

Tiziano Tealdo - Marco Bevilacqua - Paolo Pera

# COLUMBUS BRIDGE PROTOCOL

**SURGICAL AND PROSTHETIC GUIDELINES FOR AN IMMEDIATELY LOADED,  
IMPLANT-SUPPORTED PROSTHESIS IN THE EDENTULOUS MAXILLA**



*Preface by George Zarb and Giulio Preti*

*Translation by Genni Anna Genobbio, Cuneo*



Milan, Berlin, Chicago, Tokyo, Barcelona, Bombay, Istanbul,  
London, Moscow, Paris, Prague, Saõ Paolo, Warsaw



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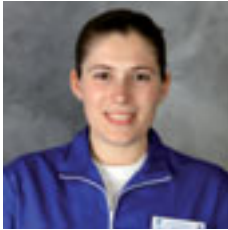
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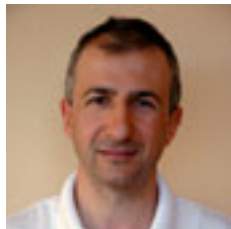
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## FOREWORD

The invitation to write a foreword to this exceptional text reminds me that we, as clinical academics and practitioners, are at a crossroads in our joint efforts to manage problems of mutual professional concern. We recognize that most of our universities are funded by the commercial manufacturing giants, somewhat like the pharmaceutical industry, and that this may not be particularly controversial. However, there is a familiar risk here, and that is the inadvertent and sometimes even deliberate blurring of the line between disinterested advice and sales pitches, which underscores what is happening in the current populist approach to dental implant treatment. The most disturbing thing is not so much the marketing methods per se, but the goals that are implied and even articulated.

In medicine, it has been frequently observed that it is not in the economic interests of a corporation who sells pills to unhealthy people for those folks to be actually healthy. Or to be more precise, for the people to perceive themselves as being healthy. Their actual physical state then becomes irrelevant since what really matters is whether someone believes there is something wrong that can be rectified with pills. If so, the company has a new potential customer. Critics call this *disease mongering* – a stark reminder that “health condition branding” shifts the line between the healthy and the diseased states. We risk a comparable emerging predicament in dentistry where any number of missing or diseased teeth is marketed as an ominous case of *partial edentulism* or worse still a *terminal dentition*. No wonder general dentists are tempted to flock to weekend courses when there is such a pandemic around, waiting to be diagnosed and treated both surgically and prosthodontically.

Professional judgment and integrity remain the key determinants that make our profession special, with a bottom line that must continue to engage us scrupulously and unremittingly. It is therefore both a privilege and a delight to encounter scientifically based treatment concepts developed and applied in the manner that our Genoan colleagues have systematically sought to present. They applied their ideas with intellectual rigor and in the context of well-argued and scrupulously designed protocols.

Their results speak for themselves and already offer enormous promise for those patients whose dental disease outcomes necessitate this text's described interventions. Above all, the authors' judgment reflects integrity of purpose and interpretation that is indeed noteworthy. This book offers a clean line of demarcation between commercial interests and professional ones. It recognizes the indispensable role of quality standards from different manufacturers without attributing documented successes to product specification. And in so doing, the primacy of clinical judgment and skills is underscored – a rare but desirable approach in today's era of implant and technique material brands. This text encourages all of us to seek to match, and perhaps even hope to emulate, the authors' outstanding treatment outcomes by recognizing that scientifically based rigor in patient management remains the major determinant of time-dependent success.

*George Zarb*

Professor Emeritus, University of Toronto, Canada  
Editor-in-Chief, *International Journal of Prosthodontics*

The original surgical-prosthetic protocol designed by Per-Ingvar Brånemark for long-term, predictable osseointegration of endosseous implants has undergone important changes and modifications secondary to continued basic science and clinical research and improved clinical experiences. Modifications in the protocol have occurred in both surgical and prosthetic aspects.

A protocol that was originally designed to treat mandibular edentulism has evolved to treat edentulous and partially edentulous patients, including the most difficult situations. These changes, together with unprecedented commercial pressures, led the entire dental community to focus their interests on implant techniques independent from levels of specialist competencies. In the many-sided panorama created by this phenomenon, basic principles of prosthetic treatment, the definitive goal for osseointegrated implants treatments, were not always taken into account.

Disappointing results, similar to those obtained in the beginning of osseointegrated implant treatment, were recorded. Brånemark himself in the article "On looking back with Per-Ingvar Brånemark" (*Int J Prosthodont* 2004;17:395-396) stigmatized this situation. Long-term predictable surgical and prosthetic results described by the international scientific community validated the concept of osseointegration. Published results and findings should not disregard the competence and precision of those involved with clinical research and treatment; competence and precision are the specific characteristics of this work I am pleased to introduce.

The authors describe solutions to maxillary edentulism with immediately loaded fixed prostheses based on obtaining primary implant stability and controlling masticatory loads. The treatments illustrated in this text have been applied with a rigorous approach in the scope of a protocol following basic principles of oral treatment: assessment of the local and functional systemic conditions of the stomatognathic system. The most appropriate treatment solutions were chosen on the basis of preoperative conditions and the characteristics of edentulism for each specific patient. The surgical treatment phase was accomplished with the use of surgical templates precisely and specifically fabricated for each patient.

All essential prosthodontic parameters were identified for fabrication of the prostheses: sophisticated precision of master casts; measurements of jaw relationships; passive; accurate fit of the prostheses; optimal esthetics; and phonetics.

In conclusion, this is an exceptional textbook resulting from the varied clinical experiences of the authors, acquired over many years of treating patients with implant prosthodontics and developed in the academic environment by the Department of Prosthodontics, University of Genoa. Readers and clinicians who apply the protocol described in this work will embark on a sure path, without the uncertainties of the first voyage to America of the great explorer from Genoa, who inspired the authors in choosing the title of their work.

*Giulio Preti*

Professor Emeritus, University of Turin, Italy

Director of the Italian National Observatory of Oral Health of Disadvantaged Communities



## AUTHORS' NOTE

The use of dental implants inserted into alveolar bone as substitutes for lost or nonrestorable teeth has radically modified prosthodontic treatment planning. Before osseointegration of dental implants provided predictable results to treat edentulism with fixed implant prostheses, dentists were compelled to use prosthetic treatments supported and retained by edentulous ridges and natural teeth.

The studies conducted and reported by Brånemark and his colleagues at the University of Göteborg introduced the use of endosseous implants in clinical dentistry. Implants of various materials and shapes had been proposed and used for years previous to the discovery of osseointegration. Brånemark did not invent dental implants; through in-depth clinical trials and studies on bone repair, Brånemark proposed a strict protocol for dentists relative to using commercially pure titanium dental implants and a precise surgical protocol with scientifically-documented predictability. Over time, the applied principles of osseointegration and implant prosthetics have been modified. The scientific method has been used to simplify the original protocols proposed by Brånemark.



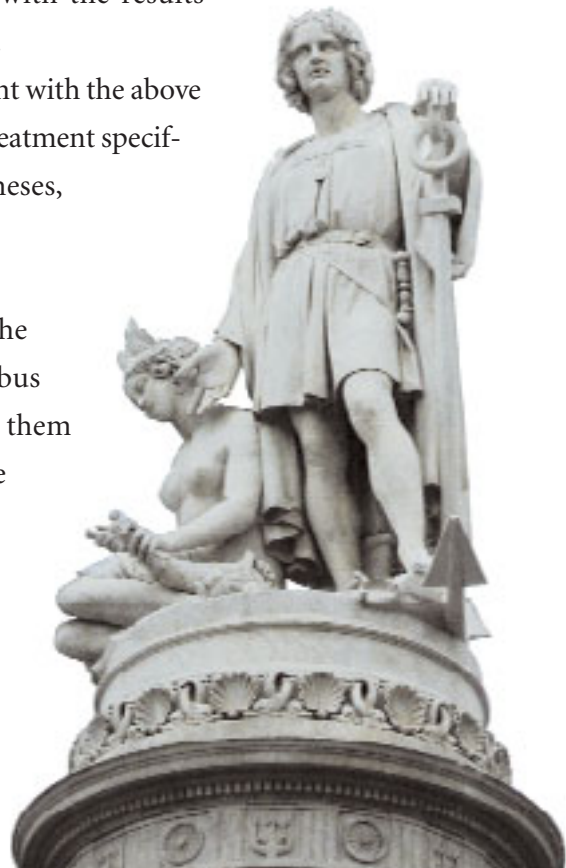
Columbus Bridge Team, Ceva, Northern Italy, December 2007.

In recent years, immediate occlusal loading in edentulous jaws has become an accepted treatment option in implant protocols. Increased knowledge and reported experiences by numerous researchers and clinicians modified the original principles proposed by Brånemark, especially regarding the optimal times to load implants. Reductions in the times relative to loading dental implants were proposed, researched, and studied; reduced loading times were still cognizant of patient needs and scientific principles. In fact, the use of new protocols with immediate functional loading of dental implants also reduced patient discomfort and facilitated treatment by decreasing the amount of time patients may have needed to continue to wear removable prostheses. Clinical visits were also decreased. In order for the profession to accept the new protocols, the protocols had to achieve implant survival and prosthesis success consistent with the results obtained with traditional, unloaded healing protocols.

The Columbus Bridge Protocol was developed consistent with the above goals: maintenance of predictable implant/prosthetic treatment specifically designed for edentulous maxillae, fixed prostheses, and immediate occlusal loading.

Why Columbus? The great navigator did not invent the Americas. The Americas existed well before Columbus indicated the route that allowed his society to reach them and develop their huge natural resources. In the same way, the Columbus Bridge Protocol indicated a path that, when observed, describes treatment of edentulous maxillae with immediately loaded implants to obtain predictable therapeutic, functional, and esthetic results.

In the field of implants/prostodontics, where new treatments without sufficient scientific documentation have too often been presented, the authors in the Department of Prosthodontics at the University of Genoa think that dedication of the protocol described in this text to Columbus is appropriate, as Columbus was moved by great curiosity in his quest for the route to the West Indies. Columbus meticulously prepared for his voyage, which was considered indispensable for him and his crew to reach new horizons. The authors believe that clinicians should possess the same curiosity and skill in preparing to treat their patients as Columbus exhibited in his desire to explore the New World.



Christopher Columbus

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## CHAPTER 2

### BONE TISSUE REPAIR

COLUMBUS BRIDGE PROTOCOL	
SURGICAL PROTOCOL	PROSTHETIC PROTOCOL
External hex rough-surface implants	Screw-retained fixed prosthesis
Implant length $\geq$ 13 mm, $\varnothing$ 4 mm	Plaster impression with pick up technique
Underprepared osteotomy	Rigid splinting with metal framework
Implant insertion torque $\geq$ 40 Ncm	Passive fit with the luting technique
Angled implants in native bone	Acrylic resin occlusal surfaces
Angled conical abutments	No distal cantilevers
No bone regenerative techniques	Immediate functional load 24–48 h after surgery

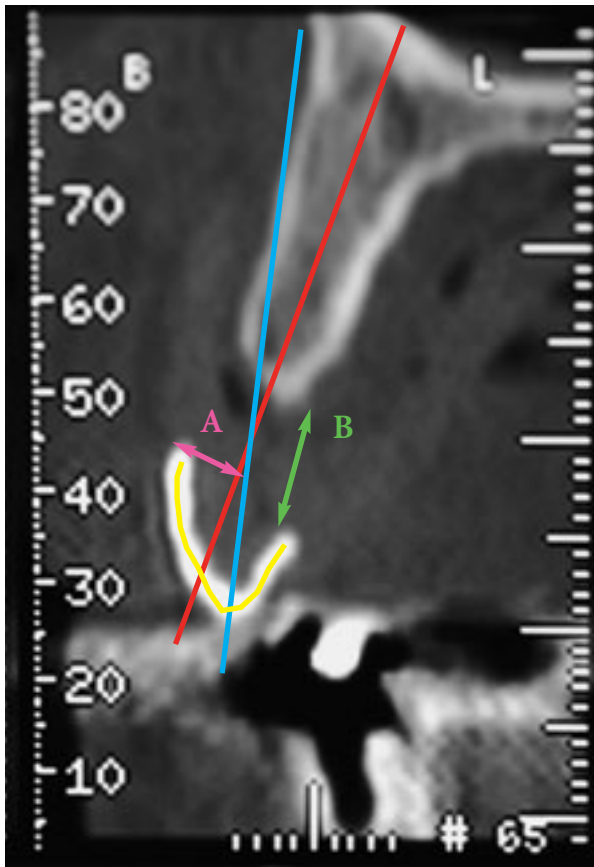
**Table 2.1**

Insertion of a dental implant causes a localized inflammatory reaction in the narrow spaces between the implant surface and the host bone. Osteogenesis restores the bone volumes between these two surfaces. This restorative process leads to wound healing according to a biologic sequence that has evolved over time.

The biologic mechanisms of bone repair are independent from the stimulus causing the trauma,

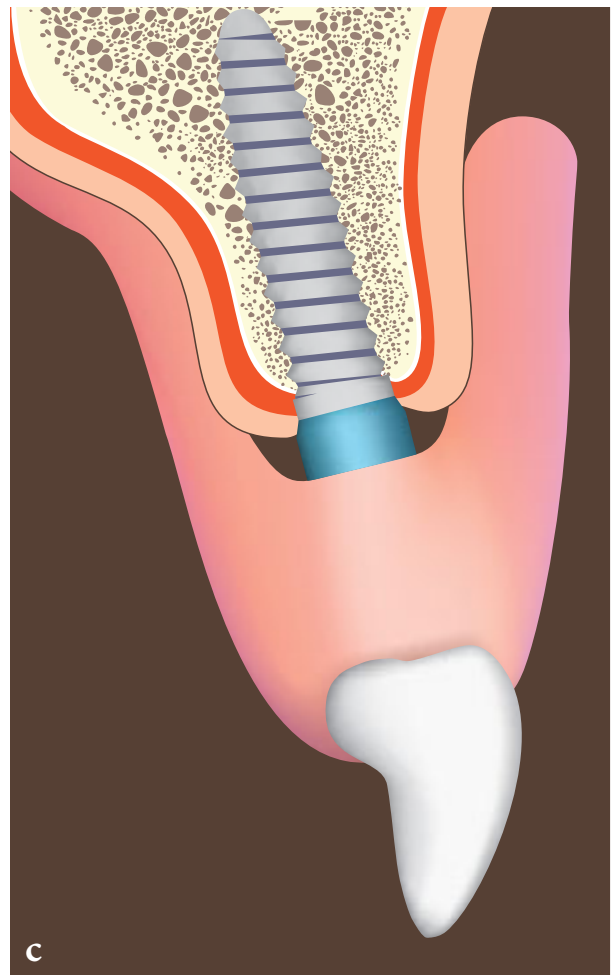
be it accidental or iatrogenic. Wound healing is dependent on the type of skeletal bone involved. The chronologic sequence of the tissue responses implies common aspects and times in wound healing, including systems of cascade compensation controlled by local and systemic factors that are biohumoral and mechanical in nature.<sup>1</sup>

Bone is an evolved expression of connective tissues and always forms through the substitution

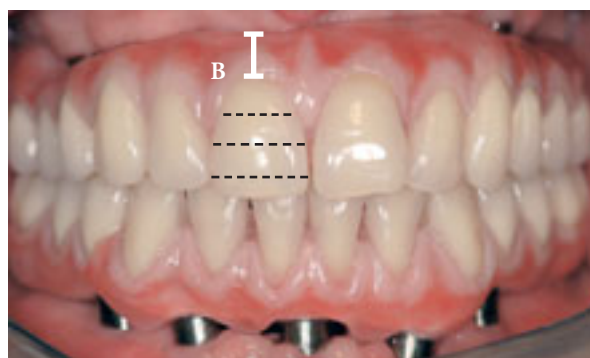


**Fig 3.14** - Cross-sectional image of a CT scan with a scanning appliance in place. Labial profile of the artificial tooth (*yellow*); long axis of the tooth (*blue*); long axis of the implant (*red*); distance between the labial surface of the artificial tooth and the long axis of the implant (*arrow A*); distance between the cervical portion of the artificial tooth and the crest of the edentulous ridge (*arrow B*).

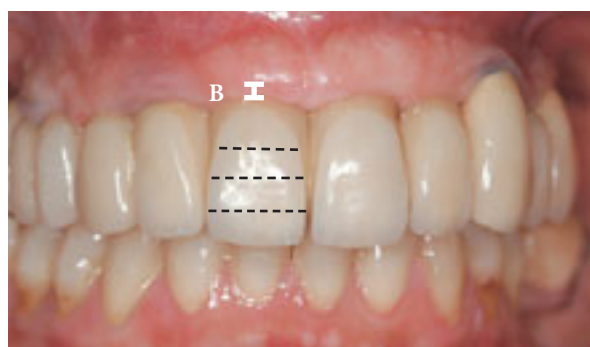
**Fig 3.15** - (a) Clinical profile image of a patient with a maxillary complete denture in place. (b) Clinical profile of the same patient without the maxillary complete denture. This image demonstrates the amount of support the maxillary labial flange provides to the patient's upper lip. A fixed prosthesis is contraindicated in this case because of the anterior cantilever and the difficulties associated with oral hygiene. (c) Cross-sectional schematic illustration of an anterior maxillary overdenture designed with a labial flange that would support the upper lip.



treatment. If the prosthesis is unsatisfactory to the patient or clinician, new prostheses will have to be fabricated so the surgeon can identify the implant locations relative to the planned positions of the artificial teeth. In either case, the prostheses are duplicated with autopolymerizing acrylic resin for use as radiographic templates per Mecall and Rosenfeld.<sup>10,11</sup> These templates can be made radiopaque quickly and inexpensively by painting them with four to five layers of spacer, to which has been added amalgam powder (20% in volume) for each artificial tooth (Fig 3.13). The radiographic template is placed into the patient's mouth, and a CT scan is made, after which the CPI is evaluated, and the definitive treatment planning process begins (Fig 3.14). Clinical situations with marked residual ridge or bone resorption and significant prosthetic overjet (see Fig 3.14;  $A > 5$  mm) require maxillary implant-retained overdentures with labial flanges (Fig 3.15), a design that is easily and predictably accomplished. Overdentures are also required in the treatment of other clinical situations as well – for patients who have high smile lines or unacceptable phonetics with fixed prostheses or certain biomechanical situations – but these cases are not discussed in this textbook. When the distance between the cervical portion of the artificial teeth and the implant restorative platform is greater than 25% of the length of the artificial tooth (Fig 3.16;  $B > 25\%$ ), the recommended treatment protocol should include soft tissue reconstruction, ie, a Toronto bridge prosthesis. When the distance between the cervical portion of the artificial teeth and the implant restorative platform is less than 25% of the length of the



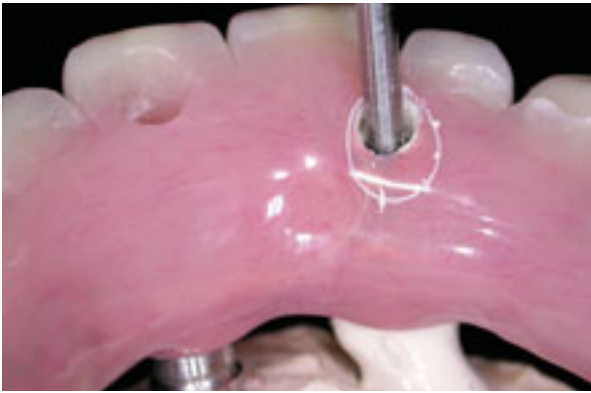
**Fig 3.16** - Clinical anterior image of a patient treated with maxillary and mandibular fixed prostheses. If distance B is greater than 25% of the clinical length of the central incisor (artificial tooth), it is advisable to fabricate a prosthesis that replaces the missing soft tissues.



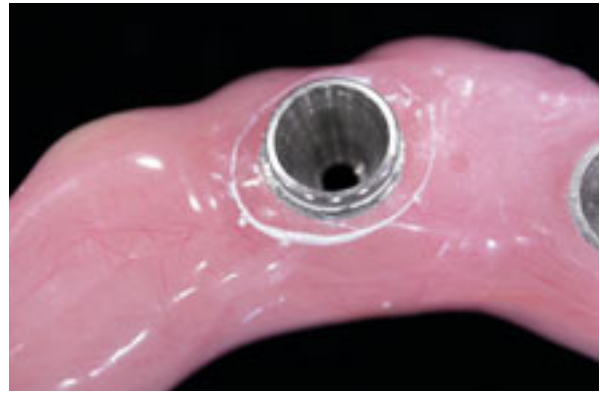
**Fig 3.17** - Clinical anterior image of a patient treated with a maxillary fixed prosthesis. If distance B is less than 25% of the clinical length of the central incisor (artificial tooth), it is possible to fabricate the prosthesis without replacing the soft tissues since minimal resorption has occurred and soft tissue replacement is not required.



**Fig 3.18** - Laboratory image of a finished surgical-prosthetic template. This maxillary portion was also used as the scanning appliance. Note the blue radiopaque material that was placed onto the labial surfaces of the maxillary teeth.



**Fig 9.81** - The large hex driver used to remove the retaining screw at the maxillary left central incisor implant site.



**Fig 9.82** - Close-up image of the titanium cylinder-casting interface after luting passivation.



**Fig 9.83** - The process illustrated in Figs 9.75 through 9.82 is repeated for the right distal titanium cylinder (maxillary right second premolar implant site).



**Fig 9.84** - The framework being seated onto the right distal titanium cylinder, despite the nonparallel implants.



**Fig 9.85** - The prosthesis in place on the analogs as the right distal titanium cylinder is being cemented to the casting. The prosthesis is retained to the anterior right implant site with a laboratory screw.



**Fig 9.86** - Close-up image as the cement sets between the right distal titanium cylinder and the framework.



**Fig 9.87** - The excess cement is removed after cementation.



**Fig 9.88** - The left distal titanium cylinder in place on the conical abutment laboratory analog prior to commencing the luting process.



**Fig 9.89** - The framework passively in place on the titanium cylinder in the maxillary left second premolar implant site.



**Fig 9.90** - The prosthesis in place on the analogs as the left distal titanium cylinder is being cemented to the casting. The prosthesis is retained to the anterior right implant with a laboratory screw.



**Fig 9.91** - Close-up image as the cement sets between the left distal titanium cylinder and the framework.



**Fig 9.92** - The excess cement is removed after cementation.

## Patient III

Age	50 years
General health	Hypertension
Smoking habit	No
Cause of tooth loss	Generalized severe periodontitis
Bone quality	Type 2
Type of implants	Conical 4 × 11.5-mm Full Osseotite NT (sites 12, 14, 22, 24)
Type of conical abutments	17 degrees (site 12) 25 degrees (sites 22, 24) 45 degrees (site 14)



Preoperative smile



Preoperative frontal view  
with patient in centric occlusion



Occlusal view of provisional FFP



Frontal view at insertion appointment  
with provisional FFPs in place



Occlusal view of soft tissue healing,  
4 months postsurgery



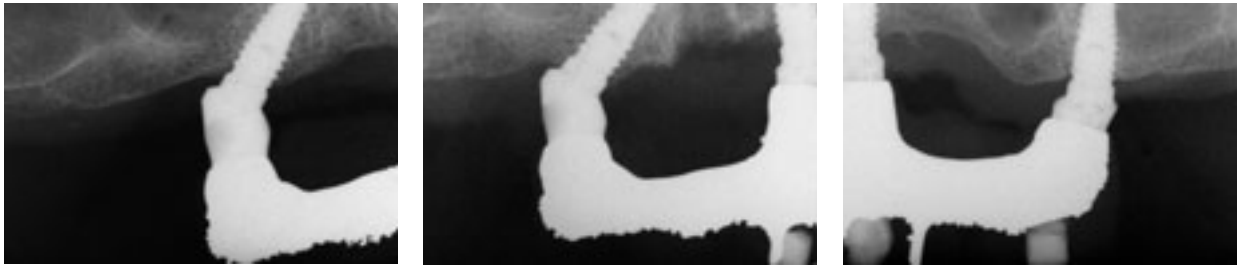
Frontal view of definitive FFPs  
with patient in centric occlusion



Occlusal view of definitive FFP



Smile with definitive FFPs in place



Intraoral radiographs at time 0



Postoperative intraoral radiographs at 12 months



Postoperative intraoral radiographs at 24 months



Postoperative panoramic radiograph at 36 months