Masterclass in Clinical Practice

Dental Implants

with

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Developing the emergence profile: Part 1 Healing abutments

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Introduction

A dental implant and its implant-supported crown should always aim to replicate the size and shape of the missing natural tooth/teeth it replaces. This is important for aesthetics, function, plaque control access and long-term success of the treatment. The ideal 3-dimensional positioning of the implant is crucial and, for purposes of this masterclass, this aspect as well as quantity of soft tissue will be assumed to be ideal.

This Masterclass is Part 1 of a series of 3, which will focus on the soft tissue training and development of the emergence profile using healing abutments (Part 1) and provisional restorations (Part 2). Part 3 will provide tips to accurately relay the morphology of the emergence profile created to the dental technician to assist with the design and fabrication of the final implant-supported restoration.

Define emergence profile:

The emergence profile is the contour of the implant restoration as it emerges from the implant platform.[1]

To develop the soft tissue around an implant restoration, one needs to understand the natural tooth's soft tissue biology and the differences between the two. There are significant differences between a natural tooth's transmucosal zone (the dentogingival unit) and that of an implant. The dentogingival unit consists of three sections. Most apically the supra-crestal fibres insert into the cementum of the root (approximately 1mm in dimension). Moving coronally we find the junctional epithelium which is attached to the enamel via hemi-desmosomes (approximately 1mm in dimension) and coronal to that the gingival sulcus (also close to 1mm in dimension). This unit is known to many of us as the Biologic Width although this term is not used anymore.

The dentogingival unit is a very stable environment when healthy and should not be invaded by restorative margins deeper than 1mm. It has a richer blood supply than peri-implant gingiva and this ensures a more efficient inflammatory response to fight plaque bacteria.

The implant-gingival unit is different in that it has no fibres inserting into the abutment/implant, with the collagen fibres running parallel to the abutment/implant. This is not as effective to prevent sub-gingival bacterial migration or to create a stable gingival architecture. The full length of the attachment of soft tissue to the implant/abutment is via hemidesmosomes which may break down easier once bacteria are allowed to accumulate at the gingival margin - leading to pockets around the implants with the potential of bone loss.[2]

It is important to ensure that the implant is surrounded by attached keratinized tissue to ensure that the transmucosal component around the implant protects the underlying bone and creates a stable implant-gingival unit. The width and thickness of keratinized tissue affects not only the health of the peri-implant gingival component, but also the aesthetic outcome.[3] Against this background it is easy to understand that the shape of the implant restoration is of great importance to form and support the gingival architecture as it has no fibre insertion to aid this process.

According to Gomez-Meda et al. (2021) the aesthetic biological contour concept guides the development of the emergence profile of an implant supported restoration.

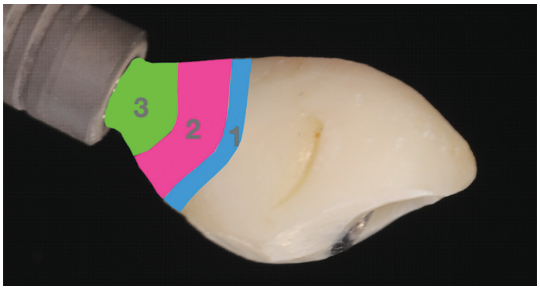

Figure 1: The aesthetic biological contour concept as described by Gomez-Meda et al. 2021

Figure 2: CT image showing the different shapes of teeth 11-16 at the crest of the alveolar bone.

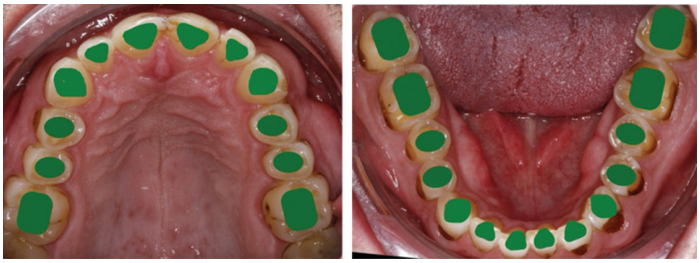

Figure 3: Axial view of the maxilla and mandible clearly illustrates the different shapes of teeth within the trans-mucosal zone. A round implant and healing abutment cannot satisfy the aesthetic and functional requirements of such a variety of shapes.

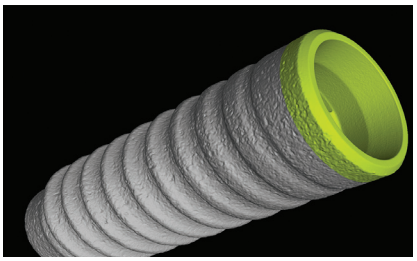

Figure 4: Implants are round in cross-section and this shape does not mimic the natural tooth.

The subgingival contour of the emergence profile consists of three zones (Fig. 1).[4]

1. E Zone (Esthetic Zone) which is the first 1mm apical to the free gingival margin and should be convex to match the shape of the tooth being replaced or the contralateral tooth.
2. B Zone (Bounded Zone) is the next 1-2mm apical to the E Zone and is dependent on the implant positioning and quantity of soft tissue. A convex design may help create the illusion of thicker tissues.
3. C Zone (Crestal Zone) is the 1-1.5mm immediately coronal to the implant shoulder. The abutment in this area should be either straight of concave to allow space for the supra-crestal connective tissue and prevent bone remodeling.[4]

When looking at the natural tooth, the emergence profile of the crown differs depending on the type of tooth (oval, triangular and rhomboidal) (Fig. 2).

No natural tooth root is completely cylindrical in shape, as illustrated in Figure 3, however almost all dental implants are cylindrical in cross-section (Fig. 4), with the only differences being the diameter of the cylinder. The size of the dental implant placed can be selected based on the type of tooth being replaced, for example a narrow diameter in a lateral incisor site and a wider diameter in a molar site.

It is therefore clear that the components we attach onto the implant and the implant-supported crown will be responsible for recreating the shape and size of the missing natural tooth/teeth and the ideal morphology of the peri-implant soft tissue.

What can be used to shape the emergence profile?

When a dental implant is surgically placed, the clinician may opt to immediately attach the compatible healing abutment onto the implant and suture the gingiva around the healing abutment, or a cover screw may be placed on the implant and the gingiva sutured over the implant to allow for undisturbed, submerged healing. With the latter, a second stage surgery will be required to expose the implant and attach the healing abutment once sufficient healing has occurred.

There are three main functions of the healing abutment, namely:

a. Protection – During the healing post-implant placement, it protects the implant platform and the peri-implant soft tissue.
b. Soft tissue shaping – The healing of the peri-implant soft tissue takes the form (shape and contour) of the healing abutment.
c. Access – Allows the clinician access to the implant for integration assessment, impression taking and fitting of the restorations.

Types of healing abutments

1. Standard stock healing abutments (One-piece or two-piece)
2. Temporary abutment with added composite resin
3. Customizable healing abutments (prefabricated)
4. Customizable healing abutments utilizing CAD/CAM (laboratory fabricated)

1. Standard stock healing abutments

The latest stock healing abutments, such as the BLX system from Straumann® come in different gingival heights (GH). This is the emerging part of the healing abutment, which is concave in shape, allowing for soft tissue development during healing. The upper cylindrical part also comes in

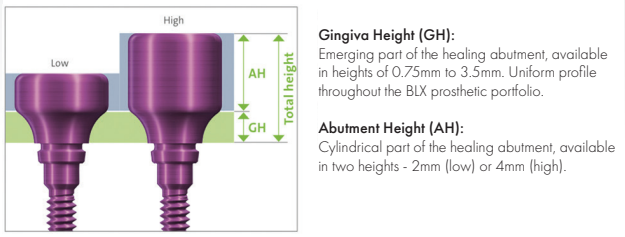

Figure 5: The total height of a healing abutment is the sum of the gingiva height (GH) and abutment height (AH)

Figure 6: Healing abutments used to be round in all cases but of late some companies have launched a range of anatomically correct healing abutments.

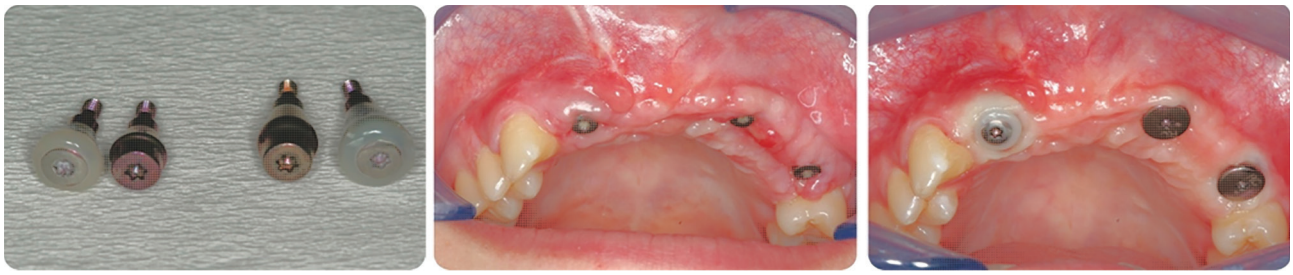

Figure 7: Standard healing abutment in the top right lateral incisor site (12) has been modified with composite resin to facilitate shaping of the emergence profile.

different abutment heights (AH). Together the GH and AH form the total abutment height (Fig. 5).

The surgeon should consider the correct GH to accommodate the depth of the implant in relation to the crestal bone height. The AH should allow the healing abutment to emerge through the soft tissue so that the restorative clinician has adequate access to the implant, without overgrowth of soft tissue.

When choosing the final abutment, the restorative clinician should choose the same GH of the abutment as that of the healing abutment, so that there will be no impingement of soft tissue or bone, and that the soft tissue will be supported as was developed during the healing phase.

Up to now, all healing abutments were also round (Figure 6) and the only solution for a more anatomically correct healing abutment was to customize it. This was done by either modifying a healing abutment with composite (Fig 7), alternatively shaping a titanium two-piece abutment (Fig 8). Over the past year, anatomically shaped healing abutments have become available and in future one can expect more companies to follow this trend (Fig 9).

When the restorative clinician examines an implant case and finds the healing abutment is too narrow to accommodate a definitive implant crown, the healing abutment can simply be changed into a wider AH healing abutment, so that the emergence would correspond better to the final crown

Figure 8: On the left a healing abutment with a separate screw is flattened on the facial aspect to create a slightly better profile than a round healing abutment would. This cannot be done if the healing abutment is a solid piece as one cannot get an exact positioning of the healing abutment after flattening the facial side. With the separate screw the healing abutment can be orientated with the flat side on the facial aspect before tightening. On the right one can see the flatter facial gingival profile created like this.

Figure 9: Anatomical healing abutments available in different sizes/shapes (Megagen®, Korea). On the left the triangular shape for a maxillary incisor and on the right the oval shape of a premolar and rectangular shape of a molar. This will provide a more anatomically correct soft tissue profile.

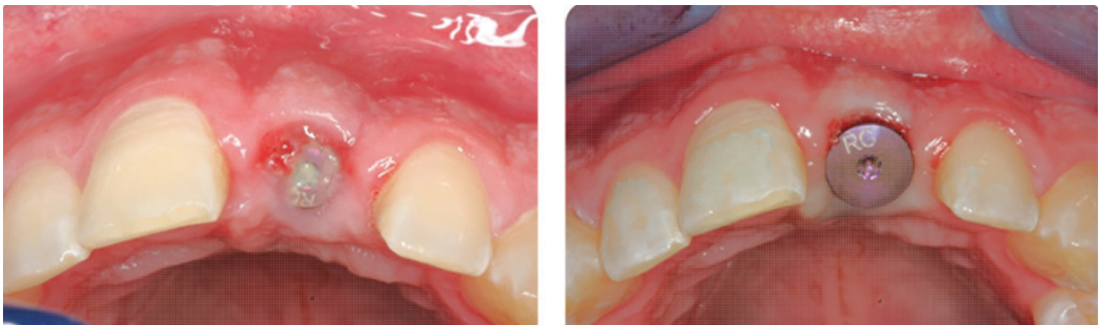

Figure 10: The replacement of a narrow healing abutment (left) with a wider healing abutment (right) prevents soft tissue overgrowth during the healing phase. Note the blanching within the gingiva from the pressure. This blanching should disappear within 5 minutes. If necessary, loosen the HA to allow blood flow into surrounding gingiva a few times and slowly tighten again until blanching disappears after 5 minutes.

emergence (Fig 10). It is important not to stress the tissue too much in this procedure as necrosis may follow. If the healing abutment needs to be much wider, a small incision may release the tissue tension and prevent necrosis.

2. Temporary abutment with added composite resin

If an implant is placed too deep to accommodate the use of a standard stock healing abutment, a temporary abutment can be modified by the addition of composite resin. The composite resin part can further be modified into a more concave shape above the implant shoulder, and the tooth shape can be mimicked by the shaping of the resin (Fig. 11)

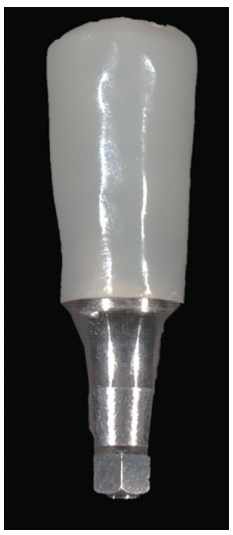

Figure 11: Temporary abutment modified with composite for an implant placed deeper than usual.

3. Customizable abutments (prefabricated)

With a customizable healing abutment, the idea is to create an emergence profile of the peri-implant supporting tissue immediately after implant placement achieving a natural appearance and promoting peri-implant soft and hard tissue maturation.

Several implant companies have the option of a customizable healing abutment. This customizable healing abutment is usually fabricated from a polyetheretherketone (PEEK) which can be trimmed and polished according to the desired, site-specific emergence profile (Fig 12).

4. Customizable abutments utilizing CAD/CAM.[5]

In combination with a dental laboratory, digital technology may be used to design a customizable abutment which accurately replicates the emergence profile of the natural tooth.

A digital intra-oral impression and CBCT are taken to capture the patient's socket size dimension at the CEJ level (Fig 13). The customized healing abutment is then designed and milled using CAD/CAM technology or can be printed after digital design. It features a concave transmucosal design with an emergence profile to become gradually convex with an emergence angle not exceeding 30 degrees.

This information can be merged with the implant planning to design and fabricate the customizable abutment prior to surgery. This healing abutment then accurately recreates the patients' soft tissue and is modified in its dimensions and transmucosal zone to guide peri-implant tissue into the proper shape.

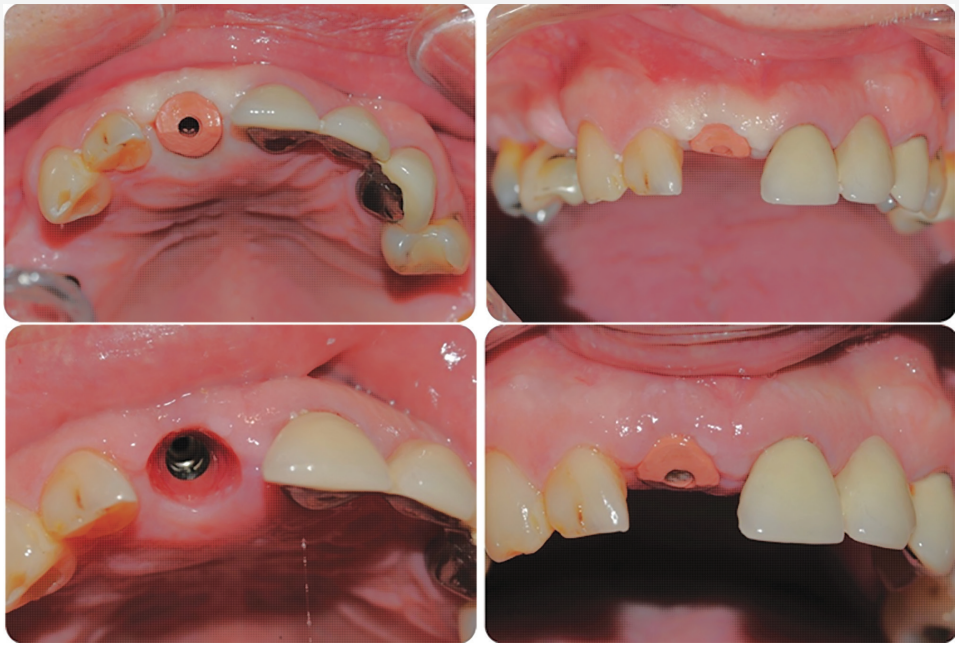

Figure 12: The PEEK abutments are adjusted according to the desired emergence profile and attached onto the implant either at time of surgery or during the tissue conditioning phase. The ideal emergence profile can be seen in the bottom left image.

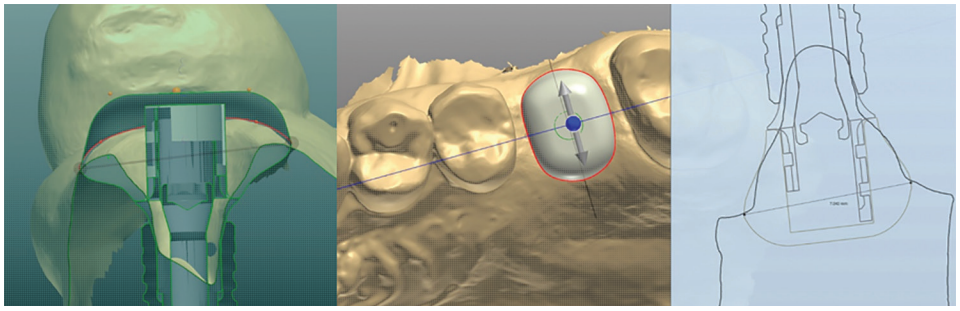

Figure 13: Information from a digital intra-oral impression and a CBCT prior to tooth extraction can be used to recreate the ideal emergence profile as a customized abutment.

Polymethylmethacrylate (PMMA) and polyetheretherketone (PEEK) are commonly used, but zirconia abutments have also been described.

The designed part is then cemented onto a Ti-base or titanium temporary abutment, after which it is polished and finished to be placed directly after the correct 3-D planned implant placement (Fig 14 and 15).

Importance of the Emergence Profile:

a. Aesthetic appearance of the restoration – If the emergence profile has been created properly, the final restoration will blend seamlessly with the surrounding soft tissue and the adjacent teeth. Ideally the implant-supported restoration should appear to "emerge from the soft tissue" with a natural transition (Fig 16).

b. Stable peri-implant soft tissues – Tight, closely-adhering, healthy peri-implant soft tissue helps to minimize the risk of food impaction and bacterial infiltration around the implant, thereby ensuring long term health of the surrounding soft tissue (Fig. 16).

c. Oral hygiene maintenance – Proper restoration contours will ensure that the restoration is cleansable by correct brushing and flossing.

A poorly designed emergence profile can lead to:

- gingival recession - exposing the abutment or eventually the implant itself,
- ridge-lap prosthetic design to attain aesthetic outcome but compromising the maintenance of oral hygiene (Fig 17).
- Poor aesthetic outcome.

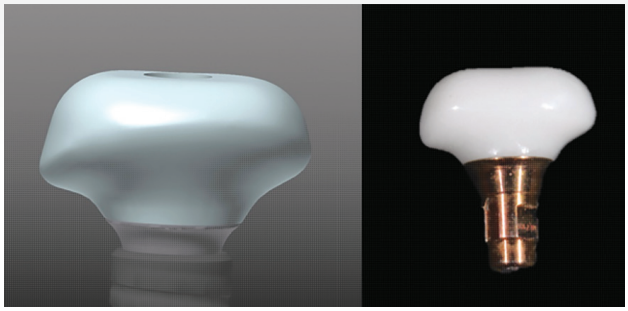

Figure 14: The digitally designed customized abutment (left) versus the polished customized abutment (right) ready for insertion at time of surgery.

Conclusion

Ideal emergence profile design aids prosthetic crown design to facilitate soft tissue support, prevent recession, minimize food impaction, and facilitate proper oral hygiene measures by the patient. Ideal emergence profile design can be achieved by modifying standard healing abutments or temporary abutments with composite resin, using the new generation anatomic healing abutments, utilizing prefabricated customizable healing abutments, or merging the information from pre-operative intra-oral impressions and CBCT to fabricate a customized healing abutment in the laboratory.

Figure 15: The polished customized on the printed model (top) and intra-oral after a period of healing (bottom).

Figure 16: Implants were placed in 11 and 21 positions after removal of the two fractured teeth. The implant crowns appear to emerge from the gingiva like the adjacent teeth. Patient education was done, and the improved plaque control can be seen at follow up of the final crowns.

Part 2 will guide the development of the emergence profile using fixed, provisional implant-supported restorations and clarify when and how you should be modifying the contour to recreate the natural emergence profile.

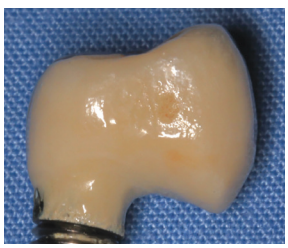

Figure 17: A ridge lap crown design shows a situation which is impossible to maintain healthy due to poor emergence profile design.

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