Review Article

Impression Techniques in Fixed Prosthodontics

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Abstract

An impression is an imprint produced by "the pressure of one thing upon or into the surface of another" or the negative likeness. Only when we have a thorough knowledge of materials, their qualities, and techniques of manipulation, we can produce an impression of high quality. To generate duplications as accurately as possible, various impression techniques have been developed. Each technique has advantages and disadvantages of its own. This paper aims to review all impression-taking methods used in fixed prosthodontics.

Keywords: Computer-aided design-computer aided manufacturing, Conventional, Digital, Impression techniques, Pick-up impression.

Introduction

The accuracy of the dental impressions is crucial to a successful dental restoration. An impression is an imprint or negative replica. It allows for the duplication or replication of human bodily tissues, which would not have been achievable without longer chair side time. It is not technically possible or desirable to fabricate prostheses or restorations directly in the patient's mouth. Hence, the prepared tooth or teeth in the mouth, or the area where the denture rests, must be precisely replicated in a cast or model. The accuracy of an impression depends on the materials used for impression making as well as the techniques. To generate duplications as accurately as possible, various impression techniques have been developed.[1] The dimensional stability of the impression material could have an influence on the accuracy of the final restoration. Elastomeric materials (addition-cured silicones and condensation-cured silicones) are most frequently used as the impression material in fixed prosthodontics.[2] This paper aims to review all the techniques of impression making in fixed prosthodontics.[3]

It is very important that the clinician selects an appropriate impression technique and materials to accomplish this task.[4] The accuracy of the cast depends on the properties of the impression techniques, impression materials used, and the properties of cast and die materials. Each technique and material have its advantages and drawbacks. It is evident that the clinician must choose the most appropriate material and technique based on evidence, even though the ideal material and technique have not yet been developed. This article is an update of studies done by various dignities through time and their conclusions.[5] This paper summarizes the techniques to be adopted in fixed prosthodontics based on available evidence.

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Impression Techniques

There are several techniques for making fixed partial denture (FPD) impressions. They are:

Conventional techniques

a. Putty-wash impression
b. Dual-phase impression
c. Mono-phase impression
d. Hydrocolloid laminate technique
e. Copper-band impression technique
f. Impression using vacuum-adapted splints
g. Impression using preformed crown shells
h. Dual-arch impression technique
i. Functional check bite impression
j. Matrix impression system
k. Cast impression coping technique
l. Sectional impression technique
m. Digital impressions.

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Recent techniques

A. Digital impressions
   a. Chairside production
   b. Laboratory production
   c. Centralized fabrication in a production center.

Putty-wash impression

This is a stock tray impression technique. Here are two methods to make a putty wash impression.

1. One step/Single mix putty-wash impression
2. Two step/double mix putty-wash impression.

One step/single mix putty-wash impression

Both the light body and putty are used in this procedure. The stock tray is filled with the putty material. A full mouth impression is then taken using the loaded stock tray after the light body material has been syringed around the tooth preparation.

Two step/double mix putty wash impression

In this method, a putty impression is made in a suitable stock tray and the light body is then syringed over both the prepared tooth and the putty impression. Polyethylene sheet can be used as a spacer for the light body, as it prevents penetration of the putty in to the inter-proximal areas or it is achieved by scraping the material with a round bur or blood pressure blade.[6] A uniform wash space is needed for an accurate impression. Nissan *et al*., advised using a two-step technique because there is an uniform wash space for the light body material to polymerize.[7]

Advantages

1. Shortens the process and lowers the cost of making customized trays
2. Metal stock trays are rigid and less likely to warp.

Disadvantages

1. More impression material is required
2. Sterilization of metal trays is must
   The polymerization shrinkage may occur uneven as the thickness of impression material is uneven.

Dual-phase impression

This impression technique is also known as the "custom tray impression technique" or the "laminate single impression technique." Both heavy and wash types are combined together in this method. The use of heavy-body and light-body addition silicone, along with a rigid custom tray and a thorough clinical method, results in the most accurate impressions. Furthermore, a rigid stock tray can be used with these materials. In this method, the light body is placed directly on the preparation after being laminated in a thin layer on top of the heavy body. This lamination serves to prevent direct contact between the heavy body and the preparation surfaces, which could result in the cast surface being rough.[8] Without using a syringe, the heavy body material also forces the light body material into the gingival sulci and records the preparation details.

Advantages

1. Compared to the stock tray approach, less material is used to make an impression
2. Since the tray is only used for one patient, sterilization is not a problem
3. The distortion brought on by uneven polymerization shrinkage is reduced to a minimum by the impression material's uniform thickness
4. Patient comfort.

Disadvantages

1. Custom tray fabrication is time consuming
2. To reduce distortion, the tray must be constructed 24 h before usage
3. For some patients, the residual monomer from special tray may cause tissue irritation.

Mono-phase impression

This process mimics dual phase impression, with the exception that only medium-viscosity material is used for the tray and syringe material. A custom tray with a 3 mm spacer and medium viscosity (regular body) elastomeric impression material is used. In this technique, the surface reproduction may not be good like that of light body material. Because of less filler content, the medium viscosity material will show a greater amount of polymerization shrinkage when compared to that of heavy body materials. Monophasic polyvinyl siloxane impression materials maintain their dimensional stability and accuracy when using rigid stock trays.[9]

Hydrocolloid laminate technique

A combination of reversible (agar) and irreversible (alginate) hydrocolloids is used in the hydrocolloid laminate technique. The area to be recorded is covered with chilled alginate mix from the stock tray after being injected with agar using syringe material [Figure 1].[10] The alginate sets through a chemical reaction and the agar through contact with the cold alginate. Agar, which comes into contact with the tissue surface, reproduces the most surface details.

Advantages

1. It is more economical compared to the newer elastomeric impression materials
2. Good surface reproduction but sometimes due to high viscosity of alginate, agar may be displaced.

Copper-band impression technique

Select copper bands to fit each prepared tooth. The fitted contoured and festooned bands are cut to a length 2 mm longer than the crowns of the prepared teeth. The facial surfaces should be marked for identification when placing the band on the prepared teeth [Figure 2].[11] A soft mixture of beeswax and paraffin should be used to line the metal tray. Heat it over a flame. To ensure that

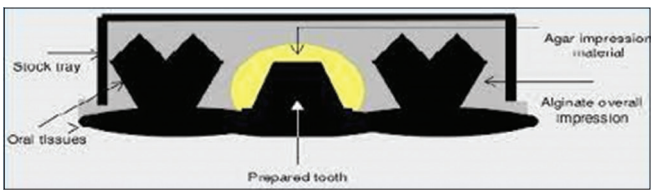

Figure 1: Hydrocolloid laminate technique

the wax impression has fine border detail, carefully place the wax-lined impression tray in the mouth. Lift the bands away from the wax impression after removing the tray. Remove majority of the wax from the impression, leaving a good border seal intact. Paint the inside of the wax impression once it has been trimmed, covering the inside as well as the exterior surfaces of the bands with adhesive to ensure retention of the impression material. Fill each band with a rubber-base or silicone impression as needed. Apply pressure with the ball of your finger to the preparations by placing the bands over them until the impression material sets. Remove the excess material using a pair of cotton pliers while the band is in place. Proceed in this manner until all band impressions are firmly attached to each tooth. Fill the wax-lined tray with the rubber impression material. Place it in the mouth, and hold it until the impression material is completely set. The copper bands holding their impressions will come out with the impression when it is removed. Make a thorough check for inaccuracies in the impression. All margins of the preparations should be distinct and easy to read with free of voids or air bubbles.[12]

This technique includes the following combinations.

1. Original copper tube and modeling compound method
2. A variety of copper tube and elastomer combinations
3. Resin copings and elastomer
4. Polycarbonate crowns and elastomers
5. Resin (provisional) crowns or FPDs with elastomers.

The impression material that usually becomes a component of the impression is used in all of the above techniques in a rigid carrier. The finish line is recorded initially in the carrier. The displacement of the gingiva is usually accomplished as the modeling compound or elastomer is delivered to the sulcus.

Impression using vacuum-adapted splints

In 1970, Antony LaForgia gave a simplified procedure for making impressions of multiple abutments, using vacuum adapted temporary splint material as a tray former. Here, tray former is fabricated using temporary splint material. Following the completion of tooth preparation, cold-curing resin is mixed and added to the tray former to fill the edentulous areas and space left by preparations. The resin-filled tray former is then placed onto the arch, where it cures acrylic using cold polymerization. Except for one stop that is kept on the occlusal area, the internal surface of the tray is relieved. Thin rubber base adhesive is applied all over the tray and allowed to dry. It is now loaded with heavy body rubber base impression material and a primary impression is made. All the internal surfaces are relieved for final impression and perforations are made on the occlusal and incisal surfaces. Using a syringe or spatula, the tray is evenly filled with light and regular body rubber base impression materials before being set on the abutments in the mouth. The final impression is formed using regular-body rubber base impression material in an enlarged stock tray or an acrylic resin tray after the material has set.[13]

Impression with preformed crown shells

In this technique for each tooth preparation, prefabricated temporary crown shells are used and a final over impression is then made using a stock tray.

1. Take a preformed polycarbonate crown and adjust the gingival margin to extend slightly to the finish line of the preparation. The crown should fit loosely over the tooth. Adjust the proximal contacts to avoid binding on contiguous teeth
2. Cover the internal and external surfaces of the provisional crown shell with the adhesive indicated by the manufacturer that is specific to the impression material
3. Mix a regular-body elastomeric impression material and fill the provisional crown shell without air entrapment [Figure 3]
4. Seat the crown onto the prepared tooth covering the finish line and allow the material to set
5. Finally make a pick-up impression using regular-body impression material in a full-arch stock tray[14] [Figure 4].

Dual-arch impression technique

The simultaneous recording of tooth preparation and the opposite antagonistic teeth inside a single impression for the manufacture of one or two indirect restorations was originally introduced by Wilson and Werrin in 1983.[15]

Figure 2: Copper band is placed onto the tooth and buccal surface is marked

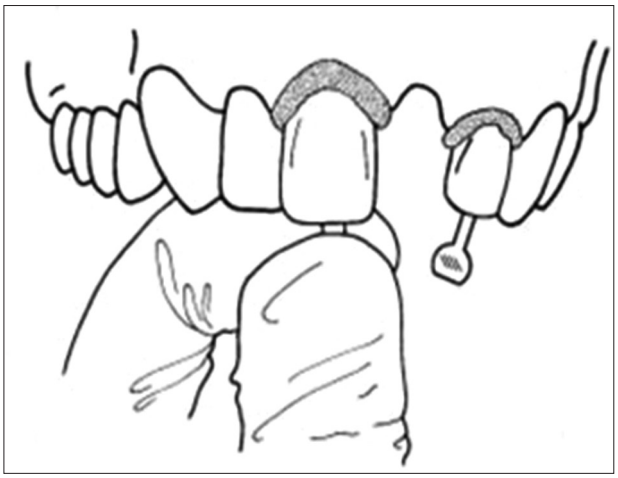

Figure 3: Preformed crown shells filled with impression material are seated on tooth preparations

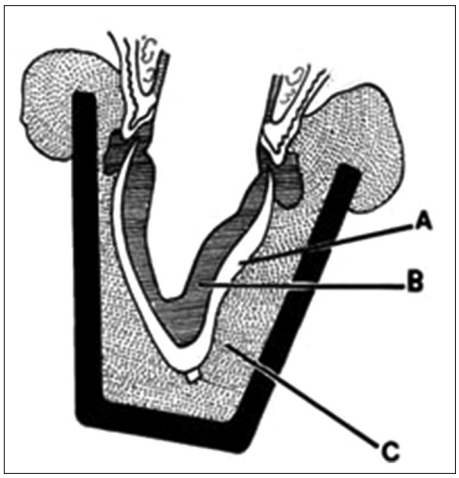

Figure 4: Cross-sectional view of preformed shell (a) with impression material, (b) seated on tooth preparation over impression made with regular body material, and (c) in complete arch impression tray. Thin, relatively uniform thickness of impression material

Technique

1. Inject the syringe material into the area to be recorded
2. The high viscosity material is mixed and loaded in excess on both the arches
3. The tray is placed in between the arches
4. Patient is asked to bite slowly
5. After making impression, the patient is instructed to open his mouth slowly
6. The tray will adhere to one arch as the patient opens his mouth
7. The tray should be removed using bilateral pressure to reduce distortion
8. The impressions are boxed and casts are poured with die stone
9. Articulation should be done on a hinge articulator with an incisal pin to maintain vertical dimension.

Advantages

- As only one part of the arch is recorded, less impression material is required
- As both the arches are recorded simultaneously, less time is taken
- Maximum intercuspation position can be recorded due to functional impression.

Disadvantages

- Distortion occurs as the tray is not rigid
- Can only be applied to one casting per quadrant
- Uneven distribution of impression material.

Functional check-bite impression

Checkbite impression is made conventionally with unilateral tray using medium body rubber-base impression material. After fabricating a provisional FPD of acrylic resin, a functional Checkbite impression is made. There should be a few days gap between the tooth preparation and the impression procedures. The temporary restoration is removed from the mouth and occlusal surface is reduced to add 1–2 mm of wax. Then, centric relation record is first established accurately. Later final verification of the centric relation position is carried out.

The opposing teeth used in developing the wax chew-in record are dried and painted with a sheet of thin, wet cellophane, and the patient is asked to close the jaws in centric position. After the interim restoration with the connected chew-in record is removed from the mouth, the acrylic creates an accurate imprint.[16] The acrylic index attached to the opposing teeth is not disturbed after gingival retraction. Once the gingival displacement is achieved the syringe and tray are filled with rubber-base impression material and the impression is made in centric position. The abutment preparations, edentulous ridges, and functional index are now present on both sides of the completed impression.

Matrix impression system

This system uses three impression materials. It attempts to overcome the deficiencies of the older systems besides incorporating their best features.

1. A suitable elastomeric semi-rigid material is required to form the matrix
2. An elastomeric impression material with high viscosity, which will bond to matrix-forming material, and
3. The pickup impression is made using a stock tray and a medium viscosity elastomeric impression material, leaving the remaining arch exposed.[17]

The four forces (relapsing, retraction, displacement, and collapse) that affect the gingiva during the critical impression-making phase when attempting to register the subgingival margins are efficiently controlled by this system.[18]

Cast impression coping technique

This technique uses a stock tray and because of the laboratory phase, second impression appointment is required. This waiting period leads to better imprints and healthier periodontal tissues. Moreover, this method avoids the need for gingival displacement, creates a better impression environment, and has no postoperative sensitivity. This technique can be performed without local anesthesia.[19]

Technique

After the completion of teeth preparation, an alginate impression is made and die stone is poured. Provisional restoration is cemented on to the prepared teeth and the patient is called for another appointment for making the final impression.

Dies are prepared and coated with several layers of die spacer so that the copings will have at least a space of 0.7 mm for the light body impression material. Furthermore, blockout material can be placed beneath the margin areas to allow the casting to extend about 1.0 mm past the margin without engaging any undercuts. Each coping has a mark on the buccal surface to allow for proper orientation during the impression procedure. The internal surfaces of the copings may be roughened to secure the impression material within the coping. A polyether

material is recommended, as it is accurate enough for the wash and strong enough for the pickup phase.

The clean cast copings are tested to ensure the proper fit and preparation coverage at the final impression appointment. The cast copings are filled with light body syringe material using syringe and placed on each prepared tooth. For improved visibility, it is best to keep the copings slightly under filled. Then, a stock tray is filled with heavy body impression material and positioned onto the arch and the tray is removed in a snap fashion and the temporaries are recemented. Die stone is poured into the impression and then additional laboratory work is done to fabricate the restorations.

Sectional impressions and "every other tooth" technique in FPD

Retraction cords must be used to displace gingiva while maintaining the tissues healthy. The interdental papillae are strangled when the retraction cord is placed simultaneously around all teeth after multiple anterior tooth preparations with close root proximity. This may lead to black interdental triangles and deteriorate gingival health.[20] To avoid this, "every other tooth" technique of gingival displacement in combination with sectional impressions can be employed. It will provide a better master cast in multiple tooth preparations. According to literature, this technique is beneficial for gingival health while restoring multiple teeth especially the lower anterior teeth.[21]

Digital impression

With the computer-aided design-computer aided manufacturing (CAD/CAM) techniques, a concept of intraoral digital impressions was put forward in the early 1980 s.

Digital impressions have evolved drastically with time. The starting point for all systems is the capture of an accurate digital impression. Scanners are the means for obtaining dental images in dental CAD/CAM systems for constructing fixed dental prostheses. There are CAD/CAM systems that can digitally scan fixed restorations and produce them chair side or that can take chair side digital impressions and are then sent to a laboratory. A virtual three dimensional 3D model is created based on three sets of data (stone cast, impression body, and intraoral) obtained from the scanning process.

Chairside production

The dental surgery is where the CAD/CAM system's components are all located. Hence, dental restorations can be made at the chairside without the need for a laboratory procedure. The digitalization tool is an intraoral camera, which typically takes the place of a traditional impression in clinical situations. This saves time and also provides the patient indirectly made restorations at one appointment.[22]

Laboratory production

This variant of production is equivalent to the traditional working sequence between the dentist and the laboratory. The dentist sends the impression to the laboratory where a master cast is fabricated first. The remaining CAD/CAM production steps are carried out completely in the laboratory. With the assistance of a scanner, three-dimensional data are produced on the basis of the master die. These data are processed by means of dental design software. After the CAD process, the data will be sent to a special milling device that produces the real geometry in the dental laboratory. Finally, the exact fit of the framework can be evaluated and, if necessary, corrected on the basis of the master cast.

Centralized production

In this variation, it is possible for "satellite scanners" in the dental laboratory to be connected with a production center through the Internet. The production center receives data sets created in the dental laboratory to build the restorations using a CAD/CAM system. The production center then delivers the prosthesis to the relevant laboratory. Hence, the first and second production processes happen in the dental laboratory, while the third one happens in the production center.

With the techniques of CAD/CAM being applied in the field of prosthodontics, a concept of intraoral digital impressions was put forward in the early 1980 s.[23] Digital impression techniques are advertised as an alternative to conventional impressioning.[24]

Discussion

This article discussed various impression techniques for the fabrication of a successful FPD. The favorable as well as the unfavorable points of each technique were analyzed and various approaches were outlined to eliminate most of the unfavorable points while recording void-free impressions of tooth preparations for fixed prosthodontics.

A good quality impression is a prerequisite to the fabrication of well-fitting laboratory made restorations. The impressions that are made from 2 to 4 mm spaced trays produced more accurate impressions. Therefore, it is advisable not to exceed the tray space of 2 mm for any elastomeric impression materials tested.

A study conducted by Chugh *et al*., concluded that two-step putty-wash technique with 1–2 mm spacer thickness is more acceptable and a viable alternative to obtain accurate impressions.[25]

In their earlier *in vitro* study, Ender and Mehl compared the precision of conventional and digital impressions on full-arch scanning, finding that the accuracy of digital impressions was similar to that of conventional impressions.[26]

According to Chochlidakis *et al*. Digital versus conventional impressions for fixed prosthodontics: A systematic review and meta-analysis, the following conclusions were drawn.

1. Dental restorations fabricated with the digital impression technique presented statistically similar marginal discrepancies compared with those obtained with the conventional impression technique[27]
2. In comparison to SLA/polyurethane dies, digital dies produced restorations in digital impression groups with less marginal and internal discrepancies

3. Similar outcomes were discovered for both the marginal and the internal discrepancy in the traditional and digital groups with reference to "pressing" and CAD-CAM fabrication procedures
4. Similar discrepancy measurements were observed for the restorations when polyether and PVS were used as the conventional impression materials.

The dentist must also select impression materials that are appropriate for each case and will provide the greatest chances of success.

Conclusion

Digital impression techniques are faster and the operation time can be shortened. The conventional impression technique is still advised for full-arch impressions.[28] The oral cavity presents many challenges to the clinician when it comes to recording accurate detail in a moist environment. The ability to record impressions will be aided by the use of an effective technique and appropriate materials.[29] Since the field of impressions is so vast, still the inventions are being made and studies are being carried out for producing an ideal material and an ideal technique to make the job of the dentist and technician easy.[30]

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