IMPRESSION TECHNIQUES IN REMOVABLE PARTIAL DENTURES

INTRODUCTION:

A negative likeness or copy in reverse of the surface of an object. An impression of partially edentulous arch must record accurately the teeth in anatomic formanatomic form and surrounding tissues in functional form .A minor support comes from the abutment teeth The major support comes from elastic fibrous connective tissue pad overlying the alveolar process .

CONCEPT OF FUNCTIONAL IMPRESSION The term functional impression means recording the functional form of the residual ridge tissue & to obtain uniformity of support when the functional load is applied

Applegate used impression wax to load functionally the residual ridge .Hindel felt that free –end denture base under masticatory load should be related to metal framework when it is seated. Holmes used four different materials with altered cast technique • Leupold & Kratochvil used Zinc-oxide Eugenol paste to record the shape of residual ridges .Kramer & Singer used a double impression technique based on load distribution by Hindel .McCracken concluded that a functional technique should be used when constructing mandibular distal extension based partial denture

INDICATIONS FOR FUNCTIONAL IMPRESSION

- 1. Mandibular distal extension partial dentures -Only a limited ridge area can be used as a stress bearing site.
- 2. Mainly Kennedy's class I & II edentulous arches.

OBJECTIVES OF FUNCTIONAL IMPRESSION (O.C. Applegate)

- 1. To obtain the maximum area of coverage
 - 2. Traumatic impact on any area must be avoided
 - 3.At rest there must be no islands of ischemia
 - 4. Under work loads all areas must receive massage stimuli.

IMPRESSION MATERIALS USED:

- 1. Irreversible hydrocolloid
- 2. Elastomeric impression materials
- 3. Reversible hydrocolloid
- 4. Fluid waxes
- 5. Metallic pastes
- 6. Soft reliners

Differentiation between two main types of Removable Partial Dentures

- a. First type is the completely tooth borne partial denture.
- b. Second is the tooth and tissue-borne partial denture as in Class I & II.

Force	Movement	Primarily counteracted by
Vertical masticatory force, bilateral	Tissueward rotation of base around fulcrum line	Rests Base coverage
Displacing vertical force	Vertical displacement	 Direct retainers. Indirect retainers.
Vertical masticatory force, unilateral	Tissueward movement on masticatory side and displacing movement or non masticatory side occurs around anteroposterior axis passing through crest of residual ridge and occlusal rest on masticatory side.	 Occlusal rest. Basic coverage
Horizontal masticatory force, unilateral and bilateral	Buccolingual movement of denture base around vertical axis passing through the middle of the partial denture	 Base extension on buccal and lingual of ridge and the rigidity of the major connector. Bracing components.

FACTORS INFLUENCING THE SUPPORT OF DISTAL EXTENSION BASE

- 1.Contour & Quality of residual ridge
- 2.Extent of residual ridge coverage by the denture base
- 3. Type & Accuracy of impression registration
- 4. Accuracy of fit of denture base
- 5.Design of partial denture framework
- 6.Total Occlusal load applied
- 7.Status of abutment teeth

a) Abutment teeth: The type of rest and the amount of support provided by the abutment tooth must be based on interpretation of the diagnostic data collected from the patient. In evaluating the potential support from abutment teeth following factors should be considered.

- 1. Periodontal health.
- 2. Crown and root morphologies.
- 3. Crown-to-root ratio.
- 4. Bone index area.
- 5. Location of the tooth in the arch.
- 6. Relationship of the tooth to other support units.
- 7. The opposing dentition.

b) Residual ridge: In evaluating the potential support available from the edentulous ridge area, consideration must be given to following:

- 1. The quality of the residual ridge, which include contour and quality of supporting bone.
- 2. The extent to which the residual ridge will be covered by the denture base.
- 3. The type and accuracy of the impression registration.
- 4. The accuracy of the denture base.
- 5. The design characteristics of the component parts of the partial denture framework
- 6. The anticipated occlusal load.

1)Contour and Quality of ridge:

The ideal residual ridge to support a denture base would consist of:

- Cortical bone covering relatively dense cancellous bone.
- Broad flat crest with high vertical slopes.

- Covered by firm dense, fibrous connective tissue.

2) Extent of residual ridge coverage by the denture base :

The broader the coverage, the greater the distribution of the load, which results in less load per unit area. All available space must be used without encroaching on movable tissue.

3) Type and accuracy of impression registration :

The residual ridge can be said to have two forms namely, Anatomic & Functional form.

ANATOMIC FORM :The surface of the residual ridge at rest. It is the shape of the ridge before functional load is applied.



FUNCTIONAL FORM : It means the shape of the residual ridge tissue when it is functioning to support the denture base. It is the shape of the ridge after functional load is applied.



Some dentists believe that anatomic form is the most physiologic form for support of the denture. Functional form the residual ridge is recorded under some loading, whether by

occlusal loading, finger loading, specially designed individual tray, or the consistency of the recording medium.

4. Accuracy of the fit of the denture base :

Accuracy of the contact of the tissue surface of the base with the tissue that cover the residual ridge enhance the support of the distal extension base.

5.Design of the partial denture :

Denture base areas adjacent to abutment teeth are primarily tooth supported. As you proceed away from the abutment teeth, they become more tissue supported. Therefore it is necessary to incorporate characteristics in the partial denture design that will distribute the functional load equitably between the abutment teeth and the supporting tissues of the edentulous ridge.

Some rotational movement of a distal extension base around posteriorly placed direct retainers is inevitable under functional loading.

Steffel and Kratochvil have reported that as the rotational axis (fulcrum line) of the denture is moved anteriorly, more of the residual ridge is used to support the denture base, thereby distributing stresses over a proportionally greater area.

6. Total occlusal load applied :

The total occlusal load applied is influenced by

1. The number of teeth.

2. Width of the occlusal surfaces.

3. Increasing the occlusal efficiency of the artificial teeth by the addition of supplemental grooves and sluice ways which aid in the cutting action and improve the masticatory performance of the teeth.

Theories for obtaining support for distal extension partial denture

Steffel has classified advocates of the various methods for treating the distal extension partial denture as follows:

- 1. Those who believe that ridge and tooth supports can best be equalized by the use of stress-breakers or resilient equalizers.
- 2. Those who insist on bringing about the equalization of ridge and tooth support by physiologic basing, which is accomplished by a pressure impression or by relining the denture under functional stresses.
- Those who uphold the idea of extensive stress distribution for stress reduction at any one point

McLean and others suggested the taking of a so called "functional impression".**Cummer** in 1928, described a technique known as sectional impression technique. The saddle area was recorded by means of a primary compound impression and then a secondary compound impression of the teeth was made.

Applegate O.C. in 1937, proposed a method whereby the denture saddle before processing, was rebased with waxes and under biting force.**Spreng** of Switzerland suggested a technique known as the "chewing impression". Soft gutta-percha in a vulcanite tray was molded by chewing pressure and related to the partial denture metal frame work by means of a plaster impression.**Hindels** in 1952, described a modification of Mcleans "functional impression".**Leupold and Kratchovil** in 1965 described the "altered-cast procedure" to improve tissue support for removable partial dentures.

They fabricated a metal framework on a cast made from irreversible hydrocolloid impression. A layer of base plate wax is adapted on edentulous area over which layer of acrylic resin was adapted with metal mesh work in place. Border moulding was done with low-fusing modelling plastic – ZOE impression paste is used to make final impression without applying any finger pressure. Edentulous parts of master cast were sawed off. The framework with attached impression correctly seated on the master cast and firmy secured with sticky wax. The new impression is boxed and altered edentulous sections of cast are poured using stone to form an altered cast.

Rapuano in 1970 described single tray dual impression technique for distal extension cases that records the residual ridges dynamically and the remaining teeth statically.**Bauman** in 1982 described a modification of the altered cast technique wherein he recorded the centric relation by placing an occlusal rim and then made a irreversible hydrocolloid impression over the prosthesis and remaining teeth. The new master cast thus obtained was mounted on the articulator by means of the interocclusal record. Teeth were arranged and the denture processed.

Methods for obtaining functional support for the distal extension base :

- 1. McLean and Hindel's techniques
- 2. Fluid wax technique
- 2. Selective tissue placement impression method

McLean's physiologic impression :(fig-3)



It is a Dual impression technique. Custom tray was constructed over preliminary cast of the arch.Functional impression of the distal extension was made.Then a hydrocolloid impression was made with the first impression held in position with finger pressure.

Drawbacks : Finger pressure could not produce the same functional displacement of the tissue that biting force produced. The apparent advantage of this technique was lost with this weakness.

Hindel's modification :

An acrylic resin tray is processed on a cast made from an impression that should include all the areas of future tissue support of the partial denture. The tray should cover the edentulous areas upto the border tissue attachments and should include the retromolar pad. Impression of the edentulous area is made with ZnOE paste.



In a successful impression, the tissue side of the tray is fully covered with impression material and no part of the tray itself is visible. To establish a relationship between the teeth and mucosa in a displaced state, a perforated tray with 2 circular openings of approximately 18 mm diameter in the region of 1st molar was used.

The soft tissue impression tray was placed in the mouth and the perforated tray loaded with irreversible hydrocolloid impression material was inserted over the teeth and acrylic resin tray.Pressure is exerted on the underlying tray by passing gloved index fingers through the openings of the perforated tray until they contacted the tray and kept till the alginate hardened. The impression is then removed as one unit(fig-4).The master cast thus obtained would be a replica of the teeth and undistorted surface of the mucosa, but the two will be related to each other with the mucosa in a functional state.

2. Fluid wax functional impression :

Developed by O.C. Applegate and S.G. Applegate and differs from wax wash or correction impression which was originally developed by Earl S. Smith. The latter used Iowa wax as compared to impression wax (Korecta wax No.4) which is more fluid. The term fluid wax is used to denote waxes that are firm at room temperature and have the ability to flow at mouth temperature. Key to the use of fluid wax lies in space and time. By space, we mean that there should be enough space between the tray and the denture foundation, therefore relief

should be provided. After the application of fluid wax, it should be left in the patients mouth for 5 to 7 minutes as the wax flows sluggishly and early removal will result in distortion. Water bath maintained at 510 to 54 degree C into which a container of wax is placed. Fluid wax is painted evenly over impression base.Peripheral extension of the impression tray is critical. Borders must be short of all movable tissue but not more than 2 mm as the wax does not have sufficient strength. Tray is seated in patients mouth and the tissue movements are simulated. The tray is removed and the surface examined for tissue contact which is shown by a glossy surface and where there is no contact the surface will be dull. If needed additional wax is painted on those areas of no contact. Tray must remain in the mouth for 5 minutes after each addition of wax.Borders can be reinforced by application of hard wax using a hot spatula.More fluid wax is brushed on just inside the border to provide excess that will then be turned at the border by repetition of previous movements.Ridge areas recorded in their static or anatomic forms are removed from the master cast by sawing with a spiral saw in two planes, one cut at right angles to longitudinal axis of ridge 1 mm distal to abutment tooth and second lingual and parallel to lingual sulcus.Completed impression is seated on remainder of cast after anatomic ridges have been removed. Surface of cast anteriorly is pained with sodium silicate or some other seperator. Base of cast is immersed in 1/2 inch of water for 5 minutes to provide saturation for stone.Ridge areas are poured with stone.

Objectives of fluid wax technique :

1.Recording primary stress bearing areas in their functional form.

2. Recording other basal seat or non bearing areas in their anatomic form.

3. Maximum extension of borders within the physiologic tolerance of bordering structures.

4.Fluid wax impression may be used to make a reline impression for an existing partial denture or to correct a distal extension edentulous ridge portion of the original master cast.

3. Selective tissue placement impression procedure :

Selective tissue placement impression method is based on histologic nature of tissues that cover the residual alveolar ridge. It also depends on the nature of the residual ridge bone and its positional relationship to the direction of stresses that will be placed on it. The objective is to develop denture bases that will use those portions of the residual ridge that can withstand additional stress and at the same time relieve the tissue of the residual ridge that cannot withstand functional loading and remain healthy.Framework with attached trays is tried in patients mouth.Thin layer of red stick modelling plastic is painted on tissue sides of the impression trays by first softening the modelling plastic with flame.Placed in patients mouth after tempering in 135oF water and repeated several times.Borders are perfected by heating individual areas.Borders of compound impression are shortened 1 to 1.5 mm and whole inside of the impression with the exception of buccal shelf region, is relieved approximately 1 mm.Modelling plastic is removed from holes in trays.Final impression with elastic impression material wash.Then the altered cast technique is followed.

Advantages of altered cast technique (Leupold and Kratochvil)

The altered cast technique is a definite step towards preservation of the oral structures.(

Advantages :

1. Remarkable stability in the denture base region of distal extension removable partial dentures.

- 2. A positive occlusion which will remain for long periods of time.
- 3. Reduced stress on abutment teeth from unfavourable forces.
- 4. Reduced number of post insertion adjustments.

Impression method using individualized full arch tray for mandibular distal extension partially edentulous arch

Functional impression technique

Support of a distal extension denture base can be obtained even after the partial denture is constructed using a functional method consists of adding a new surface to the inner, or tissue side of the denture base.Partial denture is constructed on cast made with irreversible hydrocolloid impression anatomic impression.Space provided between denture base and ridge by adapting a soft metal spacer over ridge of the cast before processing denture base.Actual impression making consists of low fusing modeling plastic (tempered in a water bath) over the tissue surface and seated in patients mouth. Repeated several times

until an accurate impression of ridge is made. Entire surface of modelling plastic scraped off to a depth of 1 mm and final impression made with ZnoE paste or rubber base impression material.Occlusal discrepancies must be corrected.

Advantage : Amount of soft tissue displacement can be controlled by amount of relief given to modelling plastic before the final impression is made.







Review of Literature

John B. Holmes et al (1965) conducted an investigation to study the amount of movement resulting from an occlusal load on mandibular distal extension partial dentures fabricated from impressions made by various techniques and to detemine which impression technique would permit the least movement at the time of insertion of the partial denture.

The techniques investigated were:

- 1. Stock rimlock tray technique using irreversible hydrocolloid.
- 2. Individual resin tray using irreversible hydrocolloid.
- 3. Altered cast technique using:
- a. irreversible hydrocolloid.
- b. Injection type rubber base impression material.
- c. Metallic oxide impression paste.
- d. Korecta wax IV*.

The results showed that;

1. The stock rimlock tray with the irreversible hydrocolloid resulted in the greatest amount of movement.

2. The individual resin tray with the irreversible hydrocolloid resulted in the greater amount of movement than the altered cast technique which showed least movement.

3. Of the materials used with the altered cast technique, Korecta wax IV* resulted in the least amount of movement in all test dentures.

4. The greatest movement using altered cast technique was with the alginate (irreversible hydrocolloid). Movement with the metallic oxide paste and rubber injection impression material was nearly identical for all patients.

Farhad Vahidi (1978) compared tissue displacement of a functional impression technique and a one-material impression technique for distal extension ridges. Ten patients 25 to 75 years of age with mandibular bilateral distal-extension ridges were selected at random each patient had all lower anterior teeth and at least first premolars on each side. An impression with irreversible hydrocolloid in a stock tray was made for a preliminary cast. Impression using three techniques were made for each patient. Functional impression technique. Applegate's functional fluid wax technique was used with an acrylic resin tray. Single impression technique. Mercaptan rubber base impression material was used. Mucostatic impression technique. The impression was made with a loose mix of irreversible hydrocolloid in the same type of spaced custom tray as was used for the mercaptan rubber impression.

He concluded from this study that the amount of soft tissue displacement caused by an impression procedure depends upon tissue resiliency, proximity to abutment teeth, and nature of the impression material. The amount of tissue displacement with Korecta wax was greater than with mercaptan rubber in about two thirds of the ridges when compared to a mucostatic impression using irreversible hydrocolloid. The results of this study confirmed that the amount of tissue displacement increases from the last abutment to the retromolar pad on the crest of the ridge. It also indicated that the amount of tissue displacement varied in different patients when using the same impression techniques according to the histologic characteristics of the tissue.

Richard J. Leupold, Robert J. Flinton and David L. Pfeifer (1992) clinically compared the vertical displacement of distal-extension removable partial dentures made from different impression techniques. Techniques studied were: 1) a stock tray impression made

with irreversible hydrocolloid (Jeltrate) that served as control, 2) an altered cast impression made with light-bodied polysulfide rubber(Permlastic, and 3) a border molded custom tray impression made with light-bodied polysulfide rubber. The custom tray used for this impression had definitive stops in places that would not interfere with occlusal rest seats on the abutment teeth. An intraoral loading device was made with an aluminium clutch that could be luted to the patient's remaining mandibular teeth, so that it would not interfere with the ability of the removable partial denture framework to rotate. The clutch was fitted to the remaining teeth with autopolymerizing acrylic resin and luted with Dycal. The loading device had movable segments that could be conformed to the length and contour of the patient's mandibular arch. In each of these segments were two adjustable measuring screws.

As the posterior screw was loaded, a resultant gap would occur between the denture base and the anterior screw. The number of rotations of the loading screw were the same for the control and the two experimental groups. The test results demonstrated different vertical displacement of the denture bases. A fast set, dimensionally stable recording medium was injected bilaterally between the anterior screw and denture base and the plaster records were measured at the point of greatest concavity with a midified metal thickness gauge. The results showed that under simulated intraoral loading, denture base vertical displacement was dependent on the impression technique used, the altered cast impression best provides controlled tissue support that results in the least amount of denture base vertical movement.

They concluded that the one-piece cast made from a border-molded custom tray precludes the potential problems inherent in additional clinical and laboratory procedures. Therefore, it may be the impression of choice in the treatment of distal-extension removable partial denture and that a border molded custom tray impression may be a technique that is comparable to the altered cast impression technique for distal-extension partial dentures.

Richard P. Frank, James S. Brudvik and Carolyn Jean Noonan (2004)

conducted a study to determine the efficacy of an altered cast compared to a one piece cast with regard to base support, abutment health, and patient comfort overtime. Seventy-two patients receiving a mandibular bilateral distal extension removable partial denture were assigned randomly for treatment using either a one-piece or an altered cast. The space between the soft tissues and the base when the framework was related to the teeth was measured cross sectionally at half the length of the denture base. Mobility, gingival index, and sulcus depths at 6 locations around each abutment tooth were recorded at insertion and again 1 year later.

Results showed that there was 0.15mm less space between the ridge crest and base in the altered cast group underextension of the base occurred only in the one-piece cast group recall at 1 year, 42% exhibited decreased base support and 33% has increased gingival inflammation, the deepest probing depth decreased in 61%, mobility decreased or remained the same in 80% of the direct abutments, and 88% of the subjects were satisfied.

They concluded that the altered cast impression procedure does not offer significant advantages over the one-piece cast, provided the standards used in this study are met. These include a completely extended impression, use of magnification to adjust and ensure complete seating of the framework, and coverage of the retromolar pad and buccal shelf by the base.

To Improve supportive ability of edentulous ridge

- 1. Optimum extension of denture base.
- 2. Surgical preparation.
 - a. Removal of hyperplastic tissue to improve the supportive ability of the ridge.
 - b. Removal of tori or bulbous areas to permit full extension of denture base.
- 3. Physiologic basing (Functional impression).
 - a. Altered cast procedure. This procedure is covered in a number of partial denture textbooks.
 - b. Functional relining procedure prior to delivery of completed partial denture.
- 4. Timely relining or rebasing.

To Reduce the applied load to the residual ridge

- 1. Reduction of artificial teeth buccolingually.
- 2. Reduction in the number of posterior teeth.
- 3. Maintain sharpness of cusps.

4. Provide adequate sluceways after occlusal correction.

Conclusion

As the distal extension cases in removable partial dentures are tooth tissue supported, an impression technique which equalizes as much as possible the support derived from the edentulous area and that received from abutment teeth is mandatory. Thus the impression must records and relates the tissues under the same loading, distribute the load over as a large an area as possible, delineates accurately the peripheral extent of the denture base.

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REFERENCES:

1.McCrakens "Removable partial denture prosthodontics". 9th edition.

2.Miller "Removable partial prosthodontics". 2nd edition

3. Stewart, Rudd, Kuebker "Clinical removable prosthodontics". 2nd edition

4.Richard P. Frank, James S. Brudvik and Carolyn Jean Noonan "Clinical outcome of the altered cast impression procedure compared with use of a one-piece cast." J. Prosthet. Dent. 2004; 91:468-76.

5.Richard J. Leupold, Robert J. Flinton and David L. Pfeifer "Comparison of vertical movement occurring during loading of distal-extension removable partial denture bases made by three impression techniques". J. Prosthet. Dent. 1992; 68: 290-3.

6.Farhad Vahidi "Vertical displacement of distal-extension ridges by different impression techniques". J. Prosthet. Dent. 1978; 40(4): 374-377.