تحري كمية التحضير لأسنان معدّة لاستقبال تيجان معدنيّة–خزفيّة محضّرة من قبل طلاب ما قبل التخرّج في كليّة طبّ الأسنان في جامعة دمشق

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الملخص

المقدمة: تعدّ التيجان الكاملة من الترميمات الخارج تاجية الأساسية التي تحضر في مجال اختصاص التعويضات الثابتة. هدفت هذه الدراسة إلى تحري كمية التحضير لأسنان معدة لاستقبال تيجان كاملة من قبل طلاب ما قبل التخرج.

المواد والطرائق: تحرت الدراسة الخصائص البعدية لأسنان محضرة بالمقارنة مع مقابلاتها من الأسنان الطبيعية. تألفت العينة من 104 توأم جبسي لأسنان محضرة علويّة وسفليّة خلفيّة معدة لاستقبال تيجان كاملة من قبل طلاب ما قبل التخرج.

النتائج: كان متوسط كمية التحضير أكبر من الكمية المثالية المقترحة في الأدب الطبي السنّيّ. وبرزت حقيقة ذلك في البعد الأنسي الوحشي؛ إذ زاد متوسط كمية التحضير أكثر من 1 ملم عن مثيلاتها في الكمية المثالية.

الاستنتاج: كان التحضير الزائد للأسنان النتيجة الأكثر وضوحا في هذه الدراسة.

كلمات مفتاحية: التحضير الزائد، التيجان الكاملة.

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An Investigation Into the Amount of Preparation of teeth Receiving Metal- Ceramic Crowns Prepared by Undergraduate Students in Damascus Dental School

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Abstract

Introduction: Full crowns are the main extracoronal restorations to be prepared in the field of Fixed Prosthodontics speciality. The aim of this study was to investigate the amount of preparation of teeth to receive full crowns provided by undergraduate dental students.

Materials and methods: The study investigated the dimensional characteristics of prepared teeth, in relation to their unprepared antimeres. The sample consisted of 104 dies of maxillary and mandibular posterior teeth prepared to receive full crown by undergraduate dental students.

Results: The mean amount of tooth reduction was more than the ideal amount suggested in the literature. This was especially true of the mesiodistal dimension, since the mean amount of preparation exceeded the ideal amount by over 1.00 mm. conclusion: Over-preparation was a predominant finding in the course of this study.

Index Words: Overpreparation, Full crown.

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Introduction:

The dental literature abounds in textbooks and articles outlining how teeth should be prepared for crowns and bridges and there are generally uniform views on what is desirable or ideal in terms of tooth reduction. Anecdotal articles would indicate that this is often at variance with what is actually achieved in practice. This may result from a variety of factors which might determine what is humanly achievable given the individual circumstances operating in each particular situation. In order to know how much reduction was made for the prepared teeth, it is possible to compare the dimensions of the preparation with the dimensions of its antemeric natural tooth since it has been demonstrated that teeth were symmetrical in their mesiodistal dimension.[1-3] Similarly no tendency for either left or right teeth was found to be systematically larger in their buccolingual dimensions.[4]Teeth were found to be symmetrical to some extent in their buccolingual and mesiodistal dimensions.[5]

The principles of tooth preparation were emphasized to regulate the process of tooth preparation to receive indirect restorations.[6-8]Conservation of tooth tissue was the first principle to be mentioned. Shillingburg et al. (2012) regarded preservation of remaining tooth structure as important as replacing lost tooth structure. Therefore, intact surfaces should be maintained without compromising the retention and appearance requirements. However, the preparation should give the crown enough thickness for the material used in its construction to withstand occlusal forces.[7]Furthermore, the removal of adequate tooth tissue allows the manufacture of restorations with appropriate cosmetic results without the over-contouring of the finished restoration. Smith (2006) stated that buccal and incisal reduction should be sufficient to enhance the appearance. Proximal reduction is also important to achieve translucency at the mesial and distal surfaces of the crown. If metal-ceramic crowns are used, given that lower occlusal surfaces are often more visible in most patients, the occlusal surfaces of lower posterior teeth should be reduced more than the upper posterior ones. This will allow a thicker porcelain layer to be built up thus potentially improving aesthetics

A reduction of approximately 1.2 mm is needed on the facial surface. If facial reduction is less than 1.2 mm for a base metal-ceramic crown or 1.4 mm for a noble metal-ceramic crown, the crown will be either opaque or over-contoured.[7] The incisal reduction should be 2.0 mm depth. Inadequate incisal reduction results in poor incisal translucency in the finished crown. The lingual surface should be reduced by minimum amount of 0.7 mm. Those portions of the lingual surface that will have a ceramic veneer should have 1.0 mm of clearance.[7]

If posterior teeth to be crowned and in the areas where there will be ceramic coverage, reduction should be between 1.5 mm and 2.0 mm. The reduction on the functional cusps should be 1.5 mm if the coverage will be metal only, and 2.0 mm if the metal will be veneered with ceramic. Smith (2006) stated that it is impossible to reduce teeth to such an extent without jeopardising the integrity of the dental pulp.

In metal-ceramic crowns, the facial/axial reductions in excess of 1 mm might compromise the remaining tooth structure external to the pulp, whereas 2.0 mm of occlusal reduction is commonly achievable even on the teeth of young patients.[10] Thus, this study aimed to investigate the amount of reduction in the mesiodistal and buccolingual dimensions when teeth are prepared by dental undergraduate students in the dental school of Damascus university.

Materials and methods:

A sample consisted of 104dies of upper or lower posterior teeth prepared to receive full crowns. The sample was derived from sets of working dental casts drawn randomly from the work of 5th year undergraduate dental student during the course of Fixed Prosthodontics at Damascus Dental School, over a period of four months in 2017. Only prepared teeth with their contralateral natural teeth were included. The contralateral teeth should have had no obvious caries or restorations affecting one of the surfaces to be measured, no clear malformations or abnormal morphology, or any defect in the casts resulting from poor impression or pouring techniques that might have an effect on the studied area.

The maximum mesiodistal (MD) and buccolingual (BL) diameters were measured using the technique described by Moorrees (1957) for the natural contralateral teeth. The buccolingual diameter was the greatest distance between the labial/buccal surface and the lingual/palatal surface of the tooth crown. It was measured directly with a sliding calliper, held at right angles to the mesiodistal crown diameter of the tooth.

The mesiodistal diameter is taken as the greatest distance between the approximal surfaces of the crown. In this study it was measured with a customised sliding calliper, in which the tips had been

precision machined. This instrument was held parallel to the occlusal and vestibular surfaces of the crown.
The minimum mesiodistal and buccolingual diameters were measured for the prepared teeth. The minimum mesiodistal dimension (Min.MD) i.e. the minimum distance between the mesial and distal surfaces was recorded of the prepared crown. It was measured with the modified calliper held parallel to the occlusal and vestibular surfaces of the prepared crown (Figure1). Similarly, the minimum buccolingual dimension (Min.BL) was recorded for the prepared teeth.
The same investigator recorded the measurements. Calibration for zero was checked after each reading.
The amount of preparation in MD dimension was calculated as the MD dimension of antimere minus the Min.MD dimension of prepared crown. Whereas, the amount of preparation in BL dimensionwas calculated as the BL dimension of antimere minus the Min.BL dimension of prepared crown.

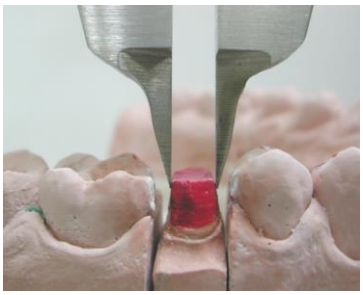

Figure 1 The mesiodistal dimension of the prepared crown measured with the customised calliper held parallel to the occlusal and vestibular surfaces of the crown

Results:

Measurement error was assessed by duplicate measurements of 20 sets of dental casts randomly drawn following a one-week interval. The method error was assessed by calculating the standard deviation of a single determination using the method of Dahlberg (1940). The mean value for method error was (0.08 mm)
A paired samples t-test was applied to the data of the sample to test the differences in the amount of preparation between MD and BL, dimensions (Table1).
The amount of preparation in MD (3.3 mm) was significantly more than BL (2.9 mm) dimension (p< 0.000).

Table 1The descreptive statistics of the amount of preparartion in the mesiodistal and buccolingual directions.

		Mean	N	Std. Deviation	Std. Error Mean
	Prep MD	3.3149	104	.94351	.09252
	Prep BL	2.9002	104	.92525	.09073

The teeth were categorised according to their position in the dental arch (Table2). It was found that the mean amount of tooth preparation for the mesiodistal dimension is only significantly higher in the upper molar (3.7 mm) area than upper premolar (3 mm) and for the buccolingual dimension the lower premolars (3.3 mm) more than upper ones (2.6 mm) (Figure1).

Table 2The amount of tooth preparation according to their position in the dental arch

N		Mean	Std. Deviation	Minimum	Maximum	N
Prep MD	Upper Molar	19	3.7800*	1.23320	1.33	6.08
	Upper Premolar	38	3.0305*	.72218	1.34	4.86
	Lower Premolar	29	3.2206	.78661	1.18	4.76
	Lower molar	18	3.6494	1.15065	1.53	6.26
	Total	104	3.3340	.96987	1.18	6.26
Prep BL	Upper Molar	19	2.8837	1.03981	1.34	5.48
	Upper Premolar	38	2.5876**	.73379	1.36	4.35
	Lower Premolar	29	3.2617**	.83573	1.58	4.55
	Lower molar	18	2.9950	1.12631	1.05	5.52
	Total	104	2.9002	.92525	1.05	5.52

*significant difference
**significant difference

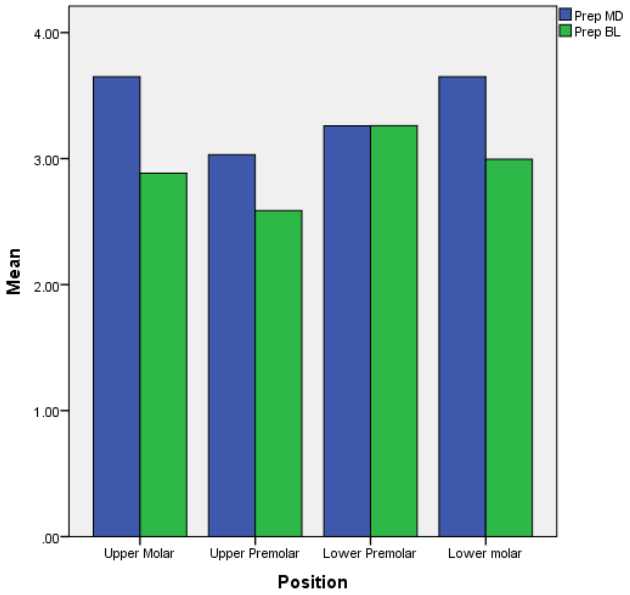

Figure 2A diagram representing a comparison in the mean amount of tooth preparation between the mesiodistal and buccolingual dimensions according to the position of the preparation in the dental arch

Discussion:

Teeth were found to be symmetrical in their mesiodistal dimension[1,2,13] except the lower first molar ($P<0.05$)[14] and buccolingual dimensions. Studies through twin studies could not demonstrate, , any genetic basis for dental trait asymmetry. [4,15, 16]

Many investigators have previously used the method, described by Moorrees (1957), utilised in this study for measuring tooth size. [2,4,13,14, 17]

The method error values of the study were found to be smaller or comparable with those reported by previous investigators. The mean value of the Dahlberg coefficient in this study was 0.08 mm. The corresponding mean values reported by previous investigators were 0.07 mm[14], 0.09 mm[17], 0.011 mm[1], 0.09 mm[11].

As no significant difference was found between antimeric teeth in the dental arch in the MD, BL, this made it possible to estimate the original dimensions of teeth already prepared to receive full crown restorations, by measuring the antimeric natural teeth in the same arch.

The amount of tooth preparation calculated in this study in the MD dimension is a combination of the amount of preparation in the mesial surface added to the amount of preparation in the distal surface. Similarly, the amount of tooth preparation in the BL dimension is a combination of the amount of preparation in the buccal surface added to the amount of preparation in the lingual surface.

The mean amounts of preparation used in the restoration are compared with the ideal amounts stated in the previous literature (Table4). The ideal amounts of preparation in the BL dimension were calculated as combination of the amount of preparation of the buccal surface plus the amount of preparation in the lingual surface.

For example the amount of preparation in BL dimension for metal-ceramic full crown in mm was calculated as the following:

1.2 to 1.4 (Buccal surface) + 0.7 to 1.00 (Lingual surface) = 1.9 to 2.4 mm.

These amounts were suggested by Shillingburget al. (2012) depending on I) the type of metal used in the alloy; 1.2 mm for a base metal-ceramic crown or 1.4 mm for a noble metal-ceramic crown, II) whether the lingual surface is metal without a ceramic veneer (0.7 mm) or with a ceramic veneer (1.0 mm).

Table 4 Statistical comparison between the ideal amounts of preparation and the mean amounts of preparation found in the study

Type	Dimension	N	Mean crowns (Study)	Range (Ideal)
Metal-ceramic	Prep MD	104	3.3	2.0-2.4
	Prep BL	104	2.9	1.9-2.4

It can be seen from Table (4) that the mean amounts of MD and BL preparation for metal-ceramic crowns in the study reported here were more than those regarded ideal.

The small amount of preparation (under-preparation) would lead to an oversize crown restoration in the studied dimension or to a thin layer of restoring material.[18,19]

In contrast with the findings of the current study, some authors have found in both in-vitro and in-vivo studies that under-preparation is predominant during tooth preparation. Under-preparation in the labial shoulder was found by Seymour et al. in two different studies. Seymour et al. (1995) compared the labial shoulder dimensions of (a) twenty five single rooted extracted teeth hand held and prepared for bonded crowns by a group of experienced clinicians and (b) the working dies of twenty five single rooted teeth prepared in vivo by the same group. The results revealed insufficient removal of tooth structure at the labial margins. However, the dies studied were nearer to the ideal, giving mean ± SD (a) 0.7 ± 0.3 (b) 1.0 ± 0.3 for shoulder width, respectively. In different study by Seymouret al. (1996) the mean shoulder width value (±SD) of extracted teeth prepared by one of three dentists was 0.752 mm (± 0.174 mm).

Under-preparation was predicted also by Dunne (1993), in a study that looked into the visual perception of size and distance. He examined the ability of dental undergraduates and practitioners to adjust the gap of callipers to their estimate of various test sizes. The range of estimates was large, extending from 0.31 mm to 1.74 mm. When trying to estimate a 1 mm gap, 70% of readings were below this size. If similar errors were repeated during clinical preparation, they would lead to under-preparation. Under-preparation was also suggested as a cause of narrow interproximal spaces in extensive fixed bridges investigated 10 years after cementation[23]. Cassidy and Gutteridge (1994) stated tooth reduction is often overestimated by clinicians.

On the other hand, a large amount of preparation would possibly lead to more damage to tooth and pulp. Differing percentages of endodontic complications following tooth preparation have been reported. These ranged from 5.7%[25] to 10% 5 years after cementation of restorations[26]. The frequency of pulpal involvement of abutment teeth was also compared with that of unrestored control teeth 13.3% vs. 0.5% [27] and 15% vs. 3% for teeth treated for advanced periodontal disease [28].

However, no other study has looked at the amount of preparation removed from tooth structure in general dental practice or in dental faculties.

Conclusion:

The amount of tooth preparation for full crown restorations was investigated by comparing the dimensions of prepared crowns to their natural antimeres. The mean amounts of tooth preparation found in this study were more than the ideal amounts suggested in the previous literature. This was especially presented in the MD direction, since the mean amounts of preparation exceeded the ideal amount by over 1.00 mm. It can be concluded that over-preparation was a predominant finding in the course of this study.

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تاريخ ورود البحث: 2018/03/26.
تاريخ قبوله للنشر: 2018/05/20.