TOOTH PREPARATIONS

SCIENCE & ART

CLOVIS PAGANI

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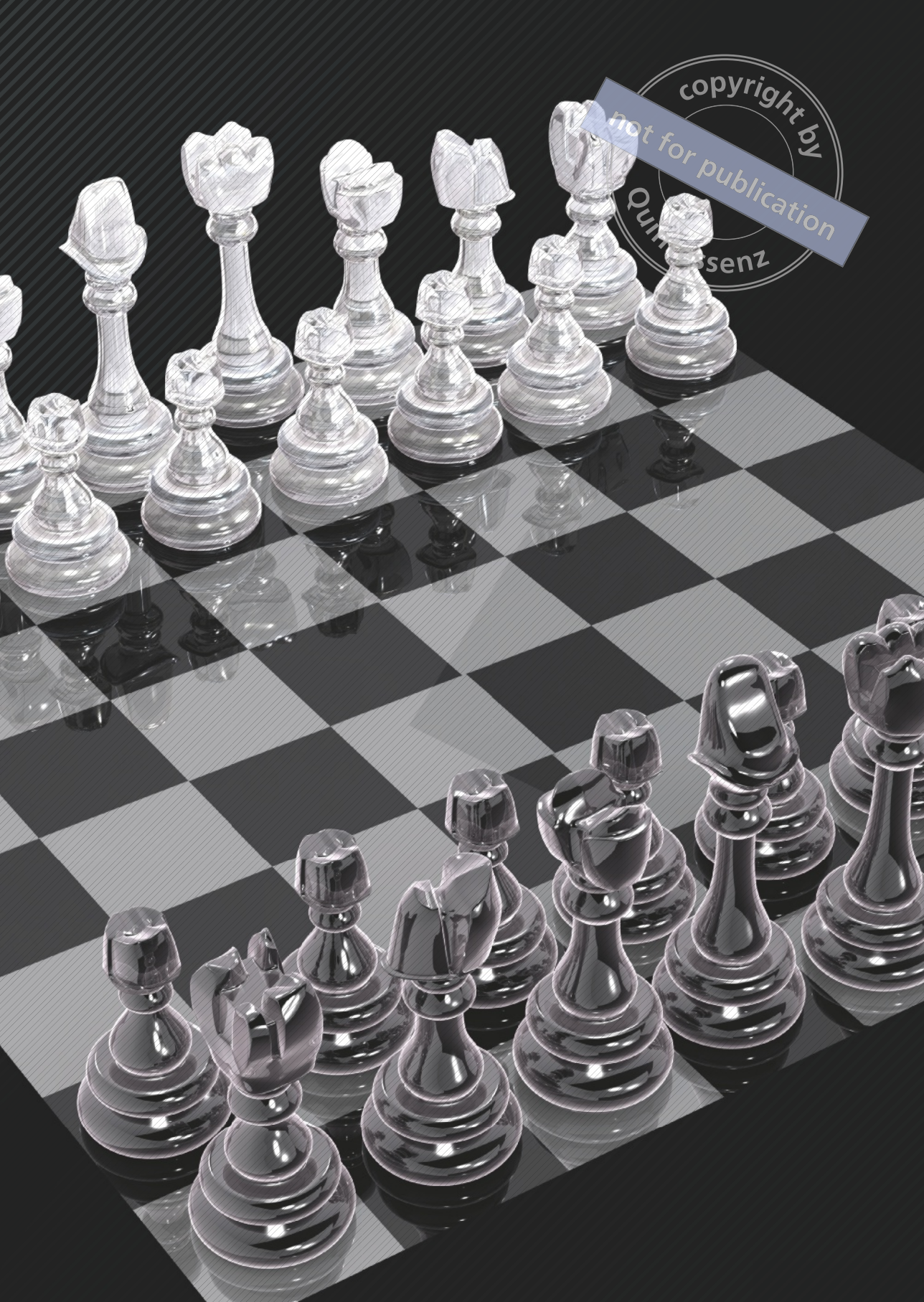

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PREFACE

When I was invited to write the Preface for this book, I must confess that I did not realize the commitment at the time. When the book arrived in my hands, however, I began to gradually feel the responsibility that I was facing. Suddenly, that friend and colleague of 40 years turned into an earnest steward demanding of me an accurate analysis of his work – a most powerful and comprehensive one, as he confidently said. I realized then that our friendship could not interfere with that analytical process, since scientific purpose was the absolute criterion of the action to be performed. I had no alternative but to start reading. And then everything changed!

I found myself facing a work of undeniable value. From its prodigious and exciting cover, I as the reader could already anticipate the wonder I would experience from then on. Care and good taste impressed me throughout my reading; the book awakened in me the enthusiasm and desire to use it as my sovereign guide in my clinical activity. This is said without exaggeration, dear readers, for those who venerate books, as I do – I feel them, hold them, squeeze them – this book is both a privilege and an ecstatic pleasure.

To those for whom it is intended, this book will be invaluable; an investment comparable to that made by acquiring the venerable handbook Shillingburg introduced to clinical and restorative dentistry at the time. I state without hesitation that this book will enjoy the same success and have the same significance for dental practitioners; furthermore, this work is up-to-date, has magnificent 3D illustrations, and has a clear and objective meticulousness on the part of the author and his collaborators.

The book is divided into eight carefully written chapters, providing the reader with essential theory, sound practice, and reliable guidance for further studies. Chapter 1 is an introduction to indirect restorations. It explains skillfully and strongly the theory and practice of this important and ongoing stage of everyday practice. Chapter 2 deals with restorative planning, and it is marvelous! The explanations lead not only to an understanding of the subject matter, but to how to incorporate it into professional practice. In Chapter 3, the principles and sequences of preparation are very clearly detailed, and are supported by sophisticated illustrations, the quality of which is in keeping with the best and most outstanding in dental books published to date. Chapters 4 and 5 focus on intracoronal and extracoronal restorations, and the same textual and illustrative quality is maintained. Chapter 6 presents conservative preparations, the focus being on preservation in operative procedure and the observation of biology. The chapter also covers the appropriate tools for conservative dental procedures. Chapter 7 discusses compromised teeth with the same attention to detail and care. Chapter 8 is about adhesive milled restorations. The material is well founded and presented in an innovative and clear manner, showing

that the issue should no longer be considered inaccessible, or a matter for the privileged few, due to the technology available in dentistry today, which should be used properly and with discretion.

I would like to honor and congratulate Professor Clovis Pagani and his collaborators for the esthetic consistency and relevance of this work. The editing is true perfection. To future privileged readers of this book, it is my hope that the knowledge you assimilate from it will make you more competent, more skilled, and more professional. That is indeed what I wish for myself!

Happy reading!

José Roberto Rodrigues, Associate Professor
Former Director, School of Dentistry
São José dos Campos – UNESP

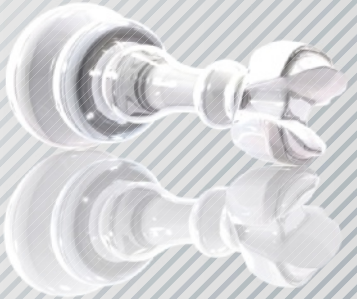
INTRODUCTION

More than merely specific expertise is expected from dental professionals today; they are required to be skilled in human relationships, be able to communicate with their patients, take responsibility based on self-criticism, and, above all, be accurate in their practice of dental operatory. In the past, the pioneers of our profession claimed that the success of restorative practice depended more than 60 percent on the technical refinement applied to cavity preparations. This assumption still applies, and with more relevance than ever before. The new materials require accurate measurements, dimensions, and customization for dental procedures. Underlying this is the importance of preserving dental tissue and function at all cost, as well as the sovereignty of esthetics, the main measure of dental success for much of contemporary society. While new technologies serve as auxiliary and complementary tools in the routine of the modern dental practitioner, the suitability of clinical and restorative choices also plays a major part in the success of clinical practice today.

Although traditional remnants of restorative practice still persist, cosmetic dentistry is undeniably the main movement that is at the heart of, and is shaping, the dentistry profession today. Patients are demanding that dental professionals adhere consistently to the rules of esthetics; philosophical principles that derive from the fundamental works of Aristotle.

In the book that you hold in your hands, dear reader and colleague, we have tried to approach – without semantic tricks and unnecessary erudition – the significance of knowing the background and basic principles of current practices of cavity preparation; these being, in essence, utility and functionality. Professionalism in dentistry is not about geographical location, the ergonomic arrangement of pieces of work equipment, or dazzling waiting rooms. Rather, it is mainly about skills and the refinement of operative details – in short, the essential, non-negotiable principles of precision, care, and a sound biological and scientific knowledge base.

You will find in this work a step-by-step approach to the current requirements demanded by cavity preparation in every indication that may arise, to enable you to accomplish successful clinical and restorative treatments. You will see, for example, that a detailed and comprehensive planning phase is mandatory in order to carry out cavity preparation efficiently and effectively. You will understand that the sequence of cavity preparation respects periodontal health, the protection of the pulp-dentin complex, the tooth remnant,



occlusion, and the mechanical function of the elements to be restored. The first and only purpose of this book is to provide colleagues who care about the quality of their clinical activities the close attention to detail and the cavity preparation steps that have never gone out of fashion. Indeed, how could a philosophy of practice that carries with it the essential factors for success ever go out of style?

We hope, dear colleagues, that this book gives you the opportunity to practice a dentistry that has as its foundation the principles of quality, honesty, and the true fire that earns our profession its place amongst the elite professions in the world today.

Thank you for your attention, we wish you all success.

Clovis Pagani

DEDICATION

I dedicate this work to the countless individuals and professors who participated in my academic and professional training, whom I shall never forget. I want to thank and honor:

Prof. Dr. Armando Curti Junior

Prof. Dr. Cervantes Jardim

Prof. Tit. Dan Mihail Fichman

Prof. Dr. Delcio Pasin

Prof. Dr. Henrique Cerveira Neto

Prof. Dr. João Cândido Carvalho

Prof. Dr. João Vieira de Morais

Prof. Adj. José Roberto Rodrigues

Prof. Tit. Júlio Jorge D'Albuquerque Lossio

Prof. Dr. Marcelo Augusto Galante

Prof. Dr. Marco Antonio Bottino

Prof. Tit. Maria Amélia Máximo de Araujo

Prof. Dr. Newton José Giachetti

Prof. Dr. Pedro Americo Machado Bastos

Prof. Dr. Ruy Fonseca Brunetti

To the School of Dentistry of São José dos Campos – ICT – São Paulo State University – UNESP.

To the professors of the Department of Restorative Dentistry, School of Dentistry – ICT – Universidade Estadual Paulista – UNESP.

To the Napoleão Publishing House - Leonardo, Guilherme and all employees for the friendship, caring, dedication, and promptness in the preparation of this work.

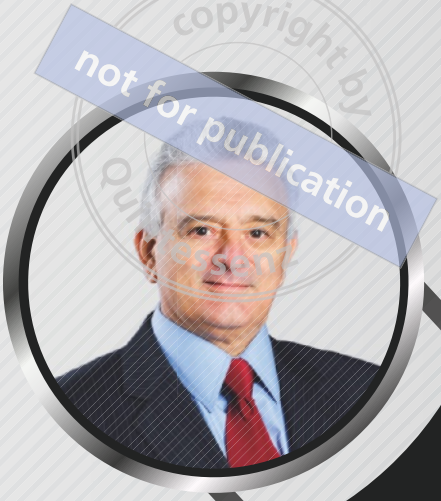
To the students Beatriz, Isabella and Geraldo, and all undergraduate and graduate students, you are surely the main reason for this work.

I have been a teacher for 40 years and have taught many people during that time, but most importantly I am a learner.

I GIVE INFINITE THANKS TO GOD, WHO ALWAYS SUPPORTS ME.

AUTHOR

CLOVIS PAGANI



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Specialist in Aesthetic and Prosthetic Dentistry

SPECIAL THANKS

To my parents Francesco (in memoriam) and Malvira (in memoriam), thank you for my existence. I am grateful for the love and care you gave me during my whole life. YOU were my first teachers.

To my brother Giacomo, you were a guide, friend, and always a reference.

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To my dear children Rodrigo, Vinicius, and Lucas, I cherish the understanding and inspiration, you are the main stimulus in everything I do. You always have been and will be the main reason for my battle in this life.

To dear Ana Lucia Sampaio Galante, for your support and encouragement. Thank you also for being at my side in times of sorrow and joy.

If this step is an achievement, it is not only mine, IT'S OURS. I love you all.

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To my parents, João and Alice, who by being an example of character have guided my familial and professional life.

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To my godfather Francisco Saliby (in memoriam), great encourager and professional and personal example, I owe to him my being the professional that I have become.

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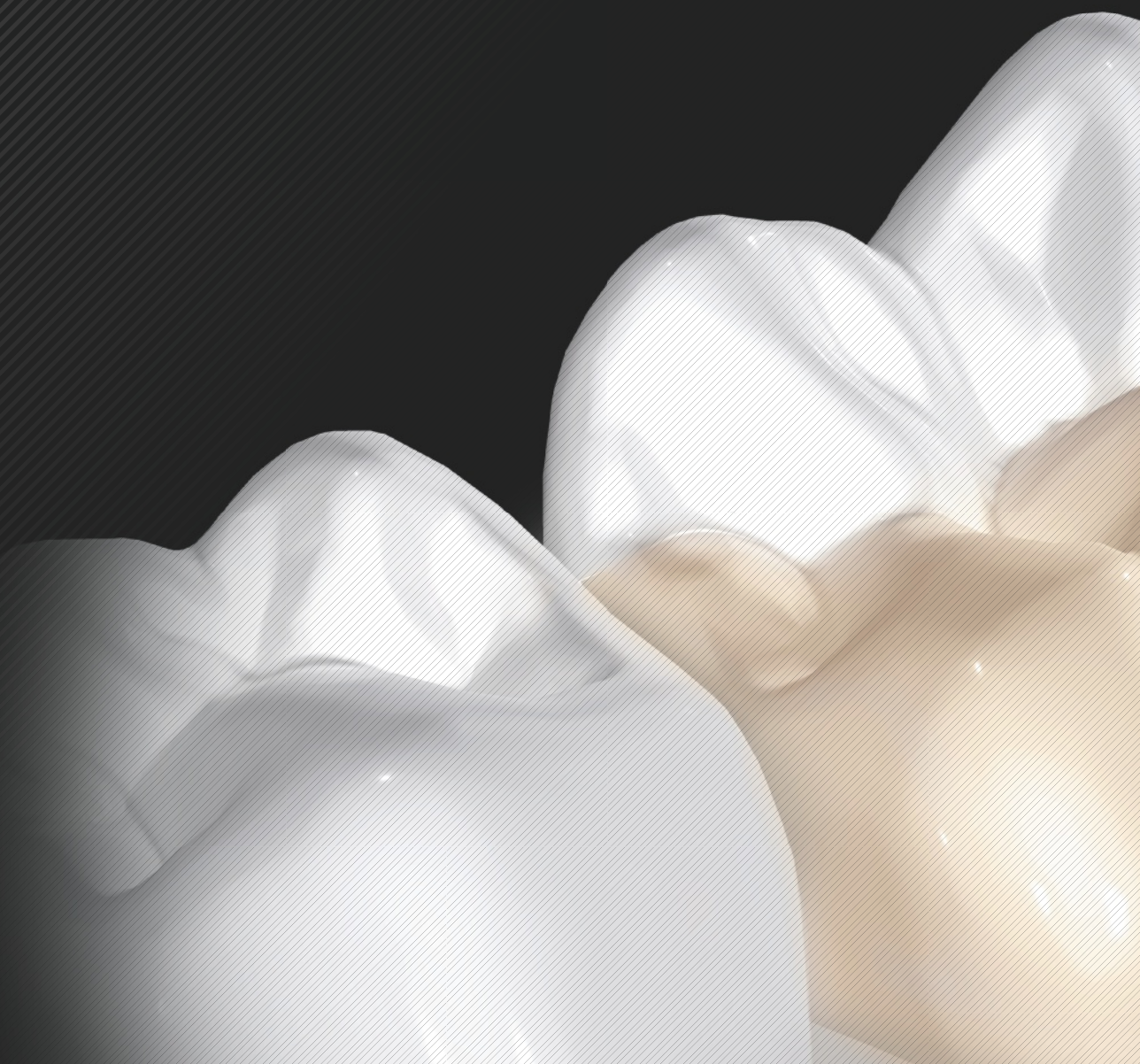
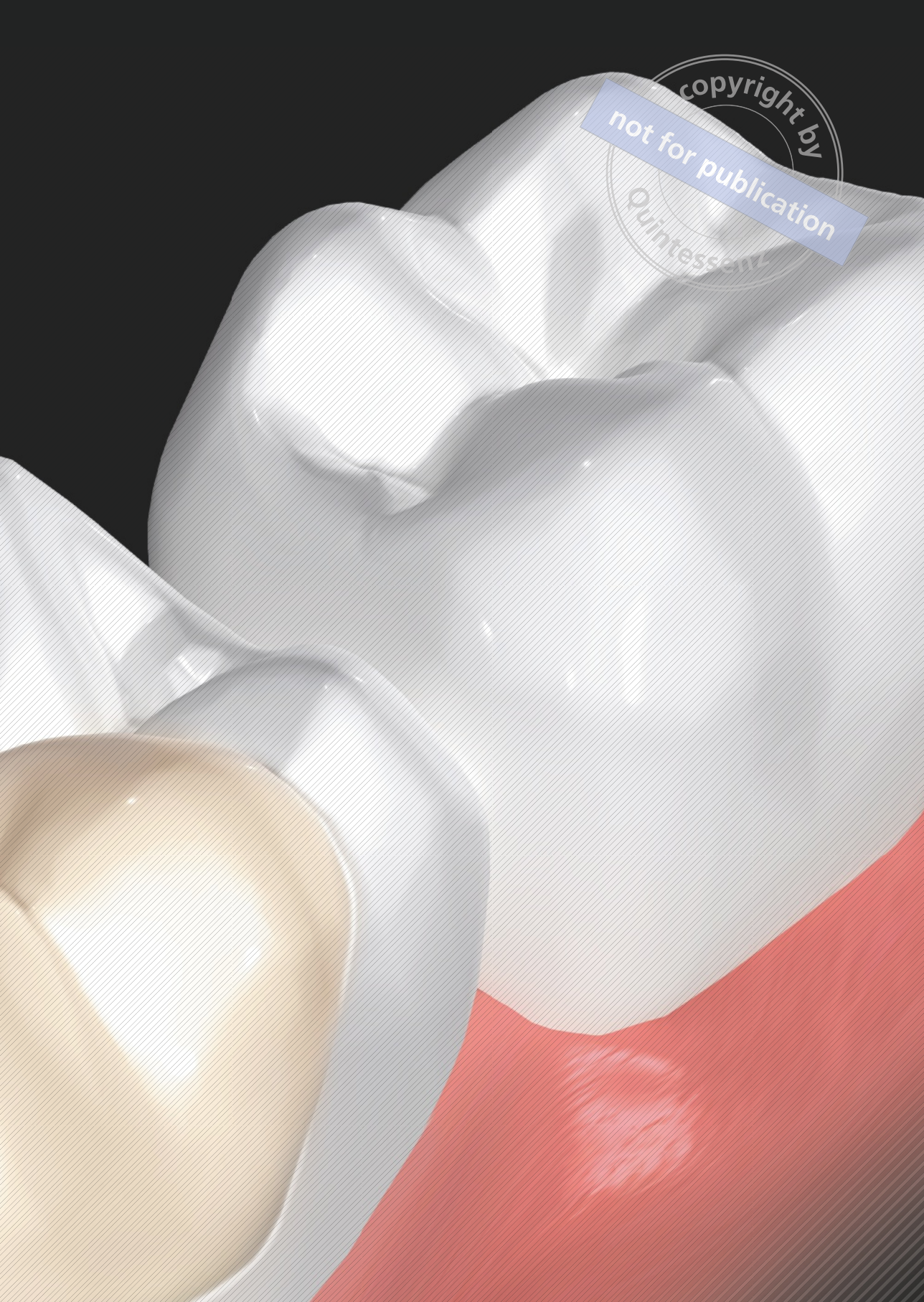
CHAPTER 01

INTRODUCTION TO INDIRECT RESTORATIONS





INTRODUCTION

The replacement of missing natural teeth by artificial ones has long been a concern of humans. One of the difficulties encountered in making these replacements is realizing a treatment that restores function and esthetics in a satisfactory manner and ensures clinical longevity without overloading the abutment teeth.[3-6]

The preparation of a tooth to receive an indirect restoration can be conceptualized as a selective grinding process of enamel and/or dentin in various quantities, areas, extensions, and predetermined forms. This grinding process is accomplished within a pre-established operative sequence of steps, employing instruments with specific forms and dimensions to create space for a single restoration or a fixed or removable prosthesis.[2,3,7]

Indirect restorations are among the main restorative options indicated for teeth with extensive coronal destruction. This type of restoration is manufactured on a gypsum model in the laboratory and then luted to the tooth that was previously prepared and impressioned. Indirect restorations may be indicated for the reconstruction of one or more elements of an arch.

The main indications for indirect restorations are depicted in Figures 1-1 to 1-7.[1,7]

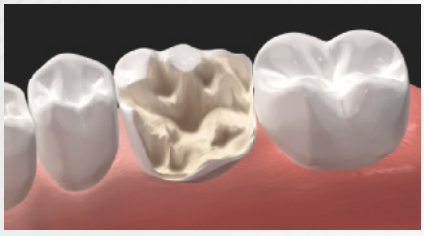


Fig 1-1 Teeth with extensive coronal destruction.

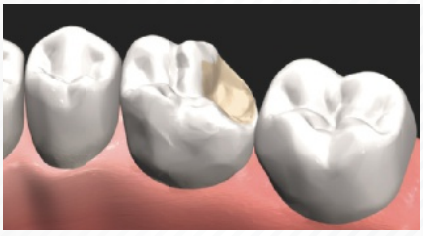


Fig 1-2 Teeth with fractured cusps.

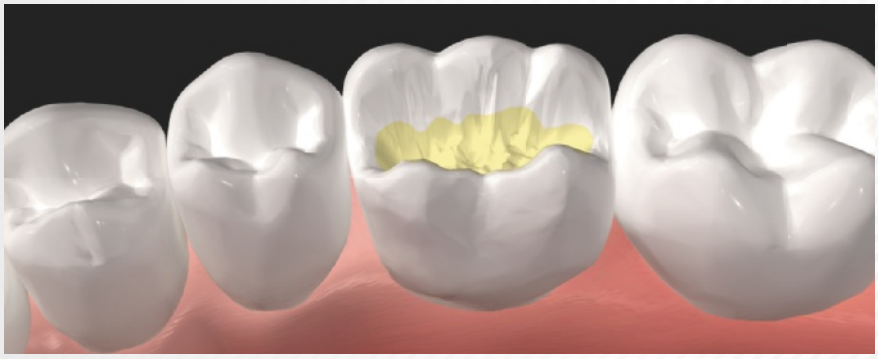


Fig 1-3 Replacement of direct restorations.

Fig 1-4 Correction of the position of extruded, non-occluding or malpositioned teeth.

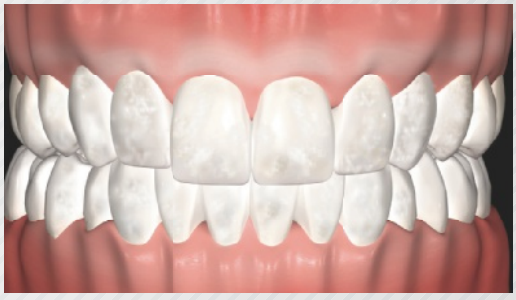


Fig 1-5 Teeth with malformation, such as hypoplasia and amelogenesis imperfecta.

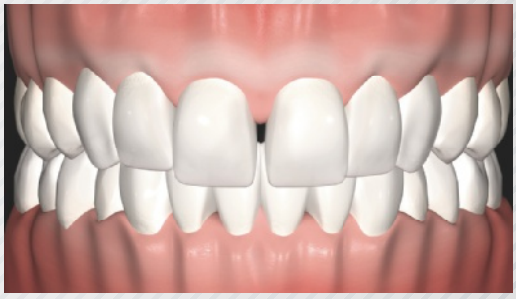


Fig 1-6 Closure of small diastemas.

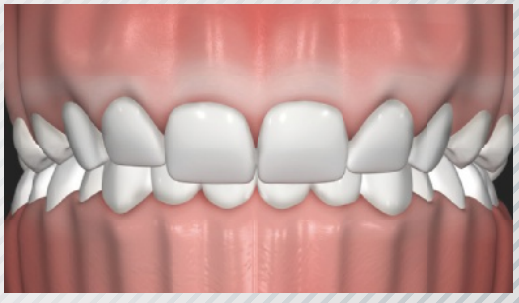


Fig 1-7 Teeth with short clinical crowns.

INTRACORONAL RESTORATIONS

Intracoronal restorations are those that fit within the anatomic contour of the tooth's clinical crown; those that do not cover any cusp are classified as inlays (Fig 1-8).

In the absence of one or more dental elements, a fixed partial prosthesis is indicated, in which the replaced missing tooth, called a pontic, is connected to the remaining neighboring teeth, called abutment teeth, which have intra- or extracoronal preparations (Fig 1-9).

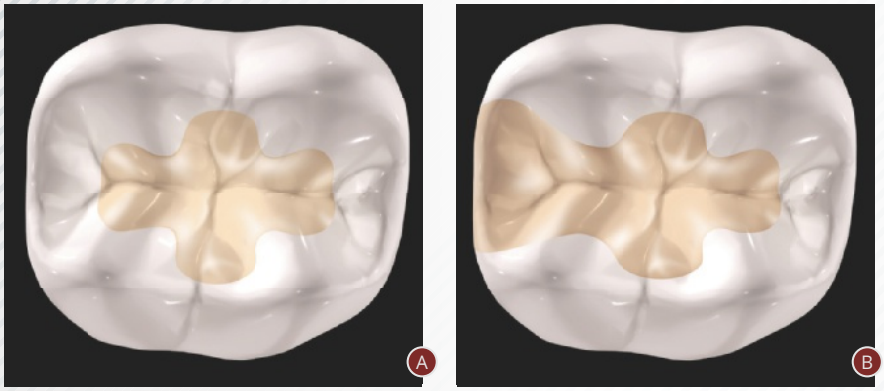


Fig 1-8 Intracoronal restoration. Occlusal (A). Mesio-occlusal (B).

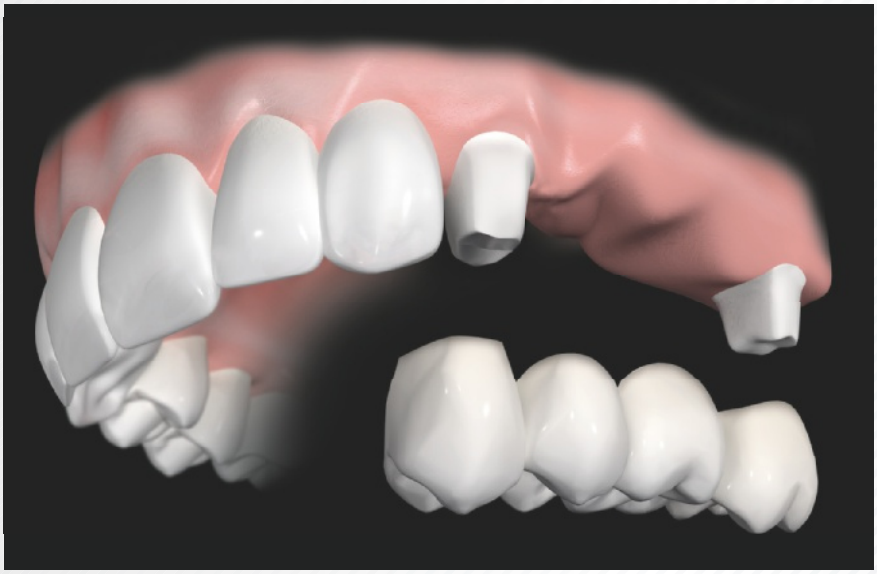
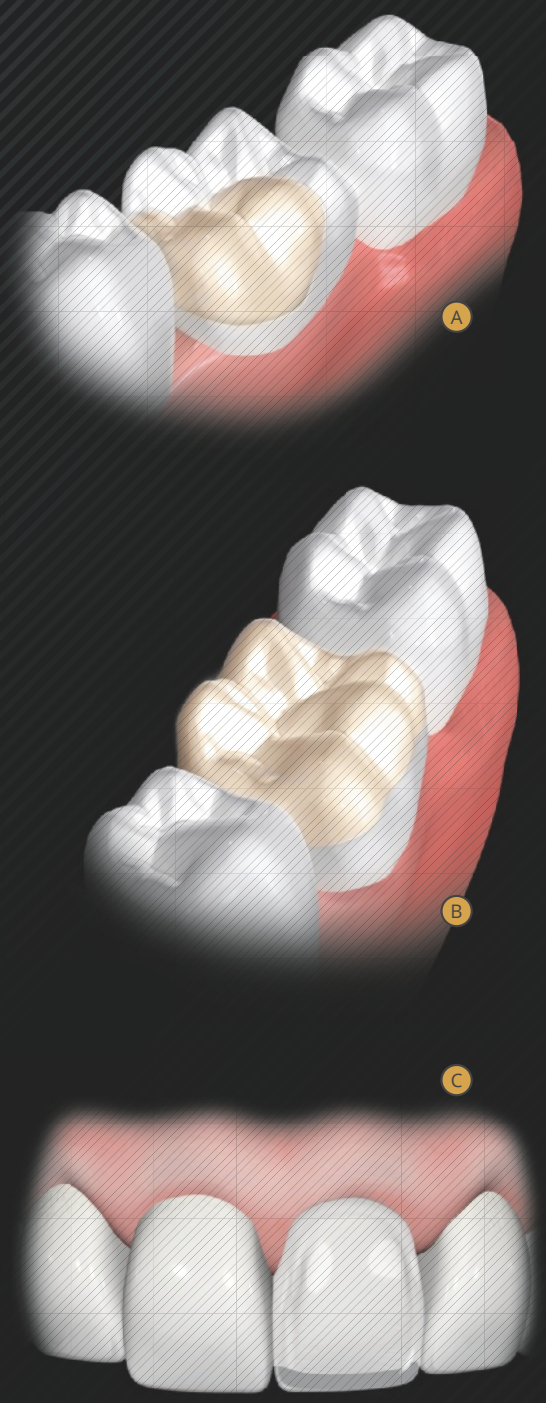


Fig 1-9 Fixed partial prosthesis.

EXTRACORONAL RESTORATIONS

Extracoronal restorations are those that cover the external surface of the tooth's clinical crown. Full-contour extracoronal restorations cover the entire outer surface of the tooth; partial-contour extracoronal restorations cover one or more parts of the surface of the tooth (Fig 1-10).

Fig 1-10 Extracoronal full-contour restoration (A). Extracoronal partial-contour restoration (B).



Crowns are extracoronal restorations in which the external surface of the clinical crown of a single tooth is covered by a single piece. The main functions of crowns are to re-establish the morphology and function of the lost coronary portions of the tooth and to protect the remaining dentition. When some surfaces of the clinical crown are covered, the indirect restoration is called a partial-contour extracoronal restoration, and can be classified as either an onlay or an overlay.

Onlays are those restorations that cover one or more cusps of a tooth. When the coverage extends partially to the buccal and lingual surfaces, they are called overlay restorations (Fig 1-11A and B).

Ceramic veneers are partial-contour restorations. Interest in these restorations has grown in recent years, mainly due to the increasing search for improved esthetics, in conjunction with the development of ceramic materials and adhesive dentistry. For ceramic veneers, a thin layer of ceramic material is applied that is cemented to the tooth using resin cement (Fig 1-11C).

Fig 1-11 Onlay (A). Overlay (B). Anterior veneer (C).

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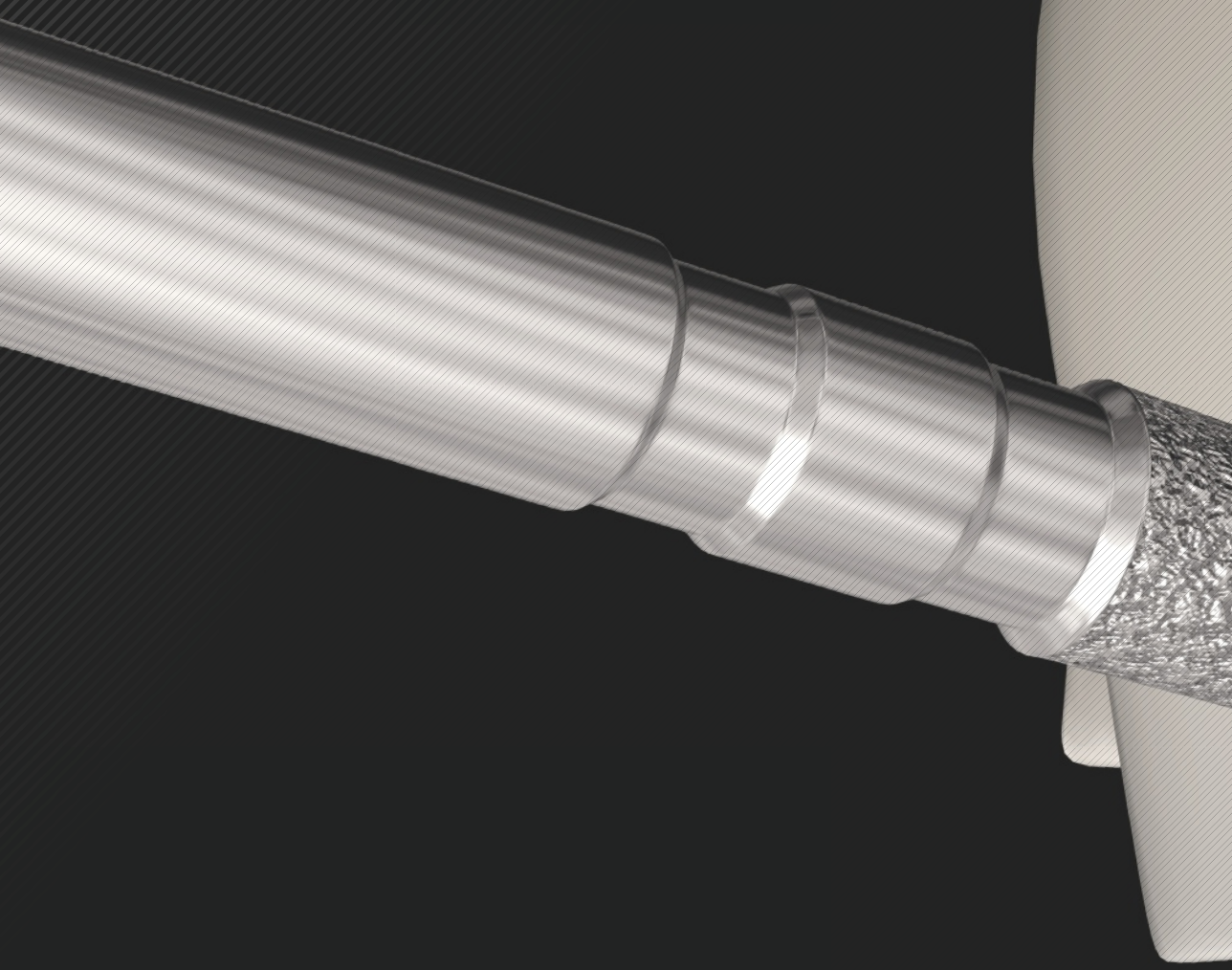
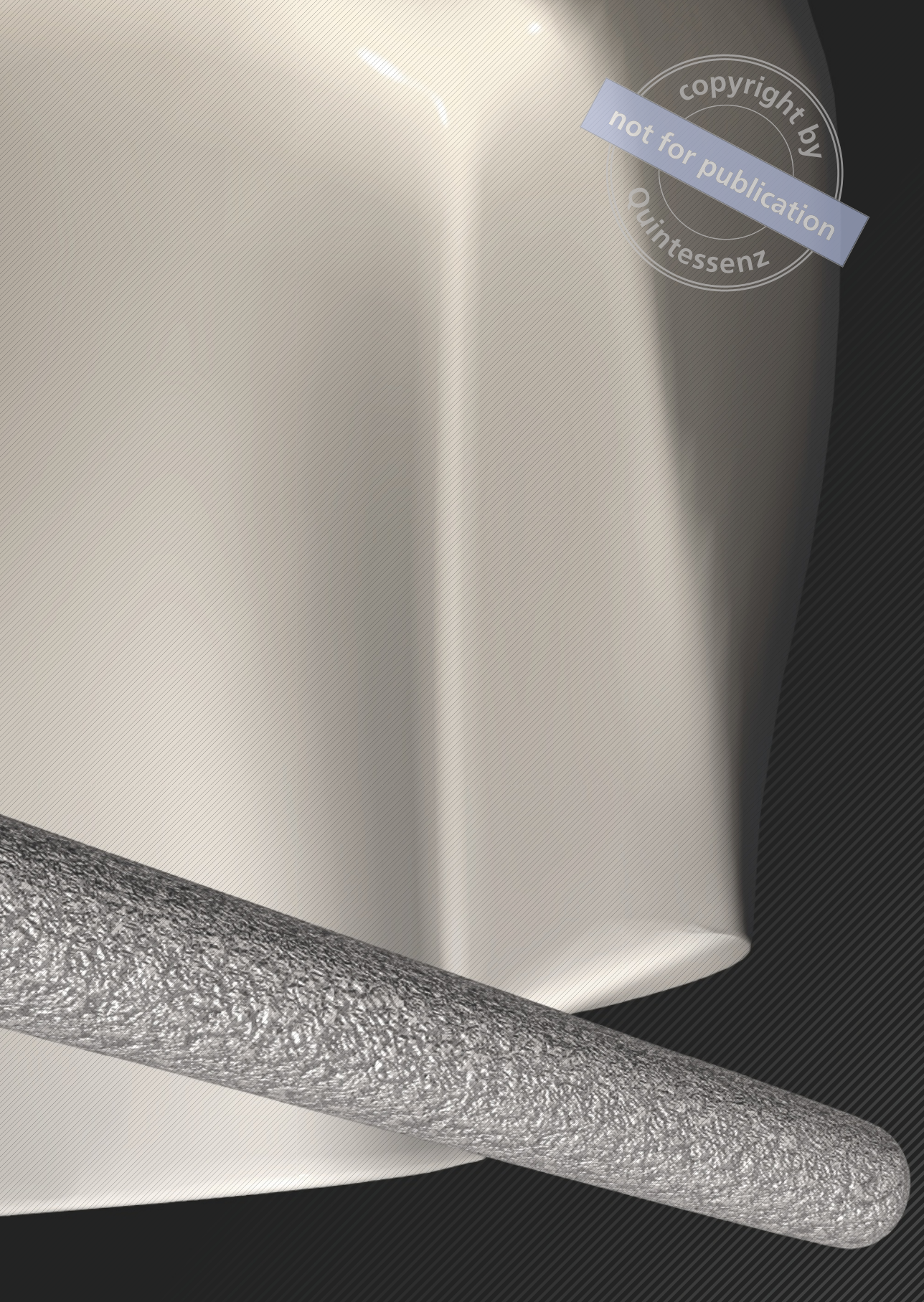
CHAPTER 06

CONSERVATIVE PREPARATIONS

MINIMALLY INVASIVE DENTISTRY





INTRODUCTION

The search for excellence in the reestablishment of esthetics and function in cases of rehabilitation led to the improvement and development of techniques in the dental industry. This ultimately fulfilled patients' needs for functional, long-lasting restorations, and a beautiful and harmonious smile.[1,11]

Demand for lifelike, unnoticeable esthetic restorations requires painstaking resources and knowledge from dental professionals in order to deal with the complexity of the procedures involved in the reestablishment of function and esthetics.[2] With the growing trend toward ceramic-based, indirect restorative materials, as well as the progress made in adhesive systems and the evolution of restorative materials, minimally invasive preparations have become a reality.[3]

The underlying premise of minimally invasive preparations is maximal preservation of healthy tooth structure. Thus, the preparation will not follow geometrical patterns, nor should it have boxes or retention grooves. Rather, it is based on the minimum reduction required to provide sufficient thickness to the restorative material to obtain the desired esthetics and function. An important feature of the preparation is to provide a form which facilitates the proper insertion of the restoration.[14,15] Minimally invasive preparations can be distinguished from traditional preparations, especially with regard to retention and form of resistance.[36]

A minimal amount of geometrical preparation is required to facilitate the insertion and positioning of the restoration during the final cementation procedure. Of secondary importance are the geometric and mechanical parameters of a preparation. This allows for the maximum preservation of the remaining tissues and therefore a conservative approach (about a quarter of the amount of tooth reduction compared to a full-crown preparation).[13,37-40,43]

A key objective in minimally invasive dentistry is to provide sufficient reduction of the tooth, since a restoration requires adequate thickness to provide mechanical strength to the material.[41,42,44] Recommended thicknesses are about 0.3 to 0.5 mm for the cervical area, 0.7 mm in the middle and incisal thirds, and a minimum of 1.5 mm for the incisal coverage.[16-21] These values correspond to the mean thickness of enamel.[22] Accuracy in obtaining these dimensions is the most difficult aspect of tissue reduction because these final thicknesses are closely related to the final volume and shape of the restoration.[16]

Tooth reduction is guided by the shape, thickness, and position of the future restoration. Therefore, it is of fundamental importance that the shape of the future restoration is known prior to the completion of the preparation (Fig 6-1). Several techniques can be used to obtain the goal of tooth reduction,[23-27] such as a diagnostic wax-up followed by a restorative trial (mock-up) that indicates the position of the future restoration.[14,28]

Upon approval of the mock-up, the next step is the completion of the preparation. The amount of structure that needs to be reduced will be determined by the selected restorative material and the relation between the shade of the substrate and that of the final restoration. Darker substrates require greater reduction to achieve the desired final result with lighter colors, always within the limitations of each case.

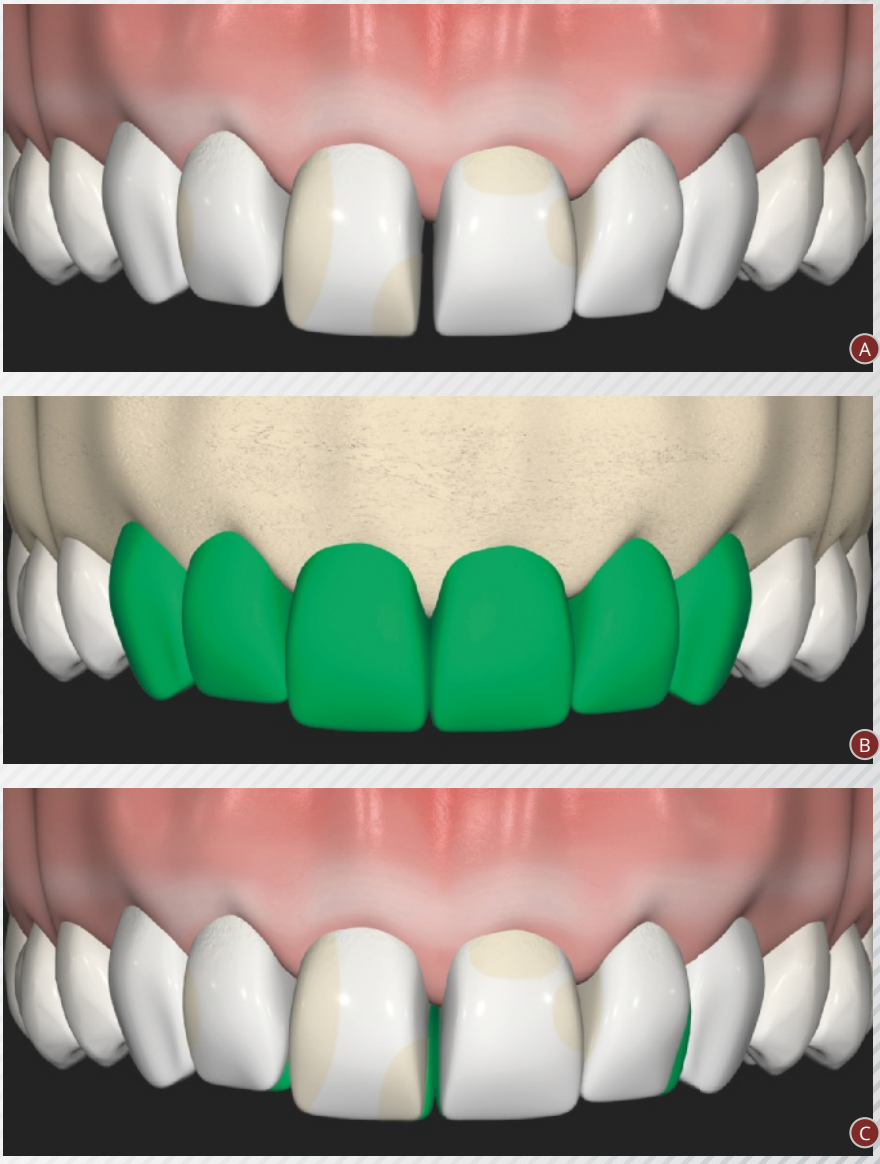


Fig 6-1 Simulation of an initial clinical situation (A). After the diagnostic wax-up on the model (B). Ideal recontouring of the anatomy (C).

The diagnostic wax-up that represents the original tooth volume should be used as a reference for the tooth preparation. This basic principle saves a significant amount of healthy tissue; not only is the enamel preserved, but also the dentinoenamel junction. The simplest and most important tool for enamel reduction in this technique is a silicone guide made from the wax-up, which is vertically or horizontally sectioned (Fig 6-2).[29,30]

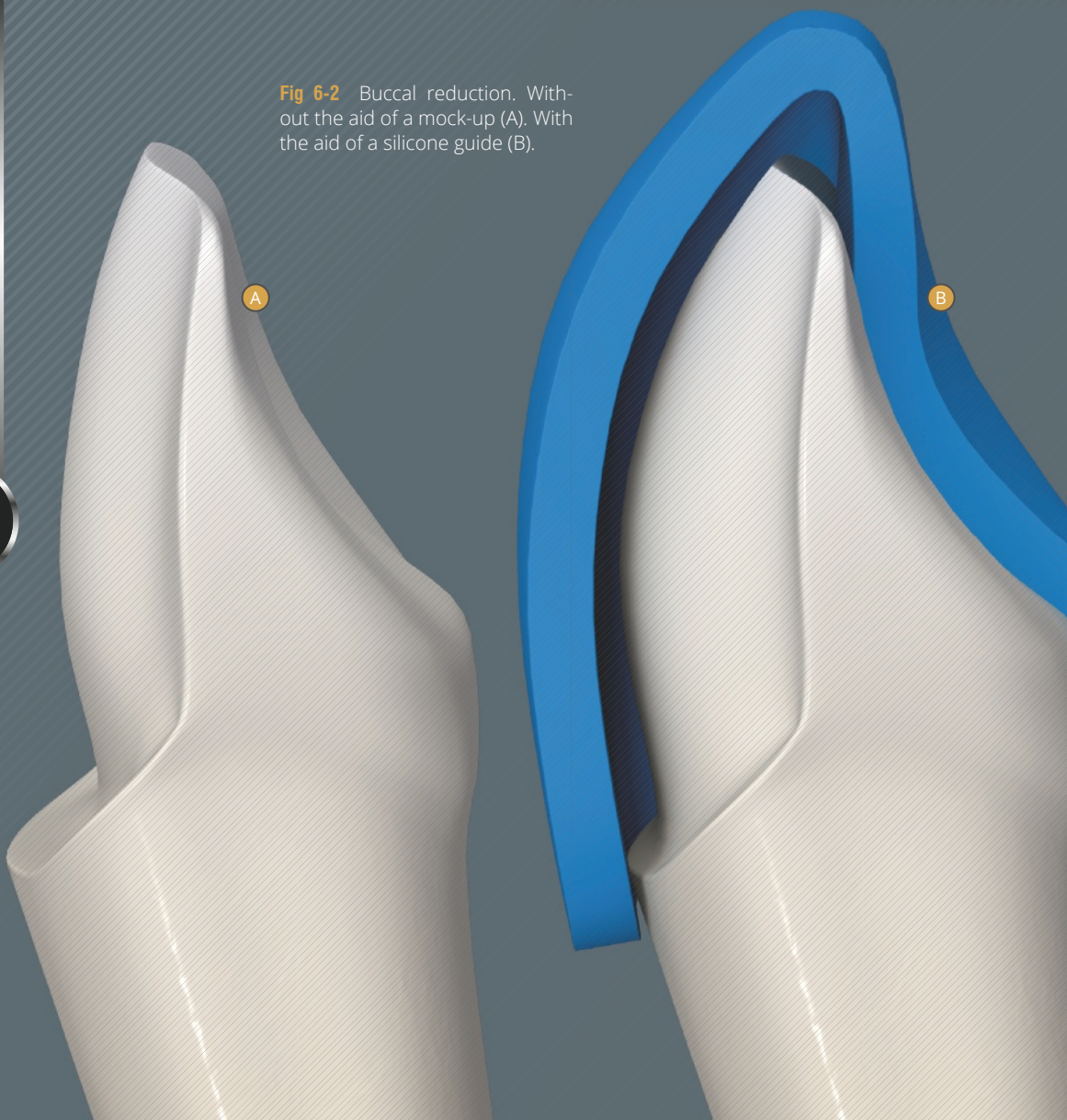


Fig 6-2 Buccal reduction. Without the aid of a mock-up (A). With the aid of a silicone guide (B).

PREPARATION FOR VENEERS

Veneers are partial extracoronal restorations usually indicated for anterior esthetic rehabilitations. The main purpose of a veneer is to cover the labial-proximal surfaces and potentially the incisal border of the anterior teeth in an attempt to correct color discrepancies, shape, texture, function, and position of the elements in the dental arch.[4]

Veneers in anterior teeth have existed in dentistry since the 1930s. This technique was described by Pincus,[5] who made temporary veneers for Hollywood actors and actresses to modify their smiles for filming and photo shoots. However, they only began to be used in dentistry in the early 1980s, when in 1983 Simonsen and Calamia,[41] and Calamia[6,7] described the porcelain etching process, which solved the problem of the longevity of these restorations by improving their adhesion to dental tissue.

The characteristic of minimal invasiveness in preparations for dental veneers has become increasingly important due to the current focus in dentistry on conservative procedures.

Veneers are indicated when a conservative solution is sought to resolve esthetic problems.[10] The main indications for veneers/laminates are:[8-10] teeth with discoloration that are resistant to whitening procedures, unsatisfactory shape or contours (size or volume) requiring morphological changes, closing diastemas, minor alignment corrections, restoration of defects in the enamel, teeth with fluorosis, and teeth with small fractures and tooth deformities.

The severity and extent of any of these factors require further evaluation, which is instrumental in achieving the goals of treatment and recovering function and esthetics.

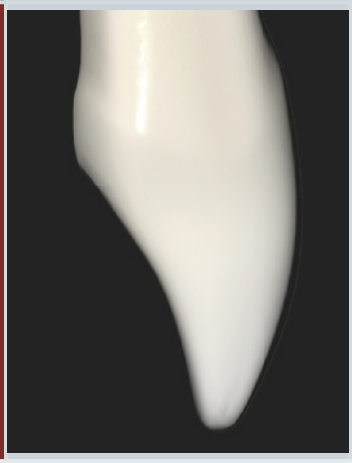
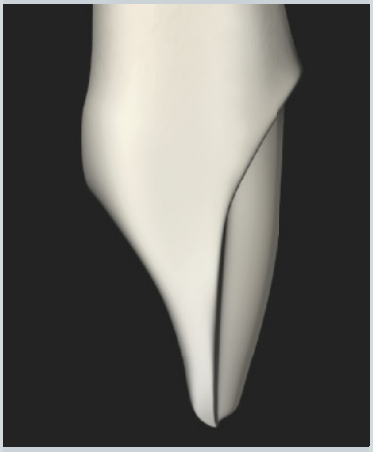
However, there are situations in which the use of veneers is less suitable:[10,12] cases with reduced interocclusal space, presence of deep bite with slight overjet, bruxism, parafunctional habits, severe dental crowding, periodontal disease, and teeth with extensive restorations that are indicated for a total crown.

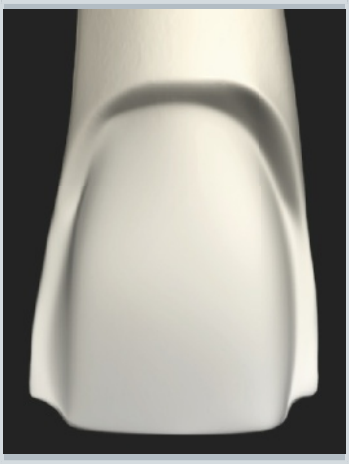
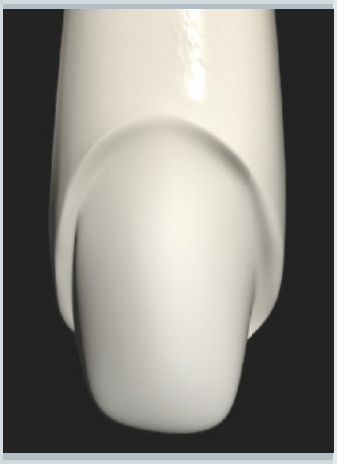
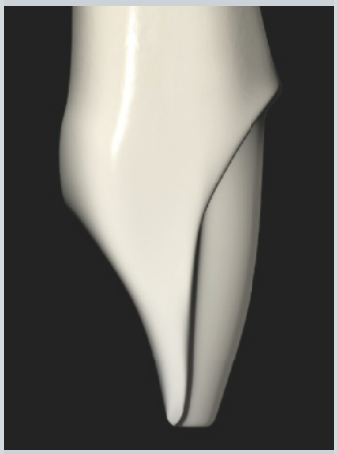
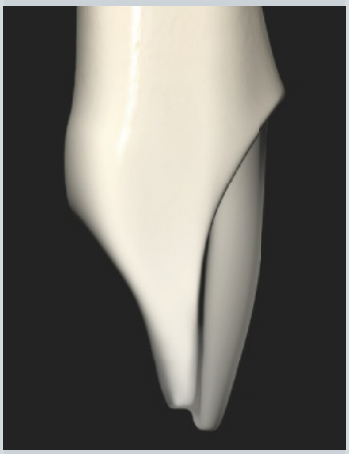
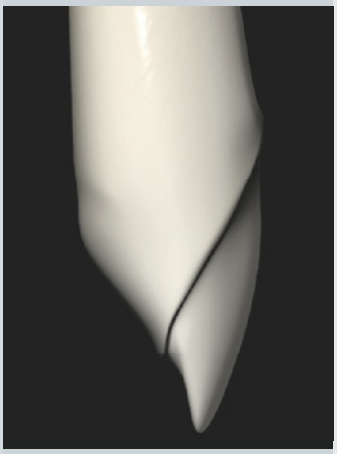
There are several preparation designs for ceramic veneers,[31] which vary according to the extent of the preparation (Table 6-1).

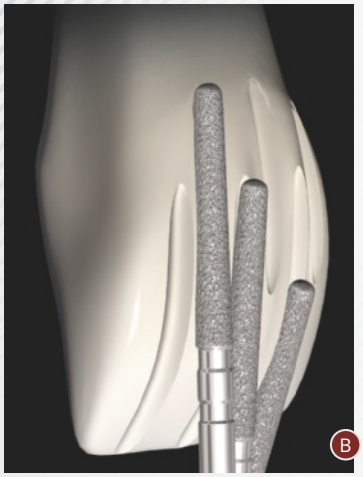
The use of different preparation techniques is dependent on several factors: amount of remaining tooth structure, presence of previous restorations, length of the clinical crown, and presence of endodontic treatment.

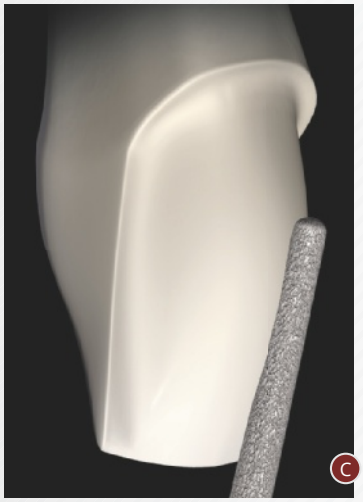
Different clinical studies have evaluated the long-term behavior of teeth restored with ceramic veneers, using several preparation designs.[32-35] These studies have concluded that ceramic veneers are a good restorative option. Survival and success rates of over 80% for these restorations have been reported.[5]

Table 6-1 Types of conservative preparations, extension, and labial and proximal views

TYPE	CONSERVATIVE PREPARATION	CONVENTIONAL/CLASSIC PREPARATION
EXTENSION	Dental hard tissue	Preservation of the proximal contacts without coverage of the incisal border
LABIAL VIEW		
PROXIMAL VIEW		

CONVENTIONAL PREPARATION WITH INCISAL COVERAGE	CONVENTIONAL PREPARATION WITH PALATAL/LINGUAL CHAMFER	EXTENDED PREPARATION
Preservation of the proximal contacts with coverage of the incisal border	Preservation of the proximal contacts with coverage of the incisal border, creating a palatal/lingual chamfer	Removal of the proximal contacts with coverage of the incisal border until the middle third
		
		





PREPARATION FOR VENEERS

The continuing evolution of bonding processes to dental structures makes possible the implementation of more conservative restorative techniques and enables the use of minimally invasive preparations (Figs 6-3 to 6-8). In teeth with slight or no discoloration, for example, ceramic veneers with thicknesses ranging from 0.3 to 0.7 mm may be used.[33]

Based on this philosophy, extremely thin ceramic veneers (0.1 to 0.7 mm) emerged, requiring minimal tooth reduction that is limited to merely smoothing sharp angles and eliminating undercuts. Teeth indicated to receive this type of restoration usually have favorable characteristics such as a good insertion axis and adequate space for the restoration. These preparations have very specific indications, where reshaping or correction of tooth volume is necessary by adding material.

It should be noted that ceramic veneers are of limited use in situations requiring major correction.

Fig 6-3 Preparation of the central incisor without involvement of the incisal edge. Intact tooth (A). Orientation grooves on the labial surface, with a tapered diamond bur following the inclination of the incisal, middle, and cervical thirds (B). Labial reduction (C).

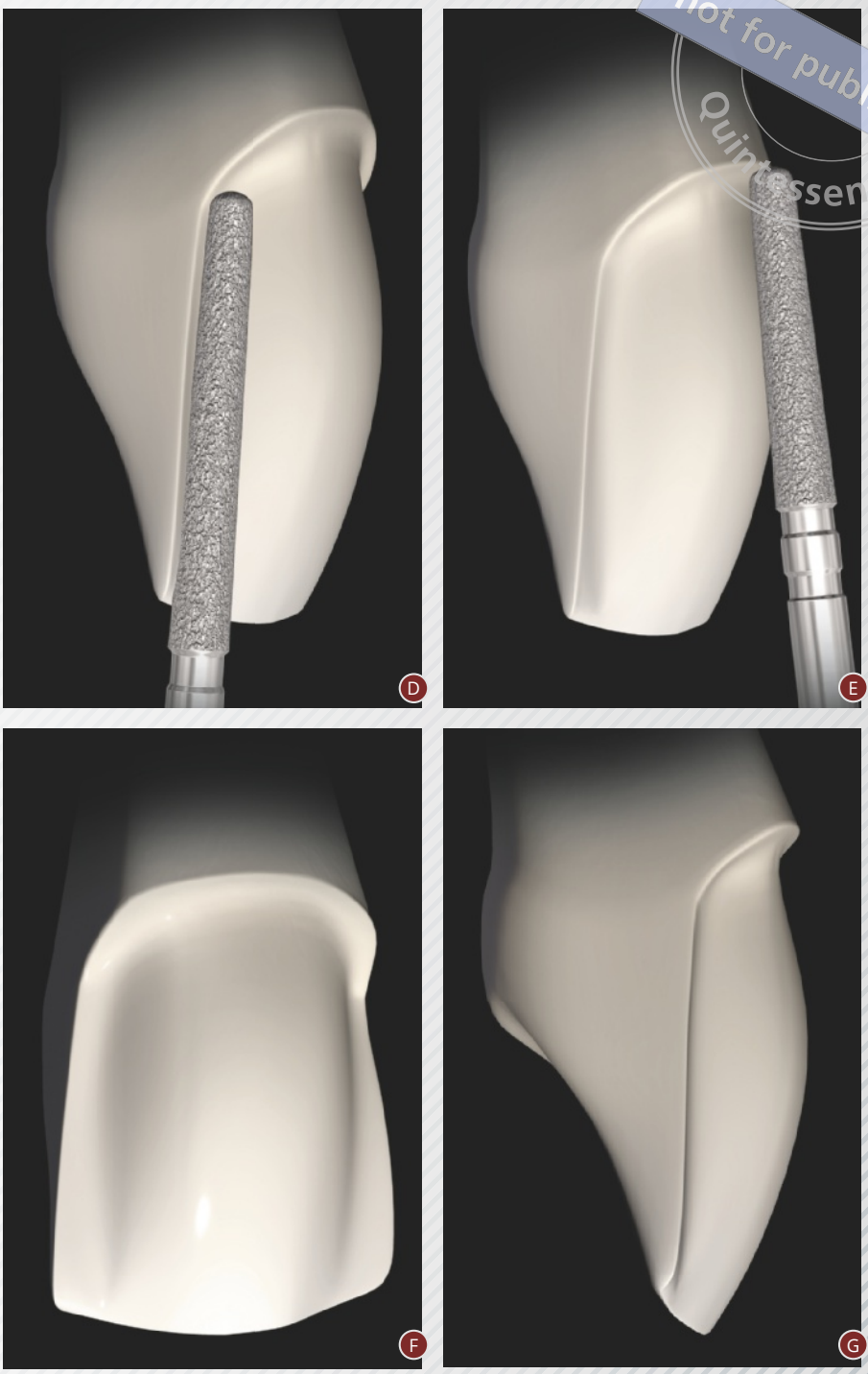


Fig 6-3 Labial axial reductions (D). Proximal axial reductions (E). Final preparation from the labial aspect (F). Final preparation from the proximal aspect (G).

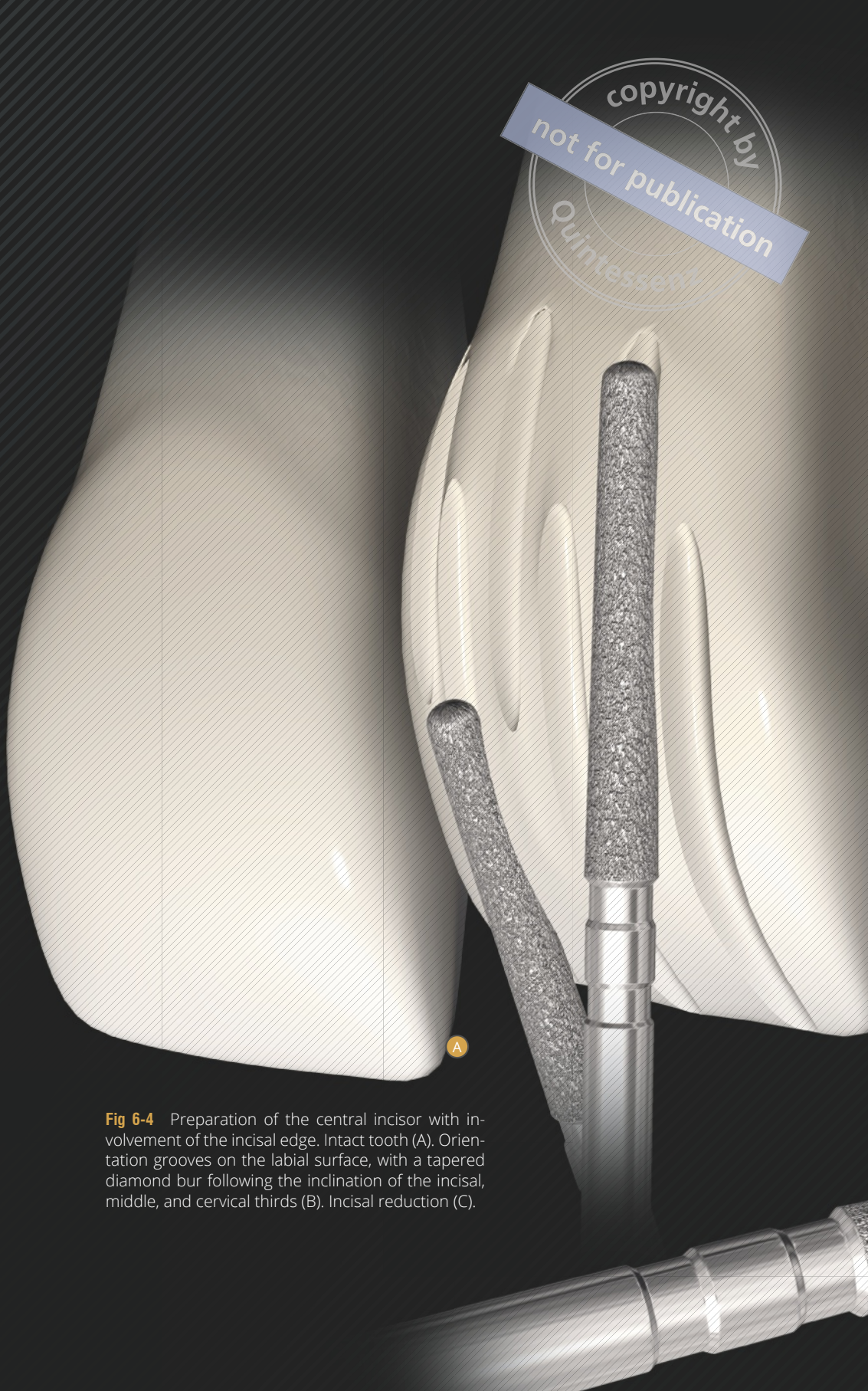
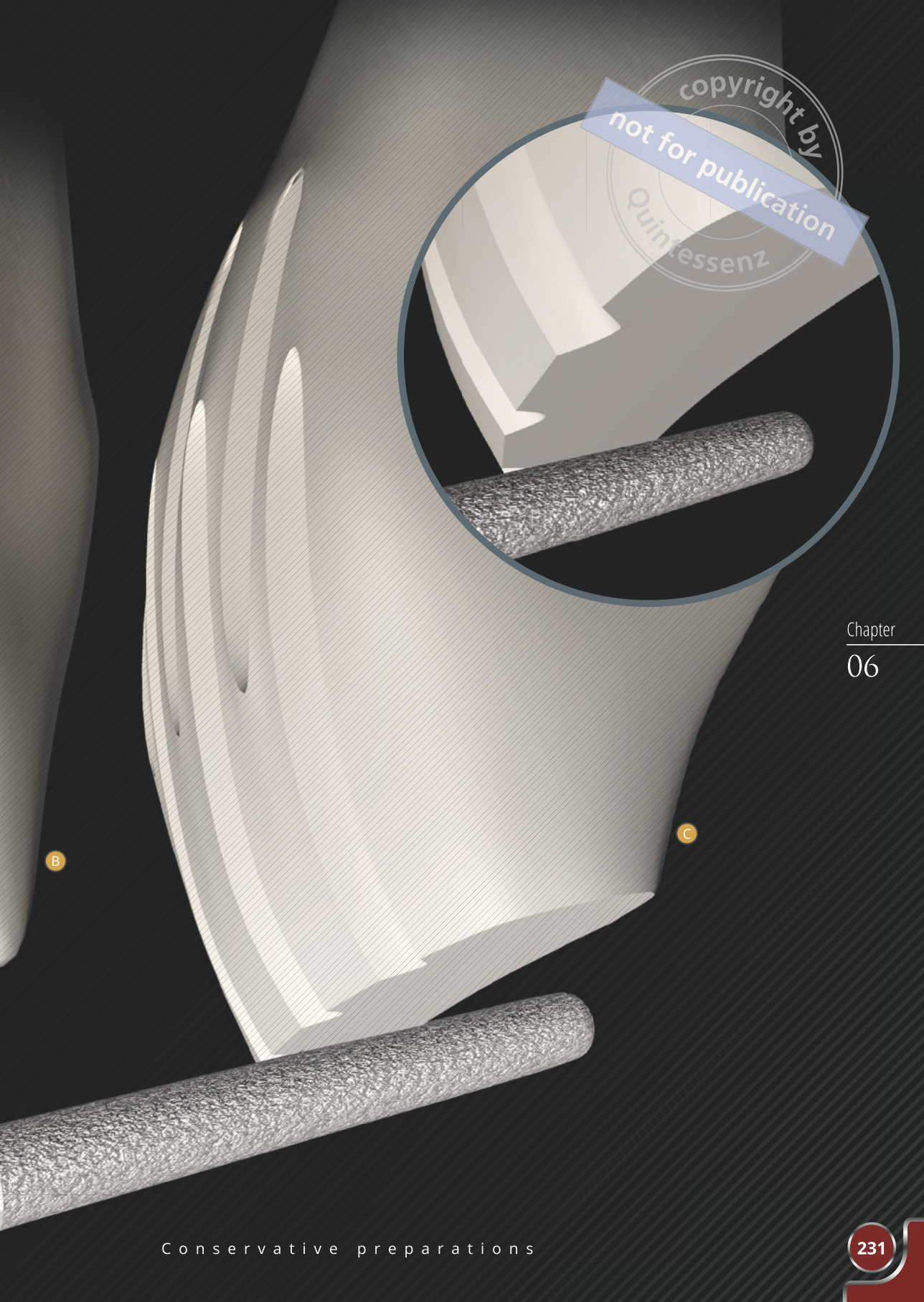


Fig 6-4 Preparation of the central incisor with involvement of the incisal edge. Intact tooth (A). Orientation grooves on the labial surface, with a tapered diamond bur following the inclination of the incisal, middle, and cervical thirds (B). Incisal reduction (C).



Tooth Preparations: Science & Art by Prof. Clovis Pagani and co-authors is a fully illustrated guide on tooth preparations, a fundamental part of daily dental practice. It contains essential theory and sound practice, including more than 700 high-quality 3D images. The most current concepts on tooth preparations for indirect restorations are covered, with a focus on biological care, preservation in operative procedure, and precision. The book is divided into eight chapters, covering topics such as restorative planning; state-of-the-art principles, sequences, and tools for preparations; intra- and extracoronal restorations; compromised teeth; adhesive milled restorations; minimally invasive preparations; and preparations for CAD/CAM restorations. This book provides a clear and objective outline of different conservative preparation designs indicated for a variety of clinical situations and is an indispensable addition to the collection of all restorative dentists.

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