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Original Research Article

Evaluation of Impression Accuracy Making with Different Kind of Tray

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Abstract: The aim of this study was to evaluate how tray shape (half or full arch) and impression procedure affect the precision of impressions. Half arch and full arch trays in metal and plastic were utilized in combination with a two stage impression technique. For each technique-tray combination, 10 impressions were made of a master cast with two steel rod representing the mandibular left first premolar and first molar, where a standard steel rod was placed. Each steel abutment had four marks, which served as a reference point. With a universal measuring microscope, the x-, y-, and z-coordinates were computed for each mark on the master cast and impressions. The span between marks and the reference point on the impressions were calculated and compared with those of the master cast. All techniques employed with the full arch metal trays and the plastic trays had distances that were not significantly different from the master cast ($P < 0.05$), while for the half arch plastic trays, it was different from the distance in master cast but the distances were not significantly different from the master cast ($P < 0.05$). Half arch plastic trays produced correct impressions. When full arch were employed, the full arch metal tray impressions were dimensionally better than full arch plastic impressions.
Keywords: impression procedure, tray shape, plastic trays mandibular teeth

INTRODUCTION

Impression materials are utilized to duplicate or reproduce form and correlation of teeth and oral structure. Their purpose is to make a precise duplicate of the oral surrender tissue and then pour the impression. Several factors affect the precision of impression materials, they include; impression material manipulation [1], thermal changes after removal [2], kind of impression material [3], tray impression retention [4], tray deformation [5], impression tray design [6] impression material thickness [7], impression technique and impression removal [8].

During these years, there has been a propensity to use plastic stock trays rather than custom made ones or the metallic tray to make impressions for crowns, bridges and implants. Also, these plastic trays have been utilized in different forms, for instance, half arch or triple technique or a full arch in combination with different materials with different viscosities. Tray rigidity and material thickness are among many variables that have been reported as important factors in making precise impressions [9, 10, 7]. It has been indicated that the tray should be rigid enough to stand the forces provoked during the impression procedures without distortion [11]. Regarding the thickness of the material, it has been recommended that a thin even layer of about 2 mm of impression material make the most accurate impressions [13].

Custom trays are trays specially designed for an individual case. They give an even thickness of the impression material and often reduce the volume of impression material needed. Stock trays are the trays that come in pre-determined sizes. They may either be in metal or in plastic. The term “stock tray “ is used in the literature independent of whether the trays are made of metal or plastic. Nevertheless, it is important to differentiate between metal and plastic stock trays, because the accuracy of metal and plastic stock trays

can be different due to differences in their rigidity. Moreover, the use of stock trays, independent tray material, results in an uneven bulk thickness of the impression material, which increases the risk for inaccuracy [13, 10, 7].

Other important factors in impression preciseness are related to the rigidity and dimensional stability of the tray. The tray should be stiff and stable enough so as not to be altered during insertion and retrieval of the tray-impression complex from the mouth. Any tray deformation, especially elastic deformation, will lead to distortion mistakes. Metal trays are more rigid than plastic trays. Among plastic trays, there are different levels of rigidity. The aim of this study is to evaluate how tray shape and material can affect the accuracy of impression when a half or full tray in metal or plastic is chosen.

MATERIALS AND METHODS

A full lower arch master model was made of self-curing Resin (Dentsply-Caulk, Milford, DE) with a standard rod placed in the first pre molar area and the same rod placed in first molar region.

Fig-1: To standardize measurement between to separate abutments

Impression technique

The four impression groups are distributed as follows:

1. Plastic full arch stock tray (Disposable impression trays, Henry Schein Inc, Melville, NY, USA) where heavy and light bodied additional silicon (EliTe HD +Zermack, Italy) materials were used with the two phase technique.
2. Plastic half arch stock tray (Disposable impression trays, Henry Schein Inc, Melville, NY, USA) where heavy and light bodied additional silicon (EliTe HD +Zermack, Italy) materials were used with the two phase technique.
3. Full arch metal tray (Rim-lock trays, Dentsply-Caulk) where heavy and light bodied additional silicon (EliTe HD +Zermack, Italy) materials were utilized with the two phase technique.
4. Half arch metal tray (Rim-lock trays, Dentsply-Caulk) where heavy and light bodied additional silicon (EliTe HD +Zermack, Italy) materials were utilized with the two phase technique. After master model had been constructed, the next step was to standardize the way the impressions were made.

For this purpose, the master model was attached by two screws to a half inch thick aluminum plate. This plate was nine inches long and seven inches in width. Three stainless steel pins, each with a diameter of 3/8 of an inch and a height of five inches, were vertically positioned on the aluminum plate, two in the back and one in the front of the master model.

The three vertical pins on the base plate guided a second plate to where either the metal or the plastic tray was attached. This system controlled the location of the impression trays in three dimensions every time an impression was made. Three plastic stops were assembled on the pins.

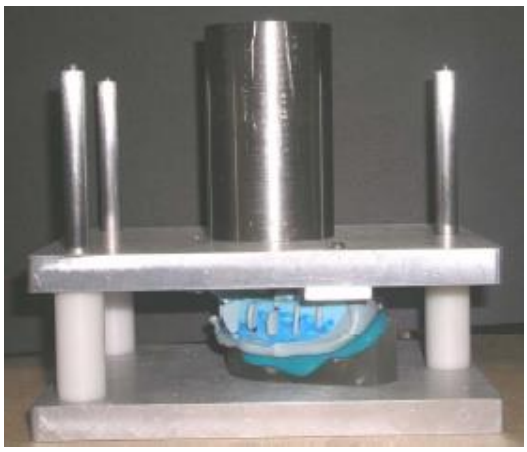

Fig-2: The tray against the model

Measurements

The method used in this study to analyze the accuracy of impression is via the use of microscopes and the measurement of distances between standard rod that duplicates the abutments on the master model and impressions. In this study, we decided to use 10 impressions per group. The coordinates of the marks were recorded 10 times for the master model. Comparisons between the different tray groups were carried out via the use of a t-test and pair wise comparisons.

RESULTS

Using a t-test and pair wise comparisons, no significant differences were found between the investigated groups and the master model ($p<0.05$). All techniques used with the half arch plastic trays had distances that were different from the master model but they are not significant, while for the full arch trays, the two stage technique resulted in a distance that was significantly shorter than the matching distance on the master model; nevertheless, with alginate impression materials, distances were different but not significant.

Table 1: Mean and standard deviation of ten rounds of measurements performed on the four marks of the Master model

Distance	number	Mean(micron)	SD(micron)	minimum(micron)	maximum(micron)
Mark1	10	18071.5	27.9	18032.4	18121.8
Mark2	10	15577.4	26.3	15538.3	15613.6
Mark3	10	17665.2	70.1	17567.9	17789.3
Mark4	10	9994.1	26.1	9959.0	10036.5

Table 2: Measurements from ten impressions taken with afull arch plastic tray and the heavy/light bodied technique

Distance	number	Mean(micron)	SD(micron)	minimum(micron)	maximum(micron)
Mark1	10	18062.1	24.3	18033.8	18104.1
Mark2	10	15579.5	25.0	15543.3	15625.8
Mark3	10	17592.6	63.5	17510.0	17738.2
Mark4	10	9984.1	27.1	9943.3	10049.2

Table 3: Measurements from ten impressions taken with a half arch plastic tray and the putty/light bodied technique

Distance	number	Mean(micron)	SD(micron)	minimum(micron)	maximum(micron)
Mark1	10	18043.3	128.3	17856.0	18353.9
Mark2	10	15476.4	102.2	15364.6	15737.5
Mark3	10	17623.7	126.7	17458.6	17888.1
Mark4	10	10189.4	587.0	9775.7	11831.8

Table 4: Measurements from ten impressions taken with a half arch metal tray and the heavy/light bodied technique

Distance	number	Mean(micron)	SD(micron)	minimum(micron)	maximum(micron)
Mark1	10	18066.3	17.6	18029.6	18089.8
Mark2	10	15631.9	103.1	15580.6	15924.2
Mark3	10	17658.7	69.9	17542.8	17739.3
Mark4	10	9997.0	18.5	9979.9	10044.8

Table 5: Measurements from ten impressions taken with a full metal tray and the putty/light bodied technique

Distance	number	Mean(micron)	SD(micron)	minimum(micron)	maximum(micron)
Mark1	10	18054.3	15.1	18032.1	18079.8
Mark2	10	15579.7	19.2	15553.0	15615.0
Mark3	10	17667.0	68.4	17544.6	17744.7
Mark4	10	9939.0	312.5	9050.8	10078.2

DISCUSSION

The discrepancies found on these two groups are probably still clinically acceptable for certain procedures. Differences in distances up to 90 μm between abutments for a fixed partial denture have been estimated as acceptable, because the periodontal ligament measures from 100 to 250 μm. Probably, even values higher than 90 μm are acceptable for some patients. It means that perhaps under pressure, the bridge fabricated from a slightly different sized cast could seat onto the abutments and fit properly against them. Fortunately, such big variations in length are found only when dealing with edentulous spans where the impression material bulk is big and highly susceptible to polymerization shrinkage and thermal changes. Intra abutment dimensions are not adequately affected by all impression variables to make them clinically important. The rigidity of the tray is one of the multiple factors related to impression accuracy [13]. Great distortions of trays have been shown in a study when comparing plastic stock trays with metal trays while performing impressions with putty material [10]. Plastic tray flexibility was probably the cause for the distortion seen for groups with two stage technique where the pressure created by the putty could have initially distorted the trays and then the pressure of the light material during the second impression stage increased the distortion even more. Rigid trays have been recommended by some authors such as Gordon et al. who found up to 100 μm difference on inter abutment distances and 260 μm cross arch discrepancy when utilizing plastic stock trays [13, 9]. They attributed this distortion to tray flexibility. Comparable distortion was found in this study with the plastic trays when using an impression technique with putty materials [19].

It is almost impossible to simulate and analyze all the variables affecting such a complex event like the impression procedure. The complexity of impression making probably goes even further than one could possibly imagine. In our study, half arch tray either in metal or plastic are less accurate than full arch tray; nevertheless, the difference are not statistically significant, so it seems that half arch tray can be used in making impression for single crown fabrication due to less bulk of materials available and less shrinkage occurs during setting. Some of the variables not considered are: use of custom tray, mouth temperature, moisture, undercuts, other impression materials, cast production, and castings just to mention but a few.

In our study, the master model was designed based on what has been done in previous studies, using six degree taper stainless steel abutments for a 4 unit fixed partial denture. The reviewed studies have used parallel walls up to 12° taper, which is probably closer to reality.

Pins to standardize tray seating are very popular among these *in vitro* studies. Seating pressure is not commonly standardized, but it seems to have some influence on material behavior .The differences in weights utilized for the different techniques were because different techniques, materials and trays required different levels of pressure to establish ideal master /tray relationship. Undercut is another variable that was not included in this study. Its importance based on impression accuracy is well recognized [12]. The greater the undercut, the more likely a thin layer of impression material will deform permanently. On the other hand, the thicker the material layer, the more susceptible it becomes to polymerization shrinkage. Thin layers of 2-3 mm of impression material are accepted to produce accurate dies even in the presence of undercuts [21, 22].

The instrument utilized for the measurements is a Unitron Microscope capable of measuring as low as 1 μm. It has been expressed theoretically that bucco-lingual dimensions of dies produced from distorted putty impressions from tray recoil are much smaller, producing oval shape dies rather than round shape dies [9]. Nevertheless, it was very unlikely that we could have detected any significant difference measuring the impressions directly.

One study reported better fitting of the resulting castings on the master model when metal or rigid plastic trays were used [9]. It seems that in half arch tray, the less amount of material helps to improve the accuracy of impression that occurs in double technique due to less shrinkage.

CONCLUSION

This study however shows that the impressions make with full metallic tray are more accurate but using of half arch trays for making impression of a single or diagnostic crown are clinically acceptable.

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