

A Systematic Review of Impression Technique for Conventional Complete Denture

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Abstract The importance of an in depth review of impression making for complete dentures lies in the assessment of the historical value of all the factors related to physical, biologic and behavioral areas and the time in which they were discussed and taught as well. This review documents the historical development of knowledge associated with scientific advancement from 1845 to the present year, i.e. 2009 related to impression procedures in conventional complete denture prosthesis. Search for articles was done through electronic media the Pubmed.

Keywords Impression techniques · Conventional complete dentures · Evolution of impression making · Advances in impression making

Introduction

History of impression making for complete denture dates back to the era, when wood or ivory blocks were carved to accommodate the intra oral contours. More advanced techniques have come into use today and this is because of a thorough knowledge of the oral tissues, their behavior and their reaction to manipulation for making impressions. The advancement in the impression techniques promotes the need for new impression materials and sometimes, development of new material leading to an improved impression technique.

The importance of an in-depth review of impression making for complete dentures lies in the assessment of the

historical value of all the factors related to physical, biologic and behavioral areas and the time in which they were discussed and taught as well [1]. This review documents the historical development of knowledge associated with scientific evolution from 1845 to the present year i.e. 2009 related to impression procedures in complete denture prosthesis.

Electronic Search Engine the Pubmed was used as the source of articles for this review.

Literature Review

Review of literature was done by Zinner and Sherman in 1981 assuming that any important technique/theory of impression making published in dental journal is eventually published in a textbook [1].

Analysis of history on complete denture impression making can be done era wise i.e. from 1845 to 2009. Prior to 1600 era, complete denture replacement were not made due to lack of understanding of retention and replacement. The various developments found in literature are summarized as follows.

- Ivory and wooden teeth were mounted on gold plate.
- Ancient Egyptians (300 BC) wired artificial anterior teeth for esthetics.
- Till eighteenth century, teeth and bones of cattle and ivory were used to make prostheses.
- In 1711, Matthias Gottfried Purman recorded use of wax.
- In 1728, Pierre Fauchard made dentures by measuring mouth with compasses and cutting bone to approximate shape for the space to be filled.
- In 1736, Phillip Pfaff of Germany used plaster casts and described a procedure for recording maxillomandibular

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relations. Impressions of half of the mouth at a time were made with wax.

- In 1844, Plaster of Paris was first used as an impression material, the credit for which goes to three dentists—Westcott, Dwinelle and Dunning.
- In 1848, gutta percha was first introduced which was placed in boiling water, kneaded and molded same way as wax and immediately inserted firmly into mouth [2].

1845–1900

Basic principles of complete denture impression making were introduced in the middle of nineteenth century which were

- a. Concepts of atmospheric pressure.
- b. Maximum extension of denture bearing area.
- c. Equal distribution of pressure.
- d. Adaptation of denture bearing tissues [2–4].

Earlier single impression was thought sufficient for fabrication of complete denture. But in this era, preliminary impression of gutta percha, beeswax or modelling compound was followed by a secondary wash impression made of plaster within the preliminary impression [3, 4]. Anatomic considerations was given emphasis for the functions of retention, stability and comfort of complete denture. Tissue behavior and the effects of impression making on tissue was not considered. Open mouth method of impression technique was used in this period. Border molding varied from pulling the cheeks downward to having the patient move the cheeks in a downward direction [5, 6]. Evolution of impression trays took place during this era in order to carry the impression material [7].

1900–1929

In this era accuracy was given importance. Closed mouth impression technique was introduced [8]. Release/escape vents within the final impression trays to prevent build up of excessive pressures was advocated [6, 7]. Rebase impressions were called as impression of secondary type using a free flowing material which compensates for changes in the tissues and were made within an existing denture or base plate. Proper denture extension through various methods of border molding to capture/record the anatomy of tissues contiguous to denture borders was introduced.

Two techniques were developed for recording the flabby maxillary ridge.

- 1. Compressive compound impression technique, which displaced the flabby ridge palatally. Rationale was that,

as the patient functioned, the denture would move forward and returning the tissue to their normal stage.

- 2. Hypertrophied tissue should be recorded in its passive form.

Various methods were described for border molding [7, 8].

- a. Sucking and swallowing action.
- b. Moving peripheral musculature in direction of the attachment, which resulted in occlusion of the muco-buccal fold both in height and width by the denture borders. It was considered biologically sound and within limits of muscle function.
- c. Moving peripheral musculature in opposite direction of attachment which caused foreshortening of final denture borders.

Concept, location and placement of posterior border seal for complete maxillary denture was considered on anatomic as well as mechanical basis. Various considerations were:

- 1. Extending PPS $\frac{1}{4}$ th inch beyond the vibrating line when upper anterior tissue was displaceable.
- 2. Ending posterior denture border at fovea palatine.
- 3. Ending PPS at vibrating line of the palate which continues till today [9].

Most important biologic concept introduced in this era was an awareness of oral and perioral muscle as related to borders of complete denture impressions. There was an attempt to relate borders and denture—bearing tissues to denture function. Shift from purely mechanical technique of denture construction to biologic/biomechanical concept took place. Modeling compound was used for primary impression, plaster for final impression within the primary impression or within a custom tray made of metal, vulcanite or base plate. Concept of esthetics in impression making was introduced [7].

1930–1950

This era recognized the anatomy of the denture bearing area and muscle physiology as related to impression procedures. There was greater knowledge of muscle anatomy, physiology and its effects upon dentures. Border molding was stressed by moving peripheral musculature in the direction of its fibres [10]. Need to cover retro molar pad completely for stability was stressed [11]. Emphasis given for immediate denture impression techniques not only for esthetics but also for maintenance of muscle tonicity in the peri oral musculature [12].

New impression materials were introduced like,

- a. Reversible hydrocolloid
- b. Zinc oxide–Eugenol

c. Zinc oxide–oil of cloves.

Modeling compound and plaster remained the two major impression materials for primary and final impression procedures. Construction of an individual tray from a cast of preliminary impression was emphasized and final impression made in this individual/customized tray. Relationship of mandibular posture with impression procedure was recognized. Closed mouth procedure at correct vertical dimension of occlusion in centric relation was advocated [13]. Emphasis was placed more upon making impression of displaceable tissue in its passive state. Concept of mucostatic was introduced in this era wherein the best possible adaptation of impression material to tissues to capture them in their passive undistorted form was emphasized.

1950–2009

Emphasis was given on the biologic factors affecting complete denture impression making i.e. on flanges, border molding and denture extensions. More attention was given to posterior palatal seal area and to esthetics. There was greater understanding of properties of various materials used in complete denture impression like plaster, modeling compound and materials used for impression trays. Properties of zinc oxide eugenol impression paste and its reaction with tissues was better understood [14].

In 1951, attempt was made to classify various impression techniques based on contemporary literature and observation of impression procedures. The classification developed was as follows:

- a. Use of actual anatomy of the individual patient or arbitrary landmark.
- b. Mouth position while impression making (closed/open-mouth).
- c. Relative amount of pressure exerted on the tissues by the impression material. (Pressure, non-pressure, negative pressure/selected pressure) [15].

Chester and Boles in 1957 described an impression procedure, balanced semi static impression procedure wherein the anterior and lateral walls of the palate were considered as the primary stress bearing area instead of alveolar ridge as it is always remodeled after loss of teeth while the palate is maintained the same from birth with no changes after loss of teeth. It is considered for a normal healthy edentulous maxilla and can be used with any other technique. It is indicated especially for roofless/closed palate dentures [16].

In 1952, alginate impression technique was described, a non pressure type of impression. Dentures made from this type of impression were compared with dentures made

from impressions of impression compound. This study conducted for 2 years showed that inflamed areas and hypertrophied tissues were seen with pressure impressions, while dentures with alginate impression had no tissue breakdown even when duplication was necessary after 2 years [17].

In 1956, two impression techniques were described.

- (a) Technique for unfavorable mandibular ridges where the oral tissues have lost the ability to adjust to the unfavorable situation. This technique makes the impression in three stages [18].
- (b) Minimum pressure complete denture impression technique is applicable to any type of ridge form. Injection method is used to provide relief for hard areas in the mouth for both maxilla and mandible. Lower impression is made with slight movement of the tongue and borders are developed such that it does not interfere with normal movements [19].

In 1963, physiologic complete denture impression technique was described where Tench's neuromuscular concept was used for making complete denture impressions. It involves the function of sucking and swallowing to develop

- Complete passive contact of all impression borders to the basal seat tissues.
- Passively fill all marginal spaces.
- Basal seat coverage that is compatible with function [20].

In 1966, two techniques were described

- a. Impression by use of sub atmospheric pressure (also called as vacustatic technique): It obtains an accurate vertical and lateral record of the tissues through the application of controlled pressure. The difference between sub atmospheric pressure within the tray and sub atmospheric pressure outside the tray, seats the tray centrally over the basal seat which retains it in a static position. A measured volume i.e. 10 inches of vacuum is established in the space between the tray and the denture base tissues. The impression material in a fluid state flows from the border region into the space and covers the basal seat tissues evenly thus recording the shape of the tissues without distortion or strain following Pascal's law of hydraulics [21].
- b. Flange technique: This technique involves making of impression of the soft structures adjacent to buccal, labial, lingual and palatal surfaces of dentures and incorporating the resulting extensions into denture construction. These extensions are described as flanges or flange modifications it increases the area of intimate contact of the denture with the oral structures thus

improving stability, function, comfort and appearance of complete dentures over other techniques [22].

In 1971, a modified impression technique for hyperplastic alveolar ridges was described where surgical preparation was contraindicated. This was done in two steps where two cold cure acrylic trays were prepared on relieved primary casts. Keys were prepared in one of the trays, numerous holes were made in the second tray and fitting into keyed position. After border molding, base plate wax was removed and flanges were reduced 1–2 mm with exception over tuberosities and posterior palatal seal area. Light body material was used for initial tray as corrective wash material and excess removed. Second impression was made with second tray until the keyed parts were in contact. After the material was set impression was removed as a whole unit [23].

In 1972, applied plaster impression technique for maxillary complete denture was described. It is applicable in cases of combination syndrome wherein the soft tissue of anterior part of the maxillary ridge is soft and movable and should be recorded in undistorted state. Placement of impression tray in mouth causes distortion of such mobile tissues and hence plaster is applied directly to the tissues. Vibrating line is marked with indelible pencil on the palate of the patient and plaster is applied in thin layer with gauze pieces. A wooden tongue blade is used to stabilize the plaster soaked gauze pieces. Once it sets another layer of plaster is applied. Cellophane cone is made and plaster put in it, tip is cut and plaster is squeezed layer wise in vestibular areas. About 6–7 layers of plaster is applied. Blast of air into vestibular space aids in removal of the impression. Cast is poured [24].

In 1973, composite impression procedure was introduced. Different materials are used according to local indications. They are used where large impressions are difficult or impossible to obtain with a single tray. This procedure is applied in four techniques which are

1. For edentulous ridges where mucosa displaced impression of the healthy denture bearing tissue is obtained with zinc oxide eugenol paste in a custom tray without spacer. Undisplaced fibrous soft tissue is recorded with impression plaster in a second tray of cold cure resin over the first tray.
2. For immediate denture where impression of the tissues is obtained with controlled mucosal displacement (ZnO-E paste) and borders are molded under controlled condition (alginate).
3. In cases of restricted access where principle of split tray is used. Preliminary impression with modeling compound using sectional stock tray is made, impression of one side of jaw is extended across the central line, cast is poured, overlap region is located in impression of the other side and cast of jaw is

completed. Location of two halves of the impression is refined for an accurate cast on which denture can be constructed.

4. For maxillary surgical defects where preliminary impression is made using modified stock tray with modeling compound in defect area. Impression is completed with alginate [25].

In 1979, dynamic impression technique was described which is based on the assumption that every patient has a steady and characteristic oral functional pattern. The anatomic functional reproduction of the ridge and the tissues requires the knowledge of the space to be occupied by the denture i.e. neutral zone. Recording of neutral zone should be reproducible under standardized condition resulting in approximate basic form which was confirmed by a study conducted by Beresin and Schiesser [26].

In 1979, a study was conducted to determine if clinical differences exist between two different denture techniques. Rate of residual ridge resorption were determined for patients wearing dentures made by two techniques:

- a. Complex—which involved location of true hinge axis for facebow transfer to mount upper cast on a semi adjustable articulator, lower cast in centric relation records and occlusal corrections are made on articulator.
- b. Standard—arbitrary mounting of upper cast, lower cast in centric relation, teeth arranged in tight centric occlusion. After processing, occlusal corrections made on articulator, placed in mouth and further occlusal corrections done.

Cephalographs showed no statically significant differences between the two groups [27].

In 1992, an alternative impression technique was presented by Goldstein for extremely mobile teeth utilizing amalgam condensers. Apically applied pressure on the mobile teeth minimizes the risk of accidental tooth extraction during impression removal [28].

In 2002, a study was conducted on the effect of three impression techniques on complete denture retention in mandibular flat ridge case.

1st technique—Zinc oxide euginal paste (ZnO-E) pressure impression (open mouth)

2nd technique—ZnO-E pressure impression (closed mouth)

3rd technique—functional and anatomic impression using tissue conditioner and rubber base material. The study concluded that mandibular denture bases constructed from closed mouth technique were more retentive than the other two techniques [29].

In 2003, a study compared the number of post insertion adjustment visits required by patients with dentures made

from border molded definitive impression using modeling plastic impression compound (traditional technique) and with patients whose dentures were made from border molded definitive impressions using heavy body vinyl polysiloxane impression material. No significant difference was found [29].

In 2003, a survey was conducted on complete denture final impression to identify impression philosophies, technique and materials used in United States dental schools. The survey showed that

1. Selective pressure technique was used for making final impressions of edentulous arches.

Common techniques used were

- a. Boucher's technique—1 mm wax relief is given over the entire basal area of the custom tray, tray is trimmed 2–3 mm short of the peripheral extensions, border molding is done, periphery is again trimmed 1 mm short, wax removed to provide space for wash impression material.
- b. Halperian's technique—1 mm relief wax over the peripheral extensions of the custom tray.

Tray in intimate contact with basal seat areas forms a butt joint from the peripheral wax for border molding completion. Master cast is directly poured into the border molded tray without wash impression.

2. Use of plastic molding impression compound for border molding.
3. Use of visible light cured composite resin material for custom tray.
4. Making vent holes in custom tray.
5. Teaching open mouth impression technique [30].

In 2004, a study was conducted to compare the swallowing and phonetic techniques for assessing the location and shape of the neutral zone. Study showed that the phonetic neutral zone appeared to be narrower posteriorly compared to the swallowing zone, thus limiting premolar and molar positioning [31].

In 2005, a modified functional impression technique was described which used a removable functional acrylic resin handle that was attached to custom impression trays allowing an excellent peripheral sealing zone got by patient conducted muscular and jaw motion [32].

A survey conducted in 2005 of U.S. Prosthodontists and dental schools on current materials and methods for final impressions for complete denture prosthodontics found that there was a variation of the materials and techniques used for final impression. There was an increase in use of polyvinyl siloxane and polyether material for border molding procedures instead of the traditional green stick compound [33].

A study was conducted in 2006 to assess whether simple complete denture techniques can provide patient satisfaction where patients were randomly divided into two groups to receive dentures using traditional and simplified techniques. In traditional group, final impression was made in custom-made tray; face-bow recording and semi-adjustable articulator was used with articulator remount after insertion. In simplified group, impressions were made in stock trays, no face-bow recording and a monoplane articulator was used with no articulator remount after insertion. The results supported the use of simplified technique which was easier to master and reduced treatment costs [34].

In 2008, Dr. Joseph Massad described an impression technique which involves the layering method of impression making that maintains the integrity between layers of the impression materials of varying viscosities and controls the path of insertion thus minimizing the incidence of overextension [35].

In 2009, Fraser McCord listed studies done by El Khartia regarding the technical aspects of complete denture fabrication. Earlier versions of injection-molded systems to process acrylic resin-based dentures were perceived to be less consistent than conventional compression-molded techniques. Recent studies, however, have indicated that complete dentures processed by twenty-first century injection molding techniques exhibited greater accuracy and dimensional stability than those processed via standard compression processing. El-Khartia carried out a study to determine if the processing technique in any way influenced the surface of acrylic denture bases. The study demonstrated that denture bases processed via the injection technique exhibited a smoother surface than those processed via a conventional processing technique. McCord et al. sought to determine if the nature of the impression material, used to record the mandibular definitive impression, influenced the outcome of the treatment as measured by patient opinion. Three types of impression material were used to record the definitive mandibular impression:

- (1) A light-bodied poly (vinyl siloxane) material (Provil, Heraeus Kulzer, Dormagen, Germany).
- (2) A two-paste system of zinc oxide eugenol (SS White Mfg., Gloucester, UK).
- (3) An admix of impression compound and tracing compound.

It was found:

- (1) Dentures processed on casts poured into the zinc oxide eugenol impression were never the denture that was most preferred and was least preferred in 8 out of 11 occasions.
- (2) Dentures processed on casts poured into the Admix impression were the denture that was most preferred

in 7 of the 11 occasions and was least preferred on 1 occasion.

- (3) Dentures processed on casts poured into the poly (vinyl siloxane) impression were the denture that was most preferred on three occasions and was least preferred on two occasions.

Clinicians do need to reflect on what impression material is used to record the mandibular impression, especially the atrophic mandible, if some degree of predictable successful outcome is to be realized [36].

Discussion

Recording of denture bearing tissues for complete dentures is important from many aspects like health of the tissues, function and retention of dentures. Theories of impression making have evolved through trial of variety of materials and methods. Introduction of new materials has led to evolution of newer techniques in impression making. Use of gutta percha, impression plaster, impression compound, alginate and elastomeric impression material for making primary impression has been quoted in literature of which gutta percha and plaster are no more in use because of manipulation difficulties.

Initially tissues were recorded evenly irrespective of their anatomy and role played by them in retaining, supporting and stabilizing the dentures. All the tissues were recorded under equal pressure (mucocompressive technique) which resulted in compromised health of tissues. No technique was available for cases like atrophic ridges, flabby tissues.

In the second half of nineteenth century principles of impression making which took into consideration the atmospheric pressure, extension, adaptation and distribution of pressure were introduced. Open mouth impression was the technique of choice. Although anatomy was considered, tissue behaviour was not given importance.

During early twentieth century, shift from mechanical to bio-mechanical concept of denture construction was seen. Importance of posterior palatal seal area in the retention of maxillary denture was identified. Also the concept of esthetics in impression was introduced. As the knowledge regarding muscle anatomy, physiology and their role in the success of denture grew, need to record the borders was stressed. Alginate and zinc oxide eugenol were introduced and closed mouth technique was advocated. The disadvantages of closed mouth technique are that it requires construction of occlusal rims or interim dentures.

A major transformation in impressions began in mid twentieth century when material properties and biologic factors affecting the impression were better understood.

Impressions were classified as pressure, non-pressure and selective pressure. Stress bearing and non stress bearing areas were differentiated. Selective pressure technique for final impression which records stress bearing areas under pressure and non stress bearing areas under minimum pressure gained importance. Relief was provided in final impression in non stress bearing areas. This helped to maintain the health of tissues. Inflammation and hypertrophy of tissues seen with mucocompressive technique was eliminated with selective impression technique. Different technique for unusual conditions like excessively resorbed ridges, flabby ridges, ridges with surgical defects, restricted mouth opening were described. Levin, Boucher, Rudd and Morrow, Sharry advocated different spacer designs to provide space for impression material.

Conclusion

Success of complete dentures largely depends on accuracy of impression. Accurate impression needs a thorough understanding of anatomy, physiology of supporting structures, properties and manipulation of materials. This review shows that a wide range of materials and techniques is available for different situations. Based on the particular condition, dentist needs to select material and technique of impression for success of complete denture therapy.

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