IMPRESSION TECHNIQUES FOR
FULL DENTURES.

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Contents.

Introduction..................................................page 1
A Brief History of the Development of Impression Techniques..............................page 3
Anatomical and physiological Factors of Importance in the Consideration of Impression Techniques..................page 11
Important Landmarks.............................................page 23
Preservation of the Remaining Tissues..................................page 25
Factors Contributing Toward Retention in Impressions..............................page 28
Materials-A Brief Survey of Impression Materials............................page 33
Impression Techniques................................................page 39
Problems in Impression Procedures........................................page 83
Specific Indication for Particular Impression Techniques.............................page 87
Possible Future Developments in Impression Techniques...........................page 90
Conclusion...............................................................page 92
Bibliography..............................................................page 93
Introduction.

"Thus, when there is a depression, there must be an elevation on the surface in proportion to lodge in the depression and reciprocally a depression on the surface of the denture to fit an elevation on the gum."

Fauchard 1746.

The production of satisfactory impressions is only one of many stages in the construction of full dentures. The impression procedures are dependent upon the results of a careful clinical and radiographic examination of the mouth and jaws, and upon an appreciation of the biological and physiological problems of each patient. These problems may be complicated by pathological conditions of the mouth of either local or systemic origin.

The provision of functional and stable dentures for an edentulous patient is dependent largely on the occlusion and retention of these dentures.

The retention of dentures is directly related to the conformity of the denture bases with the tissues of the mouth, and this conformity depends entirely on the accuracy with which the impression technique reproduces the detail of the predetermined oral tissues, which provide the foundation for the denture. During the registration of the surface contours of the tissues the physiological and anatomical limits of these tissues must not be exceeded.
This review describes and evaluates the various techniques used in the construction of full dentures. It also traces the historical development of these techniques and discusses the anatomical, physiological, and physical principles upon which the evaluation of the techniques is based.
A Brief History of the Development of Impression Techniques

Examples of partial denture construction by the Etruscans are described by Bremner (1) and the oldest examples are generally considered to be about 2,500 years old. The retention of these appliances by wires, ligatures, or bands does not seem to have been a great problem, although the object behind their construction was obviously the restoration of appearance rather than function.

It is significant therefore that a description or example of full denture construction does not occur until 1685. In that year Anton Nuck (2) of Leyden describes briefly the construction of a full lower denture from a piece of hippopotamus tusk. It is inferred from his writings that full upper dentures were not often constructed because of difficulties of retention.

However, considerable progress seems to have been made during the next fifty years. Pierre Fauchard (3) in 1746 gave a very complete description of the construction of full upper and lower dentures. These dentures were carved laboriously by hand from blocks of ivory or bone. They were retained in place by springs. Fauchard did appreciate the fact that the denture base should be a negative reproduction of the residual alveolar ridges, but had neither impression nor model to help him. His main contribution seems to have been the use of steel springs to retain the dentures. From his writings it is gathered that, prior to his time, springs of whale bone were commonly used.
In 1756 Platt (4) devised an impression method using wax sections. He also made a bite recording, and constructed plaster models from his impressions.

Gardette (5) was probably the first to appreciate the value of atmospheric pressure as an adjunct to the retention of full dentures. He is claimed to have been aware of this factor as early as 1780 but can be authenticated no earlier than 1800.

Weingerger's (6) account and illustrations of Washington's various dentures are especially interesting. The dentures themselves are still in a good state of preservation and many documents concerning their construction have managed to avoid destruction. The dentures themselves are crude in construction and are similar to those described by Fauchard (3). Retention was by means of spiral springs and scant attention has been paid to the anatomy of the mouth. They probably give a reasonably clear picture of the type of work carried out between 1780 and 1800.

The introduction of metal impression trays by Kneisel (7) in 1836 was of considerable benefit to the technique of impression taking.

In spite of the fact that plaster models could be produced, dentures were constructed in much the same manner as Fauchard (3) had done. The plaster was used merely as a guide while carving the denture base. This state of affairs continued until about 1830 when the model was used as a basis for constructing a metal die for swaging a gold base.

Westcott (8) claimed that his partner and himself were the first to use plaster as an impression material in 1844.
Plaster was used in desperation in an attempt to obtain an impression from a patient whose oral tissues were easily distorted. He also points out the difficulty of removing wax impressions without distorting them.

The appearance of Gutta-percha as an impression material in 1848 and the invention of modelling compound by Stent (9) in 1856 gave the practitioner of the day a wider range of materials from which to choose.

Vulcanite, as a material for denture construction, came into use about this time and consequently the interest of the dental profession in denture construction greatly increased. Impression techniques remained crude for many years. Most operators seem to have been content to obtain merely a negative imprint of the tissues of the mouth. Distortion of the impression caused little concern. The anatomy and physiology of the tissues involved were ignored.

By 1870 Westcott (8) had further developed his plaster technique. His procedure was to begin with a preliminary impression in wax in a metal impression tray. From the tissue surface of this wax impression he removed, by scraping, a layer of wax $\frac{3}{8}$ to $\frac{1}{4}$" in thickness except for a strip across the posterior border or retro-molar region and a small area in the region of the incisive papilla or midline crest of mandibular ridge. An individual impression tray was thus created and was held at a fixed distance from the tissues by anterior and posterior "stop". The tray was then loaded with a thin mix of accelerated plaster of Paris, care being taken to avoid a surplus of this material. It was seated in the mouth with a vibratory motion, posterior contact being made first. He stressed the fact that the plaster of Paris must be thin and that the tray
must be seated before the initial set of the plaster had begun. Westcott's technique is of particular interest as it is very similar to techniques advocated more than seventy years later. Westcott was obviously trying to avoid a technique which resulted in displacing forces and discomfort by the use of a suitably adapted impression tray and an impression material that caused a minimum of tissue distortion. His work will be further considered in connection with later workers.

In 1873 Oakley Coles (10) gave quite a detailed description of the impression techniques then in use. He described techniques using wax, plaster of Paris, and impression compound.

Using wax, he placed softened beeswax in a suitable tray level with the free border of the tray. The tray and wax were then placed in hot water until ready to be placed in the mouth. The patient was instructed to rinse the mouth with cold water and the tray and wax inserted in the mouth and seated firmly and evenly. Any unsupported wax around the margins of the tray is moulded against the tissues. The impression was released by pulling back the cheek to allow air around the periphery. Cold water was then poured over it and it was removed.

The impression compound technique was similar to that for wax and he considered its greatest value to be its hardness when cold.

The technique for plaster of Paris was less exacting. The impression tray merely filled with a creamy mix of plaster and inserted in the mouth. The posterior border was seated first in order to bring the surplus impression material to the anterior part of the mouth.
Coles' book is devoid of any consideration of the anatomy of the mouth or the areas to be covered by the denture base. It goes no further than stating that: "If the gums are edentulous they should be firm and insensible to slight irritation, and it is, above all things, important that there should be a normal condition of the salivary and mucous glands."

There is evidence that Coles did have a vague appreciation of the value of peripheral adaption in an impression. His description of adapting the unsupported borders of his impression, his belief that spiral springs no longer were necessary to retain dentures, and his instructions for stimulation of the flow of saliva with carbolic acid and glycerine are signs of the early beginnings of modern techniques.

Almost ten years later correspondence by Tod (11) and Stewart (12), concerning the difficulties in the attachment of spiral springs to denture bases, is an indication that the retentive impression was by no means universally known.

There were signs however, that considerable interest was being taken in obtaining retention at the impression stage. In 1882 Parson (13) was emphatic that firmness of adhesion was due to accuracy of the fit of the base against the bearing tissues. He asserted that, if the dentures fitted accurately, vacuum chambers and springs were completely unnecessary.

Wilson (14) in 1886 suggested that "hard" areas be mapped out and scraped away on the impression and the "soft" areas be scraped away on the model. This was apparently a rather crude method of providing relief and peripheral seal areas.
That the factors, contributing to the retention of dentures, were beginning to receive attention is seen in the writings of Hepburn (15), who claimed that retention of dentures was due to the capillary action of the saliva film between the tissues and the denture base. He drew a parallel between retention of dentures and the attraction between two glass slabs which adhere strongly, even in a vacuum, if there is a film of moisture between the two adjacent surfaces.

Observations, such as this, gradually caused the realisation that the accurate reproduction of the surface detail of the tissues was essential. Techniques with retention as their main object slowly began to evolve.

The method of Melotte (16), reported in 1889, was an interesting attempt to obtain both peripheral seal and surface detail. His technique was to load an impression tray with softened wax and immediately cover this with a thin mix of plaster of Paris. The tray was then placed in the mouth and seated firmly in position. The wax was supposed to ensure correct extension of the borders of the impression and the plaster to provide the surface detail. It is probable that most of these impressions were overextended and caused undesirable tissue displacement. Distortion, during removal, would also have been difficult to avoid.

In 1890 Bryan (17) suggested the use of Gum Tragacanth as a method of retaining dentures, not only when first inserted but for continued use. While this suggestion appears ridiculous to-day, the fact that it was published in a reputable professional journal is evidence of the interest of the problem of retention of dentures.
Storer-How (18), in 1895, advocated a method of obtaining peripheral seal. The estimated periphery of the completed denture was outlined on the model and a groove scraped into the plaster around this outline. This resulted in a beading being reproduced in the periphery completed denture. There was little science in the method adopted, although in many cases it probably secured excellent retention for a period.

Pearsall (19), while in 1895, remaining faithful to springs as a method of retention, did point out that plaster of Paris reproduced the "grooves of the muscles" well if the patient alternately opened and shut the mouth while the plaster was setting; and that dentures constructed from such impressions, were said to be more comfortable than if other methods had been used.

The early history, in the development of impression techniques, may be considered to have ended about this period. The beginning of the Twentieth Century saw a great change in techniques. A realization that anatomy and function were basic considerations for impression techniques obviously brought about this change.

It is noteworthy that, in almost all these early techniques, any attempt at securing retention in a denture was brought about by mechanical modification of the impression, the resulting model, or the denture base. From the time it was realized that atmospheric pressure played a part in the retention of dentures attempts were made to harness and utilize its power. "Vacuum chambers" in the vaults of dentures were advocated from 1835 until well into the present era, although it must be admitted that most authoritative authors of this period doubted the value of these devices.
It is also striking that, during this period, it was the maxillary impression and denture that caused the greatest concern. Very much more space is devoted in the literature to the edentulous maxilla than to the edentulous mandible and its problems.
Anatomical and Physiological Factors of Importance in the Consideration of Impression Techniques.

Schlosser (20) has stated: "I demand a full compliance with the physiological requirements, not only of the tissues and structures involved in the support and retention of the dentures, but also of all the associated structures attached to the maxilla and mandible. This applies particularly to the muscles and ligaments that propel or restrict the mandible in movements of speech, mastication, and facial expression."

The tissues and structures, to which he refers, may be considered from two main aspects.

(1) Those which are concerned primarily with support and the absorption and dispersal of the forces of mastication.

(2) Those which limit the area of tissue surface covered by the denture.

The supporting tissues consist of

(1) Oral mucous membrane which covers the residual alveolar ridges and hard palate. It enmeshes vessels and nerves in its submucosa.

(2) Underlying osseous structures.

In the detailed study of these tissues the work of Pendleton (21) is of the utmost value. A study of his work reveals the following facts.

The Oral Mucous Membrane.
The oral mucous membrane consists of two distinct parts.

(1) Superficial covering of epithelium of the
stratified squamous type.

(2) Underlying fibrous connective tissue, which supports the epithelium and varies in type and thickness in various parts of the mouth. It also varies from person to person. Its fibres run parallel to the surface.

In the lips and cheeks this connective tissue is of a much looser character than that found in the vault of the maxilla and on the residual alveolar ridges. In these latter situations it is, as a rule, thick and dense.

This dense connective tissue is distributed in the following way. In the vault of the palate it is more dense in those regions anterior to the first molar. It covers the residual alveolar ridges of both maxilla and mandible except at their posterior extremities, which are distinguished by the tuberosities of the maxilla and the retro-molar papillae of the mandible. Behind these landmarks loose connective tissue is found.

On the buccal and labial surfaces of the ridges of the maxilla and mandible the connective tissue is somewhat less dense than that found on the crests.

A band of dense tissue extends in the maxilla, from the crest near the incisive papilla, along the hard and soft palates to the uvula.

Loose Connective Tissue.

Loose connective tissue is found at the outer borders of the residual alveolar ridges wherever there is a physiological need for elasticity. It is also found above and below the muscles that form the lips and cheeks and in the velum palati.
In the mandible it is found surrounding the structures of the floor of the mouth. It also is found supporting the labial and buccal tissues, and in the maxilla it subdivides and supports the adipose tissue in the vault of the palate.

**Adipose Tissue.**

Adipose tissue is found in the hard palate. It lies in two symmetrical fields on either side of the ridge of the intermaxillary suture. These fields extend laterally to the base of the residual alveolar ridges. They extend from the incisive foramen to a plane in the region of the first molar tooth. In the region posterior to this plane the adipose tissue becomes less abundant and mucous glands replace it in the lining of the soft palate.

A considerable amount is found in the lower jaw in the areolar tissues adjacent to the musculature and the glandular structures. This is particularly so in the floor of the mouth, although the amount is extremely variable.

**Osseous Structures.**

The structural framework of the maxillae and palatine bones is dense. Its inner and inferior surfaces show the most compact forms. The outer and superior surfaces are of a lighter nature. This characteristic is found in the bony structure of the maxilla and mandible, except in the posterior region of the mandible where the development of the external oblique ridge gives rise to bone of a very dense nature.

Except in cases of greatly protracted re sorption, the residual ridges of the maxilla and mandible are massive bony structures. Considerable variation is seen in different individuals.
In the maxilla there is a dense palatine plate, and a thinner buccal plate which is supported by bone of a compact nature. The central portion is bone of the cancellous type.

There appears to be much variation in the density of the cancellous bone in different persons. In specimens from persons in middle life the framework is quite compact, while from those of a more advanced age the trabeculae are thin, and there is a great increase in size of the marrow spaces.

A similar process occurs in the palatine process. Here however, the least atrophic changes occur.

The union of the maxillae is marked by an irregular development of bone. This development is sometimes so great that it assumes the proportion of an osseous tumour. It usually extends from the cuspid plane to a plane in the region of the second molars.

A similar [exostosis] is often found singly or bilaterally on the inner surface of the mandible. Thoma (22) describes these as [bony] protuberances having an extremely thick cortex surrounding a spongiosa, and developing in later life for an unknown reason.

**Labial and Buccal Border Musculature.**

In considering in detail those structures which define the borders of an impression it is most helpful to examine further work of Pendleton (23). His careful dissections of the structure of the mouth have been carried out solely to determine their relationship to full denture construction.

He found that the muscles of the mouth, which belong to the facial system, usually have an osseous origin and cutaneous insertion. There are however, exceptions to this:—both origin
and insertion may be cutaneous, as is seen with the obicularis oris, or they may be osseous and aponeurotic as is seen with the buccinator.

The dissections indicate that the obicularis oris assisted by the caninus and triangularis probably have the greatest influence in the problem of denture construction.

The osseous origin of the facial muscles, affecting the labio-buccal borders of an impression is restricted. Their clinical significance is limited by the relation of the muscle bundles to the periphery of the impression itself. The potential force of their action is great, but is nevertheless minimised by the presence of large areas, padded with adipose connective tissue, which are free from muscle attachments. These muscle free areas act as buffers and aid in the resisting of forces which would otherwise affect the stability of a denture.

Pendleton's (23) work reveals the interesting fact that the buccinator is the muscle which is primarily concerned with labio-buccal borders of the impressions. Only in cases of extreme resorption do the incisive and depressor nasi muscles usually have fibres close to the denture border. Swensen (24) does, however, point out that the anterior border of the masseter muscle limits the disto-buccal extension of the mandibular extension.

MacMillan (25) draws attention to the fact that the muscle attachments of the edentulous patient are very different from those of the person with a natural dentition.

He states that the attachments of the buccinator muscle
may extend, in both maxilla and mandible, almost to the crest of the ridge and that the buccal flanges of a denture must rest upon mobile muscle tissue instead of stable muco-periosteum. Swensen (24) has pointed out that the situation may be further complicated by the inferior border of the zygomatic process which often comes into contact with the denture border. In these cases the muco-periosteum in this region is usually firm and unyielding.

In a similar manner fibres of the mylohyoid muscle often extend for several millimetres above the mylohyoid line and may extend as far as the crest of the ridge. In cases of extreme resorption of bone there may be only a narrow space along the crest of the ridge which is free of muscle fibres.

**Soft Palate.**

Pendleton (23) agrees with MacMillan and in his consideration of the soft palate maintains that the adaption of the posterior palatine border of the maxillary impression is fundamentally the same as other peripheral contacts, although the tissues themselves are very different in their characteristics.

The muscles affecting the movements of the soft palate are, for the most part, far removed from their bony attachments. There are two exceptions to this — the uvula muscle, arising from the posterior nasal spine, and the palato-pharangeus which is attached to the palatine aponeurosis on either side of the uvula muscle. The area of these attachments extends approximately 4 millimetres on either side of the mid-line.

The palatine aponeurosis supporting the soft palate is a tough flexible collagenous structure capable of resisting great pulling forces. The muscle free part of the aponeurosis,
lying between the bone and the muscle bundles, varies in width from one to twelve millimetres. A considerable area, free of direct muscle action, is usually available for posterior adaption.

In extending the posterior border of the impression on the soft palate, it is found that the aponeurosis and submucosa thicken and movement of the tissue increases as the area of contact is increased toward the posterior from the palatine border.

He considers that the establishment of the precise extension of the impression tray is a prerequisite, irrespective of the technique used.

Harris (26) gives a description of Houses' classification of the soft palate. He gives three classes of soft palate.

Class I In which there is a distance of 5 millimetres or more between the distal border of the hard palate and the anterior border of the movable tissues of soft palate.

Class II In which the anterior border of the movable tissues of the soft palate is posterior to the distal border of the hard palate, but the distance between them is less than 5 millimetres.

Class III In which the movable tissues of the soft palate drop down abruptly from the distal border of the hard palate.

The Tongue.

Pendleton (23) believes that the tongue is one of the most potent factors in the retention and stability of dentures; the extrinsic muscles of this organ being of the greatest importance to the Prosthetist.
These extrinsic muscles are the hyoglossus, styloglossus, genioglossus and palatoglossus. These control the action of the tongue and thus influence the movements of the floor of the mouth.

The principal muscle of the tongue is the genioglossus which arises from the genial tubercles of the mandible and has fibres radiating throughout the length of the dorsum of the tongue. Its attachments are, without exception, tendinous and consequently often cause trouble in adapting the impression borders. This is particularly so in cases of extreme resorption. In these cases the form of the genial tubercles may be greatly accentuated.

The styloglossus and hyoglossus are of importance only from the point of view that they are responsible for tongue movements.

The palatoglossus arises at the side of the tongue and passes upward in front of the palatine tonsil. It forms a thin sheath at its insertion into the palatine aponeurosis. Its constrictor action is not of very great clinical importance because it is remote from its field of operation.

**The Sublingual Region.**

This region is that part of the floor of the mouth between the inferior surface of the body of the tongue and the mandible. It is covered with mucous membrane supported by the mylohyoid and geniohyoid muscles. On either side of the frenulum linguæ are the opening of the ducts of the submaxillary and sublingual glands.
The Sublingual Structures.
The sublingual gland, the submaxillary duct and the lingual nerve are the structures of importance from the point of view of impression taking. They are all virtually supported by the mylohyoid muscle. Their presence renders the adaption of the lingual flange of a mandibular impression a critical procedure.

The Retromolar Area.
The retromolar area, together with the retromylohyoid space, is one of the most difficult areas to be considered as tissues of considerable variation of character are found.

The retromolar area is located at the posterior limits of the crest of the body of the mandible at the point where the body and ramus join. The area is ovoid in shape and is characterised by an elevation near its centre known as the retromolar papilla. This area should always be included in the area covered by the impression as it marks the posterior limits of immovable tissue. Anterior to this process the submucosa consists of adipose and glandular tissues and lends itself to post-dam techniques. The submucosa lying to the posterior and to the medial is composed of loose connective tissue which envelops the fibres of the pterygomandibular raphe. The pterygomandibular raphe continues upward and medially from these attachments to the pterygoid hamulus.

The Region of the Superior Constrictor and Internal Pterygoid Muscles.
The superior constrictor muscle arises from the lower third of the pterygoid process and the hamular process from the pterygomandibular raphe, from the posterior fifth of the
mandible and from the side and root of the tongue. The fibres pass backwards and are inserted into the median raphe of the superior constrictor. The lower fibres arch downward and are overlapped by the middle constrictor.

It should be particularly noted that the attachment arising from the mandible is an indirect attachment only. These particular fibres form a membrane which constitutes the floor of the mouth in its postero-lateral areas.

The lower part of the internal pterygoid muscle is intimately related to the posterior border of the mylohyoid but is sharply and distinctly separated from it. Extended insertion of the internal pterygoid muscle is found along the mylohyoid ridge.

The lingual nerve passes between the lower part of the internal pterygoid muscle and the mylohyoid ridge. Here it is near the former position of the third molar tooth. The sublingual division of this nerve passes downward and forward to supply the sublingual gland and mucous membrane. Indiscriminate extension of the lingual flange of a mandible impression may result in a denture which impinges on this nerve.

The Retromylohyoid Space

This area commonly called the "Throat Form Area" is closely connected with the previously described area. MacMillan (25) defines this area as being limited by the reflection of the mucous membrane over the anterior aspect of the glossopalatine muscle, the side of the tongue, the lingual portion of the superior constrictor muscle of the
pharynx, the distal border of the mylohyoid muscle and the floor of the mouth. Harris (27) notes that its size is determined by the functional movement of the palatoglossus muscle and overlying mucous membrane when the tongue is protruded. He also describes Neil's classification of this area. The areas are classified with the tip of the tongue projected just beyond the border of the lower lip.

Class I  There remains a space of \( \frac{3}{8} \)" or more in diameter.

Class II  The space is present but smaller than \( \frac{3}{8} \)".

Class III  The mucous membrane is pulled directly up to the mylohyoid line and the space is obliterated.

**General Considerations.**

Pendleton (23) states that the following points are particularly worthy of note.

1. The tissues of the face and mouth are distributed with great regularity.

2. The denture bearing areas of the mouth are well stocked with elastic tissue which act as buffers.

3. Glandular and fatty tissues are conveniently located at or near the denture border areas. These tissues are ideally suited to contact by the denture borders as they possess an extremely high degree of elasticity. For this reason it is difficult to see the reasoning behind De Van's (28) conclusion that the tissues of the mouth are such that peripheral seal and post-dam seal should be avoided wherever possible.

4. The insertion of \( \text{musculature} \) at or near the denture border influences retention and stability.

5. Collagenous tissues are not suitable to be used as areas of adaptive contacts with the denture border, as they lack the property of elasticity.
(6) A lack of abundance of fatty tissue is of considerable influence in determining the ability of the tissues to cope with the forces of mastication.

(7) The edentulous mouth is usually ideally suited to the wearing of dentures.

(8) All changes of expression under emotional stimuli are caused by contraction of the muscles of the face. Emotional stability is therefore a definite factor to be considered.
Important Landmarks.

Before impressions are taken there are certain definite landmarks to be observed. These are structures whose negative reproduction should appear in the impression or structures limiting the periphery of the denture.

Boucher and Edwards (29) have compiled a list of these structures, which is very helpful. They have also developed a definite terminology for the negative reproduction in the impression of such structures.

<table>
<thead>
<tr>
<th>Maxilla</th>
<th>Maxillary Impression</th>
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<tbody>
<tr>
<td>Anatomical Structure</td>
<td>Corresponding Area in Impression</td>
</tr>
<tr>
<td>Labial frenum</td>
<td>Labial notch</td>
</tr>
<tr>
<td>Buccal frena</td>
<td>Buccal notch</td>
</tr>
<tr>
<td>Maxillary tuberosity</td>
<td>Maxillary tubercular</td>
</tr>
<tr>
<td>Anterior border of Masseter muscle</td>
<td>Masseter groove</td>
</tr>
<tr>
<td>Pterygo-maxillary notch</td>
<td>Pterygo-maxillary post-dam</td>
</tr>
<tr>
<td>Vibrating line</td>
<td>Palatal post-dam</td>
</tr>
<tr>
<td>Incisive papilla</td>
<td>Incisive fossa</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Mandible</th>
<th>Mandibular Impression</th>
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<tr>
<td>Anatomical Structure</td>
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<tr>
<td>Labial frenum</td>
<td>Labial notch</td>
</tr>
<tr>
<td>Lingual frenum</td>
<td>Lingual notch</td>
</tr>
<tr>
<td>Buccal frena</td>
<td>Buccal notch</td>
</tr>
<tr>
<td>Anterior border of Masseter muscle</td>
<td>Masseter notch</td>
</tr>
<tr>
<td>External oblique ridge</td>
<td>External oblique groove</td>
</tr>
<tr>
<td>Mylohyoid ridge</td>
<td>Mylohyoid groove</td>
</tr>
</tbody>
</table>
Lingual tuberosity       | Lingual tubercular depression
Retromylohyoid space    | Retromylohyoid eminence
Retromolar papilla      | Retromolar fossa

It is surprising that they omit the fovea palatina from their list of important landmarks. These small depressions are usually reproduced in the impression and can be helpful, together with palpation, in determining the posterior border of the hard palate. Sears (30) states that they mark the posterior limit of the hard palate and should, as a rule, be only just included within the impression area.

It is felt that the pterygomandibular ligament should be included in this list of superficial landmarks, because of the part it plays in limiting the posterior extensions of the maxillary and mandibular impressions. The median raphe likewise is worthy of inclusion, as faulty impression techniques result in irritation of this area.
Preservation of the Remaining Tissues.

Our impression techniques should be such that the final dentures should not cause atrophic or degenerative changes in the tissues of the mouth.

For many years clinical evidence has been used to suggest that dentures are responsible for undesirable tissue changes. In 1888 Atkinson (31) claimed that an epithelial enlargement of the soft palate and uvula was brought about by a denture, but gave little evidence to show how this could be so. Butler (32) in the following year wrote on the changes caused by dentures. He was of the opinion that dentures caused an increase in the rate of shedding of the superficial epithelial cells, resulting in the formation of shallow ulcers. He also thought that lack of heat conduction of denture base causes congestion, inflammation and often suppuration.

De Van (33) is of the opinion that bone reacts more favourably to compression than to shearing or torsional forces. He states that compact bone is produced as the result of torsional forces. It is difficult to visualise, in the maxilla or mandible, torsional forces capable of producing compact bone.

Stansbery (34) points out that compression results of the tissues results in a diminution of tissue fluids, the contents of the arteries and veins being expelled. This could possibly interfere with the nutrition of the tissues, in his opinion.

It seems however, that there is little in the way of scientific evidence to support many of these statements.
Weinman and Sicher (35) find that, within the limits of tolerance, mechanical forces stimulate the deposition of bone and lack of function causes atrophic changes. They state that a satisfactory explanation for this phenomenon has not yet been advanced. MacMillan (36) also believes that lack of function is one of the greatest factors resulting in atrophic change.

Wright (37) noted that resorption occurred very slowly in some cases and rapidly in others. While he was of the opinion that occlusion was a major factor, he adopted the pessimistic view that fractures of the mandible due to resorption under dentures could be expected.

In view of these statements it is interesting to observe that Schlüssel (38) is convinced that the best way to preserve the residual alveolar ridges is by means of dentures constructed from accurate functional impressions.

In this respect the later work of Pendleton (39) is extremely interesting. He carried out a series of microscopic examinations of oral tissues. These tissues were taken from subjects who had not worn dentures and from subjects who had worn dentures. He was unable to discover any observable difference in the tissues of the two groups of subjects. He reached the conclusion that tissue changes in the jaws appear, as a rule, to be caused by some type of injury. Whether or not these were due to biological reaction to mechanical influences he was unable to determine. He also concluded that the state of health of the subject was of extreme importance in determining the reaction of the tissues to injury.
Sears (30) also is of the opinion the ability of the tissues to be preserved is largely controlled by the factors of general health — vitamins, minerals, endocrines and hormonos, exercise, protein intake and other metabolic determinants. The work of Miller and Wolf would seem to confirm this. They found that precocious alveolar bone destruction was almost always associated with an excessively high carbohydrate intake.

It seems reasonable to expect that, if the patient is in a good state of health, the impression technique is unlikely to be responsible for any increase in the rate of resorption of the residual ridges, provided that the forces exerted, as a result of the technique, do not exceed reasonable limits.
Factors Contributing Toward Retention in Impressions.

Tuckfield (41) has defined retention as: "The resistance offered to a force directed at right angles to the seating surface which tends to lift the denture from the supporting surface of the tissues."

Retention and stability are two properties which are usually considered together. Retention is usually considered as being developed at the impression stage and stability is developed at the subsequent stages. It is obvious, however, that the greater the retention the greater the resistance to unstabilising forces. It is important that the maximum retention be developed at the impression stage without exceeding any biological limitations.

Prothero (42) holds that full dentures are retained by adhesion and atmospheric pressure. He defines adhesion as: "The molecular attraction exerted between the surfaces of bodies in contact." He notes that a film of liquid must be present and that adhesion takes place between dissimilar substances. He believes that unavoidable movement of the tissues reduces the retentive effects of adhesion. The surface area covered by the base of the denture is also important. The greater the area covered the greater the retention. Gravity is also given some credit in retaining full lower dentures.

Turner (43) and Landa (44) are of a similar opinion but also point out that adhesion is also closely associated with cohesion, and it is this property which prevents the dispersal of the molecules of the film of saliva, lying
between the denture base and the tissues. Cohesion therefore is the property of attraction of similar molecules to one another.

Schlosser (20) thinks that adhesion only is responsible for the retention of dentures and does not mention atmospheric pressure as being a contributing factor.

Wilson (45) dismisses atmospheric pressure as having any value, except when a vacuum chamber is employed. Retention is given by the property of what he terms "adhesion by contact."

The statements of many of those who propose atmospheric pressure as the major retentive force give the impression that a steady force of 14.7 pounds to the square inch is exerted upon the denture. One earlier author, Atkinson (31), declared that the presence of a denture upset the state of equilibrium between the tissues and the atmosphere and that this resulted in pressure being exerted on the tissues, with undesirable consequences.

This state of affairs, of course, does not exist. The position has been very well summarised by Hall (46) who says: "Atmospheric pressure, contrary to the opinion of many is not a kinetic force acting conjointly with adhesion and cohesion in the position of the basal seat. The space between the denture and the adapted tissue is completely filled with aerated saliva equalising the pressure within the space with that of the atmosphere without the space. Were the maximum pressure of air (exerted) by complete removal of the interposed saliva and evacuation of the space thus formed, we could then have the maximum pressure of the air 14.7 pounds pressure to
the square inch."

In other words it appears that a partial vacuum cannot exist unless there is movement of the denture base relative to the tissues. The greater the relative movement the greater the partial vacuum until the stage is reached when the seal is broken and air admitted. This movement would be intermittent and would not be likely to have any undesirable effect.

Hall also considers capillary force to be of value in retention. Capillary force being that force which retains a thin film of liquid between two closely approximated surfaces.

The value of atmospheric pressure as an aid to retention has been argued for many years. As early as 1889 Land (47) maintained that atmospheric pressure was of no consequence in retaining dentures and this view has been held by many up to the present time. It is remarkable that little in the way of scientific investigation into the rationale of denture retention has been carried out until quite recent times.

The work of Snyder, Kimball, Bunch and Beaton was of value in this respect. They measured the forces required to dislodge both dentures and specially constructed bases in normal and in reduced atmospheric pressures. Their results show quite definitely that atmospheric pressure does play a definite part in the retention of dentures. They found that, in the great majority of cases, a reduction of 70% in the atmospheric pressure resulted in the retention force of the denture or base being reduced by half.

Although it was in no way connected with dentistry, the work of Budgett (49) is worthy of investigation. Budgett
carried out a series of experiments to determine the nature of the adherence between optically flat steel surfaces. He found that:

(1) Intermolecular attraction between the solids is negligible.

(2) A liquid film is necessary between the two surfaces before the adhesion between them is of any consequence.

(3) That only 4% of the force required to break the film can be attributed to surface tension effects.

(4) The greater part of the adhesion is due to the molecular cohesion of the liquid and the tensile strength of the liquid.

(5) The nature of the liquid between the surfaces had a great bearing on the degree of adhesion between the two surfaces.

He also found that, even with flat surfaces up to 25% of the adhesive effect could be attributed to atmospheric pressure.

The accuracy of the two surfaces is also of extreme importance. Eberle (50) quotes figures for Johannson guages whose surfaces are extremely accurate. The thickness of the film between their surfaces is of the order of only 0.00001 of an inch and the force of adhesion is 440 pounds per square inch. The force of adhesion in plain surface tension (i.e., an infinitely thick film) is only 25 grains per square inch.

It is obvious that an impression cannot hope to reproduce the accuracy of the Johannson guages and the work of Skinner and Chung (51) and the calculations of Stanitz (52) would indicate that adhesion plays a small but definite part in the retention of dentures. Moses' (53) contention, that the force of atmospheric pressure gradually takes over from the force of
adhesion during denture displacement would seem to be a logical conclusion.

Skinner, Campbell and Chung (54) carried out a series of clinical experiments on the forces required to dislodge dentures and found that peripheral seal and post-dam seal aided retention. They also found that the introduction of relief areas always resulted in a decrease in retention.

In the light of present knowledge it would seem that,
(1) Atmospheric pressure plays a major part in the retention of dentures.
(2) Adhesion plays a smaller but useful part.
(3) Maximum possible coverage of the basal seats increases the effects of both atmospheric pressure and adhesion.

It must not be forgotten that the nature of the occlusion of the dentures and the shape of their surfaces play an equally large part in the retention of dentures for as Pendleton (55) has said concerning impression techniques: "No method is more infallible than one based on the operator's knowledge of the jaws portrayed by the clinical characteristics. The retention of complete dentures may be accomplished only when the biological factors are appraised with understanding."

Materials.

A Brief Survey of Impression Materials.

Mauk (56) considers the desirable properties of an impression material to be as follows:

(1) It should be agreeable to the patient in colour, taste, odour, and consistency.
(2) It must not injure the oral tissues in any manner.
(3) Its maximum plasticity should lie within a temperature range of heat and cold that is readily tolerated without discomfort in the mouth.
(4) It should copy fine details of the surface accurately and retain its form without distortion when removed from the mouth.
(5) It should pass from the plastic to the rigid state promptly, yet allow sufficient time for manipulation.
(6) It should not expand, contract nor warp in the rigid state at ordinary room temperatures.
(7) Its preparation and manipulation should be easy and not require elaborate equipment.
(8) It should be free from deterioration, so that its working properties are constant.

The following materials are available for impression procedures.

(1) Wax.
(2) Gutta-percha.
(3) Plaster of Paris.
(4) Impression compound.
(5) Impression plaster.
(6) Reversible and irreversible hydrocolloid impression materials.
(7) Rubber base impression materials.
(8) Silicone base impression materials.

(1) Wax.
Wax is probably the oldest of all impression materials. It is usually used in the form of beeswax. Osborne (57) gives the following properties for beeswax.
(a) Soft and workable at 40°C.
(b) It is very soft when heated and may be used in those cases where force is contraindicated.
(c) It is devoid of elasticity at all temperatures.

In spite of the use of more modern materials the use of wax is still advised in certain techniques.

Disclosing pastes which may also be used as corrective linings are also used at the present time. These have a wax base.

(2) Gutta-percha.
Gutta-percha has virtually disappeared from use in the field of denture impressions. It is, however, still used in connection with other prosthetic work. Prothero (42) states that it becomes plastic at 130°F. and has the advantage of being elastic. This enables it to be removed from undercuts and having been removed tends to return to its original form.

It suffers, however, from the property of cold flow. Its use has been recommended for certain types of functional impressions.
(3) Plaster of Paris.

This impression plaster is a modified form of plaster of Paris. Modifiers have been added in order to regulate the setting time and to control the setting expansion.

Skinner (58) raises an objection to plaster on the grounds of its setting expansion. When restrained by an impression tray it exhibits considerable distortion, especially in the palatal section of the impression. This objection does not hold when it is used as a corrective lining. The only objection to its use in this fashion is its tendency to fracture.

(4) Impression Compound.

This is one of the most widely used of all impression materials. As recently as 1950 Schlosser (38) maintained that impression compound was the equal of any other material for use in the construction of full dentures.

The linear thermal coefficient of expansion of impression compound is considerable compared with other materials. This problem can be reduced to negligible proportions if suitable techniques are adopted. If the bulk of material can be chilled and the impression surface alone heated the expansion problems are practically overcome.

The material tends to distort if removed from the mouth before being thoroughly chilled, although this is due to faulty manipulation rather than an inherent fault of the material itself.

Flow in modern compound materials is small enough to be
neglected. (58).

(5) Impression Pastes.

These materials are generally used as corrective linings in specially constructed trays or in conjunction with compound impressions.

(59)

Skinner, Cooper and Zeihm are of the opinion that the essential ingredients and fundamental chemistry are probably identical with those of ordinary Zinc oxide and Eugenol cement. Zinc oxide, Eugenol, Rosin appear to be essential components of these pastes. Fillers are often added to reduce the thermoplastic properties of some of these pastes. They found considerable variation in the properties of various manufactured pastes. Some exhibited a greater flow than impression compounds conforming to American Dental Association Specification No.3. Azgarzadeh and Peyton (60) also found considerable variation in various products. They found that the ability to reproduce surface detail was an outstanding feature of these pastes, although this property was subject to considerable variation.

The oral mucous membranes of some patients appear to be greatly irritated by these pastes. It is possible that, in these cases, inaccurate results could be obtained due to an inflammatory reaction of the tissues.

(6) Reversible and Irreversible Hydrocolloid Impression Materials.

These materials have been developed mainly for use in the field of partial denture construction. Techniques have been advocated, however, in which they are used as impression materials for edentulous mouths.
While their manipulation is different, their properties are so alike that they may be considered together. Skinner, Cooper and Beck (61) found that the reproduction of undercuts was excellent. However, both materials shrunk by syneresis or evaporation of water if exposed to air. This is a natural phenomenon common to all gels. This effect can be reduced by storing in air of 100 percent humidity, somewhat less shrinkage then occurring with the alginate materials. Both materials tend to react with dental stone; the alginate materials much more so than the agar materials. Skinner and Pomes (62) found that immersion in water tended to make alginate materials swell and that the use of fixing solutions tended to increase the dimensional stability. Later work by these workers (63) indicated that the accuracy of the two materials was equal if properly manipulated.

From the point of view of full denture impressions these materials suffer from the following disadvantages:

(a) Used alone they are unsuitable for techniques where mucocompression and peripheral seal is required, being a semi-liquid when inserted into the mouth and distorting if pressure is exerted during the setting stages.

(b) Used as a corrective lining they do not adhere well to any normally used individual tray materials. The result is that the thin layers of hydrocolloid material tend to peel away from the tray when it is removed from the mouth.

(7) Rubber Base Materials.

Fairhurst, Furman, Schallhorn, Kirkpatrick and Rydge, report that these materials are classified as thickol liquid polymers. Rapid polymerisation is produced by the introduction of lead peroxide and sulphur suspensions into the thickol liquid polymer.
The properties were found to be very similar to those of the hydrocolloid materials. The surface of the stone model was not, however, affected by the rubber base materials and they could be stored in air without shrinkage.

Their use for full impressions has not been developed. They would appear to suffer from the same disadvantages as the hydrocolloid materials.

(8) **The Silicone Base Materials.**

The silicone base materials are the most recently developed of the impression materials. The Commonwealth Bureau of Dental Standards (65) reports that the details of the chemistry involved in their polymerisation is not yet available. The Bureau also reports that they are dimensionally very stable and superior to the rubber base materials in the reproduction of undercuts.

The use of these materials for full impressions has not yet been developed. They appear to have properties of coherence and stability that would indicate use as corrective linings. They suffer from the disadvantage of reaction with gypsum products if not left for several hours after polymerisation. Personal observation indicates also that air, trapped within the impression, tends to distend the surface of the impression if close to the surface.
Impression Techniques.

Wright (66) defines an impression as: "A suitable imprint of the desired denture supporting and border tissues of the edentulous or partly edentulous jaws which has been obtained by properly adapting to these structures an appropriate material which retains its form on removal from the mouth."

The fact that the mouth is not a solid, static and incompressible object has created problems in attempting to reproduce that which conforms to Wright's ideal. This has resulted in two distinct types of impression techniques which differ in their fundamental approach to the problem.

The proponents of one type believe that the tissues of the mouth must be treated in a manner which takes into account their anatomical and histological structure. They contend that, by virtue of their nature, certain tissues are best suited to perform certain tasks, and that an impression technique should be adopted that results in:

1. A differential loading of the tissues of the basal seat so that, during function, the greatest load is placed on those tissues best suited by nature to bear it.

2. The peripheral tissues being sufficiently displaced to maintain contact with the denture borders during normal function.

These techniques are all based on the assumption that the denture bases are moved during function and that this movement results in intermittent compression of the underlying tissues. Atmospheric pressure as a major retentive force is also usually assumed.
Techniques of this type may be classified as **mucocompressive**.

The proponents of the other type of technique believe that all types of tissue distortion are undesirable. They state that tissue compression of any type will result in:

1. Displacement and loss of retention of the denture base or
2. Resorption of the underlying tissues or
3. A combination of both (1) and (2).

They believe that an impression should be a reproduction of the desired tissues in a state of rest. These techniques may be broadly classified as **mucostatic**.
Mucocompressive Techniques.

Pendleton's (21) (23) investigation of the tissues of the denture bearing areas would seem to confirm the theory that the tissues in certain regions are suited to certain tasks.

In the maxilla

(1) The crests of the residual alveolar ridges are ideally suited to absorb the greater part of the forces of mastication.

(2) An area lying between the border of the crest of the ridge and lateral to the median raphe of the palate is suited to the absorption of a smaller portion of the forces of mastication.

(3) The tissues lying between the border of the crest of the ridge and the buccal and labial reflection is of a nature which would withstand a certain amount of displacement and therefore a peripheral seal may be obtained in these regions.

(4) The tissues lying between the posterior border of the hard palate and the moving part of the hard palate may also be utilised for purposes of obtaining a seal.

(5) Tissues overlying the incisive foramen, the posterior palatine foramina, and the median suture of the palate should be subject to the absolute minimum of pressure.

In the mandible

(1) The sides of the residual alveolar ridge are suited to the absorption of the force of mastication.

(2) The tissues of the peripheral regions are suitable for the creation of a peripheral seal, in spite of the mobility of the tissues of the floor of the mouth.
(3) The crest of the ridge is usually composed of dense inelastic fibrous tissue and should not be subjected to any compressive forces.

(4) In case of extreme resorption of alveolar bone care must be taken to avoid, during function, pressure upon the tissues overlying the mental foramina.

To conform with these concepts an impression technique must be developed that will:

(1) Place a physiologically tolerable load on certain predetermined areas.
(2) Place a smaller load on other predetermined areas.
(3) Displace certain tissues within physiological limits.
(4) Avoid the placement of pressure on certain predetermined areas.
(5) Record these tissues while in this state.

While Pendleton was not responsible for the introduction of mucocompressive techniques, his work did confirm many of the theories and clinical findings of the earlier workers in this field.

None of these techniques has any means of estimating the exact proportion of the load that each area of the tissues is able to bear. However, most mucocompressive techniques, if carried out carefully, appear to give satisfactory results, and the latitude of tolerance of the tissues concerned would seem to be sufficiently great to take care of any small errors of estimation.

It should be obvious that, with mucocompressive techniques, the examination of the patient is of the utmost importance. The operator must have a good knowledge, for each individual
case, of:-

(1) Shape of residual alveolar ridges.
(2) Condition and nature of the bony structure of these ridges.
(3) Size and position of the various areas which may be utilised for bearing purposes.
(4) Size of the buccal-labial space.
(5) Position and depth of the various muscle attachments.
(6) Shape of maxillary palate.
(7) Nature and size of maxillary tuberosities.
(8) Nature and size of retro-molar papilla.
(9) Form and size of soft palate.
(10) Extent and type of the retromylohyoid space.
(11) Position of and type of tissue covering the zygomatic process.
(12) Degree of development of the mylohyoid, and oblique ridges.
(13) Degree of development of the median suture of the palate.
(14) Muscle and tissue tone.
(15) Tongue size.

All these factors have considerable influence in mucoccompressive impression techniques and must be observed in great detail by means of visual, digital and radiographic examinations. All other features of a normal examination are naturally included.

A consideration will now be given to the various techniques which are of interest or which have influenced the development of impression methods.

Before doing so it should be pointed out that there are
two basic types of mucocompresive techniques.

(1) **Manual Type.**

With this type of impression the compression of the tissues is controlled by the operator. The peripheral moulding is usually carried out by manual manipulation of the lips and cheeks.

(2) **Functional Type.**

With this type of impression both compression of the tissues and the peripheral moulding are usually carried out by the muscular action of the patient.

The functional type of impression is usually considered to give the greatest tolerable extension of the denture base, but requires good and intelligent patient co-operation. If this is lacking the manual type is to be preferred.
The Technique of P. T. and J. W. Greene.

The mucocompresive technique that probably had more effect upon the development of prosthetic dentistry than any other was that of P.T. and J.W. Greene (67). It was one of the earliest scientifically planned techniques.

When they first developed the technique is uncertain, but it is known that they commenced teaching their methods about 1900. After the death of P.T. Greene in 1910 the details of the course were presented in book form.

They were convinced that atmospheric pressure was the prime factor in the retention of dentures. They also thought that much of the trouble, experienced by practitioners of the day, was due to the fact that it was usual to provide "relief" for the non resiliant areas of the basal seat. This relief was usually obtained by scraping the impression in the appropriate places or providing a removable spacer in the denture base. The Greene brothers were of the opinion that it was better to compress the softer areas of tissue an amount just sufficient to provide an "equilised strain on hard and soft parts."

They used special trays with small or removable handles. These trays had very shallow flanges and a tray was selected which did not extend past the border of the hard and soft palates. The following procedure was generally adopted:

Maxillary Impression.

(1) Select suitable tray.
(2) Load with impression compound so that palatal portion is seated first.
(3) Seat tray and press surplus material against buccal
and labial surfaces of residual ridge.

(4) Partially muscle trim by getting patient to make facial movements while compound is soft.

(5) Chill and test for retention.

(6) Locate posterior border, which must be on soft immobile tissue, by softening posterior border with hot water, placing in mouth and instructing patient to swallow. This will show line of demarcation between mobile and immobile tissue and will ensure that compound is adapted to the region of the hamular notch. Trim back to this line.

(7) Reduce thickness of peripheral border until it is somewhat thicker than required in the finished impression.

(8) Record surface detail by flowing fine stream of hot water over tissue surface of chilled impression and reseating.

(9) Warm labio-buccal margins with flame. Each side of impression is treated separately. "Pinch up edge slightly" reseat and instruct patient to make all possible facial movements. Repeat until muscles fail to "cut any deeper" in the softened compound.

(10) Post-dam procedure is carried out by softening the full thickness of compound at the posterior border, reseat, and instruct patient to press against the posterior border with the tongue.

(11) Chill. Then flame peripheral borders lightly. Reseat and press with fingers against the outer surfaces of the cheeks and lips in order to "conform" the impression against the tissues.

(12) Chill and check.
They recommend that a large compound rim be added to the tray surface and while soft the patient is instructed to bite into the softened compound. This is chilled and at stage (3) and subsequent stages the impression is retained by the patient.

Mandibular Impression.

1. Select tray. This is a shallow tray which must also leave the anterior border of the masseter free.
2. Load with compound.
3. Seat and press compound against ridge and into retromylohyoid space with finger.
4. Partially muscle trim by instructing patient to bite against the operator's fingers.
5. Chill impression in mouth.
6. Place large compound rim on tray surface, seat and instruct patient to bite into compound until there is an impression of the crest of the maxillary ridge.
7. Warm tissue surface with stream of hot water, reseat and obtain surface detail and equalisation of pressure under light biting pressure.
8. Muscle trim borders by heating periphery as before and trimming, with impression under biting pressure, by instructing patient to perform vigorous movements with mouth and tongue. The mouth is to be kept closed.

In cases, where retention of a mandibular denture was difficult, the Greene brothers recommended that the lingual border of the impression should be extended laterally in the bicuspid region. This attempts to obtain a seal by extending the denture border into the sub-lingual saliva pool. Fish (68)
recommends a very similar procedure.

The Greene brothers did not consider that a corrective lining was necessary, although they showed the procedure. They believed that impression compound would record all the surface detail necessary for good results. Schlosser (38) has always been of a similar opinion. Young (69) has also reported work that indicates that the maximum of surface detail is not desirable and may result in irritation of the underlying mucous membrane.

This technique is in many ways a sound technique. It conformed quite well to the concept of a mucoccompressive impression. It was not ideal but in skilled hands should, even today, give good results. It had the following weaknesses:

(1) It relied on the selective nature of the semi-solid impression compound to compress the resilient tissues more than the harder tissues. This property would vary according to the heat and type of impression compound. The amount of water taken up by the impression compound has been found to have a considerable effect on its properties.

(2) The procedure of "conforming" that is pressing the periphery of the impression against the tissues by means of massaging the lips and cheeks could easily result in too tight a peripheral seal.

(3) The method of functional retention of the impression is rather crude.

(4) The handling of mobile fibrous ridges is rather difficult.

(5) Considerable manipulative skill is required. The technique should not be condemned because of this, but it is a disadvantage.
The Greene brothers handled the matter of mobile fibrous tissue in one of two ways.

(1) Removal, either by chemical cautery or heroic surgical removal.

(2) To displace labially or buccally during the initial seating.

(3) To replace in normal position and, at the same time, compress by pressing the labial or buccal section of impression compound against the mobile tissue.

It was hoped that recording these mobile tissues under pressure would cause a gradual reduction in size. Wilson (45) also advocated this treatment although he did not believe in mucocompressive impression techniques.

This technique has been considered in a fairly detailed manner because it represented an interesting attempt at a scientific functional impression technique and formed the basis for many techniques which followed.
Clapp modified and improved the Greene brothers' impression technique. In his technique trays with removable handles are used and seated and partially muscle trimmed his impression in the same manner as the Greene technique. The tray handles are removed at this stage and correctly shaped bite rims added to the impressions. These rims are contoured and vertical dimension is established. An accurate centric recording is then taken.

The impressions are treated to record surface detail by flaming and reseating. They are then muscle trimmed and adapted to the buccal and labial tissues in the same manner as the Greene technique.

The post-dam seal is treated in a different manner. The impression is trimmed to the function of the mobile and immobile tissue; the area of the post-dam is mapped out and tracing stick compound is added to the corresponding area on the impression. This is flamed, placed in the mouth and recorded under functional pressure.

Clapp's technique complies with most of the requirements for a mucocompressive technique. The post-dam technique is easily controlled and modified.

The technique suffers from the same disadvantage as the Greene technique in that there is a danger of overcompression of the peripheral tissues and that considerable skill in the manipulation of impression compound is required.
This technique is identical with that of Clapp except that special metal trays, designed by Tench are used.

These trays, which have removable handles, are of a metal which is soft enough to be modified easily.

Small pellets of impression compound are placed in a tray and it is seated in the mouth. The accuracy of the tray is observed by the thickness of the pellets of compound. The tray is then modified by bending the tray until an even clearance of one eighth of an inch is obtained.

These trays had the advantage of reducing the bulk of impression compound and assisting in the even distribution of force. In all other respects the technique is identical to that of Clapp.

It is interesting to note that this is one of the techniques recommended by Gysi and Kohler (72).
In 1924 Hair used an interesting technique, which used a combination of impression compound. It was a manual technique. The manual methods began to return to favour about this time.

The technique is to obtain accurately muscle trimmed compound impressions. These are obtained by using trays with short flanges.

1. Compound loaded into tray and seated.
2. Partially muscle trimmed by manually moving lips and cheeks.
3. Lingual section of mandibular denture trimmed by slightly protruding tongue and moving from side to side.
4. Chilled and cooled.
5. Flanges reduced in thickness.
6. Flanges heated in sections and muscle trimming completed by manual manipulation of lips and cheeks and protrusion and movement of tongue.
7. Vibrating line of soft palate marked with indelible pencil.
8. Maxillary impression reseated and pencil line transferred to impression and impression trimmed.
9. Tracing compound placed on post-dam area, flamed and seated to obtain post-dam seal.
10. V shaped groove cut along crest of ridge from molar region to posterior border.
11. V shaped groove cut along region of crest of mandibular ridge.
12. All hard or mobile areas relieved by scraping of compound.
(13) Thin corrective lining taken in plaster of Paris, muscle trimming being carried out while the plaster is setting.

This is quite a sound technique. It suffers from the disadvantage, common to all manual techniques, that there is a danger of underextension of the impression borders if the manipulation of the tissues is carried out in a too vigorous manner. Seating pressure also may be uneven if care is not taken.

It should be noted that pressure is applied to the bearing areas, by removing compound from those areas on which pressure is not required.

This technique has the advantage that considerably less manipulative skill is required than in the Greene (67) and Clapp (70) techniques.
Technique of F.M. Hight (73).

This technique, although devised principally for mandibular dentures, gave indications of the beginnings of the era of individually constructed impression trays. In Hight's technique an oversize compound impression is taken and a model is cast. A stock metal tray is modified to suit this model. The labial and lingual flanges are cut away and the tray flattened in the molar and bicuspid region. Metal is left extending well into the retromylohyoid fossa.

The tray is loaded with impression compound and seated on the plaster model. It is removed from the model, surplus compound trimmed away.

This compound tray is then flamed around the peripheries and muscle trimmed in sections. It is removed, chilled and relief areas scraped away, especially over the rough area, the area of the median suture, over any nobile tissue.

A plaster of Paris corrective lining is then taken, muscle manipulation being kept up until setting commences.

This is a manually muscle trimmed technique. The use of the model ensures that the tray is accurately seated and correctly seated. In this way the chances of error are reduced and the necessity of repetition avoided. The corrective lining avoids the necessity of accurate surface reproduction in impression compound.

The main disadvantage of this technique was the destruction of large numbers of stock metal trays, and interference from the handle of the tray.
Technique of C. L. Alexander (1927) (74)

This technique is a true individual tray technique. It was also a functional technique. It was detailed for the maxillary impression only but could be adapted for a mandibular impression.

A compound impression is taken in an oversize tray and a model is cast into it. After separation a shellac base is accurately laid down on the model. A correctly shaped bite rim is attached to this base and the maxillo-mandibular relationship is recorded. This is mounted and the teeth set in position.

At the try-in stage, after the position of the teeth has been adjusted, the periphery of the shellac base is heated and muscle trimmed. On the completion of muscle trimming a corrective lining in plaster is taken.

This technique, while simple is open to criticism from several aspects.

1. Use of the primary model for the try-in stage is undesirable as retention and stability of the base cannot be at a maximum.

2. There is little advantage in completing the try-in stage before the final impression is taken. If the impression is unsatisfactory the set up teeth are likely to be disarranged.

3. The direct muscle trimming of a heated shellac base is a dangerous procedure, as its working temperature is high.
Technique of F. S. Weir (75)

In this technique compound impressions were taken and carefully muscle trimmed by the manual method. The posterior border was located by anatomical landmarks (the hamular notches and posterior border of the hard palate) and compression of the post-dam region obtained with tracing stick compound. Relief areas are scraped away, especially over the anterior and posterior palatine foramina.

The peripheries are then shortened by about one eighth of an inch and the tissue surface scraped from this edge toward the crest of the ridge. This is done in order to avoid peripheral tissue contact with the compound. A corrective lining is then taken in plaster of Paris and muscle trimmed manually while the plaster is setting.

This technique, by moulding the periphery in plaster of Paris, avoids the danger of overcompression of the peripheral tissues. Particular care would have to be taken to avoid overshortening of the borders when muscle trimming. It is usually considered unnecessary to provide relief over the posterior palatine foramina as the overlying tissue is usually quite thick.
Technique of E. C. Pendleton (1928) (76).

Pendleton constructs individual compound trays by carefully taking a compound impression in a metal tray. The compound impression is removed from the metal tray and muscle trimmed by heating the peripheries, transferring to the mouth and manually manipulating the tissues of the lips and cheeks. The lingual border of the mandibular impression is trimmed by instructing the patient to swallow while the border is soft.

Post-dam seal is obtained by mapping out the soft area anterior to the vibrating line of the soft palate and obtaining compression of this area with soft carding wax. The peripheries are then reduced by one to two millimetres. Pressure over relief areas is reduced by scraping of the compound. Compound is cut well away from the mylo-hyoid ridge.

A small hole is bored over the palatine foramen. Muscle trimmed corrective linings are then taken in plaster of Paris.

The technique was modified slightly in 1931 (77) by using a metal tray from which the centre portion of the palate has been removed. This avoids pressure on the tissues over the median suture.

Pendleton's technique is quite sound and if carefully carried out should give good results. It has the big advantage of being reasonably simple and could be carried out in a reasonably short time.

There is a danger of overcompression of the bearing areas
and severe reduction of the peripheral borders and care is required because of this. There is also the danger of warpage of the compound trays. The use of bite rims attached to the trays could be helpful in this respect.
Technique of F. Trebitsch (1928) (78).

In this technique primary impressions in plaster of Paris are taken and models cast. On these models shellac base plates are adapted and wax bite rims fastened in position.

Centric relation is established and post-dam seal is obtained with soft carding wax.

The borders of the tray are then reduced and heated slightly and bent clear of the tissues. If necessary the lingual borders are extended with black gutta-percha.

Plaster corrective linings are then taken under functional biting pressure and muscle trimmed by the patient's facial and tongue movements.

This technique which should be capable of giving excellent results, suffers from the danger of warpage of the shellac trays. The use of a primary impression of plaster of Paris has the advantage of avoiding tissue distortion at this stage.

In 1930 he developed a technique (79) for the treatment of mobile lower ridges. It is a functional technique but makes use of a vulcanite instead of shellac tray. The centric relationship is established and the tray is lined with black gutta-percha. The patient is allowed to wear this for an extended period. The black gutta-percha will flow slowly at body temperature and a functional impression results. Phillips (80) in 1928 and Henderson in 1931 described similar techniques using soft wax as a lining material. Care would be
required to prevent overextension of the peripheral borders with this technique. Use of an excessive amount of lining material would result in large amounts being forced out around the peripheries.
This technique of Schlosser is regarded as one of the classic all compound techniques. He is one of the few modern exponents of compound as an impression material. The following technique is adopted.

1. Primary impressions are taken in impression compound.
3. Soft metal trays adapted to these models in such a way that there is a space of two or three millimetres between the tray and the model. There should also be sufficient clearance to allow for peripheral trimming.
4. These trays are loaded with impression compound and reseated on the models.
5. Bite rims are added and centric occlusion is recorded.
6. The borders are trimmed manually, adapted to the tissues by pressure against the lips and cheeks, and then retrimmed functionally by the muscular movements of the patient. The mouth is kept closed during this procedure.
7. Post-dam was obtained by mapping out the post-dam region and adding soft carding wax, which must not be thicker than two thirds of the amount of tissue yield.
8. Relief areas are treated by scraping away compound, flaming and reseating.

He later decided that muscle trimming of the labial frenum could only be done manually if satisfactory results were to be obtained and adopted this as a standard procedure.
The maxillary impression is usually muscle trimmed in three sections and the mandibular in four.

Schlosser's technique which he states is a refinement of the techniques of Greene (67), Clapp and Tench (71), overcomes most of the problems of these earlier techniques. Manipulation is reasonably easy and the dangers of overcompression of tissues is to a great extent avoided by retrimming functionally after adapting the compound to the tissues.

In order to maintain an even thickness of compound he eventually suggested (20) the use of a small button of shellac base plate in the palate of the tray. This prevents the tray from approaching too close to the tissues, but is a potential undesirable pressure area.
Technique of S. H. Supplee (34) (1934)

This technique is essentially a functional modification of Pendleton's (76) technique. It has the advantages that the bearing areas are recorded under biting pressure and that muscle trimming is functionally performed.

The addition of bite rims to the compound trays strengthens them considerably and should overcome the problem of warpage.

Supplee used a material for his corrective which was somewhat heavier in consistency and slower setting than plaster. It was probably the forerunner of the modern impression pastes.
Technique of R. W. Tench (85) (1934)

Tench developed a technique which was very sound, and a modification was later found to be particularly useful for mandibular impressions.

Primary impressions are taken in plaster and models cast. On these models a layer of baseplate wax is laid down and dusted with French chalk. On top of this another layer of baseplate wax is adapted and trimmed to the shape of a tray. This wax pattern is invested in a two piece mould, and cast in lead or other suitable low fusing metal.

Bite rims are added to the trays and impression compound is placed over the bearing areas and seated in the mouth. Centric relation is established and the bearing areas again recorded under functional pressure. This is followed by a plaster of Paris corrective lining under biting pressure and with functional muscle trimming.

The plan of this technique fulfills most of the requirements for a mucocompressive impression. The use of a cast metal tray seems to be an unnecessary refinement and at the time would have had little advantage over vulcanite. To-day the methyl-methacrylate resins have distinct advantages in this respect, for, if a clear tray is constructed, areas of heavy pressure are easily observed.
Technique of W. H. Terrell (86) (1936)

This technique aroused considerable interest when first presented and, even to-day, is one of the most widely used of all impression techniques. It is a manual technique and the chances of error, if this method is correctly carried out, are small. The following procedure is adopted.

(1) Compound impressions are taken and manually muscle trimmed as accurately as possible. The position of the post-dam area is traced on the tissues with indelible pencil and transferred to the impression. The outline of the post-dam area is lightly grooved. In cases of severely undercut lingual extensions, the compound is cut away in this region and chilled. An addition of tracing compound is then moulded into place. If carefully done, this piece can be removed and the components of the mandibular impression pieced together after removal from the mouth.

Relief areas are mapped out and the corresponding areas in the compound scraped to a depth that exceeds the resiliency of the bearing areas.

(2) The models are cast and upon these models individual trays are constructed. If handles are added they should be small and placed so that interference with muscle movements is avoided.

(3) The trays are tried in the mouth and the borders adjusted so that there is a clearance of one eighth of an inch between the periphery of the tray and the muco-buccal and muco-labial reflections.

(4) The posterior border is adjusted to the vibrating line
of the soft palate.

5. The maxillary tray has tracing stick compound added to its borders and these are muscle trimmed manually in three or four sections.

6. Tracing stick compound is added to the post-dam area and seated. Any surplus compound is removed, the compound flamed and reseated.

7. Compound is added to the borders and tissue surface of the mandibular tray, so that, when seated, compound flows over the bearing areas toward the crest of the ridge. The borders are then muscle trimmed manually in three or four sections.

8. Small holes are bored in vault of the palate and corrective linings of impression paste are taken. Manual muscle trimming is kept up until the paste ceases to flow.

The Terrell technique, although time consuming, is a very useful technique. Each stage is a relatively simple procedure and any errors are readily detected and easily corrected.

The dangers of too vigorous muscle trimming are overcome by using a tray of a non-yielding material. This tray is adjusted before muscle trimming and excessive shortening of the borders is immediately obvious.

It is noted that tracing stick compound is used to exert pressure on the bearing areas of the mandibular denture. This normally would indicate that a slightly oversize tray is required. This is not specified by Terrell and there is danger of the edges of the tray impinging upon the tissues or excessive pressure being exerted in this region.
Technique of C. O. Boucher (87) (1944)

Boucher combined the methods of Pendleton (76) and Terrell (86). For the maxilla he uses a muscle trimmed compound impression whose borders are reduced so that they are within 1.5 millimetres of the buccal reflections. A plaster of Paris corrective lining is taken. Boucher claims that plaster is a very satisfactory material for obtaining a peripheral seal providing that it is supported by a rigid tray.

The primary impression for the mandible is taken in impression compound with a plaster of Paris corrective lining. A vulcanite tray is constructed. The borders are reduced to be free of the reflected tissues and undercuts are removed. The peripheral seal is established in impression compound and a corrective lining in plaster of Paris is taken.

This technique overcomes the objection to the method Terrell adopted for his mandibular impression.

The technique for the maxillary impression requires more skill than Terrell's and errors in obtaining peripheral seal are not as easily observed or corrected.
Technique of H. H. Robin (33) (1945)

Robin is of the opinion that impressions should be taken in accurately fitting trays under moderate digital pressure.

He constructs trays of shellac base plate material on models cast from primary impressions. These trays are adjusted so that they are short of the muco-buccal fold.

They are muscle trimmed manually using tracing stick compound followed by a corrective lining of impression paste.

The technique is quite sound, being very similar to that of Terrell. The trays can be constructed rapidly but are much more liable to warp during the impression procedure.
MacMillan describes a technique for a mandibular impression which is very similar to Alexander's procedure for a maxillary impression. A primary impression is taken and a shellac tray is constructed on the model. A bite rim is added and a centric recording taken. Teeth are then set up and the secondary impression is taken in low fusing compound at the try-in stage.

The impression is taken under biting stress and muscle trimmed functionally.

The same objections apply to this technique as to Alexander's.

It is interesting to note that MacMillan advocates an extension under the tongue which is very similar to that recommended by Greene (67) and Fish (68).
Technique of C. H. Graham (90) (1948)

Graham made two obvious modifications to Terrell's technique. The first was the substitution of acrylic resin trays for those of vulcanite. The second and more important modification involved the mandibular tray.

Graham burnished lead on the mandibular model, covering the entire residual ridge and retromolar papilla and extending to the peripheries. The trays were waxed up over this lead. The completed acrylic tray thus contained a lead spacer. The lead enabled the tray to be inserted in the mouth and accurately adjusted. The lead can then be removed and tracing compound placed on the bearing areas, the crest of the ridge usually being left free.

This was an excellent modification and results in a technique which can be criticised only on the grounds that it is a manual technique.
Since this time there has been very little advance in the techniques for mucoccompressive impressions. Most techniques that have appeared in the literature have been of the mucostatic type.

Munz (91) has suggested the use of impression trays constructed from clear acrylic resin. This is an excellent procedure as it enables a close check on the accuracy of the bearing and relief areas. Collett (92) has described a technique which is very similar to Pendleton's (76) but which uses an alginate impression material for the corrective lining. Slighter greater ease of manipulation appears to be the only advantage of this technique.
Mucostatic Impression Techniques.

Mucostatic impression techniques have aroused widespread interest in the profession during the last ten years. The idea of an impression which records the tissues in a completely undistorted state is not new. Westcott (8) used plaster impressions with this purpose in view as early as 1844. Bell (47) in 1889 doubted the value of atmospheric pressure as an adjunct to denture retention. Wilson (45) in 1911 was strongly opposed to techniques which caused displacement of of tissue and advocated "uniform pressure and absolute contact." He was also of the opinion that atmospheric pressure did not play any part in the retention of dentures. Full impressions, using plaster of Paris, have been widely used since the introduction of this material as an impression medium.

Great interest was aroused in this type of impression about 1945 when it commenced to receive much publicity in advertising material published by a dental manufacturing company. Most of this early material has been written by Page, a mechanical engineer, whom Bohanen (93) credits with discovering the mucostatic principle about 1938, although Pryor (94) reports otherwise. The number of adherents that this principle gained was large and the techniques warrant investigation.

Addison (95) defines a mucostatic impression as an impression in which: "There is registered all the tissue area which rests on the mandible proper and above or below all the tissue area described as movable during normal function. The tissue area must be recorded exactly, without impingement on the musculature or tissues unsupported by bone. An impression
and subsequently a denture base must be produced which is an absolutely accurate negative of the ridge tissues in their normal passive form. There must be an accurate recording of those functionally motionless mucous ridge tissues."

The theory of mucostatic impressions was not presented as a technique but a principle.

The Mucostatic Principle.
Addison goes on to state:

1. That tissue is a semi-solid and subject to the same hydrostatic laws as a liquid. This view is held because tissue is composed of solids and liquids and, as it is a scientific fact that both solids and liquids are incompressible, it follows that tissue must be incompressible. Pascal's Law thus applies to the tissues of the mouth.

2. Retention is not due to atmospheric pressure, but is due to "interfacial surface tension" - a name coined for the force of molecular cohesion which was investigated by Budgett (49).

The mucostatic principle is open to criticism principally because of lack of scientific confirmation of these premises. The assumption that the tissues, if contained in an accurately fitting denture base, follow Pascal's Law has not been verified. The presence of lymph and blood vessels within the tissues permits the transfer of fluid to other parts of the body. If perfect contact is maintained with the tissues and pressure is exerted against the denture base it is obvious that fluid will be removed first from those areas where the tissues overlying bone are thinnest.
From this aspect the mucostatic principle ignores the anatomy and physiology of the tissues of the mouth.

The assumption that atmospheric pressure does not contribute toward denture retention has been shown to be incorrect by Snyder (48) and his co-workers. Addison (95), Eberle (50) and Levy (96) all fall into the error of concluding that a partial vacuum cannot exist between the denture space and the tissues because of the fact that this space is filled with saliva. Hall (46) has pointed out that this film is highly aerated and Stanitz (52) has shown that the film is usually incomplete.

The theory of non-displacement of tissue does not take into account the fact that folds of tissues of the floor of the mouth often cover portions of the residual ridge. Wright (97) and his co-workers found that in 35% of patients the tongue occupies an abnormally retracted position. This would cause displacement of the tissues of the mouth. In many cases it would seem necessary that some tissue be displaced in order to obtain a recording of the residual alveolar ridge. It must be borne in mind, also, that it is probably impossible to find an impression material which does not cause some displacement of tissue.

The mucostatic principle as proposed by Page applied apparently to mandibular impressions only (93), but techniques for maxillary impressions have been developed.

There are fewer variations in mucostatic techniques than with the mucocompressive techniques.
In Westcott's technique an oversize tray is constructed from a primary wax impression. Wax is removed from this impression to a depth of $\frac{1}{4}$ of one inch except across the posterior border and a small section in the anterior region. These two areas act as stops and hold the tray at a fixed distance from the tissues. The peripheries are reduced where necessary and an impression is taken in a thin mix of plaster.

This technique, even to-day, conforms fairly well with the mucostatic principle. It no doubt gave superior results to bad techniques using wax or impression compound.
This technique is somewhat similar to Westcott's except that a metal tray of suitable size and shape is used. The peripheries of this tray are modified with wax in order to carry the plaster of Paris to the muco-buccal fold. A stop of wax is placed across the posterior border in the case of the maxillary tray. An anterior stop is not used.

Wilson's method was widely adopted and even to-day is popular. A very similar technique was recommended as late as 1945 by Sloss and Rubinstien (98). Techniques such as this were in vogue until the macostatic principle was expounded.
Addison's was one of the earlier techniques which used Page's theories for its basis. It applied to the mandibular impression only.

A loose fitting tray, which allowed freedom for the muscle attachments is used. It was filled with Ackerman's cement, a type of zinc oxide and eugenol cement is loaded into the tray. The tray is then placed in position and the patient instructed to relax until the cement has set.

This technique, which does not use stops, fulfils the requirements of a mucostatic impression quite well. The absence of stops would make the positioning of the tray rather difficult.
Hirsh used primary impressions of wax. Muscle freedom was obtained in these impressions and undercuts removed. Three small widely spaced stops of black carding wax are placed in positions where they will make contact with the crest of the ridge.

The trays are filled with hydrocolloidal impression material and seated in position, the stops preventing contact of the tray with the tissues.

Hirsh however, does muscle trim his impression which is considered undesirable by most exponents of the mucostatic technique.

This technique is basically the same as Westcott's (8), but is modified to use more modern materials.
Technique of V. R. Dykins. (100)

Dykins devised a novel method of obtaining an upper mucostatic impression.

Ackerman impression material is painted with a brush on to the tissues of the maxilla. This procedure is repeated until a reasonably thick layer of material is built up and allowed to set. A tray is then filled with the same material and placed over the impression already in the mouth, allowed to set and removed.

Dykins points out that salivation causes problems with this technique and recommends premedication of the patient with 1/150 grain of atropine sulphate.

It is possible that the suspended weight of the impression material could cause, with this type of technique, distortion of the tissues.
Denen is one of the few mucostatic adherents who has attempted to confirm the claims for this type of technique. He constructed dentures for 185 patients by mucostatic techniques and for 169 by mucocompressive techniques. He found that those dentures made by mucocompressive techniques had considerably more trouble with soreness of the mouth and that all dentures made by mucocompressive technique required remaking within eighteen months. However, results of this nature require much more in the way of confirmation before they can be accepted. The fact that all the dentures, made by a mucocompressive technique, required remaking within eighteen months indicates that a faulty technique was probably used.

In Denen's mucostatic technique primary impressions are taken in impression compound. On these, a single thickness of shellac base plate is adapted to serve as a spacer. Over the top these trays are constructed of double thickness shellac base plate. The trays are perforated with small holes in order to retain the impression material.

The single thickness base plates are tried in the mouth and trimmed to avoid all muscle interference with the tissues at rest. These are placed inside the impression trays and these trays trimmed to match the spacer.

A stop is placed in the palatal section of the maxillary tray and in the bicuspid region on each side of the mandibular tray.
The impressions are taken using an alginate material. Digital pressure is released immediately after seating the trays in the mouth, and the material allowed to gel with the tissues in a relaxed state.

Denon's method is typical of any careful mucostatic technique. The same objections apply to this technique as apply to mucostatic impressions generally.

Progressed.

Advance in mucostatic techniques does not seem to have beyond this point.
Problems in Impression Procedures.

Extreme Resorption of the Residual Alveolar Ridges.
One of the commonest problems experienced in impression taking is that of obtaining a suitable impression of a greatly resorbed mandibular ridge.

This problem was studied in considerable detail by Annie Praed (102) who concluded that a technique for such a case must provide:

1. Relief from compression along the crest of the residual alveolar ridge.
2. Absence of distortion of any soft tissue that may surmount the ridge.
3. Freedom of muscle movement during mastication, deglutition and various physiological exercises.
4. Utilisation of the meagre stress bearing areas afforded by the mandible.
5. Relief over the buccal plate.

She also concluded that the ideal impression technique was of a mucocompressive type. She used an individual vulcanite tray constructed from an impression compound primary impression. The bearing areas were registered in softened beeswax in this tray, as are the peripheries. Maximum tolerable extension into the retromylohyoid space is obtained. Relief areas are cut into the tray with burs and perforations are made through the tray in these areas. A corrective lining of plaster of Paris follows. Similar techniques to this have been recommended by Graham (90), Pitton (103) and Appleby (104), whose methods differ only in the materials used. Wilson (45) also found that some displacement of tissue was required in these cases although he was opposed to mucocompressive techniques.
An interesting modification is proposed by Fournet and Tuller (105), who extended their impression on to the border of the ramus of the mandible. They use an all compound technique which is similar to Schlosser's (82) except that manual procedures are used. They claim that this extension affords considerable stability to the denture base. Interference with the maxillary tuberosity by this extension would be possible in many cases. This would limit its application.

**Mobile Tissue.**

The correct method of treatment for mobile or pendulous tissues of the residual ridge does not appear to have been decided. Greene (67), Wilson (45) and Trebitsch (79) all use techniques that cause compression of this tissue. To do this without causing intolerable displacement is obviously a matter of considerable skill and judgement. Graham (90) uses a normal mucocompresive technique in these cases except in the region of the mobile tissues where the tray is considerably oversize. This tissue is suspended in the tray while the other tissues are under compression during the setting of the corrective lining. The tray is perforated in the region of the mobile tissue. Spicer (106) removes portion of the tray and allows the mobile tissue to protrude. After recording the other tissues the impression is reseated and impression material painted over the protruding tissue and the tray. This method does not appear to have any advantage over that of Graham.

Of recent years many of these difficult cases have been successfully treated by means of metallic implants which are used to retain the denture. Killebrew (107), Bodine and Kotch (108) and Knowlton (109) have all presented similar techniques for which success is claimed. Knowlton (110) also found that these implant dentures enabled greatly
increased biting pressures to be exerted in comparison with soft tissue borne dentures. Newman and Van Huysen found that, in most cases, some inflammatory reaction of the tissues was to be found around the protruding posts and this may limit the usefulness of these techniques.

These metallic implants change the impression problem from that of full dentures to that of partial dentures. In most cases the entire load appears to be borne by the implant and the soft tissues play little part in support of the tissues.

An interesting method of modifying the shape of the mandibular by means of a tantalum mesh implant has been devised by Holland. This technique could be usefully applied in many difficult cases.

Lakner suggests the retention of maxillary dentures by means of two small bolts which pass through surgically created fistulae in the residual alveolar ridge. It is interesting to note that Fauchard condemned an almost identical technique slightly more than two centuries ago.

**Palatal Intolerance.**

The inability of a patient to tolerate palatal coverage is less common but, at times, a very difficult problem. It has been observed over a period of many years that lack of adaption of the posterior border of the maxillary denture is often the cause; a condition well described by Leuk. This condition was recognized by the Greene brothers who advocated an effective post-dam seal. This treatment in most cases appears to be effective.

In many cases however, Collett and Briggs found the problem was caused by factors and was required.
Less frequently cases are found in which palatal coverage appears to cause systemic disturbances. As early as 1877 Lacon (115) reported loss of taste and dyspepsia when the palate was covered. Recently Jaffe (116) reported almost similar findings in addition to which there was a craving for highly seasoned food.

In these cases it would seem desirable to construct a palateless maxillary denture. The tissues of the maxillary residual ridge are reasonably well adapted to the retention of such dentures. The area lying between the base of the residual ridge and the median raphe contains sufficient areolar tissue to make a peripheral seal possible.

Booth (117) points out that such dentures are comfortable and afford the tongue a greater sensation of freedom. He recommends an impression by any accepted technique and obtains the palatal peripheral seal by scraping a groove of the model.

Reyer (118) uses a manually muscle trimmed compound tray with an impression paste corrective lining. He also obtains his palatal seal by cutting a groove in his model.

It would seem preferable in these cases that an individual acrylic resin tray be constructed and the palatal seal obtained with tracing stick compound.
Specific Indications for Particular Impression Techniques.

The view that certain impression techniques are particularly applicable to certain types of cases has long been held. Such a view was responsible for the introduction of plaster of Paris as an impression material by Dunning and Westcott (8). The Greene brothers (67), who favoured compound as an impression material, thought plaster was indicated in those cases where the entire denture bearing area was hard and unyielding. Wilson (45), who favoured plaster of Paris, was of the opinion that impression compound was indicated in those cases in which the saliva was thick and ropey.

More recently Trebitsch (79) held the following views:—

(a) Mucocompressive impression compound techniques are indicated in those cases where the mucous membrane of the residual ridges is firm and resilient.

(b) Mucocompressive compound impression techniques are indicated in those cases with fibrous mobile ridges. The compound is used to obtain the desired placement of these tissues. He also recommends in these cases that the denture should be completed and relined using black gutta-percha as the impression material.

(c) If detail of the relief areas is required then a compound mucocompressive technique with a corrective lining is indicated. This technique may also be used for (a) when the construction of an individual tray is not desired.

(d) Plaster of Paris is indicated in those cases in which the tissue is rigid and non resilient. A mucocompressive compound and corrective lining technique is also suitable in these cases.
Lammie (119) selects material as well as technique as being suitable for a particular case.

(a) In bilaterally undercut cases mucostatic procedures using plaster, alginate or rubber base materials are indicated in order to avoid distortion with impression compound or impression paste.

(b) In cases of excessive salivation a technique using alginites or impression compound is recommended. Impression pastes may stimulate the flow of saliva.

(c) In a case where the tongue is active a mucoccompressive technique using impression compound with or without a corrective wash of alginate or paste impression materials is advised.

(d) In a case of microstomia he considers that mucoccompressive technique using a closely adapted tray should be used.

(e) In the case of a fibrous mobile residual ridge he advises a mucostatic technique using a soft mix of plaster of Paris, or Chick's method of using rolls of impression compound to compress the fibrous tissue.

(f) In a case where the facial muscles are strong and active a functional mucoccompressive technique with a corrective lining of impression paste is advised.

(g) In the case of an elderly patient successfully wearing full dentures he recommends that extensions should not be made greater than those of the old dentures as "age tolerates change badly."

The objection, on the grounds of the skill and judgement required, to the treatment of fibrous tissue by compression has already been noted.

Trebitsch finds that most cases can be treated by
variations of the mucocompressive techniques.

Impressions bilateral undercuts can usually be removed without distortion by posterior displacement of the impression before removal.

Lammie's assumption that an elderly patient, successfully wearing underextended dentures, cannot tolerate those which are correctly extended does not seem to be a logical conclusion.
Possible Future Developments in Impression Techniques.

Developments in impression techniques appear to be resulting in a combination of some of the principles of both the mucocompressive and mucostatic techniques.

The principal objection to the mucocompressive techniques is the fact that the bearing areas are recorded in a state of compression. These distorted tissues tend to return to their normal state and consequently exert a displacing force.

If a technique could be devised that would:

(a) Record the bearing areas in a state of rest.

(b) Provide peripheral seal.

(c) During function place the greater part of the load on the bearing areas and keep the load on the relief areas at an absolute minimum.

--: it would be said that such an impression would be compatible with our present knowledge of the anatomy, physiology, and physics of the full denture problem.

Developments along these lines are seen in a technique presented by Terrell in 1950. Terrell (120) abandoned his former technique of tissue compression and, having constructed accurate trays and placed bite rims on them, he recorded the bearing and relief areas by means of corrective lining. Digital pressure, sufficient only to maintain the trays in place, is applied. The peripheral region is recorded in plaster under normal biting pressure.

Terrell's technique displayed weaknesses in that allowance was not made for the normal relief areas. He also treated all
retromylohyoid spaces as class 111 spaces. His reason for doing this is not clear. His arbitrary method of obtaining a post-dam seal is also open to criticism and appears to defeat the purpose of the technique.

Block (121) also indicated that thought on impression techniques was developing along these lines.

The most recent technique of this type is that of Tilton(122). This technique requires the construction of an accurate tray of impression compound. This tray is made muscle free and reduced heavily over the relief areas. A corrective lining is then taken under the absolute minimum of pressure. The impression is then removed and all impression paste removed from the relief areas and the tray perforated in these regions. The impression is then reseated and held in position under heavier pressure. Plaster is injected through the relief holes and records the relief areas. Finally the peripheries manually moulded in soft wax, also with the impression seated under pressure.

Techniques of this type should give excellent results and are worthy of further investigation.
**Conclusion**

(1) A thorough knowledge of the gross and microscopic anatomy and the physiology of the tissues is required in order to carry out any impression procedure.

(2) A thorough knowledge of the physical problems involved in the retention of dentures is also required.

(3) The tissues of the edentulous jaws are ideally suited to the wearing of dentures.

(4) The nature of the tissues of the edentulous jaws indicate the use of a technique that results, in function, in a differential distribution of force to the underlying tissues and provides a peripheral seal.

(5) The theory of the mucostatic theory has not been confirmed.
Bibliography.

(1) Bremner M. D., K.
The Story Of Dentistry. 1939.

(2) Nuck, Anton
In Swensen M.
Complete Dentures P. 689 1940
and Prothero J. H.
Prosthetic Dentistry 2nd. Ed. P. 1113 1916

(3) Fauchard, Pierre
The Surgeon Dentist 2nd. Ed. 1746
Lindsay's Translation 1946

(4) Pfaff, Phillip
In Swensen M.
Complete Dentures P. 689 1940

(5) Gardette, James
In Weinberger B. W.
History of Dentistry in America Vol. 11 P. 141-142

(6) Weinberger, B. W.
History of Dentistry in America Vol 11.

(7) Kneisel F. C.
In Swensen M.
Complete Dentures P. 690 1940

(8) Westcott A.
The use of plaster of Paris for taking impressions of
the mouth. Its history and importance.
Cosmos (Dental) X11: 169-181. 1870
(9) Stent C.
In Bremner M. D. K.
Story of Dentistry. P175. 1939

(10) Coles O.
A Manual of Dental Mechanics. 1873

(11) Tod E. W.
Detachable Springs (Corres)

(12) Stewart J.
Detachable Springs (Corres)

(13) Parson T. G.
Retention of Artificial Dentures

(14) Wilson L. B.
How to make a plate fit any mouth tight without an air chamber.
Cosmos (Dental) XXV111: 191. 1886

(15) Hepburn D.
Suction plates, Air Chambers and Artificial Rugae.

(16) Melotte F. W.
Method of taking impressions.
Cosmos (Dental) XXX1 955.: 1889

(17) Bryan L. C.
Securing immediate suction in dentures.
Cosmos (Dental) XXX11: 414- 1890
(18) Storer-How W.
Catching's Compendium of practical dentistry. 1895.

(19) Pearsall W. B.
Mechanical Practice in Dentistry. 1898

(20) Schlosser R.
Complete Denture Prosthesis. 1943

(21) Pendleton E. C.
Minute anatomy of the denture bearing areas.
J. A. D. A. 21: 488-504 March 1934

(22) Thomas K.
Oral Diagnosis 2nd. Ed. 1943

(23) Pendleton E. C.
Anatomy of the face and mouth from the standpoint of the denture prosthodontist.

(24) Swensen M.
Complete Dentures. 1940

(25) MacMillan H. W.
Anatomy of the throat mylohyoid region and mandible in relation to retention of artificial dentures.
J. A. D. A. 23: 1435-1442 Aug. 1936

(26) Harris H. L.
Anatomy of the mouth and its relation to upper and lower full denture construction.
J. A. D. A. 18: 1220 July 1931
(27) Harris H. L.
Anatomical landmarks of value in full denture construction.
J. A. D. A. 28: 1765 Nov. 1941

(28) De Van H. N.
Biological demands of complete dentures.
J. A. D. A. 45: 524-527 Nov 1952

(29) Edwards L. F. and Boucher Co.
Anatomy of the mouth in relation to complete dentures.
J. A. D. A. 29: 331 March 1942

(30) Sears V. H.
Basic Principles in Dentistry 1942

(31) Atkinson W. H.
Epithelial enlargement caused by a plate.
Cosmos (Dental) VVII: 570-571. 1888

(32) Butler C. S.
Pathological conditions of the mouth due to artificial dentures.
Cosmos (Dental) XXXI: 44-47. 1889

(33) De Van H. N.
An analysis of stress counteraction on the part of bone with a view to its preservation.
Cosmos (Dental) 77: 109 1935

(34) Stansbery
Tissue changes under dentures
J. A. D. A. 15: 349 1928
(35) Weinman J. F. and Sicher H.
Bone and Bones
Fundamentals of Bone Biology. Ed. 11 1947

(36) MacMillan H. W.
Functional adaptation of the alveolar process
J. A. D. A. 1928

(37) Wright W. H.
Importance of tissue changes under dentures.
J. A. D. A.: 1027 - 1929

(38) Schlosser R.
Basic factors retarding resorption changes of residual ridges under complete denture prosthesis.
J. A. D. A. 40: 12-19 Jan 1950

(39) Pendleton E. C.
Changes in the denture supporting tissues.
J. A. D. A. 42: 1-15 Jan 1951

(40) Seidler B. Miller S. C., and Wolf W.
Systemic aspects of precocious advanced alveolar bone destruction.
J. A. D. A. Vol. 40: 49-58 Jan 1950

(41) Tuckfield W. J.
The problem of the mandibular denture.

(42) Prothero J. H.
Prosthetic Dentistry Ed. 11 1916
(43) Turner C. R.
American Text Book of Prosthetic Dentistry Ed. 6.
1932

(44) Principles and Techniques of Full Denture Construction
Landa J. S.
1934.

(45) Wilson G. H.
A Manual of Dental Prosthesis 1911

(46) Hall R.
The Rupert Hall method for entire upper and lower
dentures.
Bulletin No 2. of the Canadian Research
Foundation July 1921

(47) Land C. H.
Reproduction of Photostatic copy
Dental Digest 52:315 June 1946

(48) Snyder F., Kimball H., Bunch W., Beaton J.
Effect of reduced atmospheric pressure on retention
of dentures.
J. A. D. A. 32: 445 April 1945

(49) Budgett B. A.
The adherence of flat surfaces.

(5)
(50) Eberle W. R.
Rationale of Denture Retention.
Dental Digest 52: 315 -322. June 1946

(51) Skinner E. W. and Chung P.
The effects of surface tension in the retention of dentures.
J. Pros. Den. 1:29 May 1951

(52) Stanitz J. D.
An analysis of the part played by the fluid film in denture retention.

(53) Moses C. H.
A Critical analysis of the factors in the retention of dentures.
Dental Digest 52: 136-141 March 1946

(54) Skinner E. W. , Campbell R. L. and Chung, P.
A clinical study of the forces required to dislodge denture bases of various designs.
J. A. D. A. 46 Dec. 1953

(55) Pendleton E. C.
Influence of biological factors in retention of artificial dentures.
J. A. D. A. 23 : 1233 -1251 July 1936

(56) Mauk E. H.
American Textbook of Prosthetic Dentistry.
(57) Osborne J.
    Dental Mechanics for Students. 1939

(58) Skinner E.
    The Science of Dental Materials. 4th Ed. 1954

(59) Skinner G. W., Cooper E. N. and Ziehm H. V. J.
    SOME Physical Properties of Zinc-oxide-eugenol pastes.
    J. A. D. A. 41 449-455 Oct. 1950

(60) Azgarzadeh K. and Peyton F. A.
    Physical properties of Corrective lining pastes.

(61) Skinner G. W., Cooper E. N. and Beck F. E.
    Reversible and irreversible hydrocolloid impression materials.
    J. A. D. A. 40: 197-207 Feb. 1950

(62) Skinner E. W. and Pomes G. E.
    Dimensional Stability of Alginate impression materials.
    J. A. D. A. 33:245-256 Oct. 1946

(63) Skinner E. W. and Pomes G. E.
    Alginate impression materials.
    Technique for manipulation and Criteria for Selection.
    J. A. D. A. 35: 245-256 Aug 1947

(64) Fairhurst G. W., Furman T. C., Shallhorn R. V.
    Kirkpatrick E. L. and Rudge G.
    Elastic Properties of Rubber Base Impression Materials.
    J. Pros. Den. ___: 534 - 547 July 1956
(65) Commonwealth Bureau of Dental Standards. 
Silicones in Dentistry. 

(66) Wright W. H. 
Impression taking and Materials. 
J. A. D. A. 20 : 1611-1617  1933

(67) Greene J. W. 
The Greene Brothers Clinical Course in Dental Prosthesis. 2nd. Ed.  1914

(68) Fish E. W. 
Principles of Full Denture Prosthesis. 
3rd. Ed. 1937.

(69) Young H. A. 
Diagnosis of Problems in Complete denture Prosthesis. 

(70) Clapp G. W. 
Prosthetic Articulation.  1914

(71a) Clapp G. W. and Tench. R. W. 
Professional Denture Service.  1918

(71) Gysi A. and Kohler L. 
Handbuch Der Zahnheilkunde. 1VBand. 
Urban and Schwarzenberg.  1929.

(72) Hair I. N. 
Full Denture Construction. 
J. A. D. A. 17: 1176-1185  Dec 1924.
(73) Hight F. M.
A simple Technique to obtain maximum retention and stability in lower dentures.
J. A. D. A. 12: 778-781. 1925

(74) Alexander C. I.
Constructing artificial dentures by the double impression technique, discarding models made from the first impressions.
J. A. D. A. 14: 1024-1027 June 1927

(75) Weir F. S.
Problems of extension and adaption for impressions, with special reference to the peripheral contact.
J. A. D. A. 14: 94-101 Jan, 1927

(76) Pendleton E. O.
Impressions for full dentures.
J. A. D. A. 15: 1027-1036 June 1928

(77) Pendleton E. C.
The positive pressure technique of impression taking.
Cosmos (Dental) 73: 1045-1056 1931

(78) Trebitsch F.
Reprint from Vierteljahrsschrift Fur Zahneilkunde. Heft 2 1928

(79) Trebitsch F.
Reprint from Zeitschrift Fur Stomatologie. Heft 8 XXV111. 1930
(80) Phillips G. P.
Function in Dental Prosthesis.
Jnl. of Dent. Res. 8: 171-181 April 1928

(81) Henderson G. H.
What is the most important factor in full denture construction.
J. A. D. A. 18: 2271 Dec. 1931

(82) Schlosser R. O.
Advantages of closed mouth muscle action for certain steps in impression taking.
J. A. D. A. 18: 100-104 1931

(83) Schlosser R. O.
The tested functional impressions as a positive means for determining maximum surface extension and correct peripheral outline forms for full denture bases.
J. A. D. A. 21: 1053-1052 1934

(84) Suplee S. H.
A full impression method using true-plastic and a closed mouth technique.
J. A. D. A. 20: 1858-1865 1933

(85) Tench R. W.
Impressions for dentures.
J. A. D. A. 21: 1005-1018 1934

(86) Terrell W. H.
Retention and stability for full dentures.
J. A. D. A. 21: 1194-1204 July 1936
(87) Boucher C. G.
Complete denture impressions based on the anatomy of the mouth.
J. A. D. A. 31: 1174-1181  Sept. 1944

(88) Raybin N. H.
Effective impressions for full dentures.
J. A. D. A. 32: 330-338  March 1945

(89) MacMillan J. J.
A closed mouth technique for impressions of the lower jaw.
J. A. D. A. 34: 715-718  June 1947

(90) Graham C. H.
The importance of stress bearing areas in full denture impression technique.
Reprint from the proceedings of the eleventh Aust. Dental Congress 1948

(91) Munn F. R.
Impressions in transparent trays.

(92) Collett H. A.
Peripheral control with alginate full impressions.
J. Pros. Den. 4: 739-747  Nov. 1954

(93) Bohannan H. M.
A critical analysis of the mucostatic principle.

(94) Pryor W. J.
Physical forces used in the retention of dentures.
(95) Addison P. I.
   Lucostatic Impressions.
   D. J. A. : 51-57  Feb. 1945

(96) Levy S.
   Science versus technique in taking a full lower impression.
   Dental Digest 51: 440-444  Aug. 1945

(97) Wright C. R. and et al. Kuyskens J. R., Strong L. H.,
    Westerman K. N., Kingery R. H. and Williams S. T.
    A study of the tongue and its study in relation to denture stability.

(98) Sloss C. E. and Rubinstein M. N.
    A simplified full lower impression technique.
    Dental Digest 51: 486-489  Sept. 1945

(99) Hirsh L.
    A technique for full impressions using alginates or colloids.
    Dental Digest 52: 196-197  April 1946

(100) Dykins W. R.
    A novel method for obtaining an upper mucostatic impression.
    Dental Digest 54: 354-358  Sept. 1948

(101) Denen H. E.
    Impressions for full dentures.
    J. Pros. Dent. 2: 737-745  Nov. 1952
(102) Praed Annie
The problem of the excessively resorbed alveolar ridge with a suggested approach to denture restoration.
Thesis for degree of Doctor of Dental Science of the University of Sydney.

(103) Pitton R. D.
Precision mandibular impression technique.
J. A. D. A. 31: 1043-1045 Aug. 1944

(104) Appleby R. C.
A mandibular impression technique for displaceable tissues.
J. Pros. Dent. 4: 335-345 May 1954

(105) Fournet S. C. and Tuller G. S.
A revolutionary mechanical principle utilised to produce full lower dentures surpassing in stability the best modern upper dentures.
J. A. D. A. 23: 1028-1030 June 1936

(106) Spicer G. H.
Impressions of ridges with hyperplastic tissue.
J. Pros. Dent. 3: 163-164 March 1953

(107) Killebrew R. H.
The mandibular implant denture.
J. Pros. Dent. 2 : 618-624 Sept. 1953

(108) Bodine R. L. and Kotch R. L.
Mandibular subperiosteal implant denture technique.
(109) Knowlton J. P.
Rationale of design of mandibular implants.
J. Pros. Den. 6: 412-420 May 1956

(110) Knowlton J. P.
Masticatory pressures exerted with implant dentures as compared with soft tissue borne dentures.

(111) Newman C. and Van Huysen C.
Tissue reaction to vitallium implantation.

(112) Holland D. J.
Alveoplasty with tantalum mesh.
J. Pros. Den. 3: 352-357 May 1953

(113) Lakner L.
The surgical retention of full dentures.
Dental Digest 51: 373-375 July 1945

(114) Collett H. A. and Briggs D. L.
Some psychologic aspects of denture stimulated gagging.

(115) Lacen W. S.
Evil results from covering palate with artificial denture.
Cosmos(Dental) XIX: 377-379 1877
(116) Jaffe N. B.
Dyspepsia caused by Artificial dentures.
Dental Abstracts 1: 278 May 1956

(117) Booth L. A.
A technique for preparation of palateless full upper dentures.
Dental Digest 52: 609-611 Nov 1946

(118) Reyer E. A.
The Toothless denture.
Dental Digest 53: 80-83 Feb 1947

(119) G. A. Lammie
Full dentures Blackwell 1956

(120) Terrell W. H.
A precision technique producing dentures that fit and function.
D. J. A. 484-508 Oct 1950

(121) Block L. S.
Common factors in complete denture prosthesis.
J. Pros. Den. 3: 736-746 Nov. 1953

(122) Tilton G. E.
A minimum pressure complete denture technique.