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DEPARTMENT OF ORTHODONTICS AND PAEDIATRIC DENTISTRY

DIVISION OF ORTHODONTICS

COMPARISON OF CANINE AND PREMOLAR ROOT LENGTHS BETWEEN GROUP FUNCTION AND CANINE GUIDED OCCLUSIONS

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BY

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DECLARATION

I, Mpule Annah Lerato Moshaoa, declare that this research report is my own work. It is being submitted for the degree of Master in Dentistry in the branch of Orthodontics at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other University.

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ABSTRACT

Background: During orthodontic treatment, the maxillary canines are commonly extruded to give a patient canine disocclusion, without the clinician having previously checked as to whether the presenting function was canine guided occlusion or group function occlusion. There is a general belief that the roots of canines are longer than premolars and therefore are able to better withstand occlusal forces than the other teeth. **Aim**: The aim of this research was to compare the root lengths of the canines and premolars between and within subjects with canine guidance (CG) and group function (GF). **Methods**: Root lengths of canines and premolars were measured on periapical radiographs and compared between and within subjects with CG and GF. **Results**: The canine roots were generally longer than those of the premolars in both groups. However, this difference was much greater in the CG group compared with GF. Premolar roots in GF were significantly longer than in CG. **Conclusion:** Canine and premolar root lengths are fairly similar in GF but not in CG, where the canine roots are much longer than premolars. The roots of premolars in GF occlusion are longer than those in CG occlusion. There is no difference in root lengths of the canines between CG and GF occlusions.

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Concepts of dental occlusion have been a subject of discussion over many decades. The term ”occlusion” originates from the Latin word *“occludere*” meaning shutting up or the act of closure, or the state of being closed. In dentistry, occlusion refers to the relationship of maxillary and mandibular teeth during function, as well as when the mandible is in a static closed position.

The first definitive description of the occlusal relationships of the teeth was made by Edward Angle in 1899. His classification of occlusion was an important step in the description of malocclusion since it not only subdivided major types of malocclusion but also included a clear and simple definition of “normal occlusion” in the natural dentition (Angle, 1899). Angle’s postulate was that the maxillary first molars were the key to occlusion and that the maxillary and mandibular molars should be so related that the mesiobuccal cusp of the upper first molar occludes in the mesio-buccal groove of the lower first molar. If the teeth were arranged on a smoothly curving line of occlusion and this molar relationship existed, then normal occlusion would result (Fig 1).

Angle then described three classes of malocclusion, based on the occlusal relationships of the first molar:

- Class I: normal relationship of the molars, but line of occlusion incorrect because of malpositioned teeth, rotations or other causes.
- Class II: lower molar distally positioned relative to upper molar.
- Class III: lower molar mesially positioned relative to the upper molar (Angle, 1899).

Several types of functional occlusal patterns have since been formulated to describe relationships of the natural teeth during active excursions of the mandible, recognising that the teeth come into definite contact on one side during mastication (the working side) but not necessarily on the other (the non-working side). These

Figure 1: Classification of Class I occlusion according to Edward Angle. The mesio-buccal cusp of the maxillary first molar occludes in the mesio-buccal groove of the mandibular first molar.

concepts include group function, canine guided occlusion, flat plane teeth (attritional) and biologic (multi-varied) occlusions. “Balanced occlusion” was the first significant concept developed to describe optimum functional occlusion which advocated bilateral and balancing tooth contact during all lateral and protrusive movements (Sears, 1924). According to Sears (1924), balanced occlusions demonstrate contact positions of the masticatory surfaces so distributed that forces simultaneously applied at these contact points will maintain equilibrium. Four physical factors that govern balanced occlusion are:

1. arrangement of masticatory surfaces
2. jaw relations
3. direction and magnitude of forces applied
4. tissue resilience

This concept was developed primarily for complete dentures, with the rationale that this type of bilateral contact would aid in stabilizing the denture bases during mandibular movement (Sears, 1924).

Canine guided occlusion, which occurs when there is dis-occlusion of all other teeth by the working side canines during lateral excursions (Fig 2), is attributed to Nagao (1919), Shaw (1924), and D’Amico (1958). Canine guidance is also known as canine protected occlusion, mutually protected occlusion, canine disoclusion, canine lift, and canine rise (Thornton, 1990). Nagao (1919) stated that canines are the most appropriate teeth to guidance the mandible during lateral excursions. His theory was supported by Shaw (1924), and D’Amico (1958).The assumptions upon which the canine dominance theory came into being were:

- The maxillary canine has a good crown:root ratio capable of tolerating high occlusal forces.
- The canine root has a greater surface area compared with adjacent teeth, thereby providing greater periodontal tissue and enhanced proprioception.
- The shape of the palatal surface of the crown of the upper canine is concave and it is suitable for accommodating the crown of the lower canine during lateral mandibular movements.

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Figure 2: Demonstration of canine guided occlusion. Left lateral excursion with only the canine in contact while the rest of the teeth are in disclusion.

- The canines, upper and lower, are surrounded by dense compact bone, which tolerates the forces better than does the medullary bone. (Nagao, 1919, Shaw, 1924, and D'Amico, 1958).

In natural canine-guided occlusions, the pattern of function is vertical and the mandible does not perform marked lateral movements that would subject the canines to stress. The canines assume the role more as a guidance that actuates vertical function rather than as a resistor to lateral stress (Mohan & Siyihayanan 2012). It would appear that fewer muscles are active when canines contact during eccentric movements than when posterior teeth contact (Williamson & Lundquist, 1983). It is important to recognise and understand the nature of tooth contacts and the patterns of function that occur as they differ according to the type of the functional scheme.

The alternative to canine guidance is group function (Figure 3) which occurs when the buccal cusps of the posterior teeth on the working side are in contact during lateral movements. There is no contact on the non-working side (Clark & Evans, 2001). The most desirable group of teeth that participate in this movement include the canine, premolars, and, sometimes, the mesio-buccal cusp of the first molar.

A further concept of dynamic individual occlusion was proposed by Wigmore (1992) based on evaluation of the health and function of each individual's masticatory system. Useful in this evaluation of the dynamic and static positions of the mandible is the assessment of three factors as determined by Slavicek, (1988):

- The morphology of the occlusal surfaces of the teeth, this being the most dominant determinant of the mandibular position.
- The morphology of the hard and soft tissues of the temporomandibular joints (TMJ).
- The functional programme of the neuromuscular system and the influence of proprioception.

Figure 3: Demonstration of group function occlusion. Right lateral excursion and all the teeth in the buccal segments, including the canine, premolars, and mesio buccal cusp of first molar are in contact on the working side.

Some investigators have attempted to associate certain centric occlusions with particular types of functional occlusion presented by individuals. According to Scaife & Holt (1969) there is a predominance of canine guided function in Class I and Class II occlusions, but it is almost never seen in Class III patterns. In contrast, Tipson and Rinchuse (1991) found no relationship between the type of malocclusion and the functional occlusal scheme. Nevertheless, the nature of tooth contacts which occur in centric closure and during eccentric movement of the mandible have been demonstrated to have a profound effect on the periodontium, muscles and the TMJ (Moller and Bakker, 1988).

The number, placement and distribution of occlusal contacts control muscle activity and joint function during biting and chewing. This control implies that the inter-cuspal position is determined by positive feedback, that is, by afferent activity that varies with occlusal stability. Consequently, dental treatment that alters this input may also alter the coordination of the muscles of mastication and the function of the temporomandibular joints (Moller and Bakker, 1988).

It is important, then, for the orthodontist to consider the type of functional occlusion the patient has before orthodontic treatment. Altering the established occlusal function could possibly result in detrimental effects. The usual set up of a fixed orthodontic appliance provides for extrusion of the canines, thereby giving rise to canine guided occlusion as a treatment result even in cases where it had not been present initially. This stems from the common conception that canine guidance is preferred to group function and hence the brackets are placed highest on the maxillary canines. Canine guidance is imposed without consideration being given to the initial functional occlusal scheme. There is no information as regards differences in root morphology, if any, between canines and premolars in either group function or canine guided occlusion. Also, it has not been shown what happens in the long term to masticatory patterns in those patients who originally had group function occlusion but were treated to provide canine guided occlusion during orthodontic treatment.

Studies have been conducted on the prevalence of either group function or canine guided occlusion, with some investigators demonstrating a predominance of canine guided occlusion (D'Amico, 1958; Scaife & Holt, 1969) while others reported contrary findings with group function being the more prevalent (MacMillan, 1930; Beyron, 1964). In general, no single type of occlusion has been shown to predominate in nature (Tipson and Rinchuse, 1991; Wigmore, 1992).

While it is generally assumed by orthodontists that when the teeth are aligned and placed in good intercuspation, good function will follow, it is important for the practitioner to consider whether a relationship exists between static occlusion and functional occlusion. Rinchuse and Sassouni (1983) were of the opinion that static occlusion and functional occlusions are separate entities. Most orthodontists routinely treat to canine guided occlusion. This might be due to the fact that canines are thought to have a larger root that is able to withstand the occlusal forces placed upon them. It may be advantageous to determine the type of functional occlusion prior to initiating orthodontic treatment.

Despite the proven response of the supporting tissues of the occlusal unit to functional demands (Moller and Bakker, 1988), there is no evidence to show that the canine and premolar roots of individuals with group function are adapted to withstand the force that is placed upon them, nor whether the canine root in canine guidance systems is consistently larger. Indeed the question may be posed as to whether there is any correlation between the morphologies of the roots and the particular functional patterns to which they are subjected.

CHAPTER II

STATEMENT OF PURPOSE

Common goals of orthodontic treatment are to achieve good function and aesthetics. Bracket placement may predetermine extrusion of the maxillary canines resulting in canine guided occlusion which may not have existed prior to orthodontic treatment. This is based on the assumption that the canine has better root morphology compared with the premolars and can better withstand the occlusal forces during excursive movements. However, there is no information in the literature suggesting that maxillary canine root lengths in canine guided function are consistently different from those seen in group function occlusion. The aim of this study was to establish whether a relationship exists between the type of functional occlusion that an individual has and the root length of the canine. *The hypothesis is that canine root length in patients with group function is similar to that of the premolars, while patients with canine guided occlusion demonstrate larger canine root lengths than premolars*.

SPECIFIC OBJECTIVES

The specific objectives of this project were:

1. To compare the root lengths of canines to those of premolars:
   a) within the sample of patients presenting canine guided functional occlusion (CG group) and
   b) within the sample of patients presenting group function type of functional occlusion (GF group)
2. To compare the root lengths of canines between canine guided (CG) occlusion and group function (GF).
3. To compare the root lengths of the premolars between CG and GF.

CHAPTER III

MATERIAL AND METHODS

STUDY DESIGN

This was a chart review of the records of patients who had received dental treatment. Consent was obtained from the respective dentists to retrospectively review the available records. No patients were contacted to actively participate in this study. All reference to “subjects” is about the patient files that were included in the study. The study was approved by the Human Research Ethics Committee at the University of the Witwatersrand (M131180).

Inclusion criteria

The subjects fulfilled the following criteria in order to form part of the sample:

- Comprehensive patient records with good documentation of the functional occlusion was used; either group function or canine guided occlusion.
- Full permanent dentition up to the first permanent molars.
- All teeth in contact during centric occlusion.
- Good quality digital periapical radiographs showing the apices and CEJ’s of the teeth in the buccal segments with no evident distortion.

Exclusion criteria

- History of orthodontic treatment.
- Severe wear or attrition.
- Severely crowded teeth.
- Severely shortened roots as in apicectomy.
- Severe dilacerations.

Root Length Measurements

A Digital Vernier Caliper (GRIP, 0-150mm, Metric/S.A.E. System Conversion, Santa Ana, Ca, USA) was used to measure the root lengths of the maxillary canines and premolars from the digital periapical radiographic images which were supplied by the participating dentists. To measure these lengths, two points were first identified on the mesial and distal margins of the tooth at the level of the cemento-enamel junction (CEJ). The two points were connected to form a transverse reference line of measurement. The root length was then measured from the furthest most identifiable point on the apex of the root as a perpendicular to the reference line (Fig 4). Both the first and second premolars were measured and the average of the two was computed and used as the premolar root length. Where the first premolar had two roots, the longer root was chosen for the measurements.

For purposes of consistency, the measurements were performed during the same time of the day. However, the sequence of measurements of the two groups was randomized such that one did not start with the same group every day. All measurements were conducted by the same investigator. Measurements were done on the right side only, with the right side being chosen for consistency. Radiographs that were measured were of subjects having canine guidance or group function on both the right and the left sides.

Error of method

1. *Machine Error and Magnification*: An object of known dimension was subjected to the same imaging as the radiographs, was electronically measured by the operator, and a comparison made between the digital measurement and the known measurement. A standard deviation of less than 5% was required as evidence of the capability to use the system accurately. The values used were of the magnified image.

2. *Operator error*: Before the commencement of the study, the operator repeatedly measured root lengths on the periapical radiographs until there was consistently accurate identification of the landmarks. Subsequently, ten periapical radiographs were randomly selected and the described measurements recorded on two separate occasions at least 24 hours apart. Dahlberg's formula: $D=[\sum_{i=1}^{N}(d_i^2/2N)]^{1/2}$ (Dahlberg, 1940) was then applied to assess error of measurement.

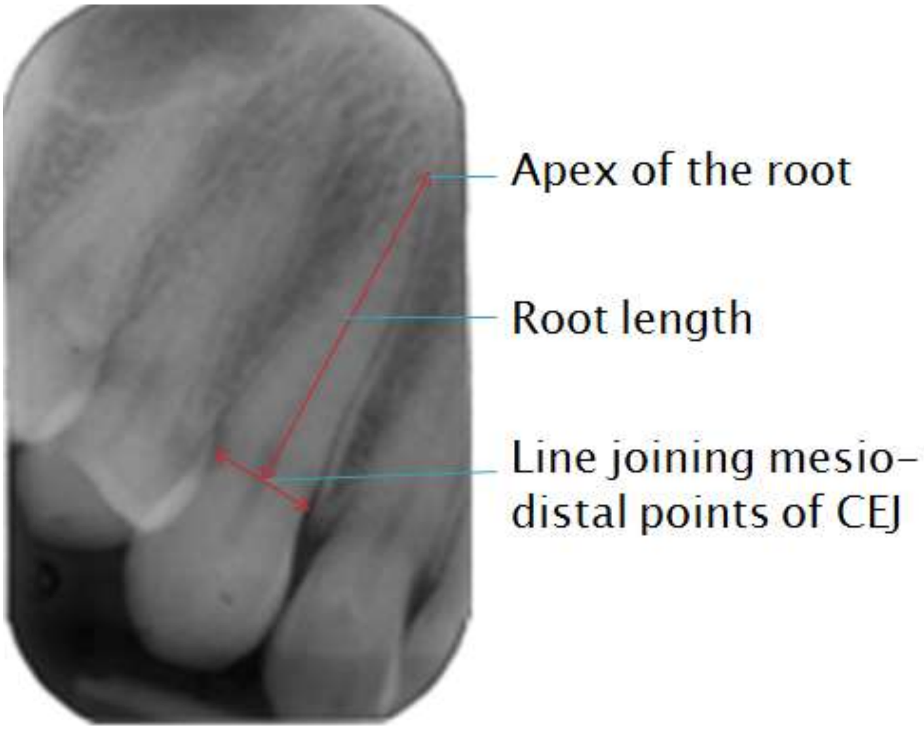

Figure 4: Measurement of root length. Root length was measured as the perpendicular distance from the root apex to a line connecting mesial and distal points on the image of the tooth at the level of the CEJ.

Statistical Analysis

All data were imported into SAS (SAS© Institute, Carrey, NC, version 9.1) where the statistical comparisons were conducted. Depending on the distribution of the data, the paired *t*-test was used to compare the lengths of the roots between the canine and premolar teeth within the same functional occlusion. Otherwise, non-parametric tests were utilised for the statistical comparisons between the two groups.

CHAPTER IV

RESULTS

SAMPLE DISTRIBUTION

Two hundred and forty periapical radiographs were initially collected. Twenty two radiographs were excluded due to non-fulfilment of the inclusion criteria as follows: three teeth had severe dilacerations, 11 had root apices that were not clearly visible, and eight of the radiographs showed the canine and first premolar but not the second premolar. This left a final sample of 218 periapical radiographs. This information is displayed in Table I.

All the racial groups of note in South Africa were represented though not in equal proportions. The sample distribution by race is shown in Table I. No statistical comparisons of significance could be done of this parameter because of the small cell sizes when the data were stratified by race.

The sample included 117 female subjects amongst whom 57 had been found to have canine guided occlusion (CG) and 60, group function (GF). Of the 101 male subjects, 66 were recorded as CG and 35 were GF occlusion (Tables II & III).

The minimum and maximum ages were 12 and 61 years, respectively in the canine guidance (CG) whilst in the group function (GF) it was 12 to 46 years. The Wilcoxon Rank Sum test showed no significant difference in age between the groups ($p = 0.89$). With the two groups combined, the mean age was 23.11 years (±9.31 years) (See Table IV).

ERROR OF MEASUREMENT

Dahlberg’s formula yielded an error of measurement of 0.0392 mm, which was considered non-significant.

TABLE I. Sample demographics. B = Black, C = Coloured, I = Indian, W = White, OCCLUDE = Type of functional occlusion, i.e. canine guided occlusion (CG) or group function occlusion(GF).

	Race				
OCCLUDE	B	C	I	W	**Total**
CG	13	4	5	101	**123**
GF	30	2	3	60	**95**
Total	43	6	8	161	**218**

TABLE II. Female distribution according to race and type of functional occlusion. B = Black, C = Coloured, I = Indian, W = White.

	Occlusal Scheme		
RACE	CG	GF	**TOTAL**
B	9	22	31
C	1	2	3
I	3	2	5
W	44	34	78
TOTAL	**57**	**60**	**117**

TABLE III. Male distribution according to race and type of functional occlusion. B = Black, C = Coloured, I = Indian, W = White.

	Occlusal Scheme		
RACE	**CG**	**GF**	**TOTAL**
B	4	8	12
C	3	0	3
I	2	1	3
W	57	26	83
TOTAL	**66**	**35**	**101**

TABLE IV. Age distribution between canine guidance and group function occlusions. OCCLUDE = type of functional occlusion, std = standard deviation. CG= canine guided occlusion, GF = group function occlusion,

		Summary Statistics (years)				
OCCLUDE	**N**	**Mean**	**std**	**Min**	**Max**	**|p|**
CG	123	23.4	10.11	12	61	
GF	95	22.73	8.18	12	46	
Total	**218**	**23.11**	**9.31**	**10**	**61**	**0.89**

COMPARISON OF ROOT LENGTHS WITHIN THE SAME FUNCTIONAL OCCLUSAL SCHEME

CANINE GUIDED OCCLUSION

The *t-test* showed that the roots of the canines were significantly longer (24.01mm, ± 3.02) than those of the premolars (15.58mm, ± 2.17). The mean difference between the two (DIFF34) was 8.42mm (± 2.65) which was statistically significant ($p<0.0001$). This information is displayed in Tables V and VI, respectively.

GROUP FUNCTION OCCLUSION

The t-test revealed a statistically significant difference between the mean lengths of the roots of the canines and premolars in the group function sample ($p<0.0001$). The mean root length of the canine was 19.07mm (± 2.14) and that of the premolars was 17.47mm (± 2.10) with a mean difference (DIFF34) of 1.6mm, (±1.19) between the two groups (Tables V & VI).

COMPARISON OF ROOT LENGTHS BETWEEN CANINE GUIDED OCCLUSION AND GROUP FUNCTION

The root lengths of canines in canine guided occlusions were significantly longer than those of the canines in group function occlusions ($p<0.0001$). The mean length in the CG sample was 24.01mm (± 3.02) while that of GF sample was 19.07mm (± 2.14). The mean difference between the two measurements was 4.96mm. (See Tables VI and VII).

The roots of the premolars in group function were longer (17.47mm, ± 2.10) than those in canine guided occlusion (15.58mm, ± 2.17). The mean difference of premolar root lengths between the two functional schemes was 1.89mm which was statistically significant at $p<0.0001$. (See Tables VI and VII).

TABLE V: Summary statistics of the variables. UR3= Upper right canine. URPM= root lengths of the premolars computed as the average of the sum of the 1st and 2nd premolars. DIFF3/4= Difference in mean root lengths between the canines and premolars. RATIO= Ratio of premolars to the canines. LCL = lower confidence interval, UCL = upper confidence interval.

VARIABLE	GROUP	N	Mean	std	Min	Max	LCL	UCL
UR3	CG	123	24.01	3.02	16.71	29.71	23.47	24.54
	GF	95	19.07	2.14	14	24.21	18.63	19.51
URPM	CG	123	15.58	2.17	10.92	21.03	15.2	15.97
	GF	95	17.47	2.1	12.2	22.96	17.04	17.9
DIFF3/4	CG	123	8.42	2.65	1.86	16	7.95	8.89
	GF	95	1.6	1.19	-0.5	6.44	1.35	1.84
RATIO 4:3	CG	123	0.65	0.08	0.45	0.92	0.64	0.67
	GF	95	0.92	0.06	0.68	1.02	0.91	0.93

TABLE VI. Results of the Wilcoxon rank-sum test for comparisons within the two occlusal schemes.

VARIABLE	GROUP	N	Mean	std	WITHIN
DIFF3/4	**CG**	123	8.42	2.65	<0.0001
	GF	95	1.6	1.19	<0.0001

Table VII. Summary statistics for the mean **differences** in root lengths between CG and GF for the premolars and canines. Also shown is the differences in the ratios of the premolar length to the canine length between CG and GF.

VARIABLE	Mean	LCL	UCL	P-Value
URPM	-1.89	-2.46	-1.31	<0.0001
UR3	4.94	4.25	5.63	<0.0001
RATIO 4:3	-0.26	-0.28	0.24	<0.0001

CHAPTER V

DISCUSSION

Dentists and orthodontists in general believe in canine dominance. Bracket placement is designed to extrude the canines hence providing canine guided occlusion, quite apart from aesthetic considerations. This research was undertaken to assess the anecdotal information that canine dominance is the occlusal equivalent of the lion being called “king of the jungle”. Three questions were addressed:

1. Do the canines always have larger root lengths than premolars in both canine guided occlusion as well as group function?
2. Are the root lengths of the canines similar in both group function and canine guided occlusion?
3. Are the root lengths of the premolars equal or different between group function and canine guided occlusion?

This discussion focuses on these three objectives as the data were presented in the results.

In comparing data from the samples of the two functional schemes, this study has shown that the roots of the maxillary right canines were significantly longer in the canine guided occlusions whilst the maxillary right premolars had significantly longer roots in the group function occlusions. The evidence showed that the canine root was dominant over the premolar roots in canine guidance occlusions whilst there was a much smaller but statistically significant difference between canine and premolar roots in group function occlusions (Tables V, VI and VII). Confirming this relationship, the ratio of root lengths of premolar to canine in group function was almost 1:1 (0.92), while in canine guided occlusion, the premolar to canine root ratio was definitely smaller (0.65).

It is tempting to ascribe these differences to functional demands ((Nagao, 1919, Shaw, 1924, D’Amico, 1958). Indeed the Form versus Function equation seems to answer quite nicely. Popularized by Moss in the 1960’s, the concept that function determined the form continues to intrigue. Moss believed that growth and development of the face occurs as a response to functional needs and neurotrophic influences. The theory would support the claim that the root lengths of the canines are longer in the canine guided occlusion simply because there are increased functional demands on this tooth. With equal confidence, the theory would explain the relatively similar root lengths of canine and premolars in group function occlusions as being related to a more equal distribution of functional stresses.

Whilst the data in this study do offer evidence supportive of the role of functional demands, there are further considerations to be explored. The study restricted data collection to the maxillary right upper segment. It is well known that there is a tendency for individuals to favour one side when masticating. Applying the logic of Moss's theory, there should then be a further difference in root lengths between the side on which mastication habitually occurs with those of the less used segments. If that were the case, then further investigations are indicated before firm conclusions may be reached. Also, the direction of mandibular movement is obviously relevant. Dental practitioners assess mandibular function by having the patient move left or right from the habitual occlusion position, and then assess the functional pattern by observing the relationships of the upper and lower canines and premolars. That is in effect initiating an opening stroke. In practice, however, it is the closing stroke that may deliver the masticatory force which one may claim determines the form of the roots of the teeth. In this regard, Lewin, Evans, & Booth (1995) observed that a signal role of the canines, maxillary and mandibular, was in the provision of multiple periodontal proprioceptive sensors. As the lower teeth approach the upper in a closing stroke, the control messages from the proprioceptive neurons divert the jaw slightly, avoiding a clash of teeth. Under that perception the increased length of root is associated rather with an enhanced area of periodontal membrane which houses the proprioceptive supply.

The study also revealed that the root lengths of premolars in group function occlusion were longer (17.47mm, ± 2.10) than those of the premolars in canine guided occlusion (15.58mm, ± 2.17). This adds to the evidence that the morphology of the roots of teeth may be associated with the functional demands to which they are subjected. If the concepts of Moller and Bakker (1988) are correct, then it becomes important that respect is paid to the pre-existing functional patterns and that treatment is directed to ensure a continuity of that original scheme. Hence careful assessment of the morphology and relative sizes of the roots of canines and premolars is indicated and the distinguishing features identified so that an appropriate decision may be made regarding the treatment objectives which determine occlusal arrangements. The traditional reliance on extrusion of maxillary canines may be challenged. Not all cases present as canine guided occlusions.

The majority of the subjects were Caucasian, a racial group whose majority did demonstrate canine guided type of occlusion. No further information can be deduced from this since racial distribution was not considered in the sample selection. Also, no statistical comparisons could be conducted because of the unequal racial distributions, with some cells presenting with sample size of zero.

Orthodontists at times tend to intrude the canines in order to increase the height of the gingival margin for aesthetic purposes. This is done so as to achieve the "high-low-high" gingival margin contour on the central and lateral incisor teeth and the canines, respectively that is expected for good aesthetics (Kokich & Spear, 1997). Once the intrusion is completed the tendency has been that the clinician would frequently either build the canine or fit a prosthetic crown to the tooth to ensure canine guided occlusion (Thayer, 1984; Auroy & Lecerf, 2010). For the patient originally presenting with group function and based on the findings of this research, it is our opinion that the canine should not be extruded as this can result in deleterious effects (Moller and Bakker, 1988). Changing the type of occlusal pattern may affect the entire masticatory system as muscle activity is different between canine guided and group function occlusions (Williamson & Lundquist, 1983). It is important, then for the practitioner to identify the type of dynamic occlusion prior to initiating treatment.

Further Clinical Applications

There may be difficulty in determining the functional patterns in patients having ectopic canines. Should the treatment aim toward canine guidance or group function? Based on the results of this study, the practitioner could use a radiograph to determine whether the root of the canine is almost similar or much longer than the roots of premolars (Figs 5, 6). If the roots are almost similar, the patient may be assumed to have group function and the canine can thus be placed accordingly.

However, if the root of the canine is long, the patient can thus be provided with a dental arrangement commensurate with canine guided occlusion.

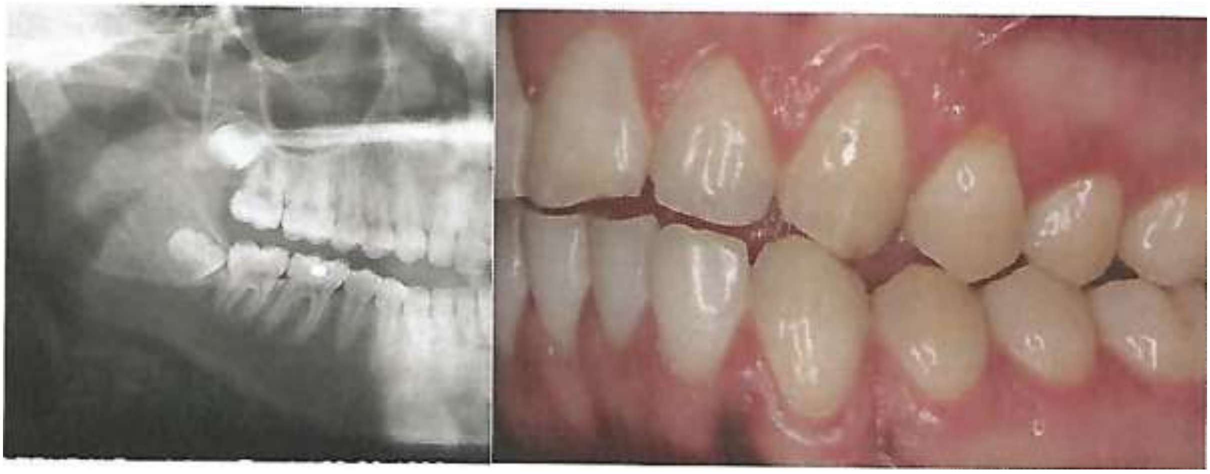

Figure 5. Photographs of a subject with group function. Note similarity in root lengths of the canine and premolars in the radiograph on the left and demonstration of group function on the right.

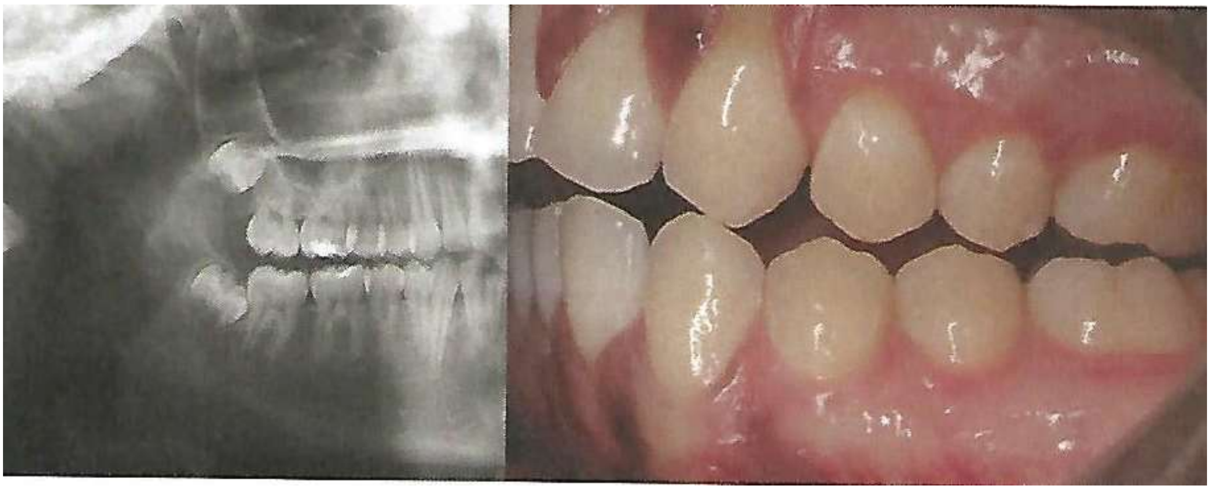

Figure 6. Pictures of a subject with canine guided occlusion. The left half of the picture is a panoramic radiograph showing prominent canine roots while the right side picture shows dis-occlusion of all the teeth except the canines in left lateral excursion.

A second clinical question concerns the case in which the maxillary canine is brought mesially to replace a missing lateral incisor. Now the first premolar must do duty as the canine. The palatal cusp of the first premolar is usually reduced and the type of functional occlusion that results would be GF or CG, depending on the practitioner. It may be most relevant to determine whether a premolar with a relatively short root may serve adequately in a canine guided occlusion.

The third question that came from the study was what happened to those patients who had group function occlusion and were subsequently given canine occlusion? A separate study needs to be carried out in order to determine whether changing the type of occlusion has any effect on the patient, (how they function) on the periodontium, or on the hard tissue structure. Could the gingival recession that is sometimes seen later in life on the canines of patients who had received orthodontic treatment, or the occlusal wear on the canines be due to changing the functional occlusal scheme of a patient?

The study has raised several questions, and follow up studies may be indicated in searching for resolution.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of the study was to establish whether a relationship exists between the type of functional occlusion that an individual has and the root lengths of the maxillary canines and premolars. To achieve this goal, only teeth from the right quadrant were utilized. The study confirmed that in the sample investigated:

- The root lengths of canines that provided disocclusion were much longer when compared with those of premolars. In group function occlusion the root lengths of canines and premolars were almost similar.

- The roots of canines in canine guided occlusion were much longer when compared with those in group function occlusion.

- The roots of premolars in group function occlusion were longer than those in canine guided occlusion.

The recommendation is that a patient should be evaluated at the start of treatment to determine the type of functional occlusion he/she may practice. The clinician should then aim, in treatment, to retain an occlusal scheme which will enable the particular functional occlusion to remain effective. Based on the results of this study, the assumption that canine guided occlusion should be provided for every patient can be challenged.

<u>LIMITATIONS OF THE STUDY</u>

This study was not without limitations. While the objectives were met, more could be done. Specifically;

- Data collection relied on the determination by the relevant practitioner of the functional occlusal scheme of their patients but the clinical presentation could not be confirmed by the researcher. However, the choice of practice ensured that the practitioner had long years of experience and regularly recorded the occlusal schemes of their patients. Despite this limitation, nevertheless the results of the study confirm a statistically significant difference between the groups.

- The periapical radiographs were not taken in a completely standardized manner. A magnification factor was applied to assist in overcoming this limitation.
- While not one of the objectives, information obtained from this study nevertheless showed predominance of canine guidance in the Caucasian while group function was dominant in the black group. However, no comparisons could be done by race because of the unequal distribution of the sample among the different ethnic groups.
- While data was collected from both sides of the arches, the study investigated only the upper right segment. This was a practical solution to the otherwise enormous quantity of data were all teeth included.
- It was extremely difficult to find records for this study as the majority of practitioners do not record the type of functional occlusion. A prospective study, then, will be appropriate to evaluate the effects of providing canine guided occlusion to a previously stable group function.

RECOMMENDATIONS FOR FURTHER RESEARCH

- A research project that assesses the possible effects/results of changing the functional occlusal scheme i.e. what happens to the patients that had group function occlusion and were subsequently given canine guided occlusion?
- Aesthetic considerations between group function and canine guided occlusions.

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