Original article

Fabrication of provisional restoration on freshly prepared tooth: indirect and direct technique

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Abstract:

Background: Provisional restorations are fabricated to protect the prepared tooth structure during period between the preparation and the final restoration, and the techniques applied are direct, indirect and indirect direct. Various materials are used to fabricate provisional restoration, such as, preformed crown, acrylic, metal shell, composite, etc. ***Objectives***: The study was designed to evaluate the advantages of fabrication of provisional restorations by indirect technique over direct technique. ***Methods***: This prospective comparative study carried out in the Department of Prosthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University, Dhaka, from January 2006 to December 2007, included 20 patients each for insertion of provisional restorations fabricated by indirect (group A) and direct (group B) technique. Outcome was evaluated on the basis of marginal adaptation, biocompatibility and aesthetic status. Results: On day 7 of provisional restoration, grade I marginal adaptation were observed in 75% and 40% of group A and group B patients, respectively, and on day 15 were 75% and 20%, respectively. Grade I biocompatibility on day 7 of group A patients were 100% and group B 30%, and on day 15 was 95% and 35%, respectively. Grade I aesthetic status on day 7 were in 100% of both group A and group B patients, and on day 15 was 95% and 85%, respectively. None of the patients was in grade III, either in marginal adaptation, biocompatibility or aesthetic status. ***Conclusion***: Indirect provisional restoration is better and safer in relation to marginal adaptation, biocompatibility and aesthetic status.

Key words: fabrication; provisional restoration

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Introduction:

In fixed partial denture, provisional restorations are inserted on freshly prepared teeth, for the time being, until a final prostheses is inserted. Provisional restorations have evolved through significant changes during the past several decades. Probably the most stimulators of change is provisional restoration have been major amount of fixed prosthodontics therapy[1]. Provisional restorations are fabricated to protect the prepared tooth structure during the period between the preparation and the final restoration[2]. After tooth preparation, a temporary protective or functional restoration is fabricated over the prepared tooth to be used until the fabrication of the final prostheses. Temporary restorations are usually fabricated and provided on the same day of tooth preparation[3]. Provisional restorations can also be used for extended treatment intervals by providing long term tooth protection and stabilization during adjunctive peri-

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odontal and endodontic treatment procedures[4-5]. Mechanically the provisional restorations, during function, must resist functional loads that occur during chewing as well as resist removal forces without fracturing[6].

There are several methods, such as, direct, indirect and indirect direct technique to fabricate provisional restorations. Various materials are used to fabricate provisional restoration, such as, preformed crown, acrylic, metal shell, composite, etc. In the direct technique, the prostheses are fabricated in the patient's mouth by inserting an impression which is previously taken before tooth preparation and loaded with acrylic resin material. In the indirect technique, it is fabricated outside the patient's mouth, on a mode which is prepared from an impression taken before tooth preparation. In practice, direct technique is commonly used; but it has some disadvantages, like it caused more polymerization shrinkage of the prostheses that results in poor marginal adaptation, adverse reaction to oral tissue because of its residual monomer, proper curing of the material is not possible in presence of oral fluid, and also exothermic heat produced during polymerization causes discomfort to the patient. On the other hand, as in the indirect technique, the prostheses is prepared outside the mouth in the laboratory, therefore, it is free from these disadvantages, though it takes more time and extra cost.

Many dentists will not go for indirect provisional restoration because of high laboratory cost. However, indirect provisional restorations have certain advantages: (a) stronger and durable material like acrylic resin can be used; (b) any aesthetic or occlusal change can be made on an articulator, (c) there is also no contact of free monomer with the prepared tooth or gingival than cause tissue damage, and (d) it avoids subjecting a prepared tooth to the heat created from the polymerizing resin.

Provisional restorations fabricated by direct technique are though cheaper and easier to fabricate but have certain disadvantages, like it shows poor marginal adaptation because of polymerization shrinkage, its residual monomer causes tissue inflammation and exothermic heat of polymerization causes pulpal damage and patient discomfort.

In our study, we tried to find out the outcome of both indirect and direct technique of fabrication of provisional restorations on freshly prepared tooth in our hospital.

Materials and Methods:

This prospective comparative study was carried out in the Department of Prosthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University, from January 2006 to December 2007. Forty patients who fulfilled inclusion criteria were divided into two groups: Group A (n=20) for insertion of provisional restorations fabricated by indirect technique, and Group B (n=20) for insertion of provisional restorations fabricated by direct technique.

Inclusion criteria were (a) one or more missing tooth/teeth for restoration by fixed partial denture, (b) endodontically treated teeth for restoration with fixed prostheses, (c) fractured drown, and (d) healthy periodontal tissue. Exclusion criteria were (a) periodontally compromised patients, (b) parafunctional habit, like bruxism, (c) vertical fracture, and (d) developmentally defective teeth.

Provisional restoration by indirect technique

Before tooth preparation, an impression is made with silicone rubber and allowed to set (external surface form [ESF]). After tooth preparation by maintaining standard technique, another impression is made and a cast poured (tissue surface form [TSF]). Separating medium is applied uniformly with a camel hairbrush, over the tissue surface form and allowed to dry. When the cast is thoroughly dry, the finished line of the preparation is marked with a sharp and soft lead pencil to serve later as a guide for trimming. Autopolymerizing resin (opaque variety) is mixed. The mixing is then poured into the tissue surface form (mould should not be overfilled and the resin should reach the level of the gingiva). The TSF is sealed into the external surface form, and lightly held together by rubber bands. The assembly is then placed in warm water. After five minutes it is removed and the external surface form is separated from the cured resin restoration, which usually remains in contact with the tissue surface form. Resin flush is eliminated with an acrylic trimming bur and a fine grit garnet paper disk. Care is taken for any resin blebs or remnants of stone on the internal surface of the restoration. Finishing touch is given with carborundum bar and polishing is done with wet pumice powder. The final restoration is cemented with zinc oxide eugenol cement on the prepared tooth surface.

Provisional restoration by direct technique

First, an impression is made with silicone rubber and sectional impression tray, and then tooth preparation is carried out by maintaining standard technique. After tooth preparation and bleeding control, the prepared tooth and the surrounding tissue is coated with petroleum jelly. The autopolymerizing resin is mixed and loaded into the impression taken earlier. The

resin is allowed start polymerization, When the rubbery stage of polymerization (about 2 min in the mouth), it is removed from the mouth and excess material is removed with a scissors and again inserted into the same place. During this procedure, sufficient aircooling is provided with a air syringe over the area. After the polymerization is complete, the tray along the restoration is removed from the mouth and the restoration is departed from the impression and soaked in warm water for 3 5 min. Margins are marked with a pencil. Voids in the restoration is checked and corrected by additional material. Excess material is trimmed up to the finish line. The restoration is completed by carborundum bur and polished with polishing material (stone bur, sandpaper No. 0, pumice powder). The final restoration is cemented with zinc oxide eugenol cement on the prepared tooth surface.

Evaluation: The prepared provisional restoration was evaluated in patient's mouth for marginal adaptation of the prostheses to the prepared tooth, biocompatibility of the restoration and aesthetic status on day 7 and day 157-8. Any defect was corrected by adding resin.

Marginal adaptation: The index was based on the adaptation of the restoration to the margin of the prepared tooth. Grade I: No visible evidence of crevice along the margin into which explorer will penetrated. Grade II: Visible evidence of slight marginal discrepancy with no evidence of decay; repair can be made or is unnecessary. Grade III: Discoloration on the margin between the restoration and the tooth surface.

Biocompatibility: The index was based on the criteria of gingival redness and bleeding on probing. Grade I: No bleeding on probing and no plaque accumulation. Grade II: Mild to moderate bleeding. Grade III: Severe bleeding.

Aesthetic status: The index was based on colour, surface, morphology of tooth. Grade I: Exactly similar to adjacent/contralateral natural teeth. Grade II: Slight mismatched to adjacent/contralateral natural teeth. Grade III: Not similar to adjacent/contralateral teeth.

Data analysis: Collected data were compiled and analyzed using computerbased software (SPSS, version 13).

Results:

Table 1 shows marginal adaptation of provisional restoration of grade I and grade II (none in grade III) of group A and group B patients on day 7 and day 15. On day 7, marginal adaptation of grade I was seen in 15 (75%) and 8 (40%) patients, and marginal adaptation of grade II was seen in 5 (25%) and 12 (60%) patients of group A and group B, respectively. Statistically, no significant variation was observed. On day 15, marginal adaptation of grade I was seen in 15 (75%) and 4 (20%) patients, and marginal adaptation of grade II was seen in 5 (25%) and 16 (80%) patients of group A and B, respectively. Variation was significant (P<0.01).

Marginal adaptation of grade I and grade II of group A patients on day 7 was 15 (75%) and 5 (25%), and on day 15 was 15 (75%) and 5 (25%), respectively. No significant variation was observed. Marginal adaptation of grade I and grade II of group B patients on 7 was 8 (40%) and 12 (60%), and on day 15 was 4 (20%) and 16 (80%), respectively. The variation was not statistically significant.

Table 2 shows biocompatibility of provisional restoration of grade I and grade II (none in grade III) of group A and group B patients on day 7 and day 15. On day 7, biocompatibility of grade I was seen in 20 (100%) and 6 (30%) patients, and biocompatibility of grade II was seen in 0 (0%) and 14 (70%) patients of group A and group B, respectively. Statistically,

Table 1: Marginal adaptation of provisional restoration

Group/ Follow up	Grade I No. (%)		Grade II No. (%)		P value
	Marginal adaptation				
Day 7					0.054ns
Group A	15	(75.0)	5	(25.0)	
Group B	8	(40.0)	12	(60.0)	
Day 15					0.001**
Group A	15	(75.0)	5	(25.0)	
Group B	4	(20.0)	16	(80.0)	
Group A					1.000ns
Day 7	15	(75.0)	5	(25.0)	
Day 15	15	(75.0)	5	(25.0)	
Group B					0.301ns
Day 7	8	(40.0)	12	(60.0)	
Day 15	4	(20.0)	16	(80.0)	

Group A : Indirect technique (n=20)
Group B : Direct technique (n=20)

Fisher's exact test, ns = Not significant
** = Significant at P<0.01

Table 2: Biocompatibility of provisional restoration

Group/ Follow up	Grade I No. (%)		Grade II No. (%)		P value
	Biocompatibility				
Day 7 Group A Group B	20 6	(100.0) (30.0)	0 14	(70.0)	0.0001***
Day 15 Group A Group B	19 7	(95.0) (35.0)	1 13	(5.0) (65.0)	0.0001***
Group A Day 7 Day 15	20 19	(100.0) (95.0)	0 1	(5.0)	1.000ns
Group B Day 7 Day 15	6 7	(30.0) (35.0)	14 13	(70.0) (65.0	1.000ns

Group A : Indirect technique (n=20)
Group B : Direct technique (n=20)

Fisher's exact test, ns = Not significant,
*** = Significant at P<0.001

Table 3: Aesthetic status of provisional restoration

Group/ Follow up	Grade I No. (%)		Grade II No. (%)		P value
	Aesthetic status				
Day 7 Group A Group B	20 20	(100.0) (100.0)	0 0		
Day 15 Group A Group B	19 17	(95.0) (85.0)	1 3	(5.0) (15.0)	0.605ns
Group A Day 7 Day 15	20 19	(100.0) (95.0)	0 1	(5.0)	1.000ns
Group B Day 7 Day 15	20 17	(100.0) (85.0)	0 3	(15.0)	0.231ns

Group A : Indirect technique (n=20)
Group B : Direct technique (n=20)
Fisher's exact test, ns = Not significant

the distribution was highly significant (P<0.001). On day 15, biocompatibility of grade I was seen in 19 (95%) and 7 (35%) patients, and biocompatibility of grade II was seen in 1 (5%) and 13 (65%) patients of group A and B, respectively. Variation was highly significant (P<0.001).

Biocompatibility of grade I and grade II of group A patients on day 7 was 20 (100%) and 0 (0%), and on day 15 was 19 (95%) and 1 (5%), respectively. No significant variation was observed. Biocompatibility of grade I and grade II of group B patients on 7 was 6 (30%) and 14 (70%), and on day 15 was 7 (35%) and 13 (65%), respectively. The variation was statistically not significant.

Table 3 shows aesthetic status of provisional restoration of grade I and grade II (none in grade III) of group A and group B patients on day 7 and day 15. On day 7, marginal adaptation of grade I was seen in all 20 (100%) patients of both group A and group B. On day 15, aesthetic status of grade I was seen in 19 (95%) and 17 (85%) patients, and aesthetic status of grade II was seen in 1 (5%) and 3 (15%) patients of group A and B, respectively. Statistically, no significant variation was observed.

Aesthetic status of grade I and grade II of group A patients on day 7 was 20 (100%) and 0 (0%), and on day 15 was 19 (95%) and 1 (5%), respectively. No significant variation was observed. Aesthetic status of grade I and grade II of group B patients on 7 was 20 (100%) and 0 (0%), and on day 15 was 17 (85%) and 3 (15%), respectively. The variation was statistically not significant.

Discussion:

Provisional restorations are fabricated to protect the freshly prepared tooth structure during the period between tooth preparation and insertion of the definitive restoration. These restorations are also referred to in the literature as interim, temporary or provisional restorations (prostheses). Such restorations should be uncomplicated and inexpensive to fabricate in a short period of time. Several laboratory and clinical techniques for the fabrication of provisional restorations have been described in the literature, such as the indirect technique, direct technique and indirect direct techniques for both single and multiple unit restorations[2].

Crispin et al. evaluated marginal accuracy with direct

and indirect techniques. They reported that indirect fabrication provided significant improvements in marginal fit relative to direct method when methylmeth acrylate resin was used. They demonstrated that marginal fit of polymethyl methyacrylate restoration could be improved by up to 70% with an indirect technique[9].

Monday and Blais observed that the marginal fit of provisional restorations that have been polymerized undistributed on stone cast was significantly better than provisional that have been removed from mouth before becoming rigid[10]. Rosentiel and Gegauff reported that cementation of provisional restoration with zinc oxide eugenol cement reduced surface hardness that might result in margin discrepancy[11]. Lepe et al. reported that volumetric polymerization shrinkage of polymethylmeth acrylate was 6% which would play an important role in fit of a provisional restoration[12].

Yannikakis et al. immersed provisional materials into various staining solutions for up to one month. They reported that all the materials showed perceptible colour changes after one week. After one month, the methyl methacrylate materials exhibited the best colour stability[13].

Waerhaug and Zander found that there were presence of plaque material in areas with poor marginal adaptation and roughness of interim restoration which was a constant source of gingival inflammation[14]. Garvin et al. concluded that periodontal inflammation associated with provisional treatment could be expected to be a reversible process provided that the amount of gingival irritation is minimal and provisional treatment occurs over a short time span[15]. Hensten Pettersen and Helgeland reported that there was no contact of free monomer with the prepared tooth or gingiva which might cause tissue damage in indirect technique[16].

Yannikasis et al. immersed provisional materials in various stating solution for up to one month and reported that all materials showed perceptible colour changes after one week, and after one month the methylmethacrylate materials exhibited the best colour stability[13].

In our study, we selected two group of patients for insertion of provisional restorations fabricated by indirect technique (group A, n=20) and another group of patients for insertion of provisional restorations fabricated by direct technique (group B, n=20). We evaluated marginal accuracy according to the California Dental Association Quality Evaluation System[7]. Marginal adaptation on day 7 showed that 75% patients of group A and 40% patients of group B were in grade I. On day 15, 20% group B patients were in grade I. The cause of marginal discrepancy was volumetric shrinkage of the resin restoration and dissolution of luting agent. Though zinc oxide eugenol cement reduces surface hardness, it was used for easy removal of the restoration and its easy availability. Marginal adaptation of provisional restorations fabricated by indirect technique showed similar results as above studies.

In our study, analysis of biocompatibility showed that after 7, 100% patients of group A and 30% patients of group B were in grade I, i.e. no bleeding on probing and no plaque accumulation; and 70% patients of group B were in grade II, i.e. mild to moderate bleeding on probing. On day 15, 95% patients of group A and 35% in group B were in grade I, and 65% patients of group B were in grade II. The percentage of bleeding on probing in direct provisional restorations were higher than indirect provisional restoration. The cause of gingival tissue inflammation was due to irritation from the irregular margin of the restoration where place accumulated. Our result is similar to the above studies as because provisional restorations prepared with direct technique shows more marginal discrepancy.

In our study, on day 7, aesthetic status of all the patients of both the groups were grade I, i.e. exactly similar to adjacent/contralateral lateral teeth. On day 15, aesthetic status of 95% group A and 85% of group B patients was grade I. The difference was marginal, which indicates that aesthetic statu of provisional restorations prepared by any technique with the same material, like polymethylmethacrylate show minor difference.

It has been reported that provisional restorations fabricated indirectly have superior margins to those from direct techniques because the acrylic resin polymerizes in an undisturbed mater[17-18]. Polymerizing autopolymerizing acrylic resin under heat and pressure improves the physical properties of the material. Reinforming the vacuum or pressure formed matrix allows it to be secured to the cast on which the provisional shell is polymerized[19-21]. Moreover, fabricating a provisional restoration wholly or in part using an indirect method reduces exposure of oral tissues to monomer, heat, shrinkage and reduces the volume of volatile hydrocarbons inhaled by a patient[18,22].

Most patients, however, require a more conventional approach. Fabricating provisional restorations directly on teeth using the 'direct method' is suitable for single units and up to 4 unit partial denture provisional restorations[23].

Conclusion:

Provisional restorations fabricated by direct technique though cheaper and easier to fabricate but have certain disadvantages, like it shows poort marginal adaptation because of polymerization shrinkage, its residual monomer causes tissue inflammation and exothermic heat of polymerization causes pulpal damage and discomfort to the patient. On the other hand, indirect provisionals have certain advanges, such as, stronger and durable material like acrylic resin can be used, any aesthetic or occlusal change can be made on an articulator, no contact of free monomer with the prepared tooth or gingival that can cause tissue damage, and marginal fit is better.

Although longer time is required to fabricate an indirect provisional restoration, it reduces the clinical time. We may conclude that marginal adaptation, aesthetic and biocompatibility, fabrication of provisional restorations by indirect technique on a freshly prepared tooth is better than restorations fabricated by direct technique.

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