

Emergence profile management in the esthetic zone

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SUMMARY

Objective. Implantation and prosthodontics in the anterior zone are considered the most difficult procedures in dentistry. Creating an appropriate emergence profile is necessary to achieve both stable peri-implant tissues and esthetically acceptable outcomes with implant-supported restorations, especially when conditions are limited. This article provides clinical recommendations and presents solutions on how to establish a proper emergence profile when unfavorable clinical outcomes occur.

Materials and methods. Online database PubMed and Cochrane Library were searched by using the following keywords in various combinations: dental implant, emergence profile, esthetic zone and soft tissue shaping. All studies fulfilling the selection criteria were carefully reviewed and 8 studies that met the principles were selected for this review.

Clinical considerations. The emergence profile is influenced by multiple factors, including the position of the implant and the surrounding soft tissues. It is essential to have a thorough understanding of different zones of the emergence profile and their relationship with various factors, such as implant position and soft tissue quality. The guidelines presented in this article shows possible manipulations on the restoration design according to implant position and surrounding soft tissues.

Conclusions. Implant position and soft tissue condition have to be evaluated carefully before making prostheses in order to achieve the proper esthetic view. Understanding distinctive emergence profile characteristics results in the best possible esthetic outcome.

Clinical significance. Acknowledgement of how to design an emergence profile when clinical conditions are not in clinician's favor helps to accomplish sufficient results.

Keywords: dental implant, emergence profile, esthetic zone, soft tissue shaping.

INTRODUCTION

One of the most challenging procedures in dentistry is implantation and prosthodontics in the anterior zone. There are many issues to consider for the best possible esthetic outcome (1). Natural-looking implant-supported restoration – always a desirable prosthetic outcome – is determined by the emergence profile, which can be manipulated by various factors (2, 3).

Emergence profile is the contour of a tooth or restoration, such as the crown on a natural tooth, dental implant, or dental implant abutment, as it relates to the emergence from circumscribed soft tissues (4). It plays a significant role in the creation and maintenance of the gingival architecture,

determining the definitive shape and anatomy of the peri-implant soft tissues (5).

Planning implant placement and restoration requires a fluent collaboration between an oral surgeon and a prosthodontist. The dimensions that must be considered during implant placement are depth, buccolingual and mesiodistal positions, and axial inclination. According to those parameters, the implant-supported restoration can be manipulated to achieve the best esthetic outcome.

Unfortunately, it is not always possible to place the implant ideally due to the unfavorable state of the soft and hard tissues, the patient's financial situation, or the motivation to collaborate. In those cases when implant position or soft tissue conditions are not in our favor some challenges occur when creating an esthetic emergence profile. In those situations, a clinician has two options – to accept the poor outcome or manipulate the clinical case by restorative or surgical procedures – soft/

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hard tissue augmentation or even implant replacement.

Ideally, immediate implantation is a perfect solution to be performed if there are no contraindications for it – in that way the emergence profile can be maintained, and the further prosthetic process is optimized.

The situation mentioned above meets the perfect circumstances and creating the appropriate emergence profile requires only following the ideal clinical case protocol.

As known, it is very common to follow the key elements for optimal emergence profile in order not to cause any hard or soft tissue loss. The purpose of this article is to introduce the main factors that are needed to create an emergence profile in the esthetic zone and to present the solutions to unfavorable clinical outcomes when clinical conditions are limited. The clinical protocols and the proper selection of the right one will be presented and discussed.

MATERIALS AND METHODS

Search strategy

A comprehensive research was conducted on both Pubmed and the Cochrane Library to indicate articles published up to January 2015. The search utilized the following keywords: “dental implant”, “emergence profile”, “esthetic zone” and “soft tissue shaping”. This inquiry retrieved a total of 68 publications.

Study selection

Our study selection process adhered to strict criteria to ensure the quality and relevance of the included articles. We limited our search to articles published in English, followed by a meticulous screening of titles and abstracts for suitability. Further selection and filtration were done by reading the titles of the articles and their abstracts. Publications were screened to exclude studies that did not focus on emergence profile shaping in the esthetic zone on implants, studies exploring soft tissue management in the posterior zone and studies involving animal models. No duplicates were identified. To be included in this literature review, studies had to focus on restorative dentistry in the anterior zone on implants contouring soft tissues, relation between implant position and soft tissue thickness had to be clearly defined. After review and data extraction 8 studies met the inclusion criteria and they were included in the final review.

Factors which determine the success of the emergence profile

The emergence profile is part of the implant-abutment-restoration component that extends from the alveolar bone to the free gingival margin (6). The subgingival contour of the emergence profile of an implant restoration consists of three main zones: E, B, and C (Figure 1). Each of these zones will be in contact with a specific type of tissue, and its design will have a different function (7).

E zone (esthetic zone)

E zone is the subgingival area that is apical to the free gingival margin, about 1 mm in length (8). It should imitate the natural tooth appearance thus it has to be the same shape as the contralateral or extracted tooth. The E zone on the temporary (or definitive) crown should uphold a free gingival margin in the right position. Ideally, it should have a convex contour. If an implant happens to be in a buccal position – the E zone should be straight or concave. (9). Concavity in this area might cause a deficiency of soft tissue support and might result in a poor esthetic outcome. Overcontoured (an excessively contoured) E zone might also cause the recession of the free gingival margin and compromise the long-term esthetic result (8).

B zone (bounded zone)

B zone is described as the area, which is positioned apically to the E zone. As it is considered, an ideally placed implant is 3–4 mm apical (10) to the restorative tooth zenith point. The B zone is approximately 1-2 mm (11) and it is influenced by the quality and quantity of the soft tissues and the implant position. In case there is a lack of surrounding tissues, the esthetic outcome can be improved with connective tissue graft by enhancing the gingival phenotype. Additionally, the convex design may create an illusion of thicker tissues (8, 12). Also, it is important to mention that the shape of the B zone is determined by the position and design of the implant neck (10).

C Zone (crestal zone)

The C zone is described as the 1-1.5 mm length area located closest to the implant platform (13, 14). As the purpose is to achieve the best esthetic outcome, it is necessary to avoid pressure on the surrounding hard tissues – this can be obtained by making a straight or slightly concave design of the C zone (10). Also, it is not allowed to over-contour the provisional restorations to prevent bone remodeling, which might lead to bone loss, and maintain



Fig. 1. Biological contour zones of the emergence profile on implant-supported crown

the supra-crestal connective tissue (15). In summary, the most manipulative zone is the C Zone – it can be changed by 3 main variables: implant design, its width, and the depth of implant placement (implant depth) (16).

The proposed EBC emergence profile zones help us understand adequate emergence profile designs and achieve the best esthetic results as well as biologically stable conditions avoiding bone remodeling and recession of the soft tissues.

Aesthetic changes (PES) – objective evaluation of esthetics

There happen to be difficulties evaluating and recording esthetics of peri-implant soft-tissues in everyday restorative dentistry. Some clinicians use subjective questionnaires for patients where they can express their opinion about the appearance of the restoration and surrounding tissues. However, it is an insufficient evaluation method, thus Fürhauser and colleagues presented a more objective assessment method for soft-tissues around single implant restorations (3).

Pink Esthetic Score (PES) is used to evaluate peri-implant soft tissues in the anterior zone describing 7 variables: mesial papilla, distal papilla, soft-tissue level, soft-tissue contour, alveolar process deficiency, soft-tissue texture, and soft-tissue color. Each parameter is evaluated visually by comparing soft tissues around the implant-supported tooth with the contralateral tooth. Rating scores are 0, 1, and 2. 0 points are for a poor outcome and conversely 2 points – are for the best outcome. The maximum score possible is 14. Only papillae are evaluated as complete, incomplete, or absent. Evaluation of all other variables is performed using reference teeth (Figure 2) (3).

Even though the PES scale is a more objective evaluation than used before, the patient's opinion



Fig. 2. Implant-supported single-tooth restoration in region 11. PES scores: distal papilla = 2; mesial papilla = 1; soft tissue level = 2; soft tissue contour = 1; alveolar process deficiency = 2; soft-tissue color = 1; soft-tissue texture = 2. Overall pink esthetic score (PES): 11.

still has to be taken into account to predict the best esthetic outcome as well as patient satisfaction.

3D Implant Position

As well known, the state of the remaining soft tissues, abutment emergence profile, and implant platform type are the essential criteria for esthetic and biological outcomes. However, it is greatly dependent on the implant position (12, 17). The fundamental factor for long term esthetic and functional success is proper implant position in the bone, which includes the implant depth, interproximal position, bodily position, and axial inclination (17).

Implant Depth

Implant depth is the fundamental factor for shaping the emergence profile because it defines the transition between the implant platform and the restoration. In an ideal situation, the implant has to be placed 3-4 mm apically from the gingival zenith of the restoration (17). According to the authors, placing the implant deeper can cause complications, such as mucositis and peri-implantitis (18). Meanwhile placing an implant less than 2 mm apically from the ideal zenith point of the future restoration creates esthetic and functional challenges, as the transition between the implant platform and the restoration becomes sharp.

Interproximal Position

The interproximal (mesiodistal) positioning of the implant has to be considered carefully – the optimal distance between the adjacent implants or teeth has to be objectively evaluated according to biological principles – it has to be at least 2-3 mm between the implant and neighboring teeth or implants (19). In case two implants are placed



Fig. 3. An X-ray of an implant-supported restoration tooth No.11. Slightly concave distal and convex mesial emergence profile due to distal position of an implant.

next to each other, it is important to ensure a secure distance between them. Otherwise, the height of the papilla between them will be reduced (20). Also, the mesiodistal position is usually determined by the gingival zenith of the anterior teeth because it adds value to the esthetic outcome (21). Even though the interproximal position of the implant looks correct according to the gingiva zenith, hard and soft tissues have to be assessed accurately (22, 23). The mesiodistal position of the implant will determine the design of the emergence profile. If the corresponding implant will be placed mesially, the mesial emergence profile curve will be slightly concave or straight, while the distal wall of the emergence profile will be more convex (Figure 3) (8, 24). Therefore, it is necessary to fabricate temporary crowns before making the final prostheses to acquire the best esthetic result.

Bodily position – palatalisation

The amount of present alveolar bone in the edentulous area determines the implant's bodily position (25). Ideally, a gap of about 2 mm between the implant and the buccal wall should be left for filling in the bone graft. This place is called the jumping distance (26). If the surgeon places the implant more palatally, the prosthodontist has more space for creating an ideal emergence profile (Figure 4). It is easier to manufacture concave or convex profiles, based on the amount of soft tissues and the prosthetic needs (12). If there is a lack of soft tissues – a convex emergence profile should be created to make the best possible esthetic appearance. And vice versa – overcontoured restoration may lead to gingival recession due to excessive

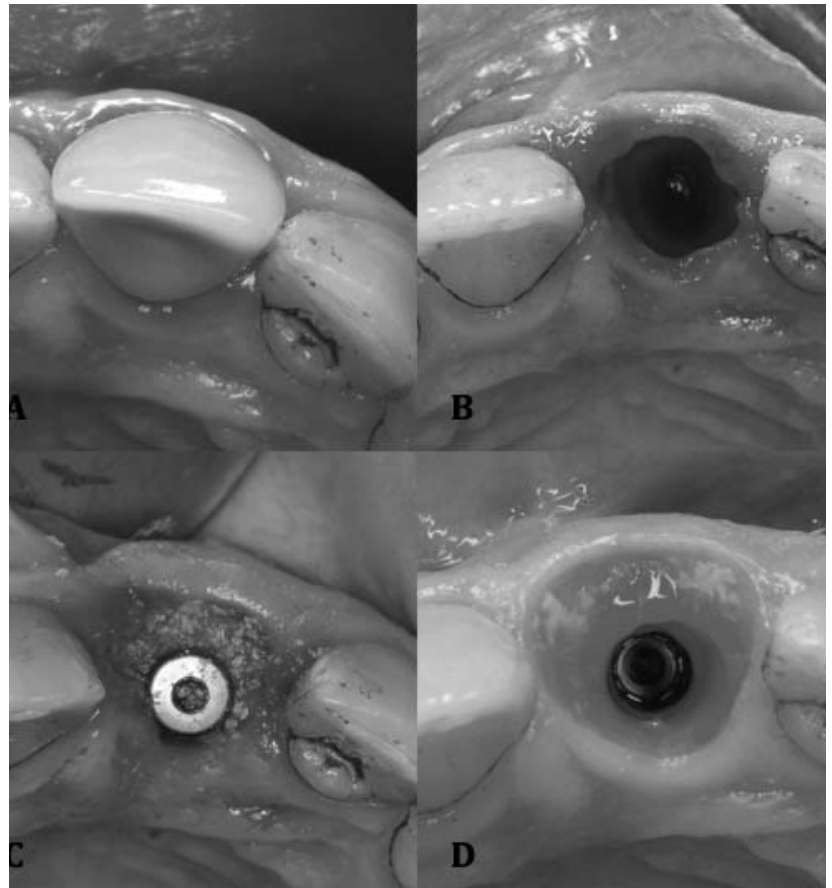


Fig. 4. A – initial situation; B – post extraction socket; C – immediate palatally placed implant with bone graft; D – ideal emergence profile.

pressure. To avoid the latter situation – connective tissue augmentation should be proceeded (10). Slightly bleached mucosa should be seen immediately after placing a restoration, this indicates that soft tissues have support and the pink color will return in a few minutes. Conversely, a greyish shadow will appear if the facial contour is not supported sufficiently (12). If an implant is placed labially, emergence profile formation is limited and only a flat and undercontoured profile is possible. Facial implant position usually determines poorer esthetic outcomes due to the lack of soft-tissue support (10).

Axial Inclination

The axial inclination of the implant defines its angulation orofacial and mesiodistally. Excessive tilting of the implant body and abutment in the buccolingual plane results in prosthetic complications, and reduction of the hard and soft tissues (Figure 5) (27). If the implant's inclination is facial – only a flat and undercontoured emergence profile is possible, which might lead to poor esthetic. Another problem is the width of the buccal wall of the alveolar bone – if an implant is tilted excessively facially the crestal bone is thin thus the most coro-

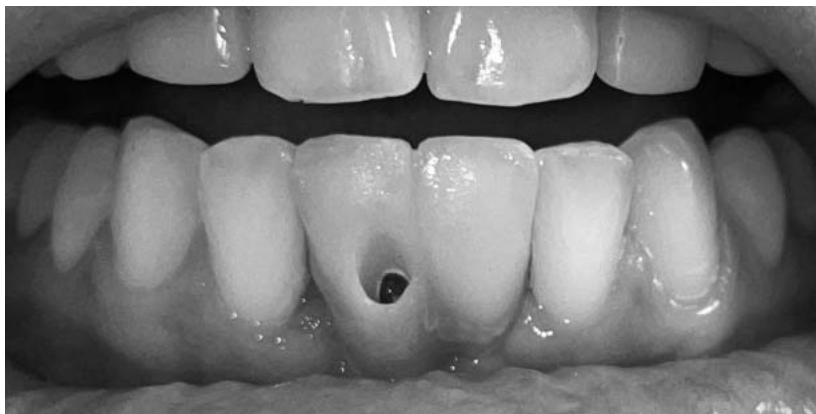


Fig. 5. Facial inclination of implant tooth No. 41, poor esthetics due to labial screw access. Insufficient soft and hard tissues, thus pink ceramic was used to create a natural-looking view.



Fig. 7. Implant supported restoration with evident flare emergence profile. Placing implant less than 2 mm apically from the ideal zenith point of the future restoration results in the sharp transition between the implant platform and the restoration.

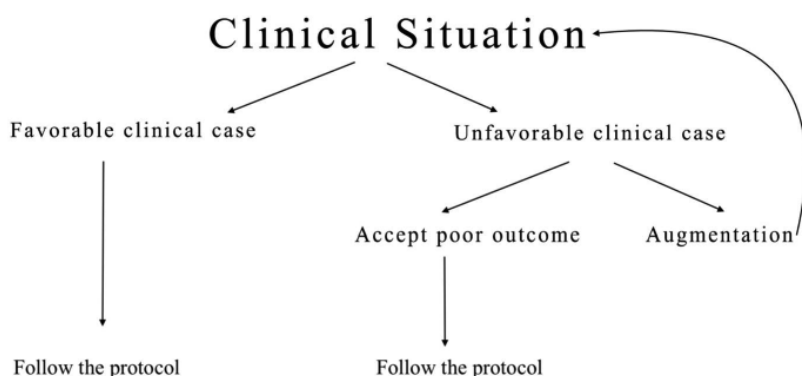


Fig. 6. Decision tree describing the solutions according to the clinical situation

nal part of the bone will happen to resorb (25, 26). As known, the bone in the posterior area is usually flat, whilst in the anterior region it becomes more convex-scalloped (28).

Soft tissue Biotype

It is known that the thickness of soft tissues is critical for positive clinical outcomes of implantation (29–31). In the literature thin gingival biotype is described as ≤ 1.5 mm thickness and conversely ≥ 2.0 mm is defined as thick (32). A thin biotype is always related to gingival recession. Another way to evaluate the thickness of soft tissues is transparency. If a periodontal probe tip put into the gingival sulcus is seen through the gingiva – the biotype is thin and if it is camouflaged by tissue – we consider it as thick (33). As well as gingival tissues, thin, compared with thick, peri-implant tissues are more prone to recession (30). As an esthetical outcome, especially in the anterior zone, is very important – a greyish shadow in the peri-implant gingiva, due to the thin biotype and transparency of the metal abutment could be considered as a failure (34). Therefore, taking into account esthetic and functional benefits, thick peri-implant mucosa is always desired.

In the peri-implant area, the thin tissue biotype is described as less than 3 mm thickness, conversely thick biotype is associated with more than 4mm density of mucosa. Correspondingly, due to the lack of thickness of soft tissues around implants, papilla recession may appear. Nevertheless, even in very complicated and unfavorable situations papilla loss is lesser due to thick peri-implant mucosa (33). Additionally, tissue thickness has an important role in immediate implantation. There are number of studies showing increased gingival recession in patients with a thin biotype in immediate implant placement cases in comparison with patients with a thick biotype, where gingival recessions are minor (35, 36).

Clinically, the thick gingival biotype has flat architecture thus shorter papilla occur and counter, thin biotype is associated with longer papilla. In the esthetic zone, especially having a thin mucosa biotype, soft tissue augmentation should be considered prior to the immediate implantation. It might help to maintain or recreate decent papilla height and to achieve the best possible result (37). On the other hand, the lack of papilla can be masked by contouring the prosthesis properly – creating the apically positioned contact point (29).

Peri-implant mucosa biotype is an important parameter esthetically and functionally by influencing the soft and hard tissue changes. It is desired to have a thick biotype, unfortunately, it is not always possible. It is critically important for clinicians to be able to evaluate patients’ mucosal phenotype and to proceed with surgical procedures such as soft tissue grafting if needed. Being able to see and manipulate

the peri-implant soft tissues lead us to more predictable surgical and prosthetic treatment outcomes.

CLINICAL CASES AND PROTOCOLS

Favorable conditions

As there are many variations of how an implant can be placed into the alveolar ridge, we have chosen to describe the most contrary clinical cases – the best and the worst clinical situations, which can reveal the importance of immediate implant placement. The guidelines for the different clinical cases are presented in the decision tree below (Figure 6).

According to mentioned factors that influence the esthetic success in implants' prosthetic dentistry, the best circumstances before making a final restoration were characterized as 4 mm implant depth, palatal buccolingual position, the distance between the adjacent teeth or implants – 1, 5 mm, axial inclination – parallel to the adjacent teeth or implants (meaning that screw access has to be in the cingulum of the restoration), already shaped gingiva (meaning that immediate implantation was performed and emergence profile has been saved). Completing an optimal emergence profile after immediate implantation requires preparation before the surgical procedure is performed. To maintain bone stability, it is advisable to make a temporary crown straight after the implant is placed. It is important to consider that after taking the individual healing abutment (IHA) or temporary crown (TC) off, soft tissues are prone to collapse in a few seconds, so the emergence profile has to be registered quickly. When the IHA or TC is removed, and the impression transfer is immobilised the flowable composite is poured into the emergence profile space and light cured as quick as possible. After recording the emergence profile with a flowable composite there is no need to hurry – we can perform a conventional impression protocol by using the silicone impression technique, whether using an open or closed tray method.

After measuring and screwing a final restoration, the color of the gingiva has to be evaluated carefully. If the white coloration does not disappear, too much pressure is given to the soft tissues and gingiva necrosis can occur. Therefore, it is advised to screw the restoration gradually allowing the blood circulation to recover.

Also, the zenith of the restoration has to be taken into account – it can be compared to the zenith of the adjacent teeth. Interproximal spaces are considered to be resilient, letting the tooth floss pass them by. After checking all the parameters,

we can either accept the present clinical view or seek a better solution by making the corrections respectively.

Unfavorable conditions

When it comes to the prosthetics in the esthetic zone, the most difficult clinical case scenario is having these poor circumstances: implant placement depth is less than 2 mm, buccally positioned implant, an excessive facial inclination of the implant, thin gingival biotype and narrow screwed healing abutment. In this case, a few solutions have to be considered – we can either accept the poor or compromised outcome and make a limited restoration or soft tissue augmentation can be performed by creating better conditions for a final restoration.

If it is decided to accept the poor esthetic outcome, the only proposition that remains is to manipulate the shape of restorations' emergence profile. In shallow-placed implant cases a lack of soft-tissues could be compensated by creating a convex emergence profile of the restoration. However, too much pressure on soft tissue may cause gingival necrosis, which eventually leads to an even worse esthetic result. Excessive/evident flare emergence design can also be chosen to press the soft tissues and to form a sufficient esthetic outcome (Figure 7).

In other cases, when the poor esthetic outcome cannot be accepted and it is not planned to remove the implant, soft tissue augmentation can be performed. Hereby, sufficient volume of the gingiva can be obtained, which gives better conditions for an adequate emergence profile. Additionally, black triangles can be filled by augmented soft tissue, and the zenith of the restoration can be modified, which results in a better esthetic view.

DISCUSSION

The challenges associated with implantation and prosthodontics in the anterior zone of the oral cavity are of paramount concern in contemporary dentistry. In this discussion, we take a deeper look into the critical aspects highlighted in the introduction, emphasizing their clinical significance and practical implications.

The emergence profile, often considered a subtle element, holds immense importance in the field of dentistry, particularly in achieving an esthetic outcome. Its importance lies in its influence on gingival morphology which in turn shapes the appearance of final restoration. The key takeaway here is that precise manipulation of the emergence profile can lead

to remarkably natural-looking implant-supported restoration. This is the main consideration for dental professionals aiming to deliver the highest level results in esthetic cases.

Implant position is considered to be the most important factor for the best possible esthetic outcome, thus the collaboration between prosthodontist and oral surgeon is crucial. Numberless issues while restoring the anterior implant may occur if the communication among doctors is poor. Implant position planning by using surgical guides could help oral surgeons place an implant precisely. Accurate implant depth, maintenance of interproximal distance, palatal implant position and proper axial inclination will lead to a natural-looking emergence profile.

Real world scenarios in implant dentistry often present challenges that demand creative solutions. These challenges may include unfavorable soft and hard tissue conditions, financial constraints, or patient cooperation issues. When implant placement or soft tissue conditions do not align with the ideal, clinicians are faced with the decision to accept a compromised outcome or to intervene surgically or restoratively. This highlights the importance of a clinician's ability to adapt and perform.

Understanding and selecting the right clinical protocols is essential for navigating the intricacies

of implantation and prosthodontics in the anterior zone. There is no right approach. The choice of protocol depends on the specific clinical conditions and patient needs. It is crucial for the dental professionals to remain up-to-date with the research and advancements to make optimal decisions regarding the best protocols for their patients.

To conclude, the challenges and complexities of implantation and prosthodontics in the anterior zone require a multifactorial approach. Dental professionals must take into account the nuances of the emergence profile, embrace collaboration and be prepared to adapt to various clinical scenarios. By doing so, they can deliver exceptional esthetic outcomes that not only enhance patients' smiles but also their overall quality of life. Continuous research and innovation in this field will undoubtedly lead to further improvements in implant dentistry, benefiting both clinicians and patients alike.

CONCLUSIONS

For the most favorable esthetic outcomes in the anterior zone all important factors, especially hard and soft tissue presence and conditions, implant position, and optimal emergence profile should be carefully considered for every individual clinical situation.

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