Timing of soft tissue management around dental implants: a suggested protocol

Mahdi Kadkhodazadeh, DDS ■ Reza Amid, DDS ■ Mehdi Ekhlasmand Kermani, DDS ■ Mahdieh Mirakhori, DDS
Sepanta Hosseinpour, DDS, MPH

Survival of dental implants depends on several factors; soft tissue (ST) management around dental implants is one of the foremost. Several studies have suggested techniques for ST management around dental implants, but none of them has discussed a suitable timetable for this process. This study aimed to review published articles related to the timing of ST management around dental implants and suggest a customized treatment protocol. A search of the PubMed database was conducted; the search was limited to English-language articles published from January 1995 to July 2015 with available full texts. Only in vivo studies and clinical trials in relation to the terms *soft tissue management, management timing, keratinized mucosa, free gingival graft, connective tissue graft, soft tissue, augmentation,* and *dental implant* were included. A total of 492 articles were reviewed, and eventually 42 articles were thoroughly evaluated. Those with treatment protocols in terms of the timing of ST grafting were selected and classified. ST management around dental implants may be done prior to the surgical phase, after the surgical phase, before loading, or even after loading. A thick gingival biotype is more suitable for implant placement, providing more favorable esthetic results. A treatment plan should be based on individual patient needs as well as the knowledge and experience of the clinician. The width and thickness of keratinized tissues, the need for bone management, and local risk factors that influence esthetic results determine the appropriate time for ST augmentation procedures.

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Dental implants are used for the replacement of lost teeth.[1,2] The final goal of tooth replacement with dental implants is to achieve hard tissue (HT) stability, healthy periodontal tissue, and optimal soft tissue (ST) esthetics. The characteristics of the peri-implant ST are important in achieving a successful implant restoration.[3] The success of implant and prosthodontic treatments depends mainly on patient selection, preservation of the hard and soft tissues, proper surgical technique, and loading protocols.[4] In addition to appropriate function, esthetics are highly important in dental implant treatments.[5] Esthetics in implant treatment depends on 4 factors: proper implant position; adequate bone on the buccal surface; shape and form of the final crown; and peri-implant ST status.[6-8]

The esthetic results of an implant-supported prosthesis depend on the shape and texture of the soft tissues.[9] Soft tissue recession is among the most common problems encountered in anterior implants.[10] According to Evans & Chen, gingival recession increases in patients with thin biotypes.[11] However, in a study involving patients with thick, flat biotypes, the height of the papilla next to the implant remained unchanged.[12]

The gingival biotype is a diagnostic key for the esthetic success of implants.[13] According to Abrahamsson et al, thick gingival tissue (more than 2.5 mm) can significantly prevent crestal bone loss around implants.[14] Puisys & Linkevicius reported that bone loss was lower around bone-level implants placed in sites with thick gingival biotypes.[15] In 1996, Berglundh & Lindhe stated that thin gingival tissue may lead to marginal bone loss during the formation of biologic width around implants.[16]

Moreover, due to the importance of bone volume in implant therapy—especially the thickness of buccal bone—different methods are used for diagnosis and treatment with dental implants.[17-21] Cone beam computed tomography (CBCT) is an alternative to a computed tomography scan and is beneficial for a wide range of craniomaxillofacial applications. In spite of its limitation in soft tissue visualization, CBCT's volumetric imaging generates high-resolution data with geometric accuracy and spatial resolution at a low effective radiation dose.[22-26]

Placement of an immediate implant in a thick gingival biotype can yield predictable results, and a thick biotype is more suitable for implant placement, providing more favorable esthetic results.[27] Decreased gingival thickness can lead to periodontal attachment loss and marginal bone loss.[28] Based on the results reported by Sammartino et al and Belser et al, the presence of thin peri-implant ST increases the risk of gingival recession and subsequent exposure of the metal margin of the implant prosthesis.[29,30] Vandana & Savitha, in a 2005 study in humans, and Kyllar & Witter, in a 2008 study in dogs, demonstrated that gingival thickness varies by sex and age as well as dental arch form.[31,32]

It appears that, in some cases, assessment of the ST at the implant site is as important as the HT status; therefore, clinicians must pay special attention to this tissue. Some researchers believe that if an implant is going to be covered with a thin gingival biotype, it must be positioned more coronally relative to the bone crest.[14] In some cases, even the implant crest design may change the ST status.

Soft tissue management around dental implants may be accomplished prior to the surgical phase, after the surgical phase, before loading, or even after loading.[33] Previous studies have discussed some techniques of ST management around dental implants, but none of them has evaluated the most suitable timing for this process. This study aimed to review the available literature to suggest a timing protocol for ST management around dental implants.

Materials and methods

This study reviewed existing human and animal studies to answer the following questions:

- When is the optimal time for ST augmentation (STA) in placement of dental implants?
- Does STA increase gingival thickness or width?

The PubMed database was electronically searched for relevant articles published from January 1995 to July 2015. The search was limited to English-language articles with available full texts. Key words used were *keratinized mucosa, free gingival graft, connective tissue graft, soft tissue, augmentation, soft tissue management, management timing*, and *dental implant*. A total of 492 articles were retrieved. Articles deemed to be irrelevant based on titles and abstracts were eliminated, and the full texts of potentially appropriate articles were obtained for final evaluation.

Results

A total of 42 articles were evaluated. Articles with the same treatment protocol (in terms of the timing of ST grafting) were selected. In the selected articles, ST management around dental implants was done prior to the surgical phase, after the surgical phase, before loading, or even after loading. In these articles, a thick biotype was deemed more suitable for implant placement, providing more favorable esthetic results.

Many of the selected studies investigated the relationship of the presence of keratinized tissue (KT) around implants with gingival recession. In 2008, Zigdon & Machtei reported that gingival width was negatively correlated with gingival recession and positively correlated with pocket formation.[34] In a 2013 review study on 11 articles, Lin et al stated that the presence of keratinized mucosa was associated with less attachment loss and gingival marginal recession.[35] These results were clinically significant because marginal recession and attachment loss can be endpoints of a treatment outcome. However, Bengazi et al reported that ST loss around implants can merely be the result of tissue regeneration for the stabilization of biologic width by the peri-implant mucosa.[36] The difference in results may be due to the effect of confounding factors, such as differing follow-up times, implant position, quality of ST and HT, and oral hygiene standards among the studies.[35] Warrer et al revealed that gingival recession and attachment loss occurred more frequently around implants without KT than around those with adequate KT.[37]

It has been reported that the degree of mucosal collapse depends on the biotype of the peri-implant mucosa.[8,38] Thus, converting thin and medium gingival biotypes to thick biotypes by reinforcing the KT can stabilize ST dimensions around dental implants.[39]

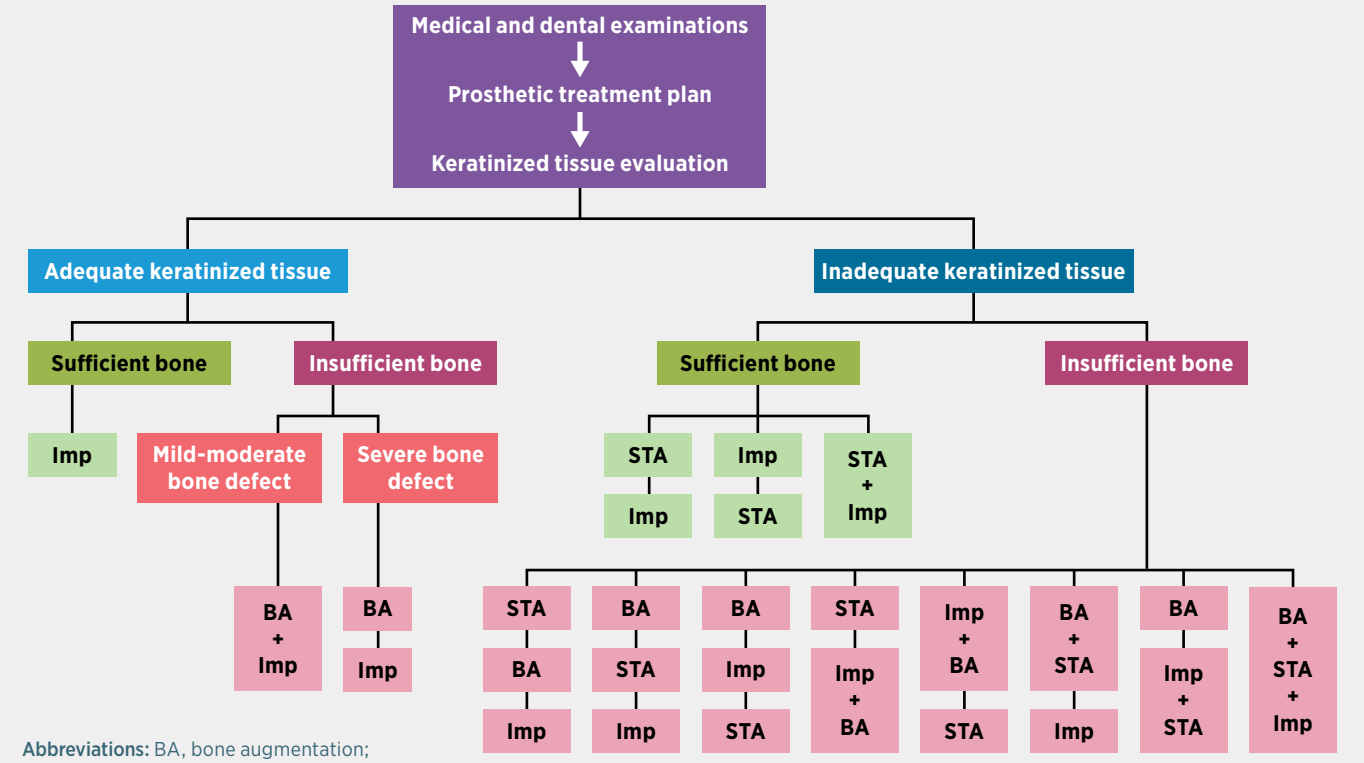
Many of the selected studies investigated the relationship of the presence of KT around implants to plaque accumulation and plaque control. Some studies have stated that no correlation exists between plaque control and the success of dental implants and presence of peri-implant KT.[40-44] However, in 2006, Chung et al found that plaque accumulation and gingival inflammation were higher around dental implants with KT of less than 2 mm.[45] The majority of studies evaluated in the current review used an apically positioned flap (APF) technique for ST management around dental implants. The APF technique has several advantages: It does not require a second surgical site, results in minimal postoperative bone loss, controls postoperative gingival margin status, and has higher patient acceptance.[46] Use of this technique can increase gingival width and vestibular depth, thus facilitating oral hygiene control by the patient. This is especially important because plaque accumulation around dental implants can cause inflammation of the surrounding tissues and may lead to peri-implantitis.[47] Moreover, regeneration of periodontal and alveolar structures lost as a consequence of infection is extremely difficult, if not impossible.[48]

Many of the selected studies investigated the relationship of the presence of KT around implants to crestal bone loss. Block & Kent demonstrated that the presence of KT was significantly correlated to the gingival health; crestal bone loss of 2 mm or more was seen in areas with lost KT.[49] Bouri et al and Kim et al reported that increased KT width around dental implants resulted in less ST loss and greater HT stability.[50,51] Cardaropoli et al prospectively measured ST and HT dimensions around 11 single-implant restorations 1 year after loading.[52] The authors concluded that buccal and lingual bone loss reached 1.3 mm within this time period; the amount of ST height loss was 0.6 mm.[52] Studies have indicated that most of these changes occur within the first 4 weeks of the implant uncovering process.[53,54] In some cases, ST grafts can be used to cover serious bone defects or for esthetic reconstruction over improperly positioned implants.[55]

Such correlations led to the introduction of several augmentation techniques to reinforce thin soft tissue, increase the thickness and width of gingiva, and increase the vestibular depth at dental implant sites. Moreover, recognition of the exact anatomy of a future implant site is essential for achieving good esthetics and sound biomechanical support. Two-dimensional radiographic evaluations cannot disclose the exact situation of buccal or labial cortical plates. A cross-sectional view is required via 3-dimensional imaging. A CBCT provides this information with less radiation than previously available methods.[56-58] Arora et al and Joshi & Gupta demonstrated that CBCT imaging of the anterior maxilla is highly recommended prior to implant placement to improve the functional and esthetic outcomes.[59,60]

Free gingival grafts (FGGs) and connective tissue grafts (CTGs) have been reported as effective techniques with predictable results for augmentation of KT width and vestibular depth.[61,62] However, these techniques are associated with complications, such as donor site morbidity (pain and discomfort),

Chart. Suggested protocol for the appropriate timing of soft tissue management around dental implants.



Abbreviations: BA, bone augmentation; Imp, implantation; STA, soft tissue augmentation.

increased surgical time, a longer healing period, and increased patient cost. To prevent these complications, use of an acellular dermal matrix, collagen matrix, APF, and coronally advanced flap (CAF) has been investigated in several studies. Studies comparing the efficacy of these techniques for increasing gingival width and thickness and improving peri-implant ST esthetics are scarce. In a retrospective 3-year study, Speroni et al demonstrated that a 1.75-mm increase in thickness of mucosa is expected 12 months following the placement of an FGG or a subepithelial CTG.[63] A greater increase in ST thickness is more likely in primarily thin mucosa than thick mucosa (2.14 versus 0.64 mm). Also, the likelihood of increase in mucosal thickness is higher in the mandible (2.17 mm) than in the maxilla (0.81 mm). In a 2010 study by Lee et al, 3 techniques (APF, APF plus collagen matrix, and APF plus FGG) were evaluated in 9 patients, and the KT widths of patients in the 3 groups were compared.[64] The results revealed that the increase in gingival width after augmentation of KT was the greatest in the group receiving APF plus FGG; the next greatest increase resulted from APF plus collagen matrix, and APF alone provided the smallest increase. The results of a study by Schwarz et al found no significant differences in the gingival thickness increases resulting from the following 3 methods: CAF, CAF plus collagen matrix, and CAF plus CTG.[65] Moreover, in their 2015 study, Bengazi et al found no significant differences in HT or ST dimensions after removing the masticatory mucosa in dogs and subsequently placing implants along with either a CTG or a gingival mucosal graft; increased gingival thickness and height were observed in both groups.[66] Basegmaz et al performed 64 implant treatments in sites with primary KT dimensions of less than 1.5 mm and signs of mucositis.[67] After 12 months, the FGG technique was significantly more successful than vestibuloplasty alone. Tissue width in the FGG group reached 2.36 mm, a significantly greater improvement compared to the 1.15 mm increase in the vestibuloplasty group. The authors theorized that the reason for the difference was the lower rate of relapse found in the FGG group.[67]

If necessary, plastic surgery around dental implants should be performed prior to implantation, during the first or second stage of implant surgery, or after prosthetic loading.[68-74]

The appropriate preoperative timing for increasing gingival width is a matter of controversy. It has been reported that this procedure may be performed during second-stage surgery or at the time of prosthetic loading. In a 2015 study by Baltacıoğlu et al, different treatment groups with preimplantation and post-implantation ST surgeries were evaluated (before, during, and after the second-stage implant surgery).[75] In their 2011 study on 2 groups with different augmentation times (either simultaneous with implant insertion or at the second-stage surgery), Stimmelmayr et al revealed that the amount of shrinkage of the FGG was greater in the group receiving augmentation simultaneously with implant placement; this difference was not statistically significant, however.[76] In the majority of studies evaluated in the current review, ST management around dental implants was performed at the time of implant surgery. This timing has

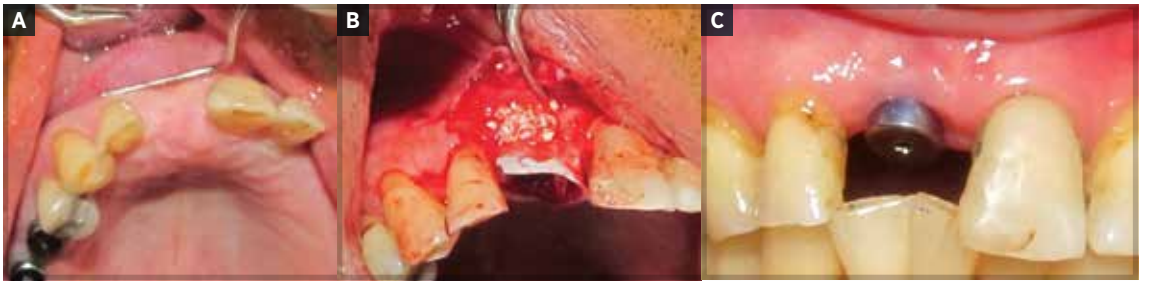


Fig 1. A. Preoperative palatal view of the anterior maxilla. The keratinized tissue is adequate and bone is insufficient (mild to moderate bone defect). B. Intraoperative situation after implant placement. Note the membrane and bone substitute placement for guided bone regeneration. C. Buccal view 6 months postoperatively.

Fig 2. A. Preoperative buccal view of a posterior mandibular site. The keratinized tissue is inadequate and bone is sufficient based on 3-dimensional evaluations. B. Intraoperative buccal view after implant placement. A free gingival graft has been placed for soft tissue augmentation. C. Buccal view 6 months postoperatively.

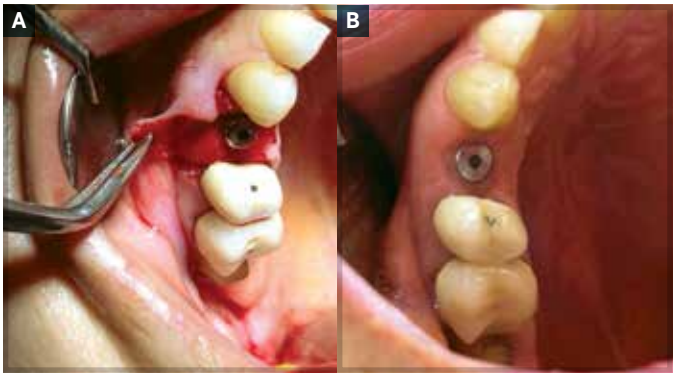


Fig 3. A. Buccal view of fresh socket implantation via acellular dermal matrix for simultaneous soft tissue augmentation. B. Occlusal view 6 months postoperatively.

several advantages: it requires fewer surgeries; enables simultaneous HT and ST healing; results in a shorter healing time; produces less pain and discomfort; causes less stress; lowers the costs; and provides greater patient satisfaction.

Protocol for soft tissue management

Soft tissue management around dental implants has been greatly emphasized in recent years. Gingival thickness, width, and contour are of great esthetic importance in the anterior region. Thin and narrow gingivae lead to gingival recession, bone loss, plaque accumulation, gingival inflammation, impaired oral hygiene, difficult impression-taking for prosthetic fabrication, visibility of the gray shadow of implants, compromised esthetics, and patient dissatisfaction.[77] Several studies have emphasized the presence of KT around implants.[78,79] However, the timing of the ST augmentation process is also important. As stated previously, this study aimed to assess the timing of ST management around dental implants, as reported in relevant studies, in order to come up with a protocol for this process.

The Chart shows the protocol suggested by the authors for the appropriate timing of ST management around dental implants in patients with adequate and inadequate KT and bone based on the time of implant placement. Due to the significance of the height and thickness of ST and the resultant effects on HT regeneration, the authors suggest that the ST status be evaluated first in terms of height and thickness. Clearly, this assessment depends on several factors, including the clinician's experience, the method of measurement of ST parameters (thickness, height, and vestibular depth), the need for HT regeneration, the implant placement site, and the implant position relative to the adjacent teeth. An ST assessment in implant candidates will reveal 1 of 2 situations: adequate or inadequate KT.

Adequate thickness and height of KT

1. If the bone is of adequate quality and quantity in all 3 dimensions, an implant may be placed.
2. If the bone is inadequate:
   a. If the bone defect is mild to moderate, implant placement and bone augmentation (BA) are done simultaneously (Fig 1).
   b. If the bone defect is severe, BA is performed first. Then, when optimal bone quality has been achieved in all 3 dimensions, an implant is inserted.

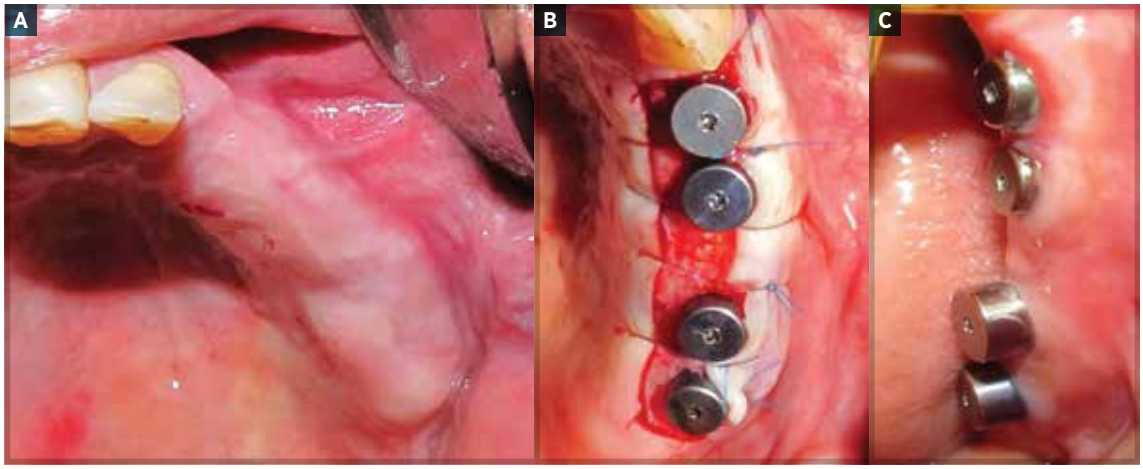


Fig 4. A. Preoperative palatal view of the posterior maxilla. The keratinized tissue is inadequate and bone is insufficient. B. Intraoperative palatal view of the apically positioned flap technique for soft tissue augmentation at the second-stage implant surgery. C. Buccal view 6 months postoperatively.

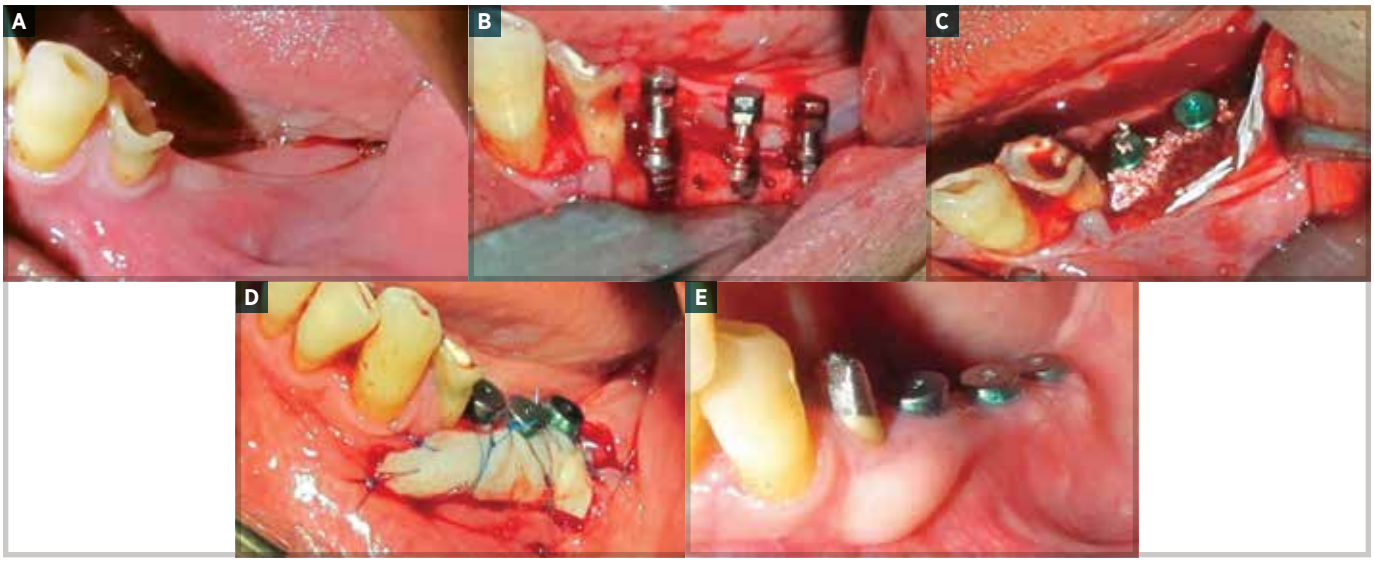


Fig 5. A. Preoperative buccal view of the posterior mandible. The keratinized tissue is inadequate and bone is insuffient. B. Implant placement. C. Bone augmentation performed simultaneously with implant placement. D. Free gingival graft for soft tissue grafting procedure. E. Buccal view 6 months postoperatively.

Inadequate thickness or height of KT

1. If the bone is of adequate quality and quantity in all 3 dimensions, the clinician chooses from the following treatment sequences based on personal preference and professional experience:
   a. STA is performed first. After the thickness and height of ST are found to be adequate, an implant is placed.
   b. An implant is placed first. STA is performed either simultaneously with the second-stage implant surgery or after restorative treatment.
   c. Implant placement and STA can be performed simultaneously (Fig 2 and 3).
2. If the bone is inadequate, the clinician chooses from the following treatment sequences based on personal preference and professional experience:
   a. STA is performed first. This is followed by BA in a separate procedure. After adequate ST and HT are ensured, an implant is placed.
   b. BA is performed first. This is followed by STA in a separate procedure. After adequate ST and HT are ensured, an implant is placed.
   c. BA is performed first. After HT has been found to be adequate, the implant is inserted. STA is performed after implantation surgery (Fig 4).
   d. STA is performed first. After ST is deemed adequate, implant placement and BA are performed at the same time.
   e. The implant is placed simultaneously with BA. After the bone augmentation and implant site have healed adequately, STA is performed (Fig 5).

f. BA and STA are performed simultaneously. After HT and ST are adequate, the implant is placed.
g. BA is performed first. After the presence of adequate HT has been ensured, implant placement and STA are performed simultaneously.
h. BA, STA, and implant placement are performed simultaneously.

After STA in a patient with implant complications such as gingival insufficiency or bone loss, inadequate thickness and/or height of KT may be encountered:

1. If HT is adequate in all 3 dimensions, STA is performed.
2. If HT is not adequate in all 3 dimensions, STA is performed in conjunction with BA.

Conclusion

In this review study, most of the articles evaluated were case reports. More randomized clinical trials are required to reach more definite conclusions. However, the current information on this topic reveals that clinical decision-making depends on the patient's needs as well as the knowledge and experience of the clinician. The protocol suggested in this article can help clinicians to select the technique and appropriate timing of soft tissue management around dental implants. Some of the timing sequences presented in the protocol have yet to be used in studies; therefore, they can be used as a guide for researchers and to facilitate the comparison of results in this field.

The important points to be taken from this article are the importance of assessing the patient's needs and determining the gingival width and thickness and vestibular depth with accurate methods prior to implant surgery. Keeping these considerations in mind will help the clinician to stabilize esthetic results, ensure periodontal health, and achieve patient satisfaction.

Author information

Drs Kadkhodazadeh and Amid are associate professors, Dr Kermani is an assistant professor, and Dr Mirakhori is a dentist, Department of Periodontics, Dental Research Center, Research Institute of Dental Sciences, Shahid Beheshti University of Medical Sciences, School of Dentistry, Tehran, Iran, where Dr Hosseinpour is a research fellow, School of Advanced Technologies in Medicine.

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