

Effect of tray adhesive for alginate impression on accuracy of occlusal contactsSoe Zaw Oo¹, Myat Nyan², Kyaw Tint³

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Accurate occlusal contact relation is necessary for all restorations and devices in dentistry as correct diagnosis, proper treatment planning and perfect restoration ensure satisfactory chewing efficiency. To achieve this goal, accurate impression is extremely important. Among various factors contributing to inaccurate alginate impression, lack of adhesion to the tray is an important one. A study was conducted to investigate the effect of tray adhesive for alginate impression on accuracy of occlusal contacts of mounted stone casts. Alginate impressions were made in 20 dentate participants with or without the use of tray adhesive in stainless steel tray and acrylic custom tray and then the casts were poured in dental stone immediately. Occlusal contact points at maximum intercuspation (MI) intra-orally were recorded by using articulating paper and images of occlusal contacts were taken. The occlusal contacts of mounted opposing casts were also determined and recorded. The percentage of accurate occlusal contacts of mounted casts was determined by dividing the number of accurate contacts observed on the casts with total contact points clinically determined, multiplied by 100. The accuracy of occlusal contacts between samples with tray adhesive and without tray adhesive was compared for stainless steel stock trays and acrylic custom trays. The occlusal contacts were significantly more accurate in samples resulting from impressions using alginate tray adhesive both in stock trays and custom impression trays than those without using tray adhesive ($P < 0.05$). The accuracy of occlusal contacts was greater in samples resulting from impression using tray adhesive both in stock trays and custom impression trays. It is concluded that tray adhesives are necessary to obtain accurate dental impressions with alginate and more accurate duplication of occlusal morphology can be achieved with the use of tray adhesive during impression making.

Keywords: alginate, impression, accuracy, tray, adhesives, occlusal contacts**Introduction**

Among the various impression materials, alginate impression materials have been widely used for removable prosthodontics and also the most

commonly used impression material in an orthodontic practice for making diagnostic and working casts. Alginates are irreversible hydrocolloid materials that were originally developed in the 1930s [1]. The main advantages of alginates are the ease of use, the low cost, their hydrophilic characteristics, and the good patient

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acceptability [2, 3]. In most of the private dental clinics in Myanmar, the alginate impression material is widely used to take the impression for various types of restorative management, especially in removable partial dentures and complete dentures fabrication. However, there are some drawbacks such as they have low tensile strength [1], dimensional changes due to syneresis and imbibition (loss of water and uptake of water), lack of adhesion to impression trays [4] and low resistance to tear and deformation [5]. While dimensional changes can be prevented to some extent by immediately pouring the cast with dental stone, lack of adhesion to the tray can contribute to a serious problem in dimensional change through distortion as the set alginate impression material can be detached from the impression tray when removing it from the oral cavity. As a result, accurate impression cannot be obtained.

To overcome this problem, mechanical locking is used by providing irregularities, holes, undercuts or nets on the surface of impression tray. However, since the impression materials have low tear strength and cannot be sufficiently integrated with the impression tray by only the mechanical holding force [6]. Therefore, separation, detachment and dislodgement of material from the tray usually occur at the holes and periphery of the tray and a specific adhesive is necessary in order to prevent this and to obtain an impression with high accuracy. It can be imagined that such a detachment of alginate from the impression tray results in inaccuracy of impression especially vertically. The resultant cast poured from the impression may have oral structures that are changed in dimension vertically affecting the occlusal contacts and occlusion of the resultant prostheses.

Mechanical retention is achieved by the presence of undercuts and perforations into which the unset material flows, set, and becomes locked. The

chemical adhesive method uses an adhesive material delivered in a volatile solvent. The solvent then evaporates, leaving the entire tray surface covered with the adhesive, which is retained within the molecular network of the superficial layer of the tray material [8]. Impression retention is related to the chemistry of the adhesive agents and to the surface chemistry of the resin tray material. Thus, solvent evaporation is considered as the “setting” of the adhesive, and is dependent on time, temperature, and relative humidity [8].

Anyhow, impression retention plays an important role in the accuracy of the cast and the resulting definitive prosthesis. Correct centric and eccentric relations are necessary and important when constructing dental prostheses. By having the more accurate impression, the less selective grinding is needed and the more natural occlusal form can be obtained and less errors in occlusion at chair side delivery visit and less time and energy is needed for troublesome selective grinding. Without the use of tray adhesive for alginate, separation of alginate impression from the tray may be an unavoidable problem to get accurate impression and which can influence on correctness and accuracy of occlusion of final prostheses.

The present study was aimed to investigate the effect of alginate tray adhesive for alginate impression on accuracy of occlusal contacts of mounted stone casts.

Materials and methods

The study was approved by Ethics and Research Committee of University of Dental Medicine, Mandalay, Myanmar. Twenty dental students were selected according to the selection criteria. After thorough informed consent process, alginate impressions were taken in each subject. Primary impression was made by using alginate impression material in stainless steel perforated stock trays with

and without using alginate tray adhesive (figure 1).

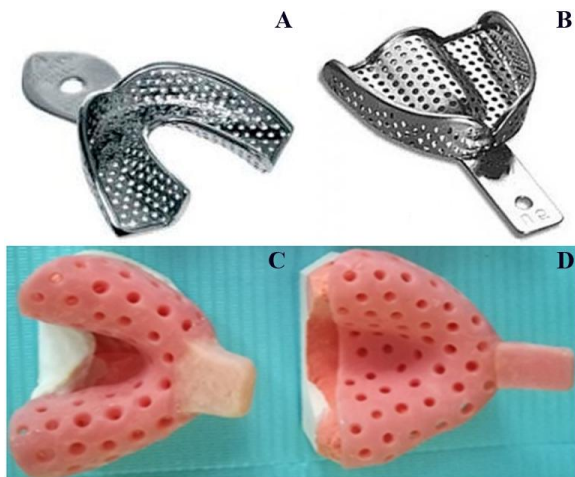


Figure 1. Impression trays used in the study: Perforated stainless steel trays with rim-lock for (A) mandibular and (B) maxillary arch and perforated custom trays for (C) mandibular and (D) maxillary arch

When using tray adhesive, a thin layer of tray adhesive was applied to the whole inner surface of impression tray and let it dry for about 15 minutes and then took an impression (figure 2).

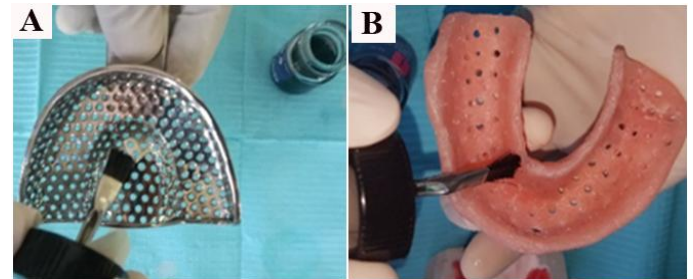


Figure 2. Application of tray adhesive (A) Stainless steel stock tray and (B) self-cure acrylic custom tray

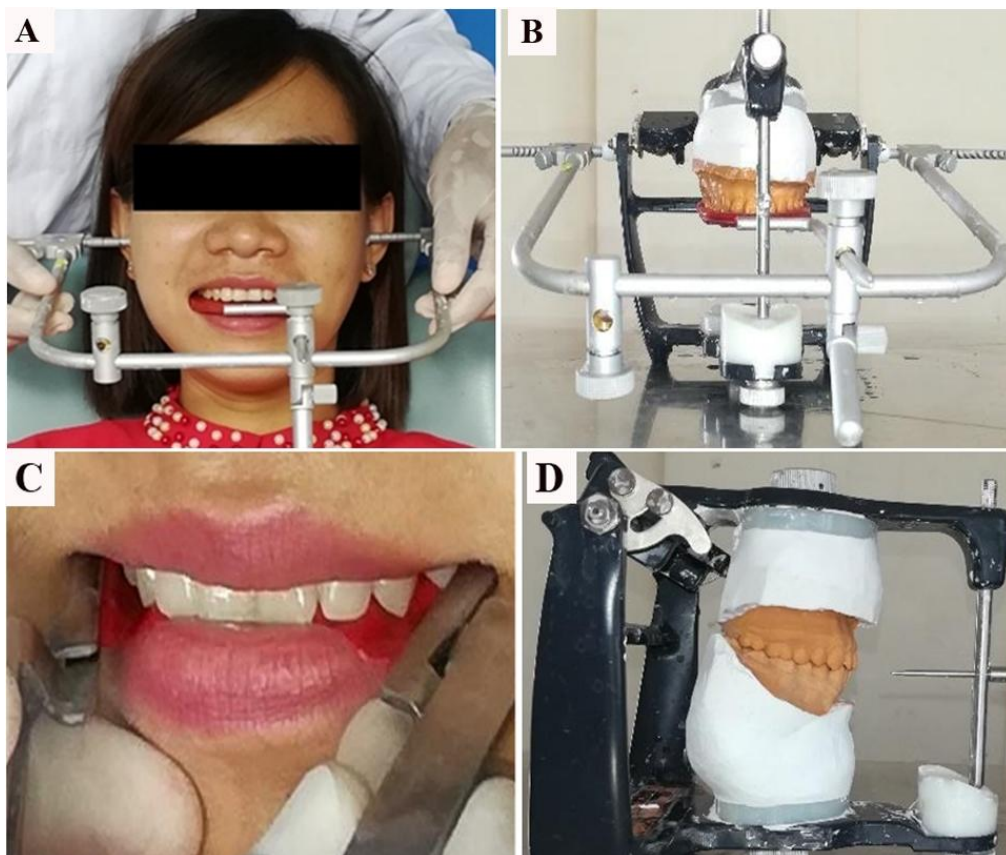


Figure 3. (A) Clinical photograph showing facebow registration

(B) maxillary cast mounted on mean-value articulator using facebow transfer

(C) Intraoral image showing obtaining occlusal contacts using articulator papers bilaterally in centric occlusion and

(D) Both casts mounted in maximum intercuspation on mean-value articulator

The impressions were poured with dental stone (Type IV) and then custom trays were fabricated with self-cured acrylic resin material using 3-4 mm spacer. These individual trays were perforated with uniformly distributed holes of 2.5mm in diameter. Secondary impressions were made with self-cure acrylic custom trays: first without using tray adhesive and the other using tray adhesive. The impressions were poured immediately with dental stone (Type IV). Facebow registration was done to record relation of mandibular condyle to maxillary arch so that positions of maxillary and mandibular casts were accurately transferred onto mean-valued articulators (Pro Arch IG, Shofu, Tokyo,

Japan) (figure 3A, B, D). The casts were mounted on articulator in maximum intercuspation.

Clinically the occlusal contacts between two opposing arches were checked by placing standardized articulating paper in between the opposing occlusal surfaces. After prophylaxis and drying of all teeth, the subject will be asked to open and close his/her mouth in maximum intercuspation (MI) and the occlusal contacts were assessed using articulating paper (GC Asia Dental Co. Ltd) (figure 3C). In this way, when in occlusion, the contacts were marked on the upper teeth and the lower teeth. Using mouth retractors and an intraoral mirror, occlusal surfaces of both arches were

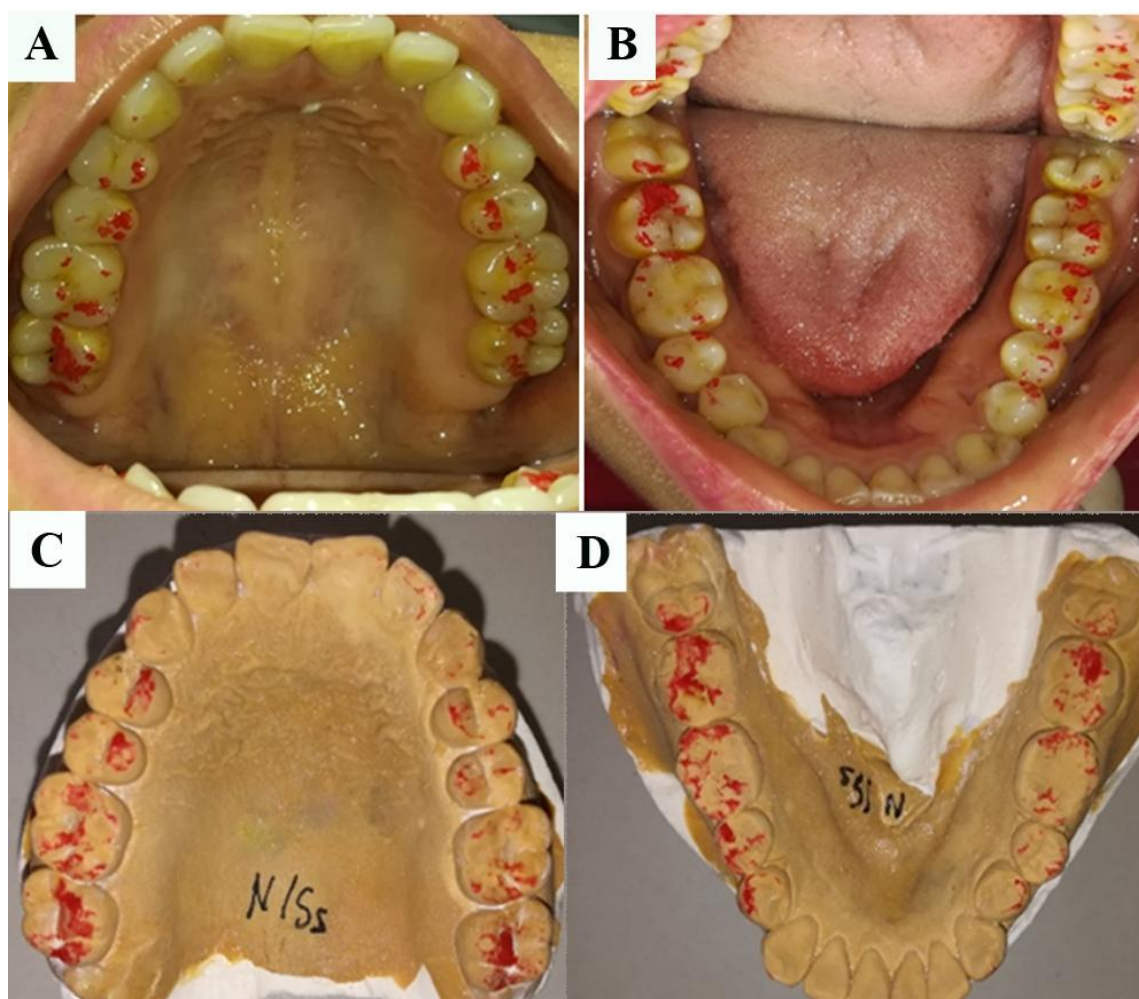


Figure 4. Intra oral images indicating occlusal contact points revealed by articulating paper marks (A) maxillary arch (B) mandibular arch and images of corresponding (C) maxillary arch and (D) mandibular arch showing occlusal contact points on the casts after tapping on articulating paper

photographed. On the articulators, the occlusal contacts between two opposing casts were checked by placing standardized articulating paper in between the occlusal surfaces and simulate the centric occlusion by manually tapping the upper and lower casts for 30 times. The resultant stain areas were compared with those in clinical images (figure 4). The percentage of accurate occlusal contacts of mounted casts was determined by dividing the number of accurate contacts observed on the casts with total contact points clinically determined, multiplied by 100. The percentage of erroneous contacts was also determined in the same way.

Results

The data collected from each participant were tested for normality of distribution by using Shapiro-Wilk normality test and all the measures followed a normal distribution, so revealed the parametric data. Because of sample size of the study was only 20, non-

parametric test, Wilcoxon Signed Ranks test was used to compare the accuracy of occlusal contacts resulted from impression with and without using tray adhesive. Erroneous occlusal contacts on mounted casts obtained from impression with and without using tray adhesive were also compared.

The accuracy of occlusal contacts of mounted opposing casts resulted from alginate impressions with the application of alginate tray adhesive to the trays were higher both in stainless steel stock trays 83.94 (± 14.56) % and self-cured acrylic custom impression trays 86.86 (± 10.49) % as compared to accuracy of occlusal contacts of the mounted opposing casts resulted from alginate impression without the use of tray adhesive in stock tray 72.41 (± 17.82) % and custom tray 73.07 (± 10.11) % (figure 5).

The erroneous occlusal contacts occurred on mounted opposing cast resultant from alginate impression using stainless steel tray without tray adhesive

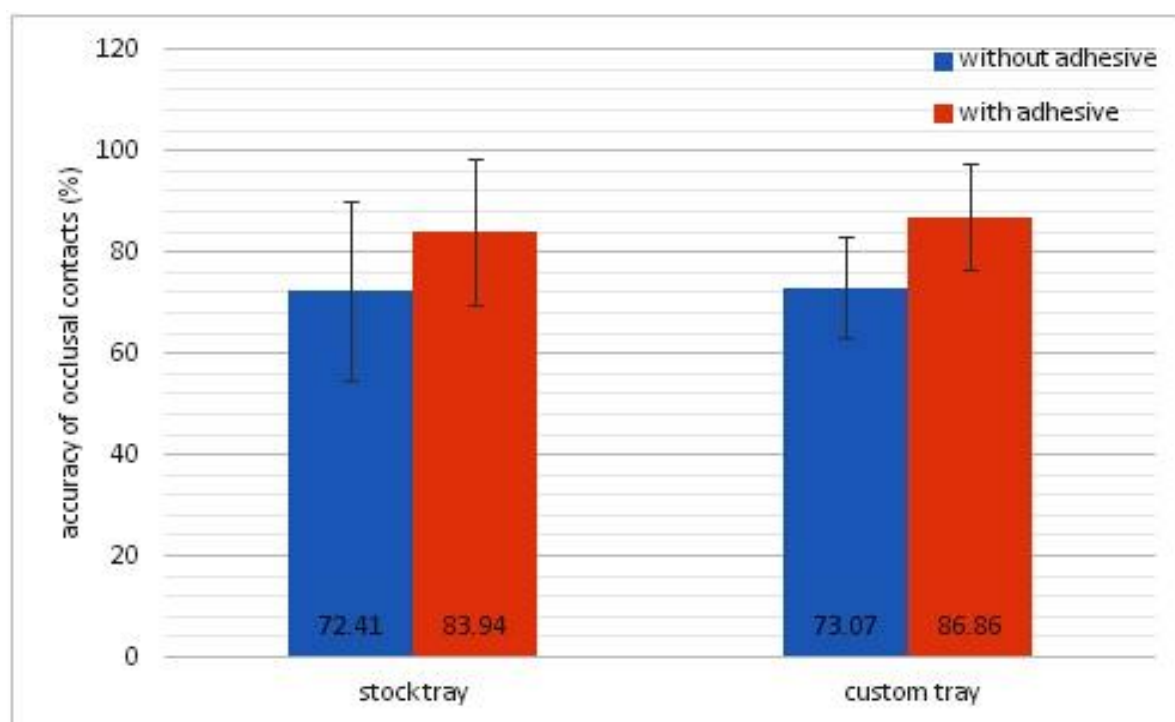


Figure 5. Comparison of mean accuracy of occlusal contacts between opposing casts obtained from impressions with and without using tray adhesive in stock trays and custom trays. ($P = 0.001$ for stock tray and $P < 0.0001$ for custom tray).

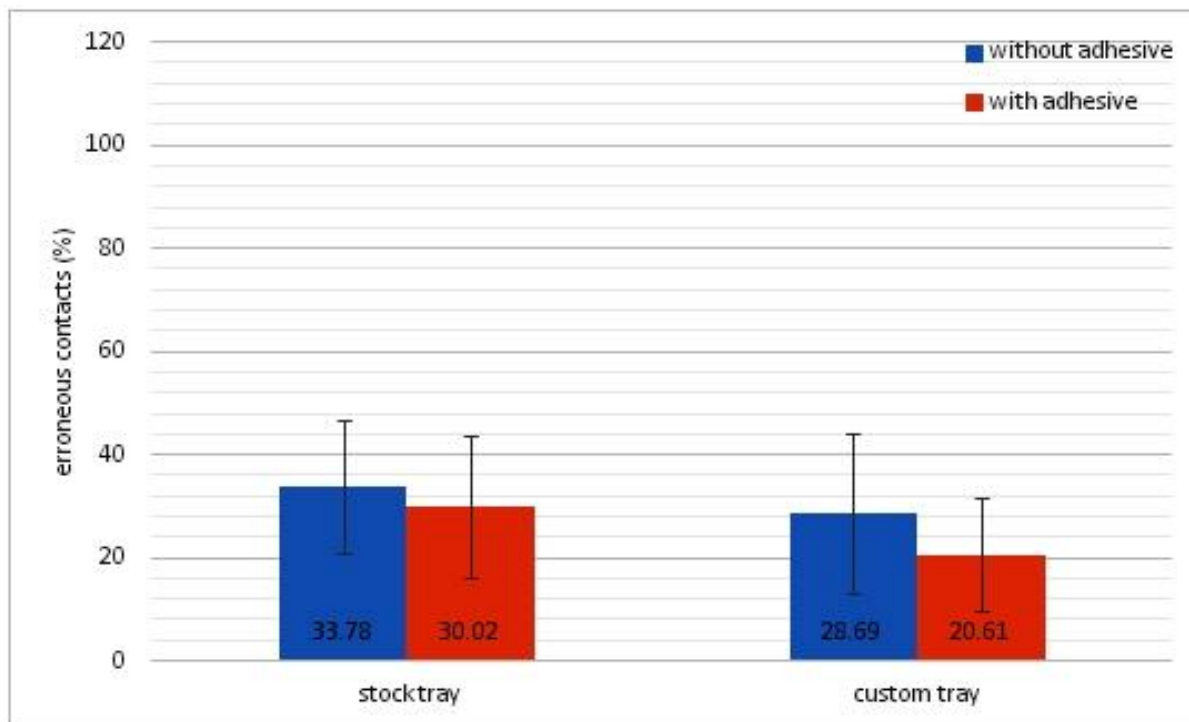


Figure 6. Comparison of mean accuracy of erroneous occlusal contacts between opposing casts obtained from impressions with and without using tray adhesive in stock trays and custom trays. (P = 0.122 for stock tray and P = 0.004 for custom tray).

33.78 ± 12.93 and with tray adhesive 30.02 ± 13.85. The erroneous occlusal contacts occurred on mounted opposing cast resultant from alginate impression using self-cured acrylic custom tray without tray adhesive 28.69 ± 15.36 and with tray adhesive 20.61 ± 10.97 (figure 6).

This study demonstrated that alginate impression using tray adhesive in both stainless steel stock trays and self-cure acrylic custom trays ensured more accurate occlusal contacts and reduced erroneous contacts. To assure accurate and consistent results application of alginate tray adhesive is mandatory.

Discussion

There are many techniques to modify the impression tray to retain the impression material firmly by mechanical means. Making the retentive holes in the impression tray is one of the mostly used techniques to provide mechanical retention

with the alginate impression material. The smaller holes (1.6 mm diameter) more effective retainers than the larger ones (2 mm diameter)[9].

Alginate adhesives can be used, apart from perforations, for retention of alginate to the impression tray. Use of alginate tray adhesives overcomes displacing forces during withdrawal of the impression from the mouth [10]. The use of alginate tray adhesive is to provide the adhesion between impression tray and alginate impression material and enhance the accuracy of the alginate impression. This study compared the accuracy of the occlusal contacts of mounted opposing casts obtained from alginate impression with and without using tray adhesive in stainless steel trays and also compared the accuracy of occlusal contacts with and without using tray adhesive in self cured acrylic custom trays.

Marafie et al. (2008) studied the effects of chemical adhesive or self-stick adhesive system on retentive strength of

impression materials to plastic substrates with and without mechanical retention [8]. According to their results, 0.108 (0.004) MPa for non-mechanical retention with chemical adhesive and 0.152 (0.033) MPa for mechanical retention combined with chemical adhesive, showed that application of chemical adhesive enhanced the retention of alginate impression material to impression tray regardless of type of tray retention.

Also in the present study, the accuracy of occlusal contacts of mounted opposing casts resulted from alginate impressions with the application of alginate tray adhesive to the trays were higher both in stainless steel stock trays 83.94 (± 14.56)% and self-cured acrylic custom impression trays 86.86 (± 10.49)% as compared to accuracy of occlusal contacts of the mounted opposing casts resulted from alginate impression without the use of tray adhesive in stock tray 72.41 (± 17.82) % and custom tray 73.07 (± 10.11) % . Because there are no similar studies in the literature, comparative values to other testing could not be directly made. Nevertheless, the use of tray adhesives was associated with better accuracy of occlusal contacts and it may be due to better adhesion of alginate material to the tray without being detached during removal from the mouth.

There were erroneous contacts apart from accurate occlusal contacts occurred on mounted opposing casts. We also compared the percentage of erroneous contacts occurred on mounted opposing stone casts obtained from impressions with and without using tray adhesive in stainless steel stock trays and self-cured acrylic custom trays. There were no significant differences between the erroneous occlusal contacts occurred on mounted opposing cast resultant from alginate impression using stainless steel tray without using tray adhesive 33.78 \pm 12.93 and with tray adhesive 30.02 \pm 13.85. However, significantly more

erroneous occlusal contacts were found when self-cured acrylic custom tray was used without tray adhesive (28.69 \pm 15.36) compared to that using tray adhesive (20.61 \pm 10.97).

According to the results of the present study, the highest accuracy of occlusal contacts was 86.86 % resulted from alginate impression using tray adhesive in self-cured acrylic custom trays. However, the erroneous occlusal contacts were occurred in all samples. The highest erroneous occlusal contacts were occurred in impressions made without tray adhesive in stainless steel stock trays 33.78 %, and the lowest 20.61 % from impressions made with tray adhesive in self-cured acrylic custom trays.

There were more erroneous occlusal contacts occurred in impressions made with or without tray adhesive in stainless steel trays as compared to self-cured acrylic custom tray. This may be due to the larger amount of tray space result in inadequate support of impression material and uneven thickness of the impression material lead to distortion in impression even in adequate retention of material to the impression tray. Slight movement of the tray during gelation may be another possible factor. Millstein, Maya and Segura (1998) stated that impressions made from custom trays were more accurate and consistent in reproduction than were stock tray impressions [11].

In fixed and removable prosthetics, the cast of the antagonistic arch articulates with the partially edentulous one that requires rehabilitation. The antagonistic cast must accurately reproduce the occlusal morphological features to simulate the actual clinical intercuspation in the articulator. Routine clinical practice uses irreversible hydrocolloid for the impression of the antagonistic arch because it is the most practical material [7]. As the impressions of the arch to be restored and the opposing arch are taken

with alginate, errors in dimensions of each impression would sum up in the resulting casts and so also in the removable partial denture which is fabricated using these casts. Changes in vertical dimension necessitate thorough correction at chair side by grinding the occlusal surfaces of the artificial teeth in the removable partial denture. This is not only time-consuming, but also leads to flat occlusal surfaces and loss of anatomical shape of the cusps resulting to inefficient grinding and chewing.

Clinically, alginate impressions in stock trays are usually made for impression of opposing dentition during fixed prosthodontic cases and according to the results of present study, impressions made without tray adhesive produced more erroneous contacts, thus would consequently result in faults in final prostheses. Although these can be corrected clinically, more chair-side time will be necessary to do so. Perfect re-polishing would also be a hard work. Therefore, the use of tray adhesive should be encouraged to all clinicians.

Furthermore, alginate impressions in acrylic custom trays are often made for definitive or final impression of the arch to be restore with removable prostheses. The cast must accurately reproduce the occlusal morphological features to simulate the actual clinical intercuspation in the articulator with accurate occlusal contacts. Retention of impression material to the tray influence the accuracy of impression also the accuracy of occlusal contacts between mounted opposing casts. Thus, the use of alginate tray adhesive for alginate impression enhances the retention between the tray and impression material. More accurate the occlusal contacts of mounted dental casts, the least number of occlusal discrepancies will be developed in the prosthesis.

It can be noted that occlusal contacts in stone casts were not 100%

accurate. The reason may be that impressions of both arches were made using alginate. It will be interesting to conduct a similar study using silicone impression materials which can reproduce more accurately. Other limitations in the present study are that the % change of dimension of dental stone used in the study was not considered and that mounting plaster was not used in study procedure. The latter would be important as one recent study showed that ordinary dental plaster expands considerably and it might change the spatial relation of upper and lower stone casts after mounting in the articulator [12].

Conclusion

Alginate impression using tray adhesive in both stainless steel stock trays and self-cured acrylic custom trays ensured more accurate occlusal contacts and reduced erroneous contacts and therefore routine application of tray adhesive for alginate impressions is recommended in daily prosthodontic practice.

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