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NOVEL SPACER DESIGNS TO LIMIT THE RESIDUAL ALVEOLAR RIDGE RESORPTION IN EDENTULOUS ARCHES

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Abstract

Objective: *To provide a new system of spacer design for the fabrication of complete denture prosthesis bearing in mind the pattern of residual alveolar ridge resorption, the stress-bearing, and relieving areas.*

Background: *Certain anatomical structures of the edentulous arches are incapable of bearing compression and thus, undergo detrimental changes. Hence, care should be taken to avoid the application of excessive forces on those structures. The residual alveolar ridge of maxillary and mandibular arches have different patterns of resorption. When areas susceptible to resorption are subjected to unwarranted compression, the rate of bone resorption accelerates leading to loss of retention of the prosthesis and diminished support available for the future prosthesis. Thus, it would be prudent to design spacers keeping in mind the resorption pattern of the edentulous arches.*

Conclusion: *The spacer designs presented in this article are likely to provide better stress distribution by displacing the stress-bearing structures and preventing the resorption of vulnerable areas by relieving such areas. The new design of the spacer advocated could limit some amount of bone resorption, if not, completely prevent it.*

Keywords: Tissue stops, spacer wax, complete dentures, final impression.

Introduction

Edentulism is declining at a rate of approximately 1% per year but this is offset by the increasing life expectancy. Thus, the number of edentulous patients fairly remains the same or is increasing slightly.[1-2] Rehabilitation with complete denture prosthesis is a time-tested treatment modality that serves both the functional and aesthetic needs of an edentulous patient. They are a great tool when fabricated accurately, and meticulously following the proper guidelines. At the same time, any errors can lead to problems with the outcome and long-term functionality of the dentures. Every step in the fabrication of complete dentures must be given equal attention. One of the cardinal steps in complete denture fabrication is impression-making. The objectives behind making an impression are to provide support, stability, resistance to dislodgment, aesthetics for the complete dentures, and to preserve the underlying anatomical structures.[3] The accuracy of impression-making is paramount in keeping harmony with the underlying soft and hard tissues of the denture-bearing area.

Many theories have been put forward by different schools of thought for recording denture-bearing tissues. The most significant of them are the mucocompressive technique described by the Greene brothers (1900),[3-4] mucostatic technique by Harry L. Page (1944)[5], and the selective pressure technique by Carl O. Boucher (1951). According to mucocompressive theory, the entire denture-bearing area is recorded in function. The advocates of this technique believed that the chances of the prosthesis getting dislodged while carrying out routine functions were very minimal, but it leads to the placement of additional pressure on the entire denture-bearing area and increased chances of residual ridge resorption. On the other hand, the mucostatic impression technique deals with making an impression of displaceable tissue in its passive state, and interfacial surface tension was considered as one of the main factors that provided retention for the prosthesis.[4] Carl O. Boucher suggested applying pressure over stress-bearing areas and relieving the relief areas, creating equilibrium between the resilient and non-resilient tissues. Thus, the selective pressure technique is one of the commonly followed techniques for making final impressions.[6] The selective pressure is provided by relieving the relief areas using a spacer under the custom tray.

The custom tray is an individualized impression tray made from a cast recovered from the preliminary impressions. A custom tray should be able to carry the impression material to the mouth, and control and confine the material to enable it to record accurately the minute details of the denture-bearing area.[7] Custom trays are usually fabricated using autopolymerizing acrylic resins, thermoplastic resins, visible light-cured resins, or with thermoplastic shellac baseplates.

Space can be created in the custom tray for providing relief by adapting spacers of different thicknesses. Various materials employed as spacers include baseplate wax, casting wax, thermoplastic sheets, tin foil, etc.[8] The most commonly employed is a baseplate wax used as a spacer under an autopolymerizing resin custom tray. The objectives of employing a spacer include providing relief for the relieving areas and ensuring uniform space for the final or wash impression material. The main motive behind providing relief is to ensure that the areas which cannot withstand forces do not get compressed in function. When the forces of mastication continually compress the vulnerable structures it leads to unwanted changes in the tissues like resorption of the underlying residual alveolar bone.

Residual alveolar ridge resorption is a continuous and progressive process after the extraction of teeth. The literature suggests different rates and patterns of ridge resorption for both the maxilla and the mandible. The pattern of ridge resorption has to be kept in mind before designing a spacer as the force distribution can be varied and controlled with the use of a suitable spacer.

The maxillary edentulous arch: It resorbs upwards and inwards with progressive narrowing of the arch due to bone loss that follows the direction and inclination of the roots of the teeth. The incisive papilla remains constant as it is little affected by ridge resorption.[9-10]

The mandibular arch: There is a bit of controversy when it comes to the mandibular ridge resorption pattern. According to one school of thought, the mandibular ridge resorbs downwards and forwards. Thus, the alveolar ridge inclines outwards and the mandible becomes progressively wider.[9-10] Whilst, the other school of thought suggests that the mandibular arch like the maxillary arch resorbs to shrink downwards and backwards.[11-12]

The present article aims to present a scientific way of designing spacers for completely edentulous arches keeping in mind the pattern of residual alveolar ridge resorption so that long-term success can be achieved by preserving the existing alveolar bone for the conventional complete denture prosthesis.

A brief review of the existing spacer designs:

Various authors have recommended several ways and methods for designing spacers and providing relief during final impression-making. A few noteworthy of them have been briefly mentioned here.

1. Spacer design by Boucher CO (1951):[6,10]

Baseplate wax of approximately 1mm thick for the outlined border is used to provide relief for the custom tray that is employed for making the final impressions. For the maxillary edentulous arch, the whole of the impression surface is covered excluding the posterior palatal seal area. The posterior palatal seal area is excluded to provide additional stress in this area to achieve a posterior border seal. The author suggests that it also acts as a guiding stop to help position the impression tray. In the mandibular arch, wax covers the crest and slopes of the residual ridge. The borders and buccal shelf areas on either side are left uncovered, to apply pressure on the primary stress-bearing areas. Extra wax can be placed in the region below the mylohyoid ridge to make space for the action of the mylohyoid muscle. The author does not recommend a wax spacer if a metallic oxide impression paste is selected for making the final impressions.

2. Concept of relief by Winkler S:[13]

Selective relief is accomplished for the custom tray depending on the clinical needs presented by the particular patient. The usual areas of relief recommended by the author are the incisive papilla, the rugae zone, and the midpalatine areas. A small hole, no more than 1 mm in diameter, is placed in the midpoint of the tray for control of hydrostatic pressure built up in the tray during the final wash. He has left the choice of placement of other escape holes at the discretion of the operator to control wash impression pressures.

3. Design of spacer by Morrow RM et al.:[8]

The authors advocate first blocking out the undercuts, followed by the application of one layer of baseplate wax over the cast and trimming it to the previously drawn outline 2 mm short of the resin tray border. Three tissue stops are made by removing 4 mm squares of wax to expose the cast. The exact location of tissue stops can vary. The authors think that the size and position of the tissue stops may vary according to the dentist's requirements and sometimes the tissue stops may or may not be required.

4. Design recommendations by Mac Gregor AR:[14]

He recommends the placement of a sheet of metal foil in the region of the incisive papilla and mid-palatine raphe. The author also feels that some areas that may require relief are maxillary rugae, areas of mucosal damage, and the buccal surface of prominent tuberosities.

5. Design of spacer by Neill DJ and Narin RI:[15]

He advocated the placement of a sheet of 0.9 mm casting wax over the outlined area of the cast that will provide a space between the cast and the impression tray.

6. Concept of spacer design by Rahn AO and Heartwell CM:[16]

Two methods have been advocated by Heartwell- the first method includes providing space and relief in the prosthesis by scraping off the impression compound in the area to be relieved. The second method provides 5 relief holes by placing three holes along the rugae and two holes in the posterior glandular region.

7. Spacer design by Sharry JJ:[17]

The author recommends adapting a layer of base plate wax over the whole area outlined for the tray including the posterior palatal seal area. Four tissue stops, 2 mm in width located in the molar and cuspid region that extends from the palatal aspect of the ridge to the mucobuccal fold are given. A relief hole is given in the incisive papilla region.

8. Design of spacers by Bernard L:[18]

He advocates placing a layer of 2mm thick baseplate wax in the area of the casts that usually have softer tissues as this avoids the displacement of soft tissues covering the palate and the residual ridges.

9. Concept of spacer by Halperin G and Rogoff P:[19]

They recommended the 'Philosophy of custom impression tray with peripheral relief '. This is achieved by placing 1 mm of wax on the borders of the custom tray to provide space for the green stick compound to form a butt joint with the custom tray and record the borders accurately.

10. Spacer design by Shetty S et al. (2007):[20]

According to them, a sheet of 0.4mm thick wax is adapted over the entire maxillary cast except in the region of PPS. Over this, a 1.5 mm thick layer of modeling wax is adapted avoiding the crest of the ridge and the palatal shelves, as the crest and the palatal shelves are stress-bearing areas.

11. Use of Polyvinyl thermoplastic sheet as spacer:[21]

Kaur H et al. (2016) used a polyvinyl sheet that was vacuum-formed over the cast for providing space and then the stoppers were provided by trimming into it. The authors thought that this method overcomes the variability in the thickness of the spacer in different regions created while manipulating the wax.

Prescribing a scientific spacer design for completely edentulous patients:

1. Spacer design for sound residual alveolar ridge architecture:

a. Maxillary arch:

The spacer design ends 2 mm above the extension of the custom tray borders. A spacer wax of 0.5 mm thick is adapted only on the incisive papilla to provide additional relief to the nasopalatine nerves and vessels (Fig. 1a). A spacer wax of 1.5 mm thick is adapted over the mid palatine raphe, crest of the ridge and buccal slopes of the residual ridge (Fig. 1b). The incisive papilla receives a total of 2 mm relief, followed by the mid palatine raphe 1.5 mm so that the sharp mid palatine bony suture is avoided and the instability of maxillary denture is avoided. The crest and the buccal slopes of the residual ridge are relieved by 1.5 mm, as the maxillary ridge resorbs upwards and inwards. The relief provided on the buccal slopes and crest ensures decreased pressure on these areas hence lesser bone resorption, thus preventing narrowing of the maxillary arch. The palatal slopes of the maxillary edentulous ridge are secondary stress-bearing areas; hence they are not covered to provide any relief. There is no requirement for tissue stops, as the custom tray on the palatal aspect itself provides proper re-orientation while making the secondary impression. The margin between the wax spacer and the custom tray is a butt joint. After completing the border molding, the spacer wax is removed and three to four escape vents of 2 mm diameter are drilled using a round carbide bur. One vent is placed exactly in the region of the incisive papilla and two to three vents are placed in the midpalatine raphe region depending upon the length of the arch.

b. Mandibular arch:

There are two schools of thought regarding the residual ridge resorption of the mandibular arch, hence two design protocols for the mandibular edentulous arch. According to the first school of thought, the mandibular edentulous arch resorbs downwards and outwards, thus the buccal slopes of the ridge can take up some load and act as a secondary stress-bearing area. The spacer is provided only on the crest and lingual slopes to provide relief to prevent progressive widening of the mandibular edentulous arch. A spacer wax 1.5 mm thick is adapted over the crest and the lingual slopes. (Fig. 2a, Fig. 2b)

For the believers of the second school of thought, the spacer design is changed by including the buccal slopes rather than the lingual slopes in addition to the crest of the ridge. (Fig. 3a, Fig. 3b) However in both concepts, the buccal shelf area and the retromolar pads are left uncovered. The buccal shelf areas are perpendicular to the occlusal forces hence resistant to resorption and act as the primary stress-bearing areas.

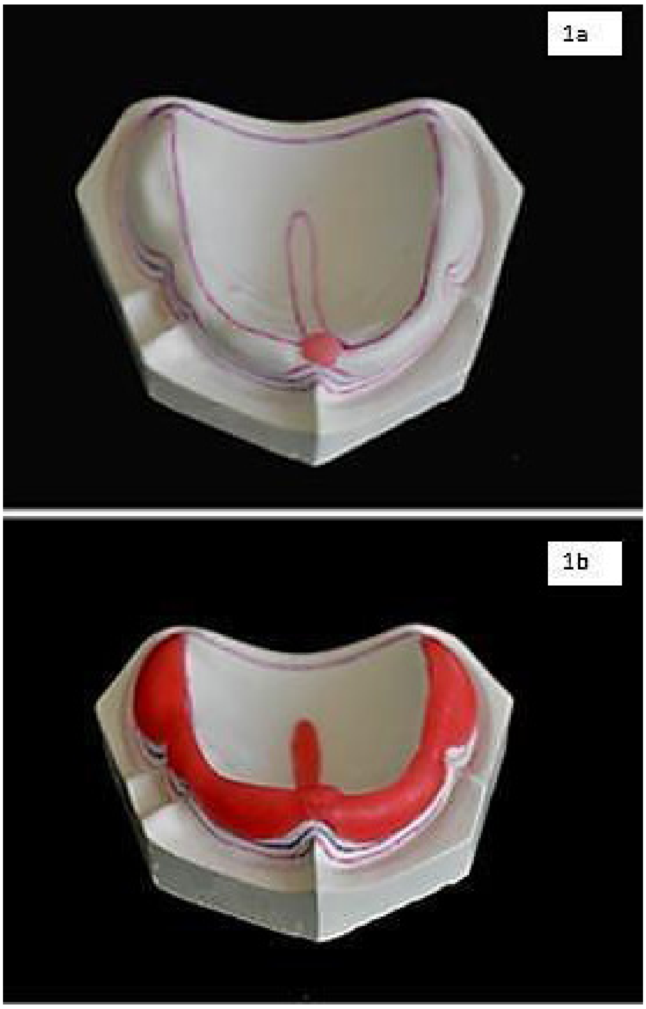

Fig. 1a: Outline of spacer design for sound residual alveolar ridge architecture with 0.5 mm spacer in the area of incisive papilla for maxillary edentulous arch.

Fig. 1b: Wax spacer 1.5 mm thick adapted over the midpalatine raphe, crest of the ridge and buccal slopes of the residual ridge.

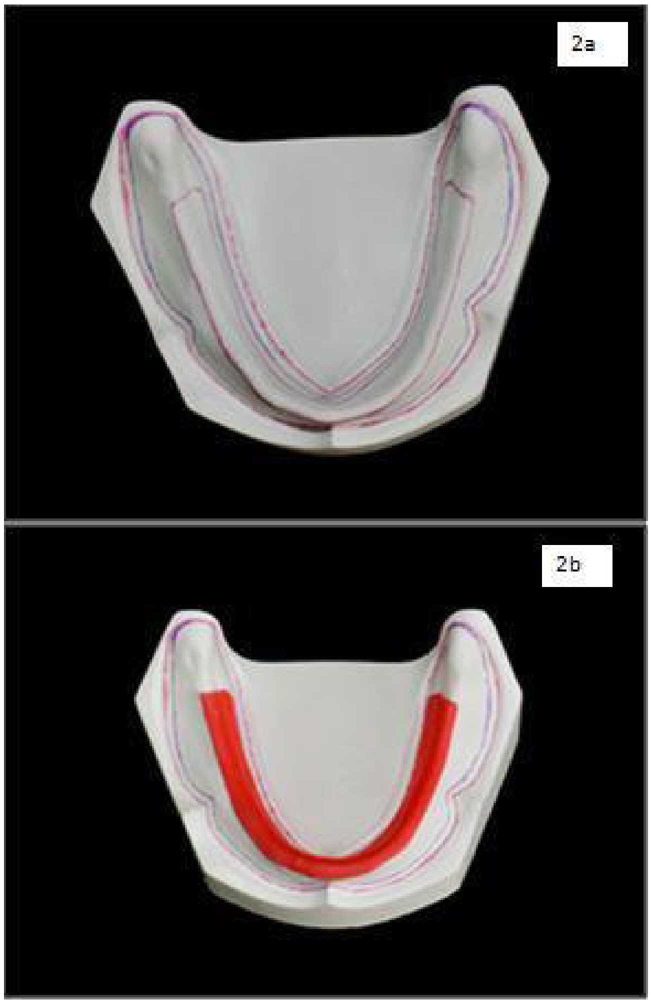

Fig. 2a: Outline of spacer design in case of sound residual alveolar architecture for mandibular edentulous arch for first school of thought, who believes that the mandibular edentulous arches resorbs downward and outwards.

Fig. 2b: A wax sheet 1.5 mm thick is adapted over the crest and the lingual slopes of the residual ridge for mandibular edentulous arch.

Tissue stops are not required in both the spacer design protocols as the buccal shelf area, retromolar pads and the respective slopes of the residual ridge provide adequate re-orientation for the custom tray. After completing the border molding, the spacer wax is removed and two escape holes of 2 mm diameter in the canine region can be drilled using a round carbide bur. Another school of thought states that there is no need for escape vents for the mandibular custom tray as the impression material can escape from the buccal and lingual inclines without building undue pressure.

The authors are believers in the first school of thought for residual ridge resorption in the mandibular arch, and hence the spacer designs described for the mandibular arch are based on

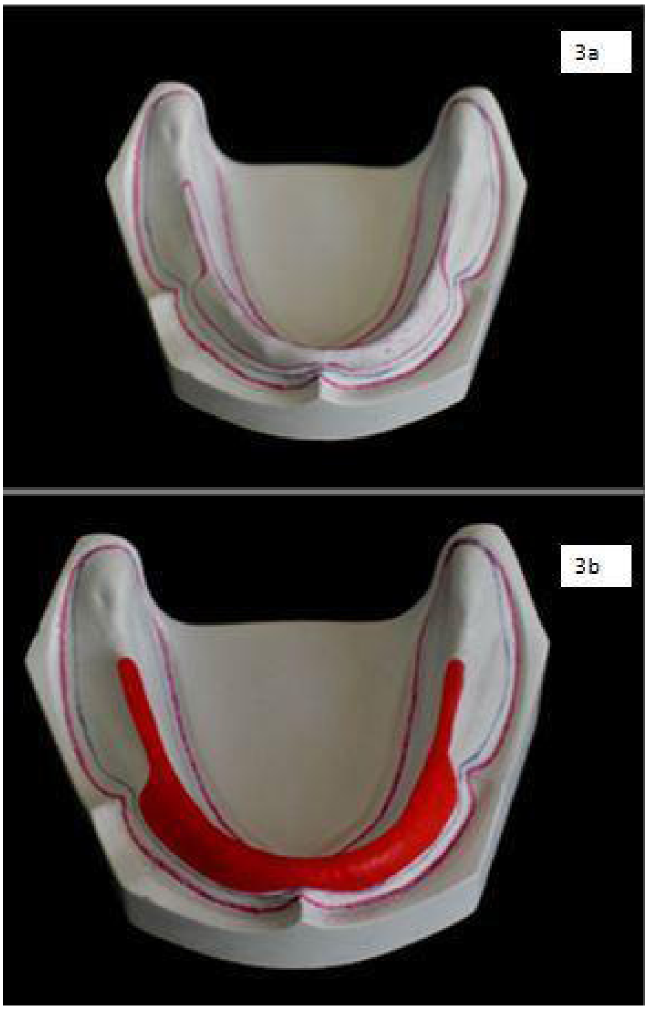

Fig. 3a: Outline of spacer design for normal ridge architecture of mandibular edentulous arch resorbing downward and inward.

Fig. 3b: Wax sheet 1.5 mm thick is adapted over the crest and the buccal slopes of the residual ridge for mandibular edentulous ridge except in the buccal shelf area.

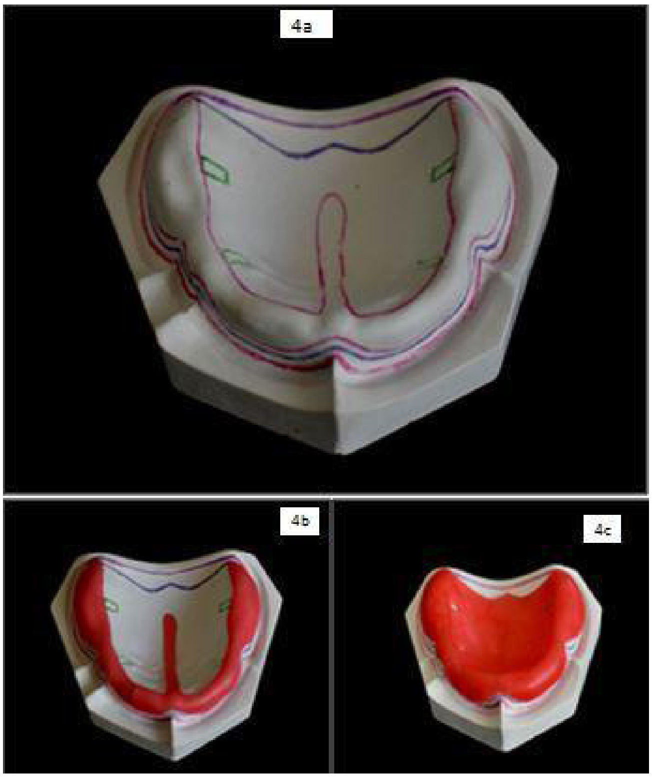

Fig. 4a: Outline of full spacer for compromised ridge architecture for maxillary edentulous arch that requires relief for the entire arch.

Fig. 4b: First layer of 0.5 mm thick wax sheet is adapted over the incisive papilla, the midpalatine raphe, crest of the ridge and extending to include the buccal slopes of the ridge.

Fig. 4c: Second layer of wax sheet 1.5 mm thick adapted to provide full spacer. There are four tissue stops (2 mm x 5-6 mm), two anterior to first premolar and two mesial to second molar on the palatal slopes of the ridge.

this concept.

2. Designing a full spacer for compromised ridge architecture or whenever indicated:

a) Maxillary arch:

Certain systemic conditions like diabetes, warrant a relief over most of the edentulous arch to prevent residual alveolar ridge resorption. In such clinical situations, a 0.5 mm thick wax sheet is adapted over the incisive papilla, the midpalatine raphe, crest of the ridge, and extends to include the buccal slopes of the ridge that stops 2 mm short of the custom tray outline. This ensures a proper relief and thereby a lesser force on these structures comparatively (Fig. 4a, Fig. 4b). Over this a second spacer of thickness 1.5 mm is adapted to include the entire arch including the previous spacer that again stops 2 mm short of the custom tray outline (Fig. 4c). The margin between the wax spacer and the custom tray is a butt joint. The posterior palatal seal area is left uncovered. Four tissue stops of dimension 2 mm in width and 5-6 mm in length are placed on the palatal slopes of the residual alveolar ridge. Two of them are placed anteriorly in the first premolar region and the other two are just mesial to the second molar region on either side of the arch. These tissue stops run perpendicular to the ridge and slope down to the palatal region. Since the tissue stops are given only on the palatal slopes, the crest and the buccal slopes of the ridges that are prone to resorption are not at all affected. After completing the border molding, the spacer wax is removed, and escape holes of 2 mm in diameter are drilled using a round carbide bur. One relief hole is placed exactly in the region of the incisive papilla and two to three holes are placed in the midpalatine region depending upon the length of the maxillary arch. Additional relief over other regions of the arch may be provided by placing relief vents as the particular clinical situation warrants.

b) Mandibular arch:

A 0.5 mm thick sheet of wax is adapted over the crest and lingual slopes of the residual ridge 2 mm short of the custom tray outline (Fig. 5a). Over this 1.5 mm thick sheet of wax is adapted over the whole arch including the previously placed spacer that ends 2 mm short of the custom tray borders (Fig. 5b). The buccal shelf areas and the retromolar pads are not covered by the spacer. Two tissue stops are given on the buccal slopes in the canine region. The dimensions are 2 mm in width and 3-4 mm in length, as the ridge height available is usually limited in the mandibular arch. After completing the border molding, the spacer wax is removed, and escape holes of 2 mm diameter are drilled using a round carbide bur. The number of escape vents is left to the discretion of the clinician as per the demands of the clinical situation.

3. Spacer design for special requirements like flabby ridge or similar conditions:

a. Maxillary arch:

A wax sheet of 1.5 mm thickness is adapted over the outlined flabby tissue area and also extends to include the incisive papilla, the mid-palatine raphe, and the buccal slopes of the ridge. (Fig. 6a, Fig. 6b). Over this a second layer of 1.5 mm thick spacer wax is adapted to cover the entire arch that is 2 mm short of the custom tray outline except for the posterior palatal seal area (Fig. 6c). This design ensures that the flabby tissue is sufficiently relieved by providing 3 mm of space for the final impression material. Additionally, escape vents may be drilled in the flabby region or a window technique of impression-making may be used. Four tissue stops of dimensions 2 mm in width and 5-6 mm in length are placed on the palatal slopes of the residual alveolar ridge. Two stops are placed in the region of the first premolars and two mesial to the second molars on either side of the arch for tray re-orientation during the making of final wash impressions.

b. Mandibular arch:

A wax sheet of 1.5 mm thickness is adapted over the outlined flabby tissue area. Another sheet of wax of 1.5 mm is adapted over the entire mandibular arch except for the buccal shelf and retromolar pad areas, 2mm short of the custom tray outline. The buccal shelf and the retromolar pad areas are left uncovered as they are stress-bearing areas and help in the orientation of the custom tray during impression making (Fig. 7a, Fig. 7b). The total spacer in the region of flabby tissue is 3 mm, providing enough space to record it without causing any displacement. Additionally, escape vents may be drilled in the flabby region or a window technique of impression-making may be employed. Two tissue stops are provided on the lingual slopes of the ridge in the region of the first premolar or just distal to the flabby tissue region as dictated by the extent of the flabby tissue. Dimensions of the tissue stops are 2 mm in width and 3-4 mm in length depending on the height of the residual ridge present. The tissue stops are placed on the lingual slopes of the ridge as

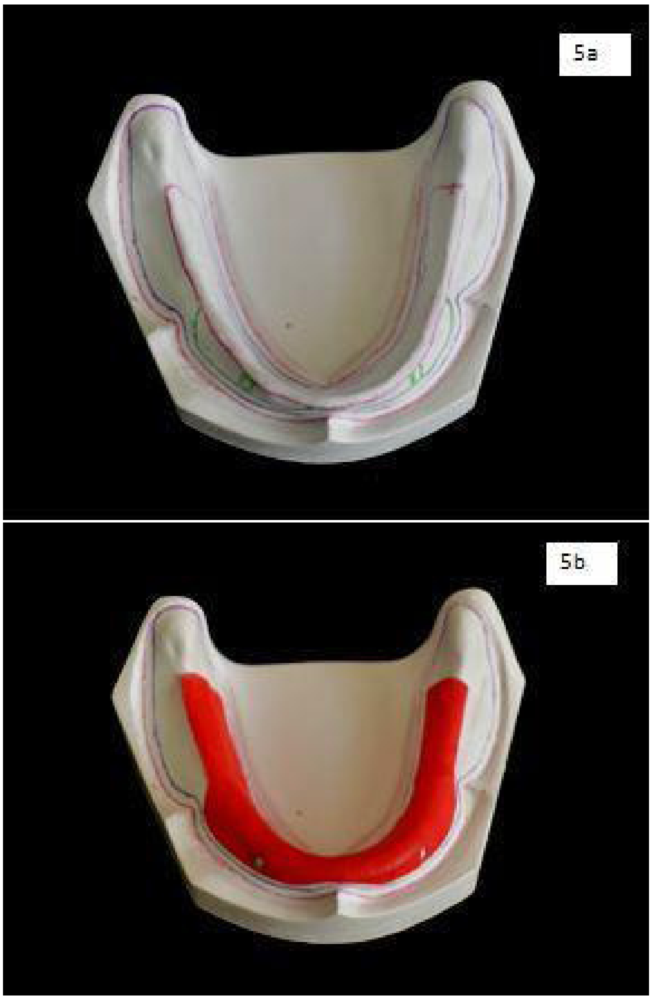

Fig. 5a: Outline for full spacer for compromised ridge architecture for mandibular edentulous arch that requires relief for the entire arch.

Fig. 5b: Full spacer adapted over the crest and lingual slopes with buccal extension and two tissue stops.

Fig. 6a: Outline of spacer design for special requirements like flabby ridge in the maxillary arch.

Fig. 6b: First layer of wax 1.5 mm thick is adapted over the flabby tissues and the mid palatine raphe

Fig. 6c: Second layer of wax 1.5 mm thick is adapted all over with four tissue stops (2 x 6 mm), two anterior to first premolar and two mesial to second molar on the palatal slopes of the ridge there is no scope to provide any tissue stops in the anterior flabby tissue area.

4. Prescribing spacer design for removable partial dentures / special clinical needs or any other clinical situation other than those described:

If the clinician encounters conditions other than those mentioned above, any combination of the principles described above for the spacer designs can be applied. The spacer should be designed keeping in mind the anatomy of the residual alveolar ridge, the dimensions of the remaining ridge, and the condition of the overlying mucosa. The basic principles of science must be adhered to and followed for the successful outcome of any treatment plan.

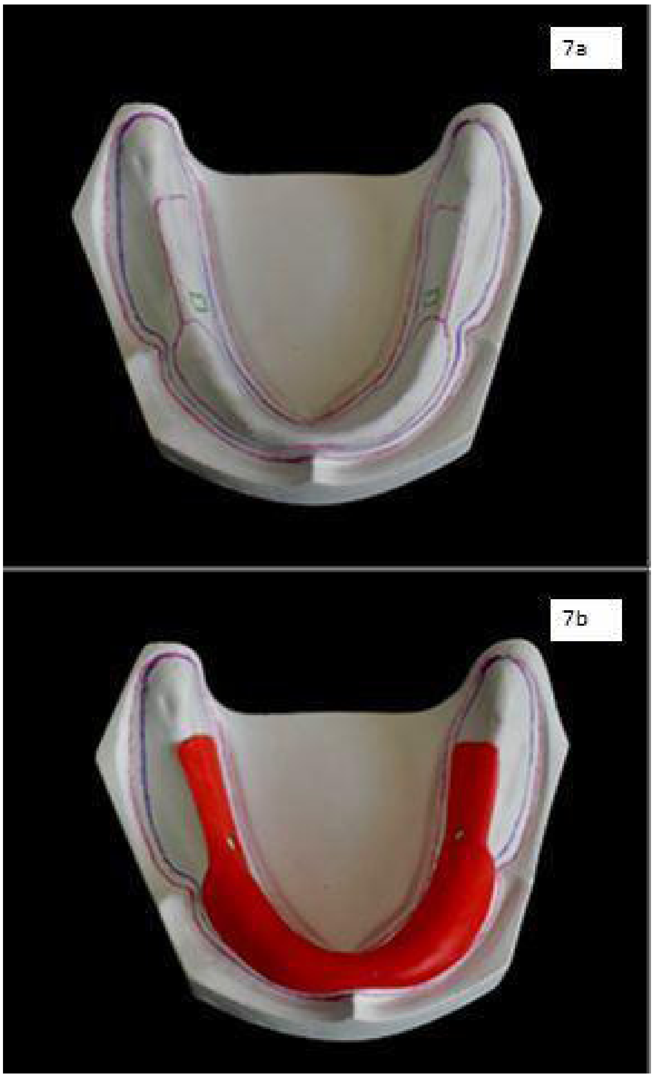

Fig. 7a: Outline for spacer design for special requirements like flabby ridge in the mandibular arch

Fig. 7b: Full spacer adapted over the crest, flabby tissue area and extending over the lingual slopes with two tissue stops.

Discussion:

Maintenance of the orofacial region is essential and will influence the appearance, function, communication skills, and interpersonal relations and has an impact on socialization, thereby enhancing the quality of life.[22] The harmony of the dentures with the orofacial tissues is of paramount importance in long-term success. Hence, maintenance of the existing residual alveolar ridge is one of the main criteria to be considered while fabricating a complete denture prosthesis.

To uphold the principles of the selective pressure impression technique it is very important to provide proper relief to the reliving structures and at the same time displace tissues that can withstand forces without causing any undesirable changes. There are plenty of spacer designs recommended in the literature and there are a lot of variations in the concepts and designs. The earlier designs have not considered the pattern of ridge resorption to prescribe the design of the spacer.

The basis for the formulation of the present spacer design is the pattern of alveolar ridge resorption. Hence, all the schools of thought related to the same are incorporated and in turn, it complies with DeVan's concept.[23] The spacer designs are delineated based on different ridge conditions encountered by the clinicians on a day-to-day basis. The stoppers are placed in such a manner that it assists the process of impression-making as well as does not impinge on relief areas. In addition, relief holes are provided to help the excess material escape and there is no excess pressure built up.[24]

In flabby ridge cases, the most commonly employed technique is the use of a custom tray with a window to avoid displacement of the tissue while recording the same.[25] The main concern in cases of flabby ridges is the provision of enough space, which is addressed by providing a spacer of 3 mm. The article intends to cover most of the clinically encountered situations. Any other situation other than those mentioned can be addressed by the clinician by applying the same principles described.

Conclusion:

The importance of a good impression cannot be stressed enough in making a dental prosthesis, especially in complete denture fabrication where the entire support and stability are provided by the underlying tissues. The spacer design helps not just in recording the areas accurately but also in the preservation of the underlying structures. A new spacer design is suggested here keeping in mind the pattern of alveolar ridge resorption. This novel approach should address the frequently encountered problems of ridge resorption to some extent if not completely curb it.

References:

1. Cooper LF. The current and future treatment of edentulism. J Prosthodont 2009;18:116-122
2. Papadaki E and Anastassiadou V. Elderly complete denture wearers: A social approach to tooth loss. Gerodontology 2012;29:721-727.
3. Zarb GA, Bolender CL, Hickey JC and Carlsson GE. In Boucher's Prosthodontic Treatment for Edentulous Patients. 10th edition.CV Mosby, St Louis, 1990, 194-223
4. Starcke EN. A historical review of complete denture impression materials. J Am Dent Assoc 1939;91(5):1037-1041.
5. Page HL. Mucostatics: A Principle not a technique. Chicago, 1946, p. 1-31
6. Boucher CO. A critical analysis of mid-century impression technique for full denture. J Prosthet Dent 1951;1:472-491
7. Ferro KJ, Driscoll CF, Freilich MA, Guckes AD, Knoernschild KL and Mcgarry TJ. The glossary of prosthodontic terms: 9th edition. J Prosthet Dent 2017;117:e28
8. Morrow RM, Rudd KD, Rhoads JE. Dental laboratory procedures, complete dentures, Volume one. 2nd ed. CV Mosby: Toronto; 1986. p. 26-56.
9. Winkler S. Implant site development and alveolar bone resorption pattern. J Oral Implant 2002;28(5):226-229.
10. Zarb GA., Bolender CL, Eckert SE, Jacob RF, Fenton AH, Mericske-Stern R. Prosthodontic treatment for edentulous patients: complete dentures and implant- supported prostheses. Mosby: St. Louis; 2004, p.225-245
11. Parkinson CF. Similarities in resorption pattern of maxillary and mandibular ridges. J Prosthet Dent 1978;39(6):598-602.
12. Tallgren A. The continuing resorption of residual alveolar ridge in complete denture wearers: a mixed longitudinal study covering 25 years. J Prosthet Dent 1972;27(2):120-132.
13. Winkler S. Essentials of complete denture prosthodontics. 2nd edition. Ishiyaku Euro- American: USA;1996, p 88-106
14. Mac Gregor AR. Fenn, Liddelow and Gimson's Clinical Dental Prosthetics. 3rd ed. Wright, Butterworth:Oxford; 1994. p. 43-77.
15. Neill DJ and Nairn RI. Complete Denture Prosthetics. 3 rd ed. Wright: London;1990.p. 25
16. Rahn AO, Heartwell CM. Text book of complete dentures. 5th ed. Elsevier Science: India;2002. p. 221-47.
17. Sharry JJ. Complete denture prosthodontics. 3rd ed. Blakiston: USA;1974. p. 191-210.
18. Bernard L. Impressions for complete dentures. Quintessence: Chicago; 1984.p.71-90
19. Halperin, Graser, Rogoff, Plekavich. Mastering the art of complete dentures. Quintessence: Chicago;1988. p. 43-51.
20. Shetty S, Nag PV, Shenoy KK. The selective pressure maxillary impression: A review of the techniques and presentation of an alternate custom tray design. J Indian Prosthodont Soc 2007;7:8-11
21. Kaur H, Nanda A, Verma M, Koli D. Technique for adapting a spacer for a custom impression tray. J Prosthet Dent 2016;116(6):851-852
22. Patil MS and Patil SB. Geriatric patient - psychological and emotional considerations during dental treatment. Gerodontology 2009; 26: 72-77.
23. DeVan MM. The nature of the partial denture foundation: suggestions for its preservation. J Prosthet Dent 1952;2:210-218
24. Frank RP. Analysis of pressures produced during maxillary edentulous impression procedures. J Prosthet Dent 1969;22:400-413.
25. Crawford RW, Walmsley AD. A review of prosthodontic management of fibrous ridges. Br Dent J 2005;199:715–719.