DENTAL PRACTITIONER PERFORMANCE WHEN INCORPORATING ATTACHMENTS IN IMPLANT-RETAINED OVERDENTURES WITH UNSPLINTED ABUTMENTS

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Abstract

The aim of the present study was to evaluate the performance of dental practitioners incorporating attachments into overdenture prostheses, via the direct method, before and after an instructive course.

Forty randomized gypsum models, with implants either angulated or parallel to each other, were given to forty dentists before and after an instructive course. A rubber dam or temporary light-curing composite resin was seated around the ball abutment, to avoid acrylic resin penetration while incorporating the attachments to the implant overdenture.

A comparison of proportions test showed statistically significant differences between the rubber dam and temporary composite resin groups. There were no statistically significant differences between the groups with parallel and angulated abutments, before or after the course.

Temporary light-curing composite resin as a block-out material is superior to a rubber dam, when incorporating attachments into the implant overdenture. The practitioners were more successful after the course, without considering the type of block-out material. The success of the practitioners was not affected by the angulation of the abutments before or after the course.

Keywords: Implant, education, overdenture.


Introduction

As mentioned in the Mcgill consensus statement, an implant-supported overdenture is currently the standard option for the treatment of edentulous patients 1, 2. In order to generate a retentive force for overdentures, several types of attachments have been developed. They are mainly classified into splinted anchorage systems such as the bar type, and unsplinted anchorage systems such as the ball type 3. Owing to the smaller space requirements within prostheses, ease of cleaning, affordability, and lower sensitivity to procedures, unsplinted anchorage attachments are preferred by many practitioners for the retentive unit of implant-retained overdentures 4,5. Although implants that retain overdentures should be parallel to one another and in the path of the prosthesis insertion, as well as perpendicular to the occlusal plane, the procedure is limited by bone quality, anatomical structure, and dentist’s clinical ability which tend to result in deviation from the ideal path of insertion 6,7. Ball attachments, magnetic attachments, bar attachment systems, and telescopic crowns have been used to anchor overdentures. O-rings offer several advantages when used in these systems, including ease of insertion and removal, improved hygiene, ease of maintenance, low cost, and elimination of the superstructure bar 8. There are various techniques for incorporating the attachments into the
overdenture. Broadly, they can be classified as direct techniques (performed by the clinician intraorally) or indirect techniques (performed by the technician in the laboratory). No single method or technique has been proven to be superior, and there is inconclusive evidence on the clinical superiority of using the direct versus the indirect method.

The advantages of the indirect technique include reduced chair time, avoidance of contact with the acrylic monomer, optimal polishing, and the use of an acrylic resin with better mechanical properties for the incorporation of the attachments, due to pressure polymerization. Patients suffering from motor control diseases can be better treated using this technique. However, impression taking for implant position recording through the use of implant transfer copings and analogues may introduce discrepancies, resulting in incorporation inaccuracy. Where present, these inaccuracies can cause incomplete settling of the intaglio surface of the prosthesis onto the tissue, because the attachment location creates a primary early barrier on the prosthesis insertion path. The direct technique for mounting a stud attachment intraorally is simple, less expensive, requires less prosthetic elements, and allows the patient to retain the prosthesis. The disadvantages of the direct technique include that it requires a skilled clinician, and precise control of the prosthesis position during the curing of the auto-polymerizing resin. Particular care must be taken to avoid flow of resin into undercuts, which may render prostheses removal difficult, traumatic, or even impossible. The skill and experience of the practitioner affect the success of the direct incorporation procedure.

The purpose of the present study was to evaluate the performance of dental practitioners when incorporating attachments into overdenture prostheses via the direct method, before and after an instructive course. The effects of two different block-out materials (a rubber dam versus resilient composite resin) on the performance of the practitioners were also compared. The null hypothesis was that there would be no difference between the performance of dental practitioners when incorporating the attachments in the overdenture prosthesis with either a rubber dam or resilient composite resin.

**Materials and Methods**

The ethical committee of Suleyman Demirel University approved this study (approval #91). Forty practitioners attending a course on implant retained overdenture application constituted the study subjects. The aim of the course was to provide significant details about implant-retained overdenture prostheses. In the course, the indications and advantages of implant-retained overdentures, and the planning of the treatment procedure were described by a practicing prosthodontist, working as an Associate Professor in a dental faculty. The attachment types, how to select the most appropriate and useful attachment for each patient, and the attachment incorporation process were explained via digital slide presentations. The course concluded with case presentations describing all steps of the treatment procedures from beginning to end, particularly the incorporation procedure, and photographs of complications were shared with the participants. The last presentation of the course was a fifteen-minute video detailing a case of direct incorporation of a ball attachment retainer. The practitioners’ (twenty-three men and seventeen women) mean age was 27.6 years. The amount of experience of the practitioners ranged from three to five years. More experienced practitioners, i.e., those undertaking a PhD program at University, or those who had attended a similar course before, were directed to take a different course. The course completed by the subjects in the current study was conducted over two weekends, and the performance of the practitioners was evaluated before and after the course.

**Model Preparation**

Two impressions were obtained from an edentulous model, and poured in order to obtain two master models. Two holes were formed in the canine areas for the placement of the implant analogues. In one model, the implant analogues (Dio implant analogues, Dio Implant System Co. Ltd.) were placed parallel to each other. In the other model, one analogue was perpendicular to the horizontal plane, and the other was placed at a thirty-degree angle of inclination from the vertical axis. Impressions were then taken from the master models with two implant analogues inserted in the canine areas, simulating an
edentulous arch with two implants. From these impressions, using eighty implant analogs (DIO laboratory fixture analog, Dio Implant System Co. Ltd.) forty cast models were obtained. Twenty of the subjects were assigned models with parallel implants (Figure 1), and the other twenty subjects were assigned models with implant pairs that were angled from each other by thirty degrees (Figure 2).

Fig 1. The parallel implant analogues were mounted in the canine region of the cast model, and the abutments were screwed.

Fig 2. An implant analogue mounted in the canine region at an angle of thirty degrees from the vertical axis.

As non-axial implants were defined as ranging from twelve to thirty degrees by Koutouzis and Wennström in 2007, the angulated abutments were positioned at the maximum of this range; thirty degrees. Ball attachment abutments were screwed into the implant analogues, which served as overdenture retainer elements. Due to the minor inconsistencies between each impression and cast model, a number was assigned to each model and an overdenture was fabricated individually for each model. In order to standardize the position, height, and inclination of the artificial teeth in every overdenture, a silicon index technique was used during the fabrication of the overdenture prostheses. Forty randomized gypsum models including implants that were either angulated or parallel to each other were given to forty dentists, before and after the course. The practitioners who received the angulated or parallel models before the course received the same kind of model after the course, in order to evaluate the impact of the course.

The gypsum model was isolated with spray sealer before the trial began. Each practitioner was asked to attach the O-ring (DIO ball attachment, Dio Implant System Co. Ltd.) retentive component to the previously fabricated overdenture prosthesis using self-cure acrylic resin material. Each dentist used either temporary light-curing composite resin (Figure 3) (Temp-it BLUE Temporary Filling Material, Spident, SPI Dental, Incheon, Korea) or a rubber dam (Figure 4) (Royal Shield Dental Dams, Elastomade Accessories Sdn. Bhd., Malaysia) as block-out materials.
Rubber dam or temporary light-curing composite resin was seated around the ball abutment to avoid acrylic resin penetration. The prosthetic housings were placed on the ball abutments. The denture was placed, coated with low-viscosity silicone, and evaluated for space between the housings and the denture, ensuring at least two millimeters of space over each housing. No hole or perforation was prepared for the escape of excess acrylic resin. The housings were coated with an auto-polymerizing acrylic resin. The denture was placed with firm finger pressure until polymerization was complete.

Performance Evaluation

After polymerization was complete, each denture was removed and checked for any excess acrylic resin in the intaglio or on its outer surfaces. The overdentures that were properly incorporated and exhibited no damage to the model were accepted as successful (Figure 5).

Wash type elastomeric impression material was used to detect any misfits. Any damage around the attachment or stuck overdenture was recorded (Figure 6). The test was repeated after the course, and the practitioners’ performances were re-evaluated.

Results

In this study, the dentists were encouraged to remove the denture from gypsum models without any damage. Even chipping in the gypsum was included as a failure. The failure scores before and after the course are shown in Figure 7.

Fig 6. An example of failure, where acrylic resin has stuck around the abutment undercut area, causing fracture during removal from the model.

Fig 7. Distribution of failures among the groups.

Direct attachment incorporation with a rubber dam was found to be less successful both before and after the course. The angulated group recorded lower scores than the parallel group, but the difference was not statistically significant. Before the course in the group with rubber dam block-out, seventeen failures were recorded, eight of which were recorded in the angulated rubber dam group. In the group with temporary light curing composite resin, eleven failures were recorded, eight of which were recorded in the angulated composite resin group.

After the course, in the rubber dam group four failures were recorded, two of which were recorded in the parallel abutments group. Temporary light-curing composite resin was successful in the parallel and angulated abutments groups. After the course, only one
failure was recorded with the angulated abutments, and none with the parallel abutments, in the resilient composite resin group.

The comparison of proportions test showed statistically significant differences between the rubber dam and temporary composite resin groups when all of the models before and after the course were compared ($p = 0.003$) (SPSS 21.0).

There were no statistically significant differences in the effectiveness of temporary composite resin before and after the course, for either parallel or angulated abutments ($p > 0.05$). Similarly, there was no statistically significant difference in the effectiveness of rubber dams before and after the course, for either parallel or angulated abutments ($p > 0.05$). Statistical analysis showed that the practitioners were more successful after the course, without considering the type of block-out material ($p = 0.026$).

**Discussion**

The null hypothesis, that there would not be any difference between the performances of dental practitioners when incorporating attachments into overdenture prostheses with rubber dams or resilient composite resin, was rejected. The use of perforated elastic material in attachment incorporation has been investigated in many studies, but no published reports were found of studies investigating the use of light-cured temporary composite resin. One study has been reported in which an examination glove was used to avoid acrylic resin jamming around the abutment, during direct and indirect techniques. The direct technique has been found to be superior in both the immediate and long-term, based on after-care scores. Therefore, only the direct technique was used in this study, and different block-out methods were compared. Resilient composites are used by practitioners during various treatments, but they may be a good option as a block-out material due to their resilient structure.

With regard to the angulation of abutments, it has been reported that overdenture attachment retention was affected by the angulation of the gold matrix, but no differences were found when titanium matrices were used. However, excess acrylic material around the angulated abutment could be the main reason for failure, when periimplant tissues are injured either by the acrylic material or during the incorporation procedure itself.

The cast gypsum model is far from replicating the elasticity and composition of the mucosa, as acrylic material can bond to a gypsum surface, but not to mucosa. Therefore, less failure may occur in the oral cavity, but a large area of contact between self-cured acrylic material and mucosa is not desirable, due to potential adverse effects. In addition, the elasticity of the mucosa may compensate for misfits, potentially negating failures that could lead to more serious problems in the future. A rigid surface makes it easier to detect any seating problems.

The statistical analysis revealed that the practitioners were more successful after the course. Therefore, it can be concluded that the aim of course was fulfilled. The temporary composite resin was found to be more successful when an analysis was conducted without considering the models compared (angulated vs. parallel), before and after the course. Thus, resilient composite resin may be a better and safer block-out choice for inexperienced practitioners.

**Conclusions**

While incorporating attachments to overdentures, temporary light curing composite resin is superior to a rubber dam, as a block-out material. The practitioners were more successful after the course, without considering the type of block-out material used. The success of the practitioners was not affected by the angulation of the abutments, before or after the course.

**Declaration of Interest**

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**References**


