teeth. Hence, it could be used as reference points for cast superimposition.

- TOTAL NUMBER OF PAGES – MAIN MANUSCRIPT: 18 PAGES
- WORDS COUNT FOR ABSTRACT: 179
- TEXT WORD COUNT: 2124
- Source(s) of support: NIL
- It's not presented anywhere
- Conflicts of interest: There are no conflicts of interest.
- The manuscript has been read by all the authors and it is believed that the manuscript represents honest work.
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