

COMPARISON OF THE EFFECT OF SECTIONAL MATRIX SYSTEMS KERR HAWE, PALODENT ON FRACTURE STRENGTH OF CLASS II COMPOSITE RESTORATIONS: AN INVITRO STUDY

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ABSTRACT

Aim: One of the main purposes of restorative dentistry is establishing a proper proximal contact. Sectional matrix bands have a precontour design which causes the final restoration be so similar to the contour of natural tooth. The main aim of this study is comparison of the effect of different sectional matrix systems on fracture strength of class II Composite restorations.

Methods and materials: Disto-occlusal box was prepared in artificial lower second premolar, then the walls of cavity were cured with “S₃ bond” bonding agent. Composite (GradiaPosterior) was placed in 3 increments of 2 mm and each layer cured for 20 seconds. Three different matrix systems (palodent, kerr hawe, Tofflemire) type were used for restoration. Then teeth tested in a holder of Instron device, under the gradually increasing force till failure of cases. The Study was Experimental and samples Volume in the total was 30. Kruskal-wallis test was used in this study.

Results: The results showed that the the fracture strength of Kerr, more than Palodent and these two are more than Toffelmier. Non-parametric Kruskal-Wallis test to compare the fracture strength between tooth groups showed that this difference is not statistically meaningful. ($p = 0.178$)

Also the test of Mann-Whitney, a comparison between the two, fracture strength restoration, the groups showed that the difference between the groups is not statistically significant. ($p > 0.05$)

Conclusion: Fracture strength of teeth restored with sectional matrix bands of palodent and kerr hawe, no significant differences with teeth restored with Toffelmier.

Key words: Class II composite restorations, Fracture strength, Sectional matrix system.

Introduction

One of the main objectives of restorative dentistry is re-establishing a desired proximal contact. If the proximal contact stays too open it can lead to food trap, dental migrations, periodontal complications and caries.¹⁻³ If the contact is too tight, it may lead to dental migration or trauma to periodontal tissue when a dental floss is passed through proximal contact with excessive force.^{4,5}

The conducted retrospective clinical studies have stated caries and fractures of restorations and teeth as the main factors for the replacement of composite restorations.^{6,8}

The prospective studies that were carried out during 1996 to 2002 on the performance of posterior composites yielded the same results.^{9,10}

An 8-year-old follow up of composite resins showed that main cause for failure of restorations were secondary caries and restoration fracture.¹¹

The risk of marginal ridge fracture can be reduced in different ways. Generally, the higher filler content of a composite results in increased resistance to fracture and modulus elasticity.¹² Another factor that can affect the ridge marginal strength is the proximal contour shape in occlusogingival direction. Ultimate proximal contour of a restoration is affected by the shape of matrix strip used. In the past, only Tofflemire simple strips were used to repair class II cavities. Nowadays, with the increasing use of composites for posterior teeth restoration, different systems of sectional matrix strip and separator rings have been marketed with a variety of design. Sectional matrix strips have a predesigned curvature, which ultimately

create restorations closer to the contour of natural teeth. Also, the use of separator rings with proper wedging guarantee stronger contact. In the case of using flat matrix strips, the proximal contact surface is small and is placed in marginal region of ridge. Therefore, using precontoured matrix strips results in creation of bigger proximal contact surface and higher volume of the proximal composite. As a result, if precontoured matrix strips are used instead of flat ones, marginal ridge will have a better support.¹³

Considering that class II composite restorations account for a large part of the restorations and their fracture strength is very effective in the success of the treatment, and also there are few studies in this field, we decided to design the present study with the aim of comparing the effect of using different systems of sectional matrix strip (Palodent, Kerr hawe) on fracture strength of class II composite restorations.

Features of Matrix Strips

Various types of retainer matrix and matrix strips are available, so choosing a particular type as the best system is a difficult thing to do. [Figure 1]

An ideal system has features that include:

- Proximal contact must be precisely reconstructed
- The strip should be thin enough, so creating a strong contact would be possible, while having enough strength so it does not bend or wrinkle.
- The strips should be varied so that they can be adapted to the various shapes of the teeth.

- The matrix strip should be stable and allow the correct tightening of the strip in the cervical margin region.

The problem with this system is that most of the systems, except limited systems, create a flat proximal surface and the contact point is usually placed in the marginal region of ridge and as spotted instead of the middle third.¹⁴

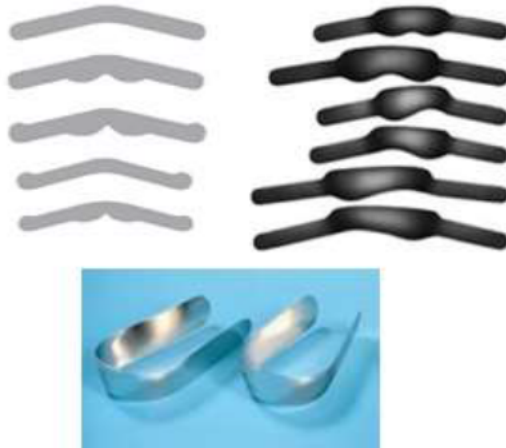


Figure 1. Different types of conventional matrix strips.

A series of systems that are very useful for creating optimal interproximal contacts are sectional matrix strip systems along with the use of metal rings with spring properties. The ring strongly presses the sectional matrix ridges in the cavity to the tooth, which results in a better matching of the strip with the margins, while also applying a continuous separating force to the teeth, that ultimately leads to creation of stronger contacts.¹⁴

Advantages of Sectional Matrix Strips

The advantages of sectional systems are: create a wedging state that results in a better proximal contact; create better proximal contour in posterior composites compared to conventional matrices; and compared to circumferential strips, facilitate the insertion of the matrix, especially in restorations that involve only one proximal surface.^{15,16} (Figure 2)



Figure 2. A few of today's sectional systems.

Materials and Methods

The type of study and statistical population

Study Type: Experimental

Study population: Mandibular acrylic second premolar teeth

$S_1 = 75.8$ Mean 1 = 330.2
 $S_2 = 44.5$ Mean 2 = 272.6
 $N = 29$
 $A = 0.05$
 $B = 0.2$

$$N = \frac{(Z + Z) (S + S)}{(Y - X)} = 9$$

Sample Size and Calculation Method

To estimate the minimum size of the sample, the mean strength of Gradia posterior composite was used, which was measured in the previous study for two types of matrix strips, and by considering error percentage of 0.05 and test power of 90%, the minimum sample size for each matrix strip obtained as about 9, which to increase the accuracy of the work, 10 samples were considered for each matrix strip, a total of 30 samples were estimated.

Sampling method

Simple non-probability sampling method

Project Implementation Method

In order to simulate the oral environment, artificial teeth were arranged inside a plastic mandibular arch. Each arch is similar to a human jaw that accommodates artificial teeth in itself in the arrangement of natural teeth. In this study, the contact between the ridges of second premolars and the first molars was evaluated.

In all samples, a cavity was milled as MO using a diamond fissure burs turbine 010. Dimensions of this cavity were 5 mm in the buccolingual dimension, 5 mm in the occlusogingival dimension and 3 mm in axial dimension, which were measured in all samples using a gauge. In order to create a composite grip in acrylic teeth, an undercut was embedded inside of the cavities at axiokingival angle using a diamond fissure burs 008, cavity walls were stained for 2 minutes with monomeric methyl methacrylate (trademarked by Akro Parsm, Marlik medical industries company) to increase the bond between restoration and cavity. In order to prevent injury to the first molar, a metal coated model of this sample was used.

Three types of matrix strip systems were used to restore the cavities:

1. Matrix straight strip of Standard ToffleMire Matrix. KerrHawe (HANGER. Germany) with ToffleMire Matrix (KerrHawe) as the control Group
2. Palodent sectional matrix strip along using a separator ring (PalodentDentsply, USA)
3. KerrHawe sectional matrix strip along using a separator ring (KerrHawe, Kerr, Switzerland)

Gradia Posterior universal composite (GC, Japan) was used to restore the cavities.

After inserting the matrix strip and the wedge, the ring separating cavity walls was stained with (Dental) S3 Bond Kuraray, Japan bonding, the composite was placed inside of the cavity in three 2mm-layers, and each layer were cured with the device for 20 seconds.

After finishing the restoration process, the teeth were removed from the arch and placed in a special acrylic holder. Then the occlusal surface was restored to a horizontal and smooth surface, so that exactly 3 mm of composite remained in the occluso cervical dimension. All stages of milling and restoration were performed by the student.

In the next step, the holders were placed inside of a Servo-hydraulic testing machine under a gradually increasing force, so that the force was applied at the middle of restoration and at 90° until the samples were fractured. The machine that was used was MTS 858 Mini Bionix® II 858 (MTS Systems Corporation, MN, USA) and experiments were conducted at Nikbakht Engineering collage.

Method of Data Analysis and Description

Data analysis and description was performed using SPSS version 19 software. Kruskal–Wallis test was used to compare the means in the three groups.

Results

In this study, which was conducted with the aim of comparing the effect of using different systems of sectional matrix strip on fracture strength of class II composite restorations, 30 dentures were studied in 10 groups. The results of applying force on the teeth of these three groups are presented in Table 1.

Matrix Tape	Mean (±SD)	Maximum	Minimum	p value test (Kruskal-Wallis)
Toffelmier	81.8 (± 12.2)	103	62	P = 0.178
Palodent	87 (± 11.3)	99	60	
Kerr	94.1 (± 15.1)	123	77	

Table 1: Mean distribution and standard deviation of restoration fracture strength in three studied dental groups (grouped by type of matrix strip)

The results showed that the fracture strength in the Kerr group is more than that of Palodent and fracture strength

of these two are more than the Toffelmier. The Kruskal-Wallis nonparametric test for comparing the fracture strength of restoration between the studied dental groups showed that this different is not statistically significant (P=0.178). Also, Mann-Whitney test for two by two comparison of restorations fracture strength in studied groups showed that this difference is not statistically significant between the groups (P<0.05). (Table 2)

Matrix Tape	Toffelmier	Palodent	Kerr
	P-value Mann Whitney Test	P-value Mann Whitney Test	P-value Mann Whitney Test
Toffelmier		0.212	0.064
Palodent	0.212		0.733

Table 2. Two by two comparison of restoration fracture strength of the dental groups

Discussion

Since one of the main factors in the failure of composite restorations is the composite mass fracture,^{6,8} finding ways to improve the restoration strength can be effective in increasing its clinical life. On the other hand, Lacy in 1987, stated that some causes for limited use of posterior composites are lack of sufficient durability, difficulty in achieving the proximal contact, post restoration sensitivity, marginal sitting and recurrent caries.¹⁷

The results of this research showed us that fracture strength in restored teeth with sectional matrix strip are at an optimum level and there is no statistically difference between them.

The findings of this study are not consistent with the results from the study by Margolis in 2009, entitled “The use of sectional matrix strips in class II composite restorations.”¹⁸ The result of their study point to usefulness of using sectional matrix strips in posterior composite restorations, as it leads to the creation of proper contour and sufficient fracture strength.

Loomans *et al* conducted a study, titled “Evaluating mean strength of proximal contacts in posterior composite restorations”, and conducted that proximal contact after using a sectional matrix strip along with separator ring is significantly better than Toffelmier matrix strip. It is worth noting that in this study, out of the three existing groups, sectional matrices (Danville, Palodent) were used in two groups and Toffelmier was used in the other group. The only difference between these two studies is in the type of sectional matrix strip that they used. This means that two types of Palodent, Kerr hawe are used in the present study, while two types of Danville and Palodent are used in the Loomans study.¹⁹

Peumans *et al* studied the effect of two factors of matrix system type and composite type (packable or normal). For this purpose, Automatrix matrix, Lucifix matrix and Palodent matrix systems along with P60 composite,

which is a packable composite, and Z100 composite, which is a normal composite, were used. It was concluded that the best contact in class II composite restorations is achieved using Palodent system, which is a sectional matrix system, but in the current study, Palodent did not have a significant difference with Toffelmier.²⁰

In another study by Loomans *et al*, they also concluded that the use of precontoured sectional matrices leads to creation of stronger marginal ridges in class II composite restorations.¹³

The results of present study were not consistent with these studies.

The study by Schennib *et al*, on examining the proximal contact of class II composite restorations by using 6 different matrix strip systems and sample size of 84 (14 samples was considered for each matrix strip system), showed that using only systems with predesigned curvature is not enough for creating an ideal contact, and special attention should be paid to other aspects such as how a matrix is placed, type and method of wedging, as well as the use of separator rings.²¹

Conclusion

Using the analysis of statistical data, these results were obtained:

1. Fracture strength in teeth restored by Palodent sectional matrix strips is not different from that of teeth restored by Toffelmier matrix strips (p-value=0.212).
2. Fracture strength in teeth restored by Kerr sectional matrix strips is not different from that of teeth restored by Toffelmier matrix strips (p-value=0.064).
3. There is no significant difference between teeth restored by Palodent and Kerr have sectional matrix strips (p-value=0.178).

Suggestions

1. Due to the use of limited types of sectional matrix strip in the present study, it is suggested that in future studies, the other types of sectional matrix strips should be used.
2. It is suggested that other studies be conducted in a wider range of data.
3. Since the fracture strength of proximal restorations with sectional matrix strip and Toffelmier is not different, these matrix strips also can be used in restorative parts along with Toffelmier.

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