ANGULAȚIA RADICULARA MEZIODISTALA A CANINULUI-EVALUARE RADIOLOGICA LA PACIENȚII ORTODONTICI

CANINE MESIODISTAL ROOT ANGULATION-PANORAMIC RADIOGRAPHIC ASSESSMENT IN ORTHODONTIC PATIENTS

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Abstract:

Introduction: The objective of this study was to evaluate, through panoramic radiographs, the mesiodistal axial angulation of the canines in patients with dental maxillary anomaly with crowding.

Methods: The experimental sample consisted of 30 patients (15 male, 15 female) in permanent dentition, treated with fixed appliances. Panoramic radiographs of the patients were taken at the beginning (T1) and at the end (T2) of the treatment. The mean values of the canine axial angulation at T2 were compared with the mean values at T1 and correlated with gender and associated anomalies. Data were analyzed with Pearson and Spearman's correlation.

Results: The mesiodistal axial angulation of the canine differed significantly between T1 and T2. Dental maxillary anomalies with crowding associated with class I and class III malocclusion have a significant effect on canine angulation.

Conclusions: The panoramic radiograph is an effective and comprehensible tool for the axial canine position assessment in everyday practice.

Key-words: *panoramic radiographs, canine angulation*

The contemporary society highlights individual appearance and physical beauty; facial and dental aesthetics are considered synonymous with success, social acceptance and appreciation. In line with this statement, the patients' demand for orthodontic treatment involves mainly physiognomic reasons, but the practitioner's goal is to correct malocclusions by positioning the teeth in harmony with the surrounding tissues, achieving an accurate static and dynamic occlusion and improving the patient's aesthetics in a correct morphologic and functional context [3, 21].

When we establish the objectives of the orthodontic treatment, each tooth's 3-dimensional space situation must be evaluated using positional parameters (mesiodistal, vestibulooral, occlusogingival) and angular parameters (mesiodistal angulation, vestibulooral inclination, axial rotation). The anterior teeth angulations, mainly those of the canines, define the space that teeth inhabit in the dental arch and have an unequivocal impact on incisors' inclinations and overjet [2, 3].

Mesiodistal axial angulation of the canine is considered as one of the elements influencing static and dynamic occlusion and patient's smile. Crowns might not provide appropriate indications for the angulation and, in addition, the roots need to be evaluated [1, 7, 8].

Positioning the teeth with near parallel root at the end of the active mechanics reside in an important element for treatment stability and this objective can be achieved more easily with pre-angulated braces that are commonly used in everyday practice [3, 7, 16].

The aim of this study was to assess through panoramic radiographs, the mesiodistal axial angulation of the canine in orthodontic patients with dental maxillary anomaly with crowding. We evaluated the correlation between this angular parameter of the canine and patient gender and associated anomalies.

Material and method.

The experimental sample consisted of 60 panoramic radiographs of 30 patients (15 male,

15 female) undergoing orthodontic treatment. All patients were in permanent dentition, aged between 14 and 17 (average 15.23 years old) and the orthodontic treatment duration was between 18 and 32 months (average 25.40 months). All subjects were treated orthodontically with fixed appliances (Roth prescription for straight wire technique), with first premolars extractions, by the same clinician. The informed consent of the patient was obtained before the orthodontic treatment.

Radiographs were performed at the beginning of the treatment (T1) and prior to debonding (T2) at the end of the treatment. The sample was selected according to the following criteria:

1. All radiographs were taken with the same machine (Planmeca Proline, Helsinki, Finland) by the same operator, under standard conditions with a cephalostat, with the clinical Frankfort horizontal plane parallel to floor and the facial midline plane in a vertical position [9, 12, 24].
2. All patients presented dental maxillary anomaly with crowding, associated with other anomalies and the space discrepancy above 5 mm.
3. All permanent teeth were present with the possible exception of third molars (no loss or agenesis of any permanent teeth).

Mesiodistal canine angulation was appreciated according to the literature using specific reference lines: the upper horizontal (the most inferior points of the right and left orbits), the lower horizontal (the centre of the right and left mental foramens), cusp tip (used as a reference point for the canines), root end (represented by the root apex) and as a complementary reference root canal image [23]. Data were collected and analysed statistically using SPSS for Windows application. Specific tests were performed and the results were considered significant for p value lower than 0.05.

Results

At the beginning of the treatment, the mean values for mesiodistal axial angulation of the canine were variable, in accordance with the space discrepancy, revealing greater values for the female gender (f) when compared to the male gender (m), especially in the lower arch. Non-significant statistical gender differences were found when comparing the mean values of mesiodistal axial angulation of upper right canine, at the beginning of the treatment (Table 1).

Topography	Gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.	p value
Upper Right	f	87.47	3.80	0.98	85.36	89.57	81	95	
	m	86.60	1.96	0.51	85.52	87.68	83	89	0.60
Upper Left	f	88.07	4.95	1.28	85.33	90.81	81	95	
	m	83.87	3.38	0.87	82.00	85.74	79	97	0.01
Lower Right	f	84.80	7.37	1.39	81.82	87.78	76	93	
	m	78.33	5,19	1.34	75.46	81.21	74	95	0.002
Lower Left	f	89.27	8.83	2.28	84.38	94.16	81	113	
	m	78.40	4.67	1.21	75.81	80.99	72	87	0.002

Table 1. Means and standard deviations of the mesiodistal axial angulations of the canines at the beginning of the treatment (T1)

At the end of the orthodontic treatment, the values were higher in the upper arch compared to the lower arch, for both genders. Non-significant statistical gender differences were found for upper left canine at the end of the treatment (Table 2).

Topography	Gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.	p value
Upper Right	f	90.13	1.46	0.38	89.33	90.94	88	93	
	m	89.00	1.25	0.32	88.31	89.69	87	91	0.04
Upper Left	f	89.40	1.35	0.35	88.65	90.15	88	92	
	m	89.80	2.64	0.68	87.94	90.86	86	98	0.58
Lower Right	f	87.67	1.63	0.42	86.76	88.57	85	90	
	m	85.80	1.42	0.37	85.01	86.59	84	89	0.004
Lower Left	f	87.93	3.39	0.88	86.06	89.81	83	96	
	m	84.67	2.32	0.60	83.38	85.95	82	89	0.005

Table 2. Canine mesio-distal angulation at the end of the treatment (T2)

According to gender, the mesiodistal axial inclination proved to be smaller for the lower right canine and higher for the upper right and lower left canine, with statistically significant differences, for females (Table 3).

Topography T2-T1	gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.	p value
Upper Right	f	2,67	3,02	0,78	1,00	4,34	-3	8	0.77
	m	2,40	1,76	0,46	1,42	3,38	0	5	
Upper Left	f	1,33	4,91	1,27	-1,39	4,05	-8	9	0.02
	m	5,53	4,29	1,11	3,16	7,91	-3	15	
Lower Right	f	2,87	5,08	1,31	0,05	5,68	-7	10	0.007
	m	7,47	4,90	1,26	4,75	10,18	-8	12	
Lower Left	f	-1,33	7,09	1,83	-5,26	2,59	-17	7	0.001
	m	6,27	4,43	1,14	3,81	8,72	-2	16	

Table 3. Gender distribution for mesiodistal axial canine variation during orthodontic treatment

When comparing initial and final values for canine angulations, in correlation with associated anomalies, we observed significant statistical differences for the lower left canine in class I patients, and for the lower right canine in class III patients (Table 4, 5).

Topography T2-T1	Gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.	P value
Upper Right	f	2,75	2,33	0,47	1,77	3,73	-2	8	0.34
	m	1,67	2,88	1,17	-1,35	4,68	-3	5	
Upper Left	f	2,75	4,53	0,93	0,84	4,66	-8	9	0.14
	m	6,17	6,31	2,57	-0,45	12,78	-4	15	
Lower Right	f	4,33	5,51	1,13	2,00	6,66	-8	11	0.06
	m	8,50	3,83	1,57	4,48	12,52	1	12	
Lower Left	f	1,33	7,36	1,50	-1,78	4,44	-17	16	0.002
	m	7,00	1,41	0,58	5,52	8,48	5	9	

Table 4. Variation of mesio-distal canine angulation in patients with associated class I anomaly

Topography T2-T1	Gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.	P value
Upper Right	f	2,31	2,35	0,46	1,36	3,26	-3	8	0.20
	m	4,00	2,83	1,41	-0,50	8,50	2	8	
Upper Left	f	3,35	5,10	1,00	1,29	5,41	-8	15	0.81
	m	4,00	5,03	2,52	-4,01	12,01	-3	9	
Lower Right	f	6,19	4,76	0,93	4,27	8,11	-7	12	0.02
	m	-1,50	5,32	2,66	-9,97	6,97	-8	5	
Lower Left	f	2,65	7,39	1,45	-0,33	5,64	-17	16	0.71
	m	1,25	3,59	1,80	-4,47	6,97	-2	6	

Table 5. Variation of mesiodistal canine angulation in patients with associated class III anomaly

For patients with class II anomaly associated with crowding we did not notice significant variation in the canine axial angulation (Table 6).

Cl.II/1									
Topography T2-T1	Gender	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean	Min.	Max.	P value	
Upper Right	0	2,11	2,49	0,59	0,87	3,35	-3	8	0.25
	1	3,17	2,29	0,66	1,71	4,62	0	8	
Upper Left	0	3,44	5,53	1,30	0,69	6,20	-6	15	0.99
	1	3,42	4,34	1,25	0,66	6,17	-8	9	
Lower Right	0	3,61	6,02	1,42	0,62	6,61	-8	12	0.07
	1	7,50	3,45	1,00	5,31	9,69	1	11	
Lower Left	0	1,28	7,03	1,66	-2,22	4,77	-17	11	0.26
	1	4,25	6,80	1,96	-0,07	8,57	-9	16	
Cl.II/2									
Upper Right	0	2,52	2,77	0,60	1,26	3,78	-3	8	0.97
	1	2,56	1,51	0,50	1,40	3,72	0	5	
Upper Left	0	3,86	4,96	1,08	1,60	6,12	-8	15	0.49
	1	2,44	5,27	1,76	-1,61	6,50	-6	9	
Lower Right	0	5,76	5,31	1,16	3,35	8,18	-8	12	0.28
	1	3,78	5,78	1,93	-0,67	8,22	-7	9	
Lower Left	0	4,10	5,57	1,21	1,56	6,63	-9	16	0.049
	1	-1,33	8,70	2,90	-8,02	5,36	-17	11	

Table 6. Variation of mesiodistal canine angulation in patients with associated class II anomaly

Discussions

The conventional panoramic radiograph serves as a diagnostic tool most often used to assess the teeth and their axial inclinations and to evaluate root parallelism prior to, during, and after orthodontic treatment. [20, 23] Despite their widespread use, conventional panoramic radiographs have been criticized for their dimensional inaccuracy. [22, 24] Larheim and Svanaes emphasized that horizontal measurements were unreliable. [11] Angular measurements, such as axial tooth inclinations, are not as variable and in line with this statement, accurately assessing mesiodistal tooth angulation with panoramic radiograph is possible. [1, 2, 13, 14]

When the treatment was initiated, the mean values were greater in the upper arch compared to the lower arch and we noted the same hierarchy at the end of the treatment. The ideal mesiodistal

root positioning is still dubious in the literature. Some authors defend that finishing with parallel roots reduces the risk of space reopening after space closure mechanics. [16, 18, 21]

For the canines evaluated in our study, reduced angulation necessitates less space, in line with the space discrepancy encountered in dental maxillary anomaly with crowding diagnosis for the orthodontic patients enrolled in this study. This has special importance for cases treated with extractions - correcting canine position demands space and for this reason more attention must be given to anchorage and mechanics. The objectives of the orthodontic treatment include functional occlusion, aesthetics, and stability, elements that are possible to be reached by establishing appropriate axial inclinations of the teeth with near parallel roots especially when closing extraction sites, which are more susceptible to open if adjacent teeth are not parallel [8, 19, 25]. In line with these, values must be closed to 90 degrees, in order to obtain a functional and stable occlusion. For the canines analysed in our study, values were closer to 90°, at the end of the treatment, especially in the upper arch.

Patient gender has an effect on canine axial angulation- values measured reveal to be higher in females compared to males at the beginning and the sequence remains the same at the end of the treatment. For the mandibular canines, the present study revealed a more upright position in their bony bases after the orthodontic treatment compared to the maxillary canines. The differences are statistically significant and smaller for the female gender for the left side. This result may be related to local factors: alveolar bone development, crowding and the difference that could exist in muscles activity between the right and the left side of the same patient and among the 2 genders. [4, 6, 10, 15, 17, 25]

Associated anomalies act particularly on the canine axial angulation: differences were significant for the lower left canine in class I patients, for the lower right canine in class III patients and in a smaller amount in class II patients. The findings of our study showed that the space discrepancy exerted a greater influence on mesiodistal axial angulations of the canine and associated anomalies can demand particular biomechanical features in order to arrive at a correct dental position. [5, 14, 24]

Conclusions

Within the limitation of our study the subsequent conclusion can be exposed:

- The panoramic radiograph proved to be an important and valuable tool for assessing mesiodistal axial angulation.
- Canine movement and variation in mesiodistal angulation are related mainly to patient gender.
- If this radiograph is taken before the braces are removed, some changes in the axial angulation can be performed, thus improving tooth position and case stability, as accurate angulation is directly related to dental alignment.
- The assessment of mesiodistal tooth angulation with panoramic radiography should be reinforced by a thorough clinical examination of the dental arches.

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