

Dentofacial Esthetics

From Macro to Micro

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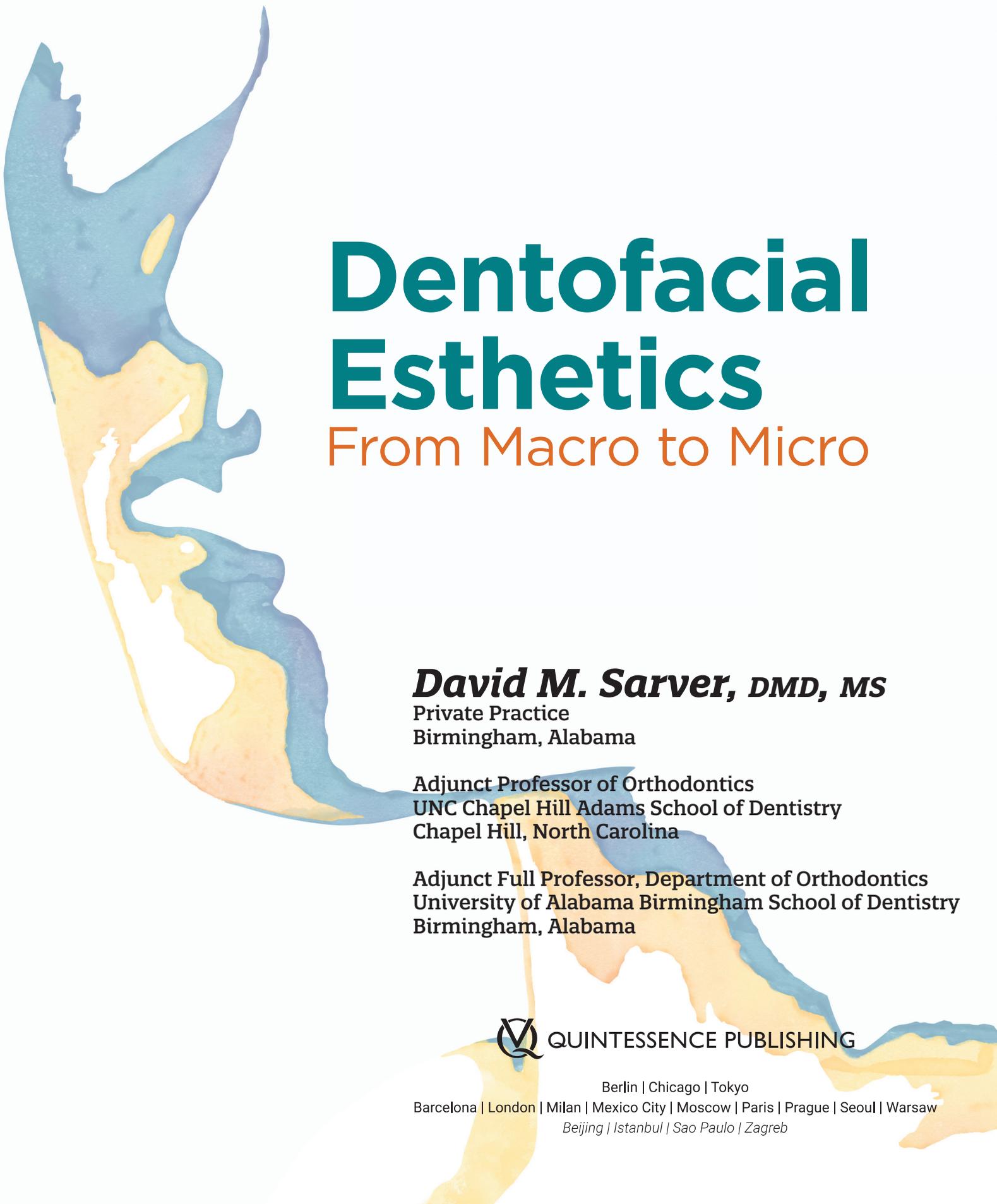
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Dentofacial Esthetics

From Macro to Micro

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Preface

Cephalometric analyses developed in the 1950s made orthodontists more aware of the role of underlying jaw disproportion in the creation of malocclusion. Even as late as the 1970s, the removal of premolars to camouflage skeletal components was a routine and acceptable treatment method, particularly in Class II malocclusions, where this treatment often resulted in profile flattening that became recognized as the “dished profile.” Assessment of a successful outcome was, and still is, often judged by “putting plaster on the table.” Using plaster models as the focus of orthodontic treatment is what I term *occlusal centric*, and as a result, inadequate attention is paid to the patient’s appearance, which includes both the face and the smile.

You’ll see in this book extensive use of digital imaging technology both to communicate with patients and to plan treatment. In the foreword to my first book, *Esthetic Orthodontics and Orthognathic Surgery* (Elsevier, 1998), Dr William R. Proffit stated that “In an important way, computer imaging changes the very focus of orthodontic and orthognathic treatment. When the primary visual aid in discussing treatment with patients is a set of dental casts, the focus almost has to be on how the teeth fit. When facial images become an important part of the treatment presentation, a greater focus on facial outcomes is inevitable.” Those words were written 21 years ago! My primary focus in that textbook was facial esthetics and the development of

digital projections of surgical outcomes and how additional esthetic options such as rhinoplasty could be incorporated into the patient’s treatment.

Where have we gone from there? From there we have greatly expanded our vision to include the face, smile, and the teeth. Additionally, the upsurge in interdisciplinary treatment has broadened the field of orthodontics well beyond “braces” and solving occlusal problems. Another important aspect to consider is the skeletal and soft tissue facial changes expected over time. I received a good background in craniofacial growth during my residency at the University of North Carolina, but my clinical experiences seeing patients 10, 20, and 30 years after orthodontic treatment and my surgical experiences led me



to research the literature on how the soft tissue changes with time. Most of these studies were based on cephalometric analyses, so I expanded my reading to the area of facial plastic surgery, where rejuvenation of the aging face is a prominent part of what they do. All of this research taught me to plan treatment to keep the patient looking as youthful as possible for as long as possible. As a result, many of the cases you will see in this book have 20- to 30-year follow-up records.

This is not a cookbook on how I provide orthodontic treatment. Every orthodontist has a different wrinkle on how to handle every orthodontic problem, so what are my major aspirations for this book?

1. To broaden your “esthetic eye,” showing you how to look at patients in a different way.
2. To create a new diagnostic model with an emphasis on smiles and appearance without diminishing functional treatment goals.
3. To inspire change in your treatment-planning process from being problem oriented to goal oriented. In the past we have been taught problem-oriented treatment planning, which focuses on the problems with a tendency to overlook the positive attributes of a patient’s appearance and smile. It is important that we do not dictate treatment to the patient but rather through interactive communication (facilitated with digital imaging) arrive at a treatment plan

that addresses the patient’s goals of treatment.

4. To clarify the objectives and treatment strategies through checklists designed to provide a framework for fluidity in treatment planning.

This book has been an evolution of thought over 40 years. During that time I have lectured and conducted numerous courses that have led to interaction with other clinicians who contributed to refinement of my thinking. I believe that evolution will no doubt continue for all of us clinically and academically. After years of effort in the creation of this text with constant changes in thinking and research in all fields of dentistry, I am sure the book will speak for itself.



Acknowledgments

I would like to thank all of my office staff, particularly Rebecca Payne and Cynthia Grammas, for their diligence and efforts in tracking down patients as far back as 35 years ago to come in for updated images. Those types of records really contributed to my effort to get across the idea that orthodontics is more than a 2-year decision—it is the decision for a lifetime. Also, thanks to Erika Killian both for keeping track of the old paper charts from cases prior to digital records and keeping track of and making sure that we have releases from all the patients in the book. And to the rest of my team for keeping our practice on track while my attention was diverted to this project.

I would also like to thank Sara Proffit for her generosity in loaning me her husband, Dr William R. Proffit, to serve as my editor

on this book. I know that he spent countless hours correcting my grammar and streamlining the text to be as clean and to the point as possible. And he was supposed to be enjoying his retirement!

Thanks also go to Dr Daniel Diaz Rubayo for the very difficult task of gathering pertinent research papers for the bibliographies of each chapter. In addition to that task, he performed many of the cephalometric superimpositions, which is much appreciated.

I would also like to express my appreciation to Bryn Grisham, Director of Book Publications at Quintessence, for her leadership on this project, and to Sarah Minor, Book Production Specialist, who performed all of the production work such as layout, image coordination, etc, in the book, which contains over 2,500 images and illustrations.

Particular thanks go to Leah Huffman, Senior Editor and Deputy Editorial Director at Quintessence, for the number of hours she spent helping create captions for many of the images and fielding phone calls and emails from me, offering guidance to lend depth to the book.

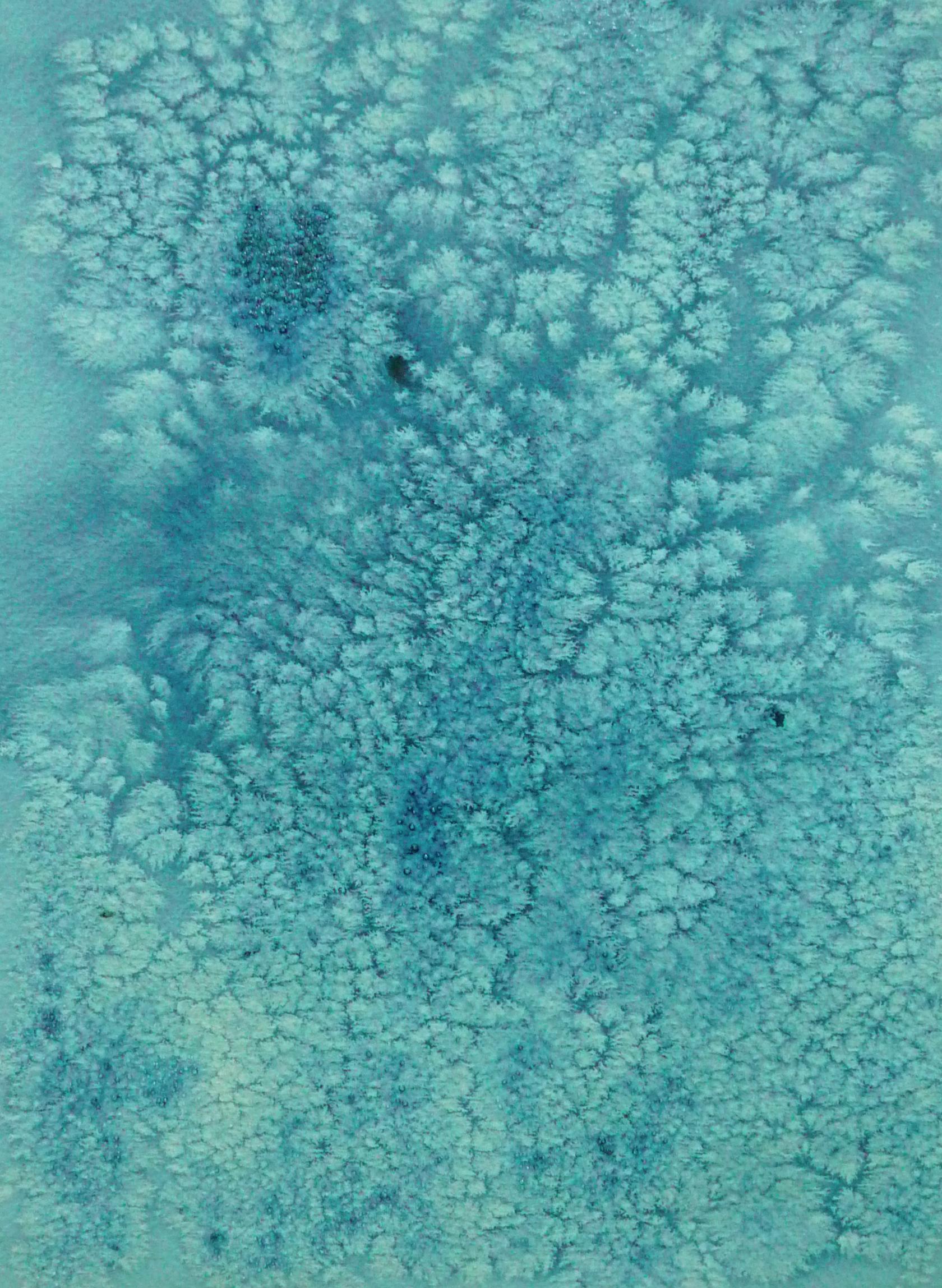
I would also like to thank Dr James Ackerman of Chapel Hill, North Carolina, who has for years served as a friend and somehow made sense of and translated my creative madness into coherent thinking.

Finally, a very large thank you to my wife, Valerie, for her forbearance of my absences while I worked on this project, from start to finish, for several years. My children—Dave, Leigh, and Suzanne—also deserve credit for developing into fine people while their father was often engrossed in his own career.

Dedication

This book is dedicated to Dr William R. Proffit, former Chairman of the Department of Orthodontics at the University of North Carolina (1975–2001). He was a consummate teacher, researcher, mentor, and friend. Without his inspiration and guidance, this book would have never been written.





Why Did I Write This Book?

My Personal Journey

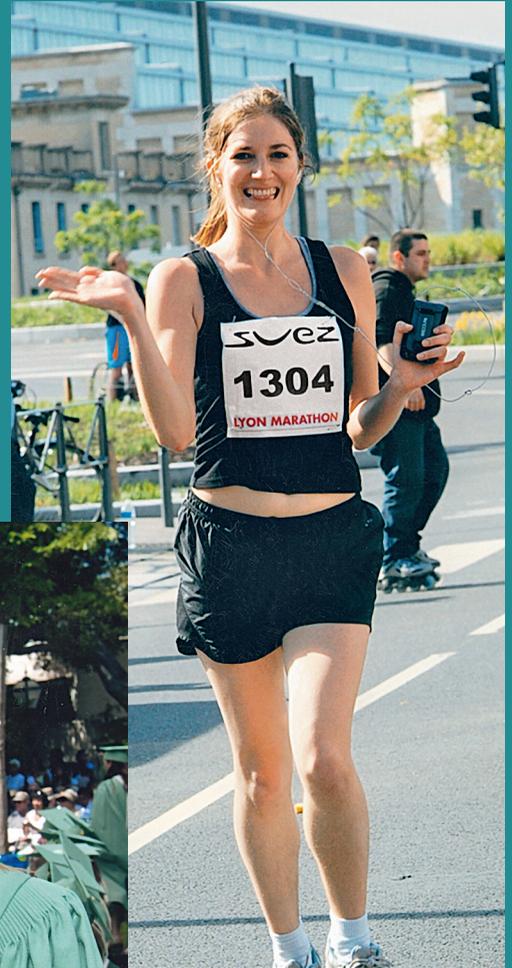
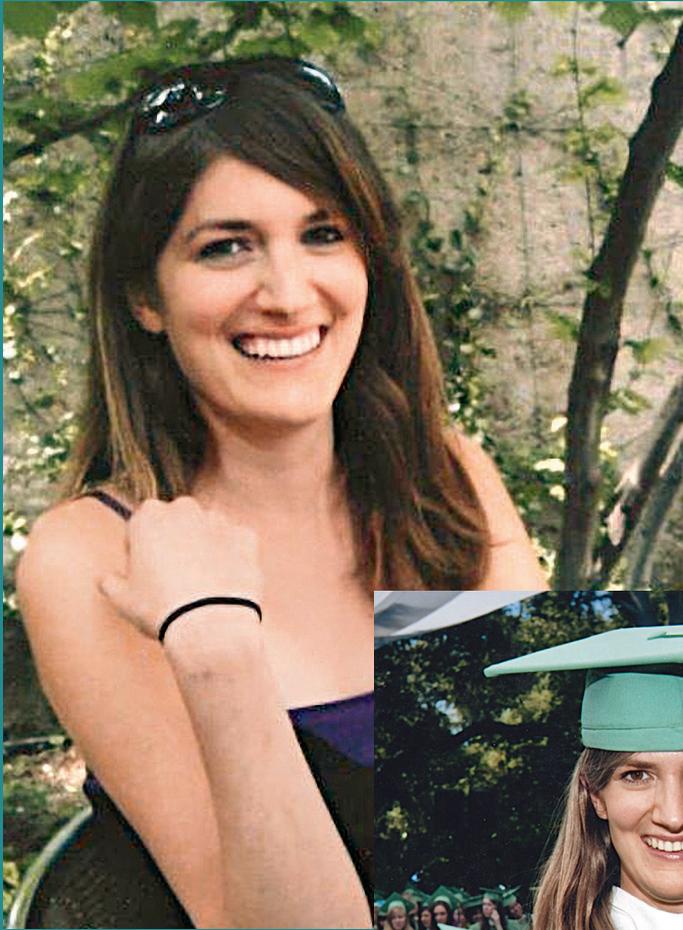
Each time I sit down to write about facial esthetics and orthodontics/orthognathic surgery, I question why I am doing it. But the answer is simple: I got tired of people saying “I saw Sarver for 45 minutes at a meeting so I’ve heard his stuff.” There is a big picture that I want to convey to dentists and orthodontists, and the only way I can do that is to get people interested in seeing and reading how I incorporate modern esthetic concepts into treatment plans that yield maximally esthetic outcomes. So that is my motivation: for dentists to have a global picture of how facial esthetics works, at least in my mind.

My background is straightforward. After dental school at the University of Alabama-Birmingham, I was fortunate to be accepted into the orthodontic residency program at the University of North Carolina, where I had a degree of exposure to modern surgical-orthodontic treatment that I couldn’t have had anywhere else at that time. Afterward I accepted a faculty position in the dental school at University of Alabama-Birmingham and began by helping to establish the formal orthognathic surgery program there. That is how I developed an eye for the face first.

As we began incorporating facial plastic surgeons into our macro-esthetic planning sessions at both the school and my private

practice, my appreciation for the value of soft tissue evaluation in our cases grew. I also started receiving invitations to speak to multidisciplinary esthetic groups and found myself sitting in the audience listening to presentations from non-orthodontists. (Side note: I am now a Fellow of the American Academy of Esthetic Dentistry, an interdisciplinary dentistry group with members including restorative dentists and all other specialists. I strongly encourage others to become involved with interdisciplinary groups of this type for the valuable insights that can be gained.) In my case, I learned (1) what dentists are doing in the area of esthetics and how they think, and (2) the wide degree of understanding or misunderstanding that dentists have about orthodontic diagnosis and treatment. As a result, it has become one of my missions to educate dentists about contemporary orthodontic thinking.

That, in fact, is the goal of this book. I also hope it can help our colleagues in surgery understand how orthodontists can partner with them in dealing with major dentofacial problems that are beyond orthodontics alone, and encourage the interdisciplinary dental team to embrace a broader assessment of the patient than just the smile. The esthetics of the smile is important, but the patient’s overall facial appearance determines how they look to others.



Pretreatment photos of the patient prior to an accident that severely damaged her dentition. Her story, which follows, emphasizes the importance of not reflexively treating patients based on past experience but deliberately thinking the problem through.

Thinking Our Way Through Problems

My wife worked for IBM for 23 years in the late 20th century. Why is that significant? Thomas Watson founded IBM as a typewriter company, but with the advent of computers in the early 1980s, technology had begun to change. The developments and advances in both hardware and software were occurring at warp speed, and my wife would come home on a Monday night with a thick stack of training manuals that described all the updates for the week. I asked her how she could be expected to read all of them and call on her clients at the same time. She reminded me of the IBM motto coined by Watson: THINK. “I read what I can, but the fact is that the technology is so new, when we are advising our clients or installing computers we just have to think and solve the problems as we encounter them.”

Consider what orthodontists do every day: We start with a plan and then solve the problems that we encounter as treatment progresses. No orthodontist has 100% of cases go the way they originally planned; we all have to think and navigate our way to a finish. Let me take this concept a step further and acknowledge my teacher, Dr William Proffit. All University of North Carolina orthodontic residents who were educated by “the Prof” will tell you that he taught us to think our way through problems. To this day, if I ask him a question I am likely to get another question as his reply. Proffit’s philosophy is that by making me think and helping me arrive at a conclusion on my own, I am more likely to remember and understand. He has helped educate generations of orthodontists who are taught how to *think first*. So the style of this book is to ask a lot of questions and encourage you to think along as the series of questions leads to an answer. When you encounter a patient with a problem you’ve never seen before, asking the right questions is the key to coming up with the best way to deal with that situation. The

following case beautifully illustrates that point.

A 24-year-old woman (Fig 1) was referred to me as an emergency patient. On a Friday afternoon I received a phone call from a local prosthodontist, who said “David, I have an emergency patient who I need you to see immediately.” My response was, “Really, an orthodontic emergency that has to be seen on Friday afternoon?” “Just shut up and see the patient!” he retorted. So at 3:30 that afternoon I met the patient at my office, and as soon as she smiled (Fig 2), I blurted, “This is an emergency!”

So here’s the story. This young lady was out for an evening jog in Paris (that would be in France, not Texas!), where she was employed, when she was struck by a car. She was hospitalized for a couple of weeks,

***We just have to think
and solve the problems as
we encounter them.***

suffering from fractured limbs, ribs, and, obviously, teeth. The traumatized teeth were stabilized with a bonded fiber strip (Fig 3). I certainly don’t mean to criticize the dentistry that was provided at the time, since the main objective of the trauma team was to keep her alive. Once she was physically stabilized, her physicians gave her permission to return home here to Birmingham. Her parents called to make an appointment with the prosthodontist, who agreed to see her as soon as she arrived back in town. Once he saw what he had to deal with, he made the call to me.

The first question I asked myself: What’s under there?

Intraorally (Figs 4 to 6), it was difficult to identify exactly which teeth were intact, their vitality, and the long-term viability of both the bone and the teeth. Presumably there were teeth (or remnants of teeth) and roots, but what I actually saw was large blobs of acrylic on the surface of

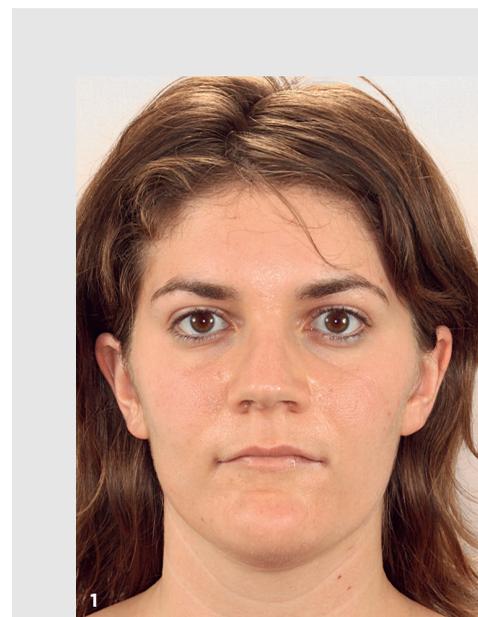
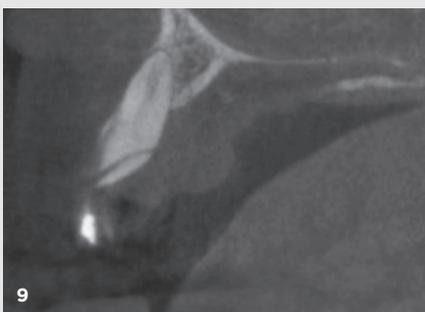


FIG 1 At age 24, this woman was struck by a car and severely injured.

FIG 2 Her smile reflects the significant damage that she sustained to the anterior teeth and the temporary stabilization that was placed following the accident. Once the patient was stabilized, she was referred to me by her dentist for guidance regarding what treatment direction would be best for her.

FIG 3 The close-up view of the smile shows that the damaged teeth had been stabilized with a massive amount of composite and fiber. This is not to imply any criticism of the dental procedure; the medical team was struggling to save her life and did what they could to hold the teeth in place.



FIGS 4 TO 6 The first intraoral examination showed teeth covered in plastic with hyperplastic and inflamed gingiva. My initial thought was that these teeth were going to be lost and that a bone graft and implant would be required. I think this would be the first thought for most dentists. But first, to find out what was remaining under all the composite, I took a CBCT.

FIG 7 It appeared that the roots of the teeth were intact but the maxillary left lateral incisor crown had been fractured from the root.

FIG 8 The vertical view of the CBCT revealed a fracture of the root of the maxillary left lateral incisor.

FIG 9 The sagittal view demonstrated that the fracture of the maxillary left lateral incisor was not completely through the root but was instead an oblique fracture with some facial aspect of the enamel remaining. This was to be a promising finding.

what appeared to be teeth and a tremendous amount of plaque accumulation and gingival hypertrophy, both certainly understandable. So the first step was to take a CBCT scan, which revealed that most of the crowns of the teeth were intact, as were most of the roots (Fig 7). However, as I looked at different vertical views of the CBCT, I noted that the root of the maxillary left lateral incisor was horizontally and diagonally split (Fig 8). The sagittal view demonstrated that this was an oblique fracture of the maxillary left lateral incisor (Fig 9) and that the roots of the central incisors were anteriorly avulsed, completely displaced from the original tooth socket. Furthermore, the maxillary left lateral incisor crown appeared to be fractured and lost, and the root remained but was vertically displaced (see Fig 7).

What was my first reaction upon seeing the extent of the injury?

My first thought was, all of these traumatized teeth are going to have to be extracted because saving them would probably be impossible. Of course, removal of the traumatized teeth sets up a cascade of treatment effects that must be considered. Removal of all the anterior teeth would result in a massive bony defect, which would require an equally massive bone graft to restore the alveolar bone. Subsequent atrophy of the alveolar bone would be expected. Next, the restorative phase of treatment would include either a number of implants (remember that consecutive implants are often esthetically unacceptable) or a removable appliance. This cascade of effects is quite complex and requires each part of the treatment to be done well.

Given the severity of the injury, what is the goal of treatment?

This reaction—thinking in terms of *what* to do rather than *why* we should do something—is typical of how many clinicians approach treatment planning. Instead, what I needed to ask myself was, what is the primary goal of treatment? My answer?

To preserve as much bone as possible, as is the case in many combined orthodontic-restorative cases. Given the fact that these teeth are severely traumatized and out of position, how is that possible? This led to my next question.

As scary as this looks, is there anything that might be working in my favor?

In fact, there are three things: (1) While the teeth are avulsed labially, one of the sagittal cuts shows a layer of bone and periosteum on the facial side (Fig 10). Furthermore, when we look at the horizontal cut (Fig 11), we can see that although the alveolus is shattered labially, that view also indicates that it has a layer of periosteum over it. Periosteum means that we have some osteogenic potential left. (2) Because the teeth are still present, that means a periodontal ligament is also present, and that also has osteogenic potential. Finally, (3) the anterior avulsion of the teeth has left a three-wall defect, which is, from my knowledge of periodontics, very favorable to bone grafting. Adding all this up, unless healing is already to the point that ankylosis has developed, orthodontic tooth movement is probably the most sensible approach to preserving bone because we have a periodontal ligament remaining, the teeth are being moved back into a three-wall defect, and we have periosteum. We now arrive at the final question.

If I take a chance on orthodontic tooth movement, what is the worst that can happen?

Like anyone, I am very aware of the risk tolerance that must be considered when we undertake any form of treatment, and I certainly must take it into account in a case like this. My conclusion was simple: the worst that could happen is that the teeth would be lost, which would put us back where I was with my initial reaction—that all of these teeth need to be removed!

With the patient's understanding of the situation, I decided to undertake



FIG 10 The sagittal view showed that the maxillary central incisors had been labially intruded by the vertically directed blow to the teeth.

FIG 11 There appears to be a layer of periosteum and bone on the labial aspect of the maxillary incisors, with three bony walls still present and intact—another promising finding.

FIG 12 By carefully removing the bonded fiber and acrylic splint using a high-speed handpiece, intact teeth were revealed with the edges of the incisors fractured. It appeared as though the maxillary left lateral incisor crown was lost.

orthodontic treatment and, under the circumstances, the sooner the better. After administering local anesthesia, I gently removed the bonded splint and all the bonding material with a bur and handpiece (Fig 12). Using a diode laser, I then removed all the hypertrophic gingiva, revealing all the tooth surfaces (Fig 13). A welcome surprise was that the maxillary left lateral incisor had some enamel remaining, which would give me the surface on which to bond an attachment so that it could be

moved along with the rest of the teeth. Full fixed appliances were placed on the maxillary teeth (Fig 14), with an attachment on the maxillary left lateral incisor, and a 0.016-inch archwire was placed. One week later the teeth had moved appreciably, particularly the left lateral incisor (Fig 15). By 3 weeks, approximately 3 mm of posterior movement had resulted, with the maxillary anterior teeth being brought back into the smile. Six weeks after her first visit, the maxillary anterior teeth were

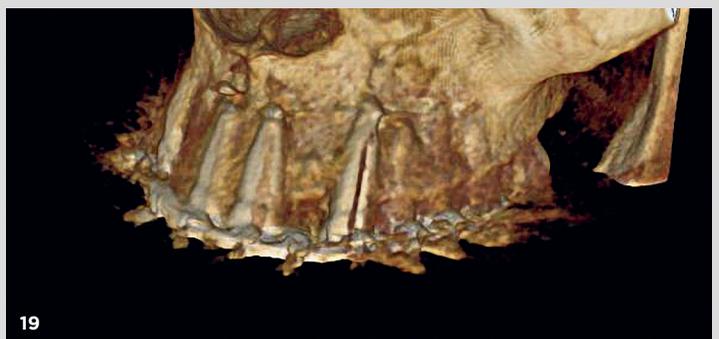
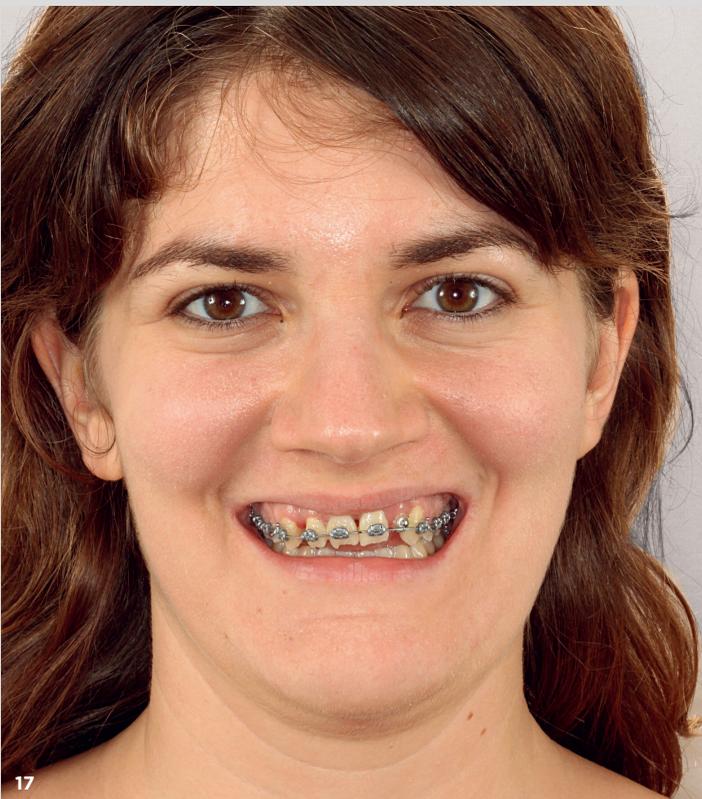
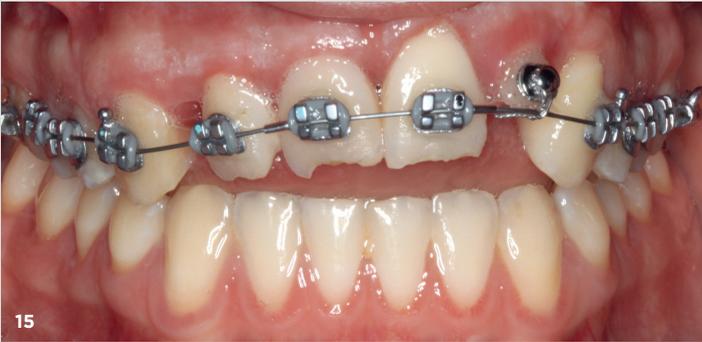


FIG 13 All of the hypertrophic gingival tissue was removed with a diode laser, and surprisingly I was able to spot a piece of enamel still intact on the facial aspect of the maxillary left lateral incisor. Knowing from the CBCT that the enamel was attached to the root of the tooth, this meant that even though the tooth would eventually be lost, I now had an opportunity to bond an attachment to the patch of enamel to serve as a “handle” to extrude the lateral incisor, thus generating bone.

FIG 14 Once the biodressing was cleaned and all of the bleeding and oozing was controlled, orthodontic appliances were placed, including a button on the remaining enamel on the facial of the maxillary left lateral incisor. Initial alignment was begun with a light Nitinol archwire.

FIG 15 One week later, the gingiva was much healthier, and extrusion of the maxillary anterior teeth had begun.

FIG 16 Six weeks after appliance placement, much progress had been made in aligning and extruding the teeth to be more level with the posterior segments.

FIG 17 After 6 weeks of alignment, the patient’s smile had improved dramatically. Importantly, the teeth and alveolar bone appeared to be following the extrusion of the roots of the teeth.

FIG 18 The occlusal view demonstrated arch alignment, the alveolar width appeared to be good, and the extruded maxillary left lateral incisor now clearly displayed the vertically directed fracture from the facial to the palatal.

FIG 19 After the initial 6 weeks of treatment, the patient had to return to her home in Paris to resume her job and would be transferred to the care of an orthodontist there. Before she left, my CBCT taken reflected intact roots and improved alignment of the roots into the alveolar housing from which they had been avulsed.



FIG 20 Six months later she returned to Birmingham for nasal revision to correct the damage to her nose caused by the accident.

almost in contact with the mandibular incisors, and a CBCT showed intact roots that, surprisingly, were asymptomatic (Figs 16 to 19).

At this juncture the patient informed me that she had to return to Paris to attend to her work demands, and we transferred her to an orthodontist there. She returned 11 months later for repair of the nasal damage she had suffered (Fig 20), and I noted that the interim orthodontist had chosen to replace and reposition the existing brackets. Unfortunately, the brackets were very low on the incisal edges (Fig 21), resulting in intrusion of these teeth and diminished incisor display on smile (Fig 22). Additionally, the maxillary lateral incisors had been removed, and the four remaining anterior teeth had undergone endodontic treatment. The main point, however, is that updated CBCT and periapical radiographs (Fig 23) demonstrated excellent bone formation around all the teeth. I decided to reset the brackets again to extrude the maxillary anterior teeth and added pontic teeth for better esthetics (Figs 24 to 26). Three weeks later, vertical incisor position was much more favorable in terms of both her smile appearance (Fig 27) and occlusion. The patient then moved to New



FIG 21 Her interim orthodontist had chosen to replace the original brackets and position them more incisally. As a result, both the canines and central incisors were intruded out of occlusion.

FIG 22 The intrusion of the incisors resulted in less incisor display on smile than when she left my care.

FIG 23 The restorative dentist obtained periapical radiographs, which showed good bone support but also revealed that numerous root canal treatments had been performed.

FIGS 24 TO 26 Upon her return to my care back in the United States, I reset the brackets to close the open bite, extrude the maxillary incisors for greater tooth display, and achieve better canine guidance prior to restoration.



York City, and we coordinated her restorative care with a dentist there, who elected to place two three-unit fixed bridges (Fig 28). Her smile was nicely restored (Fig 29). Six years later I was able to see her after completion of her restorative work. Her final intraoral and smile images (Figs 30 and 31) reflect the excellence of the final outcome. Then my curiosity was aroused. I never really knew what she looked like before her accident, so naturally I asked her if she had any photos she might share showing her smile at stages prior to the mishap. Her mother brought some the next day (see page 2), and I admit to not only being pleased that she had truly been restored to her original face and smile but also shocked at the fact that I could not tell the difference between her pre-accident photos and her images 6 years later (Figs 32 to 34)!

In summary, the prosthodontist and I were presented with a situation that I had never seen before, and we were under severe time constraints compelling us to make decisions and act swiftly. Why did the prosthodontist refer this patient to an orthodontist rather than to an oral surgeon, the obvious referral? He felt that the orthodontist would understand best the physiology and possibilities to consider in order to make a broad decision based on knowledge of alveolar growth, change, response to tooth movement, and finally, facial and smile esthetics.

FIG 27 With extrusion of the anterior teeth, the appearance of the smile was dramatically improved. The patient then relocated to New York City, and treatment was now coordinated with her new restorative dentist.

FIG 28 For the definitive restorative treatment, two three-unit prostheses had been placed.

FIG 29 Incisal edge placement in her final smile was excellent, resulting in complete incisor display and a consonant smile arc.

FIGS 30 AND 31 At the 6-year posttreatment follow-up, slight periodontal changes can be seen on the maxillary central incisors.

I admit to not only being pleased that she had truly been restored to her original face and smile but also shocked at the fact that I could not tell the difference between her pre-accident photos and her images 6 years later.





What You Can Expect

In this book, I am going to throw a ton of material at you. At one of the first courses I ever gave, one of the responses I received on the course feedback form said “I came to get a sip of water and I got a firehose stuffed in my mouth.” It is a lot of material, and I want you to be able to sit at home with the book as something to think about and refer back to at the same time. I hear from many orthodontists who have taken my in-house course that they have used the information they learned, for example how to lateralize a canine and use a diode laser to correctly contour the gingiva, to demonstrate to the family dentist that indeed a canine in the lateral incisor position can look like a lateral incisor if the treatment is done well. The book also includes references that I think are pertinent to you. These are not only articles written by me but other papers I will discuss in this book, so you will have them to refer to.

My son, during his radiology residency at the University of Arkansas, expressed an interest in becoming a medical school faculty member and was studying what makes a good teacher. He encouraged me to read a book called *Make It Stick: The Science of Successful Learning*.¹ Its premise is that we want our audience to listen to and understand at least 90% of what we’re trying to teach them. The two major methods for accomplishing that are (1) engagement and (2) repetition. If you find it difficult to understand what I am trying to teach you, then I am not doing a good job of engaging you. I learned this lesson many years ago when I was one of many presenters at a very large orthodontic meeting and was admonished publicly

by one of my fellow lecturers that my material is “far too complicated and no one can comprehend it.” He concluded by saying “I predict that you will disappear into the dust bin of orthodontic history.” That night at the lecturer’s reception, I approached him to have a conversation, and of course he was a little on guard. I put him at ease by saying “I am here to thank you.” That was probably not what he expected; however, I believe that there is an element of truth in everything someone says to you, positive or negative. I had thought all day about his remark that my material was too complicated. Given my Alabama background, I think that if I can understand something, it must be very understandable. My conclusion was that the material was not too complicated—I was just not teaching it well. So I spent the entire following year revamping all of

If you don’t see it, you won’t treat it.

my lecture material to try to make it more understandable. This book, I think, is a considerable advance over its predecessor from that perspective.

Perhaps the mantra for this book is “If you don’t see it, you won’t treat it.” In the chapters that follow, I want to teach you to see the face and dentition in a different way, understand what the problems are, put them in perspective with the patient so that you and the patient agree on what the focus of treatment should be, and then choose the most appropriate and effective treatment methods.

1. Brown PC, Roediger HL III, McDaniel MA. *Make it Stick: The Science of Successful Learning*. Cambridge, MA: Belknap Press, 2014.

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