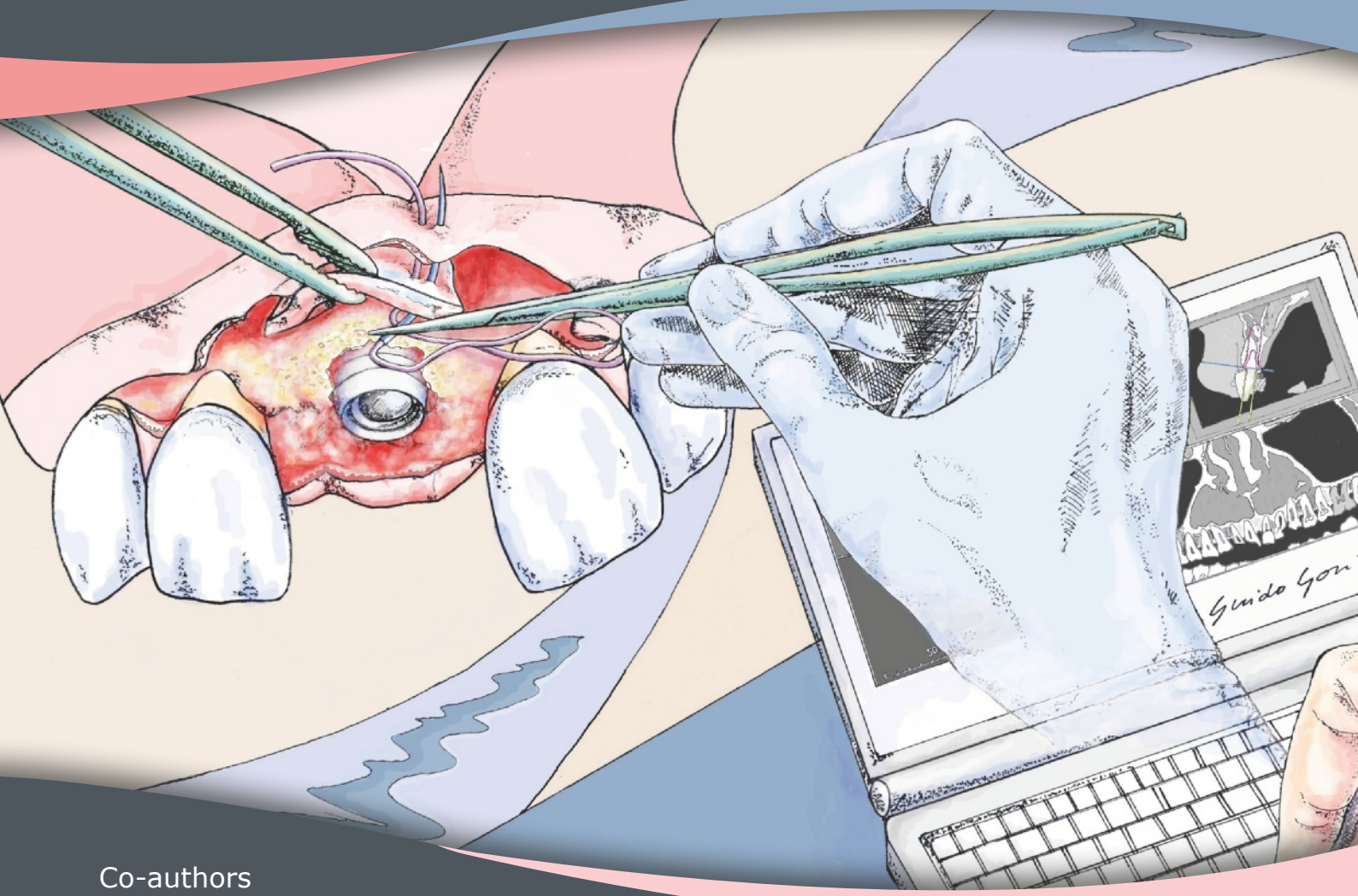
Giovanni Zucchelli Claudio Mazzotti

Mucogingival esthetic surgery 1 around implants



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QUINTESSENCE PUBLISHING

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QUINTESSENCE PUBLISHING

Berlin | Chicago | Tokyo
Barcelona | London | Milan | Mexico City | Moscow | Paris | Prague | Seoul | Warsaw
Beijing | Instanbul | Sao Paulo | Zagreb

ISBN: 978-88-7492-091-4

QUINTESSENCE PUBLISHING
ITALIA

Quintessenza Edizioni S.r.l.
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Printed in Italy

FOREWORD

This book from Giovanni Zucchelli, as well as the previous one, Mucogingival Esthetic Surgery, is a marvelous opportunity to take a journey through biology, esthetics, and surgery.
Prof Zucchelli has been able to put all the passion and the science that guides him in his profession—from research to teaching to clinical practice—in this volume, which provides the attentive reader useful technical information and a guide for surgical decision making.
Meticulous application of biologic foundations and a refined technique—achieved after many years of study, research, and dedication to clinical practice – along with perfect step-by-step documentation of all of the techniques, allow the readers to follow the path outlined by the author, to share the importance of the mucogingival techniques applied to implantology, and to make them their own.
In summary, this is a magical book in which science meets art and poetry, a book that makes us explore the secrets of soft tissue surgery around implants, but also tells us so much about its author and of his professional commitment and passion.
The clinicians who are about to browse through this book will not be able to refrain from reading it passionately, as if it were a rousing novel, and turn it into a guide for their surgical choices, as I have done.

Massimo de Sanctis

FOREWORD

This work by Giovanni Zucchelli and Claudio Mazzotti, with Carlo Monaco and Martina Stefanini as co-authors, represents a milestone in modern implantology that will survive the physiologic obsolescence of printed paper in the scientific field due to its strong subliminal ethical message and for the coherence of the educational path expressed in a masterful flow of chapters. The ethical message derives from the countless emotions and reactions that this work will provoke in all of the clinicians, scholars, and educators that care about the oral and psychologic health of the patients they treat.

After immersing themselves in this book, after a careful evaluation of the clinical cases presented that were solved with innovative and predictable approaches due to their long follow-up, the following question will arise: How did we get to this point?

The "subliminal ethical message" derives from the warning enclosed in this work: the lack of knowledge and tendency for improvisation in medicine inevitably create a series of physical and psychologic problems for our patients.

After this caution notice, by going into scientific detail and treating the topic exhaustively, this book offers all of the educational tools for the clinicians to perform implantology correctly.

The classification of peri-implant esthetic defects provides a practical tool that allows the clinician to establish the best-suited therapy.

This volume offers an innovative vision regarding the proposed therapeutic solutions and at the same time presents a balanced perspective about when to use traditional options, such as bone augmentation, along with masterful techniques for soft tissue management; it offers a modern and interdisciplinary vision of implant treatment in which periodontology and restorative dentistry fuse together in a rational and effective stream to solve "impossible" clinical cases.

Through this book we have confirmation that thorough knowledge of the different fields of dentistry is the critical foundation for ethical and modern implant treatment. The sequence of the chapters allows not only the expert clinician but also the student to enter the world of modern implantology through a coherent learning path.

This work serves the objectives of both a textbook for students and a valid instrument to update the professional knowledge of experienced clinicians.

Lastly, I express my appreciation toward the authors and co-authors who, thanks to their efforts, have allowed the creation of a piece that will contribute to improving the health of our patients—which should be the ultimate goal for all clinicians.

Furthermore, I am sure that this work will endure the passage of time unaffected thanks to its strong ethical advice along with an undisputed educational value.

Tiziano Testori

PREFACE

As a periodontist, I have witnessed the birth of implantology feeling somewhat detached and, I must admit, also a bit disturbed since I was faithful to the teaching “better to have a tooth even if in a terminal stage than any kind of implant”. They spoke of surfaces and bone, that is to say “osseointegration”. Not that this is not important; on the contrary, if osseointegration had not become a certainty I would not be here writing the preface for this book.

My interest in implantology began when “keratinized tissue” came onto the scene, and its importance for the hygiene maintenance and long-term survival of implants started to be acknowledged. The term peri-implant soft tissues had not been coined yet, a term that for most is still synonymous with keratinized tissues, but there was talk of soft tissues useful for the sole purpose of protecting the bone. However, there was never a mention of that which could be most appreciated by the patient: the shape and size of the tooth (clinical crown for the experts), the color and texture of the gingiva (peri-implant mucosa for the experts), and how the tooth emerges from the gingiva (emergence profile for the experts). What is the patient aware of? What does the patient want? These are the questions that triggered my interest in implantology and gave impetus to the birth of this book.

To make it simple, patients don’t want to perceive any difference between the implant and their tooth. The shape of the tooth’s clinical crown on its apical half depends on the contour of the gingival margin and the height of the papillae; the remaining coronal half depends, so to speak, on the skill of the dental technician in reproducing the shape of the neighboring teeth. The clinical crown length of the implant depends on the distance between the incisal edge (responsibility of the dental technician) and the mucosal margin, which should be at the same height and have the same scallop as the gingival margin of the contralateral tooth. The papillae, very important for the patient, are also made up of soft tissues and should fill up the entire interdental space up until the contact point, which should also match the contact point of the contralateral tooth.

The patient is also able to see the buccal mucosa, which should be indistinguishable from the gingiva on the adjacent teeth, as much or as little keratinized as it may be.

The emergence profile of the implant crown should also draw inspiration from the natural tooth. The ideal seagull wing-shaped profile, which we consider pretty and natural, is created by the convexities of the buccal enamel and of the buccal soft tissues. However, the latter convexity does not extend more than 3 to 4 mm apical from the gingival margin; more apically, the soft tissues follow the profile of the underlying bone, which proceeds in a palatal direction. If we consider that the buccal bone is found at least 3 to 4 mm from the mucosal margin of the implant crown, it is difficult to think that bone reconstruction techniques can be done to augment the buccal soft tissue profile when the soft tissues around adjacent teeth do not have a convex buccal profile but follow a palatal inclination.

This right here is how this book was born, from the understanding that peri-implant soft tissues play a decisive role in our patient’s esthetic satisfaction. No longer do soft tissues serve the sole purpose of preserving bone; soft tissues must please the patient. More specifically, the soft tissues that determine patient satisfaction are suprabony; they are found several millimeters coronal to the buccal bone crest (mucosal margin of the implant crown) and interproximally (the papillae), and their stability depends mostly on the thickness of the connective tissue of which they are composed rather than on the position and thickness of the underlying bone.

Faithful to the old definition of keratinized tissue, we have the supraperiosteal soft tissues that should protect the bone crest and improve plaque control performed by the patient. The difference between suprabony soft tissues and supraperiosteal keratinized tissue is related to the surgical techniques. Bilaminar techniques are meant to augment the thickness of the suprabony soft tissues with the main goal of improving esthetic patient satisfaction. The free gingival graft technique has the goal of augmenting the height of the keratinized tissues to improve hygiene maintenance and peri-implant health.

The sequence of this book's chapters follows my personal path when approaching implantology and express my somewhat personal vision of it. I started with the treatment of peri-implant soft tissue dehiscences (PSTDs), most of which affected implants without buccal bone defects or even those previously treated with bone reconstruction techniques. In other words, I started with patients who complained about esthetic defects around the implant crown despite good implant osseointegration. The esthetic and functional long-term success of a procedure that combined prosthetics and surgery led me to think that perhaps the role of the soft tissues was being underestimated and maybe the role of the integrity of the buccal bone was being overestimated.

The next step, regarding the very successful treatment of soft tissue dehiscences associated with buccal bone defects, confirmed my suspicions about the key role of the soft tissues and the prosthetic restoration in spite of the lack of integrity of the buccal bone.

The successful treatment of peri-implant esthetic defects encouraged me toward the next step: What can be done at the time of or before implant placement to avoid these esthetic defects?

That's how the mucogingival approach to implant insertion was born, applied both to the immediate and delayed implant and changing depending on the extent of the ridge defect and of the reason (dental or periodontal) that led to tooth extraction.

The esthetic and functional success of the mucogingival approach led to the following step: application of soft tissue surgery for the treatment of borderline esthetic cases in which other more "conventional" approaches could have been applied.

It is a sort of challenge to the alleged limits of soft tissue management for the treatment of esthetic implant cases with the goal of encouraging the reader toward the "future direction" of peri-implant soft tissue surgery, which nowadays cannot be considered "predictable" by the standards of scientific evidence but that is evidently possible and can give great satisfaction to our patients. The long-term stability of the outcome, an increased number of treated cases, and the confirmation of the results by the scientific literature will tell if these alleged limits can be overcome in a predictable manner.

One of the special features of this book of which I am most proud is the treatment plan and decision tree for implant therapy in esthetic areas, starting with the reason for tooth extraction. Despite having abandoned the periodontal "romanticism" in which the implant is always the last option with respect to the conservation of a tooth, even at the expense of esthetics and function, one cannot consider the extraction of a tooth for dental reasons (endodontic problems, fracture, internal/external root resorption, invasive carious lesions) to be the same as the extraction of a tooth for periodontal reasons. In the latter case, the patient is affected by a disease (periodontitis) that should be treated (both from a nonsurgical and, if needed, surgical point of view) before starting implant-related therapies.

Postextraction implant placement is almost always “forbidden” either because the patient hasn’t completely healed from periodontitis or because the extent of the bone loss (sometimes also at the level of the adjacent tooth) is such as to prevent immediate implant placement.

This book is meant to promote the need for a periodontal background in order to strive for successful implant therapy for our patients. Not only because implants cannot be successful in patients with periodontal disease, but because periodontal, and mucogingival in particular, surgical skill is fundamental for the management of peri-implant soft tissues.

That is why we chose a title almost entirely identical to the one of my previous book. The same biologic principles and techniques that apply to mucogingival therapy around teeth are applied today to peri-implant soft tissue surgery, and they make it possible to achieve once unexpected esthetic and functional results.

The gingiva does not exist around implants and, therefore, mucogingival surgery around implants cannot exist; my wish is that this “mistake,” already mentioned in the book title, can be an incentive for the astute reader to apply around implants the same mucogingival surgical principles and techniques they have learned to apply around teeth.

Giovanni Zucchelli

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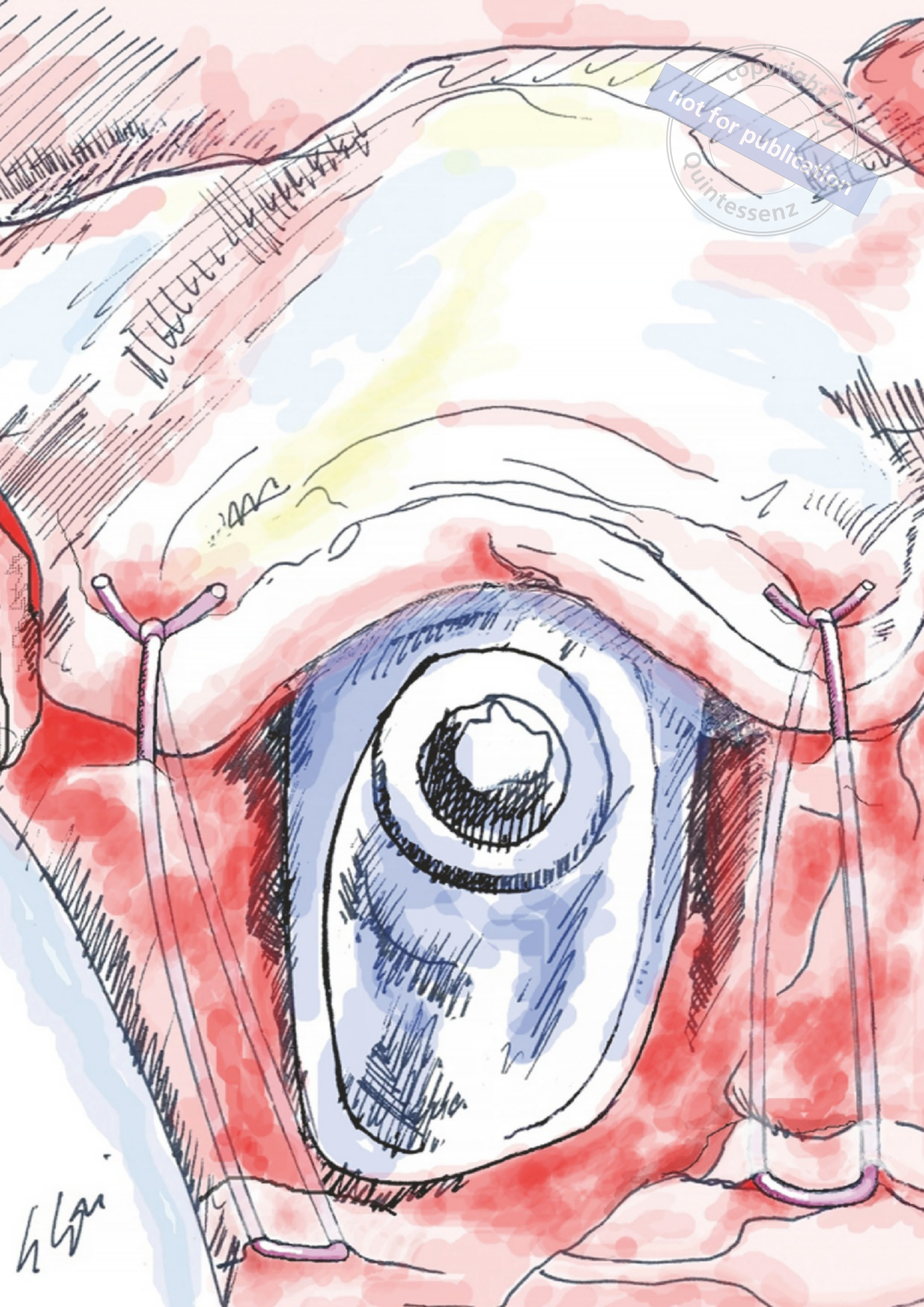
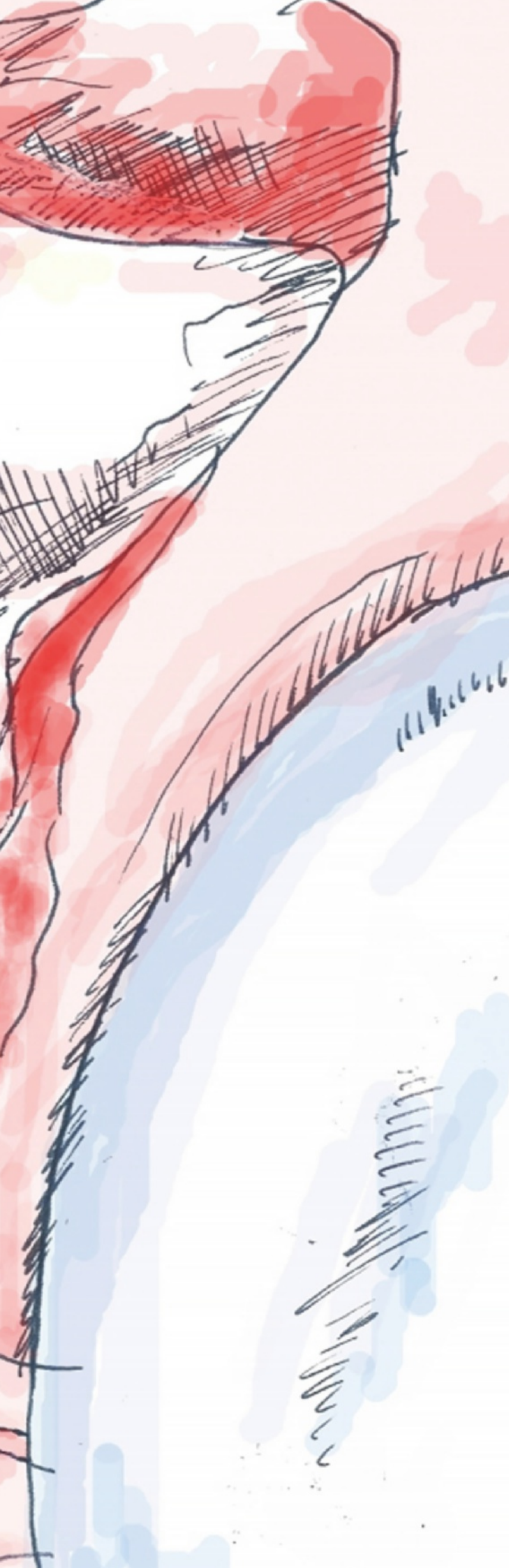
VOLUME 1

VOLUME 2





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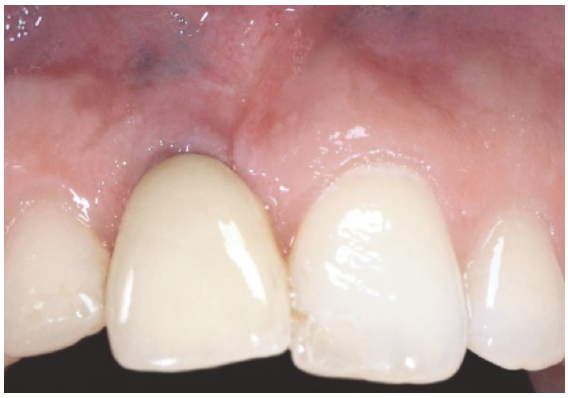
Prosthetic-Surgical Treatment of Peri-implant Soft Tissue Dehiscences



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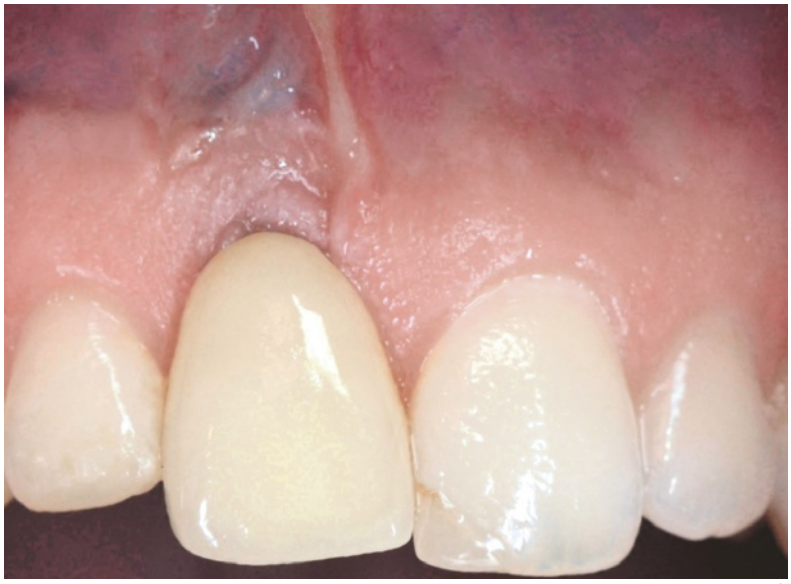
Therapy for treatment of buccal dehiscences on osseointegrated implants foresees a prosthetic-surgical-prosthetic approach. The surgical technique, which relies on the placement of a connective tissue graft covered by a coronally advanced flap, is preceded by a provisional prosthetic phase and then followed by a second provisional phase and placement of the final restoration. With this approach, dehiscence coverage is predictably obtained, and masking of the grayish hue of the underlying implant-prosthetic components is also achieved. A prerequisite for surgical coverage of peri-implant dehiscences is the absence of peri-implantitis, confirmed both clinically and radiographically.



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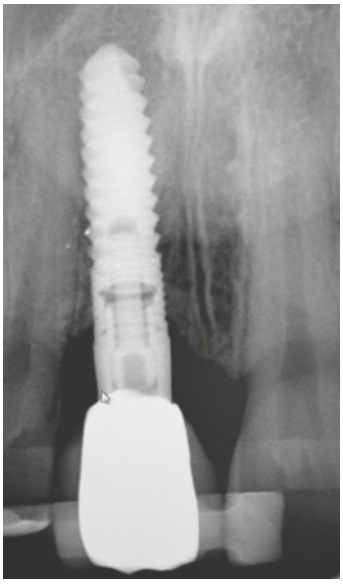
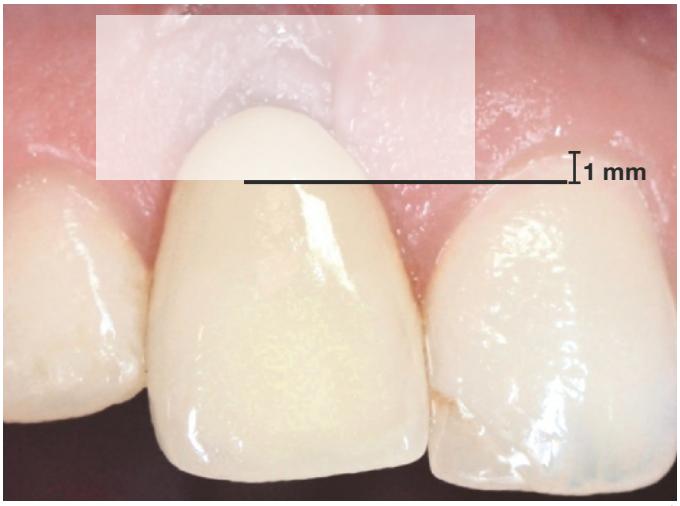


Since dehiscence coverage and soft tissue augmentation should take place at the level of the gingival margin of the contralateral tooth, the connective tissue graft should be positioned 1 mm coronally to the reference tooth's gingival margin. This is done to compensate for potential tissue shrinkage and also to obtain a surplus of marginal soft tissue, both in height and thickness, that can later be adequately conditioned during the postsurgical prosthetic phase.



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A free gingival graft would hardly survive in this position because of the wide avascular area (ie, implant-supported crown) that must be covered. Likewise, a partially/completely de-epithelialized connective tissue graft inserted into a pouch flap and placed at the level of the desired mucosal margin wouldn't have the best chances of surviving on top of the avascular implant-supported crown, or at least it wouldn't be able to maintain an adequate thickness (>2 mm). Even in case of survival and integration, the grafted area would probably differ from the adjacent soft tissues in color and surface texture, therefore not satisfying the patient's esthetic demands. For these reasons, a connective tissue graft must be used, and it should be completely covered by a coronally advanced flap. The implant's mesial and distal papillae represent the only vascular area coronal to the graft. These papillae, once de-epithelialized, will become vascular beds onto which the surgical papillae of the coronally advanced flap will be anchored. However, very small and triangular papillae resulting from adaptation to the morphology of the implant-supported crown, and not always supported by an intact osseous crest (as in the case of anatomical papillae in recession type 1 [RT1] gingival recessions according to the Cairo classification), wouldn't provide enough vascular supply for the stabilization of the surgical papillae of the coronally advanced flap. In these conditions, there would be a very high risk of early flap shrinkage with consequent exposure of the underlying connective tissue graft, reducing or nullifying the potential for coverage of the buccal dehiscence. Presurgical prosthetic treatment makes it possible to increase the space between the abutment and the adjacent teeth by means of crown removal and exchanging the prosthetic abutment with a so-called surgical abutment that is as narrow and thin as possible, which allows growth in the width, thickness, and volume of the interproximal soft tissues.

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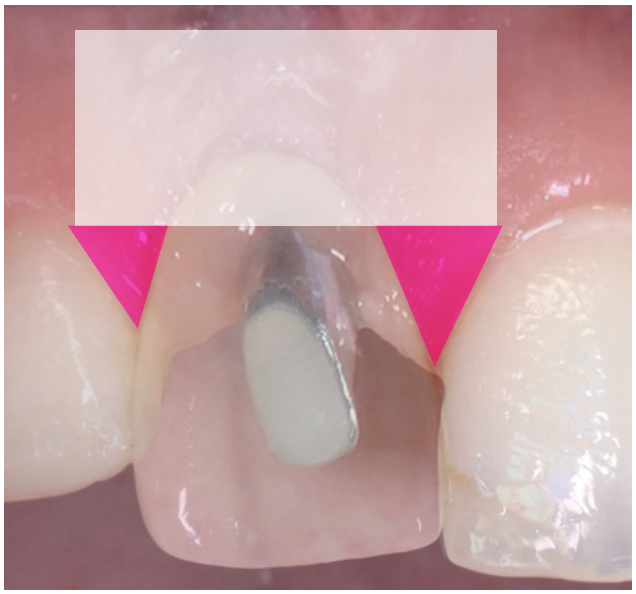

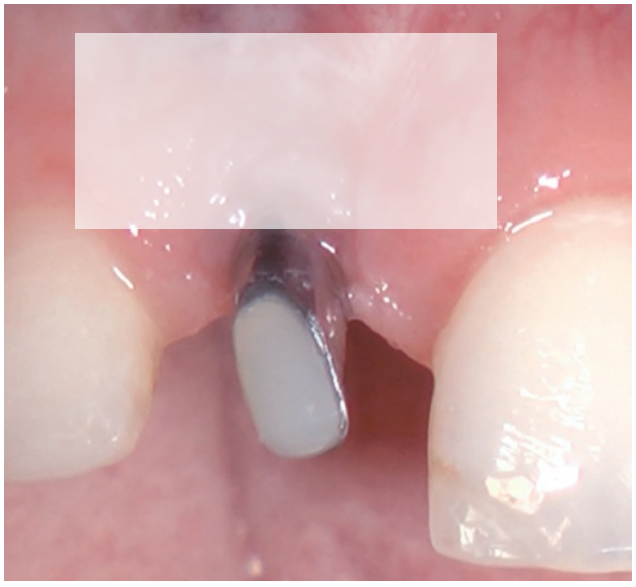

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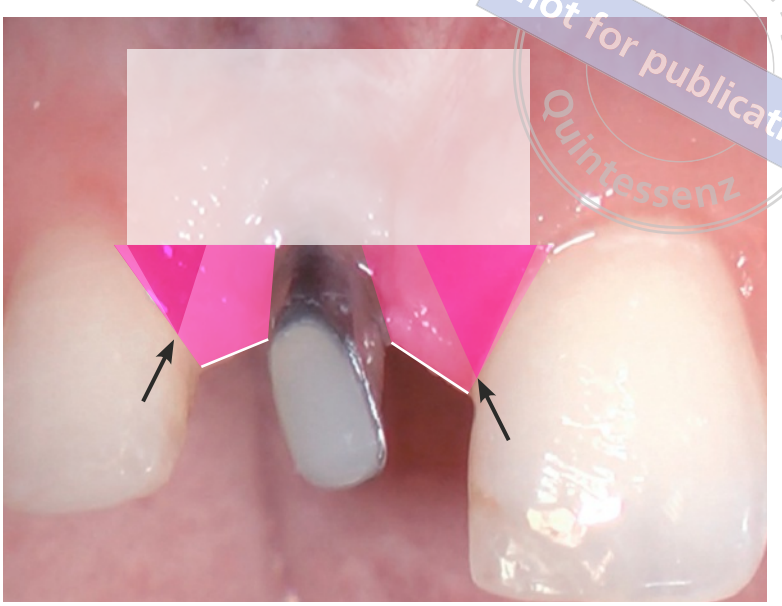
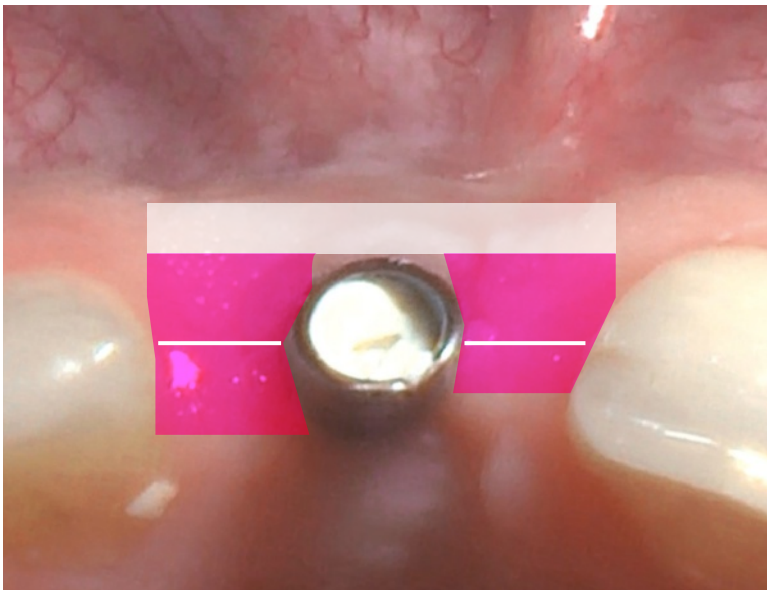
The papillae, growing into the space formerly occupied by the crown and prosthetic abutment, will acquire a trapezoidal shape with a coronal isthmus *(white lines)* instead of the former triangular shape with a coronal vertex *(black arrows)*. The presence of an isthmus will allow occlusal de-epithelialization of the papillae in a palatal direction, further increasing the vascular bed for the surgical papillae of the coronally advanced flap, which are also trapezoidal.



The time needed for the soft tissues to fill the space formerly occupied by the prosthesis and for their maturation in order to proceed to the surgical phase varies from one case to another but will never be less than 2 months.



The clinical image showing the superimposition of the initial prosthetic crown and the augmented soft tissues resulting from the presurgical prosthetic treatment emphasizes the biologic and clinical advantages of this phase: Transformation of an area that would otherwise be occupied by the avascular surface of the implant-supported crown into wide vascular beds for the surgical papillae of the coronally advanced flap that will cover the connective tissue graft.

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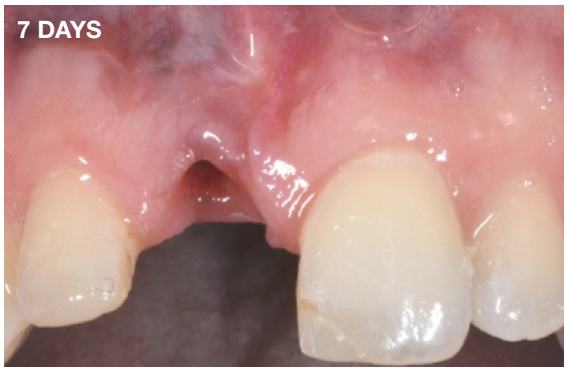
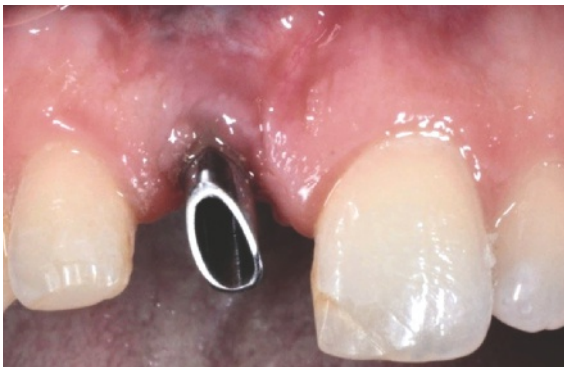
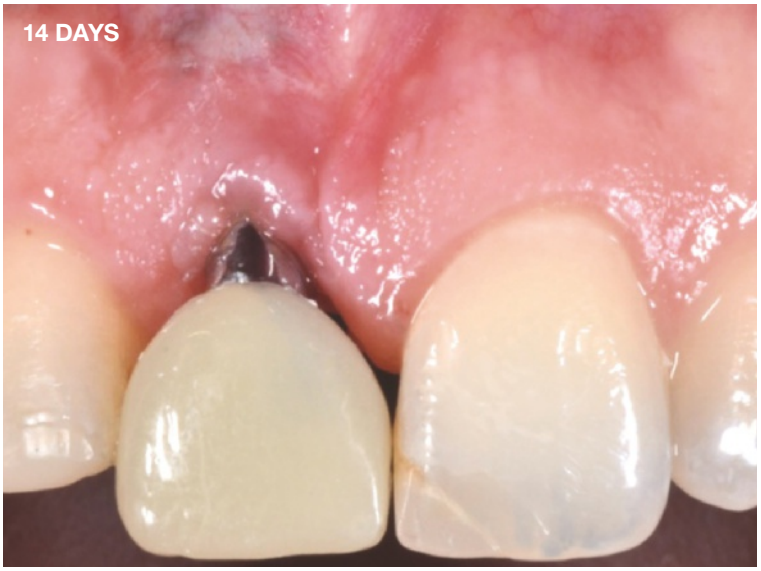
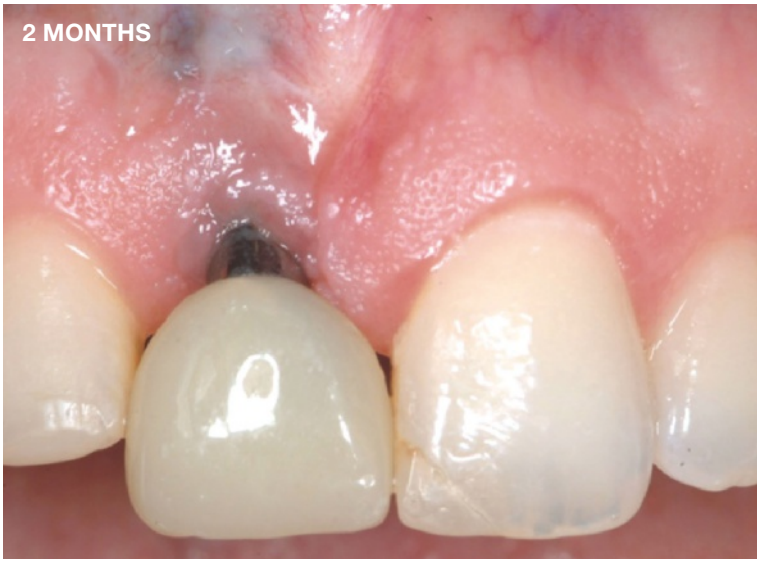
The presurgical prosthetic phase foresees the removal of the implant-supported crown and substitution of the prosthetic abutment with a surgical abutment that is as narrow as possible while being compatible with the abutment screw and also thin, being made from a material that can be reduced without risk of fracture. Both factors contribute to an increase in the distance between the abutment and the adjacent teeth. The soft tissue maturation phase requires a short provisional that doesn't interfere with soft tissue growth apically and laterally to the abutment, and the patient should be instructed to perform tooth brushing with a "roll" technique in an apico-coronal direction.

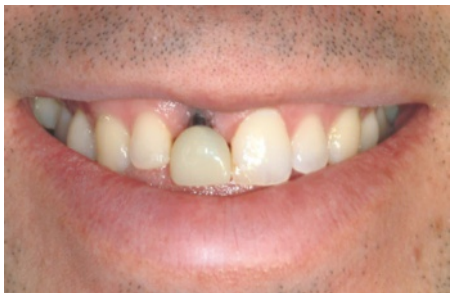


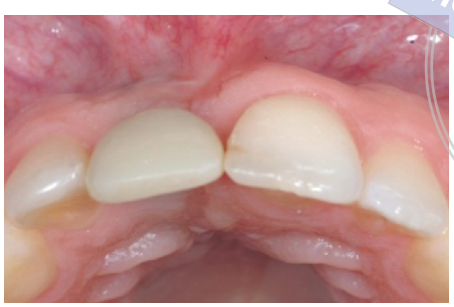


As little as 7 days later, the smooth and undercontoured surface of the surgical abutment has already allowed coronal migration of the apical soft tissues, which spontaneously almost reach the position of the gingival margin of the corresponding adjacent incisor. This leads to a reduction of the dehiscence and to a qualitative/quantitative improvement of the keratinized tissues apical to the surgical abutment. After 2 weeks the dehiscence has practically disappeared thanks to an subsequent improvement of the keratinized tissues. At least 2 months are needed in order to allow complete maturation and stabilization of the soft tissues lateral to the surgical abutment, so that they come in close contact with it. During this phase, the patient should be seen at the dental office every 3 weeks to make sure that the provisional does not interfere with soft tissue growth at any given moment.



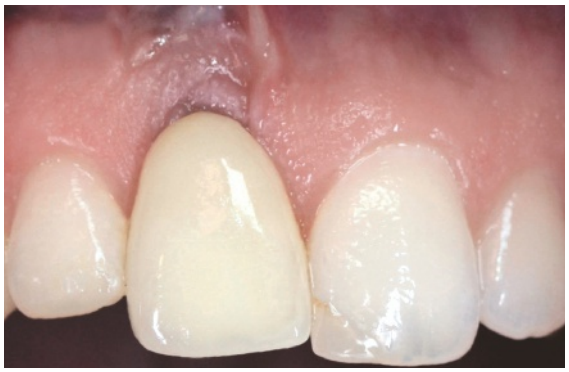






The surgical abutment should be buccally inclined the least amount possible in order to compensate, at least partially, for the incorrect angulation that implants with buccal soft tissue dehiscences usually have. In this phase, the use of titanium abutments is very useful because they allow a greater compensation than can be achieved with more esthetic abutments, such as those made in zirconia. As a matter of fact, in order to avoid weakening their resistance, zirconia abutments should have a greater thickness at the level of the implant platform, which limits changes in their inclination and consequently the growth of peri-implant soft tissues.

The surgical procedure can be scheduled whenever there are no further changes in the volume of the soft tissues apical and lateral to the abutment between follow-up visits.



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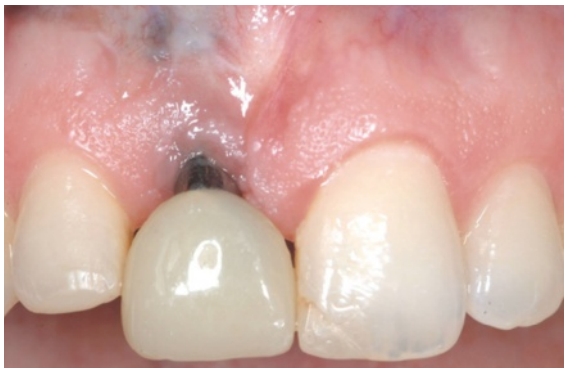
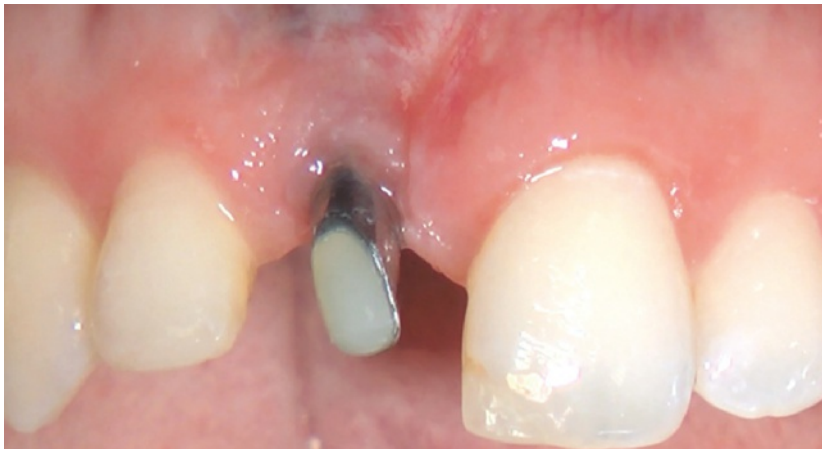
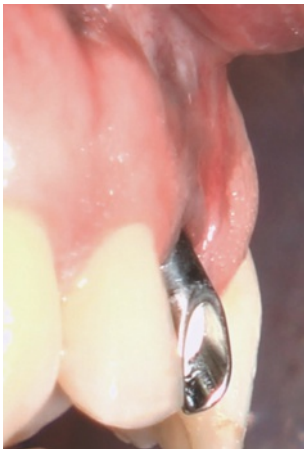


In comparing the baseline situation with the presurgical one, it becomes evident that this prosthetic phase has led to coronal migration of the buccal soft tissues, resolving the buccal dehiscence, and to the interproximal soft tissues filling the entire space formerly occupied by the implant-supported crown. During the presurgical prosthetic phase, the patient must agree to an esthetic compromise due to the use of a short provisional crown that leaves the underlying metallic surgical abutment partially exposed. This, along with the fragility of the provisional and its diminished esthetics in comparison with the definitive crown, are among the main disadvantages of the phase preceding the surgical procedure.





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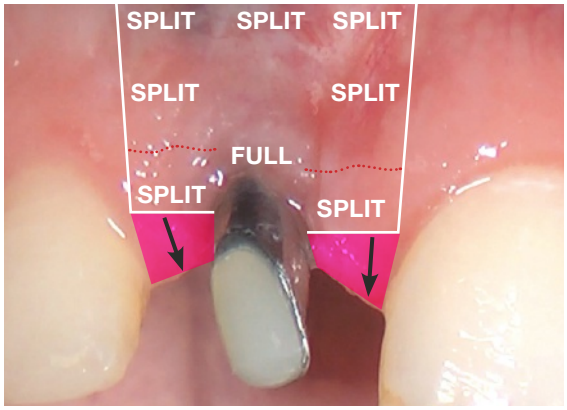
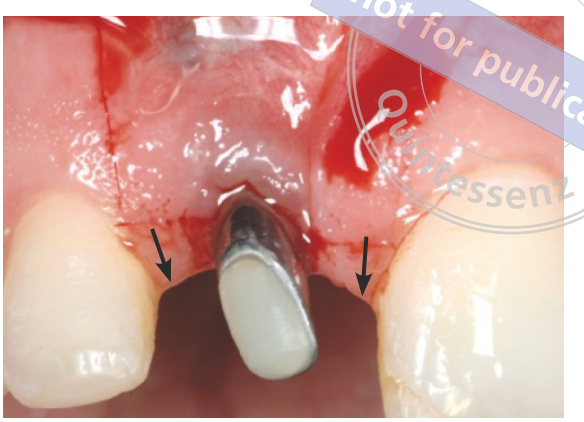
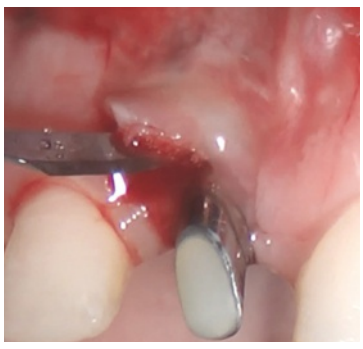
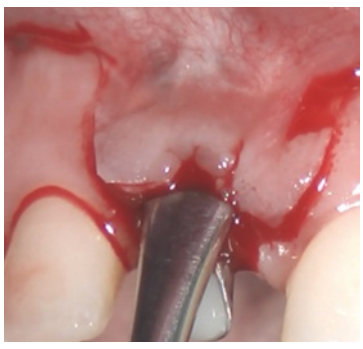
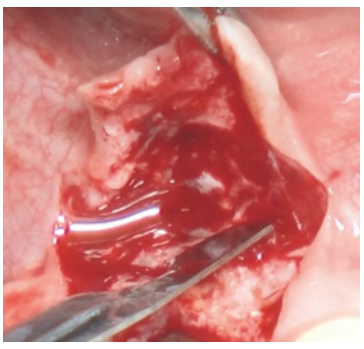


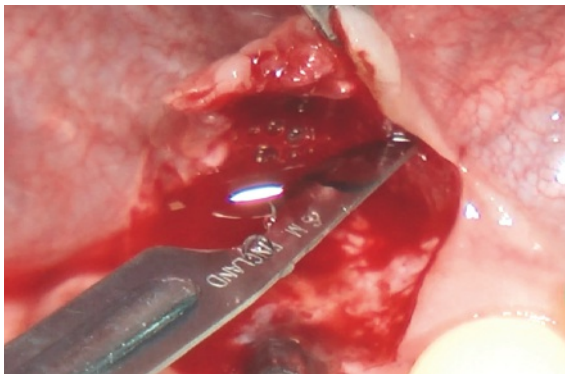


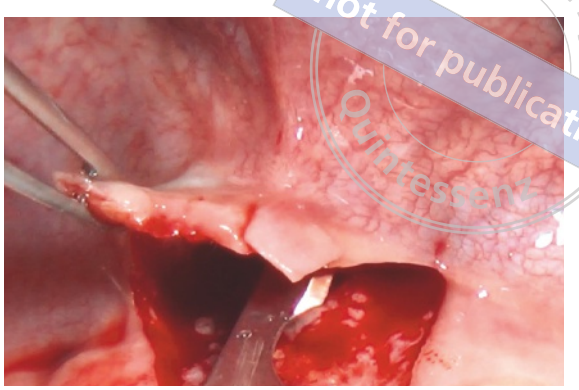
Once peri-implant soft tissue maturation is complete, it is possible to proceed to the surgical phase. This procedure consists of a coronally advanced flap with vertical incisions *(trapezoidal flap)* and placement of an underlying connective tissue graft. Flap design is executed with the surgical blade by creating bleeding lines that will guide the incisions. The trapezoidal flap design consists of two 3-mm horizontal incisions and two vertical incisions that extend as little as possible into the alveolar mucosa while being slightly divergent in a coronoapical sense. Horizontal incisions, on the other hand, are placed at a distance from the anatomical papilla *(black arrows)* that corresponds to the desired coronal advancement of the flap over the surgical abutment. In this particular case, given that the connective tissue graft must be placed 1 mm more coronal than the gingival margin of the adjacent tooth, coronal advancement of the flap is around 2 to 3 mm. The possibility of de-epithelializing the papillae palatally on their occlusal surface allows a more coronal positioning of the horizontal incisions, ie, placing them on keratinized tissue. The flap's surgical papilla is made up of the soft tissue in the area delimited by the horizontal and vertical incisions and an imaginary line *(red dotted line)* traced horizontally at the level of most apical probing depth of the buccal soft tissues. This papilla is elevated with a split-thickness incision performed by keeping the blade parallel to the external mucosal surface, taking care to keep a uniform connective tissue thickness. On the other hand, full-thickness flap elevation is done at the level of the probeable soft tissues apical to the surgical abutment by inserting a periosteal elevator into the sulcus. Full-thickness elevation is continued until overcoming the bone crest, or if the latter is not identified, full-thickness elevation should stop when the soft tissues become adherent to the underlying structures in order not to lose connective tissue adhesion. The most apical portion of the vertical incisions is elevated with a split-thickness incision, taking care to leave the periosteum in place for the protection of the underlying bone. Once the lining mucosa of the lip is reached apically, flap elevation proceeds in a split-thickness fashion in order to allow its coronal advancement. Two different incisions should be performed: one deep and one superficial split-thickness incision. The deep incision, performed with the surgical blade parallel and close to the osseous plane, allows detachment of the muscle insertions from the periosteum and the elevation of the alveolar mucosa.



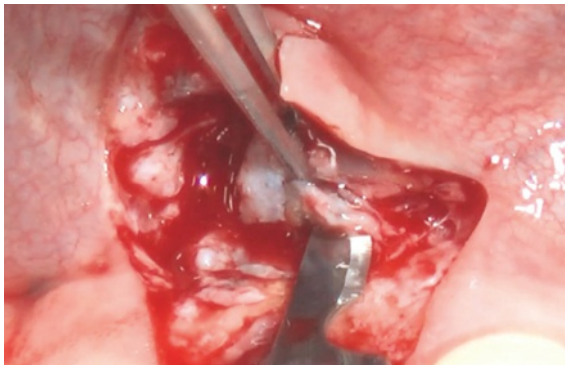


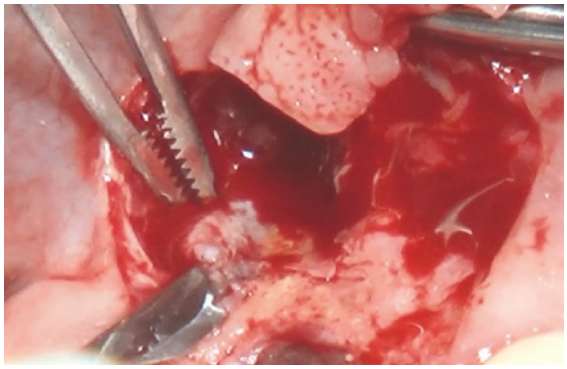






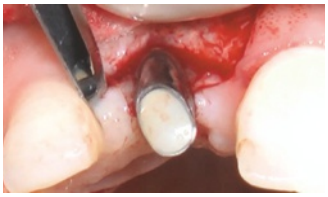
Once the alveolar mucosa has been elevated, the blade inclination can be changed to proceed apically in a direction parallel to the external surface of the lining mucosa. This superficial incision allows detachment of the muscle insertions from the inner aspect of the alveolar mucosa. The muscle fibers, detached both from the superficial and deep tissues, contract apically, thus allowing the coronal advancement of the surgical flap.

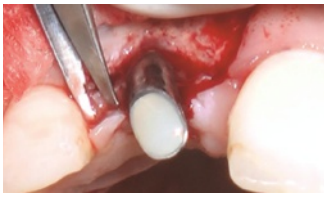


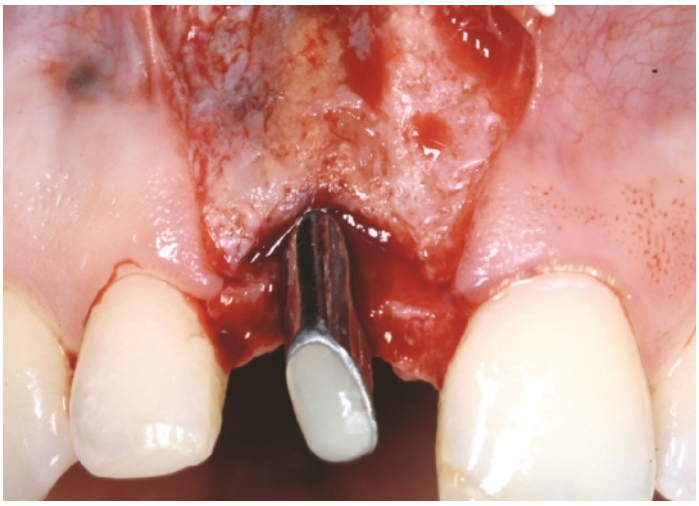


Remnants of non-osseointegrated biomaterial, scar tissue, and submucosal tissues found in the surgical site are dissected with the surgical blade in order to expose the underlying periosteum. This will aid in stabilization of the connective tissue graft and the overlying flap.

De-epithelialization of the anatomical papillae is done to create connective tissue beds that will serve as anchorage for the connective tissue graft and the surgical papillae of the coronally advanced flap. The bases of the anatomical papillae are de-epithelialized with the tip of the blade, which is inserted into the connective tissue at the level of the split-thickness incision previously made when creating the surgical papillae. Once the epithelium has been separated at the base, de-epithelialization of the papilla vertex is continued with microsurgical scissors by following the incision made with the blade. On the occlusal aspect, papillae de-epithelialization is also done in a palatal direction.



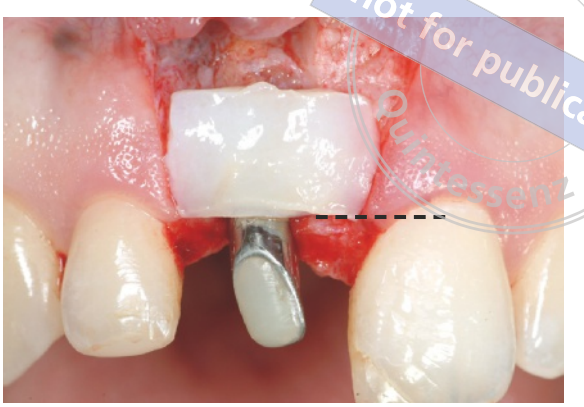


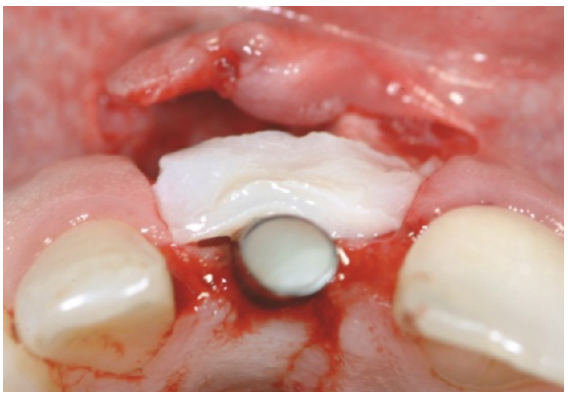


Afterwards, the recipient bed is ready to receive the connective tissue graft. The graft's mesiodistal dimensions should be 6 mm greater than the width of the surgical abutment, and its height should extend from 1 mm coronal to the gingival margin of the adjacent tooth up to 2 to 3 mm apical to the buccal bone crest. The thickness of the connective tissue graft will vary according to the thickness of the flap, but their combined thicknesses should amount to >2 mm.

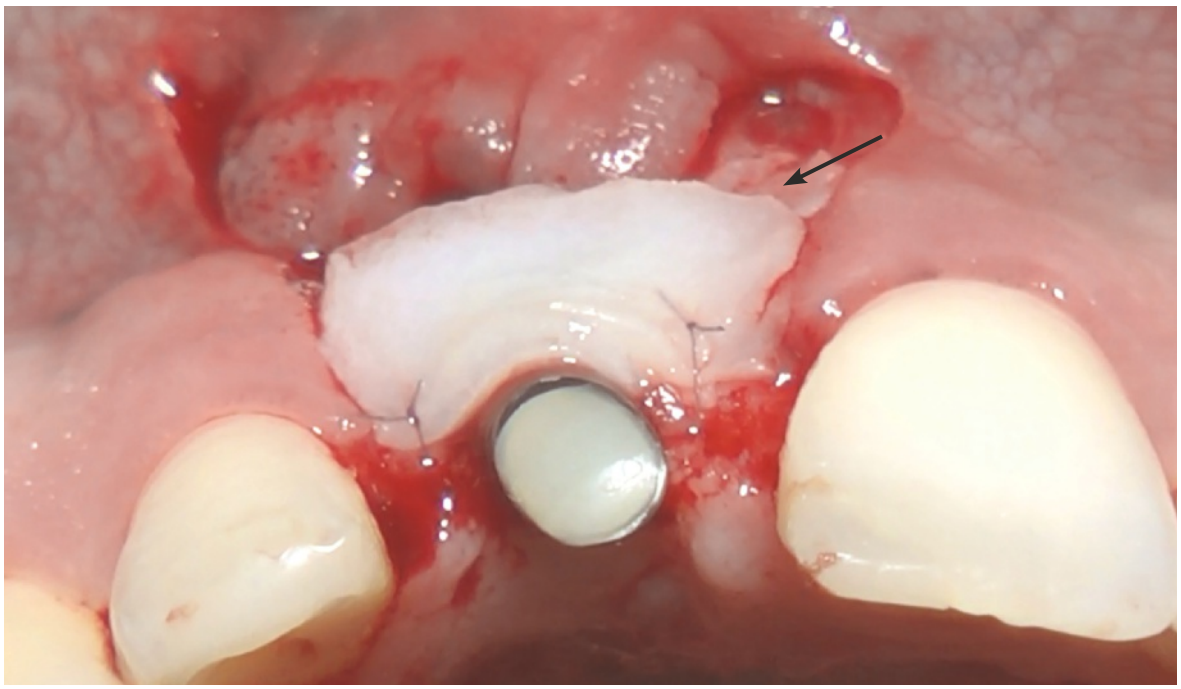
In particular, the connective tissue graft should be thicker at its central portion, which will be placed on top of the surgical abutment, and thinner at the lateral portions, which will be sutured to the base of the de-epithelialized anatomical papillae. Suturing is done by performing simple interrupted sutures with a 7-0 polyglycolic acid (PGA) material with a short (8-mm) needle. It is important that the closing knots are placed on top of the graft, and not the papillae, so that the knot fixes the graft at the base of the papilla. This method avoids an excessively coronal position of the connective tissue graft, which would wrongly occupy the area of the de-epithelialized anatomical papillae destined to anchor the surgical papillae of the coronally advanced flap.

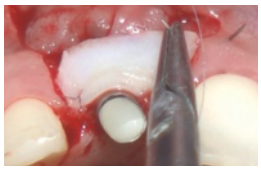
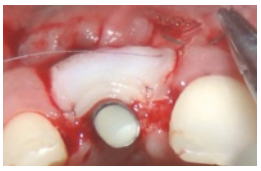
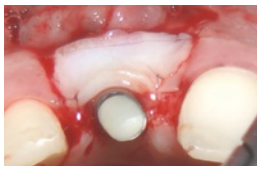
The significant buccal displacement of the surgical abutment and the larger apicocoronal

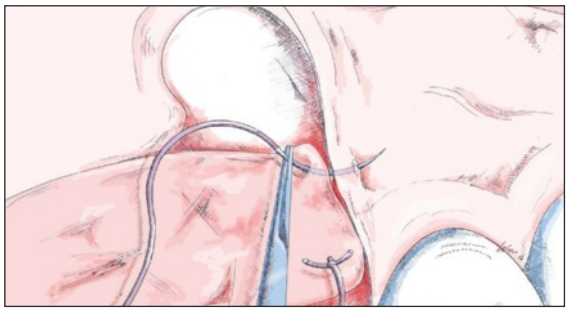
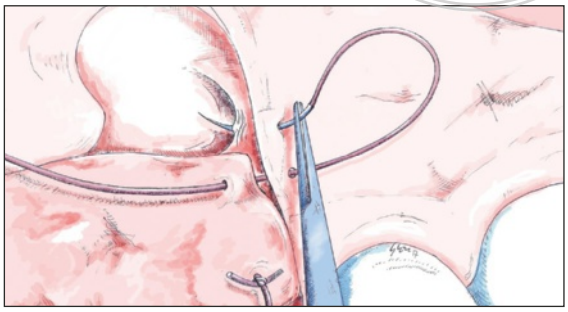


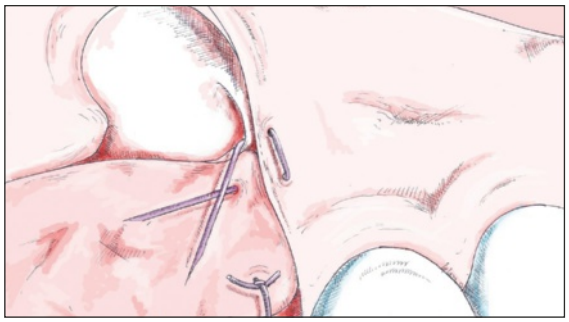
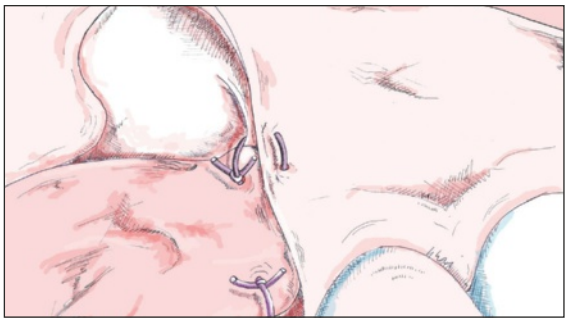


dimension of the graft (in comparison to dimensions normally used when treating gingival recessions) lead to a suboptimal adaptation of the connective tissue graft's apical portion to the underlying periosteal bed. The *black arrow* indicates the outward projection of the graft apically, which makes it necessary to fix it to the periosteum at its most apical portion.

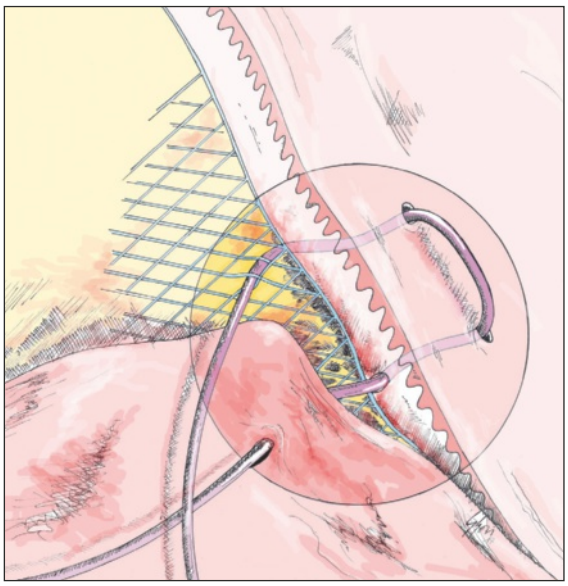


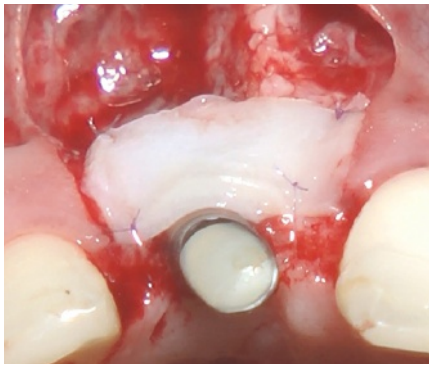
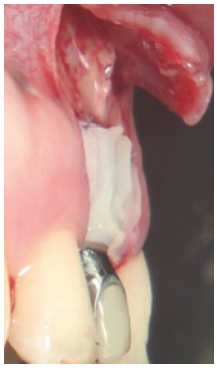
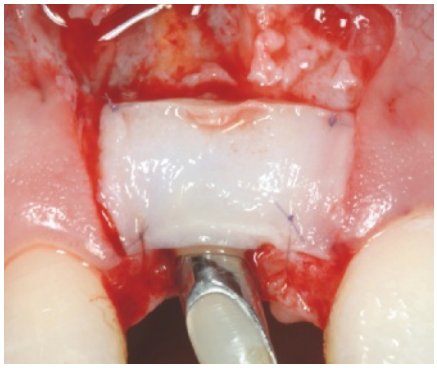




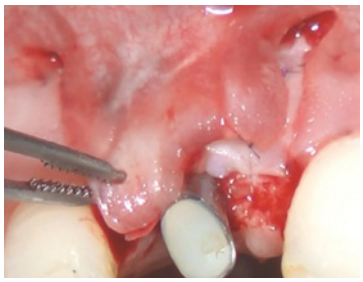




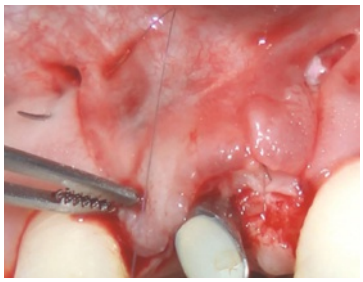



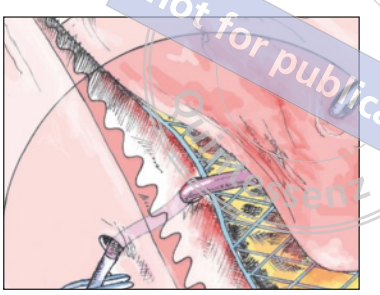
To facilitate periosteal anchorage at the level of the mesial and distal apical angles of the graft, a vertical mattress suture with external periosteal anchorage is used. With the 7-0 suture, the needle perforates the graft passing under the vertical incision and exits on the adjacent soft tissues. Apical to the previous exit point, the needle reenters the tissues, taking periosteal anchorage *(see illustrations)*, passes under the vertical incision line, and exits apical to the graft; the suture is finished with a surgical knot that is placed on top of the connective tissue graft. The two resulting apical knots (a mesial and a distal one) allow for optimal adaptation of the graft onto the periosteum.



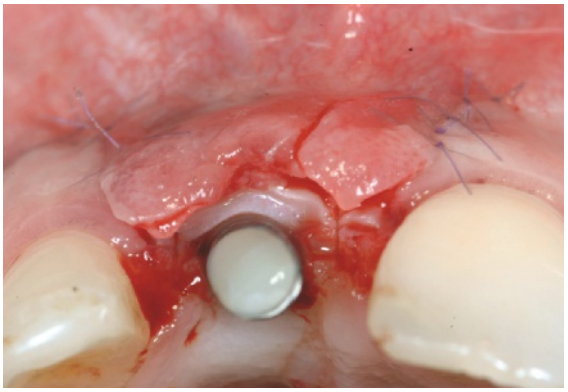




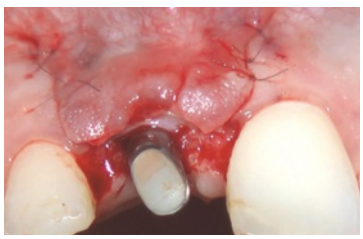


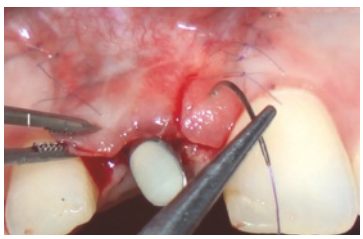
This minimizes the thickness of the coagulum formed between the graft and the underlying tissues, reducing the risk of graft shrinkage.

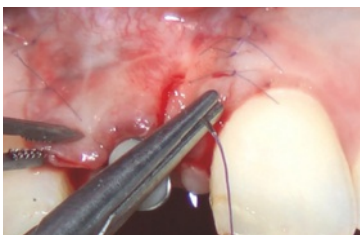
Sutures are performed in a sequence that gradually reduces flap tension, making stabilization of the surgical papillae on top of the anatomical papillae easier. For this reason, suturing is done at the level of the vertical incisions first. In order to start suturing along the vertical incisions, the surgical papilla is placed in its final position over the anatomical papilla with the help of tissue forceps; the first suture is placed at the most apical aspect of the mesial vertical incision, consisting of a simple interrupted suture made from the flap toward the adjacent soft tissues in an apicocoronal direction. If the adjacent tissues are attached gingiva, there is no need to seek periosteal anchorage. In this case, the short (8-mm) needle (with 7-0 PGA) is capable of remaining inside the span of the connective tissue, and the suture is called *intramural (see illustrations)*. The rest of the sutures along the vertical incision are performed in the same fashion: intramural, from the flap toward the adjacent tissues in an apicocoronal direction. After closing the vertical incisions, the surgical papillae are now passively lying on top of the anatomical papillae. Each surgical papilla is fixed to the corresponding anatomical papilla with a sling suture that is suspended around

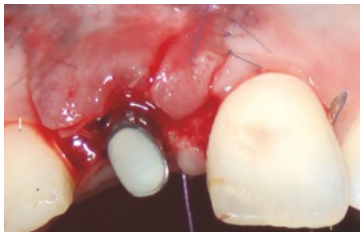


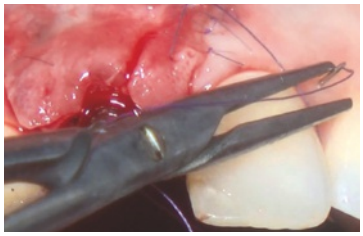
the cingulum of the adjacent tooth. The needle (11-mm, 6-0 PGA) enters buccally at the base of the surgical papilla, perforates the de-epithelialized anatomical papilla, and reaches the palatal side. The thread is positioned under the cingulum of the adjacent corresponding tooth, and then the needle returns buccally, without perforating the tissues but only passing under the contact point. Here, the needle perforates the tooth's distal papilla and exits, again, palatally. The thread is once more placed under the cingulum, and the needle returns to the starting position, where the suture is finished with a surgical knot. It is important that the compression exerted by the suture is directed toward the adjacent teeth *(black arrow)* with healthy bone crests and not toward the surgical abutment.

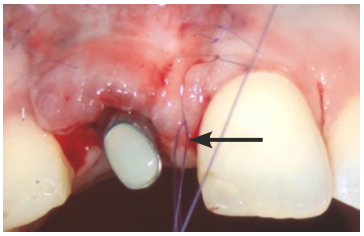




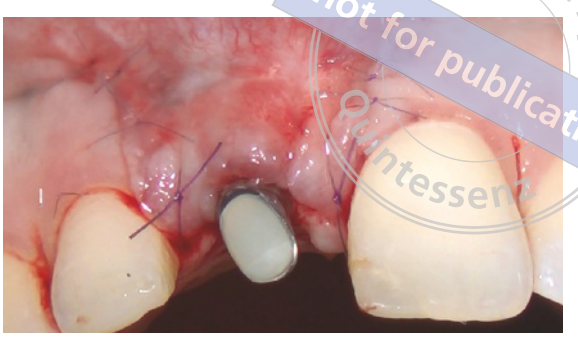


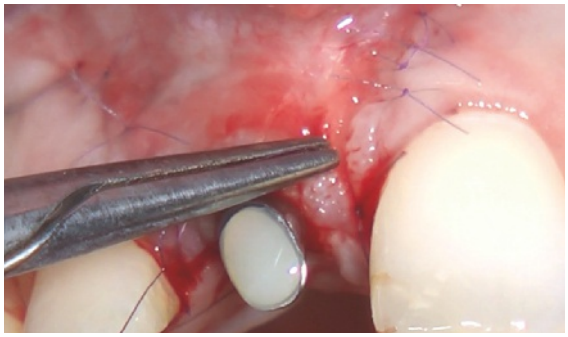


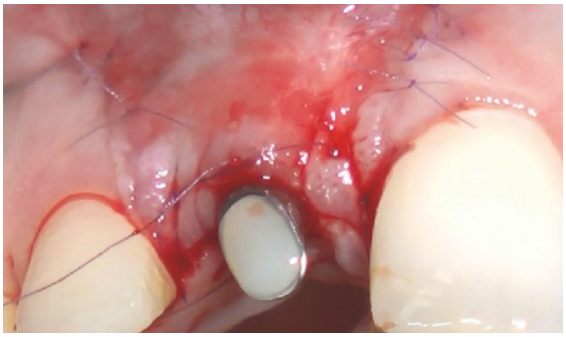


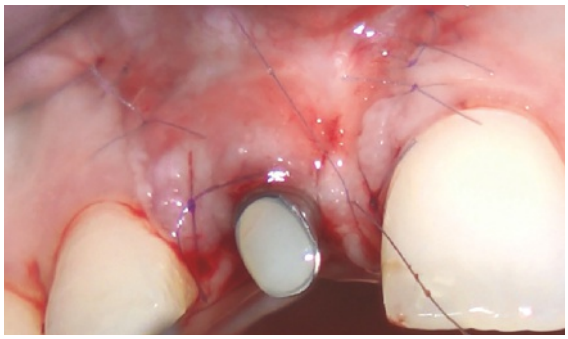


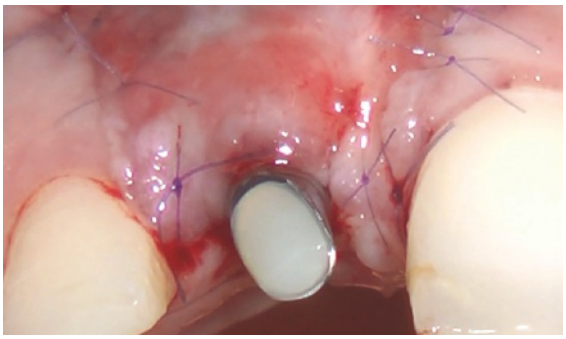
After performing the sling sutures, first intention closure between the surgical and anatomical papillae is completed in the proximity of the surgical abutment, completely tension free, with simple interrupted sutures using 7-0 PGA (8-mm needle).



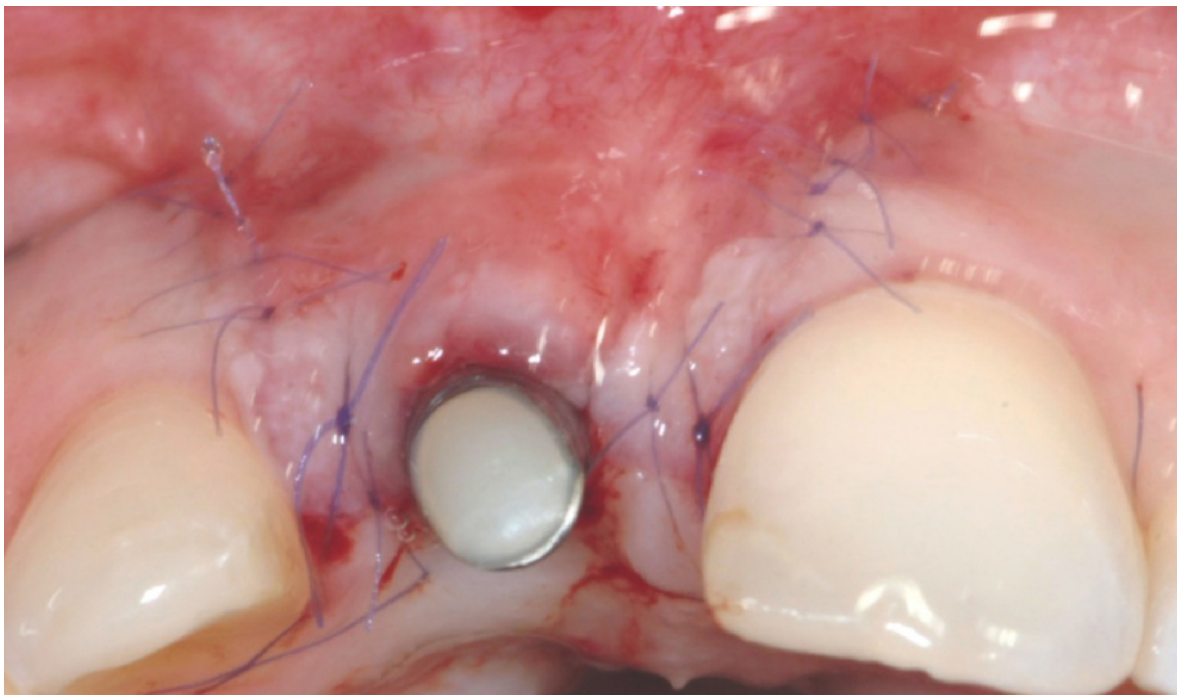


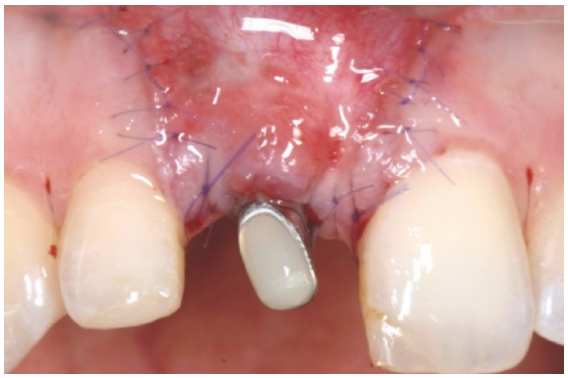


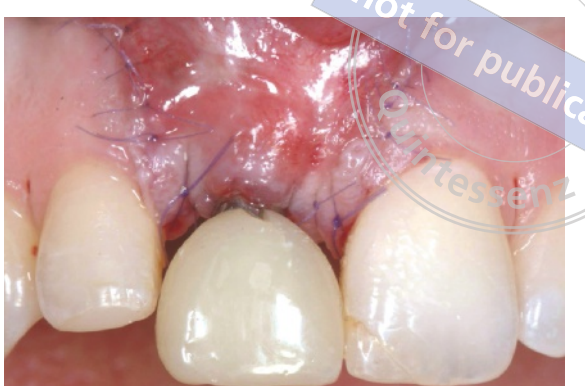




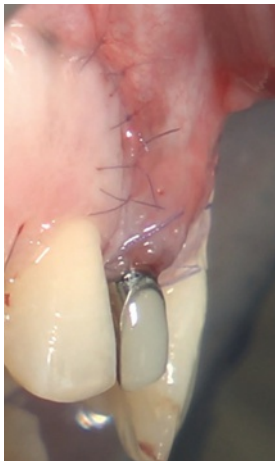
Upon completion of the sutures, it is important that the coronally advanced flap completely covers the connective tissue graft while adapting to the convex and smooth surface of the surgical abutment.

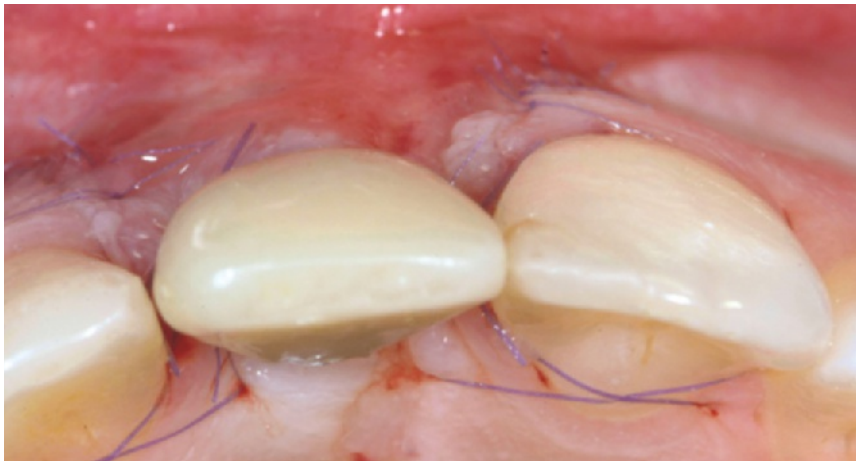




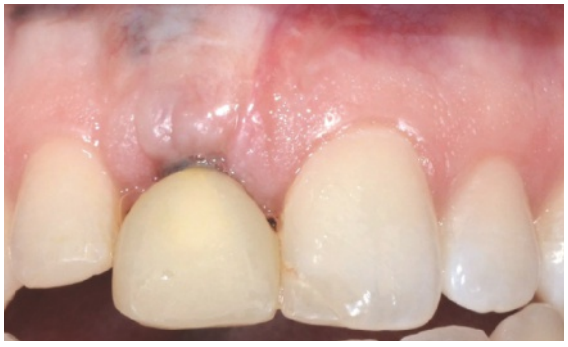


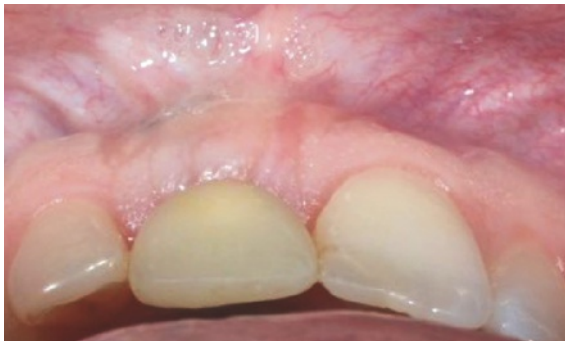
The flap should completely cover the connective tissue graft, and the marginal keratinized tissues should tightly adhere to the surgical abutment's convex surface. This provides stability to the surgical wound and reduces the risk for early flap shrinkage. From an occlusal view, it is essential to assure absence of bleeding or of coagulum formation between the marginal keratinized tissues and the surgical abutment. Early flap shrinkage could lead to failure in dehiscence coverage or, in the best-case scenario, graft exposure with a subsequent whitish/keloid appearance, typical of a free gingival graft and therefore far less esthetic.





Profile and occlusal images demonstrate how the buccopalatal deficiency has been completely corrected at the end of the surgical procedure. Afterwards, the provisional is reduced so that it won't interfere with the soft tissue healing process. Particular care must be taken during its cementation to avoid cement overflow that could infiltrate under the flap.

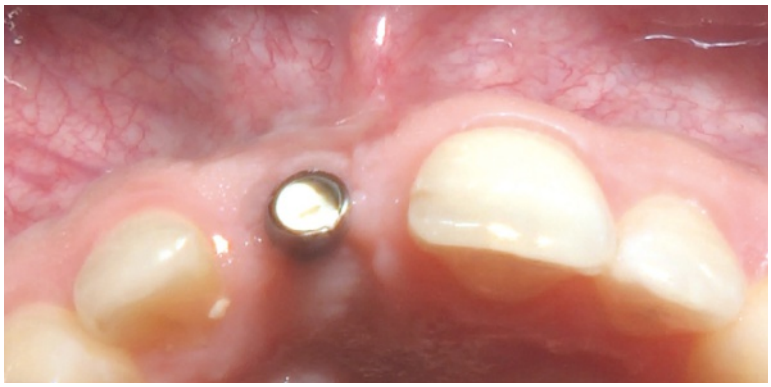


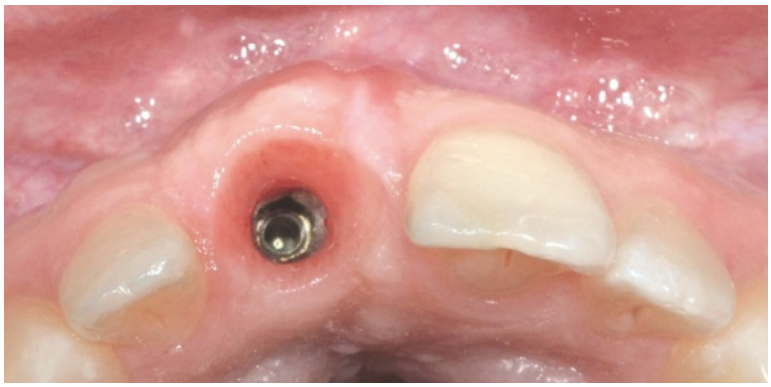


Sutures are removed 2 weeks after the surgery. At 14 days postoperatively, it is possible to notice the stability of the flap, which hasn't experienced shrinkage from its immediate postsurgical position, and the complete resolution of the buccopalatal soft tissue defect.

During a 4-month period, referred to as the **maturation phase**, the soft tissues must be free to mature both in height and thickness. The phenomenon by which soft tissues migrate coronally, after being thickened, is known as creeping. In this period, the patient is seen at monthly appointments, during which the provisional is removed and further reduced wherever it comes in contact with the soft tissues, while the surgical abutment is polished with a rubber cup; this is done to avoid hindering soft tissue growth.

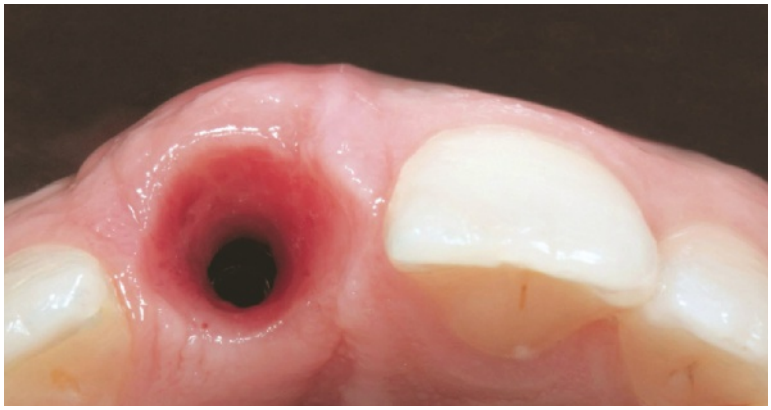
Four months after the surgery, soft tissues are stable and mature enough to start the **conditioning phase**. Soft tissue conditioning is done with a new, screw-retained provisional crown. In this phase, the goal is to apically reposition the marginal soft tissues until they reach the same level as the gingival margin of the adjacent teeth and at the same time reshape the peri-implant papillae so that they become triangular and fill the interproximal spaces completely. Repositioning of the soft tissue margin is accomplished through apical compression by progressive addition of fluid composite resin to the provisional. Meanwhile, the “squeezing” at the interproximal areas is achieved with progressive modifications of the provisional with a continuous coronal displacement of its contact points; the aim is to leave small interproximal spaces that the soft tissues can fill in a short period of time. Therefore, 3 to 4 weeks should pass between appointments for modification of the provisional crown. The definitive restoration can be placed when the marginal scallop of the provisional crown resembles that of the contralateral tooth and the height and shape of the peri-implant papillae are as similar as possible to those of the corresponding natural tooth.

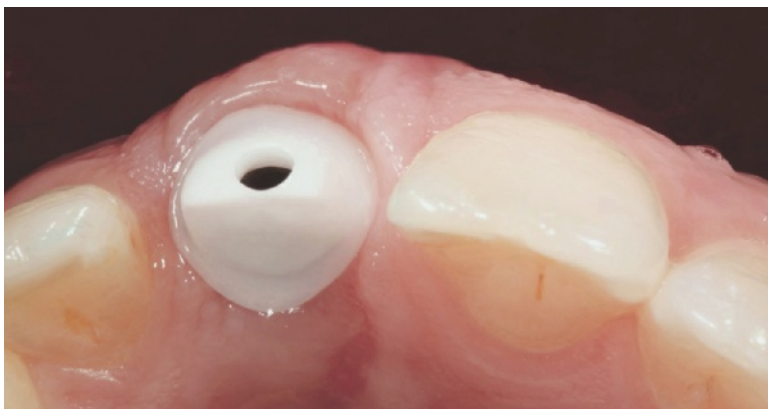




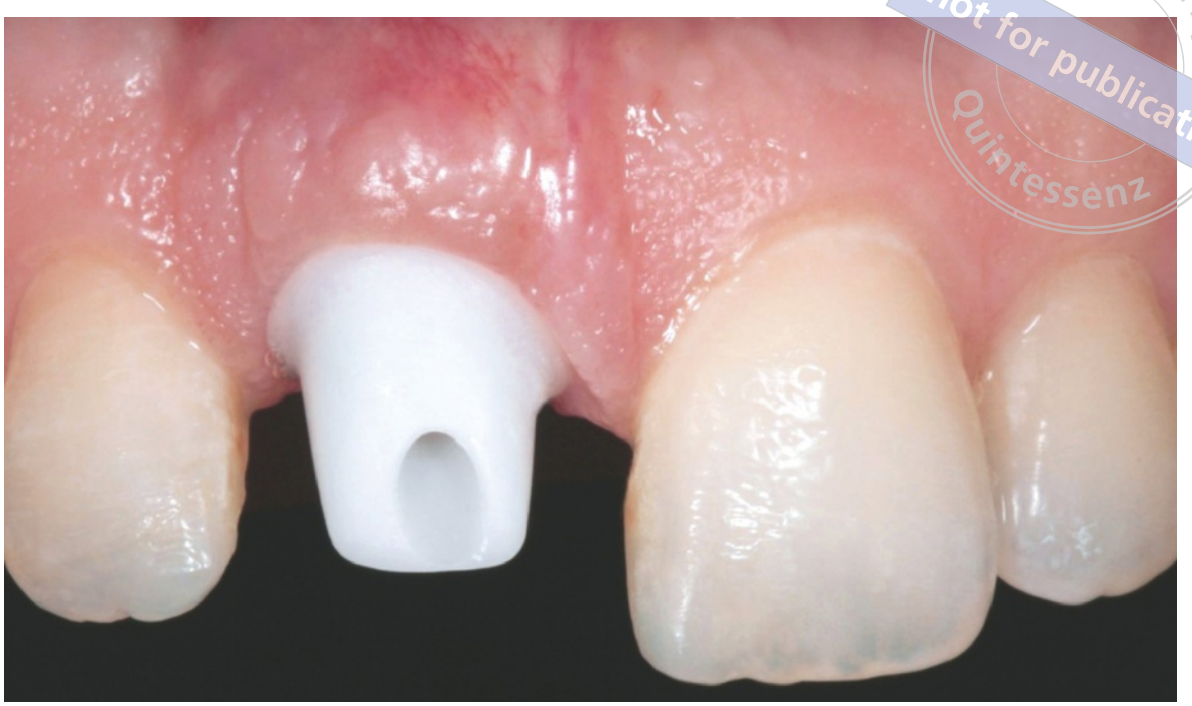
The occlusal images show the increase in peri-implant soft tissue thickness. This allows for three-dimensional compensation of the bucco-lingual and apicocoronal soft tissue deficit, treatment of the peri-implant buccal dehiscence, masking of the metallic implant structure, and creation of a new transmucosal path that will give the implant-supported crown an entirely natural emergence profile.

Soft tissue augmentation results in a significant increase at the transmucosal path between the implant head and the soft tissue margin. The patient must be instructed in adequate hygiene maintenance of the implant site so that the increase in soft tissue volume does not translate into non-physiologic probing depths, which could lead to an increased risk for developing biologic complications such as mucositis or peri-implantitis.



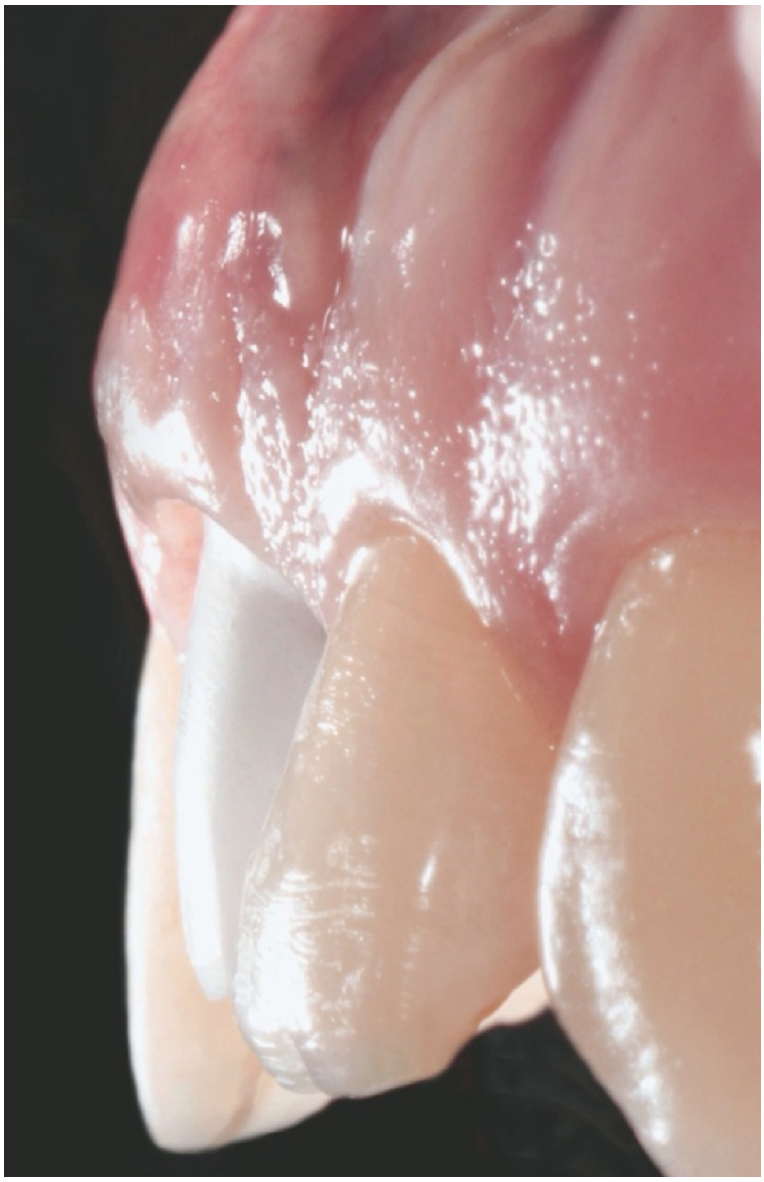


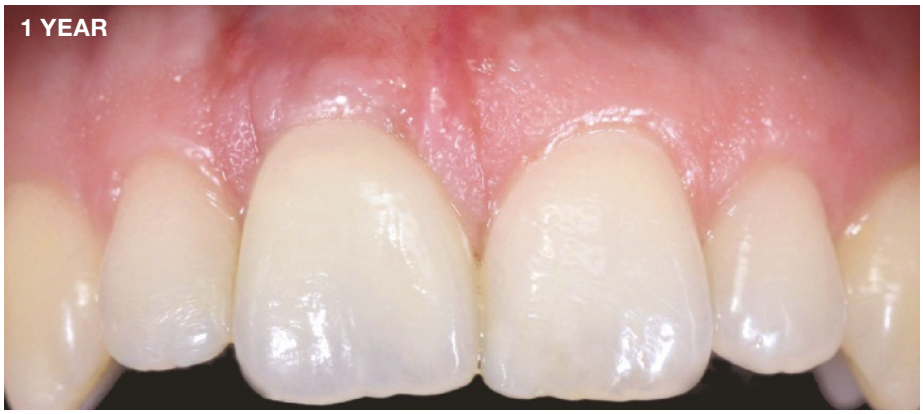
As a result of implant malposition, it is rarely possible to place a screw-retained definitive restoration in these cases. Therefore, it is almost always necessary to fabricate a personalized prosthetic abutment that will be placed and screwed onto the implant fixture. The surface of this abutment should be as smooth as possible so that it can favor epithelial adhesion and at the same time minimize subgingival bacterial plaque accumulation. The prosthetic abutment can be made from an esthetic material (zirconia), which can further reduce the risk of color alterations at the level of the soft tissue margin related to the difference in light reflection in comparison to natural teeth.



It is important for the prosthetic abutment to accurately reproduce the shape of the screw-retained provisional at the internal aspect of the transmucosal path, given that its task is to maintain the shape and height of the transmucosal path that was attained through soft tissue conditioning. Adequate support will allow the maintenance of peri-implant soft tissue esthetics over time.

It is of crucial importance that the finishing line of the prosthetic crown is positioned the least subgingival as possible (0.5 to 1 mm buccally and interproximally, respectively) or even juxtagingival in non-esthetic areas (palatally). This serves a threefold purpose: making cementum removal easier (aided also by the placement of retraction cords during cementation), better control of the crown's margin closure by the dentist and hygienist, and facilitating patient-performed plaque control.





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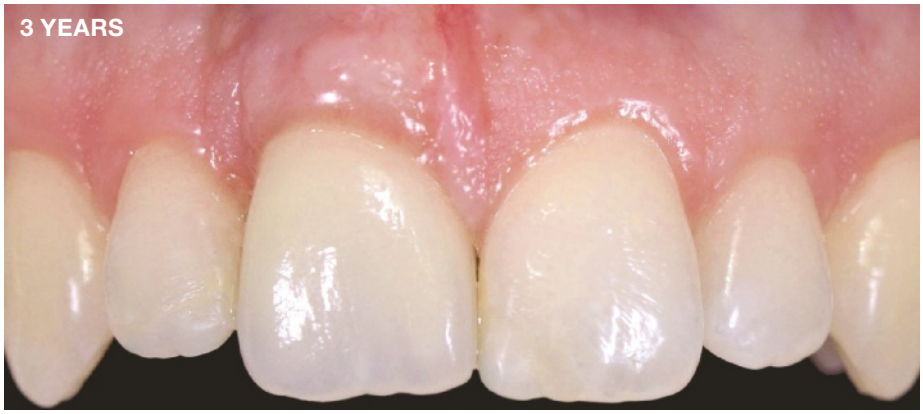
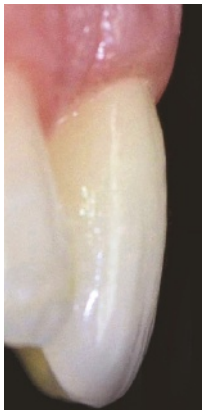
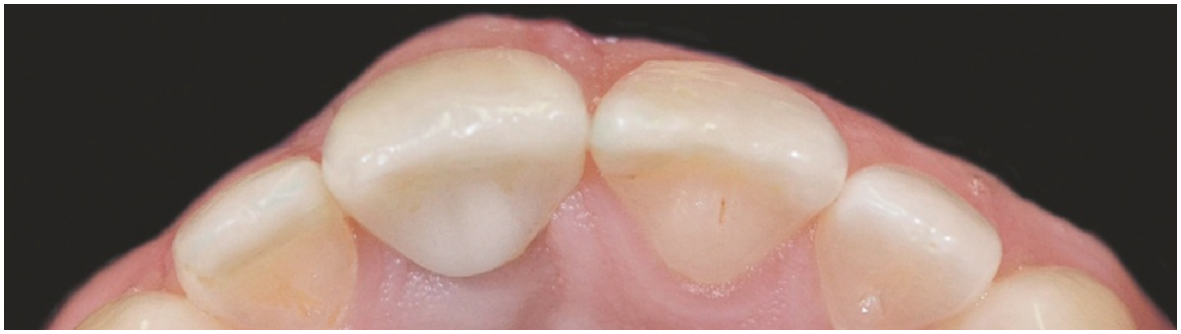
The clinical result 1 year after final restoration placement shows complete coverage of the peri-implant soft tissue dehiscence and absence of the grayish discoloration that was present as a result of the reduced tissue thickness. The scallop of the peri-implant mucosal margin resembles that of the gingival margin of the adjacent natural tooth, thus creating symmetry and harmony of the soft tissues, which are fundamental for evaluation of the esthetic outcome. The stability of the coronally advanced flap with an underlying connective tissue graft makes for an esthetically pleasing result; as a matter of fact, none of the typical signs of graft exposure, which would alter the esthetic result, are present. The definitive crown blends in well with the adjacent natural dentition, as does the surgical treated area with the neighboring soft tissues. The emergence profile is well represented, protecting the soft tissue margin from potential trauma during mastication and making the patient's oral hygiene maneuvers easier.





The esthetic result (blending of the treated area with the adjacent elements) remains stable even 3 years after cementation. Unexpectedly, further increase in buccal soft tissue thickness can be observed; this phenomenon, while reducing the risk of future dehiscence relapse, modifies the crown's emergence profile. The augmented volume buccal to the implant surface successfully hides the underlying prosthetic structure *(restorative therapy done by Dr Astrid Razem)*.



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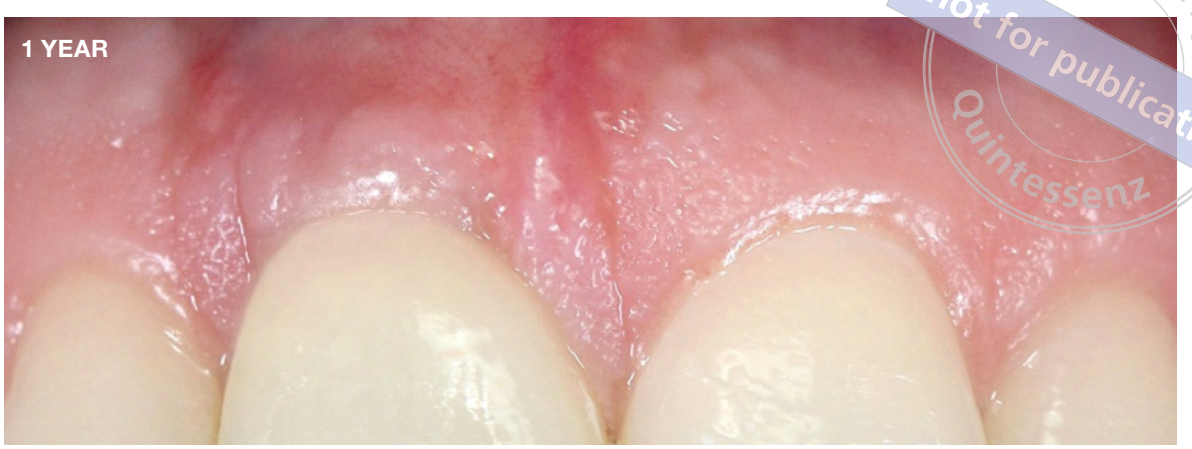

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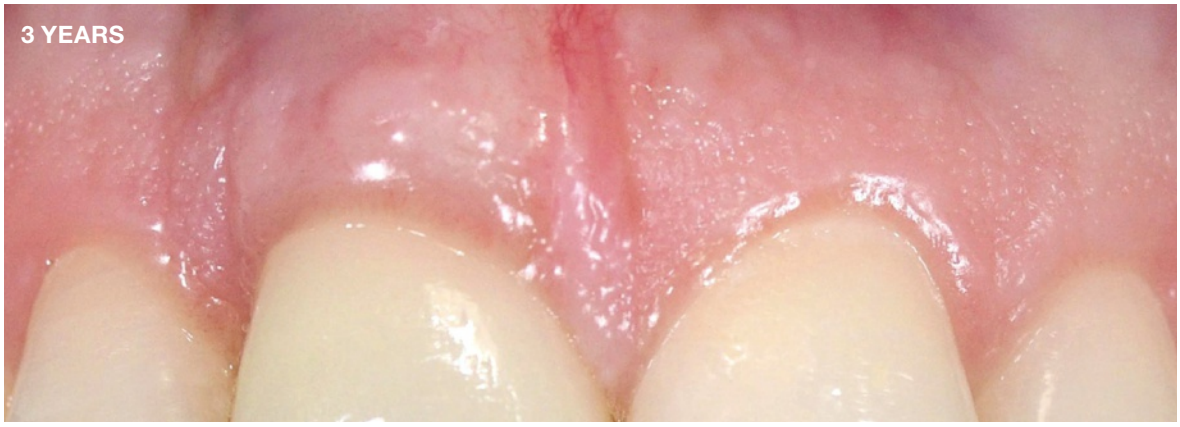
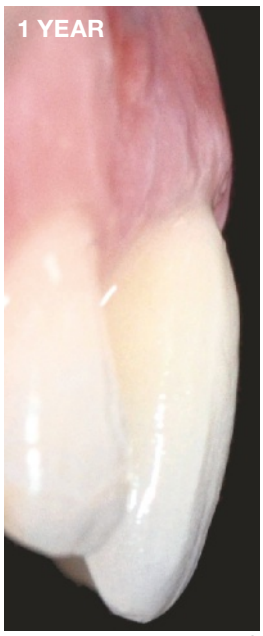
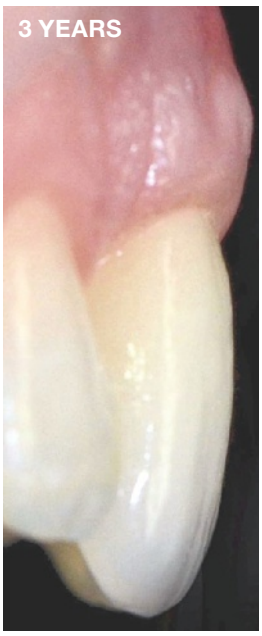


A subsequent unplanned increase in buccal soft tissue thickness, even after 1 year, is a frequent finding whenever this type of connective tissue graft is used with this surgical procedure (ie, extraorally de-epithelialized free gingival graft with a coronally advanced flap). The biologic explanation for this phenomenon could be the change in the vascular supply of the grafted connective tissue, which goes from an area of reduced terminal vascularization like the palate to a vastly irrigated area like that underneath the highly vascularized buccal mucosa.

The increase in buccal soft tissue thickness can induce further coronal migration of the mucosal margin on top of the implant-supported crown due to the "creeping" phenomenon. On the one hand, this condition can allow complete coverage of areas that previously were only partially covered, but on the other hand, it can also lead to shortening of the implant-supported crown. This is hardly ever noticed by the patient, and only a direct comparison between the clinical images over time makes this observation possible. Based on the previously established goal, ie, hindering versus favoring tissue creeping over time, it is advisable for the crown to have an over- or undercontoured emergence profile.





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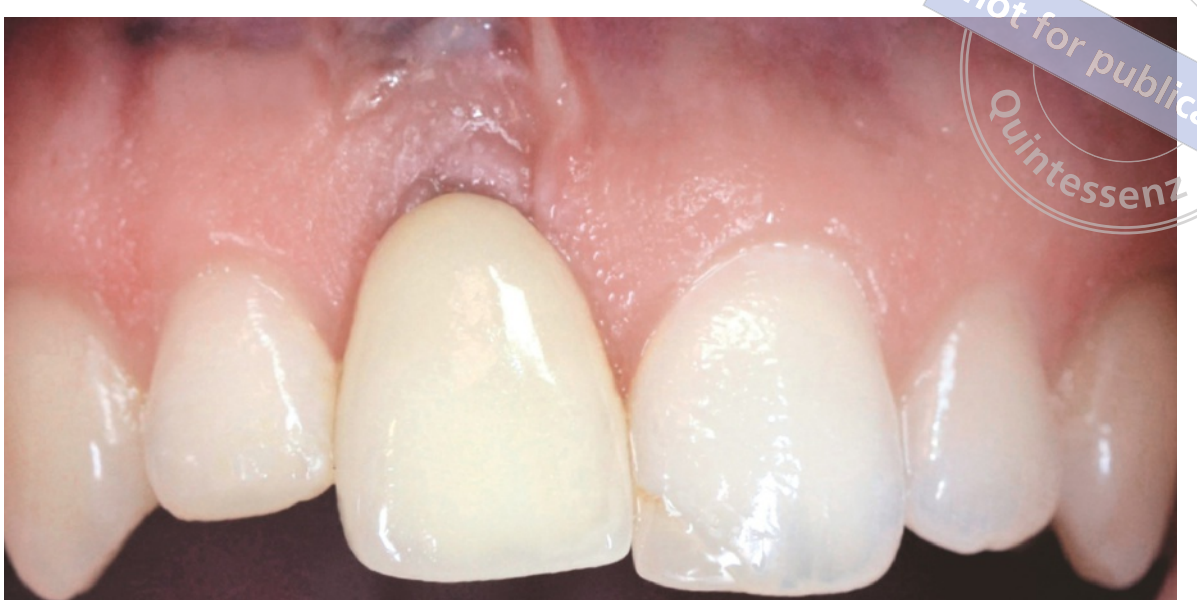

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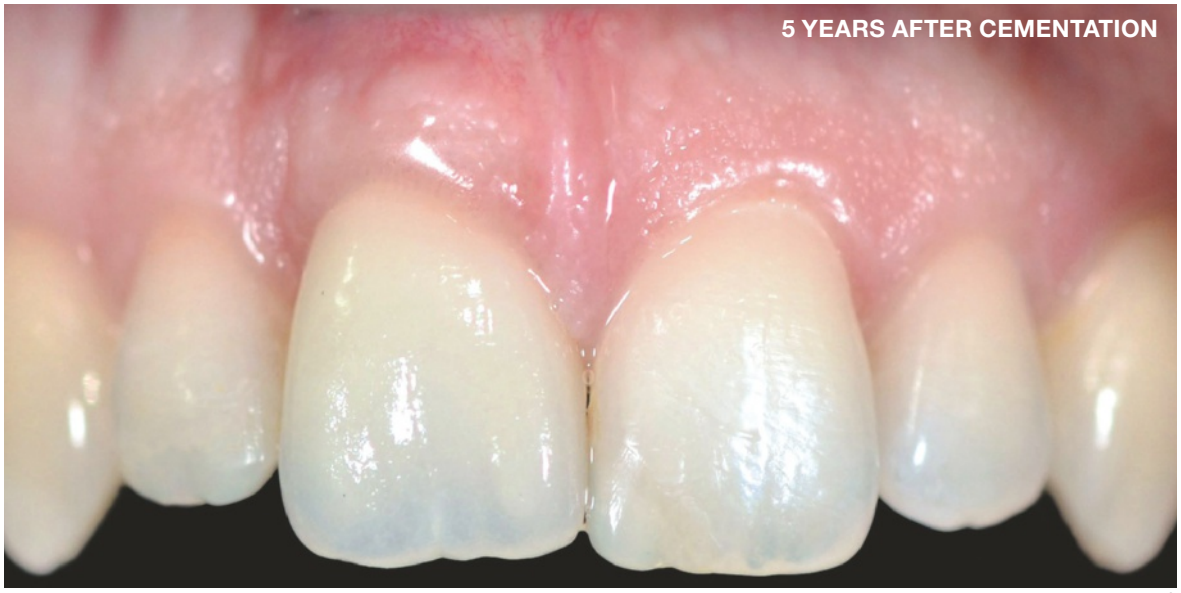

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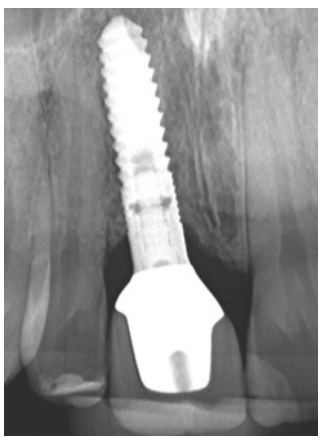
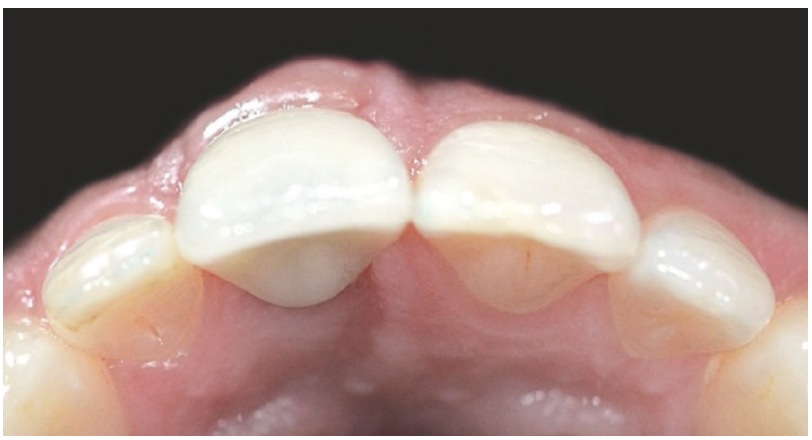
The esthetic result (blending in of the treated area with the adjacent structures) appears stable at 5 years after final restoration placement, with high patient-reported satisfaction. Even the increase in buccal thickness is maintained, with a very low risk of buccal dehiscence recurrence. The periapical radiograph shows stability of the peri-implant bone support and radiopacity of the bone crest.





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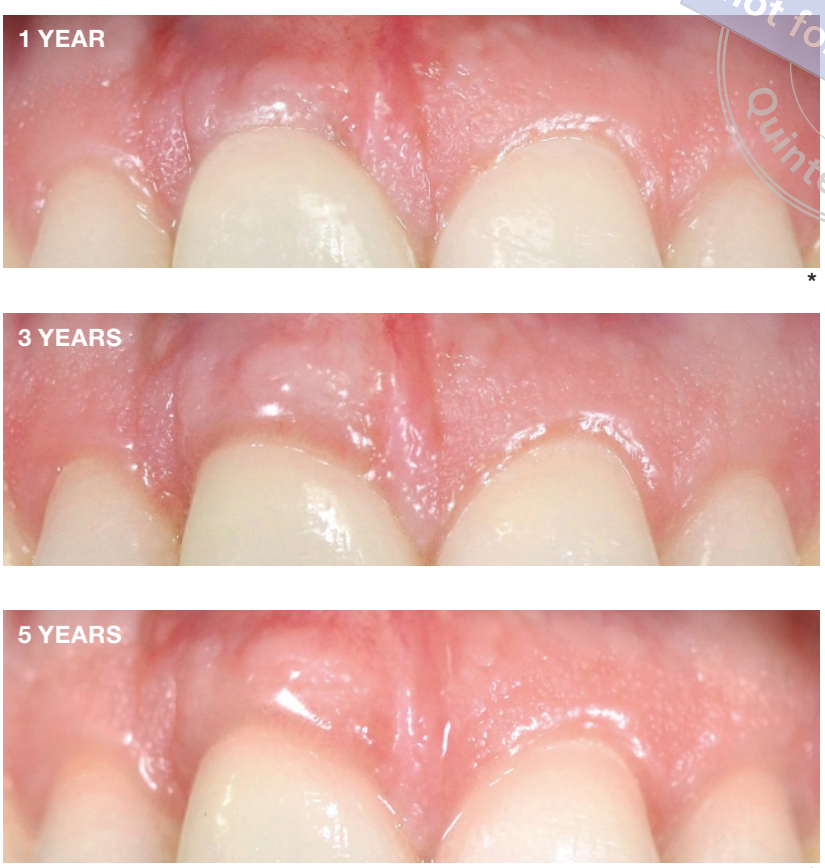

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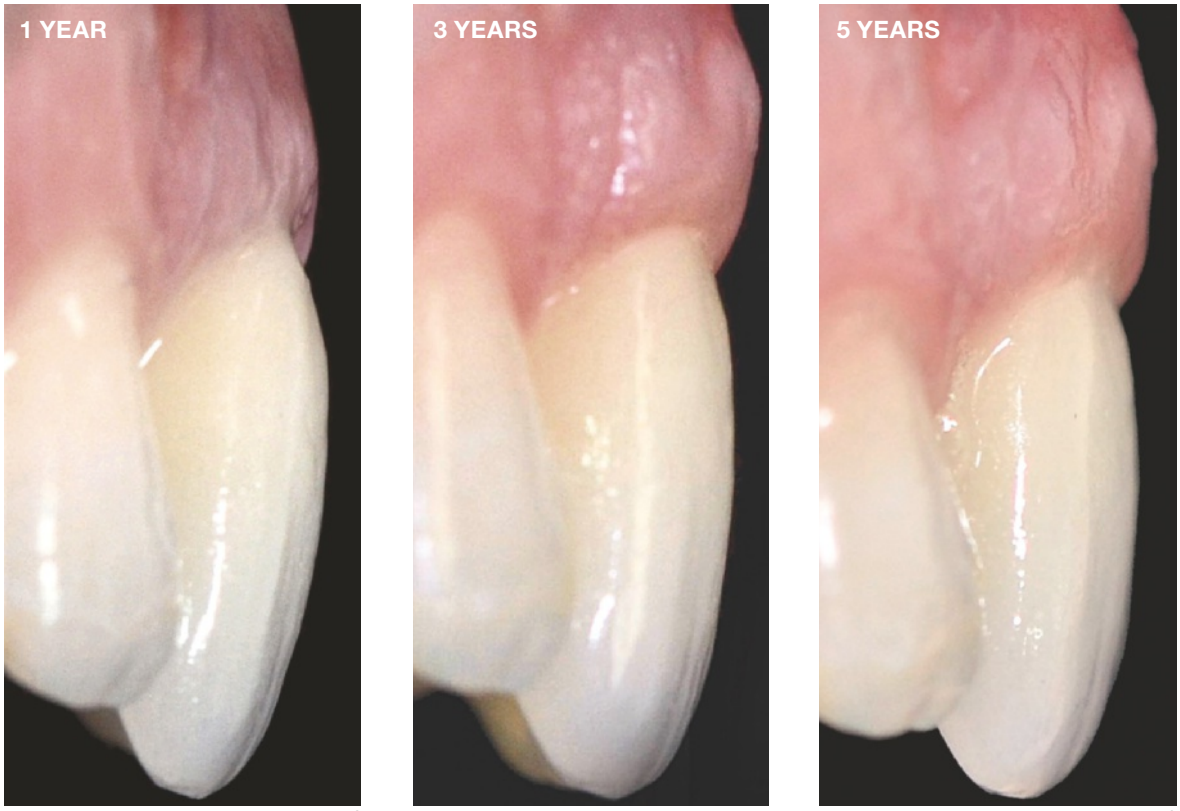
Comparison of the marginal scallop, emergence profile, and clinical crown length at the implant site at 1, 3, and 5 years after final restoration placement shows an increase in buccal soft tissue thickness and the creeping phenomenon over time. These considerations have led the authors to reduce graft thickness during surgery; the added thickness of the graft and the flap together should amount to, but not surpass, 2 mm.



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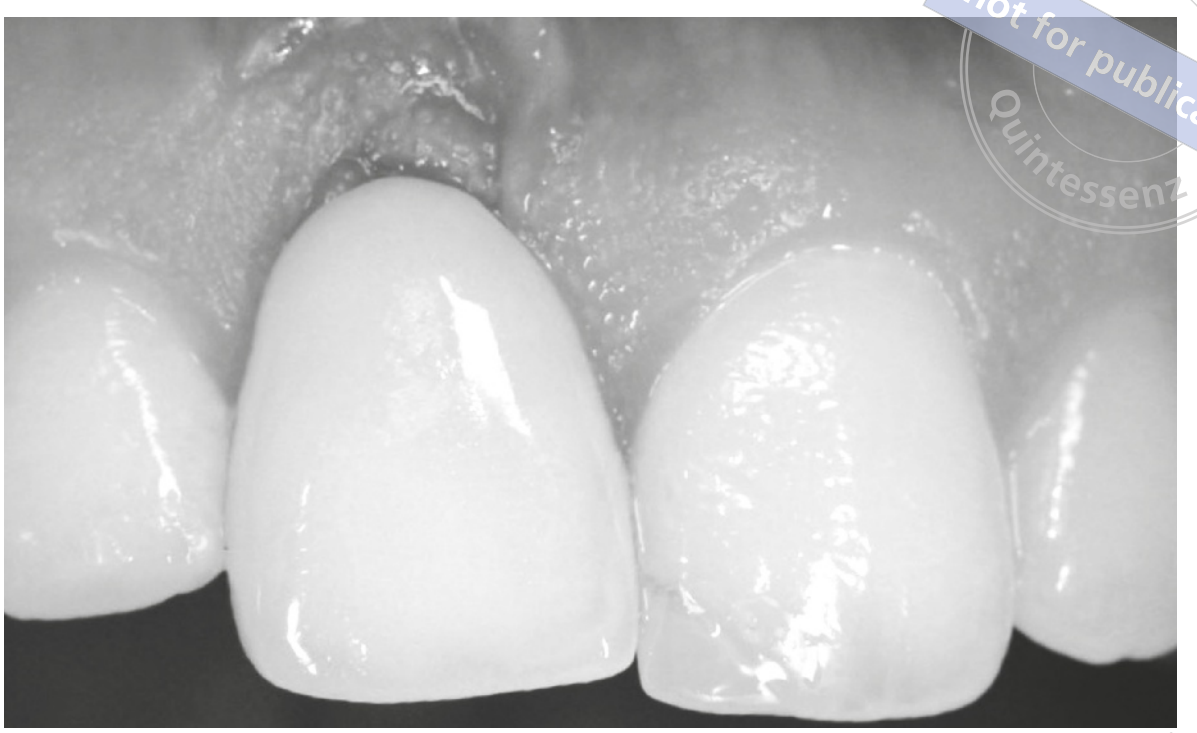

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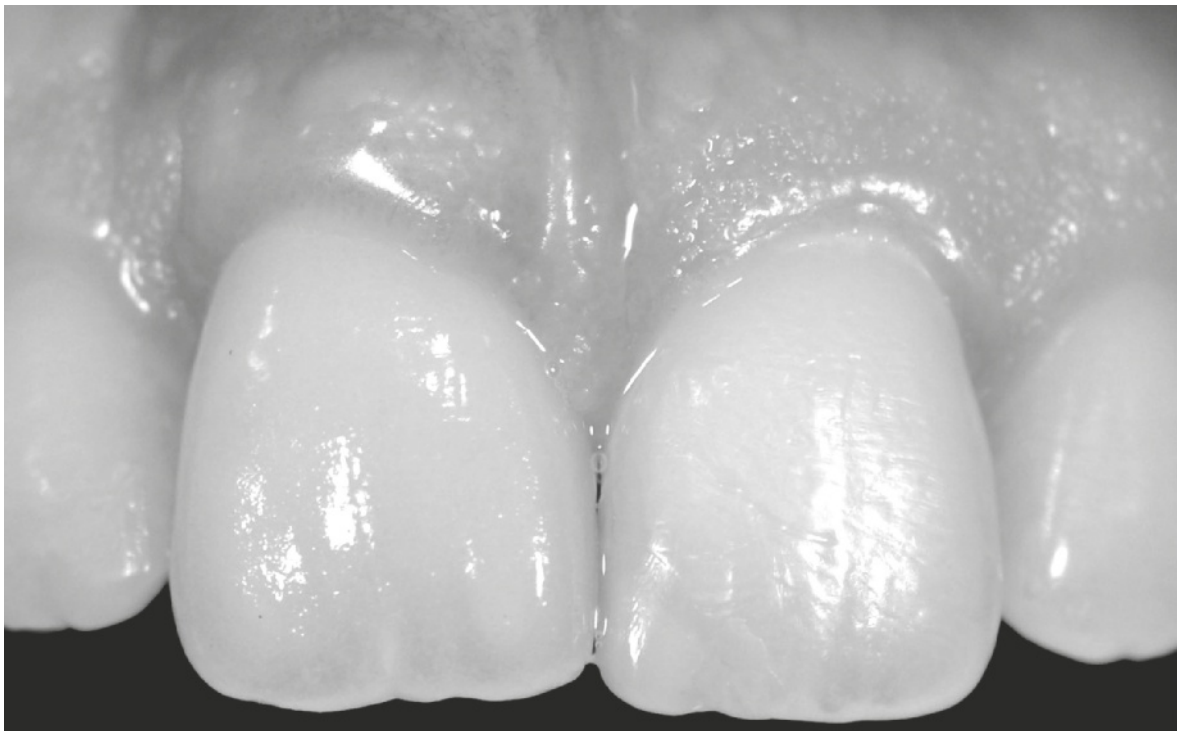

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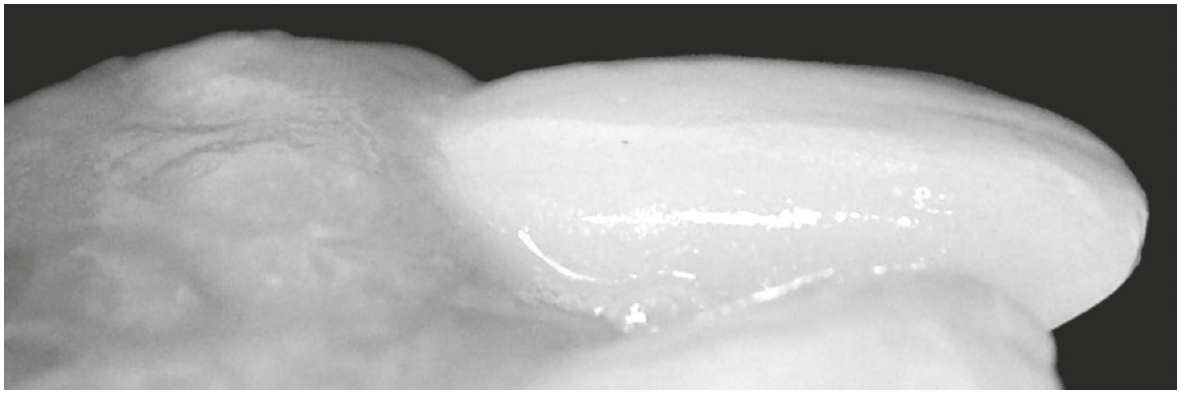

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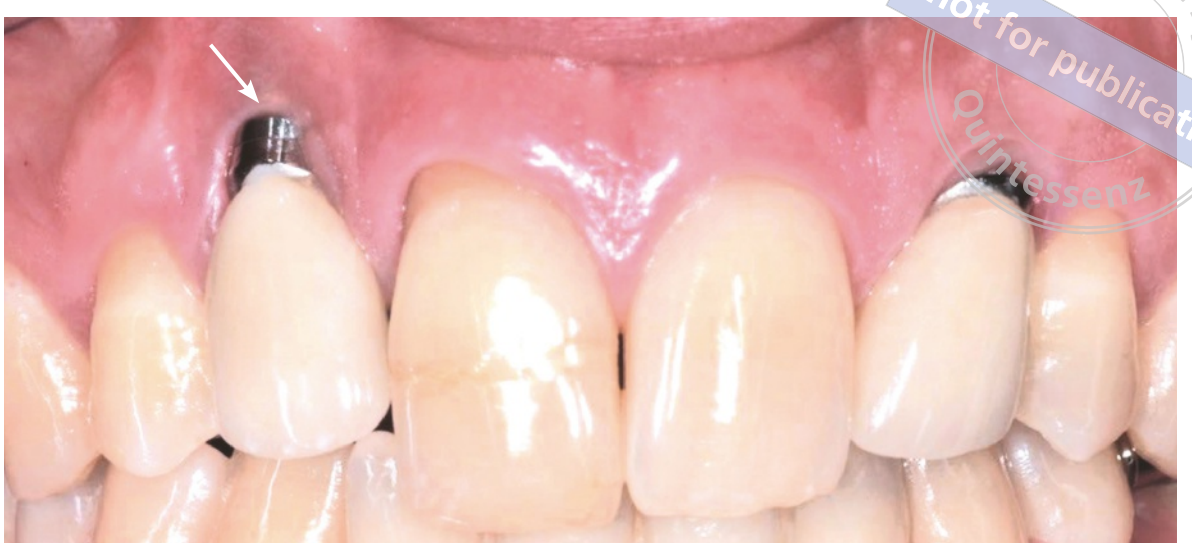
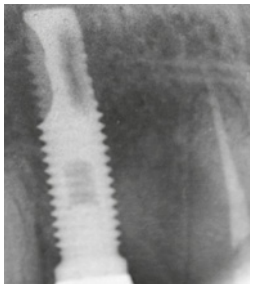
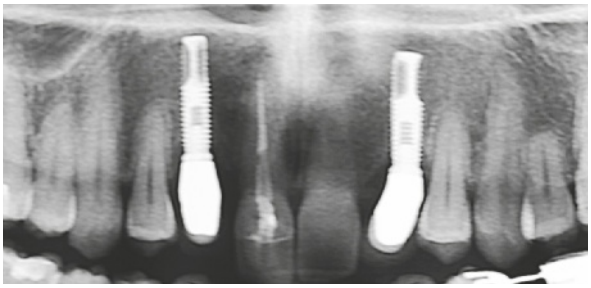
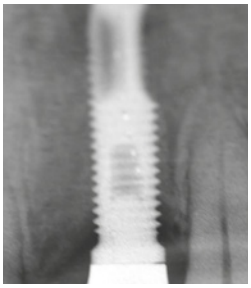
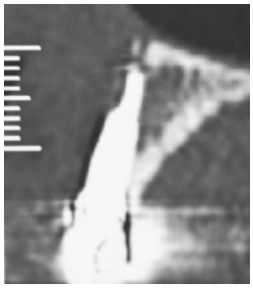
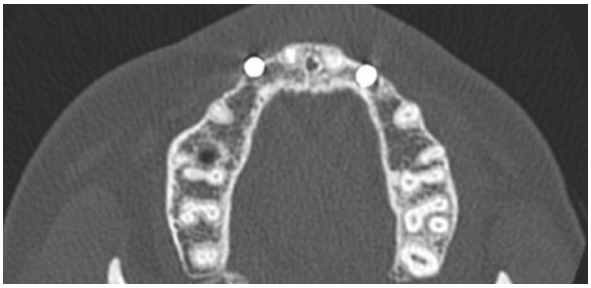


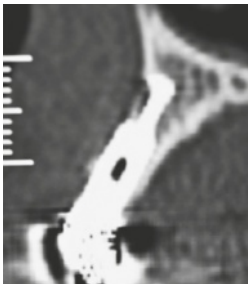




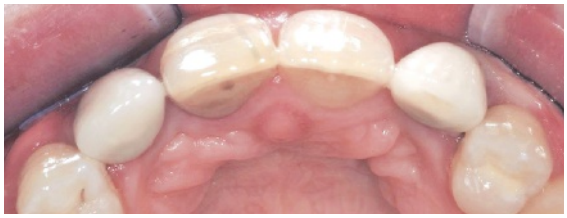


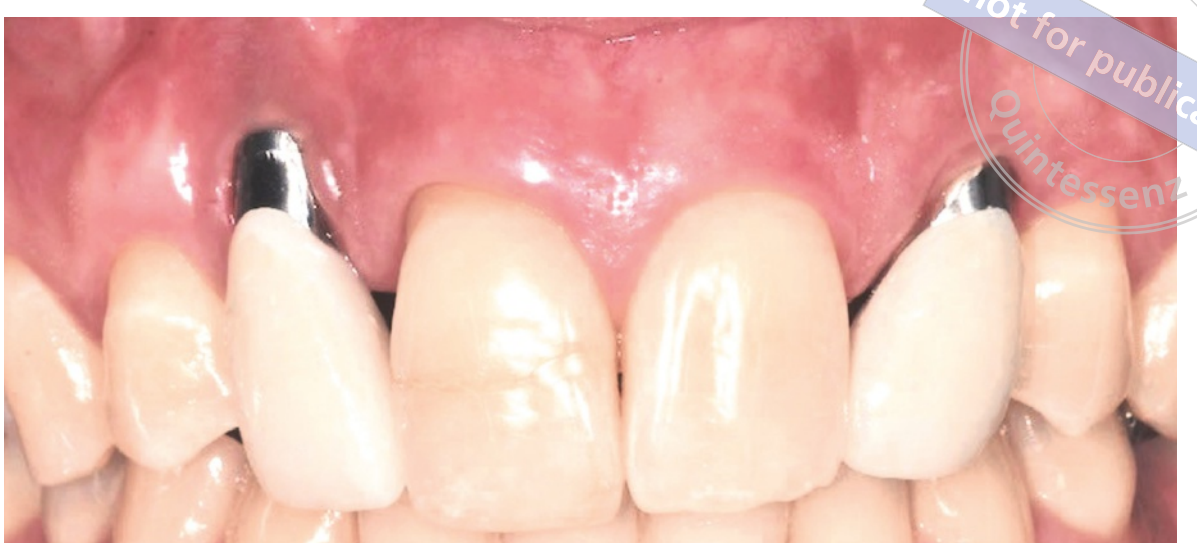


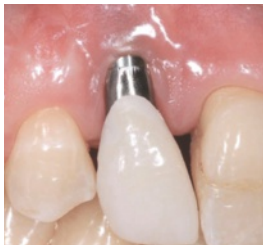


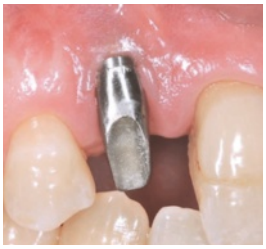


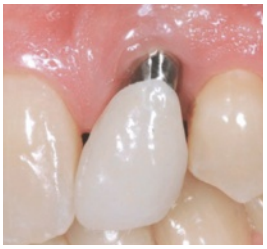
As previously described, incorrect implant placement, specifically in an excessively buccal position, is one of the main factors associated with the development of peri-implant buccal soft tissue dehiscences. The CBCT scan reveals the erroneous buccal placement, even if the scattering effect of the metallic structure makes it difficult to accurately measure the extent of the buccal bone dehiscence. The latter, along with the degree of implant malposition and probing measurements of the buccal soft tissues apical to the dehiscence *(white arrow)*, are the determining factors for the clinician's decision between treatment of the dehiscence or implant removal. The CBCT scan allows diagnosis of the buccal bone dehiscence with consequent exposure of the implant surface, while probing (without anesthesia) apical to the soft tissue dehiscence allows differentiation between an anatomical or pathologic exposure of the buccal implant surface (ie, without increased probing depths versus with increased probing depths and contamination of the implant surface, respectively). Due to the difficulty and lack of assurance regarding the possibility of attaining complete decontamination of the implant surface, the absence of pathologic probing depths at the level of the implant's osseointegratable portion *(white arrow)* is a key factor for choosing to perform surgical coverage of the peri-implant soft tissue dehiscence.

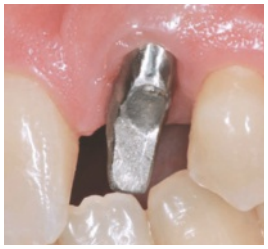




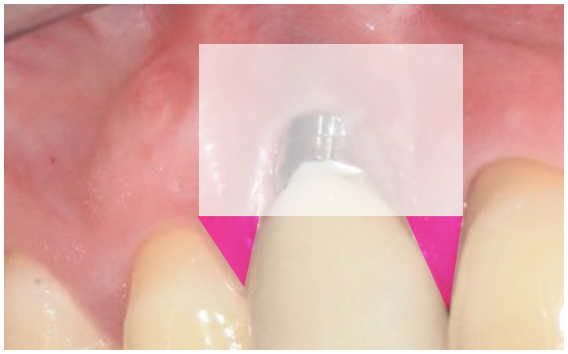


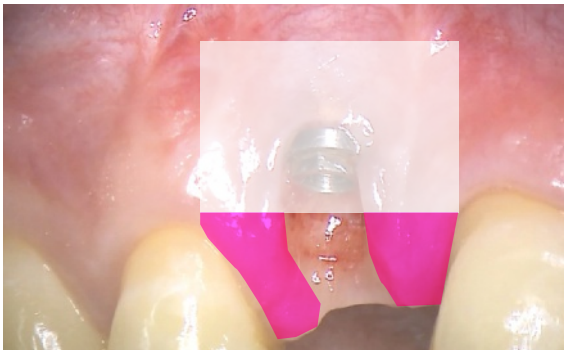


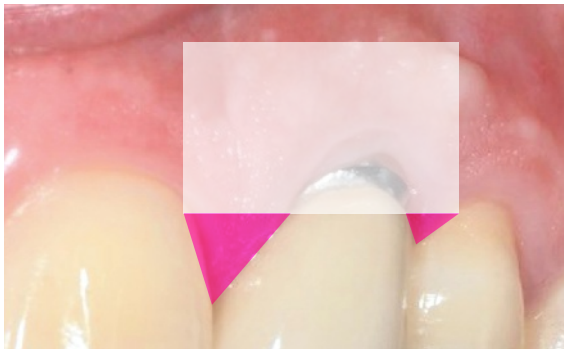


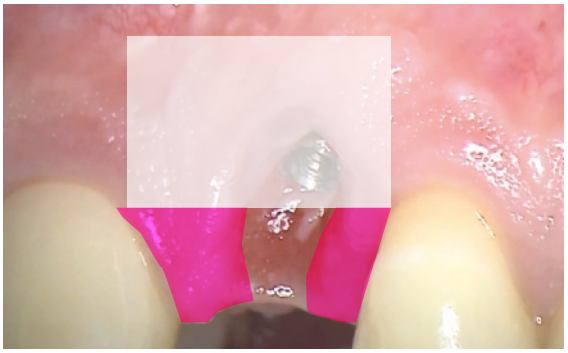


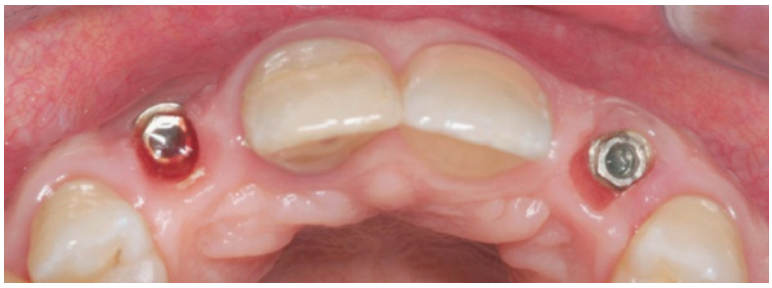
The short provisionals, cemented onto thin and narrow surgical abutments, are applied at least 2 months before surgery in order to favor buccal and interproximal soft tissue growth. This prosthetic provisional phase is crucial, given that it creates the required clinical conditions for the successful execution of the subsequent surgical phase. Taking into consideration the ideal position for the connective tissue graft, ie, more coronal than the gingival margin of the central incisors, the increase in thickness and height of the mesial and distal papillae obtained by the presurgical prosthetic phase can be appreciated. Now, these deeper and wider papillae can be de-epithelialized in a palatal direction, therefore augmenting the vascular bed for the surgical papillae of the coronally advanced flap.

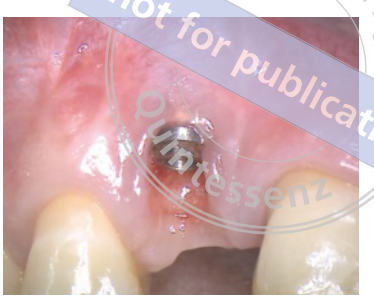




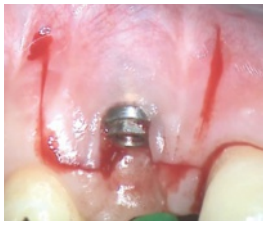


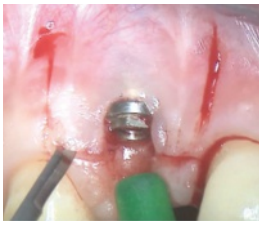


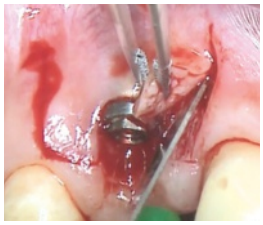


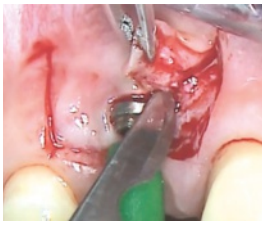


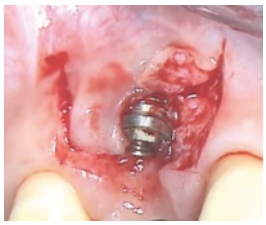
The surgical procedure will consist of a coronally advanced trapezoidal flap with an underlying connective tissue graft at the level of both maxillary lateral incisors. In the presence of thin, barely keratinized tissues and severe implant malposition, it is advised to perform the split-thickness elevation of the flap, and especially that of the surgical papillae, without the surgical abutment. This provides more space for correct positioning of the blade in order to provide an adequate shape (trapezoidal) and thickness (epithelial-connective) to the surgical papillae.

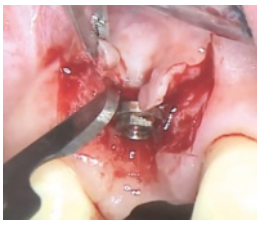


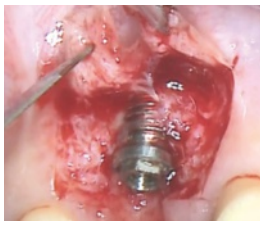


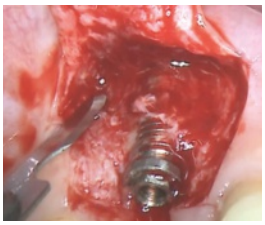






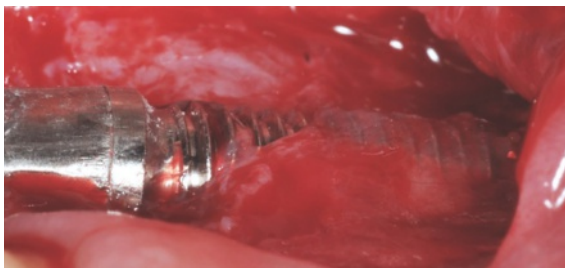


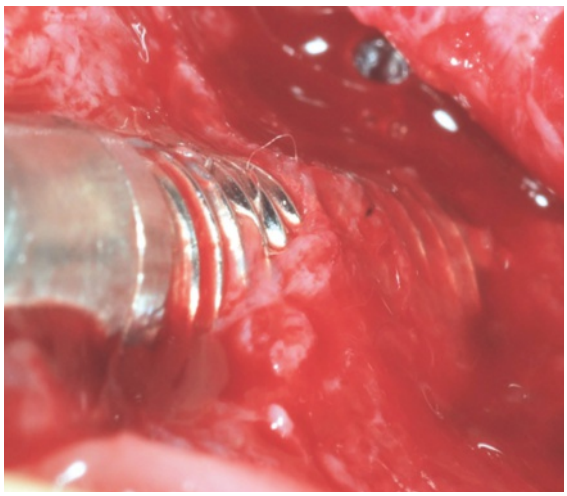




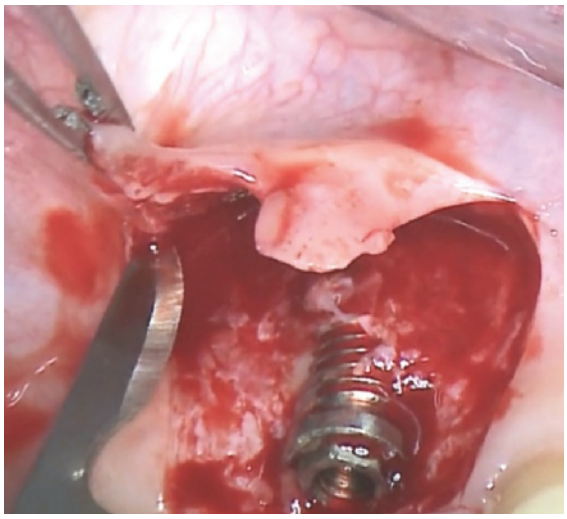
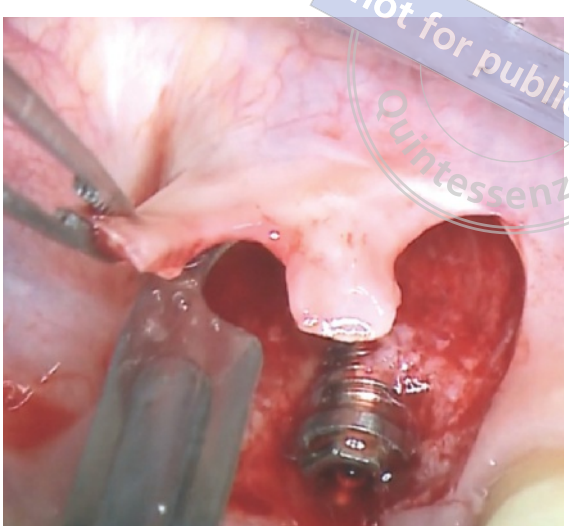
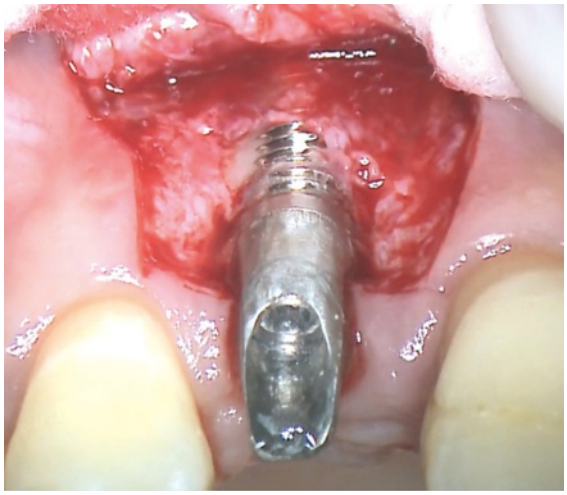
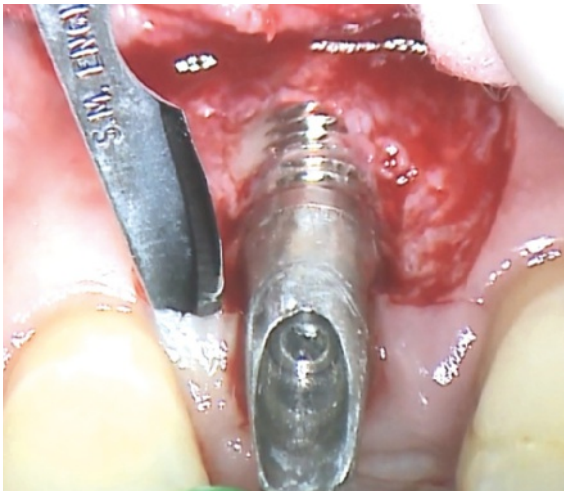
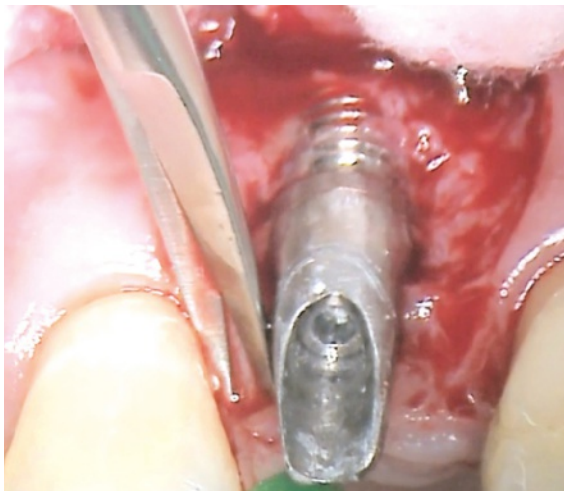
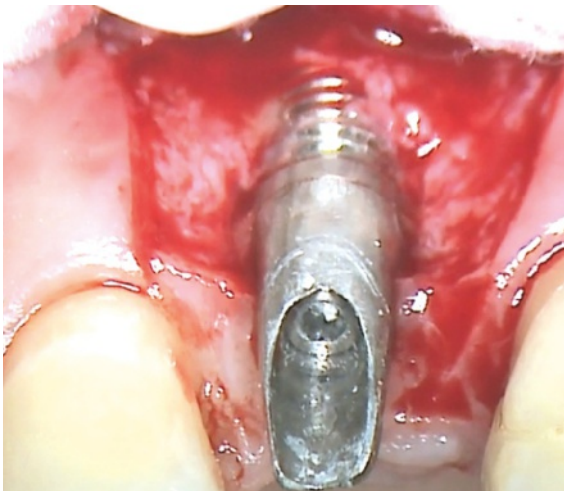
The absence of buccal probing depths renders the elevation of the soft tissues apical to the dehiscence rather complicated. In fact, this tissue, firmly adhered to the implant surface, should be elevated at a split-thickness with the tip of the blade and never with a periosteal elevator due to the risk of lacerating it and removing the connective tissue found between the implant threads.

The absence of buccal keratinized tissues and reduced tissue thickness increase the risk of flap perforation. Therefore, the flap is entirely elevated at a deep split-thickness from the vertical incisions toward the soft tissues apical to the implant dehiscence until meeting the alveolar mucosa, where a superficial split-thickness incision is performed.

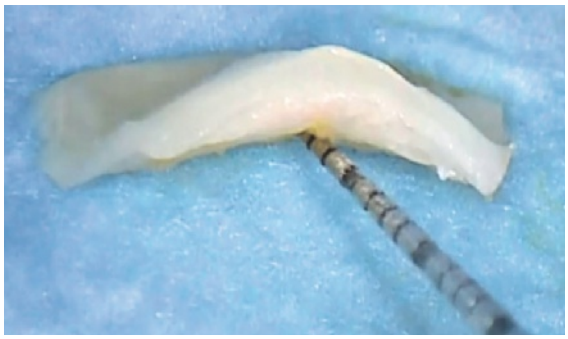


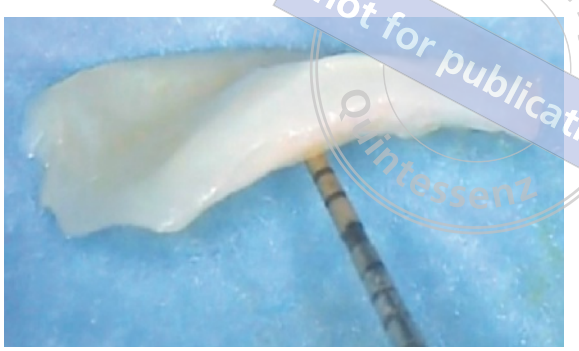


Separation of the alveolar mucosa from the underlying deep structures allows the execution of the superficial incision, parallel to the external surface of the lining mucosa, which will allow tension-free coronal advancement of the flap.

After the surgical abutment is replaced, de-epithelialization of the mesial and distal anatomical papillae can proceed; in this way, vascular beds are created to receive both the connective tissue graft and the surgical papillae of the coronally advanced flap. The epithelium at the base of the anatomical papillae is elevated with the use of the surgical blade and subsequently removed with the microsurgical scissors, proceeding toward their vertex. The presence of an isthmus at the vertex of the papillae permits de-epithelialization of their occlusal surface in a palatal direction. This increases the vascular area available for the surgical papillae of the coronally advanced flap.





The graft is procured from the palate as an epithelial–connective tissue graft and de-epithelialized extraorally with a surgical blade. The apicocoronal dimension needed for the graft is measured with the periodontal probe starting 1 mm coronal to the gingival margin of the central incisor and ending 2 mm apical to the buccal bone crest. It is important that the central portion of the graft remains thicker, as it will be placed on top of an avascular surface (implant and abutment), while the lateral parts can have a reduced thickness to facilitate suture and adaptation of the graft to the underlying surgical abutment.

The connective tissue graft is sutured to the base of each anatomical de-epithelialized papilla with a horizontal mattress suture anchored to the soft tissues palatal to the de-epithelialized area. When performing the suture, the needle perforates the graft and de-epithelialized papilla and exits palatally *(black arrow in photo; illustration B)*.

Here, the needle reenters the tissues horizontally to the exit point and comes out at the base