تقييم مقاومة الأسنان المحضرة لاستقبال تيجان كاملة للحركات الجانبية باستخدام طريقة رياضية مبتكرة

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الملخص

خلفية البحث وهدفه: يجب أن يمتلك تحضير التاج الكامل شكلاً مقاوماً للقوى المائلة. هدفت هذه الدراسة إلى تحري وجود مقاومة للقوى المائلة في التحضيرات السنية المجراة من طلاب ما قبل التخرج.

مواد البحث وطرائقه: دُرِسَتْ 41 سناً محضرة لرحى أولى أو ثانية سفلية من طلاب ما قبل التخرج لاستقبال تاج كامل، وذلك بإجراء ثلاثة قياسات. أعطت هذه القياسات مؤشراً على وجود شكل مقاوم للقوى المائلة من عدمه.

النتائج: لم يكن هناك شكل مقاوم ل 71% من التحضيرات في الاتجاه الدهليزي، و ل 90% من التحضيرات في الاتجاه اللساني.

الاستنتاج: يجب على الطلاب الانتباه أكثر للشكل المقاوم للحركات الجانبية عند تحضيرهم الأسنان لاستقبال تيجان كاملة.

كلمات مفتاحية: تحضير التاج الكامل، الشكل المقاوم للتحضيرات.

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Evaluation the Resistance form to Oblique Forces of Teeth Prepared to Receive Full Crowns by a Novel Mathematical Method

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Abstract

Background and aim: Full crown preparation must have resistance form geometry. The aim of this study was to investigate whether full crown preparation of undergraduate students work have resistance to oblique forces.

Methods: The resistance of 41 first or second lower molars preparation of undergraduate students work to receive full crowns were examined by measuring three dimensions. These dimensions gave an indication whether a resistance form exists or not.

Results: The preparations had no resistance towards the buccal direction in 71%, nor towards the lingual direction in 90% of the cases.

Conclusion: Students should pay more attention to the resistance form geometry when preparing teeth to receive full crowns

Key words: full crown preparation, resistance form.

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Introduction:

Much has been published about full crown prosthesis and the principles that guide its preparation.[1,2]

One of these principles is "retention and resistance". Resistance is defined as the features of a tooth preparation that enhance the stability of a restoration and resist dislodgment along any axis other than the path of placement. Adequate resistance depends on the magnitude and direction of the dislodging forces, geometry of the prepared tooth, and physical properties of the luting cement. The preparation must have certain features to prevent dislodgment of a cemented restoration. Mastication and parafunctional activity may subject a prosthesis to significant horizontal or oblique forces. Lateral forces tend to displace the restoration by causing rotation around the gingival margin, effectively tipping the crown off its preparation.[2]

The factors that affect both retention and resistance were explained in details. Apart from surface area which affects mainly the retention, the length, path of insertion and taper of the prepared axial surfaces in full crown preparation have significant role in increasing the resistance of the preparation to oblique or apical forces. The aim of this study was to investigate the resistance form of the preparation of undergraduate crown and bridge abutments.

Materials and methods

The sample consisted of 41 first or second lower molar prepared to receive crown/bridgework by 4th year undergraduate students during their course in Fixed Prosthodontics Department, in the Faculty of Dentistry at Damascus University. The abutments were examined on working casts by measuring the dimensions of the dies in the buccolingual direction.

The dimesions used in this study are illustrated in Figure (1). X represents the diameter of the prepared tooth at the finish line level. This would be the maximum buucolingual dimension of the prepared tooth. A digital calliper was used to measure the dimensions. Three measurements were calculated for each dimension, and the mean of these dimensions was then recoded. Y represents the maximum dimension from the lingual cups tip to the opposite point on the finish line in the buccal surface.

Z represents the maximum dimension from the buccal cups tip to the opposite point on the finish line in the lingual surface.

The prepared tooth would have resistance to oblique forces in the buccal direction if (y) is greater than (x), and vice versa. Furthermore, the prepared tooth would have resistance to oblique forces in the lingual direction if (z) is greater than (x), and vice versa.

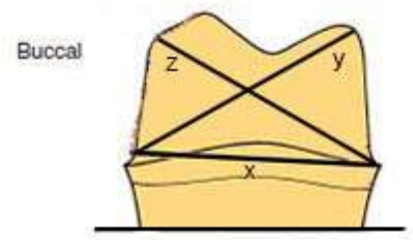

Figure 1: Tooth preparation with three dimensions used to assess the resistance form.

Results:

The results showed in general that 71% of prepared abutments have no resistance to oblique forces towards the buccal direction (Table1). Teeth prepared to receive single crowns had slightly better resistance than those prepared to receive bridges (31% and 29 % respectively).

Table 1: Resistance of preparations towards the buccal direction

Prosthesis	X > Y No resistance Number (%)	X <= Y Resistance Number (%)	Total
Crowns	9 (69%)	4 (31%)	13
Bridges	20 (71%)	8 (29%)	28
	29 (71%)	12 (29%)	41

The resistance of the prepared abutments towards the lingual direction (Table2) was less than that of the buucal direction (90% vs 71%). Thus, only 10% of the abutments had resistance towards the lingual direction. In contrast with the results of resistance towards the buccal direction, abutments prepared to receive bridges had better resistance than those prepared to receive single crowns (11% and 8% respectively).

Table 2: Resistance of preparation towards the lingual direction

Prosthesis	X >Z No resistance Number (%)	X <= Z Resistance Number (%)	Total
Crowns	12 (92%)	1 (8%)	13
Bridges	25 (89%)	3 (11%)	28
	37 (90%)	4 (10%)	41

Further analysis was performed to investigate the difference between Y and Z compared to X (Table 3). The dimensions of Y were close in general to X for

both crowns and bridges (0.98, 0.97 respectively). However, the difference was larger when Z was compared with X in both crowns (0.95) and bridges (0.92).

Table 3 The difference between the studied dimensions.

	Y/X	Z/X
Crown	0.9850	0.9503
Bridge	0.9711	0.9208

Discussion

Fixed prostheses should survive in the oral environment considerably a long time after their cementation. Many factors contribuate to this treatment including the resistance form of the preparation. More recently, it has been concluded that resistance to lateral forces and not retention along the path of insertion has the determining factor in a crown's resistance to dislodgement.[3-5]

Resistance is a function of the relationship between axial wall taper, preparation diameter, and preparation height. It decreases as taper or diameter increases or as preparation height is reduced.[6]

It has also been found that changes in convergence angle of preparation has affected resistance more than retention of crowns cemented on metal dies.[4] Therefore, laboratory tests have become focused on resistance testing through the application of simulated lateral forces.

Dodge et al tested the tipping resistance of artificial crowns cemented over teeth with 10, 16, and 22 degrees total convergence angle that had 3.5 mm height (occlusocervical dimension) and 10 mm in diameter, similar to prepared molars. It was found that 22 degrees of taper produced inadequate resistance and that there was no significant difference between the resistance of 10- and 16-degree specimens.

Similar clinical study was conducted by Trier et al who tested the concept of a limiting the taper of prepared abutments by evaluating the resistance form of 44 dies when the restorations had failed clinically through loosening from the prepared tooth. It was found that 42 out of 44 dies (95%), lacked resistance form, supporting a relationship between clinical success/failure and the all-or-none concept of a limiting convergence angle.[7]

Furthermore, an experimental study has proven that preparations with tapers greater than 20° show stress concentration within the cement which may rupture the cement lute.[8] The overpreparation of occlusal surfaces results in short axial surfaces. This would decrease the resistance form of the preparation. The principle of (ON, OFF) resistance was used in the study according to Parker et al. who calculated "critical convergence angles" beyond which a crown theoretically would not have adequate resistance to dislodgement. Abutments were categorised as having the resistance form or not. In general the results of this study showed that most of the preparation lack the resistance form especially in the lingual direction(90%). This may be explained by overpreparion of the occlusal surfaces or overtapering the axial surfaces. Not much differences were recorded when preparing crown or bridges. The resistance towards the buccal direction was better than the lingiual one. About one third of the preparation have resistance form with no much difference between the crowns or bridges (31% vs 29% respectively). The largest differences between the studied dimensions in their ratios were noted between Z and X in bridges abutments (Z/X = 0.92). This means that either the buccal surface was over-inclined or the buccal cusp was over reduced for abutments prepared to receive bridge retainers more than crowns.

Goodacre proposed that 3 mm is the minimal height dimension for premolars and anterior teeth that are prepared within the recommended taper range of 10 to 20 degrees. However, for molars 4 mm was proposed because they are usually prepared with greater convergence than anterior teeth, have a greater diameter than other teeth, and are located where occlusal forces are greater.

The students seem to over prepare the bucclal cusps or over taper the buccal surface. This could be explained by trying to provide greater space in the buccal surface for better aesthetics. As the extra space provided in the buccal surface or buccsl cusp would result in thicker porcelain layer over the metal.

If short or compromised teeth are prepared and lack of resistance form cannot be avoided, auxiliary resistance features such as grooves/boxes should be considered.[11-14]

Limitation of study:

A small sample was used in this study which may be considered as a limitation. It is preferable to investigate this novel method on a larger sample that represents the work of undergraduate student in the faculty of dental medicine at Damascus University.

Conclusion:

Students tend to over prepare teeth which jeopardise the resistance form of the preparation. Attention should be paid to the conservative preparation and resistance form.

References المراجع

1. Shillingburg HT, et al. Fundamentals of fixed prosthodontics. 4th ed. Chicago, IL: Quintessence Publishing Co; 2012.
2. Rosenstiel, S.F, Land, M.F, Fujimoto, J. Contemporary fixed prosthodontics. 4th ed. Mosby Year Book, St. Louis; 2006.
3. Wiskott HWA, Nicholls JI, Belser UC. The relationship between abutment taper and resistance of cemented crowns to dynamic loading. Int J Prosthodont 1996;9:117-39.
4. Dodge WW, Weed RM, Baez RJ, Buchanan RN. The effect of convergence angle on retention and resistance form. Quintessence Int 1985;16:191-4.
5. Wiskott HW, Nicholls JI, Belser UC. The effect of tooth preparation height and diameter on the resistance of complete crowns to fatigue loading. Int J Prosthodont 1997;10:207-15.
6. Weed RM, Baez RJ: A method for determining adequate resistance form of complete cast crown preparations. J Prosthet Dent 52:330, 1984.
7. Trier AC, et al: Evaluation of resistance form of dislodged crowns and retainers. J Prosthet Dent 80:405, 1998.
8. El-Ebrashi MK, Craig RG, Peyton FA Experimental stress analysis of dental restorations. Part III. The concept of the geometry of proximal margins. J Prosthet Dent 1969; 22: 333–345.
9. Parker MH, et al: New guidelines for preparation taper. J Prosthodont 2:61, 1993.
10. Goodacre CJ, et al: Tooth preparations for complete crowns: an art form based on scientific principles. J Prosthet Dent 85:363,2001.
11. Reisbick MH, Shillingburg HT Jr. Effect of preparation geometry on retention and resistance of cast gold restorations. J Calif Dent Assoc 1975;3:51-9
12. Potts RG, et al: Retention and resistance of preparations for cast restorations. J Prosthet Dent 43:303, 1980.
13. Woolsey GD, Matich JA: The effect of axial grooves on the resistance form of cast restorations. J Am Dent Assoc 97:978, 1978.
14. Proussaefs P, et al: The effectiveness of auxiliary features on a tooth preparation with inadequate resistance form. J Prosthet Dent 91:33, 2004.

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