The influence of supracrestal tissue adhesion on implant marginal bone level

Dental implants are widely regarded as the optimal replacement for natural teeth[1]. Although clinicians present this option to their patients with confidence in the long-term result, much remains unknown with regard to the aetiologies of certain biological, biomechanical (i.e., prosthetic) and aesthetic complications[2]; however, as health care providers, it is our responsibility to understand the implications of the decisions we make relating to the treatment of our patients. With dental implants, one of the determinants of success is long-term maintenance of marginal bone levels with minimal bone loss and a lack of complications[3].

Dental implant prosthetics can offer adept clinicians a critical tool for achieving long-term success with their patients' implants. The interaction of the prosthetic–implant connection with the peri-implant soft tissues can help to establish crestal bone levels and keep them stable. The vertical dimension is referred to as supracrestal tissue height (STH)[4], the dimension of soft tissue that surrounds an implant from the mucosal margin to the crestal bone. This has also been referred to as vertical mucosal thickness (VMT), but is most accurately termed supracrestal tissue adhesion (STAd)[5,6] as this draws parallels with the corresponding tooth dimension, supracrestal tissue attachment. It consists of a sulcular epithelium, junctional epithelium and fibrocollagenous connective tissue that is typically not attached to the abutment surface[7-9]. The interaction of STAd with its surrounding tissues is one of the keys to achieving predictable and long-term success in tooth replacement therapy with dental implants. STAd plays a critical role in marginal bone loss patterns, especially after prosthesis delivery[4]. Discussing STAd in both implant surgical and prosthetic therapy is an important way of predicting initial peri-implant bone remodelling, also known as aseptic bone resorption[10].

STAd in implant surgical therapy

In contrast to the dentogingival collagen fibres around natural teeth that insert into the cementum and bone, the fibres around dental implants are mainly parallel to the implant surface, providing a cuff-like barrier to bacterial invasion[11]. Even some of the earliest investigations into STAd of dental implants recognised that a "minimum width of peri-implant mucosa"[12] is required to establish optimal epithelial and connective tissue attachment and that peri-implant marginal bone resorption will occur if needed to create appropriate STAd[13]. Thus, STAd plays a critical role associated with marginal bone loss (MBL) as vertical positioning of the implant platform with respect to the alveolar crest could affect postsurgical bone remodelling, especially in bone-level implants. Thin VMT at the time of implant placement has been consistently associated with a larger amount of marginal bone loss[4,14,15]. Based on this finding, some authors have recommended soft tissue grafting procedures to increase vertical mucosal height at sites with a thin phenotype when shallow placement is necessary, but evidence in support of this is limited[16,17]. Subcrestal implant positioning was originally proposed as a clinical strategy to compensate for possible reductions in peri-implant marginal bone levels[18]. Anticipating the establishment of STAd by adapting apicocoronal implant positioning in relation to mucosal thickness may effectively prevent unwanted exposure of treated implant surfaces[19]. Avila-Ortiz et al[4] proposed a threshold of STAd (which they called STH) for use in future investigations and in daily clinical practice: short (< 3 mm) and tall (≥ 3 mm). These dimensions were based on the fact that the literature reported peri-implant STAd dimensions to be roughly 1.0 to 1.5 mm greater than those of natural teeth[4]. Based on these guidelines, clinicians can plan the placement of the platform of bone-level implants to allow

room for at least 3 mm STAd. A review by Saleh et al[5] suggested different treatment strategies based on the thickness of the vertical mucosa: with thick vertical mucosa (> 2 mm), the level of the implant platform should allow for selection of an abutment that provides adequate space for 2 to 4 mm STAd to minimise the risk of MBL. In the presence of thin vertical mucosa (< 2 mm), subcrestal placement in conjunction with a longer abutment should be considered to avoid abutment exposure and provide adequate space for STAd. For tissue-level implants, since the polished collar will form the connective tissue adhesion, vertical placement of this type of implant often follows the rule of "placed as deep as necessary, but as shallow as possible" to ensure the optimal 3 mm STAd is established with additional abutment height[4]. Ideally, these implants should be placed equicrestally with the rough-smooth margin at the level of the bone crest, as subcrestal placement has been found to generate excessive remodelling with tissue-level implants[20].

STAd in implant prosthetic therapy

STAd affects bone remodelling irrespective of implant level, design or prosthetic features[4]; however, bone resorption can be reduced by distancing the implant–abutment junction from the bone. This is commonly achieved by using a transmucosal abutment or a tissue-level implant. The inflammatory reaction around the microgap between the crown and abutment has a spatial relationship with the peri-implant marginal bone level[21-23]. Investigations into this relationship have found that using tissue-level implants eradicates this problem by increasing soft tissue volume and decreasing the effect of the microgap on peri-implant bone stability[24,25]. At the other end of the spectrum, evidence also suggests that the decreased distance between the alveolar crest and implant–abutment junction that results from the use of a short prosthetic abutment is a predisposing factor for early MBL regardless of VMT[26-28]. Numerous researchers have noticed that the marginal bone is preserved not only by having thick mucosa, but also by using an abutment that is more than 2 to 3 mm tall[29-31]. Independently of one another, Spinato et al[27], Blanco et al[29], Pico et al[30], Muñoz et al[32] and others have demonstrated in randomised controlled trials that MBL is nearly twice as severe when short (< 2 mm) rather than tall (> 2 mm) abutments are used, regardless of VMT. Thus, selecting an appropriate abutment height is essential to allow placement of the crown margin in a position that favours adequate STAd and minimises MBL[12].

With regard to achieving optimal aesthetics and a cleansable design, abutment height is often selected so that the prosthetic margin is placed at or slightly below the level of the peri-implant mucosa[33]. This rationale has the benefit of providing accessible margins for cement retrieval. In fact, studies show that increasing the depth of the crown–abutment margin may increase the prevalence of cement remnants, which could trigger peri-implantitis[34]. This relationship, however, should be taken into consideration long before prosthetic rehabilitation. If abutment height is only considered at the time of crown fabrication, this will often lead to the use of a short abutment to avoid having an exposed implant–abutment margin and impaired aesthetics, which will ultimately result in excessive remodelling.

There is a clinical scenario where VMT is minimal and subcrestal placement is contraindicated due to the proximity of anatomical structures. This scenario can be addressed by combining implant surgical and prosthetic therapy. As stated earlier, some authors have advocated for vertical soft tissue augmentation prior to implant placement when VMT is thin[14,16,18]. Although supporting evidence is limited, this may theoretically create adequate thickness for STAd and enable the use of a long abutment to reduce aseptic remodelling[10,16]. On the other hand, when subcrestal placement is possible, the present authors believe that it should be preferred in order to create adequate distance to establish optimal STAd, minimise MBL and reduce the risk of peri-implantitis.

Conclusions

The decision to replace a natural tooth with a dental implant must be supported by comprehensive knowledge of the surgical and prosthetic treatments that will follow. Prior to implant placement, STAd

should be considered by both the surgeon placing the implant and the restorative dental practitioner to ensure that the apicocoronal position of the implant platform and the crown–abutment margin respect this biological dimension. Achieving long-term success for our patients begins by establishing a healthy and stable peri-implant environment. This can be accomplished predictably by following the guidelines outlined in this review and ensuring adequate communication between the surgical and restorative clinicians.

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