

REVIEW

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## Systematic Review of Complete Denture Impression Techniques

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### ABSTRACT:

Much has been spoken about complete denture impression procedures. It is evident from the voluminous literature available on the subject that there has been a persistent disagreement among various authors ever since 1850 regarding the various concepts. 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.

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### INTRODUCTION

Complete denture impression techniques seem to be based upon various philosophies and personal preferences and our heads often whirl in an effort to choose the alternatives.<sup>1</sup> Nobody is satisfied with any one particular method or philosophy.

Good impressions are basic to the fabrication of a well fitting denture. An impression should fulfill MM Devan's dictum. "It is perpetual preservation of what already exists and not the meticulous replacement of what is missing".<sup>2</sup>

Ideal impression must be in the mind of the dentist before it is in his hand. He must literally make the impression rather than take it.<sup>2</sup> The impression material is shaped and molded into a negative likeness of the supporting area, a cast is made from

this impression and the denture base is constructed on this cast. As a result, the denture base fits the supporting tissues within the oral cavity. Knowledge of the muscles of facial expressions and of the anatomic landmarks is essential.

A single impression material or technique can't be applied to all patients for achievement of the best results. Hence it becomes obligatory for the dentist to update himself with all the theories and techniques of impression making as well as impression materials that can be used. The Endeavour should always be to choose the best material and apply the specific technique for a particular patient while making an impression after examining the condition of soft tissues and the bony ridges, so that best results can be obtained.

This article aims to provide basic fundamentals in making impressions of oral tissues for the purpose of fabricating artificial complete denture.

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## Historical Background

Impression making for complete denture prosthodontics has matured from the art of carving wooden or ivory blocks that accommodated the intraoral contours to the more sophisticated methods in use today.

Before the middle of the 18th century, no method was available for producing an impression of the alveolar ridge. A widely used method at that time was the painting of the ridge with a dye and the pressing of a block of ivory or bone against the dyed surfaces. Areas of contacts were scraped away from the block until the best fit for the prosthesis was achieved.

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.<sup>3</sup>

Analysis of history on complete denture impression making can be done era wise i.e. from 1845 to 2009. Prior to 1600s complete denture replacements were not made due to a lack of understanding of retention. Replacements were made only when posterior abutment teeth remained in the mouth. 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 in the mouth 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

maxillo-mandibular 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.<sup>4</sup>

### 1845 - 1899

Several basic principles of complete denture impression making were introduced in the middle of the 19<sup>th</sup> century. The concepts of atmospheric pressure, maximum extension of the denture - bearing area, equal distribution of pressure and adaptation of the denture bearing tissues.<sup>4-6</sup>

Many changes in impression making became evident in this era. A single impression, formerly deemed sufficient, advanced to a method using a preliminary impression of gutta percha, beeswax, or modeling compound. This was followed by a secondary wash impression made of plaster within the preliminary impression.<sup>5,6</sup> Anatomic considerations were given emphasis for the functions of retention, stability and comfort of complete denture. Tissue behaviour and the effects of impression making on tissue were 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.<sup>7, 8</sup> Evolution of impression trays took place during this era in order to carry the impression material.<sup>9</sup>

### 1990-1929

During the years from 1900 to 1929, there were many innovations in complete denture impression procedures. A concentrated effort was directed towards accuracy. Closed mouth impression technique was introduced.<sup>10</sup> Some authors advocated a release or escape vent within the final impression tray to prevent the build up of excessive

pressure.<sup>8,9</sup> Rebase impressions were mentioned as impressions of a secondary type using a free flowing material which compensated for changes in the tissues. Such final impressions were made within an existing denture or base plate. Greater attempts were made to understand the need for proper denture extension. Methods of border molding to capture the anatomy of the tissues contiguous to denture borders were introduced.

Two techniques were developed for handling the "flabby ridge".

- 1) The first involved a compressive type of compound impression which displaced the "flabby ridge" palatally. The rationale was that as the patient functioned the denture would move forward, returning the tissues to their normal state.
- 2) Hypertrophied tissue should be captured in its passive form.

Various methods were described for border molding include:<sup>9, 10</sup>

- Sucking and swallowing action.
- 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.
- 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:

- Extending PPS 1/4th inch beyond the vibrating line when upper anterior tissue was displaceable.
- Ending posterior denture border at fovea palatine.

- Ending PPS at vibrating line of the palate which continues till today.<sup>11</sup>

The most important biologic concept introduced in this era was an awareness of the oral and perioral muscles as they related to the borders of the complete denture impression. 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.<sup>9</sup>

### 1930 - 1949

This era recognized the anatomy of the denture bearing areas and of muscle physiology as related to impression procedures. There was greater knowledge of muscle anatomy and muscle physiology and the effects of the musculature upon dentures. Many authors advocated manipulation in border molding by moving the peripheral musculature in the direction of its fibres.<sup>12</sup> The need to completely cover the retro molar pad for maximum stability was stressed.<sup>13</sup>

Emphasis given for immediate denture impression techniques not only for esthetics but also for maintenance of muscle tonicity in the peri oral musculature.<sup>14</sup>

Several new impression materials were introduced: Reversible hydrocolloids, Zinc oxide - Eugenol and Zinc oxide-oil of cloves. Modeling compound and plaster still remained the two major impression materials used in both preliminary and final impression procedures. Construction of an individual tray from a cast of the preliminary impression was emphasized and the final impression was made in this individual or customized tray. The value of mandibular posture records and their relationship to the impression procedure was recognized. Closed mouth impression procedure at

the correct vertical dimension of occlusion in centric relation was advocated.<sup>15</sup> 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

In this period, there was increased emphasis on those biologic factors that affect 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.<sup>16</sup>

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:

- Use of actual anatomy of the individual patient or arbitrary landmark.
- Mouth position while impression making (closed/open-mouth).
- Relative amount of pressure exerted on the tissues by the impression material. (Pressure, non-pressure, negative pressure/selected pressure).<sup>1</sup>

### Historical developments of various impression techniques

Chester and Boles in 1957 described 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.<sup>17</sup>

In 1963, 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.<sup>18</sup>

In 1966, two techniques were described

- 1) 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.<sup>19</sup>
- 2) 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 as 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.<sup>20</sup>

A modified impression technique for hyperplastic alveolar ridges was described where surgical preparation was contraindicated in 1971. 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 is 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.<sup>21</sup>

Plaster impression technique for maxillary complete denture in cases of combination syndrome wherein the soft tissue of anterior part of the maxillary ridge is soft and movable was developed in 1972. This impression 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.<sup>22</sup>

In situations, where large impressions are difficult to obtain with a single tray, composite impression procedures with different materials were introduced in 1973. This procedure is applied in four techniques:

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.<sup>23</sup>

Recording the neutral zone under standardized condition with dynamic impression technique was developed in 1979. This technique gives approximate basic form which was confirmed by a study conducted by Beresin and Schiesser.<sup>24</sup>

In cases of extremely mobile teeth, an alternative impression technique was presented by Goldstein utilizing amalgam condensers in 1992. Apically applied pressure on the mobile teeth minimizes the risk of accidental tooth extraction during impression removal.<sup>25</sup>

A survey was conducted on complete denture final impression to identify impression philosophies and materials used in United States dental schools in 2003. It showed that

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

Common techniques used were:

➤ 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.

- 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.<sup>26</sup>

To minimize the incidence of overextension, Dr. Joseph Massad in 2008 described an impression technique which involves the layering method, which maintains the integrity between layers of the impression materials of varying viscosities and controls the path of insertion thus minimizing the incidence of overextension.<sup>27</sup>

Among various concepts over the years, most commonly used techniques were based on application of pressure. Ideas in relation to pressure applied:<sup>1</sup>

- Mucostatic / No pressure concept
- Mucocompressive / Pressure concept
- Minimal pressure concept
- Selective pressure concept

Mucostatic concept record the mucosa in its static, undisturbed form (supported by underlying basal bone). This is possible only if the impression material is watery and virtually requires no pressure to place it against tissues. This type of impression will

not cover enough area to afford retention, stability and esthetics of a denture.

Mucocompressive concept records the tissues in their functional / supporting form to achieve stability in occlusal function. This concept is not encouraging since it seeks to subject the tissues to a continuous pressure leads to resorptive changes in basal tissues.

Minimal pressure concept is a compromise between the Mucostatic and Mucocompressive. It states application of minimal possible pressure which is supposed to be little more than the weight of free flowing material.

Selective pressure concept is most widely accepted theory. The idea is to vary the pressure over the denture seat depending on the displaceability of the supporting tissues and hence transferring the load over to the selected areas of the seat. e.g. buccal shelf area. The selected pressure is achieved by altering the spacer thickness.

## 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.

In 1952, alginate impression technique was described which is a non pressure type. Dentures made from this type of impression were compared with dentures made from 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.<sup>28</sup>

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

- 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.
- 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.<sup>29</sup>

A study was conducted on the effect of three impression techniques on complete denture retention in mandibular flat ridge case in 2002:

1st technique–Zinc oxide eugenol 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.<sup>30</sup>

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.<sup>31</sup>

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.<sup>32</sup>

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 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 is 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. used three types of impression materials to record the definitive mandibular impression:

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

The variety of impression materials and the range of working characteristics of these materials, make possible the development of impression procedures best suited for specific conditions in each area in a given mouth. Whatever method used for making impression it should be based on the basic principles<sup>2</sup> of maximum area coverage and intimate contact so as to achieve the objectives of:

- Retention
- Support
- Stability
- Esthetics
- Preservation of ridge (supporting structures).

## Conclusion

Making impressions is an important part of every dental practice. 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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