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A comparative laboratory study to evaluate the marginal fit of two types of temporary prostheses.

Abdullah Khsara[1], Bassam Alnajjar[1], Ahmad Al Mokdad[1], Abdulhamid Al Mokdad[1]

Department of fixed prosthodontics damascus, Syria[1]

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ABSTRACT

Comparison of the marginal fit of temporary crowns made by the direct method and those made by the indirect method (CAD-CAM). When we prepare the teeth, we remove some of tooth tissues or restorations form the abutment. and after we finish the preparation the tooth will be uncover and we can't make a proper final restoration immediately because of the time that we need to manufacture the restoration in the laboratory so the practices should give their patient a provisional restoration covers the space of the final one. so that the provisional restoration consider as a main part in treatment plan for fixed prosthodontics patient and this restoration must have a good marginal fit, and after the adhesive it reduce the marginal leakage to protect the abutment and periodontal tissue. The research sample consisted of / 40 / newly extracted premolars that were divided randomly into two equal groups according to the method used in the manufacture of temporary restoration as follows: (The first group: restoration by the direct method (Trantemp) (The second group: restoration by the indirect method (PMMA)). The marginal applicability was evaluated under stereo microscope. The results showed that the indirect temporary restoration has achieved better marginal fit, where the marginal gap was less compared with direct temporary restoration. The indirect temporary prostheses (PMMA) achieved better marginal fit than the other types used in the study.

1. INTRODUCTION

According to the Glossary of Prosthodontic Terms, “provisional or interim prosthesis or restoration is a fixed or removable dental or maxillofacial prosthesis designed to enhance esthetics, stabilization and/or function for a limited period of time, after which it is to be replaced by a definitive dental or maxillofacial prosthesis [1].

When teeth are prepared, a substantial amount of tooth structure or restorative material is removed. This is to configure the teeth so that they can function as abutments for cemented or adhesive restorations. When the procedure is completed, such teeth are essentially “undressed”, but cannot be immediately restored to full form and function due to the time required by the laboratory for fabricating the a. Therefore the clinician must provide the patient with a short-term single crown or multiunit restoration which will span the gap between the preparation of the teeth and the cementation of the permanent FDP. This transitory function implies that

these restorations should be fabricated chairside, using comparatively inexpensive materials and procedures [2].

The choice of material for provisional restoration should depend on how their mechanical, physical and handling properties fulfill specific requirements of any clinical case. Biocompatibility and complications from intraoral use, such as chemical injury from the presence of monomer residue and thermal injury from an exothermic polymerization reaction should be also taken into consideration. The most common materials used for custom interim-fixed restorations are several types of acrylic resins such as polymethyl methacrylate [3] resin, polyethyl methacrylate (PEMA) resin, polyvinyl methacrylate resin, bis-acryl composite resin, visible light-cured urethane dimethacrylates and microfill resin.

Preventing microleakage can be accomplished by two means: fabricating a well-fitting provisional restoration or through the selection of proper temporary cements [4], [5]. The longest-available provisional cements on the market are zinc oxide eugenol (ZOE) temporary cements. For many years, ZOE cements have continued to be the cements of choice for provisional restorations because of their sedative and excellent antibacterial effects. Unfortunately, ZOE cements inhibit free radical polymerization in the resins; therefore, they have negative effects on the polymerization of methylmethacrylate resins used in provisional restorations [6]. In addition, if the final restoration will be bonded to the prepared tooth, the polymerization of both the adhesive system and the permanent resin cement may be inhibited, increasing the risk of debonding or even fracture in the case of low-strength ceramic or indirect composite restorations Furthermore, some patients are hypersensitive to eugenol [7].

Ideal qualities of temporary compensation materials:
• Comfort and ease of work, adequate working time, ease of forming, easy repair, and fast hardening time.
• Bio-receptive, non-toxic, hypoallergenic, and non-diffusive.
Dimensional stability during hardening.
• Easy to finish and polish.
• Adequate toughness and scratch resistance.
• Acceptable appearance, transparency, color control, color fastness.
• Acceptable from the patient, non-irritating, odorless.
• Easy to add and repair.
• Chemical compatibility with the temporary bonding material.
Low cost [4].
It provides good thermal insulation.
• Color fastness and non-absorption of dyes [8].

Marginal fit:
Definition of The term appropriate, applicable, or fine edges may be better defined by the term (non-fit) or as a gap measured at multiple points between the restoration and the tooth surface [9].

The limbic application of compensation is one of the most important topics discussed in fixed dental prostheses, due to its importance for the permanence of compensation for a longer period and the preservation of the health of the tissues around the tooth [10], [11].

There are some terms used to describe the non-fit of compensation and they are:
Internal gap: the vertical distance from the inner surface of the crown to the inner wall of the prepared tooth.
Marginal gap: the vertical distance from the inner surface of the crown to the inner wall of the prepared tooth

near the termination line.

Vertical marginal discrepancy: this is a vertical marginal discrepancy measured parallel to the line of insertion of the crown.

Horizontal marginal discrepancy: this is a horizontal marginal discrepancy measured perpendicular to the insertion line of the crown.

Overextended margin: the vertical distance from the diaphragm to the edges of the crown.

Underextended margin: which is the vertical distance from the diaphragmatic gap to the angle of the outer fossa of the tooth [12].

2. Materials and methods

The research sample consisted of 40 upper premolars with intact crowns.
Sample Teeth Entry Requirements:

1. Newly extracted upper premolar for orthodontic reasons, the crown and root are intact.
2. The teeth are of similar sizes in the vestibular and palatal dimension
3. The teeth were examined with the naked eye for root coronary fractures or fissures so that the affected teeth were excluded.

In the wake of gathering the separated teeth and safeguarded in 01% formalin solution,, the axial surfaces of these teeth were cleaned utilizing periodontal scratching instruments, and afterward the teeth were kept in the physiological serum arrangement until we follow the remainder of the work stages.

The exploration test comprised of/40/separated premolars that are ready to get impermanent crowns. They were separated into two gatherings as per the technique for crown fabricating: 20 crowns by the immediate strategy utilizing Trantemp material and/20/crowns by the roundabout strategy with the assistance of CAD CAM innovation and utilizing PMMA circles.

1. Making Acrylic Bases:

For this reason, a metal chamber was utilized by disengaging its inward surface with Vaseline to work with the arrival of the acrylic sap. The isolating circle was over plotter and the tooth was fixed utilizing saps (design gum) to guarantee the nature of fixing straightforward protractor was set in the vacant metal chamber to shape so the tooth neck are over the neck edge of the form 2 mm, then cool acrylic was blended in with a suitable consistency and filled the metal chamber containing the underlying foundations of the teeth to the upper edge of the chamber and left to solidify.

Bases for all teeth are made the same way.

2. Making individual stamps:

For this reason, a metal chamber with a measurement bigger than the chamber assigned for it was utilized to make the bases. The teeth in the initial two gatherings were covered with three layers of red grade wax. Then, oneself polarizing acrylic was blended and put inside the metal chamber subsequent to disconnecting its inward surface with a protecting material (Vaseline) and afterward setting the covered tooth inside with wax. After the solidifying of the acrylic got done, the shape framed from inside the metal chamber was eliminated and a hold was added to it, then a few openings were punctured on its whole surface.

3. Assembling of silicone guides for crowns made by the immediate technique.
In the wake of ensuring that the singular stamps are very much positioned over the teeth fixed inside the singular bases, four drains were penetrated on the external surface of the acrylic bases, accordingly guaranteeing that the composite (single stamp - tooth) is gotten back to its right position when the prosthesis is finished. Then, at that point, a was taken of the teeth of the principal bunch prior to being arranged involving gathering elastic in two surfaces (hard and delicate) in a clay wash strategy, then two imprints were added with a ballpoint pen as an extra technique to guarantee that the was gotten back to its right spot while making the prosthesis.

4. Dental Preparation:
A turbine grip is introduced on the changed plotter in the spot assigned for it, where the readiness pod is opposite to the foundation of the plotter.

The region of the end goal on the tooth before not entirely settled through a wellspring pen so the end line was 1 mm over the lacquer cemental intersection. Then, at that point, the teeth were arranged considering the safeguarding of the long-lasting contact between the base surface of the acrylic base and the foundation of the plotter during readiness.

The most extreme convexity of the tooth was first taken out utilizing a tapered bramble.

Then, at that point, the readiness was made utilizing a 1-mm profundity deciding pod (Jota 834.FG.021), and afterward a cone shaped precious stone turbine pod with an adjusted head (Horico FG199F016) with an adjusted end was utilized to give a semi-shoulder-formed finish line with a width of (1) mm and a pitch of tendency (5) degrees towards the Corona to guarantee exact estimate of the planning dividers.

The pod was supplanted with another one in the wake of planning (3) teeth.

Then, at that point, bigger distance across end cuts were utilized to eliminate undented polish crystals toward the end goal.

Subsequent to finishing the arrangement of the relative multitude of hub surfaces of the teeth of the (40) examples, a level of (4) mm at the cams was resolved utilizing a wellspring pen and a ruler. Then the crushing surface was diminished to the obvious imprints utilizing a rhombic bramble.

We acquired arranged teeth with a semi-shoulder-molded finish line with a width of (1) mm, a pitch of (5) degrees, and a level of (4) mm.

5. Making of temporary crowns by the indirect technique:
Utilize a MEDIT scanner to filter the teeth arranged for Groups 3 and 4 and plan the crowns with the EXOCAD planning program for every tooth.

The teeth were abandoned a PMMA plate utilizing a machine (MAXX DS200-5Z) Korea, then, at that point, the crowns were isolated and the limbs were managed.

6. Production of crowns by direct strategy:
The pre-arranged teeth were dried and the blending tops of the Trantemp acrylic infusion alter were utilized so we put a suitable sum inside the taken before planning and afterward put it over the pre-arranged teeth,

considering that it ought to be similarly situated as it was the point at which the was taken in the principal stage, contingent upon the drains ready inside the acrylic and the stamping lines. Agenda with moderate strain applied. Stand by 60 seconds (as indicated by the producer's directions) for the acrylic to finish solidifying and afterward eliminate the stamp. We tenderly eliminate the transitory crown shaped from within the stamps to guarantee that the construction doesn't break or break.

The extremities were taken out with a careful sharp edge and a straightforward managing of the prosthesis surfaces was performed utilizing an elastic pipe mounted on a microtor handle at 18,000 rpm with fluid nebulization.

Crowns that fizzled (break or air pocket) were disposed of and returned similarly as in the past.

7. Assessing the Marginal Gap:
Marks were set in the tooth surfaces.
For this reason, a sound system optical magnifying lens with 100x amplification was utilized and a 1 mm graduated slide was utilized as an aide for the estimations. Four estimations were recorded for every tooth of the example in the vestibular surface, the center of the parallel surface, the center of the lingual surface, and the center of the average surface, individually.

3. Results

The research sample consisted of 40 freshly extracted human teeth, each of which was prepared to receive a temporary crown, divided into two equal groups according to the type of crown studied (a temporary crown manufactured by the direct method Trantemp, a temporary crown manufactured by the indirect method PMMA using CAD-CAM technology), and a research sample was distributed according to the type of crown studied and the adhesive material used as follows:

Table No. (1) shows the distribution of the research sample before adhesion according to the type of crown studied.

Percentage	Teeth no.	Type of crown studied
%50.0	20	Temporary crown prepare in the direct method
%50.0	20	Temporary crown prepare in the indirect method CAD-CAM
%100	40	Total

Statistical Analytical Study:
The extent of the marginal gap (in microns) was measured on four different surfaces (vestibular surface, lateral surface, palatine surface, medial surface) in two different stages (pre-adhesion, post-adhesion) and the degree of marginal leakage was monitored after adherence in both the vestibular and palatine surfaces. For each tooth of the studied teeth in the research sample, then the amount of change in the marginal gap (in microns) was calculated after adhesion to each studied surface for each studied tooth in the research sample according to the following equation:
Amount of change in the margin gap (in microns) after adhesion on each surface for each tooth = the amount of border gap (in microns) after adhesion - the amount of border gap (in microns) before adhesion in the same surface of the same tooth.

Student T-test was conducted for independent samples to study the significance of the differences in the mean

amount of the margin gap (in microns) before adhesion between the group of temporary crowns made by the direct method and the group of temporary crowns made by the indirect method using CAD-CAM technology in the research sample as follows:

Descriptive Statistics:
Table No. (2) shows the arithmetic mean, standard deviation, standard error, minimum and upper boundary gap values (in microns) before sticking in the research sample according to the type of crown studied.

The studied variable = Amount of the fringing gap (in microns)						
Max.	**Mini.**	**standard error**	**standard deviation**	**Arithmetic average**	**Measurement No.**	**The type of crown studied**
260	58	6.02	53.88	146.28	80	**Direct Manufacture Temporary Crown**
165	40	2.51	22.47	83.33	80	**Indirect CAD-CAM temporary crown**

T Student test results for independent samples:
Table No. (3) shows the results of the T student's -test for independent samples to study the significance of the differences in the average border gap (in microns) before adhesion between the group of temporary crowns made by the direct method and the group of temporary crowns manufactured by the indirect method using CAD-CAM technology in the research sample.

The studied variable = Amount of the marginal gap (in microns)			
The significance of the differences	**Significance level value**	**Value t Calculated**	**The difference between the two averages**
There are significant differences	0.000	9.644	62.95

The above table shows that the value of the significance level is much smaller than the value 0.05, that is, at the 95% confidence level, there are statistically significant differences in the average amount of the marginal gap (in microns) before adhesion between the group of temporary crowns manufactured by the direct method and the group of temporary crowns manufactured by the indirect method using CAD-CAM technique in the research sample, and since the algebraic sign of the difference between the two averages is positive, we conclude that the values of the marginal gap (in microns) before adhesion in the group of temporary crowns manufactured by the direct method were greater than in the group of temporary crowns manufactured by the indirect method using CAD-CAM technique in the research sample.

4. Discussion

This study was conducted on extracted human teeth to get as close as possible to the clinical reality, and this has been approved by many researchers in other similar studies [13], [14].

Although the ideal application for practical experiments with dental materials and restorations is within the oral environment. Clinical experiments are time consuming and inconvenient for cost in our research area [15].

Human natural teeth were chosen due to their unique properties such as flexibility, bonding properties with enamel and dentin, and the complex geometry of the final preparation, which affects the results of this study. However, obstacles were encountered, such as the availability of teeth and standardization of their standards, such as the size and age of the teeth. Therefore, care must be taken while looking at the results of this study, since it was not possible to achieve perfect standardization.

In this study, the marginal fit of two types of temporary prostheses was compared by two different methods (direct and indirect) and the method of longitudinal sections was used to measure the extent of the marginal gap under a light microscope with a magnification of 100 times [16].

The size of the marginal gap was measured at four points distributed in the middle of each tooth surface, where the study (Groten and Axmann) showed that there were no differences in the results of marginal fit when choosing the measurement points randomly or if they were chosen separated from each other by distances equal [17].

The borderline gap size was measured using microdicom software.
The results showed that there were statistically significant differences as the amount of the marginal gap ranged between (58-256) microns in the prostheses manufactured by the direct method, while the amount of the marginal gap ranged between (40-165) microns in the prostheses manufactured by the indirect method. After conducting the statistical study, it was found that the amount of the marginal gap (in microns) in the group of indirectly manufactured PMMA crowns was less than the group of crowns manufactured by the direct method, and this can be explained by the occurrence of a stiff contraction in the prostheses manufactured by the direct method, which led to an increase in the size of the marginal gap and may be due to the accuracy of the CAD/CAM technology that plays an important role in the quality of the circumferential application of the prostheses manufactured with its help.

The results of this study agreed with (Dureja) that the indirect prostheses with the help of CAD/CAM technology showed better marginal fit, but they differed with him in the extent of the marginal gap, whose average was 34.34 microns in his study, and this difference may be due to a difference in the quality of the CAD / CAM device used.

The results also agreed with (Dureja) that the marginal fit was better in CAD/CAM crowns [16].

However, the results differed with researcher (Jie Wu) who compared the marginal and internal fit of three different types of materials used in the manufacture of temporary prostheses and found that temporary crowns manufactured by the direct method achieved the best fit values and the smallest sizes of the marginal and internal gaps. [18].

5. Conclusions

The indirect temporary prostheses achieved better marginal fit than the other types used in the study.

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conflict of interest:
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ethical approval:
No ethical approval has been taken.

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