

Oral Anatomy Related to Impression Making for Complete Dentures

C. de Baat¹, M.A.J. van Waas²

1. Department of Oral Function and Prosthetic Dentistry, Radbouduniversity medical center, P.O. Box 9101, 6500 HB Nijmegen, The Netherlands.
2. Department of Oral Function, Academic Centre for Dentistry Amsterdam, Gustav Mahlerlaan 3014, 1081 LA Amsterdam, The Netherlands.

Correspondence: Professor Dr. Cees de Baat. Email: cees.debaat@radboudumc.nl

ABSTRACT

Making an impression of the edentulous maxillary and mandibular residual alveolar ridge is an important part of fabricating removable complete dentures, because the proper functioning of the dentures is partially dependent on the volume and shape of the residual alveolar ridges and the surrounding soft tissues, in particular the muscles. Before an impression is made, an insight into the anatomy of the edentulous maxilla and mandible as well as of the soft oral tissues is essential. A 5-phase approach for impression making has been introduced, containing guidelines for consecutively making the preliminary impressions, fabricating the preliminary casts and the individual impression trays, making the individual impressions, and fabricating the master casts. In each phase, the concern is to achieve the best possible stability of the removable complete dentures. Adequate stability can only be achieved by developing the functional borders of the dentures adequately.

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Introduction

Making impressions of the edentulous maxillary and mandibular residual alveolar ridge is one of the most difficult components of fabricating removable complete dentures, because developing the functional borders of the future dentures in the oral cavity needs accurate attention. In case the flanges of the future dentures are too short, the dentures lack stability and retention on the residual alveolar ridges during functional movements of the orofacial muscles. In case the flanges of the future dentures are too long, the dentures will dislodge because the orofacial muscles will remove them from the residual alveolar ridges. In other words, both the under-extended and over-extended denture flanges are problematic. In many text books on removable complete dentures, developing the functional borders is recommended to solve this problem. Developing the functional borders through border moulding is carried out after shortening the flanges of the individual impression trays approximately 2 mm from the expected final length of the flanges of the future complete dentures. Subsequently, a heat-

softened thermoplastic impression compound is put on the borders of the individual impression trays and the patient is requested to make functional orofacial movements, supported by muscle moulding by the dentist, until the optimal border position at unimpaired function has been obtained. This method requires accuracy and some experience. If the thermoplastic impression compound has not been softened sufficiently, it is not plastic in the oral cavity and if it has been heated too much, it flows off or even damages the oral mucosal tissues. Moreover, a large individual difference exists in the intensity of functional orofacial movements which people can make. The only method to reach a good result is to use the anatomy of the oral cavity as the basis for assessing the correct flange borders of the future removable complete dentures. To fabricate a complete denture which stays stable in position in the oral cavity during movements of the mandible, the lips and the cheeks, the strengths of the orofacial muscles applied to the removable complete denture have to be considered. This aspect is important in case a residual alveolar ridge is not atrophic, but it

becomes essential in case of an atrophic residual alveolar ridge.

This article presents a 5-phase approach for the procedure of making an impression of edentulous, whether or not atrophic, residual maxillary and mandibular alveolar ridges, taking into consideration the anatomy of the maxilla and the mandible as well as the functions of the orofacial muscles which will interfere with the future removable complete dentures.

5-Phase approach

The procedure of making impressions of edentulous residual alveolar ridges comprises of 5 phases: preliminary impressions, preliminary casts, individual impression trays, individual impressions, and master casts. A shortcoming somewhere in the 5-phase approach has consequences for the next phase(s), leading to removable complete dentures with insufficient stability and retention.

Phase 1: Preliminary impressions

The quality of a preliminary impression is highly dependent on the correct size of the confection (stock) impression tray used. A set of anatomically-shaped confection impression trays is needed to select the optimal tray from the set. When using a tray of such set, one should realise that the design

has mostly been based on the width of edentulous residual alveolar ridges and not on their height. This means that in case of an atrophic residual alveolar ridge, the confection impression tray should not be pushed downwards onto the ridge. The confection impression tray should be positioned somewhat above the residual alveolar ridge (Figure 1). Due to the relatively large space between impression tray and residual alveolar ridge which must be filled up with impression material, a rigid impression material, preferable an alginate, must be used. This can be reached by adapting the ratio of powder to water of the alginate. In case of an extreme atrophic residual alveolar ridge, a ratio of 3:2 is recommended. Moreover, correct positioning of the impression tray is essential, namely centrally above the residual alveolar ridge. The impression is made with an excessive mass of alginate. Generally, making an impression of the mandibular residual alveolar ridge is more complicated than making an impression of the maxillary residual alveolar ridge. After the preliminary positioning of the impression tray in the mandible, the patient is requested to put his tongue on top of the impression tray and subsequently the impression tray is positioned correctly between the tongue and the residual alveolar ridge (Figure 1). Then, functional movements are incorporated into the tray borders by the dentist, manipulating the cheeks and the lip (muscle moulding).

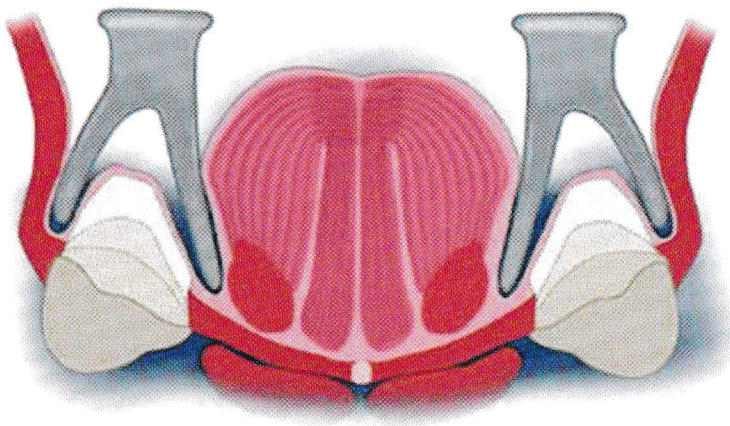


Figure 1: Schematic display of the position of the confection impression tray in relation to the residual mandibular alveolar ridge, the cheeks, and the tongue, independent of the degree of alveolar bone resorption.

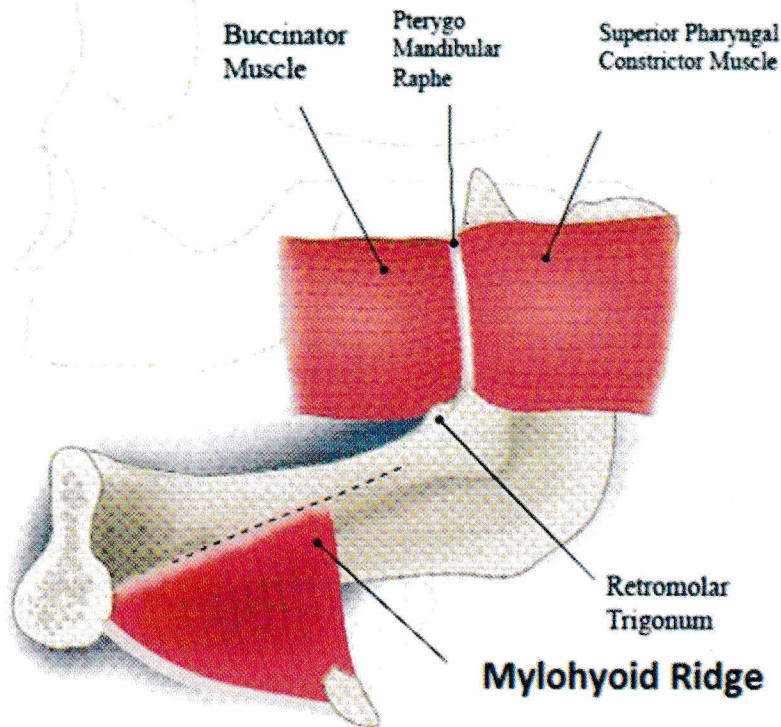


Figure 2: Schematic display of the lingual side of the right mandible. The pterygo-mandibular fold functions ventrally as attachment for the buccinator muscle and dorsally as attachment for the pharyngeal constrictor muscle. The border of the pterygo-mandibular fold reaches caudally until the retromolar pad or somewhat lingually of the retromolar pad. The mylohyoid muscle attaches to the mylohyoid line, in the anterior region somewhat cranially of the caudal border of the mandible and from this point in cranial direction until the retromolar pad.

Phase 2: Preliminary casts

To be able to fabricate adequate individualized impression trays, the preliminary casts must be studied in relation to the anatomy of the maxilla and the mandible. Subsequently, the intended flange borders of the future removable complete dentures are recorded on the preliminary casts, using a sharp pencil.

Preliminary maxillary cast:

Dorsally to the maxillary tuberosity, the pterygomaxillary fissure is situated, dorsally limited by the pterygomaxillary or hamular notch. The pterygomandibular fold connects the hamular notch to the retromolar pad of the mandible and functions

as attachment for the buccinators as well as the pharyngeal constrictor muscle (Figure 2)

For the posterior flange border of the future maxillary denture, the pterygo-mandibular fold is important because it indicates the position of the pterygo-maxillary fissure. Dorsally at both sides, the denture is extended until the deepest point of the pterygo-maxillary fissure and forms the posterior border of the denture directly dorsally to the maxillary tuberosities. When the posterior border of the denture extends beyond the pterygo-maxillary fissure, the denture will dislodge while opening the mouth extremely through tightening the buccinator muscle at the attachment to the pterygo-mandibular fold.

It is more difficult to assess the posterior border of the future maxillary denture between the two maxillary tuberosities. Two key anatomical structures are available. The first one is at the junction between the hard to the soft palate, the vibrating line. The hard palate is a part of the maxilla, usually the bone is ending dorsally with an angle perpendicular to the caudal surface, but the angle may also be oblique with the cranial border of the palatal bone somewhat more dorsally than the caudal border. When available, this minor dorsal 'lengthening' of the hard palate can be used as additional base for the future removable maxillary denture. The not bone-supported soft palate is part of the posterior boundary of the oral cavity. It is mobile and its movements are essential when swallowing and speaking. The junction between the hard to the soft palate becomes slightly visible when a patient says "ah" when the oral cavity is open. When saying "ah", the soft palate is moving cranially. It is possible to locate the junction somewhat more clearly when a patient is requested to exhale or to blow his nose strongly while the oral cavity is open and the nose is pinched. In those cases, the soft palate is bulged out into the caudal direction. A second key anatomical structures..... to assess the posterior border of the future complete maxillary denture are the palatine foveas, small depressions on the hard palate near the junction between the hard and soft palates, left and right of the median palatine suture. These structures are rudimentary ducts of salivary glands. They are frequently directly visible in the oral cavity and mostly also in the preliminary impression and on the preliminary cast.

The next boundary which should be assessed for a good function of the future removable maxillary denture is the dorso-buccal flange. Between the maxillary tuberosity and the mandibular ramus, a transversal niche is located which provides space to enable the mandible to make movements. The future removable maxillary denture can be extended into this space to cover the maxilla until its vestibular sulcus, because no muscle attachments, which could dislodge the removable denture, are present in this space. However, It is a pertinent prerequisite that the

dorso-buccal flange of the denture is thin to prevent contact with the mandibular ramus when the mandible is moving. In case the mandibular ramus touches the removable maxillary denture while moving, the denture will dislodge.

More ventrally, in the buccal premolar region, the buccal frenum is situated. It is a vertical ligament of oral mucosa connecting the residual alveolar ridge to the modiolus in the cheek. The modiolus is a point distal to the corner of the mouth where several muscles converge. Among others, the buccinator muscle and the orbicularis oris muscle meet in the modiolus (Figure 3). When speaking, laughing and singing, the modiolus as well as the buccal frenum are active and moving continuously. In case the border of the removable maxillary denture is extended until the moving buccal frenum, the denture will dislodge continuously during oral functions, such as speaking, laughing and singing.

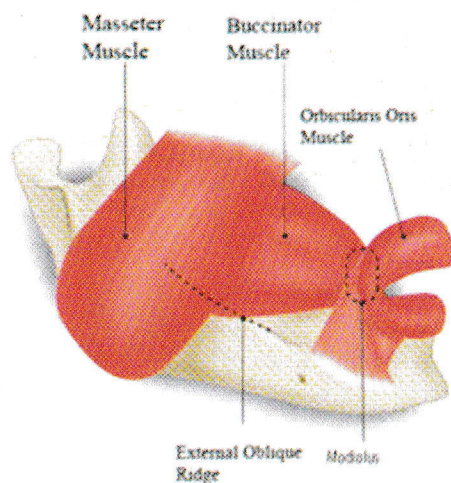


Figure 3: Schematic display of the buccal side of the right mandible. Muscles attaching to the modiolus are the buccinator muscle and the orbicular oris muscle. The masseter muscle is located buccally of the buccinator muscle.

The labial vestibular sulcus can be used entirely for extension of the removable maxillary denture because no muscles are interfering in this region. Only at the central labial frenum, enough space must

be created for movements of the upper lip. The thickness of the denture flange border in the labial vestibular sulcus is, among other factors, determined by the degree of alveolar bone resorption. The higher the degree of alveolar bone resorption, the more thick the denture flange border has to be to provide an aesthetically and functionally good support for the upper lip.

Preliminary mandibularcast

The study of the preliminary cast of the edentulous mandible starts at the retromolar pad. When observed from ventral to dorsal aspect, first the retromolar pad is supported by bone and then a mobile mucosal part can be detected, finishing at the caudal border of the pterygo-mandibular fold. The posterior border of a removable mandibular denture must be located exactly at the end of the bone-supported part of the retromolar pad.

Buccally of the retromolar pad, directly laterally of the thin buccinator muscle, the masseter muscle is located. The masseter muscle is attached to the buccal side of the body of the mandible as well as to the zygomatic arch (Figure 3). A removable mandibular complete denture must leave sufficient space for the masseter muscle to function adequately. If not, pain and a traumatic ulcer will arise during mastication. Somewhat ventrally of the retromolar pad, in the vestibule of the oral cavity, the buccinator muscle can be found, which extends horizontally from the pterygo-mandibular fold to the modiolus (Figure 2-3). When this muscle tightens, it pushes the removable mandibular complete denture downwards to the residual alveolar ridge, enhancing the stability of this denture. This property can be exploited by extending the flange of the denture tight to or somewhat below the buccinator muscle until the external oblique line, where the buccinator muscle attaches the mandible. In case of an atrophic residual alveolar ridge, it is rather easy to palpate the external oblique line and in some cases this line is visible on the preliminary cast.

Any further ventrally, the buccal frenum can be seen. Similar to the maxilla, a ligament of oral mucosa is connecting the buccal frenum with the modiolus.

Sometimes, the buccal frenum is dominantly present, sometimes it is hardly visible, particularly in older people. A removable complete mandibular denture should offer sufficient space for the functional movements of the buccal frenum.

The mental foramen is situated buccally at the body of the mandible, but in case of an extreme atrophic residual alveolar ridge it is situated at the cranial side. Through this foramen, the mental artery, the mental vein as well as the mental nerve pass from the mandibular canal to the lower lip region. The mental nerve is a branch of the inferior alveolar nerve. When a removable mandibular complete denture touches the cranially of the mandible exposed mental or inferior alveolar nerve during function, a short stab of pain will occur. To prevent this unpleasant experience, the mandibular complete denture needs maximal stability and correct occlusion and articulation. In most cases, providing some space in the denture around the mental foramen is not an adequate solution because this solution reduces the retention of the denture.

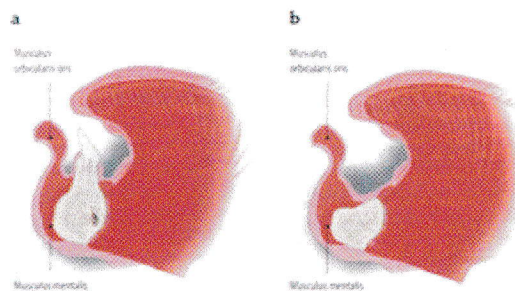


Figure 4: Schematic display of the midline of the mandible. In a dentate mandible, the mental muscle is situated at the labial part of the mandible (a). In an edentulous mandible with an atrophic residual alveolar ridge, the position of the mental muscle has moved to the cranial side of the mandible (b).

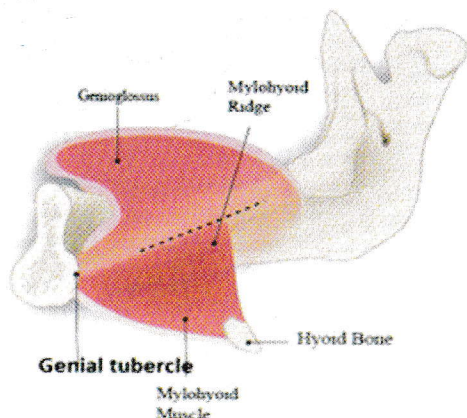


Figure 5: Schematic display of the lingual side of the left mandible showing the position of the genial tubercle, the genioglossus muscle, and the mylohyoid muscle which attaches at the mylohyoid ridge and the hyoid bone.

Lingually, the flange of a removable complete denture can be extended until the genial tubercle, the attachment of the genioglossus muscle (Figure 5). The genioglossus muscle can move the tongue ventrally and caudally. In case of atrophy of the residual alveolar ridge, the genial tubercle is very pronounced (Figure 6).

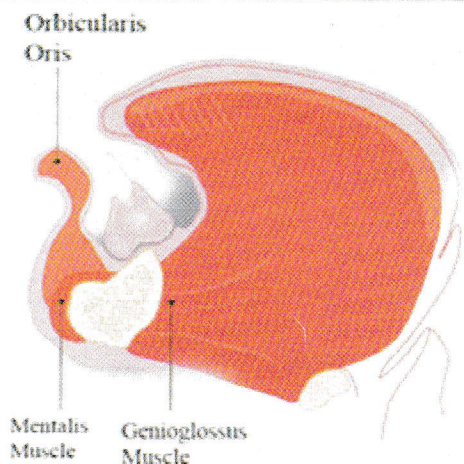


Figure 6: Schematic display of the lingual side of the left mandible with a pronounced mental spine.

More dorsally at the lingual side of the mandible, the mylohyoid muscle is shaping the floor of the oral cavity, which is extending horizontally in the anterior region and almost vertically in the posterior region (Figure 5). This anatomical structure is similar to the course of the mylohyoid line, in the anterior region somewhat cranially of the caudal border of the mandible, directly below the genial tubercle, and from this point in cranial direction until the retromolar pad, almost until the former plane of occlusion. At the other side, the mylohyoid muscle attaches to the hyoid bone, which is located centrally, posteriorly and caudally of the mandible. As a consequence, the tightened mylohyoid muscle has a somewhat vertical position posteriorly, approximately 60 degrees to the horizontal plane. In the anterior region, the lingual flange of a removable complete denture should be extended just cranially of the mylohyoid line and in the posterior region it can be extended just caudally of the mylohyoid line. The combination of denture flanges just below the buccinator muscles buccally and denture flanges below the tongue lingually improves the stability of a removable mandibular complete denture (Figure 7). By checking whether a removable mandibular denture dislodges when the patient is moving his tongue along the upper lip, the correct length of the lingual flanges can be assessed. When the denture stays at its position, the lengths of the lingual flanges are correct. In case of severe atrophy of the residual alveolar ridge, the floor of the oral cavity may be so much pronounced that it is not possible to extend a part of the lingual flanges beyond the mylohyoid lines.

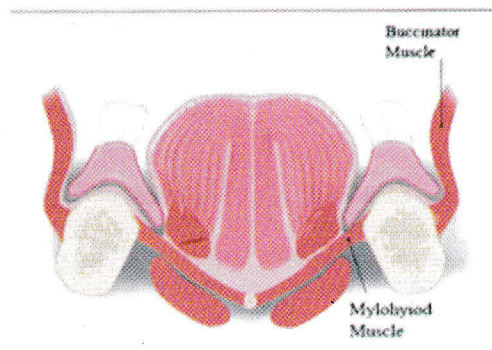


Figure 7: Schematic display of a transversal plane of the mandible and the tongue with a removable complete denture with buccal denture flanges just below the buccinator muscles and lingual denture flanges below the tongue.

border recordings of the preliminary cast should be similar at both sides. In some cases, the anatomical structure is much clearer at one side and in those cases one may copy the border recording from the clear side to the less clear side.

Phase 3: Individual impression trays

On the basis of the flange border recordings on the preliminary casts, which correspond to the anatomy of the residual alveolar ridges, individual impression trays can be fabricated. An individual impression tray is fabricated from strong and not deforming light- or self-curing acrylic and the borders are approximately 2 mm thick. Around each buccal frenum, the border is 1 mm thick and in the posterior mental spine area the border may be 3 mm thick. The posterior border of the maxillary tray must be thinner than 1 mm and must have an angle of 45 degrees to the hard palate.

The acrylic baseplate is on top equipped with a rim of wax or acrylic at the position of the original teeth. This rim has 3 functions:

1. When checking and handling the individual impression tray in the oral cavity, it supports the lip and the cheeks.
2. While making the individual impression, it serves to position the individual impression tray manually and to keep it in position to load the entire mucosal membrane equally and constantly.
3. It serves as a handle when taking the impression tray with impression from the oral cavity.

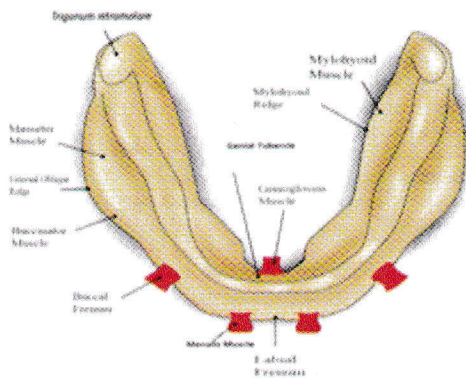


Figure 8: Important anatomical landmarks for extension of flanges of a removable mandibular complete denture.

Finally, the space at the posterior lingual level of the retromolar pad needs attention. This space undercuts the retromolar pad, inviting to be used for retention of a removable complete denture. However, a disadvantage of using this undercut is that a somewhat too much extended dorso-lingual denture flange will cause immediately a traumatic ulcer and pain while swallowing. Therefore, it makes sense to design the denture flange in this region more fluently.

Figure 8 shows the anatomical structures which are important to assess the borders of the flanges of a removable complete mandibular denture. Maximal surface coverage by the removable complete denture without disturbing its function is the challenging pursuit. Generally, the anatomy at the right and left side of the mandible is similar. Consequently, the

A plastic or metal handle instead of a wax or acrylic rim is not practical, because it disturbs the position of the lip and hampers loading the mucosal membrane equally while making the impression.

Phase 4: Individual impressions

The flange borders of the individual impression trays are assessed in the oral cavity by requesting the patient to make functional oral movements. Special attention is paid to the posterior border of the maxillary individual impression tray through requesting the patient to say "ah" with opened mouth and by checking the position of the border in relation to the palatine foveas. Finally, the fit and the flange borders are checked, using an easy to remove silicone based soft lining material (Fit Checker®, GC, Co, Japan).

When the flanges of the individual impression tray are correct initially, the final borders can be assessed, using a low-fusing thermoplastic impression compound. A small quantity of heated soft thermoplastic impression compound is introduced to the flanges of the individual impression tray concerning an area of less than 3 cm length each time. Subsequently, the individual impression tray is put into the oral cavity and the patient is requested to make functional orofacial movements with the lip, the tongue and the cheeks, supported by muscle trimming by the dentist. After assessing the final flange borders, the individual impression can be made using a thin silicone impression material and pushing the individual impression tray firmly into the correct position.

Phase 5: Individual casts

With respect to the individual casts, it is essential that the carefully assessed flange borders of the individual impression trays are reflected correctly with a raised peripheral border wall laterally. When this wall is lacking, all efforts of border assessment will have been in vain.

Epilogue

Without thorough knowledge of the oral anatomy, it is impossible to assess the correct flange borders of removable complete dentures.

The term stability has been used frequently in this article, in contrast to the term retention. That is not occasional because the stability of a removable complete denture is more important than its retention. Without adequate stability, (optimal) retention is not possible. A prerequisite for stability is molding the flange borders correctly.

Suggested reading list / References

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