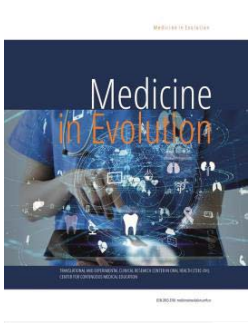
Variations in cervical preparations for metal-ceramic crowns in undergraduate dental students.



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Abstract

Objective. This study aims to evaluate the characteristics of the finish line of dental abutments made by fourth year dental students in during clinical practice in prosthodontics. Materials and methods. Eighty preparations were evaluated on working cast. All preparations were made for the application of porcelain fused to metal (PFM) crown, with non-noble metal framework. Aspects of the preparations were quantified and compared with accepted criteria defined following a review of the literature. Results. The teeth found to be most frequently prepared for PFM crowns were premolars and molars (lateral group) (80,74%). Six percent of samples presented a shoulder finish line while a chamfer margin design was noticed in 62,6%. Thirty-one percent of samples had either a feathered or no clear margin design respectively. Of the cervical preparations analyzed, 86% had been underprepared, mostly on the oral and distal surfaces. A significant difference was observed between cervical preparations on molars (preparation width ≤ 0,5 mm), comparing to premolars (preparation width ≥ 0,5 mm). Conclusion. On the evidence of this survey of this sample of undergraduate dental students, it was found that relevant guidelines for the preparations of PFM crown are not being fully adhered to.

Keywords: Procelain fused to metal crown, dental students, chamfer, shoulder, feathered

INTRODUCTION

Tooth preparation is one of the most important clinical steps in prosthodontics, as it represents the foundation of the future restauration. Knowledge of dental morphology and preparation principles are essential for the realization of grinding, ensuring that prosthetic restorations will correspond from a functional point of view, reestablish an optimal aesthetic result and are biologically compatible with periodontal tissues [1].

Porcelain-fused-to-metal (PFM) crowns have been considered the gold standard for prosthetic restauration of damaged teeth. PFM crowns have good mechanical properties, satisfactory esthetic results and an acceptable biological quality needed for periodontal health. They also present appropriate marginal and internal adaptation, but especially long-term clinical resistance. Thus, the studies show a success rate of 94.4% at 5 years, and an average durability of 47.53 years [2-4].

Dental preparation principles for PFM crown include the realization of a 0,8-1mm chamfer on the cervical area. The degree of convergence of axial surfaces towards occlusal is 6-10. All transition areas should be smooth and rounded in order to reduce the risk of stress concentration areas development, to facilitate the impression registration, PFM crown realization and its cementation [5].

The geometry of the abutment must respect the principles of homothetic preparation, respectively at the occlusal surface a reduction with preservation of morphology is indicated, thus ensuring a harmonious distribution of occlusal stresses and avoiding the appearance of stress areas at the dentin. The marginal preparation must ensure an optimal cervical closure and by its supragingival placement the necessary isolation during the cementation is obtained. Moreover, it is recommended to place the edges at the level of the enamel as the microinfiltration is lower compared to the placement of the edges at the level of the dentin. Although the opinions of dentists vary considerably with regard to optimal finish line profile and depth, there is various data concerning the extent to which recommended values are used by dental practitioners [6-9].

Pre-clinical dental students begin their dental preparation exercises with the entire tooth with ideal morphology, but this is rarely the situation clinically [10]. During the next years of dental medicine, they realize prosthetic restorations on patients addressing the Clinic of Prosthodontics.

This study is based on the model analysis of dental preparations made for PFM crown by dental students in UMFIH Cluj-Napoca, Romania. The results obtained in this study will reveal the most common errors regarding the cervical preparation for PFM crown and will highlight the most accepted recommendations of this therapeutic stage, thus influencing the prognosis and lifespan of the restoration.

Aim and objectives

This study aims to evaluate the characteristics of the finish line of dental abutments made by fourth year dental students in UMFIH Cluj-Napoca during clinical practice in prosthodontics.

MATERIAL AND METHODS

Eighty preparations were evaluated on working cast. All preparations were made for the application of PFM crown, with non-noble metal framework.

Casts where the preparations were indefinite or made for other types of crowns were eliminated from the study.

Each preparation was evaluated individually, with the removable abutment detached from the cast.

The cervical limits of the preparation were evaluated on each surface of the tooth (vestibular, lingual, mesial, distal), recording its profile and size using a magnifying loupe with a magnification of 2.5 and a digital caliper. The analyzed preparations were divided into three groups, depending on the location: incisor-canine, premolar and molar. The depth of the finish line varied between 0 and 2 mm and was categorized in 5 groups, at intervals of 0.5 mm (0, 0,5, 1, 1,5 and 2 mm).

The profile of the cervical preparations was tangential, chamfer or shoulder.

Statistical analysis

For the description of criteria regarding preparation aspect as well as their number, frequency tables were used. Data were analyzed with Statistical Package for Social Sciences, v 20 (SPSS Statistics, IBM California, USA). Differences between means were analyzed using t-test for independent samples and for analysis between two or more means OneWay ANOVA test was used, at 5% level of confidence

RESULTS

In most of the cases the cervical preparation had a chamfer profile and depth equal or below 1 mm.

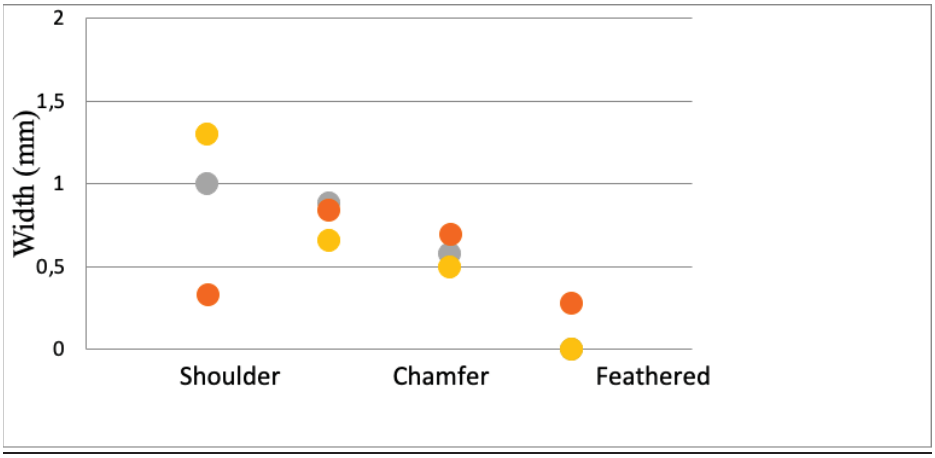

Figure 1. Mean value of cervical preparation depth and profile on different tooth localization

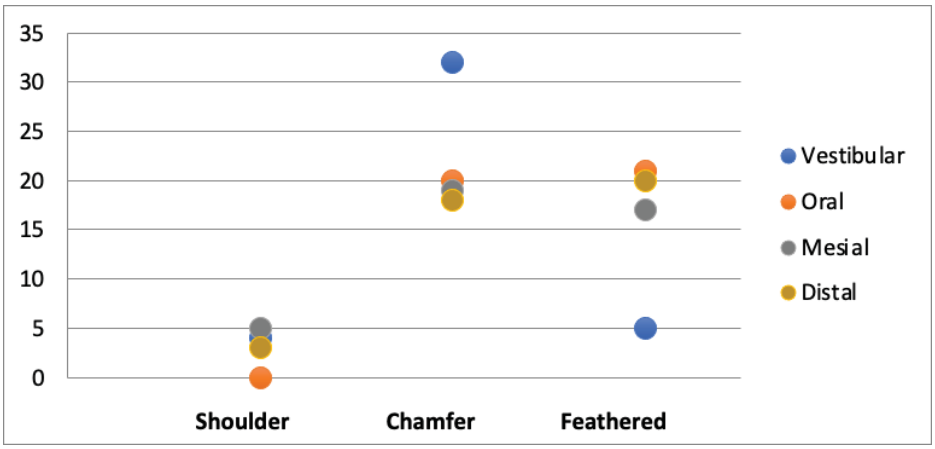

Figure 2. Mean value of cervical preparation depth and profile on different surface localization

Feathered finish line was observed mostly on molars and on oral and proximal areas.

The present study reveals that 58% of preparations have a depth strictly less than 1 mm in the vestibular, while on the lingual surface 19.7% of the preparations have a depth

strictly less than 0.5 mm in lingual and 34.5% of the preparations have a depth strictly less than 1 mm on this area.

In proximal, 24.7% of the preparations have a depth strictly less than 0.5 mm in mesial and 27.2% in distal.

Table I. Profile preparation on different groups and dental surface

Group	Depth (mm)	Labial (%)	Oral (%)	Mesial (%)	Distal (%)	p
Molar	0	5(12,3)	15(36,5)	13(31,7)	15(36,5)	0,043
	0,5	22(53,6)	19(46,3)	16(39)	17(41,5)	<0.001
	1	12(29,3)	7(17,2)	11(26,8)	7(17,2)	0,065
	1,5	2(4,8)	0	1(2,5)	2(4,8)	0,176
Premolar	0	1(3,5)	7(25)	6(21,5)	6(21,5)	0,231
	0,5	15(53,5)	14(50)	15(53,5)	16(57,1)	<0.001
	1	11(39,5)	7(25)	6(21,5)	5(17,9)	0,765
	1,5	1(3,5)	0(0)	1(3,5)	1(3,5)	0,065
Incisor-canine	0	1(9)	1(9)	1(9)	1(9)	0,124
	0,5	3(27,2)	3(27,2)	3(27,2)	7(63,8)	0,767
	1	7(63,8)	7(63,8)	7(63,8)	3(27,2)	0,013
	1,5	0(0)	0(0)	0(0)	0(0)	0

A increased frequency of undersized cervical preparation (less than 1 mm) is observed on lateral teeth (premolar, molar, p <0.001), while on the frontal teeth the finish line with a depth of 1 mm predominate except for the lingual surface where the tendency is to achieve a narrower finish line.

A significant difference was observed between cervical preparations on molars (preparation width ≤ 0,5 mm), comparing to premolars (preparation width ≥ 0,5 mm).

DISCUSSIONS

The results of the present study indicate that more than half of the preparations did not meet the technical requirements due to insufficient reduction. The consequences will be or an aesthetic defect: to overcome the lack of space needed for ceramics, the prosthetist will reduce the thickness of it, the aesthetic result will be affected, or self-maladaptation: if the thickness of the prosthetic edge is at least 1mm and the width of the limit is less than 1mm, the prosthesis will be in outline. However, in this case too, the aesthetic result will be mediocre because of the outline [1, 9].

A harmonious outline is an important criterion for aesthetic success. Over-contour crowns are not confused with natural teeth because of their different shape and their adverse effects on gingival tissues. Numerous authors have shown the link between a prosthetic over-contour and the alteration of periodontal health in the marginal gingiva [8, 11, 12].

Insufficient labial reduction, particularly near the finish line, may also result in distortion of the metal substructure during fabrication and clinical service. This leads to poor marginal adaptation, debonding, and long-term cement failure, all of which have been cited as major factors in the failure of metal ceramic crowns [12].

The judicious preparation of the dental tissues with homothetic reduction ensures the premises of an optimal periodontal health, especially if the cervical preparation has the appropriate position and profile [13].

The optimal depth of the finish line for metal-ceramic restorations is between the value of the optimal thickness necessary to ensure resistance and aesthetics and at the same

time for the achievement of a physiological emergency profile. Previous studies have reported that cervical preparations with values greater than 1 mm are sometimes needed to ensure a layer of ceramic thickness enough to restore aesthetics. The recommended shoulder finish line depth for metal-ceramic restorations is 1 to 1.5 mm, while the chamfer finish should be 0.3 to 0.5 mm for only metal coverage [14]. *In vitro* studies evaluating preparations completed by experienced dentists for metal ceramic crowns have been reported. All studies reported a tendency for clinicians to underprepare teeth when a freehand approach was used [14,15].

However, the results of the current study showed that the mean buccal shoulder depth was mostly equal or lower than 1 mm. A study reviewed by Goodacre et al, reported that shoulder depth prepared by dental students was 0.9 mm [13].

Despite the fact that a shoulder finish line depth of more than 1.0 mm for metal-ceramic crowns is recommended to produce minimal thickness for strength, and to reproduce the selected color of the shade guide, the current information available from the mentioned studies indicate that a shoulder finish line depth greater than 1.0 mm is not routinely prepared (16, 17). Still, most of the finish lines in the current study had a width lower than 1 mm especially on lingual and proximal surfaces which indicates the fact that students are very aware of the teeth dimensions and tend to avoid any excessive cut mainly reduce the risk of pulp endanger and also dental structures fragilization. During fourth year of dental medicine, students are at a stage when the concepts and requirements of the preparation design are freshly instilled and their work should constantly be checked and corrected by their instructors.

Students should be encouraged to use indexes or suitable depth gauge burs in order to improve the accuracy of preparation features, or even specific software for preparation parameter evaluation [10, 17].

CONCLUSIONS

This study highlights the difference between what is taught theoretically to dental schools about dental preparations for PFM crowns and the school results of actual practice. There was a considerable disparity between the finishing lines profile and depth recorded in this study and the ideal configurations recommended in fixed prosthodontic textbooks and the dental literature. Clinically, the finish line values of prepared teeth for fixed prosthodontics are lower than the recommended values in most cases among undergraduate students.

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