

# A New Concept in Posterior Denture Teeth Design

## Introduction

It is estimated that the prevalence of edentulousness will continue to decline within the United Kingdom and reach a base level of 6% of the adult population by 2038<sup>1</sup>. Whilst there is a perception of declining numbers, this figure still represents millions of adults and the actual numbers will be increasing in line with the increasing population. People will be living for longer, so the edentulous population will be that much older and others will become edentulous at a later stage in life. This will pose a significant problem for the profession in the years to come “as older adults have a diminished capacity to adapt to the limitations posed by wearing complete dentures”<sup>2</sup>.

“Tooth loss and rehabilitation with dentures can have tremendous patient impact and social implications. In an image-conscious society, dentures restore a sense of normalcy and allow the patient the ability to interact with others.”<sup>3</sup> The aims of denture treatment are:

- Replacement of missing teeth to restore:
  - Function
  - Aesthetics
  - Phonetics
- Maintenance of the health of the oral tissues.

The denture occlusal scheme plays an important role in achieving these aims by minimising trauma to the supporting structures, enhancing the stability of the dentures and facilitating function.

Natural teeth are suspended in the bone by the periodontal ligament, which acts as a shock absorber. This means that natural teeth act individually, with the ligament providing a biofeedback mechanism. Denture teeth are part of the denture bases, which rest on moveable and displaceable tissues. Denture teeth tend to work as a functional group and there is no feedback mechanism. Premature deflective contacts between artificial teeth cause movement of the denture resulting in possible damage to the supporting tissues.

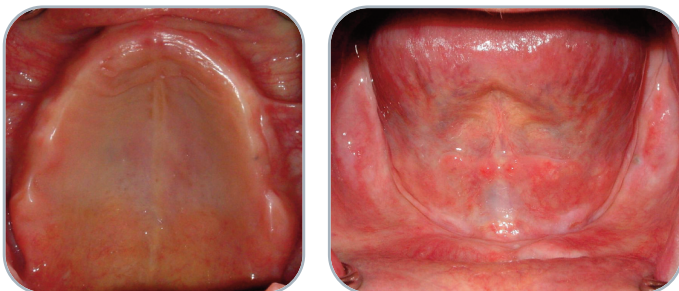


Figure 1 - Edentulous Ridges.

## Complete Dentures

The construction of complete dentures involves a number

of clinical and laboratory stages that may include some or all of the following:

- **Primary impressions** – these are the initial impressions of the patient’s edentulous arches recorded in the surgery. The dental technician would then cast stone models from these impressions and construct special trays that are specifically adapted to the individual patient’s mouth.

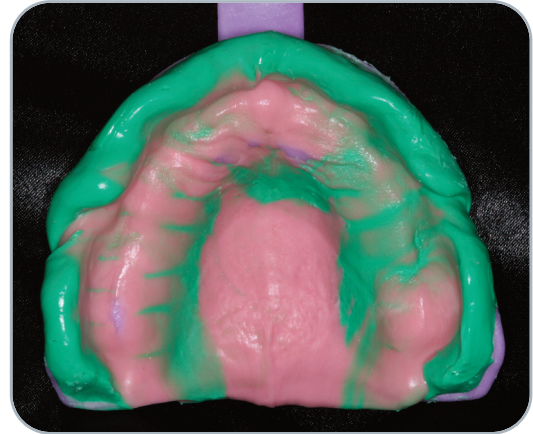


Figure 2 - Primary Impression – Doric Easy First and Doric Flo-light in Schottlander Edentulous Tray.

- **Secondary impressions** – the special trays are then used to record accurate and more detailed impressions.
- **Jaw registration** – the dental technician will construct wax rims on models produced from these initial impressions, which are representative of the position of the patient’s original teeth. The rims are modified in the surgery to reflect the current clinical situation and will provide guidance to the technician for the set up of anterior teeth on the denture. The posterior teeth are then set up in occlusion in order to provide the patient with an acceptable appearance and adequate function.



Figure 3 - Dentures Set Up for Wax Try-in.

- **Denture try-in** – the artificial teeth are set up on wax by the technician and the clinician will try the dentures in the patient’s mouth to ensure to check the appearance, phonetics and function.
- **Denture fit** – once the try-in has proved acceptable, the trial dentures are processed and finished and the dentist or the clinical dental technician finally fits the dentures.

Occlusion can be defined as the relationship of the maxillary and mandibular teeth when they are in functional contact during mandibular activity. The challenge faced by the dental technician is to establish a functional occlusion for the patient using artificial posterior teeth, as he may have little or no information about the patient’s natural teeth and their occlusal scheme.

Modern technology may allow some of these stages to become digitised and a modified workflow is likely to evolve and will continue to be developed:

- **Impressions** – primary and secondary impressions would still be recorded and the laboratory would digitally scan the model and the adjusted wax rims. This would record the anatomical detail of the jaws and the desired occlusal plane. At some point it may be possible for this detail to be scanned directly at the chairside and transmitted to the dental laboratory.
- **Reference Points** – within the denture design software Reference Points could be set to reflect the anatomical landmarks, in order to guide the set-up of the denture teeth.
- **Denture Design** – the software would allow the design of the denture base to ensure optimal coverage of the soft tissues.

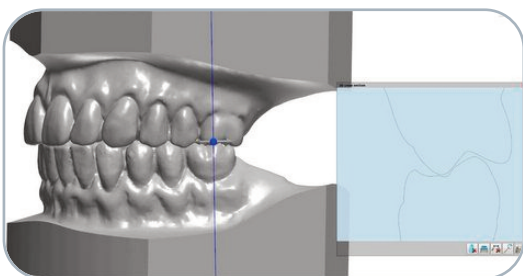


Figure 4 – Digital Dentures – planning the occlusion.

- **Selection of Teeth** – this could be done virtually and the teeth could be set up in the desired occlusal scheme within the denture design software. Where this takes place the teeth need not be set-up in wax and any change from balanced to lingualised occlusion or vice versa may therefore be performed digitally.
- **Digital Manufacture of Dentures** – after the denture design has been fine-tuned and

confirmed the dentures are constructed. This may be done by a milling machine or 3D printing.

## Occlusal Schemes

A key stage of conventional denture construction is the setting of the denture teeth on a wax base. The clinician will advise the dental technician on the selection of the appropriate mould and shade and would record the necessary anatomical detail such as the desired vertical dimension, the incisal relationship, the mid-line and the intra-alar distance<sup>4</sup>. The technician is then able to set up the denture teeth with regard to this information to achieve a natural-looking appearance and a functional occlusal scheme.

Lang, in a review of occlusal philosophies<sup>5</sup>, stated that the occlusal scheme for complete dentures has a direct influence upon their stability and to a lesser extent retention and support, all consequently having an effect upon their success. According to Lang three groups of occlusal forms are available:

- **Anatomic.**
- **Non-anatomic.**
- **Zero-degree teeth.**

The Glossary of Prosthodontic Terms provides the following definitions apply to each type:

- **Anatomic** are teeth that have cuspal inclinations greater than zero degrees and tend to replicate occlusal anatomy. Such teeth may have cuspal angles set to 20 degrees, 30 degrees, 33 degrees or 45 degrees.
- **Non-anatomic** teeth are designed in accordance with mechanical principles rather than from an anatomic standpoint.
- **Zero-degree teeth** are posterior teeth that have zero-degree cuspal angles.

Traditionally the two most common types of posterior tooth set up are bilateral balanced occlusion and lingualised occlusion.

“Complete dentures were required to maintain their ability to function during mastication by means of stabilising contacts. This led to the logical development of full-balance occlusion concept”<sup>6</sup>. In the scheme of balanced occlusion the palatal cusps of the upper teeth are in contact with the fossa of the lower teeth and the buccal cusps of the lower teeth are in contact with the fossa of the upper teeth in centric occlusion. At rest the buccal cusps of the upper teeth and the lingual cusps of the lower teeth are not normally in contact with the opposing teeth but do come into contact during excursive movements.

The advantages of balanced occlusion are:

- Distribution of load.

- Stability.
- Protection of the TMJ.
- Reduced trauma on initial insertion.
- Functional movement.
- Masticatory efficiency.
- Comfort.

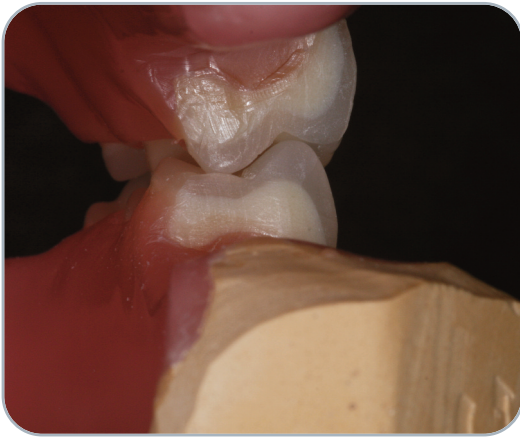


Figure 5 - Denture Teeth Set Up Showing Balanced Occlusion.

and working side teeth are in simultaneous contact over a small range of lateral excursions.

A modified version of balanced occlusion known as “lingualised occlusion” was first introduced by Gysi<sup>9</sup> in 1927. He almost eliminated the maxillary buccal cusp and the net result was a prominent palatal cusp that occluded into the lower anatomic teeth.



Figure 6 - Denture Teeth Set Up Showing Lingualised Occlusion.

However, there are a number of concerns with this occlusal scheme.

- It is a man-made concept that does not exist in nature. Indeed, Dawson<sup>7</sup> comments: “Many dentists have tried to apply the same concept of bilaterally balanced occlusion to the natural dentition but have abandoned the idea because of the disastrous clinical results. Hypermobility, excessive wear and periodontal breakdown seem to be the rule rather than the exception, since the posterior teeth succumb to the effects of the so-called balance.”
- The lingual cusps remain high – to protect the tongue – giving a negative Curve of Wilson.
- However, the patient cannot bite as well and it encourages the patient to chew sideways, like a cow, which is neither good for the joints nor the edentulous ridges.
- It is extremely difficult to set up and achieve, the cusps need to be shorter, the teeth flared and aesthetics is poor.

In lingualised occlusion the palatal cusps of the upper teeth engage in the central fossa of the lower teeth with the buccal cusps of the upper teeth tilted at such an angle so that in normal function they never come into contact with the lower teeth. In this arrangement any cusps of the lower teeth only come into contact with the upper teeth during excursive movements. In previous examples of teeth designed for lingualised occlusion the lower teeth frequently have cusps with a very low incisal angle or have fewer or smaller cusps or the occluding surfaces may have a saucer shape in which the upper palatal cusps move. The advantages of lingualised occlusion are:

- Reduced lateral stresses and dislodging forces.
- Stability.
- Ease of set-up as centric limited to the centric stop in the fossa.
- Excellent aesthetics with buccal cusp form retained.
- Enhanced functionality with good penetration of the food bolus.
- Vertical forces are more in line with the alveolar ridge.

In their guide describing Enigma<sup>1</sup> Tooth Set Up<sup>8</sup>, Bourke and Besford state that balanced occlusion refers to “simultaneous sliding contact of posterior teeth on both sides of the jaw in small lateral and protrusive excursions (up to 2mm).” They suggest that the upper posteriors are set with their palatal cusps centred bucco-lingually over the crest of the lower ridge, so that the central fossae of the lowers sit over the crest of the lower ridge. The buccal cusps of the molars are arranged to follow the compensating curve starting with the palatal cusp of the first premolar. The lower posterior teeth are set up to ensure that the upper and lower buccal cusps are in contact as well as the lingual cusps and that the balancing

In their guide on Tooth Set Up<sup>10</sup> Bourke and Besford state that “in the lingualised occlusion concept the lingual cusps of the upper posteriors bite into the central fossae of the lowers.” However the contacts are only on the upper palatal cusps and the upper buccal cusps do not contact the lower teeth in either balancing or working excursions.

It is clear from the literature that differing views abound on whether a balanced occlusion or lingualised occlusion scheme is required, yet no randomised controlled trials have been identified to date, which justify the validity of one philosophy over another. “A suitable occlusal scheme would be a critical factor for a successful complete

denture. However, there is no conclusive evidence to support which occlusal design is more appropriate for fabricating a successful complete denture. In occlusal design of conventional complete denture, lingualized occlusion can provide better clinical outcomes than other occlusal designs; meanwhile, canine-guided occlusion also can be used in clinic practice.”<sup>11</sup>

“Canine guided occlusion implies uniform contacts at maximum intercuspation position while during laterotrusive movement contact only occurs on the canine with every tooth movement, even non-working side, contact considered as an interference.”<sup>12</sup> Balanced occlusion attempts to enhance denture stability by maintaining contacts during lateral and protrusive movements. However, the theoretical benefits of this concept have to be questioned as the introduction of a food bolus prevents the concept functioning as proposed.

In canine guidance the only contact in eccentric movements is on the canines, which theoretically creates an oblique force capable of dislodging the denture. So, for many clinicians it seemed intuitive that canine guidance would result in an inherently unstable denture. However, Farias et al<sup>13</sup> report that “it did not happen. Thus, it is supposed that canine guidance does not decrease retention and stability.” They also highlight the importance of training the patient to use complete dentures with a canine guided-scheme, so as “to avoid these problems in denture retention, stability and bone resorption, it seems to be more reasonable to instruct the patient not to incise, but rather put small pieces of food in the mouth and masticate on both sides of the arch.” Additionally, Peroz et al<sup>14</sup> reported that “EMG-based studies suggest that the patients seem to avoid eccentric movements, as they did not notice the loss of retention of the maxillary dentures. On the contrary, they noted a significant improvement in chewing ability with canine-guided dentures.”



Figure 7 - Denture Teeth Set Up.

There are different theories as to why one scheme is better or worse than the other and many previous designs of teeth can be set up by the technician, skilled in their art, to be used in either format. However, in such teeth the set up has to be made differently for each format and in order to change from a balanced occlusal concept to a lingualised occlusal concept or vice versa the teeth have to be re-set up on the wax base or the occlusion/cusps reshaped by grinding to conform to the new scheme.

Setting up teeth for bilateral balanced occlusion is a complex and time consuming process for the dental technician. Whereas the setting up for lingualised occlusion and canine guidance can be more straightforward, although changes between the occlusal schemes is not easy.



Figure 8 - enigmalive Dentures.

## A New Concept

A new range of denture teeth, enigmalive S Posterior Teeth<sup>ii</sup>, have been introduced to allow more flexibility in establishing the correct occlusal scheme for each individual patient. Posterior denture teeth require proper proportion and morphology in order to support the condyle when loaded axially and provide stability. These teeth have been designed for implant-stabilised and partial dentures, where the fuller form allows them to be readily adapted to the underlying implant structures and to the remaining natural dentition.



Figure 9 - enigmalive P Posterior Teeth.

enigmalive S Posteriors have been developed by the world leading gnathological expert, Professor Rudolf Slavicek<sup>iii</sup>. They have been designed to replicate the form and function of natural teeth with a cusp angle of 35° and provide a precise occlusal relationship and can be readily set up in virtually any occlusal concept. The statement “The quality of intercuspation is important for the physiology of chewing”<sup>15</sup> refers to natural teeth, but is equally valid for denture teeth.

This new design of artificial posterior denture teeth presents clearly defined palatal stamp cusps on the upper teeth and centric stops on the occluding surfaces of the lower teeth and is particularly of merit for complete dentures. A stamp cusp is a tooth cusp that, when the tooth is in occlusion, fits in the fossa of the antagonist in a

mortar-and-pestle fashion. Centric stops are the stable points of contact between occluded maxillary and mandibular teeth and are located in the central fossae of the antagonists. The denture tooth design enables the denture teeth to be easily set up in either a lingualised or a balanced occlusal scheme. However, if the chosen scheme proves not to be acceptable in a particular clinical case, then the dental technician can readily change to the alternate occlusal scheme. This is achieved by softening the wax under the upper posterior teeth and rotating the teeth, the tooth shape allowing a simple rotation around one or more stamp cusps of the upper posterior teeth which still remain within their occlusal stops in the opposing lowers. Professor Slavicek recommends that teeth be set up in lingualised occlusion because this occlusal scheme directs the forces towards the remaining bone, avoiding any harmful forces.

However, each individual clinical scenario may require a different approach and Enigmalive S posteriors have been designed to set easily both in fully balanced occlusion, lingualised occlusion and in crossbite. The Enigma System creates a denture that is designed for the individual patient, so the "occlusal plane" is called the aesthetic plane and reflects what looks right for the patient's face. Average measurements, whilst helpful, often lead to a stereotype denture appearance that fails to live up to the potential of a beautiful creation capable of changing a patient's life.<sup>iv</sup>

The well-defined stamp cusp and fossae relationship will assist the patient in adapting to complete dentures as they become aware of the prosthetic seating. This process can be enhanced if the patient is encouraged to learn how to swallow liquids with the teeth together in order to keep the dentures stable. The patient should also be encouraged to undertake chewing exercises, creating a frontal loop instead of exaggerated lateral excursions. The well-defined and stable cusp-fossae relationship, irrespective of the occlusal scheme, facilitates this training and enhances the outcome for the patient with complete dentures.



Figures 10 & 11 – Dentures with enigmalive Denture Teeth.



iv. Sutton F & Garstang R. enigmalive S Posteriors Tooth Set Up Guide. Schottlander, Fifth Avenue, Letchworth Garden City, Hertfordshire, SG6 2WD.

## Conclusion

- The requirement for dentures, both partial and complete, will remain an important aspect of modern dentistry for many years to come.
- The construction of dentures is complex, involving a number of clinical and laboratory stages.
- Complete dentures can be set up in a number of occlusal schemes including bilateral balanced occlusion, lingualised occlusion and canine guidance.
- There is no conclusive evidence suggesting that a particular occlusal scheme should always be used for complete dentures. However, setting up for bilateral balanced occlusion is complex and time-consuming, whereas lingualised occlusion and canine guidance are more straightforward.
- The new range of enigmalive S Posterior Teeth provide a precise occlusal relationship and can be readily set up in virtually any occlusal concept.

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Additional photography provided by Ian Taylor, Clinical Dental Technician at The Dental Spa, Shrewsbury.

For further information on enigmalive teeth please contact **Schottlander on freephone 0800 97 000 79**, **sales@schottlander.co.uk** or visit **www.schottlander.com**

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