# AN IN VITRO STUDY ON THE SIZES OF PULP CHAMBERS AND CLINICAL CROWNS OF MOLARS

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**Summary.** The macromorphology of pulp chambers has been carefully studied in the last few decades. But there is a serious lack of knowledge on the sizes in different dimensions of the pulp chambers of molars. Aims of the present study are jo measure the range and mean dimensions of the pulp chambers of upper and lower molars; to detect the relation between the sizes of clinical crowns and pulp chambers for better endocavity preparation. 286 upper and lower molars, 161 first and second upper molars, 125 first and second lower molars – matured, fully mineralized and sound are used for the study. Measurements of the clinical crown-three dimensions for each tooth in mm: mesio-distal, from the approximal marginal ridge, bucco-lingual, from the top of buccal cusp to the top of the mesio-lingual (palatal) cusp. The height of the crown is measured from the buccal side. Measurements of the pulp chambers: 40 randomly selected upper and lower molars, 20 in each group without severe root canal curvatures are measured under the following technology: the pulp chambers are opened with horizontal cuts, 1 mm apically from the equator with diamond blend. After polishing the ridges the final size of the endocavity is 2 mm bellow the equator. Both buccolingual dimensions are measured as L1 and L2, and the mean as L with endodontic file and endoblock in mm. It can be useful for the lecture courses BL sizes less than ½ of the cusp distance to be avoided for endocavity preparation. A careful approach to this sizes of crowns and chambers can lead to safe hard dental tissues during endocavity preparation and especially careful approach to the approximal walls of the teeth. This findings are important for the prevention of crown fractures, of posts and pins and of crowns and bridges in young age groups.

***Key words:*** *macromorphology, pulp chambers, sizes, crowus, molars*

The macromorphology of pulp chambers has been carefully studied in the last few decades. But there is a serious lack of knowledge on the sizes in different dimensions of the pulp chambers of molars. This is an important matter for the proper sizes of endodontic cavities [1, 2, 3, 4, 5, 6, 7, 9]. All parameters of the cavities are usually defined as distance between cusps or mm from the buccal and lingual walls or from respective walls. Very little information other and completely out of date are some sizes of the crowns of molars in one manual of Restorative Dentistry from 1976 [8] and in the translated booklet of Wetzel (1947) [18]. This is the only available literature for our students at the moment. It has been established in the dental literature the relation between the size and shape of the crown and the size and shape of the pulp chamber in youth age and the age changes related to the reduction of the pulp chamber parameters [1]. Unfortunately, this fact is not always considered during endodontic cavity preparations, which often leads to iatrogenic errors. The literature review on the sizes of clinical crowns in the last 40 years shows 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 loses, especially complicated when the opposite or symmetrical teeth are destroyed too. From the literature review and the on line cross cheque of the last 20 years only 8 articles can be related to the macromorphology of the molars. Five of these studies are in vitro with large variation in the number of cases from 5 up to 700 root canals. Only in two of these studies, the sizes of the pulp chambers are measured. Only in one study, differences are observed between “young” and “old” teeth (Bjorndal).

## AIM

The aim of the present study is:

1. To measure the range and mean dimensions of the pulp chambers of upper and lower molars.
2. To detect the relation between the sizes of clinical crowns and pulp chambers for better endocavity preparation.

## MATERIALS AND METHODS

**Teeth:** 286 upper and lower molars, 161 first and second upper molars, 125 first and second lower molars. No differences are made for left or right teeth.

All teeth are matured, fully mineralized and sound, used for the practical preclinical exam of endodontics.

**Groups:** two – upper and lower teeth.

**Measurements of the clinical crown:** three dimensions are measured for each tooth in mm: mesiodistal, from the approximal marginal ridge, bucco-lingual, from the top of buccal cusp to the top of the mesiolingual ( palatal) cusp. The height

of the crown is also measured from the buccal side (h) from the enamel border to the middle part of the line between the cusps.

**Measurements of the pulp chambers:** 40 randomly selected upper and lower molars, 20 in each group without severe root canal curvatures are measured under the following technology:

1. The pulp chambers are opened with horizontal cuts, 1 mm apically from the equator with diamond blend.
2. After polishing the ridges the final size of the endocavity is 2 mm bellow the equator.
3. Both buccolingual dimensions are measured as L1 and L2, and the mean as L and the mesiodistal sizes are measured in the widest part of the pulp chamber.
4. This measurements are performed with endodontic file and endoblock in mm.

**Exclusion criteria:** non vital teeth, massive tooth loses, teeth with root caries, incisors and premolars, and not matured teeth.

## RESULTS

The mean values of the sizes of the clinical crowns of all molars are closed to the plastic Frasaco teeth for students preclinical teaching course in both dimensions MD and BL. The highest difference is in the height of the crown (h), where the differences in the upper teeth are 1,6 mm and even higher in the lower teeth – 2,8 mm. For getting used to the future endodontic cavity preparation course, this fact in the cariology course can be quite dangerous.

The mean values from these measurements are shown in table 1, 2 and 3:

**Table1.** Sizes of the clinical crowns of 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 |

**Table 2.** Sizes of the pulp chambers of molars

| Type of tooth | Dimension | Mean | Range mm |
|---|---|---|---|
| Upper teeth n = 20 | BL 1 | 5,3 | 5,0-5,6 |
| | BL 2 | 4,5 | 4,1-4,9 |
| | MD | 2,9 | 2,6-3,2 |
| Lower teeth n = 20 | BL 1 | 4,6 | 4,4-4,8 |
| | BL 2 | 3,9 | 3,6-4,2 |
| | MD | 3,4 | 3,3-3,5 |

Table 3 shows that MD sizes of the crowns are twice bigger than the MD sizes of the pulp chambers in both upper and lower molars. The BL sizes of the crowns in upper and lower molars are with very little differences from the pulp chamber sizes – 1,2 mm and 0,7 mm.

**Table 3.** A comparison of both measurements

| Type of the tooth | Dimension | Mean in mm | |
|---|---|---|---|
| | | Crowns | Chambers |
| Upper teeth | BL | 6,5 mm | 5,3 mm |
| | MD | 8,1 mm | 4,5 mm |
| Lower teeth | BL | 5,3 mm | 4,6 mm |
| | MD | 9,9 mm | 3,9 mm |


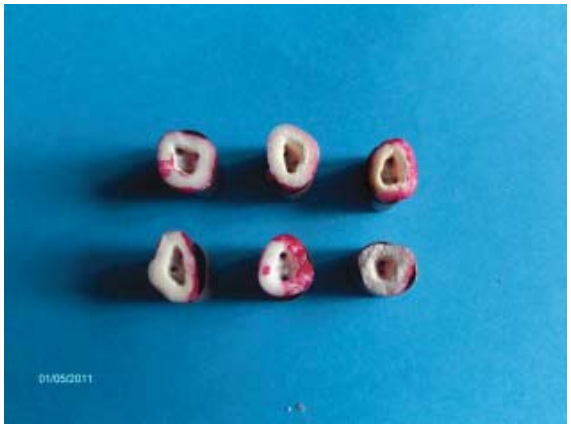


**Fig. 1 and 2.** Pulp chambers of lower and upper molars, measured in the study

## DISCUSSION

The findings in this study are very different from the ones published by Ruskov et al. (1976) [8], measured by Boianov. According to their criteria, MD of upper molars are 9.3-10.1 mm, BL 11.1-11.4 mm, and of lower MD 9.7-11.1, BL 8.9-10.3 mm.

The comparison with the data from the literature shows that the differences are up to twice, which is the case with the BL size of lower molars in Wenzel [18]. In this book, for the upper molars the measurements are MD 9.8 mm, BL – 11.5 mm and for the lower MD 10.7-11.5 mm and BL 9.8-10.4 mm.

The differences with table 1 in BL dimension are up to 4.5-6.5 mm.

Any data on the size of the pulp chambers of molars in the literature is non existing. This is an explanation why after endodontic treatment the most common mistakes are three:

1. Remaining pulp tissue in retentive lodges in the pulp chamber – sources of infection and periapical lesions, which are 19.8% of all endodontic retreatments in the Faculty of Dental Medicine in Sofia, shown in our previous study.

2. Not accurate exposure of pulp chambers, failures in working length estimation and bad preparation of root canals.

3. Overpreparation of cavity walls and crown fractures, mostly from overpreparation of medial and distal walls followed by use of posts and pins in 18.2% of all endodontic treatments in the Faculty of Dental Medicine in Sofia, shown in our previous study.

A simple algebra exercise shows that nearly in 50% of all endodontic treatments there are failures especially when we consider that with age all pulp chambers lower their sizes and orifices migrate up on cavity walls [12, 14, 16].

## CONCLUSIONS:

1. It is essential to be included again in the lecture courses that endodontic cavities cannot have BL sizes less than ½ of the cusp distance and that they need at least parallel walls.

2. There is a need of knowledge not only on the pulp anatomy but on pulp chamber sizes and crown sizes of the teeth.

3. A careful approach to these sizes can lead to safe hard dental tissues during endocavity preparation and especially careful approach to the approximal walls of the teeth.

4. These findings are important for the prevention of crown fractures, the use of posts and pins and the use of crowns and bridges in young age groups.

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