

Sizes of Pulp Chambers of Molars with Severe Root Curvatures: *In Vitro* Comparative Study

SUMMARY

The macro-morphology of pulp chambers has been studied in the last few decades, but there is still a lack of knowledge on sizes of molar pulp chambers. The aim of the present study was to measure the size of the pulp chambers of upper and lower molars with different root curvatures and to compare them with same dimensions in molars without root curvatures.

77 upper and lower molars, matured, fully mineralized and sound were selected in the following groups: 2 groups - upper and lower teeth, and 3 sub-groups, with straight roots up to 25-30°, severe curvatures up to 45° and with abnormalities 45°- 90° from the axial axis. 3 dimensions of the crowns were measured for each tooth in mm: mesio-distal, bucco-lingual, from the top of buccal cusp to the top of the mesio-lingual (palatal) cusp. All teeth were submitted to x-rays and photographed after opening the pulp chambers with horizontal cuts, 1 mm apically from the equator with diamond blend. Both bucco-lingual dimensions were measured as L1 and L2 (the mean as L), and the mesio-distal as MD; sizes were measured in mm with endodontic file and endoblock in the widest part of the pulp chamber.

These findings are important for prevention of crown and root fractures, tooth loss, and the use of crowns and bridges in young age groups.

Key words: Endodontics; Pulp anatomy; Root canals, curved.

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Introduction

Macro-morphology of pulp chambers has been widely studied¹. However, there is a serious lack of knowledge on the sizes in different dimensions of the molar pulp chambers and information on the sizes of pulp chambers of teeth with roots with severe curvatures and root abnormalities also do not exist^{2,3,9,13,15}. This is an important matter for forming the proper sizes of endodontic cavities and preventing iatrogenic errors^{4,11,12}.

All sizes of endodontic cavities are usually defined as distance between cusps from buccal and lingual walls, or from respective walls in relation of the tooth type and sex/age of the patient, not in any relation of the size and anatomy of the particular tooth roots. Very little information can be found concerning sizes of the crowns and roots of molars, but completely out of date, in a book of Wetzel from 1947¹⁵.

Relation between size and shape of the crown and size and shape of the pulp chamber in youth age, and

age changes related to reduction of the pulp chamber parameters, have been established in the dental literature¹. Unfortunately this fact is not always considered during endodontic cavity preparation, leading sometimes to iatrogenic errors^{5,6}. A practical review on sizes of clinical crowns in the last 40 years indicates a significant reduction of the mesio-distal and bucco-lingual dimension of the molars. An important matter is the preparation of the pulp chamber on teeth with massive enamel and dentine loss.

From the literature review of the last 20 years, only 8 articles can be related to the macro-morphology of the molars. 5 of these studies are *in vitro* studies with large variation in the number of cases from 5 up to 700 root canals. Only in 2 of them sizes of the pulp chambers are measured. Only in 1 study differences are observed between “young” and “old” teeth¹. The **aim** of the present study was to measure the range and mean dimensions of the pulp chambers of upper and lower molars with

different root curvatures, and to compare them with same dimensions in molars without root curvatures.

Material and Methods

Teeth: 77 upper and lower molars from both sides. All teeth were matured, fully mineralized and sound.

Groups: 2 groups (upper and lower teeth), and 3 sub-groups (with straight roots up to 25-30°, severe curvatures up to 45°, and abnormalities 45°-90° from the axial axis).

Measurements of the clinical crown: 3 dimensions (in mm) were measured for each tooth: mesio-distal (distance from the approximal marginal ridge), bucco-lingual - from the top of buccal cusp to the top of the mesio-lingual (palatal) cusp, and the height of the crown at the buccal side (h) from the enamel border to the middle part of the line between the cusps.

X-Ray: all teeth were submitted to x-rays and photographed after opening the pulp chamber (Fig. 1).



Figure 1. Pulp chambers of lower and upper molars, measured in the study

Measurements of the pulp chambers: following method was used:

1. The pulp chambers were opened with horizontal cuts with diamond blend, 1 mm apically from the equator.
2. After polishing the ridges, the final size of the chamber was 2 mm bellow the equator.
3. Both bucco-lingual dimensions were measured as L1 and L2, and the mean as L, and the mesio-distal sizes (MD) were measured in the widest part of the pulp chamber.
4. Measurements were performed with endodontic file and endoblock in mm.

Exclusion criteria: non vital teeth, massive tooth losses, teeth with root caries, incisors and premolars, teeth with hypoplasia and non-carries enamel defects and non-matured teeth.

Results

Sizes of the clinical crowns of upper and lower molars, as well as sizes of their pulp chambers, are presented in tables 1 and 2. As it can be seen, all dimensions of pulp chambers in upper molars and most in lower molars of the teeth with root canal curvatures were smaller than the sizes of the pulp chambers of teeth with straight roots.

Table 1. Sizes of pulp chambers of the molars

Size	Up to 25-30° n=20		30-45° n=20		45-90° n=37	
	Upper	Lower	Upper	Lower	Upper	Lower
L1	5.58	4.37	5.01	4.80	5.14	4.15
L2	4.91	3.62	4.14	4.15	4.05	3.55
MD	3.16	3.50	2.57	3.30	3.05	3.25

Table 2. Sizes of clinical crowns of the molars

Type of tooth	Dimension	Mean	Range mm
Upper Teeth n=161	BL	6.5	5.8 – 7.8
	MD	8.1	7.9 – 9.4
	H	4.5	4.0 – 6.2
Lower teeth n=125	BL	5.3	4.0 – 8.0
	MD	9.9	8.0 – 13.0
	H	5.2	3.5 – 7.0

Discussion

The importance of these findings is related to the fact that the bucco-lingual size of the crowns and the pulp chambers are very similar. On the other hand, reducing preparation of hard dental tissues in this area is very important and directly related to the lower amount of active axial root surface bellow this area in teeth with severe root canal curvatures.

The non existing data on the size of the pulp chambers of molars in the literature is a fact. This is an

explanation why, after endodontic treatment, the most common mistakes are: Remaining pulp tissue in retentive lodges in the pulp chamber – sources of infection and periapical lesions, which are 19.8% of all endodontic re-treatments in the Faculty of Dental Medicine in Sofia, shown in our previous study. Non-accurate exposure of pulp chamber is the reason of failures in working length estimation and poor preparation of root canals^{14,16}. Over-preparation of cavity walls and crown fracture, mostly due to over-preparation of medial and distal walls, followed by use of posts and pins, meets in 18.2% of all endodontic treatments.

It is proved in many literature sources that nearly in 50% of all endodontic treatments there are failures especially when it is considered that with age all pulp chambers lower their sizes and orifices migrate up on cavity walls^{6,12}.

Conclusions

1. There is a need of up to date knowledge not only on the pulp anatomy but on pulp chamber sizes and crown sizes of molars with curved roots.
2. A careful approach to these sizes can lead to safe hard dental tissues treatment during endocavity and pulp chamber preparation.
3. Smaller pulp chambers in molars with curvatures can be important knowledge for prevention of crown and root fractures, and teeth losses, as well as to lower need for tooth extractions, use of posts and pins and the use of crowns and bridges in young patients.

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