

DIGITAL REMOVABLE DENTURES

A True Metamorphosis

Eric D. Kukucka, DD

Nelson R.F.A. Silva, CDT, DDS, MSc, PhD



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FOREWORD

Complete Dentures in Academia: Dentures Won't Die

At the Seattle World's Fair in 1962, a time capsule was buried to be opened in the year 2000. Citizens filled the capsule with items they believed would be obsolete at the time of opening. Items included a typewriter, a phone book, and a set of complete dentures. Fast forward 26 years, and while complete dentures certainly haven't gone the way of the typewriter, their use has been dwarfed by the rise of dental implants and full-arch therapy for edentulism.

Nonetheless, the need for removable prosthodontics is not going away in the foreseeable future, as the older segment of the US population is increasing and the existing edentulous population will continue to need replacement dentures, not to mention the high price tag of procedures like full-arch implant rehabilitation. Yet curriculum time spent on removable prosthodontics in dental school is decreasing, and new dentists are graduating with a lack of confidence in their removable prosthodontics skills. Currently, many dental schools expect students to graduate with only two to five arches of complete dentures under their belt, leading many graduates to abandon the practice altogether.

Fortunately, recent decades have brought tremendous growth in digital dental technology, and dental schools have developed workflows that incorporate CAD/CAM technologies into many areas. With all these advances, the preclinical complete denture curriculum no longer relies only on outmoded educational technologies like textbook chapters, black-and-white handouts, and Bunsen burners. Current technology allows visualization of many aspects of complete denture fabrication, which can improve education and help students build confidence. As a result, digital dentures are no longer a footnote but an integral part of the complete denture curriculum, and an often-overlooked benefit is the change in students' perception of complete denture therapy. Preservation of records eliminates the stress of one mistake sending them

back to step one, and being able to customize their own workflows allows them to think critically and explore new technologies. Complete dentures are not as overwhelming or intimidating as they used to be—and a surprising number of students actually enjoy the process.

Digital workflows will eventually outpace conventional ones, but today's students need to be practice-ready in both digital and conventional modalities. Ideally, as students graduate, they can capitalize on the benefits of digital dentures while building on their strong denture fundamentals. Considering the patient population, those with complex medical needs and/or low socioeconomic backgrounds are the patients most likely to need removable complete dentures. These same patients are also likely to face the greatest challenge traveling to numerous appointments to receive their prostheses—and sometimes having to travel far to find a provider willing to provide these services. If we as educators can create a generation of general dentists that can confidently provide esthetically successful and functional complete dentures with an expedited, cost-effective workflow, so many more patients will be able to access care. As rapid prototyping and additive manufacturing hardware and materials improve, this can quickly become a reality: a world where everyone has access to a smile.

Whether you are an educator, a clinician, or a student yourself, I encourage you to use this book as a guide on your complete denture journey. Discover the possibilities with digital workflows, and change lives along the way.

Wendy Auclair Clark, DDS, MS

Associate Professor of Prosthodontics
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FOREWORD

I am honored to have been invited to write a foreword to this text on the use of digital technology in the design and fabrication of complete dentures. Over the course of more than 50 years, my professional career has spanned private practice, part-time faculty appointments at three dental schools, and consulting roles with numerous dental manufacturers. This breadth of experience has afforded me a unique perspective on the evolution of prosthodontic education and clinical practice.

What is particularly compelling about this book, and the manner in which its content is presented by Eric Kukucka and Nelson Silva, is both the timeliness of the subject matter and its broad clinical relevance. The material is equally meaningful for dental students at the beginning of their careers and for experienced clinicians and dental technologists seeking to modernize their workflows. The authors succeed in making the principles of complete denture therapy more accessible and easier to teach through digital methodologies, while simultaneously offering practicing clinicians practical tools to simplify treatment, accelerate clinical workflows, and enhance patient acceptance.

Dental students have long faced significant challenges in achieving proficiency in complete denture therapy. Ongoing pressures on dental school curricula, driven by the introduction of new disciplines and the corresponding reduction of time allocated to existing ones, have resulted in diminished clinical exposure to removable prosthodontics. As the authors rightly note, today's graduates often complete their training with fewer hands-on experiences, in part due to the labor-intensive and time-consuming nature of traditional denture fabrication techniques. Digital technologies now offer a meaningful solution to this problem. Processes that once required extensive laboratory time, such as tooth arrangement and denture setup, can be significantly streamlined, making the learning experience more intuitive, efficient, and attainable.

This text is further strengthened by its exceptional photographs and illustrations, which substantially enhance its educational value. Historically, removable prosthodontics has been an area of dentistry that many students found difficult to grasp and challenging to master within limited clinical exposure. Teaching these concepts through a digital lens, as clearly articulated by the authors, fundamentally reshapes the educational experience by improving clarity, efficiency, and predictability. The result is not only a more positive learning environment for students but also improved treatment outcomes for patients.

Importantly, the relevance of this work extends well beyond dental education. Many practicing clinicians and dental technologists were trained before the widespread adoption of digital workflows, and for this audience, the impact of this text cannot be overstated. The techniques and concepts presented offer a practical pathway for integrating digital denture technology into everyday practice, with the potential to improve efficiency, streamline laboratory and clinical processes, and ultimately enhance patient satisfaction.

The authors are to be commended for producing such a valuable and timely educational resource at a pivotal moment in the digital transformation of dentistry. This book serves not only as an instructional guide but also as a bridge between traditional prosthodontic principles and the future of digitally enabled care.

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PREFACE

From Foundation to Transformation: The Living Evolution of Removable Prosthodontics

Where the journey began

As clinicians and educators, we have long believed that few therapeutic interventions in dentistry carry as much emotional, social, and human significance as the rehabilitation of the fully edentulous patient. Behind every complete denture lies a deeply personal story shaped by loss, adaptation, resilience, and the desire to restore not only function but dignity, confidence, and identity. Throughout our careers, we have been guided by the understanding that complete denture therapy is not merely technical treatment but a responsibility that profoundly influences how patients eat, speak, interact, and see themselves.

Removable prosthodontics has always occupied a unique and essential place within dentistry. Long before the rise of implant therapy, digital workflows, and advanced restorative materials, the ability to rehabilitate edentulism represented one of the profession's most fundamental obligations. Complete dentures were never intended to be secondary or provisional solutions. They were medical devices designed to restore oral function, nutrition, facial harmony, and psychosocial well-being. Excellence in removable prosthodontics therefore demands more than just technical skill; it requires empathy, judgment, and a deep understanding of human physiology and behavior.

Yet, despite this foundational importance, removable prosthodontics has not always been treated as such. This was the inspiration behind our book.

Philosophy and purpose

More than two decades ago, Dr Gordon J. Christensen aptly described removable prosthodontics as a forgotten part of dentistry. He cautioned that while patient need remained substantial, the discipline had gradually lost prominence in both education and clinical practice. His message was not one of nostalgia but of responsibility. The need for removable prosthodontic care never disappeared; rather, the profession's engagement with it diminished.

This book exists in direct response to that reality.

We believe that to move forward responsibly, one must first understand where the discipline came from. The principles that govern complete denture therapy—support, stability, retention, occlusion, phonetics, esthetics, and biologic harmony—are not modern inventions. They are the result of decades of disciplined thought, careful observation, and clinical refinement contributed by the forefathers of removable prosthodontics.

Pioneers such as Gysi, Carlsson, Boucher, Bonwill, Vig, Gerber, Pound, Strack, Payne, Halperin, Brewer, Zarb, Abe, Graser, and Rogoff shaped removable prosthodontics into a structured and principled discipline. Their work defined occlusal philosophies, jaw relation concepts, tooth arrangement strategies,

border extension principles, and the biologic understanding of denture-bearing tissues that continue to guide clinical decision-making today.

These individuals never regarded removable prosthodontics as inferior or expendable care. They understood that treating the edentulous patient demanded precision, accountability, and compassion. They recognized that a denture's success could not be measured solely by technical execution but had to account for its effect on nutrition, speech, self-esteem, and social participation. Their teachings established removable prosthodontics as both a science and an art.

This book stands firmly on their shoulders.

From concept to collaboration

The transformation from analog to digital removable prosthodontics does not diminish these foundational contributions. On the contrary, it amplifies them. When applied thoughtfully, digital technologies allow us to preserve prosthodontic principles with greater consistency, improve their teachability, and reduce the variability that has historically challenged denture therapy. Digital workflows do not *replace* biologic understanding or clinical judgment; they demand it.

Importantly, the evolution of removable prosthodontics cannot be separated from the evolution of implant therapy. Throughout this book, principles of implant removable and implant fixed rehabilitation are intentionally woven into the discussion—not as competing treatment modalities but as complementary

expressions of the same foundational prosthodontic philosophy. We firmly believe that removable prosthodontics remains integral to successful implant rehabilitation. The diagnosis, planning, occlusal concepts, esthetic evaluation, and functional principles that underpin implant-supported treatment are rooted in removable prosthodontic thinking. Without this foundation, implant therapy risks becoming technically driven rather than biologically and functionally sound.

The origins of this project reflect that philosophy. We first met in 2015 at a digital denture meeting in Arizona, at a time when digital workflows for complete dentures were still in their infancy. What began as a professional introduction quickly evolved into a shared vision for the future of removable prosthodontics—one grounded in tradition yet oriented toward innovation. That vision was further shaped by the encouragement of a dear friend and mentor, Dr Saj Jivraj, who urged us to document and share what we were learning.

A pause that strengthened the vision

Our first dedicated working session for this book took place shortly before the global COVID pandemic, when Nelson traveled to Windsor, Canada, to meet at The Denture Center. Standing in the boardroom and sketching chapter concepts on a whiteboard, we laid the conceptual foundation for what would become this volume. The pandemic that followed delayed the project, but it also provided an unexpected opportunity for reflection and refinement.

During that period, digital dentistry accelerated dramatically, particularly in 3D printing. Recognizing the significance of these advancements, we made the deliberate decision to pause and allow the technology and clinical protocols to mature. This decision ensured that what we ultimately presented would be comprehensive, relevant, and responsible.

Following the end of global lockdowns, Nelson traveled multiple times to Windsor, Canada, and Chicago, Illinois, continuing our collaboration through 2025 as the book approached completion. These working sessions allowed us to refine workflows, validate clinical protocols, and integrate emerging technologies while remaining firmly anchored in prosthodontic fundamentals. What emerged was not a manual of techniques but a framework for understanding digital complete dentures as an evolution of conventional therapy rather than a replacement for it.

A collective effort

This book is the result of a truly collective effort. We are grateful for the support of industry partners whose commitment to innovation and education continues to shape the modern digital dental landscape. Ivoclar, SprintRay, 3Shape, GC, and Dentsply contributed not only technology but a shared belief in elevating removable prosthodontics through collaboration and education.

Equally important are the clinicians, dental technicians, educators, and researchers from around the world whose contributions make this work possible. Their insights ensure that the

content remains grounded in real-world practice while honoring the principles that have guided removable prosthodontics for generations. Together, these contributions reinforce the idea that progress is most meaningful when it respects the lessons of the past.

Looking forward

At its core, this book is not about technology. It is about responsibility.

As populations age and disparities in access to care persist, the relevance of removable prosthodontics will only increase. Millions of patients will continue to depend on complete dentures and implant-assisted prostheses as their primary means of oral rehabilitation. The question is no longer whether removable prosthodontics matters but whether the profession is prepared to meet that need with the rigor, pride, and commitment that once defined the discipline.

By integrating timeless prosthodontic principles with contemporary digital workflows, and by weaving implant removable and fixed concepts into a unified prosthodontic philosophy, we seek to restore removable prosthodontics to its rightful place at the forefront of patient care. This book honors its foundations, embraces innovation, and affirms that true progress is measured not by the tools we adopt but by how faithfully we apply enduring principles in service of our patients.

This is the living evolution of removable prosthodontics.

ACKNOWLEDGMENTS

From Eric D. Kukucka

This book represents far more than a professional milestone; it is the culmination of years of dedication, persistence, and the unwavering support of those who stood beside me throughout this journey.

To my father, thank you for instilling in me the principle that you are only as good as your next denture, your next accomplishment. That mindset shaped my work ethic and continues to drive me forward.

To my mother, thank you for always being there—a constant source of support, guidance, and perspective when it mattered most.

To Mrs Nina James, whose nearly decade-long support as my executive assistant played an instrumental role in both my personal and professional growth from private practice to Aspen Dental, your contributions have been invaluable.

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I would like to extend my sincere gratitude to all contributors to this book. Your expertise, collaboration, and shared commitment to advancing our profession have made this volume what it truly is. It is a privilege to stand alongside such a respected group of clinicians and thought leaders.

To Quintessence Publishing, I am deeply appreciative of the opportunity to bring this work to life. Your commitment to excellence and to advancing dental education globally has made this project both possible and meaningful.

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To my dearest friends Rocco, Giovanni, Paul, Dan, Carl, Giuseppe, and Talin, thank you for your friendship, support, and for being a constant presence throughout the many stages of this journey. I would also like to honor the memory of the late Fred Quinneville, whose impact and friendship will not be forgotten.

To my extended family and loved ones, thank you for your encouragement, understanding, and belief in me along the way.

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ACKNOWLEDGMENTS

From Nelson R.F.A. Silva

This book is in many ways the result of a long journey—one measured not only in pages written but in miles traveled, moments missed, and sacrifices quietly made by those I love most. Over the past 5 years, I have been away more often than I would have liked, chasing ideas, refining concepts, and building something I believed in deeply. None of this would have been possible without the unwavering support of my family.

To my wife, Renata Dias, your patience, understanding, and constant encouragement carried me through the most demanding moments. You were my anchor when the pace became overwhelming and my inspiration when doubts arose. To my daughter, Laura Franca, thank you for your love and for reminding me, even from afar, what truly matters.

To my parents, Jairo Romulo da Silva and Angela Maria Campelo Franca, I owe you everything. Your values, resilience, and belief in hard work laid the foundation upon which this project stands. To my brothers—Jairo, Angelo, Luiz Henrique, and Joao Carlos—thank you for your constant support and for always being there, no matter the distance.

I would also like to express my sincere gratitude to the Universidade Federal de Minas Gerais, Brazil, where I have the privilege of holding a faculty position. The institutional support I

received during this journey was invaluable. To my colleagues, who so generously stepped in to cover clinics during my absences, I offer my deepest thanks. Your professionalism, camaraderie, and willingness to support me ensured that both my responsibilities and this project could move forward.

I am also deeply grateful to all the contributors to this book. Each of you brought not only your expertise but also your time, dedication, and passion to this project. Your willingness to share knowledge, collaborate openly, and strive for excellence enriched every chapter and elevated this work far beyond what any one of us could have achieved alone. This book stands as a testament to your commitment and generosity.

This journey also would not have taken shape without the pivotal role of Mr Mike Girard, who brought me into close contact with my coauthor, Eric Kukucka. What began as an introduction grew into a powerful collaboration and, more importantly, a lasting friendship. Together, we transformed ideas into something meaningful.

Last but not least, I would like to thank Quintessence and its global team. Their professionalism and patience allowed this project to move forward, and I hope that more projects bring us together in the future.

This book is not mine alone. It belongs to everyone who stood behind me, believed in me, and made the journey worthwhile.

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THE MIND AND THE MOUTH: The Psychosocial Impact of Edentulism

Imagine you will lose your teeth tomorrow. Don't imagine an edentulous patient of yours, a hypothetical case study in a textbook, or even your parent or grandparent. You, personally, will lose your teeth. Seriously, try to imagine that.

How would you expect to feel? In what ways would your life change? And ultimately, what would you do about it?

In this chapter, we investigate several of the psychologic and social impacts of edentulism. In doing so, we explore the potential for digital complete dentures and learn to understand them as a critical intervention in the context of global health care.

The Dentist's Mindset

In dentistry, as in any field, it is easy for a well-meaning clinician to become lost in well-worn workflows, predetermined best practices, and academic abstractions. However, the highest standard of competence demands an empathetic, respectful, and personal approach to patient care—one that acknowledges that it is impossible

to divorce the patient (or “case”) from the psychosocial reality in which that person lives their day-to-day life.

We’re all familiar with the golden rule: Do unto others as you would have them do unto you OR treat others as you would like to be treated. Many health care professionals use this rule as a framework for advising patients who need to select one of multiple treatment options. Perhaps they ought not to.

Sreenivas Koka is a multihyphenate dentist, academic, and businessperson who specializes in prosthodontics. He has served as President of the Academy of Prosthodontics and as a high-ranking professor at institutions like the Mayo Clinic and the University of California, Los Angeles (UCLA). According to Koka, the golden rule fails insofar as it encourages clinicians to prioritize their own subjective wants and needs. Effectively, when we advise patients according to this framework, we are telling them, “I want you to choose treatment option A because the advantages of that choice are important to *me*.” But what if the patient has different priorities, wants, and needs? What if the advantages perceived by the clinician are not important to the patient?

Instead, Koka advocates implementing the “platinum rule,” a principle he borrows from the business guru Dr Tony Alessandra. According to the platinum rule, we should forget about what we want when determining how to interact with other people. Instead, we should treat others the way they want to be treated.

This mindset, we believe, is particularly important in dentistry because the relationships people have with their smiles are so psychologically complex. At his 2018 TEDxBocaRaton talk,¹ Koka noted that “a life without teeth is a life of limitations” that results in serious mental and physical scars. In this chapter, we introduce some of the psychologic effects edentulism has on mental health and social functionality and acknowledge that various psychologic and social determinants of health are often what lead to patients becoming edentulous in the first place.

The Psychologic Damage of Edentulism

Edentulous people suffer psychologically and socially both in ways that are obvious and in ways that are easy to miss. A growing body of peer-reviewed literature associates edentulism with psychologic and social conditions beyond the well-understood effects on physical health. Edentulous patients tend to retreat from typical social patterns and struggle with confidence and self-esteem. Many of the most acutely observable psychologic and social impacts of edentulism revolve around food and dining, which is almost always a key component of social life. Moreover, increasing evidence suggests that the simple act of smiling has powerful psychosocial implications, which leads us to conclude that edentulous patients face significant disadvantages. Fortunately, many successful oral health care interventions exist, and patient-centric, empathetic models of care for edentulous patients show promise for treating psychologically distressed and socially isolated populations.

The literature in every denture practice will do its best to persuade you that terminal dentition has profound psychosocial effects—and rightfully so. Living a life partially or wholly edentulous and either without dentures or with a prosthesis that fits and/or functions poorly almost always hurts a person’s romantic, professional, and social prospects. Edentulous patients experience a wide range of functional limitations and impairments, including physical, psychologic, and social disabilities that can severely affect quality of life.²

A 2019 study out of Thailand³ assessed the impact of denture retention and stability on various indicators of perceived general health, happiness, and quality of life. The study followed 130 completely edentulous participants who had been fitted with maxillary and mandibular complete dentures over a 7-year period. Among complete denture wearers, the researchers determined a strong association between happiness and “perceived general health,” with a much milder association between happiness and

oral health. However, we can reasonably assume that good oral health is a meaningful determinant of perceived general health. Essentially, when our mouths are functional and free of discomfort, we feel healthier overall. The study concludes that for people who wear dentures, achieving and maintaining the highest possible levels of denture retention and stability translates indirectly to a higher baseline level of happiness and well-being.

Effects of Edentulism on Oral Function

“Doctor, I need to improve my day-to-day diet, but I have no teeth!”

It is difficult to paint a complete picture of human happiness without addressing food. It seems obvious that humans need teeth to eat food and ingest the energy and nutrients we need to survive and live healthily, but this is less true than you might think. Ultimately, denture care is elective; patients have the option of simply not accessing it at all. Thanks to modern food science and the globalized grocery supply chain, it is relatively easy for most people to get all the nutrients they need from liquids, slurries, and pastes. But what kind of life is that? According to Koka, the more accurate assessment of the situation is that we need teeth to *enjoy* food and the social aspect of dining.

Very few people subsist on liquid diets, no matter the condition of their dentition. In practice, edentulous patients typically consume suboptimal amounts of fruits and vegetables and have lower dietary fiber intake than control groups with healthy dentitions. Edentulous populations also ingest great quantities of cholesterol and saturated fats, leading to a higher prevalence of obesity and increased risks for various cardiovascular diseases and gastrointestinal disorders.⁴

Moreover, eating without teeth can be dangerous. Many oral health professionals have heard stories of patients who own

dentures but do not necessarily wear them. Pieces of solid food that are not sufficiently macerated can become stuck in either the esophagus or trachea during swallowing. The latter case, in which the food mass blocks the windpipe, can be life-threatening. A blockage in the esophagus is known as a *food bolus*. This experience is rarely fatal, but it does produce significant discomfort, often including symptoms resembling those of a myocardial infarction. In extreme cases, patients risk perforating the esophagus and may need an endoscopic intervention to resolve the problem. According to Mayo Clinic gastroenterologist and hepatologist Dr Mark Larson, denture wearers who remove their prostheses to eat experience a greater risk of food-related blockages in the throat.⁵

Setting aside this material danger, comfortable, well-fitting, and durable oral prostheses enhance the eating experience in other ways. Although there is a large body of research on the impact of denture use on food in terms of nutrient intake (that is, the mechanical and biologic processes of eating), there has been comparatively little study on the effects of edentulism and prosthetic rehabilitation on *experiential* considerations related to food and eating. A study published in *JDR Clinical and Translational Research*⁶ suggests that replacing old complete dentures has positive social and emotional effects when it comes to eating (Fig 1-1).

The study’s authors measured a proprietary metric called “eating-related quality of life” (ERQoL) using a self-administered questionnaire called Emotional and Social Issues Related to Eating (ESIRE). The ESIRE was filled out by 55 individuals both before and after complete denture treatment, and the results strongly suggested that denture replacement can meaningfully boost ERQoL. Prior to treatment, most of the participants reported limited enjoyment of eating, especially in public settings. They reported complaints including fit issues, denture base instability, and even a diminished ability to taste food on account of not being able to chew it satisfactorily.



Fig 1-1 Replacing old, worn dentures can have a positive impact on the emotions and social lives of patients.



Many edentulous people, including conventional denture wearers, exhibit self-consciousness and low confidence around mealtimes. They may restrict their dining options or avoid some of their favorite foods for fear of being unable to chew comfortably and/or successfully. Embarrassment may cause them to avoid communal dining experiences or dining outside the home altogether.

It is also important to consider the many small, “micro-inconveniences” related to food that edentulous people endure. Preparing easy-to-eat meals may involve performing additional steps (for example fine-dicing, pureeing, or braising) that add time and effort. Denture wearers also experience frequent interruptions to mealtimes when unexpected adjustments, cleaning, or maintenance are required. These interruptions can be deeply embarrassing, but they can also simply be annoying and chip away at the denture wearer’s mental health gradually.

The Smile Factor in Human Health

When we imagine mentally healthy people, we typically picture smiling faces. In fact, smiling affects your brain, your body, and the people around you in measurable ways. According to a peer-reviewed study in *Psychology Today*,⁷ when a person smiles, the physical act of doing so sends complex neural messages that encourage well-being. Specifically, this sophisticated physiologic process releases neuropeptides, which are microscopic molecules that facilitate communication between neurons and effectively activate the body’s internal communications system. Neurotransmitters like dopamine, endorphins, and serotonin, all of which are related to smiling, lower stress and contribute to feelings of relaxation. Endorphins, particularly, can lower heart rate and blood pressure and relieve pain. A smile-associated serotonin uptick has a natural antidepressant effect.

One does not need to read a textbook to understand that most people are attracted to smiling faces, but we’ll stress this point anyway. A study published in *Neuropsychologia*⁸ used event-related magnetic resonance imaging (fMRI) to study brain activity in subjects observing human faces exhibiting various expressions. Its authors found that smiling facial expressions activated the medial orbitofrontal cortex, a region of the brain that is involved in processing stimulus-reward value. Basically, when you observe a person smiling, your brain naturally produces the sensation of being rewarded.

“A smile is contagious” may seem like a trite axiom, but a growing body of evidence confirms what many have long suspected: Regular exposure to smiling faces stimulates the brain in ways that improve mood and even correlate with positive long-term health



Fig 1-2 The ability to smile with confidence directly impacts a patient's self-esteem and mental health. Imagine the psychologic implications of being edentulous and then receiving a set of complete dentures that restores not only oral function but also emotional well-being and social confidence. What a privilege to change patients' lives in this way!

outcomes like a reduction in mortality. The cingulate cortex is an “unconscious automatic response area” of the brain that causes a person to smile involuntarily when happy or when mimicking the expression of an observed smile. Viewed through this lens, smiling is a collaborative, social act with mutual health and well-being benefits for all participants.

We should probably all smile more than we do. Research suggests that the average person smiles less frequently as they age. A typical child smiles approximately 400 times per day, but an average mentally content adult smiles just over one tenth as frequently. Even worse, a typical adult smiles only 20 times per day.

We know of several other health and wellness benefits associated with smiling. For example, the physiologic process of smiling releases cortisol and endorphins, which can reduce blood pressure, increase endurance, reduce pain and stress,

and strengthen the immune system. According to Dr Earlexia Norwood, an award-winning family physician who works in Southeast Michigan, studies have even associated smiling with increased workplace productivity and financial success.⁹

Moreover, smiling really does make us look and feel younger. A 2016 University of Missouri-Kansas City study published in *PLOS One*¹⁰ attempted to measure the effect of “emotional expression” on perceived age. Anecdotally, most people with healthy dentition “seem” to look younger when they smile. But what does this really mean? As the study’s authors explain, perceived age is no trivial matter. It is an important psychosocial factor and a meaningful determinant of social interaction. We choose the people with whom we engage socially in large part based on how old they are or appear to be. When we don’t have the critical information (a person’s actual age) we estimate as best we can, starting with the face. When we tell someone that



they look young, perhaps significantly younger than they actually are, we normally expect a warm response. Western social values privilege youthfulness, so there is real social currency in appearing relatively young for as long as possible.

In the study, participants in their late teens and early twenties were more likely to categorize subjects as “old” when they displayed sad or neutral facial expressions. In theory, smiling should be an age-irrelevant expression; we have the ability to smile in early infancy, and we typically do not lose that ability as we age. However, as one might expect, smiling faces were more likely to be interpreted as “young.” These findings are doubly significant when we consider the ways society is biased toward youthfulness, particularly in the world of work. People perceived to be younger may be more likely to compete successfully for jobs or promotions, for example. They also may have more positive customer service experiences in many settings.

Intriguingly, an increasing body of evidence suggests that the physiologic process of smiling can trick a person’s body into positivity. Research from the University of South Australia suggests that the facial muscle activity involved in smiling has a direct relationship with the generation of positive emotions. The study examined participants in whom a smile had been involuntarily induced (essentially, participants were instructed to hold a pen in their teeth in a way that forced them to exercise the same facial muscular process involved in smiling).¹¹ According to the researchers, this “covert” smiling stimulated the amygdala, which we might call the brain’s “emotional center,” to release neurotransmitters associated with emotional positivity. Effectively, the study suggests that the way we emotionally process stimuli in the outside world changes positively when we are smiling. Imagine the implications for people who cannot, or will not, smile (Fig 1-2).

Clearly, we can agree that adequate dentition is important for well-being and quality of life. Despite advances in preventive dentistry, edentulism—a morbid chronic condition—is still a major problem for global public health. Edentulous people who struggle to eat and smile normally experience meaningful psychologic trauma and social isolation; they live less healthy and successful lives than they otherwise might.

The Missing Pieces of the Global Health Puzzle

Unfortunately, despite very welcome advances in oral health care in recent decades, edentulism remains a serious problem. A recent study from the University of British Columbia on 4,247 patients¹² notes that health outcomes for edentulous patients have not kept up with the pace of significant achievements in global oral health generally. As such, edentulism remains a major and irreversible problem that contributes to poor quality of life in large populations. This poor quality of life manifests itself functionally, esthetically, phonetically, and psychologically. According to Dr David French et al,¹² adequate therapy options for edentulous patients, which provide for a viable decision-making process, ought to include legible information about long-term outcomes.

Many people struggle to accept and adapt to tooth loss, but evidence suggests that edentulous patients are willing to work with oral health professionals to improve their outcomes. A 2021 article published in the *British Dental Journal*¹³ observes that many participants reported decreased self-confidence, the avoidance of close relationships, and several symptoms associated with general anxiety following partial tooth loss. Significantly, these patients often admitted to restrictions in dietary choices and limited social activities in which they felt comfortable participating. Importantly, the study suggests that patients who wear removable partial dentures generally want greater access to information about maintaining and caring for their devices. Generally, patients have a strong desire to adhere to instruction from their dentists.

So how do we determine optimal treatment plans in this fraught psychosocial landscape? Although clinicians now have access to more treatment options for edentulous patients than at any point in history, counterintuitively, treatment options can be more difficult to navigate. With so many possibilities, how does one choose or propose the best solution for an individual case?

A good place to start is with a term coined by Koka: “value-based dentistry.” Value-based dentistry is a deliberate double entendre that pulls in both ethical and quality-per-cost considerations. First, Koka pushes back against the conventional wisdom

that *quality* is a nebulous term with no meaningful definition. Several dimensions of quality, including patient outcomes and service experience, can be assessed through something like an objective lens, which then allows for evidence-based quality control metrics. We return to these topics throughout this book.

Next, virtually everyone involved in dentistry has some understanding of financial cost, but comparatively few clinicians adequately consider what Koka refers to as the *biologic cost*. Even in a situation where oral health care is available to the user at no financial cost, some patients avoid treatment due to a profound fear of surgery. Removal of the remaining terminal dentition can be a harrowing prospect. Very few people look forward to any type of surgery, and many have a difficult time stomaching the thought of blood, stitches, anesthesia, and everything else that comes with tooth extraction.

Along similar lines, even the most efficient oral health interventions take time, and so committing to treatment creates scheduling stressors for patients. While most patients can find a way to take leave from work, arrange for childcare, and/or do whatever else needs to be done to attend their appointments, these changes to patients' regular routines are not frictionless. They require a real investment of energy, and they can have cascading consequences, even if they are individually relatively minor.

Because of what we know about the psychologic and social impacts of edentulism—that losing one's teeth has severe implications for eating, smiling, and enjoying a healthy social life—we must stress that effective dentistry begins with empathy. This textbook introduces and elucidates comprehensive workflows to help you build hard, hands-on skills, but we do not want you to start your digital denture journey by suggesting that edentulous patient care is a technical protocol that can be solved with a cold and purely analytical mind.

Creating functional, comfortable dentures requires careful custom planning and consideration of clinical, anatomical, technical, and psychosocial factors. By the end of this volume, we will have considered all the relevant aspects, which is good because there is lots of work ahead. According to the United Nations Population Fund, the global population aged 60 years or older will have swelled by nearly 250% from 2012 to 2050.¹⁴ Assuming one in five adults continues to rely on dentures,¹⁵ we will all be very busy in the years to come!

The Take-Home Message

Are you still imagining yourself with a mouth of missing teeth? You've had a lot of time to think about it, haven't you?

Effective, empathetic dental professionals must have a deep understanding of the topics discussed in this chapter. To address the deleterious psychosocial effects of edentulism, dental professionals must move away from a limited mindset. To keep pace with broader advances in global human health, we need to practice dentistry in a way that acknowledges the relationship between dentition and diet and appreciates the role of the "smile factor" in overall well-being.

Unfortunately, many dental professionals relegate complete dentures to second-choice status. This mindset must evolve. We see things differently—as do our contributing colleagues. The ongoing industrywide shift to digital treatment modalities has opened up revolutionary possibilities for overall human health and well-being such that complete dentures are the only truly viable oral prosthesis for many people.

The rest of this book is intended to help shift perspectives regarding the power of digital complete dentures. We believe the ways in which this exciting new technology can change edentulous people's lives both physically and psychologically are remarkable.

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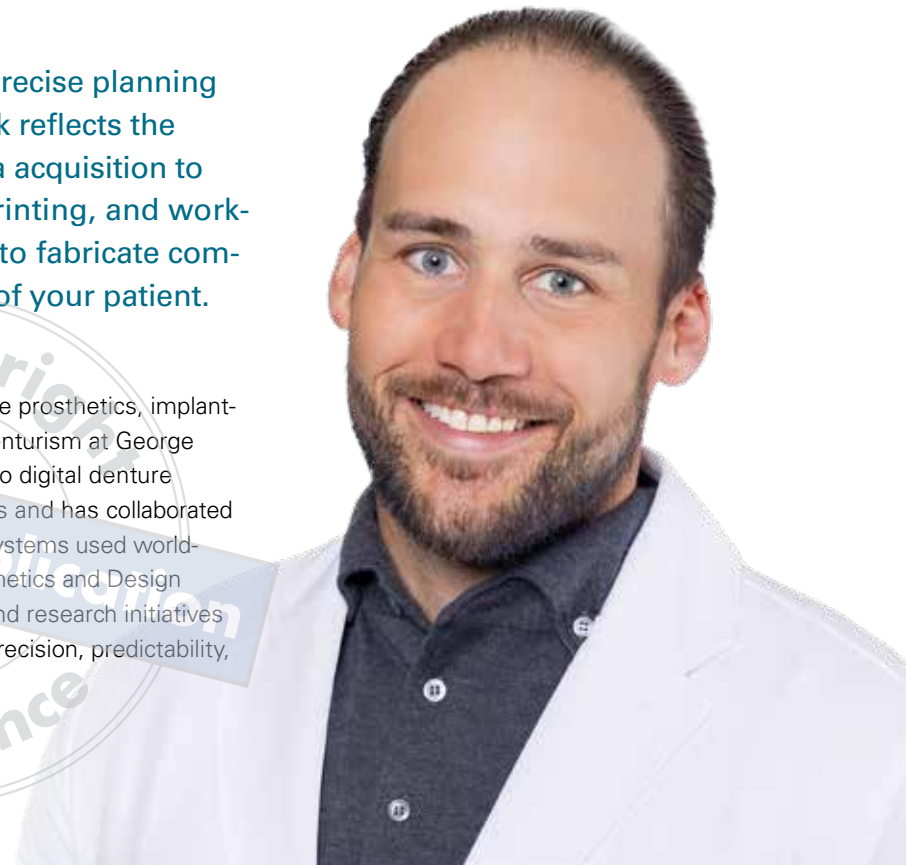
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The digital revolution in dentistry has opened doors for precise planning and execution of digital denture fabrication, and this book reflects the true power of digital complete dentures. From digital data acquisition to preprosthetic considerations, denture materials and 3D printing, and workflows galore, this book details the protocols you'll need to fabricate complete dentures that fit, function, and truly change the life of your patient.

► **Eric D. Kukucka, DD**, is an internationally recognized authority in removable prosthetics, implant-supported full-arch rehabilitation, and digital denture innovation. Trained in denturism at George Brown College in Toronto, Canada, he is widely known for his contributions to digital denture design, intraoral scanning strategies, and modern manufacturing workflows and has collaborated with leading global dental technology companies to help shape many of the systems used worldwide today. He currently serves as Vice President of Clinical Removable Prosthetics and Design Technologies at Aspen Dental, where he leads clinical strategy, education, and research initiatives supporting removable and full-arch care at scale, with a focus on advancing precision, predictability, and patient outcomes through technology and evidence-based standards.



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