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Spacer designs for impressions in conventional complete dentures: A review

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Abstract

Creating accurate impressions and master casts are essential for the fabrication of precisely fitting complete dentures. This necessitates making impressions that are capable of capturing and replicating all anatomical peripheral and denture bearing structures. Different impression techniques have been advocated for fabrication of complete dentures by various authors. Impression making for completely edentulous patients involve use of custom impression trays with different spacer designs. This article provides an insight to various spacer designs and their utilization in various clinical situations.

Keywords: Spacer Design, Impression, Relief Areas, Complete Dentures.

Introduction

Making precise impressions is crucial in prosthodontics, marking the initiation of prosthodontic treatment. The

quality of the impression significantly influences the retention, support, and stability of complete dentures[1]. The selection of the appropriate impression technique is vital, tailored to each patient's anatomical and physiological needs. Different impression techniques advocated by various authors have been described in literature spanning from 1845 to the present[2]. The plethora of complete denture impression techniques were divided into three classifications by Carl O Boucher[2]

Based on actual anatomy of individual patient or on arbitrary landmarks - Anatomic or Arbitrary.

A. Based upon the mouth position while the impression is being made -open mouth or closed mouth
B. Based upon the relative amount of pressure exerted on the tissues by the impression material when the tray is placed intraorally- pressure, nonpressure, negative pressure, or selected pressure.

The impression techniques based on relative amount of pressure exerted have been classified as mucostatic or mucodisplacing[3]:

1. Mucostatic theory[4]: It was described by Adisson (1944). Mucostatic impressions record the tissues with minimal displacement. Impression plaster is the material of choice in this technique as it does not compress and displace tissues during seating of the tray. It is indicated in patients with displaceable soft tissues that should be recorded in a passive state.
2. Mucodisplacing Techniques :

Mucocompressive theory[5]: This technique advocated the recording of tissues in their functional form. The disadvantage associated with this technique is greater resorption of residual alveolar ridges due to a continuous pressure exerted on basal tissues. Moreover, displaced tissues tend to displace the denture in their attempt to return to their original form, compromising retention.

Minimal pressure theory[5]: It advocates application of minimal possible pressure, little more than the weight of free flowing material making it. Disadvantage with this technique is that the amount of pressure applied is subjective and difficult to standardize.

Selective pressure theory[3]: This was proposed by Carl O Boucher and is the most widely accepted technique. According to this theory, while making the final impression, pressure is applied on areas capable of withstanding stresses (Stress bearing areas) whereas areas not capable of withstanding stresses (Relief areas) are relieved.

Selective pressure while making an impression can be achieved by fabricating a custom tray with a spacer with different design and thickness. The tray is fabricated such that it contacts stress bearing and supporting areas and a spacer is adapted on the relief areas. The custom trays are border molded with a wax spacer in place.The spacer is removed before making the final impression to minimize pressure in areas of relief.

A custom tray spacer is defined as "An agent applied onto a preliminary cast for fabrication of a custom tray to provide space for the impression material in order to make a definitive impression"[6]. Various authors have suggested different spacer designs with variable thickness and different materials used as spacers.

Literature Review

The different spacer designs advocated by different authors are enumerated in Table 1.

Author	Spacer Design	Spacer Thickness and Material	Relief Holes	Final Impression Material
Carl O Boucher[3]	Full coverage spacer except PPS in maxilla, Buccal Shelf in mandible. (Fig. 1). No spacer to be used for metallic oxide paste	1-2mm thick Base plate v	Mid palatine raphae, anterior part of hard palate. Mandible : Crest of the ridge,12.5mm apart	Elastomeric impression material
Bernard Levin[7]	Residual alveolar ridges excluding the buccal shelf area. (Fig. 2)	2 mm thick Base plate wax.	8-10 holes over the crest of the ridge	Light bodied Thiokol rubber
John J Sharry[8]	Complete coverage including pterygomaxillary notch and vibrating line. 4 tissue stops 2mm in width,1 each in canine and molar region, from palatal aspect of ridge to mucobuccal fold (Fig. 3)	One layer thickness of Base plate wax	Single hole in Incisive papilla. Mandible- Holes at the crest of the ridge in premolar and molar area	Zinc Oxide Eugenol (ZnOE) Impression paste
Morrow, Rudd Rhoads[9]	Complete coverage 2 mm short of the vestibular depth and line joining the Hamular notches. 3 tissue stops (4X4 mm) one in anterior region and 1 each in molar region for maxilla, 2 tissue stops in mandible, 1 each in canine region (Fig. 4)	One layer thickness of base plate wax	Centre of the palate. Mandible - Crest of the ridge	ZnOE Impression Paste or Elastomeric Impression material
Arthur Rahn[10]	Rugae and incisive papilla in maxilla. Crest of the ridge in mandible (Fig. 6)	One layer Thickness of Base plate wax	App 5 holes in anterior maxilla and mid palatine raphae	As per clinician's comfort
Halperin[11]	Peripheral relief space is provided in the area between depth of the sulcus and he circumference of height of	1mm thick base plate wax	-	Low fusing impression compound. Wash impression not

	contour of denture bearing area. 6)			recommended
Fenn[12]	Relief to be provided in all areas with thin mucosa like the midpalatine raphae. Areas requiring relief are determined by palpating the denture bearing area.	Tin-foil sheets. Thickness depends on thickness of mucosa in the area to be relieved	-	ZnOE Impression paste
Neil[13]	Complete coverage design for maxillary and mandibular arches. (Fig. 7) No spacer required if ZnOE impression paste is used.	0.9 mm casting wax.	-	Impression Plaster, ZnOE Paste, addition Silicone or Polyether
Smith et al[14]	Spacer over the crest of the ridge and midpalatine raphe in maxilla, crest of the ridge in mandible. (Fig. 8)	1 mm thick base-plate wax	-	Polyether impression material
Sheldon Winkler[15]	Selective relief in compound tray in incisive papilla, rugae and midpalatine areas by scraping the compound in these regions	1 mm scraping of intaglio surface of compound impression	-	Zinc Oxide Eugenol impression paste
Sanath Shetty[16]	Spacer wax placed in all areas except the PPS. Over the wax, a 1.5 mm thick layer of modelling wax is adapted. The modelling wax is removed from the stress bearing areas, region of the crest of the alveolar ridge and the horizontal palate. Four tissue stops are placed, bilaterally in the canine and molar region (Fig 9).	0.4 mm major connector wax	Escape holes in relief areas	Zinc oxide eugenol paste or light body Elastomeric impression material
Massad	Single impression for the	Rigid-viscosity addition	Perforated	Medium or

[17]:	edentulous patients. 4 tissue stops in maxilla (incisor, molar and mid-palate region) and three in the mandible (incisor and molar region) (Fig 10).	silicone material	Thermoplastic stock trays	light body PVS impression material
McCord and Grant[18]	Advocate addition of a small amount of tracing compound to the maxillary and mandibular special trays in the canine region to serve as a spacer. (Fig 11)	Green stick impression compound	-	ZnOE Impression Paste or elastomeric impression material

Table 1: Spacer Design and thickness

Miscellaneous Design[19] (Fig 12):

Maxilla: This design is based on minimal pressure technique. 1 mm base-plate wax is adapted over the basal area except right and left posterior hard palate. The exposed areas of the hard palate along with four tissue stoppers at canine and molar regions act as stoppers.

Mandible: this design is based on selective-pressure technique. 1 mm thick base-plate wax is placed over the residual alveolar ridge except the retromolar pad (RMP) which acts as the stress bearing area. Two tissue stops are given at the canine region.

Discussion

Preservation of oral tissues in completely edentulous patients is important for the longevity of complete denture prosthesis. The impression technique directly influences the amount of pressure exerted over the tissues by the denture. Careful designing of the spacer enables the clinician to effectively moderate and distribute this pressure to desired locations. The effect of spacer on the pressure produced on the residual alveolar ridges has been evaluated in various studies [20-24].

Frank[20] conducted simulations and measurements of impression pressure by employing trays equipped with five strategically positioned escape holes. These holes were made using a round bur (no. 6) precisely located equidistant from each other, situated 0.25 inches from the center of each pressure gauge. This study concluded that impression pressures can be controlled by tray design and material selection. Komiyama et al[21] suggested the incorporation of an escape hole with a diameter ≥1mm or a spacer with a thickness of a base plate wax sheet to reduce pressure over the residual alveolar ridges while making impressions of an edentulous maxilla. Reddy et al[22] found that a space relief using one sheet thickness of modeling wax reduced pressure exerted on the residual alveolar ridge while making edentulous impressions, irrespective of the final impression material used (Zinc oxide eugenol impression paste or light body polyvinyl siloxane). Chopra et al[23] compared the pressure generated on a simulated maxillary oral analog by impression materials in custom trays of different spacer designs. They found that the design of the spacer has a significant influence on the pressure exerted on the denture bearing tissues during final impression making. Dadarwal et al[24] carried

out an in vivo study for microstrain analysis of the selective pressure impression technique using strain gauges in mandibular complete denture impression. The authors found that using a custom tray with relief for selective pressure impression of an edentulous mandible results in a desirable pressure distribution at the alveolar crests and buccal shelves.

Thickness of the spacer is also influenced by the impression material used for making the impression. The thickness of spacer recommended by JA Hobkirk[24] is 0.5 mm for Zinc oxide eugenol impression paste, 0.5-1.5 mm for elastomeric impression materials, 3mm for irreversible hydrocolloid and 1.5 mm for impression plaster. It is therefore essential to incorporate spacers in the design of the custom trays so that pressure exerted by the denture would be in accordance with the physiological limits of underlying structures for the maximum preservation of remaining tissues.

It is thus recommended that, in the process of obtaining an impressions for completely edentulous patients seeking conventional complete denture treatment, one may opt to incorporate a spacer, equivalent in thickness to a standard sheet of base plate wax. Alternatively, an escape hole with a diameter of 1.0 mm or larger, can be employed. These measures are suggested as selective means to effectively distribute pressure during the impression-making procedure.

Conclusion

Successful rehabilitation of the edentulous patient requires accurate impressions of the edentulous arches. The impression technique varies according to the patients intraoral conditions. Stress distribution beneath a complete denture should be done such that pressure is selectively applied on the stress bearing areas to minimize soft tissue trauma and bone resorption. Thus spacer design should be carefully incorporated before making the final impressions depending on the clinical situation.

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Legend Figures

Fig 1: Bouchers spacer design

Fig 2: Bernard and Levin's design

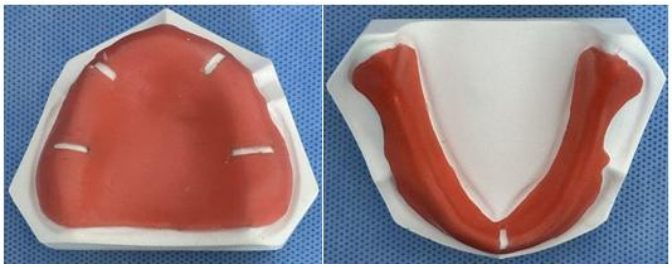

Fig 3: Sharry's Spacer design

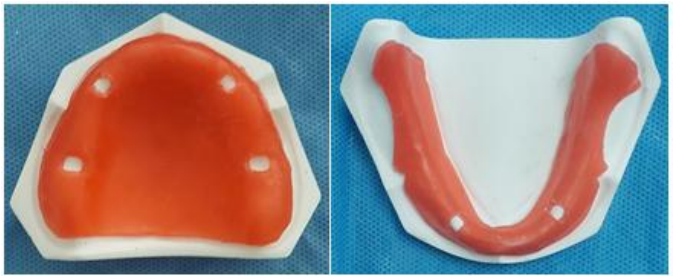

Fig 4: Morrow's Spacer design

Fig 5:Rahn's Design

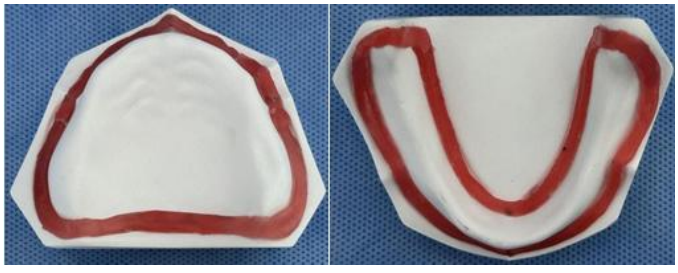

Fig 6: Halperin's design

Fig 7: Neil's Spacer design

Fig 8: Smith's Design

Fig 9: Shetty's design

Fig 10: Massad's Design

Fig 11: McCord's Design

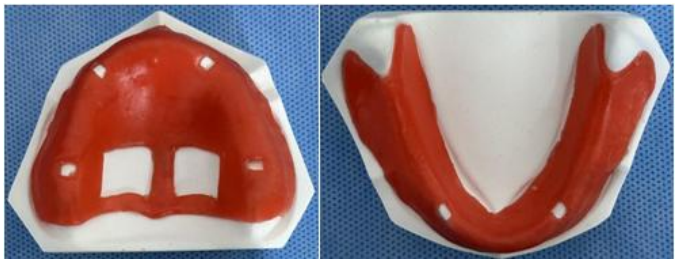

Fig 12 : Miscellaneous design