

# Palatal rugae area: a landmark for analysis of pre- and post-orthodontically treated adult Egyptian patients

H.M. Abdel-Aziz<sup>1</sup> and N.E. Sabet<sup>1</sup>

منطقة غضون الحنك: معلّم لتحليل حالات المرضى المصريين البالغين قبل وبعد معالجتهم بتقويم الأسنان

هدى محمد عبد العزيز ونهى عزت ثابت

**خلاصة:** كان هدفنا في هذه الدراسة تقييم مدى ثبات منطقة غضون الحنك قبل وبعد المعالجة بتقويم الأسنان في المرضى المصريين البالغين، واقتراح ما إذا كان يمكن استعمال ذلك في مقارنة المقاييس لتحليل التغيرات الناجمة عن المعالجة بتقويم الأسنان. وقد تم جمع خمسين نموذجاً سنياً صنعت لمرضى مصريين بالغين قبل وبعد معالجتهم بتقويم الأسنان، في عيادة قسم تقويم الأسنان بجامعة القاهرة. وكان جميع المرضى قد تقرر علاجهم بخلع متناظر للضواحل الأولى. وتم تفحص النماذج وتحليل النتائج. ووجد أن أكثر النقاط معيولة هي نقاط الغضون الجانبية الثالثة، التي يمكن استعمالها نقاطاً مرجعية في مقارنة مقاييس النماذج السنية.

**ABSTRACT** We aimed to evaluate the stability of the palatal rugae area before and after orthodontic treatment in adult Egyptian patients, and to suggest whether it could be used in superimposition in order to analyse orthodontic treatment change. Fifty pre- and post-dental casts of orthodontically treated adult Egyptian patients were collected from the clinic of the Orthodontic Department at the University of Cairo. All patients were indicated to have symmetrical extraction of first premolars. The casts were scanned and analysed. The most reliable points were found to be the lateral third rugae points, which could be used as reference points for cast super-imposition.

**La région des crêtes palatines : un point de repère pour l'analyse des patients égyptiens adultes avant et après traitement orthodontique**

**RESUME** L'objectif de la présente étude était d'évaluer la stabilité de la région des crêtes palatines avant et après le traitement orthodontique chez des patients égyptiens adultes et de suggérer si cela pouvait être utilisé en superposition pour analyser les changements apportés par le traitement orthodontique. Cinquante moulages dentaires pré- et post-traitement d'adultes égyptiens ayant suivi un traitement orthodontique ont été collectés à la clinique du Service d'orthodontie de l'Université du Caire. Tous les patients étaient signalés avoir une extraction symétrique des premières prémolaires. Les moulages ont été scannés et analysés. On a trouvé que les points les plus fiables étaient les points latéraux des troisièmes crêtes, ce qui pourrait être utilisé comme point de référence pour la superposition des moulages.

<sup>1</sup>Faculty of Oral and Dental Medicine, University of Cairo, Cairo, Egypt.

Received: 04/04/00; accepted: 20/06/00

## Introduction

Analysis of orthodontic treatment changes is an important goal not for only orthodontic researchers, but for clinicians as well. This has been successfully performed by cephalometric superimposition. Although the dental cast is an important three-dimensional record, it has yet to be used in this task. A number of investigators have studied the stability of the palatal rugae area before and after orthodontic treatment in both children and adults [1,2].

Palatal rugae are the ridges situated in the anterior part of the palatal mucosa on each side of the median palatal raphe and behind the incisive papilla. Lysell reports that in 1911 Gorla defined the rugae as the ridges that extend at least one-half the distance from the median palatal raphe to the dental arch [3]. Lebrat considered the palatal rugae in the apex of the palatal vault as a stable point, so he used it to measure the degree of maxillary teeth migration in humans [4]. In 1967, Paevy and Kendrick evaluated the relationship between the lateral ends of the rugae and the direction of tooth movement [5]. They found that they tend to follow the movement of the teeth in the sagittal plane but not in the transverse one. They therefore concluded that the rugae could be of value as a recording device on the mid-sagittal raphe. Van der Linden, in a cross-sectional study on normally growing children 6–16 years of age and six orthodontically treated patients, reported that the maximum mean changes between the rugae points in the anteroposterior plane was 0.4 mm [6]. These changes were greater in orthodontically treated cases. Ryden and Bjelkhagen used the palatal rugae as a stable landmark for superimposition to detect different occlusal changes [7]. The stability of palatal rugae as a landmark for

dental cast analysis were reported by Almeida et al. [1] and Bailey et al. [2] in extraction and non-extraction cases.

Many researchers believe that the palatal rugae possess unique patient characteristics as they are absolutely individual and therefore they could be used as a personal print for identification [8,9]. This belief was the starting point from which the idea of this study was born. Our aim therefore was to discover whether this unique patient characteristic landmark is stable or not, and whether it could be used to analyse orthodontic treatment changes.

## Methods

Fifty pre- and post-treatment dental casts of orthodontically treated adult Egyptian patients aged 17–25 years (27 females and 23 males) were collected from the clinic of the Department of Orthodontics, Faculty of Oral and Dental Medicine at the University of Cairo.

The criteria for selection were that all patients:

- had mature dentition at the beginning of treatment;
- were indicated to have symmetrical extraction of first premolars followed by retraction of canines and anterior segment using head gear as anchorage;
- were treated with straight wire technique (Roth brackets, Dentaaurum, Germany); had excellent dental casts.

By using strong spot-lighting, the palatal rugae landmarks (Figure 1) were marked on the casts using 0.5 mm HB pencil. One operator marked and the other checked the landmark. The pre- and post-treatment casts were positioned side by side because the rugae points have different patterns of shape and position. Each cast was scanned

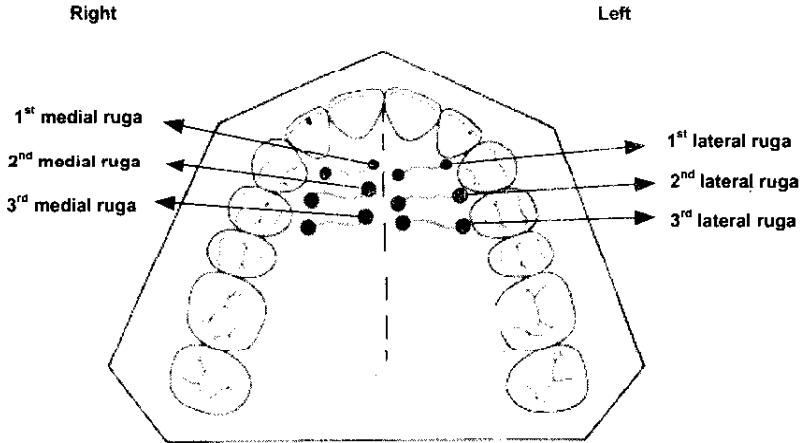


Figure 1 Landmarks on a dental cast, showing 1st, 2nd and 3rd rugae with their medial and lateral points.

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

Variable		Mean	s	Maximum	Minimum	df	t-value
1st lateral ruga	Pre	90.88	33.18	132.11	50.25	49	1.55 NS
	Post	96.98	36.38	152.47	59.41		
1st medial ruga	Pre	13.50	5.85	27.89	8.60	49	1.52 NS
	Post	18.66	8.17	28.84	5.00		
2nd lateral ruga	Pre	111.59	44.02	180.23	59.21	49	0.83 NS
	Post	108.71	46.65	182.39	58.22		
2nd medial ruga	Pre	19.51	11.19	39.85	8.00	49	1.35 NS
	Post	22.47	8.69	35.34	12.17		
3rd lateral ruga	Pre	114.77	47.47	186.04	67.03	49	0.22 NS
	Post	115.76	49.10	187.45	56.04		
3rd medial ruga	Pre	30.07	13.60	38.12	49.98	49	-0.28 NS
	Post	28.79	12.68	9.49	11.70		

Values are expressed in pixels.

s = standard deviation.

df = degrees of freedom.

NS = not statistically significant ( $P > 0.05$ ).

using Simplex DP30 computer scanner and the UTHSCSA Image Tool version 2.0 computer program. The median palatal plane was constructed on the median palatal raphe.

Three main group of measurements taken were:

- 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;

- perpendicular distance from the median palatal plane to the rugae medial and lateral points for right and left sides on each cast.

The collected data were analysed using paired *t*-test to detect any significant differences between the pre- and post-treatment records for the three different groups of measurements. Statistical analysis was performed using *SPSS*.

## Results

The pre- and post-transverse changes of the rugae points were compared (Table 1).

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

Variable		Mean	s	Maximum	Minimum	df	t-value
1st-2nd lateral left ruga	Pre	24.12	8.87	42.76	10.30	49	-1.39 NS
	Post	21.57	7.26	30.81	9.00		
1st-2nd medial left ruga	Pre	23.50	15.09	55.44	30.15	49	-1.48 NS
	Post	18.23	7.52	11.18	5.10		
1st-2nd lateral right ruga	Pre	34.38	22.57	77.13	12.04	49	-1.91 NS
	Post	28.32	18.83	57.27	9.06		
1st-2nd medial right ruga	Pre	19.58	10.87	46.10	8.54	49	-1.29 NS
	Post	17.60	11.58	43.74	9.49		
2nd-3rd lateral left ruga	Pre	26.12	20.41	67.74	8.06	49	-1.27 NS
	Post	21.85	13.10	47.01	7.21		
2nd-3rd medial left ruga	Pre	23.47	8.37	33.84	8.06	49	-1.01 NS
	Post	21.58	9.92	36.77	9.43		
2nd-3rd lateral right ruga	Pre	20.70	10.73	40.26	10.20	49	0.18 NS
	Post	21.16	12.52	39.82	10.20		
2nd-3rd medial right ruga	Pre	25.21	13.59	46.32	7.00	49	-1.87 NS
	Post	22.24	11.43	41.30	9.85		

Values are expressed in pixels.

s = standard deviation.

df = degrees of freedom.

NS = not statistically significant ( $P > 0.05$ ).

**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 median palatal plane in 50 patients**

Variable		Mean	s	Maximum	Minimum	df	t-value
1st lateral left ruga	Pre	43.64	19.75	70.00	15.03	49	1.69 NS
	Post	48.34	19.92	82.15	24.74		
1st medial left ruga	Pre	6.88	3.24	14.14	3.00	49	1.35 NS
	Post	8.79	4.68	15.52	3.00		
1st lateral right ruga	Pre	41.82	20.44	62.00	21.02	49	1.63 NS
	Post	47.02	18.49	69.00	25.00		
1st medial right ruga	Pre	6.38	2.61	11.00	3.00	49	1.56 NS
	Post	8.49	3.78	15.03	4.00		

Values are expressed in pixels.

s = standard deviation.

df = degrees of freedom.

NS = not statistically significant ( $P > 0.05$ ).

**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 median palatal plane in 50 patients**

Variable		Mean	s	Maximum	Minimum	df	t-value
2nd lateral left ruga	Pre	53.34	19.14	87.14	32.06	49	0.98 NS
	Post	55.72	22.71	89.44	31.02		
2nd medial left ruga	Pre	8.98	3.11	13.00	4.00	49	0.82 NS
	Post	10.16	3.83	15.81	6.00		
2nd lateral right ruga	Pre	54.16	22.99	86.05	29.07	49	-1.16 NS
	Post	51.37	23.05	86.15	25.00		
2nd medial right ruga	Pre	9.66	3.78	17.49	4.12	49	-0.34 NS
	Post	9.36	4.16	17.46	5.00		

Values are expressed in pixels.

s = standard deviation.

df = degrees of freedom.

NS = not statistically significant ( $P > 0.05$ ).

Although a slight decrease in the distance between the lateral point of the second rugae and the medial of the third was observed, this difference was statistically insignificant for all the points in the transverse direction. When we compared the

pre- and post-anteroposterior changes of the rugae points (Table 2), no statistically significant difference was found between the second and third lateral rugae points ( $P > 0.05$ ). A slight, statistically insignificant decrease was observed in the other mea-

**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 median palatal plane in 50 patients**

Variable		Mean	s	Maximum	Minimum	df	t-value
3rd lateral left ruga	Pre	57.68	27.54	106.00	23.00	49	1.11 NS
	Post	60.23	26.31	100.04	27.07		
3rd medial left ruga	Pre	14.26	6.50	25.08	8.00	49	1.53 NS
	Post	15.74	5.68	19.24	10.05		
3rd lateral right ruga	Pre	53.03	25.19	85.05	25.00	49	-0.37 NS
	Post	51.82	26.13	87.01	22.00		
3rd medial right ruga	Pre	10.44	6.72	22.09	4.12	49	1.53 NS
	Post	13.55	5.97	23.00	6.08		

Values are expressed in pixels.

s = standard deviation.

df = degrees of freedom.

NS = not statistically significant ( $P > 0.05$ ).

surements. Comparison between the pre- and post-treatment changes in the position of palatal rugae points in relation to the median palatal plane showed no statistically significant difference recorded regarding first palatal rugae points (Table 3), lateral and medial left second rugae (Table 4), and lateral and medial left and medial right third rugae point (Table 5). There was a slight decrease in the distance between the lateral and medial right second rugae (Table 4) and the lateral right third rugae point (Table 5).

## Discussion

Estimation of orthodontic treatment changes is a step forward to better treatment results. With this in mind, we aimed to evaluate the stability of the palatal rugae area, and the possibility of using it for superimposition. Until now, the stability of the palatal rugae area in Egyptian patients has not been reported.

Casts of both male and female adult Egyptian patients with mature dentition were used since Abou El-Fotoh and El-Sharkawy reported in 1998 that rugoscopy was absolutely individual and could be used as a personal print for identification, and that it was completely independent of sex and age [8]. The casts of patients who were given headgear for anchorage rather than Nance appliance or transpalatal arches were used in order to avoid the possible effect of these appliances on the anatomy of the rugae area [10].

Computerized cast analysis was used in a trial to obtain a standardized result [1]. Stability of the rugae points in the transverse direction concurred with Almeida et al. [1] and Van der Linden [6], who reported that changes in the transverse direction were statistically insignificant. This, however, did not concur with Bailey et al. [2] and Hausser, as reported by Bailey et al. [2], who believe that extraction of the first

premolars affect the position of the lateral point, which in turn changes the transverse distance between them.

A finding of great interest was the stability of the rugae points in the anteroposterior direction for the second and third lateral rugae points. This finding is consistent with that of Almeida et al. [1] and Bailey et al. [2] who concluded that movement of the teeth may change the position of the rugae points, so retraction of the anterior segment explains the changes that occur between the first and second rugae points.

## Conclusion

In light of these results, one can conclude that orthodontic treatment and tooth movement have no statistically significant effect on the position of the palatal rugae area; thus it could be used as a means of cast analysis and superimposition. The most reliable points were: the lateral third rugae points, which could be used as reference points for cast superimposition. For future studies it would be beneficial to use a larger sample size and wider age range.

## References

1. Almeida MA et al. Stability of the palatal rugae as landmarks for analysis of dental casts. *Angle orthodontist*, 1995, 65: 43-8.
2. Bailey LT et al. Stability of the palatal rugae as landmarks for analysis of dental casts in extraction and nonextraction cases. *Angle orthodontist*, 1996, 66:73-8.
3. Lysell L. Plicae palatinae transversae and papilla incisiva in man: a morphologic and genetic study. *Acta odontologica scandinavica*, 1955, 13(suppl. 18):1-137.
4. Le Bret L. Physiologic tooth migration. *Journal of dental research*, 1964, 43: 610-8.
5. Peavy Jr DC, Kendrick GS. The effects of tooth movement on the palatine rugae. *Journal of prosthetic dentistry*, 1967, 18:536-42.
6. Van der Linden FP. Changes in the position of posterior teeth in relation to rugae points. *American journal of orthodontics* 1978, 74:142-61.
7. Ryden H, Bjelkhagen H. Tooth position measurements on dental casts using holographic images. *American journal of orthodontics*, 1982, 81:310-3.
8. Abou El-Fotoh MM, El-Sharkawy GZ. A study of palatal rugae pattern (rugoscopy) in an Egyptian population. *Egyptian dental journal*, 1998, 44:3177-84.
9. Thomas CJ, Van Wyk CW. Elastic fibre and hyaluronic acid in the core of human palatal rugae. *Journal de biologie buccale*, 1987, 15:171-4.
10. Barwart O, Rickter M. Removable Nance appliance. *Journal of clinical orthodontics*, 1996, 30:447-9.