



## A Comparative Study of Impression Procedures for Distal Extension Removable Partial Dentures

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### ABSTRACT

**Aim:** This study was carried out with the purpose of comparing three impression methods as to which of them placed tissues most favorably.

**Methods:** The methods used were Hindels method, selective tissue placement method and functional reline method. The measurements obtained were analyzed to determine which of the three impression methods placed the mucosal tissues maximally. To compare and measure tissue placements, autopolymerizing acrylic resin platforms were constructed to the height of the occlusal surfaces of the remaining teeth. 15 orthodontic buccal tubes were placed on each side of the platform. They were arranged in three sets of five and attached to the platform over selected reference regions by means of autopolymerizing resin. The selected reference areas were in anterior, middle and posterior areas of the ridge on either side.

**Results:** No significant difference was seen in tissue placement in the anterior middle and posterior regions in each of the three methods when each method was assessed separately. Selective tissue placement method placed the tissues maximally (7.547 mm) followed by Hindels method (7.2110 mm) and the least placement was by functional reline method (5.856 mm). Tissue placement was significantly higher in Hindels method as compared to functional reline method ( $p < 0.001$ ).

**Conclusion:** Tissue placement was maximum in the posterior region, followed by the middle region and least in the anterior region of the mandibular ridge for all three methods. Selective tissue placement method showed the maximum overall tissue placement followed by the Hindels method and minimum placement was by functional reline method.

**Clinical significance:** Selective tissue placement method provided maximum overall tissue placement and can be a preferred technique for impression making for bilateral distal extension removable partial denture fabrication.

**Keywords:** Bilateral distal extension, Removable partial denture, Selective tissue placement, Hindels method, Functional reline technique.

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### INTRODUCTION

The bilateral distal extension removable partial denture presents a treatment problem to the dentist. A major factor to be considered with regard to such partial dentures is of their composite support, coming from two entirely dissimilar oral structures; the teeth and the residual ridge. If support can be utilized in such a manner that neither the teeth nor the residual ridge is abused the basis for a successful removable partial denture is established. However, if the supporting teeth or soft tissues are not used correctly and completely, consequent mobility of abutment teeth and resorption of the residual ridge results. Recording the functional impression of the ridge is one of the major steps to be taken to achieve the most favorable prognosis for the distal extension denture. Different functional impression techniques have been advocated to best ensure tissue support. This study was carried out with the purpose of comparing three such impression methods as to which of them placed tissues most favorably. The methods used were Hindels method, selective tissue placement method and functional reline method.

### MATERIALS AND METHODS

A healthy female patient, aged 32 years with bilaterally missing mandibular molars was selected for the study. The patient was free from local and systemic disease. Prophylactic scaling and polishing was performed before impressions. Three different impression procedures were employed to determine which of them placed the tissues most favorably, these were:

1. Hindels impression method
2. Selective tissue placement impression method
3. Functional reline impression method

### Hindels Impression Method

An impression was taken in a stock tray with irreversible hydrocolloid impression material that included all means of future support of the partial denture and the preliminary cast poured in dental stone. An acrylic resin special tray with medium fusing compound as spacer was fabricated. The tray was selectively relieved by scrapping of the compound from the tissue surface except in the buccal shelf area by approximately 1 mm. The tray was loaded with zinc oxide eugenol paste and brought into position into the mouth taking care that the soft tissues were left in a passive state. After set the tray was removed, the impression was examined, and excess cut away. The tray was then reinserted in the mouth. A prefabricated stock metal tray that had been provided with two openings for insertion of fingers in the first molar region (Fig. 1) and was filled with irreversible hydrocolloid impression material. The loaded tray was then seated over the teeth and the acrylic resin tray. The fingers of both the hands were pressed through the openings in the tray till they contacted the underlying tray and pressure was exerted on it and maintained till the irreversible hydrocolloid impression material had set. The completed impression was then removed as one unit and the cast poured in dental stone. The steps were repeated till five such casts were obtained.

### Selective Tissue Placement Impression Method

A metal framework of the partial denture was fabricated on a cast poured from irreversible hydrocolloid impression. The framework was a lingual plate with primary occlusal rests on 35, 45 and additional rests on 34, 44 and I bar clasp on 35, 45. Fabrication of special tray: The metal framework was tried and fitted on the mouth and on the cast. Wafers of low fusing compound were adapted on the master cast to act as spacers. The framework was heated and pressed into position on the master cast. Self-curing acrylic resin was

mixed and wafers of the resin were adapted to the cast over the framework with finger pressure. The cured resin tray and framework were removed from the cast and the borders were adjusted to within 2 mm of the tissue reflection. Holes were then placed in the trays corresponding to the crest of the ridge to allow for the escape of excess impression material. A thin layer of low fusing compound was painted over the tissue side of the impression tray by softening it with flame. The low fusing compound was first softened with a flame tempered with water and placed in patient's mouth. This procedure was repeated till the basal seat tissues were not displaced and the framework was correctly positioned. Borders were perfected by heating individual areas, placing tempered tray in tray in the mouth, manipulating cheeks and having the patient mold the lingual borders by tongue movements. The whole inside of the ray with the exception of the buccal shelf region was relieved by approximately 1 mm.

*Impressions:* The final impression was completed with zinc oxide eugenol impression paste. It was visually determined that all rests and indirect retainers were completely seated while the impression material was still fluid. Pressure was maintained on the occlusal rests until the material had reached its final set. Care was taken to avoid any downward pressure on the impression tray. Preparing the original cast and pouring the altered cast; the ridge areas were then removed from the master cast by sawing it with a saw blade in two places. One cut was made at right angles to the axis of the ridge 1mm distal to the post posterior tooth. The second cut was made lingual and parallel to the lingual vestibule. The two cuts meet anteriorly and the edentulous areas are removed. The completed selective pressure impression is seated on the cut cast and the metal framework secured to it with sticky wax (Fig. 2). Beading and boxing was completed and dental stone was used to pour the altered cast. The above procedure was repeated till five such casts were obtained.



Fig. 1: Tray for hindels impression

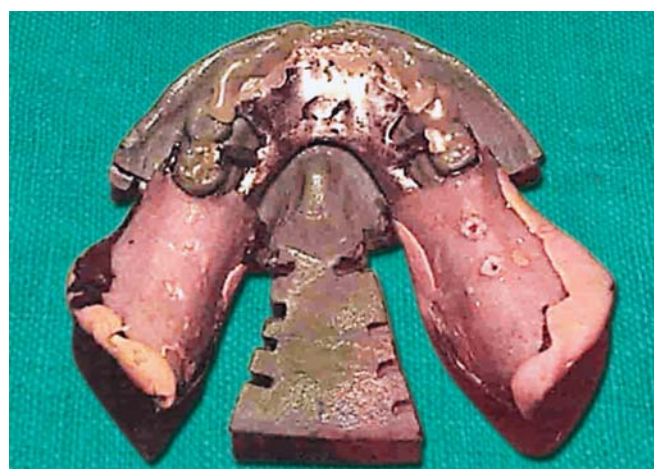


Fig. 2: Selective pressure impression for pouring an altered cast



### Functional Reline Impression Method

A partial denture was constructed on a cast made from irreversible hydrocolloid impression. The partial denture was adjusted in the patient's mouth. An acrylic trimmer was used to remove acrylic from the inside of the partial denture except the buccal shelf area to provide space for the impression material. Tissue conditioner (Viscogel) was mixed according to the manufacturer's instructions. After 2-3 minutes when the mixed material had reached a suitable consistency it was inserted in the mouth. The patient was asked to close the mouth in normal occlusion and remain in the position for no less than 2 minutes. The patient was then asked to carry out functional movements like swallowing, gently chewing, side to side movements jaw movements, tongue and cheek movements. After five minutes from time of insertion denture was removed and checked for adequate coverage. Excess material was removed with a knife. The impression was reinserted in the mouth for a further 15 minutes with the patient continuing to perform functional movements. The impression was removed (Fig. 3) and an altered cast poured as previously described. The procedure was repeated till 5 such casts were poured.

A summary of the procedure is given in Table 1.

### Measuring Assembly

To compare and measure tissue placements autopolymerizing acrylic resin platforms were constructed to the height of the occlusal surfaces of the remaining teeth (Lyte 1962)<sup>1</sup>. This platform extended over the edentulous areas distally. Fifteen orthodontic buccal tubes were placed on each side



Fig. 3: Functional impression with tissue conditioner

of the platform. They were arranged in three sets of five and attached to the platform overselected reference regions by means of autopolymerizing resin. The selected reference areas were in anterior, middle and posterior areas of the ridge on either side.

### Measurements

A piece of 22 gauge wire was selected and passed through each tube until it contacted the ridge (Fig. 4). The distance between the top of each tube and the end of the wire was measured under a compound microscope with a vernier caliper attachment at a magnification of  $4 \times 10$ . The acrylic platform was transferred to each of the fifteen casts in succession and the distance was measured and recorded for each tube. The measurements were analyzed to determine which of the three impression methods placed the mucosal tissues maximally.

Table 1: Showing the details of impression methods employed in the study

Hindels method	Selective tissue placement method	Functional reline method
<ul style="list-style-type: none"> <li>Preliminary impression with irreversible hydrocolloid impression material and stone cast poured</li> </ul>	<ul style="list-style-type: none"> <li>Preliminary impressions with irreversible hydrocolloid, casts poured and metal framework</li> </ul>	<ul style="list-style-type: none"> <li>Removable partial denture fabricated on stone cast poured from impression</li> </ul>
↓	↓	↓
<ul style="list-style-type: none"> <li>Fabrication of special tray Strengthener: Cold cure acrylic resin Spacer: Medium fusing compound</li> </ul>	<ul style="list-style-type: none"> <li>Fabrication of special tray</li> </ul>	<ul style="list-style-type: none"> <li>Special tray: Partial denture base</li> </ul>
↓	↓	↓
<ul style="list-style-type: none"> <li>Relief: Selective relief given</li> </ul>	<ul style="list-style-type: none"> <li>Strengthen: Cold cure acrylic resin and metal mesh work.</li> </ul>	<ul style="list-style-type: none"> <li>Relief: Selective relief</li> </ul>
↓	↓	↓
<ul style="list-style-type: none"> <li>Final impression: Zinc oxide eugenol</li> </ul>	<ul style="list-style-type: none"> <li>Spacer: Medium fusing compound</li> </ul>	<ul style="list-style-type: none"> <li>Final impression: Tissue conditioner</li> </ul>
↓	↓	↓
<ul style="list-style-type: none"> <li>Perforated stock metal tray loaded with irreversible hydrocolloid used to take a dual impression under finger pressure</li> </ul>	<ul style="list-style-type: none"> <li>Relief: Selective relief</li> </ul>	<ul style="list-style-type: none"> <li>Altered cast poured</li> </ul>
↓	↓	↓
<ul style="list-style-type: none"> <li>Cast poured in dental stone</li> </ul>	<ul style="list-style-type: none"> <li>Final impression: Zinc oxide pasts</li> </ul>	<ul style="list-style-type: none"> <li>Procedure repeated till 5 such casts obtained.</li> </ul>
↓	↓	
<ul style="list-style-type: none"> <li>Procedure repeated till five such casts obtained.</li> </ul>	<ul style="list-style-type: none"> <li>Altered cast poured in dental stone</li> </ul>	
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	<ul style="list-style-type: none"> <li>Procedure repeated till five such casts obtained.</li> </ul>	

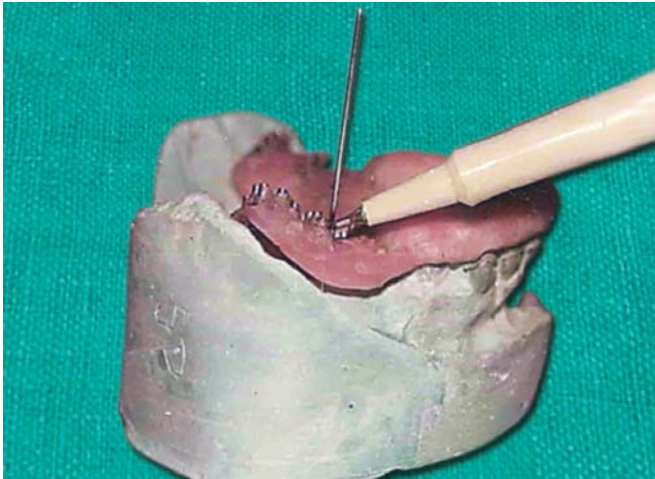


Fig. 4: Measuring assembly to evaluate tissue placement

**OBSERVATIONS**

Measurements were taken for at each of the thirty tubes for all of the fifteen casts and the results tabulated. The arithmetic mean for each impression method at each of the three orthodontic tubes were calculated and tabulated.

Further analysis was carried out in two steps as follows:

1. Comparison of tissue placements of each of the three methods separately in the anterior middle and posterior areas of the ridge.

No significant difference in tissue placement in the anterior middle and posterior regions in each of the three methods when each method was assessed separately. The tissue placement was maximum for posterior region followed by middle region and minimum for anterior region. The results are summarized in Table 2 and Graph 1.

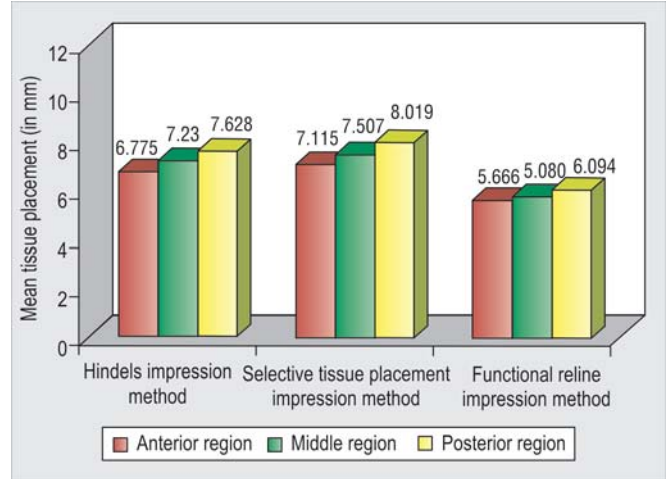
2. Comparison of overall tissue placement by the three methods.

Tissue placement is maximum for selective tissue placement method followed by Hindels method and minimum for functional relines method.

**Table 2 :** Comparison of tissue placements of each of the three methods separately in anterior, middle and posterior regions of the ridge

Comparison	t-value	p-value
<b>Hindels</b>		
Posterior vs middle	0.9786	NS
Posterior vs anterior	1.6647	NS
Middle vs anterior	1.1055	NS
<b>Selective tissue placement</b>		
Posterior vs middle	0.9753	NS
Posterior vs anterior	1.9184	NS
Middle vs anterior	1.4085	NS
<b>Functional relines method</b>		
Posterior vs middle	0.7663	NS
Posterior vs anterior	0.3923	NS
Middle vs anterior	0.4045	NS

NS: Non significance



**Graph 1:** Comparison of tissue placement of each of the three methods individually in the anterior, middle and posterior regions of the ridge on either side

Tissue placement is significantly higher in selective tissue placement method as compared to functional relines method.

No significant difference in tissue placement in Hindels method and selective tissue placement method but tissue placement is slightly higher in selective tissue placement as compared to Hindels method.

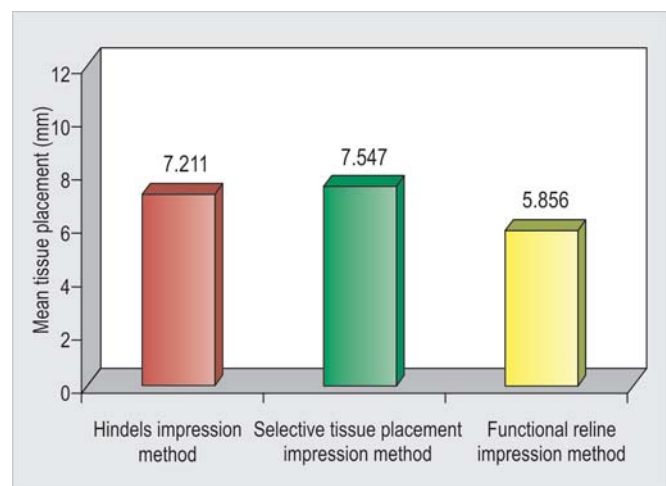
Tissue placement is significantly higher in Hindels method as compared to functional relines method.

The findings are summarized in Table 3 and Graph 2.

**Table 3:** Comparison of overall tissue placement by the three methods

Comparison	t'	p'
Hindels vs selective pressure	1.2162	NS (p = 0.1144)
Hindels vs functional relines	5.7373	p < 0.001
Selective pressure vs functional relines	6.7942	p < 0.001

NS: Non significance



**Graph 2:** Comparison of overall tissue placement of the three impression methods

## DISCUSSION

The challenge for the dentist fabricating the distal extension denture is to try and equalize the resilient support provided by the residual ridge and the nonresilient support provided by the teeth. One of the ways to achieve this is through functional impressions. This implies recording the tissues supporting a distal extension partial denture in their supporting state and then relating them to the remainder of the arch by means of a secondary impression. This was called a functional impression as it recorded the ridge under-simulated function. There are a number of functional impression methods available to the dentist and as such they place the tissues differentially. This study evaluated and compared the tissue placement by three such methods. The methods evaluated were:

1. Hindels method: It is a relatively well known technique with a number of variations in literature (Kramer,<sup>2</sup> Rapauno).<sup>3</sup>
2. Selective tissue placement method: This method was used to pour an altered cast. Studies by Applegate,<sup>4</sup> Holmes,<sup>5</sup> Leupold,<sup>6</sup> Wagle et al<sup>7</sup> have shown that the altered cast consistently produces distal extension partial dentures that have greater stability and less vertical movement.
3. Functional reline method: The use of tissue conditioners for functional impressions has been controversial. Studies by Wilson et al<sup>13,14</sup> have disapproved the use of tissue conditioners for dual purposes, i.e. for tissue conditioning and for impression purposes. They were of the view that temporary soft materials should be developed along separate lines, one for tissue conditioner and other for functional impression materials. However studies by Starcke et al,<sup>8</sup> Razeq<sup>9</sup> and Macarthy et al,<sup>10</sup> Wagle et al,<sup>7</sup> have shown that tissue conditioners can satisfactorily fulfill the role of functional impression materials.

The study was carried out on the mandibular ridge of a single patient, so as to keep the variables to a minimum.

The measuring assembly used in this study was first used by Lyte<sup>1</sup> and later by Vahidi<sup>11</sup> and Wagle et al<sup>7</sup>. According to Stewart et al<sup>12</sup> tissues are said to be placed if after partial denture insertion and wear by the patient no adverse response of the tissue in the form of inflammation, ulceration or bony resorption has taken place. If there is inflammation or ulceration then the tissues are said to be displaced. There is no method to determine if the tissues are placed or displaced at the time of the impressions. In this study since the procedures were meticulously followed it was assumed that the tissues are placed and not displaced. However, the lack of a clear-cut differentiation between placement and displacement was the principal drawback of this study.

It has been shown by Leupold et al,<sup>6</sup> Wagle et al,<sup>7</sup> that more the tissue placement less is the vertical movement occurring during loading of distal extension removable partial denture and consequently the stresses are more favorably distributed between the abutment and the ridge.

Initially the tissue placement of each of the methods was studied individually in the anterior middle and posterior areas of the ridge. Graph 1 reveals that the maximum tissue placement in all the three methods was in the posterior region, followed by the middle region and least in the anterior region. These findings were consistent with previous studies (Wagle et al,<sup>7</sup> Vahidi).<sup>11</sup> However, as Table 1 reveals none of the differences were statistically significant. The differences could be attributed to the greater depressibility of the tissues in the posterior retromolar areas. Also in the anterior areas the teeth share some of the load unlike in the posterior areas where the ridge bears the whole load in the selective tissue placement and functional reline method.

Tissue placement was also compared on an overall basis. As Graph 2 reveals selective tissue placement method placed the tissues maximally (7.547 mm) followed by Hindels method (7.2110 mm) and the least placement was by functional reline method (5.856 mm).

Table 2 reveals that the differences in overall tissue placement between Hindels method and selective tissue placement method are statistically insignificant ( $p = 0.1144$ ). Tissue placement was significantly higher in Hindels method as compared to functional reline method ( $p < 0.001$ ). Also tissue placement was significantly higher in selective tissue placement method as compared to functional reline method ( $p < 0.001$ ).

The findings indicate that undersimulated intraoral loading, tissue placement was dependent on the impression method used. Other factors that could influence tissue placement were tissue resiliency, proximity to abutment teeth, nature of impression material and the histologic character of the tissue.

Maximum placement achieved by selective tissue placement method indicated that this method provided controlled tissue support. This was consistent with previous findings on altered casts by Applegate,<sup>4</sup> Leupold<sup>6</sup> and Wagle et al.<sup>7</sup> This mucosal placement could be attributed to the placement of mucosa by the low fusing compound as also the use of altered cast. However, this method is very technique sensitive and time consuming.

Hindels method also placed the tissues favorably next to selective tissue placement method. This could be attributed to the finger pressure that was employed for loading. Simulated occlusal loading by finger pressure is arbitrary which can cause tissue displacement. However,



the method is simple and has been shown to provide consistent results.

The functional reline method provided the least tissue placement. This could be attributed to the lack of body and excessive flow of the tissue conditioner in the initial stages when occlusal load was applied. However, the role of tissue conditioners as functional impression materials cannot be ruled disregarded and further tests need to be carried by varying the powder: Liquid ratio.

Further investigations with a larger sample size need to be undertaken till we understand the enigma that is a functional impression.

## CONCLUSION

On the basis of observations, statistical analysis and discussion the following conclusions were drawn: Tissue placement was maximum in the posterior region, followed by the middle region and least in the anterior region of the mandibular ridge for all three methods. However, none of the differences were statistically significant. Selective tissue placement method showed the maximum overall tissue placement followed by the Hindels method and minimum placement was by functional reline method. However, the differences between selective tissue placement method and Hindels method were statistically insignificant.

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