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Marco Ronda

GBRSTRATEGIES

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Forewords

Marco, the author of this book, is that young man who visited me in my practice in Boston 20 years ago. He came to me to present his countless cases of guided bone regeneration (GBR), showing them to me with enthusiasm, passion, and a wealth of detail. On that occasion, he asked for my opinion with a view to having his experiences published in the International Journal of Periodontics and Restorative Dentistry, the journal I was in charge of at the time. Many years have since passed and he has published many interesting papers and accumulated significant experience, both clinical and scientific. In this volume, Marco relates his 25-year-experience in the world of GBR as a comprehensive presentation, a precise guide for the surgeon who wants to delve into these procedures, ranging from the management of less severe bone defects to the most complex cases. I would call it a veritable handbook to accompany the clinician step by step through every part of this complex but fascinating procedure. The book is replete with details: timing, guidelines, materials, devices, techniques, strategies. Nothing is left to chance, providing an outline that can be used to both significantly reduce treatment failure and build on success. Pre-GBR soft tissue management, flap design, passivation techniques, and after regeneration management of gingival anatomies are but some of the main topics in the book. Complications have not been neglected; in fact, an entire chapter has been dedicated to how to deal with them and, especially, how to prevent them.

The book ends with an interesting chapter on clinical cases. No mere review of evidence but a constructive path that, in an honest and transparent manner, describes the 'imperfections' that have contributed to improving current procedures. The volume, entitled GBR Strategies, is a must for the practice library shelves of any clinician who wishes to practice 'the art of surgery'. I truly hold it to be an essential guide for consultation at any time, as optimum preparation for whatever complex GBR surgery the clinician is presented with.

Myron Nevins

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Forewords

I met Marco in 2000, when he took part in the first edition of my Annual Advanced Osseointegration Course.

I remember the group of that year as one of the best I have ever had, both from a human and cultural point of view; many of them have become my friends. Marco was a young man with spontaneity and the charm typical of the Genoese, when they choose to be charming.

He told me about his burning passion for guided bone regeneration (GBR) techniques, which he had been using for some time but with mixed results. He had an insatiable thirst for information. Over the next few years, we kept in touch through refresher courses and dinners organized by his group; on those occasions, he confided in me that he was at last achieving exceptional results. I witnessed the results, and they were truly exceptional! In 2010, he showed me his first scientific article before sending it to the International Journal of Periodontics and Restorative Dentistry. A clinical case report with some 70 references in which he described in detail how to correctly release the flaps before suturing: an excellent paper that Ron Nevins accepted and published forthwith.

Today Marco is one of the world's greats in GBR; he is well known and invited far and wide for courses and lectures. Sincerely, he stands as one of my greatest personal satisfactions over a long teaching career.

In GBR Strategies, Marco Ronda is easily recognizable: his spontaneity and his desire to convey, above all else, his experience, experience that counts in a reliable and expert surgeon. Nor is literature-based scientific evidence neglected. It is a practical book and should be at the professional's fingertips, ready for consultation in the dental practice immediately before performing GBR surgery in the various areas of the oral cavity. A virtual discussion between lecturer and student, as it were. A book that should be ever-present on the library shelves of those who practice osseointegrated implantology – for beginners and experienced surgeons alike.

In my appraisal, this book by Marco Ronda stands as yet another point of pride!

Massimo Simion

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Acknowledgments

When I started this adventure, my mind was teeming with unique enthusiasm and energy. My hands moved across the keyboard at breakneck speed as I wrote the structural layout for each individual chapter. However, the initial enthusiasm, although never eclipsed, was soon to give way to the realization of what effort, what commitment, and what toil this adventure would entail. I realized how much time I would have to sacrifice to the detriment of my practice, my private life, my family, and my loved ones.

Writing a book is a seemingly never-ending journey and this was the case right up to the day the publishers sent me an email in which they stated: Dear Marco, we would need an introduction, preface, résumés of all the authors, photographs, dedication and acknowledgments. That was the moment I realized I was catching site of the finish line. I had truly reached the end of the race.

Now, my heart in my hand, I can at last express my gratitude, I can convey in writing what I have not been able to do in words. And please bear with me, at least at this juncture, and permit me to express the emotions permeating my words, before bowing to rationality in the ensuing chapters and pages.

As a firm believer in teamwork, I love thanking and acknowledging the merits of others. I have never been a soloist, even though it may appear to be so. It is something I learned as a boy, when I played team sports, when we consoled each other in defeat and embraced joyfully in victory. My professional career has been the same, pursued in sweat and honesty.

No one has ever paved the way for me, no one. Many, however, have contributed over time for better or for worse; the result is that I have reached the point of writing this book, which recounts my knowledge, experiences and innovations, not to mention my failures. I want to thank God or destiny, I know not which, for 30 years of my profession and life, during which I have, to date, enjoyed energy and good health. Certainly, good health is a truly great gift.

I thank my mother, Anna Maria, a special woman, charismatic, affectionate, strong, and morally upright. A woman who bore the responsibility of her family on her shoulders when my father passed away. I was 17 at the time, a difficult age, but she took me by the hand and even today she still squeezes it tight. If there is a certain determination about me it is thanks to her; if I continued with my studies it is thanks to her; if I love life it is also thanks to her and. Believe me, I could go on and on!

I thank my best friend, Giancarlo. In 1993 when, in front of a drinking fountain in Via alla Chiesa Plebana, I asked him: 'Hey Gian, what would you do if you were me? Should I go on with Medicine or not?'

Giancarlo has always been my reference point, as a human being and as a friend, forever encouraging and supporting me and this is why I consider him my number one fan.

I thank my son Alessandro and my daughters Elena and Elisabetta. They have been wonderful kids and remain so to this day, balanced, studious, and sociable. They have never given me any undue concern and, as simple as it may sound, for a parent that is something not to be taken for granted. If I have been able to invest so much energy in my work, I also owe it to them because we have been a team; they focused on their studies and I on my projects. I want to thank Daniela, the mother of my children; she took care of them in all respects and was always there. Thanks to her presence and constancy, I was able to devote a lot of time to my work, research, and practice.

I thank Deborah, a partner who has granted my life so much calm – a cheerful, giving, patient woman, generous with her affection and totally unselfish as she supports me daily.

I thank my first mentor, Dr Emilio Pratolongo, a man brimming with enthusiasm, a pioneer in implantology dating back to the early 1960s, a born surgeon, who passed all his knowledge on to me and was able to unveil my passion for surgery.

I thank Professor Massimo Simion. There is no need for me to describe him as whoever reads this book will know him well, a man Italy can be proud of. He welcomed me into his practice, and imparted his knowledge to me with humility and

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simplicity. He admonished me forcefully and encouraged me, but it is to his great credit that he got me to understand that GBR is within everyone's grasp.

And thus, it has been. We students, some to a greater and some to a lesser degree, have demonstrated it; following the same principle, I pass it on to my learners today.

I thank Professor Myron Nevins; 6,000 km may separate us but I have always felt Myron at a mere stone's throw. He has followed me and appreciated my work, but most of all he has believed in me, dating back to the very beginning. He has offered me so many opportunities to communicate and present my work on stages of great importance. If I look back today and realize that I have come a long way, it is also thanks to him.

I thank Dr Roberto Rivabella, our friendship going back some 27 years, a friendship that has matured and consolidated over our long working collaboration. A cheerful character, a flame burning every day in our practice, and someone I see as my fourth child even though he is a grown man. An ever-present professional who never misses an opportunity to say it with a smile. He has always taken the practice on his shoulders during my forced absences around the world for conferences and other engagements. A guarantee from the professional point of view, but more than anything else an indispensable human presence.

I thank Dr Fortunato Alfonsi, a colleague to whom I confided my idea to write the book; he espoused the project immediately. With his resourcefulness, dedication, and enthusiasm he helped and supported me in drawing up this volume.

Fortunato is an explosive man, full of ideas and of initiatives; more than anything else, he is a man with a heart, a sensitive and generous person, with whom I am happy to share not only my working hours.

I thank the two young colleagues with whom I have been collaborating for several years now, Dr Luca Veneriano and Dr Diego Bruno. They are two great guys; they are willing, polite, helpful, as well as competent and dedicated to this profession. They bear a tremendous load on their shoulders; every day they support me in clinical and teaching activities, but they also absorb and share with me my very many initiatives, ideas, and projects. The corrections made to this volume have also passed through their hands and I can vouch that I could not have done it as well as they have.

I thank my friend Maurizio Larosa, 'our' dental technician, a reliable and dedicated professional, with whom I set out on this journey some 30 years ago; it is a path along which we have grown together.

I thank all my staff, a group of special people who dedicate themselves every day to the well-being of our practice. It is thanks to each of them, the meticulous organization and this fantastic cogwheel that has been set in motion, that I have been able to devote part of my time to lecturing, research, and, of course, to the writing of this book. I want to thank one by one all the professionals who collaborate or have collaborated with me over the years, that is, Roberto, Marco, Ivano, Fortunato, Diego, Luca, Elisa, Laura M, Barbara, Giovanni and Patrizia; all the women who put up with me, support or have supported me, that is, Manuela M, Manuela V, Elisabetta, Alessia, Mariaelena, Laura P, Marina, Valentina, Francesca B, Amanda, Chiara, Giulia, and Francesca S.

Finally, I thank all the colleagues I have met over the years, all those who have made me enthusiastic and proud of the wonderful clinical results obtained after my somewhat heavy lectures. In particular, I reserve a special word of thanks for all those colleagues who, although no longer in the first flush of youth, decided to join in my teaching activities fully knowing that they would never perform this type of surgery. They have taught me that knowledge is our greatest asset, the kindling flame that keeps us alive and must know neither limits nor boundaries.

In all this, I thank not only those who have supported me, but also those who have hindered, challenged, and sometimes discredited me because, ultimately, it is also thanks to them that the best in me has been brought out.

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MARCO RONDA

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Author biographies

Marco graduated in Medicine and Surgery in 1990 at the University of Verona. He qualified to practice both Medicine and Dentistry. As a freelancer in Genoa, his activity mainly focused on oral surgery, implantology, and complex bone reconstructive techniques. He has a master's degree in Guided Bone Regeneration from the University of Pennsylvania. He attended the annual course in Advanced Surgery held by Professor Massimo Simion. Ronda has been a member of the board of SICOI (the Italian Society of Oral Surgery and Implantology), a scientific body, and has sat on the Member Acceptance Committee.

He is an active member of IAO (the Italian Academy of Osseointegration). He was Chairman of the IAO cultural commission Biennium from 2020 to 2022.

He is a cofounder and active member of the International Piezosurgery Academy.

He is an honorary member of DI&RA (the Digital Implant & Restorative Academy). Ongoing annual update with the American Academy of Implantology. Ongoing annual update and ongoing dental education with the College of Dentistry, New York University.

He is a speaker at his own Regeneration SI academy (Genoa, Italy) and at theoretical and practical courses in implantology and bone regeneration techniques.

He is a lecturer on master's courses at several Italian universities and an expert in guided bone regeneration (San Raffaele, Modena, Trieste, La Sapienza, Pisa, Genoa, Bologna, Padua). He has been a speaker at many national and international scientific congresses, and many courses, in Italy and abroad, dedicated to reconstructive bone surgery.

He is the author of very many scientific articles; a chapter in the book Implant therapy by Myron Nevins, published by Quintessence Publishing USA in 2019; author of a chapter in the book Piezoelectric bone surgery: the new era by Thomas Vercellotti, published by Quintessence Publishing Italy in 2016; and the author of a chapter in the Dentistry and Systemic Pathologies, by Antonio Barone, Fortunato Alfonsi, and Angelo Raffaele (EDRA Editions, 2020).

He personally follows a series of study protocols in collaboration with several universities in Italy, aimed at perfecting techniques and materials for reconstructive bone surgery.

He has successfully documented and followed nearly 500 cases of vertical bone regeneration and is recognized as the reference point for guided bone regeneration in extreme cases of bone atrophy.

If you would like to express an opinion, make a comment, or even share a doubt, write to me at info@regenerationsi.com.

Marco Ronda

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Author biographies

DIEGO BRUNO

Diego graduated with honors in Dentistry and Dental Prosthetics, with a dissertation deemed worthy of publication and medal award for valor at the University of Genoa in 2016.
He has attended several specialization courses in endodontics (taught by Professor Berutti), conservative dentistry (taught by Dr Veneziani), periodontal surgery (taught by Professor Zucchelli, Dr Mazzotti and Dr Stefanini), and regenerative bone surgery (taught by Dr Marco Ronda). He practices in Savona and Genoa. Since 2018, he has been collaborating at Dr Ronda's practice in Genoa, assisting with surgery at both clinical and teaching levels in Italy and abroad.

LUCA VENERIANO

Luca graduated with top marks in Dentistry and Prosthetics Dentistry at the University of Genoa in 2017. He has attended several specialization courses in restorative dentistry (taught by Dr Becciani), endodontics (taught by Dr Gorni), conservative dentistry (taught by Dr Tacchini), periodontal surgery (taught by Professor Zucchelli), and regenerative bone surgery (taught by Dr Marco Ronda).
He practices in Genoa. Since 2018, he has been collaborating in the practice of Dr Marco Ronda, assisting him with surgery at clinical and teaching levels in Italy and abroad.

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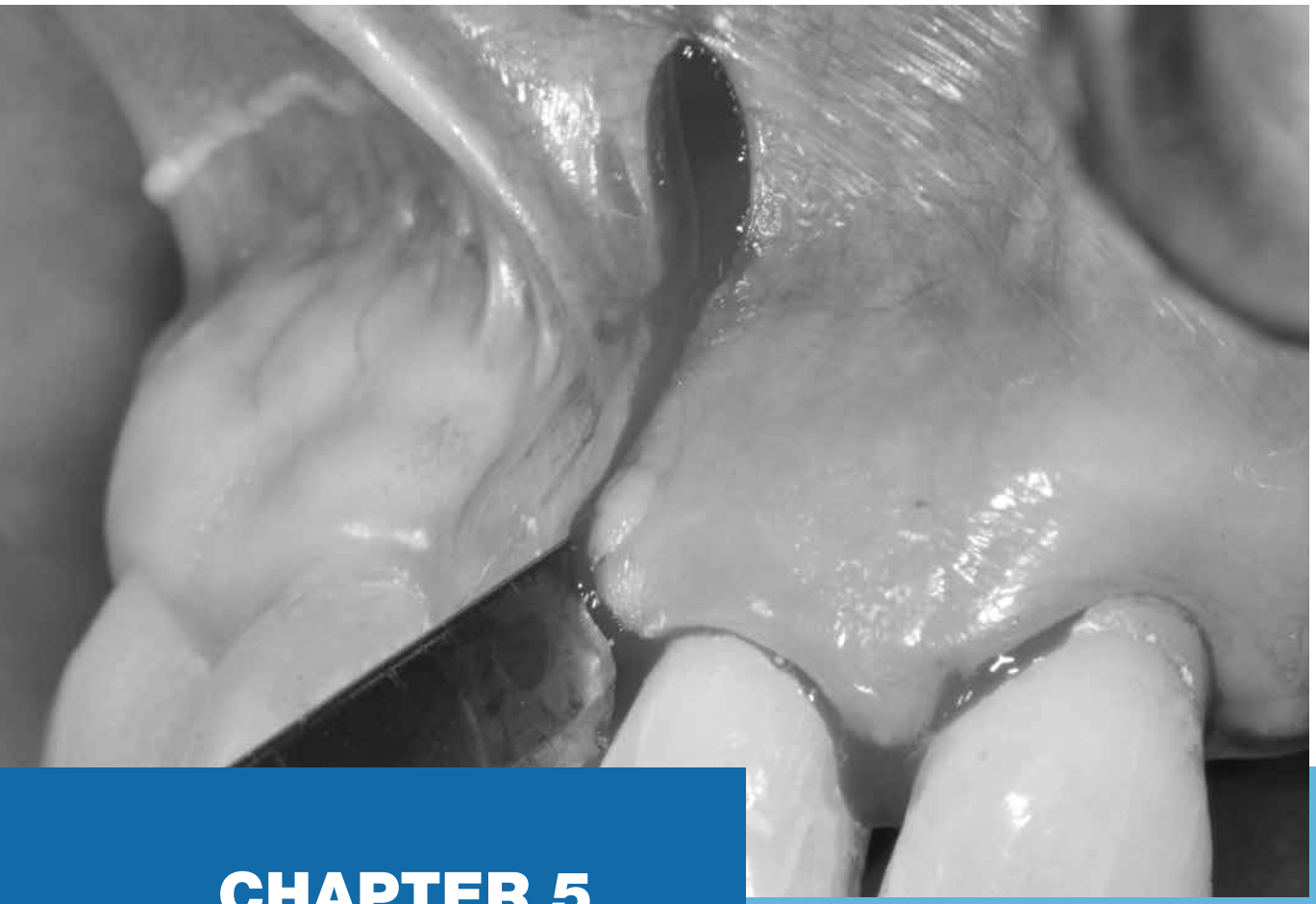

CHAPTER 5

Surgical technique and timing

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Although the guided bone regeneration (GBR) technique, going back to its earliest applications, has remained rigidly bound to its biologic principles, several changes have been introduced in both its execution and the definition of protocols. To date, contrary to what might be believed, GBR surgery is a technique that is more susceptible to the operator's knowledge than to their skills. The perfect knowledge of new protocols and the constant application of every single detail represent a defined method to make the technique repeatable and predictable.

Flap design and detachment

After adequate planning and design, the GBR surgical procedure has as its first operative step the design of the flaps and their full-thickness elevation. The incisions, no matter where they are made, should be placed in the thickness of the adherent gingiva **(Figs 5-1a and 5-1b)**. The scalpel blade suggested for this surgical step is no. 15. Its long cutting surface ensures, especially in edentulous ridges of the posterior mandible, extensive and stable contact with the residual band of adherent gingiva, which is frequently thin and mobile on the underlying planes. All incisions are carried out in two successive steps: initially, a first surface design is made, followed by a second incision made within the first but deeper and in contact with the underlying bone surface **(Figs 5-2a and 5-2b)**. The method described fully preserves the blade's cutting efficiency, which is precise and selective. Otherwise, a blade that loses its effectiveness may require greater pressure, when it is used to perform its cutting function. Thus, operational sensitivity and surgical control would be affected, especially for that portion of residual adherent gingiva that is frequently unstable and located on the bone plane underneath.
On completion of this maneuver, the flap incision may still be incomplete, even if the blade has run in perfect contact with the underlying surface bone.

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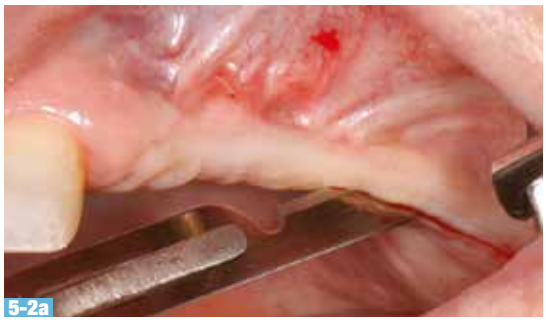
As a matter of fact, the irregularity of the bone ridge sometimes limits the complete effectiveness of the incision.

It is thus appropriate to complete the incision with the aid of a sharp periosteal elevator that runs along the incision line in perfect contact with the underlying bone plane and interrupts the remaining connective and periosteal fibers that could impede complete separation **(Figs 5-3a to 5-3c)**. This simple maneuver permits the perfect separation of the flaps and their easy and atraumatic full-thickness lifting.

This is of fundamental importance in the presence of delicate tissues with a thin phenotype. From the point of view of operative timing, flaps should be detached in centripetal mode, using the last tooth close to the defect as the fulcrum to be progressively approached. Therefore, the clinician should undertake flap detachment starting from the releasing incisions, continuing with the crestal incision, progressively approaching the delicate area around the last tooth, where the tissues are normally thin and slender. In this area, resistance to tissue detachment is reduced, all this acting as adequate premise for the perfect preservation of their total integrity **(Figs 5-4a to 5-4j)**.

The buccal flap is detached until it reaches the portion of residual bone that has retained its original morphology, highlighting the emergence of the mental nerve **(Figs 5-5a to 5-5d)**. Therefore, protection of this anatomical structure depends more than anything else on how it has been isolated and defined.

5-1a and 5-1b. Flap design in the posterior mandible; in the detail, it is possible to appreciate the location of the crestal incision made in the thickness of the residual adherent gingiva.



5-2a and 5-2. The crestal incision, made with scalpel blade no. 15, is performed with a first passage in the thickness of the flap only **(a)**, and with a second passage when the blade runs deep until it reaches the underlying bone plane and totally interrupts the flap until the thin periosteal layer is involved **(b)**.

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Implant osteotomy preparation

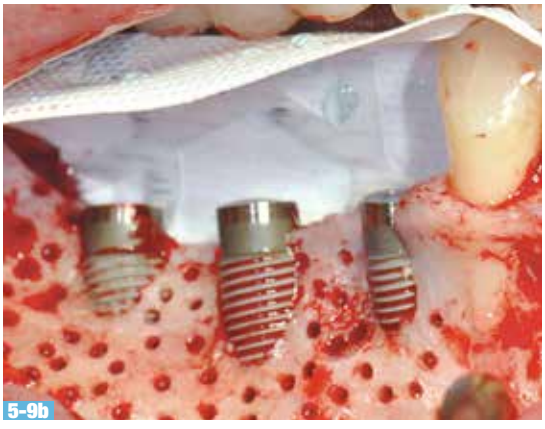
The execution of implant osteotomy preparations is the variable that differentiates a one-stage protocol from a two-stage protocol.
These procedures can be distinguished from each other based on the insertion timing of the osseointegrated implants according to either scheme:

- one stage: osteotomy preparation and implant insertion are contextual during the regenerative procedure **(Figs 5-9a and 5-9b)**;
- two stages: osteotomy preparation and implant insertion after bone regeneration is completed **(Figs 5-10a to 5-10d)**.

Each of the two approaches best satisfies the treatment objectives for which they were chosen and applied. As they differ significantly from each other, they may well give rise to differing preferences among various clinicians.

These are not mutually exclusive; both, for different reasons, contribute to obtaining the best results in the field of bone regeneration.
The following classification rationally assigns a type of approach for each defect:

1. One stage:
   - posterior mandibular sectors where the amount of residual bone can guarantee correct implant stabilization;
   - posterior maxillary sectors where the residual bone portion allows implantology without any need to contextualize the elevation of the sinus floor.
2. Two stages:
   - esthetic anterior sectors in the mandible and maxilla with vertical or even just horizontal defects;
   - posterior mandibular and maxillary sectors where the amount of residual bone does not guarantee adequate implant stabilization or limits correct spatial positioning.



5-9a and 5-9b. GBR procedure in the posterior mandible conducted with a one-stage technique. Implants in place, inserted in keeping with an imaginary line joining the residual mesial bone peak to the ascending bone profile of the mandibular branch. Note membrane stabilization on the lingual side and the presence of osteopromotion holes. The latter must be performed before implant insertion.

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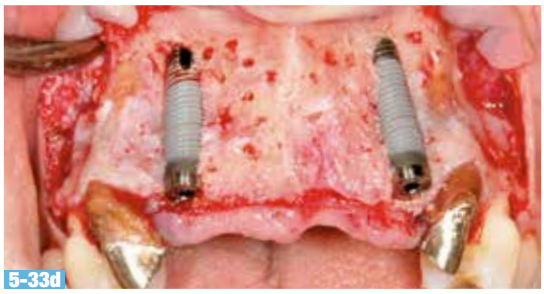

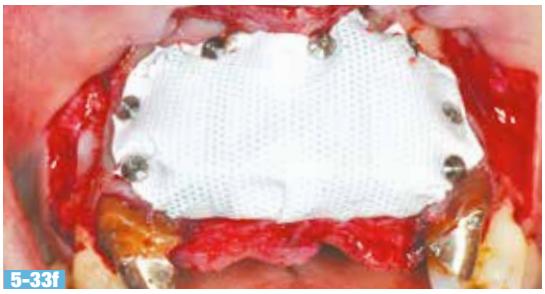

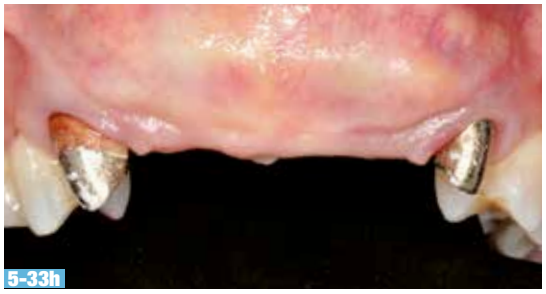

5-33c. lurgical phase of the GBR procedure using the one-stage approach. The preparation of the implant osteotomies was accomplished using a surgical guide, being fully aware of how tricky the surgical steps in an extremely thin ridge were. **5-33d.** On completion of the osteotomy and several osteopromotion holes in the recipient bed, two osseointegrated implants were inserted into the residual bone. **5-33e.** The membrane was shaped, adapted to the defect, and stabilized on the palatal side. The homologous biomaterial was placed over the defect to cover the exposed implants. **5-33f.** The membrane was flipped over the biomaterial, secured to the buccal bone wall with several pins and cleaned first with chlorhexidine and then with saline solution. This was followed by suturing the appropriately passivated flaps. **5-33g and 5-33h.** Clinical images of the newly regenerated volume, in occlusal and frontal views, at the time of membrane removal. **5-33i.** The raised membrane shows a new bone volume, mature and compact, which faithfully reproduces the shape given to the membrane during its modeling. **5-33j.** The occlusal view shows the exceptional new bone volume; however, it is also possible to catch sight of the implant heads with incorrect spatial placement (placed too buccally). This is the final outcome of a one-stage procedure applied in the case of a severe horizontal bone defect, whose residual bone portion inevitably affected the position of the implants even if the implant osteotomies had been prepared using a surgical guide.

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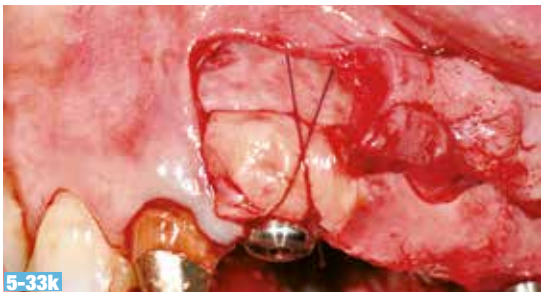
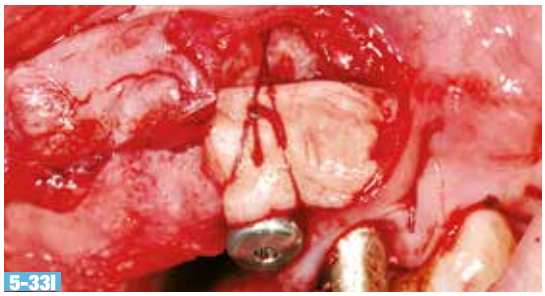

5-33k


5-33l

5-33m

5-33n

5-33o

5-33p

5-33q

5-33k and 5-33l The error in implant placement (too buccal), was corrected with a double graft of connective tissue on the vestibular side. The increased thickness of the buccal tissue ensured greater stability of the gingival parabola, destined to migrate in the apical direction. **5-33m and 5-33n.** The two connective grafts were covered by the first flap using primary intention, and moved from the palatal area to the vestibular region. **5-33o.** Through the modeling of a screw-retained temporary prosthesis, the gingival architecture was conformed, providing a full-bodied structure to the interincisive papilla; however, note the unesthetic appearance around the two lateral incisors. The connective grafts limited apical migration of the festoons but disturbed tissue texture, losing the harmony necessary in an esthetic site. **5-33p and 5-33q.** The final prosthetic restoration 9 years later. Observe how the festooning and proportions of the prosthetic elements are acceptable; however, note that the connective grafts on the buccal sides of the lateral incisors have determined chromatic alteration and differences in thickness.

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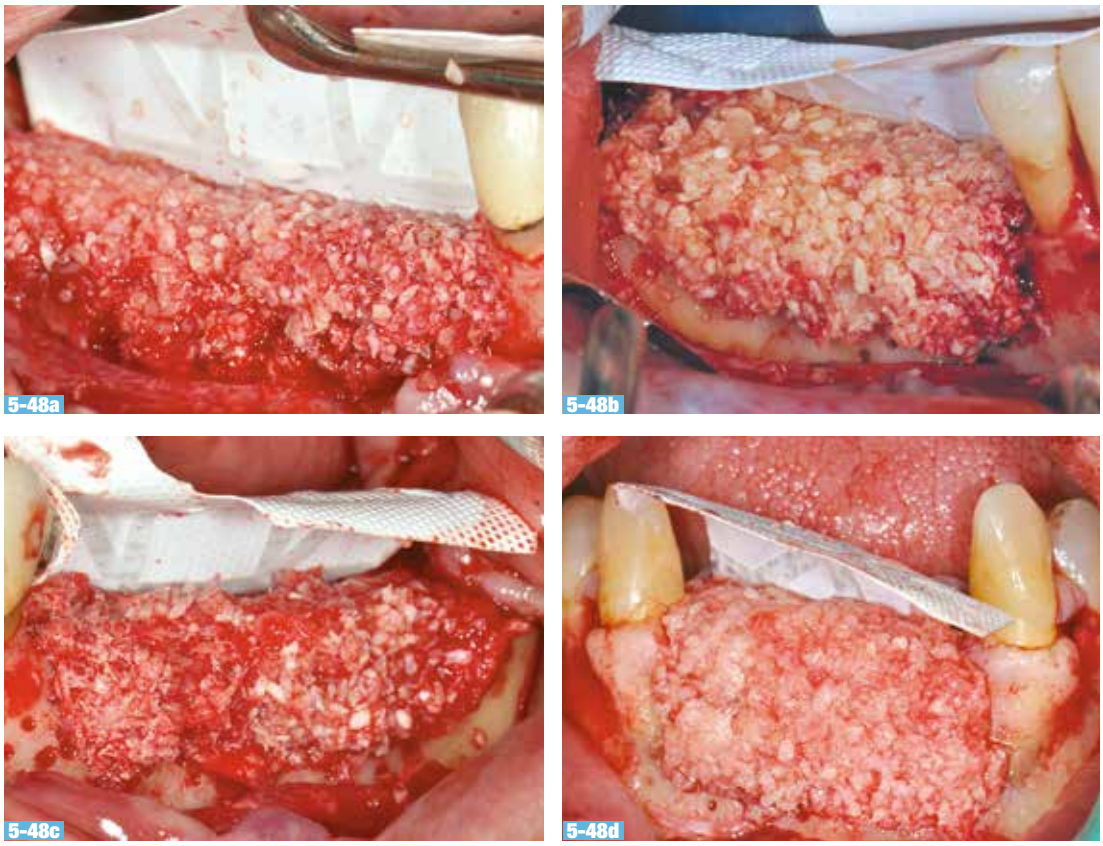

5-48a to 5-48d. Clinical examples where the advantages of membrane fixation on the lingual side can be appreciated. The grafted material cannot be contaminated either by saliva or by contact with the tongue.

The membrane can be stabilized using two different fixing systems: self-tapping screws and tacks inserted using percussion.

Both systems are equally valid but which one is used depends on the site where it is to be applied and the type of membrane that needs to be stabilized. Resorbable membranes are amenable to the use of percussion-fixed pins because self-tapping screws tend to cause the membrane edges to roll around the screws during application **(Figs 5-49a to 5-49d)**.

Nonresorbable membranes can be fixed using either system **(Figs 5-50a to 5-50d)**.

What defines the use of either system is the fixation site and the bone density of the site where it is to be applied.The lingual portion of the mandibular body and the palatal portion of the upper jaw normally consist of dense and compact cortical bone, which is resistant to penetration by fixing systems inserted using percussion. Moreover, these are difficult areas to access using percussion systems. The author prefers using self-tapping screws, whose fixing strategy must be timed precisely. In both the upper jaw and mandible, the first self-tapping screw should be inserted on the linguopalatal side in the mesial position **(Fig 5-51)**. This establishes a first relationship between the shape of the membrane and the amount of residual bone surrounding the defect.

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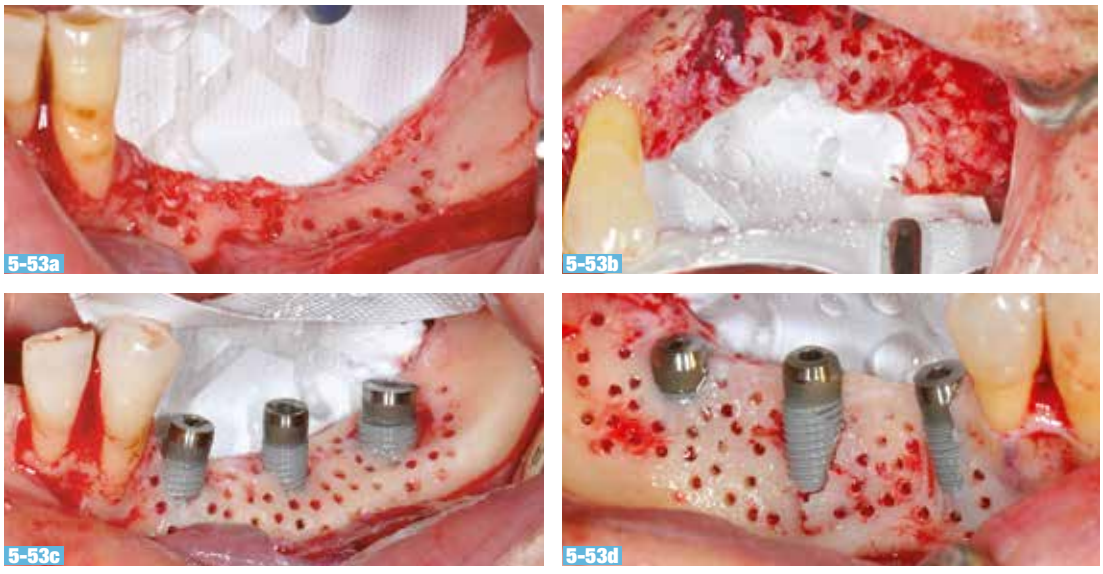
Grafting of biomaterial

The graft material is one of the main (and perhaps only) variables during the application of a protocol-rich GBR procedure. Throughout the development of this technique, authors have proposed different materials, each motivated by sometimes clinical and sometimes biologic reasons, but hardly ever both at the same time. The choice of material cannot really influence an improvement in the prognosis attributed to surgical success.

One of the possible, albeit rare, complications in GBR is contamination of the graft, whose occurrence does not to depend on the type of material used. Such an eventuality occurs when a septic process develops below the membrane, compromising the overall result, even in cases where soft tissues were perfectly closed and sealed above the barrier. For this reason, the grafting of material is a very delicate process given that, as far as possible, any contamination should be avoided. Once membrane fixation on the lingual side is completed, the membrane is gently lifted in the lingual direction, thus exposing the bone defect in its essence (two-stage procedure) or the defect around the stabilized fixtures in the residual bone (one-stage procedure). At this point, the clinician must prepare the site for regeneration to accommodate the biomaterial; thorough site cleaning is mandatory to reduce the presence of bacterial loads and to prepare for grafting. The inner part of the membrane, the surface of the implants, and the residual bone surface should be washed with chlorhexidine 0.2% for about 2 min to have a significant effect **(Figs 5-53a to 5-53d)**.

In addition, a sterile gauze soaked in chlorhexidine is inserted between the wall of the lingual bone and the inside of the same flap.



5-53a to 5-53d. After the membrane is fixed lingually, it is lifted in the same direction to clearly reveal the defect. Before starting to fill it with biomaterial, it is necessary to decontaminate and clean the inner surface of the membrane, the surface of the residual bone and, if present, the surface of the implants with regard to their extraosseous component. A chlorhexidine 0.2% wash is allowed to act on these surfaces for about 2 min, followed by a saline rinse.

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INSIDE

The main rules of timing

The timing of GBR to this day follows a strict protocol and each of its steps has a precise rationale. What is to be dutifully respected is the timing of flap passivation.
Unlike in the past, when passivation was applied at the end of surgery and immediately before suturing, today it is recommended immediately after flap elevation. Reasons relating to volumetric encumbrance and the physiology of hemostasis suggest that the flaps are to be passivated during the initial stages of osseoregenerative surgical treatment.

Why and when a one-stage procedure?

One-stage is a combined treatment surgical procedure: osseoregenerative and implantologic. It is recommended for the management of nonsevere bone defects and should be carried out by clinicians who have already acquired good experience with this type of surgery.
One-stage GBR can be used in all medium and moderate defects of both posterior jaws. It is not recommended in anterior areas, especially when the results of an osseoregenerative treatment must fully satisfy not only clinical but also esthetic expectations.

Why and when a two-stage procedure?

Two-stage GBR is a treatment mode applied to osseoregenerative procedures that differentiates between the surgical phases of GBR and implant placement. It is a procedure that is applied to severe bone defects, where simultaneous implant placement would be difficult, inaccurate, and unsafe. For the anterior areas, where a certain esthetic result is expected, a two-stage procedure is recommended.
Symmetrical gingival scalloping and papillary reconstruction depend on perfect implant positioning that is most easily achieved in the regenerated bone volume and through the use of a surgical guide. It is also the method recommended to all clinicians approaching GBR procedures for the first time and who have not yet completed their learning curve; simultaneous implant placement increases the technical difficulty of the procedure.