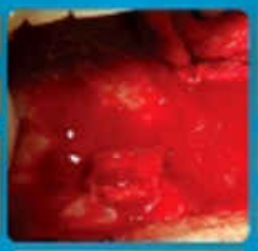
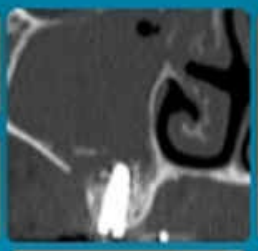
Misch's AVOIDING COMPLICATIONS IN Oral Implantology

RANDOLPH R. RESNIK
CARL E. MISCH

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RANDOLPH R. RESNIK, DMD, MDS

Clinical Professor
Department of Periodontology and Oral Implantology
Kornberg School of Dentistry-Temple University
Philadelphia, Pennsylvania
Adjunct Professor
University of Pittsburgh School of Dental Medicine
Graduate Prosthodontics
Pittsburgh, Pennsylvania
Surgical Director/Chief of Staff
Misch International Implant Institute
Beverly Hills, Michigan

CARL E. MISCH, DDS, MDS, PhD (HC)

Clinical Professor and Past Director
Oral Implant Dentistry
Temple University
Kornberg School of Dentistry
Department of Periodontics and Implant Dentistry
Philadelphia, Pennsylvania
Adjunct Professor
University of Alabama at Birmingham
School of Engineering
Birmingham, Alabama
Founder
Misch International Implant Institute
Beverly Hills, Michigan

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St. Louis, Missouri 63043

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Contributors

Steven Caldwell DDS
Private Practice – Periodontist
El Paso, Texas

Gregory Caldwell DDS, MS
Private Practice – Periodontist
El Paso, Texas

Joseph E. Cillo Jr., DMD, MPH, PhD
Associate Professor of Surgery and Residency Program Director
Drexel University College of Medicine
Division of Oral & Maxillofacial Surgery
Allegheny General Hospital
Pittsburgh, Pennsylvania

Francis R. DeLuca DMD, JD
Practicing Malpractice Attorney
Hollywood, Florida

Jarrett B. Foust DDS
Private Practice – General/Implant Dentistry
Pittsburgh, Pennsylvania

Glenn J. Jividen DDS
Private Practice – Periodontist
Dayton, Ohio

H. Ray Hazen DDS, MSD
Private Practice – Prosthodontist
Rochester, Indiana

Allen Liu DMD, MS
Private Practice – Periodontist
Seattle, Washington

John W. Preece DDS, MS
Professor Emeritus
Division of Oral and Maxillofacial Radiology
The University of Texas Health Science Center at San Antonio
San Antonio, Texas

Christopher R. Resnik DMD
University of Pittsburgh School of Dental Medicine
Graduate Prosthodontics
Pittsburgh, Pennsylvania

Robert J. Resnik MD, MBA
Internal Medicine
Cary Adult Medicine
Cary, North Carolina

Jon B. Suzuki DDS, PhD, MBA
Professor of Microbiology and Immunology (School of Medicine)
Professor of Periodontology and Oral Implantology (School of Dentistry)
Chairman and Program Director, Graduate Periodontology and Oral Implantology
Associate Dean for Graduate Education
Temple University
Philadelphia, Pennsylvania
Chairman, Dental Products Panel
Food and Drug Administration
Silver Spring, Maryland

Foreword

Oral Implantology has developed and progressed into a central core of the art and science of dentistry. This field, over the course of its existence, has transformed from a modality on the fringes of the profession to being embraced by virtually every component and aspect of our discipline. However, as with any clinical dental or medical discipline, patient outcomes continue to drive improvement of diagnoses, techniques and therapies. Improved management of patient clinical variations to treatment and unexpected results fortunately are a product of adverse experiences. Simply put, the tough cases and negative clinical situations are the best teachers, and we are wise to grow as clinicians from them.

This textbook specifically addresses implant complications for doctors on any point of their clinical learning curve, from novices to veteran clinicians with decades of experience. As our profession continues to grow and share data on clinical experiences, new complications continue to arise, giving us all a chance to benefit in knowledge from said complication. Presently, our profession is producing many excellent meetings and publishing textbooks related to new concepts in the field of Oral Implantology. However, very little has been dedicated to complications in the literature and from the podium. This is understandable, as it is not particularly enjoyable to discuss the negative consequences that occur during treatment, sometimes even despite our best efforts. This book will provide the profession with a well-needed, comprehensive textbook on a subject that is most likely to increase in frequency in the future because of the ever-growing popularity of dental implants.

The editors of this text, Professors Randolph R. Resnik and Carl E. Misch, collectively bring over a half-century of clinical education and experience to these chapters. Not only have they spent decades as top educators in this field, they have also spent countless hours mentoring implant clinicians across the world, reviewing cases and helping to provide counsel for the management of complications that occur along the way. Those experiences are what shape the content of this text. The information is presented in a logical sequence of clinical decision making, yet clearly is literature based on science and peer-reviewed research. The subject matter is very diverse and

comprehensively encompasses all facets of implant dentistry; diagnosis and treatment planning, surgical intervention, prosthetic rehabilitation, and the post-operative and maintenance phases of this discipline. The implant complications case reports contained in these chapters are well-documented and well-illustrated to serve as an outstanding guide for patient care.

Professors Resnik and Misch have assembled a wealth of talent in the field of Oral Implantology which provides a unique blend of clinical, academic, research, and medico-legal experience. These contributors have spent their careers on the front lines of this field, encountering many of the situations that are discussed, either directly or indirectly. Their goal is to reduce the clinical evidence of avoidable and unavoidable complication episodes that an implant clinician may encounter in their practice.

The authors took a great deal of care to make this text extremely comprehensive in scope, and it shows in the delivery of the content. Through a unique technique of discussing the etiology, prevention, and management of each complication, the reader is guided by the authors to a better understanding of the fundamentals of treatment, making them able to obtain a strong foundation for the understanding and treatment of these adverse events.

On a personal note, I have had a long relationship with Professors Resnik and Misch, both professionally and personally. I value the clinical and research mentorship provided to me by them over the past quarter of a century, and feel fortunate to call these men professional colleagues and friends. We who call ourselves practitioners of Oral Implantology have all been in some way touched by their contributions to the field at large.

Jon B. Suzuki DDS, PhD, MBA

Preface

Dental implants have become an accepted therapeutic approach to rehabilitate patients with edentulous sites. Vast amounts of time and resources have been dedicated to research and development within the discipline, and as a consequence, very high survival rates are reported throughout the literature with a wide range of implant types and systems. Despite all of these advances in oral implantology, treatment associated with dental implants is not free of complications. There is a learning curve necessary to build clinical competency from both surgical and prosthetic aspects of treatment, and situations occur that lead to less than ideal outcomes. Even with a high degree of experience, complications can and will arise. These complications can occur intra-operatively, post-operatively, or many years after success. Therefore, it is inevitable that the implant clinician today will be confronted with some sort of complication during the implant treatment process.

The genesis of this complications book comes from over 25 years of teaching at the Misch International Implant Institute. Private practice in oral implantology and teaching hands-on surgery to doctors taught me that if you do enough procedures, whether surgical or prosthetic, complications will arise. What sparked my interest was the understanding that even if a clinician is as careful as possible, problems associated with the treatment do occur. Additionally, because more dental implants are being placed and restored today, this obviously will lead to more complications. Unfortunately, very little exposure is given to the diagnosis, etiology, prevention, and management of these complications. Even the most benign procedures may lead to significant long-lasting devastating complications to the patient.

The lecture podium is an area where more often than not, successes are discussed. New procedures and protocols are introduced, and examples are given that outline the utility of the presenter's findings. As an educator that deals with the reality of complications with students and practicing clinicians that I mentor, I found that a large opportunity existed to aid in the deeper understanding of clinical practice by discussing how and why things go wrong during implant treatment. The popularity of the Complications seminar over the years and the feedback we received helped solidify the

conviction that I held – facing the sometimes harsh reality of what errors may occur and focusing on how to prevent them. This ultimately helps instill a greater sense of confidence going forward in the pursuit of excellent clinical care.

Because of the popularity of dental implants and the ever-changing technological atmosphere, the profession is in need of a literature based, comprehensive summary of possible complications. Technology is a vital component of the dental implant industry. Because technological advances in implant dentistry are changing at an alarming rate, procedures are often recommended without guidelines for evaluation. In the past, our philosophy would entail no recommendation on a product or technique without at least five years of data and experience. However, today, dental advertising and manufacturers often give the industry misleading and inaccurate information that may be detrimental and lead to complications.

Misch's Avoiding Complications in Oral Implantology is designed to be a comprehensive guide to the diagnosis, etiology, and management of a wide range of treatment planning, surgical, prosthetic, and maintenance complications. The underlying theme of this book is the idea that the best way to treat complications is to "prevent" them from occurring. Therefore, this book includes factual information that is literature based which allows the implant clinician to have a thorough understanding of basic principles and a strong foundation for the recognition of complications.

The five parts of this book discuss diagnosis and treatment planning, surgical, prosthetic, periodontal and maintenance, and mediolegal aspects of dental implants;

- **Part 1:** The diagnosis and treatment planning chapters include an understanding of various types of complications, radiographic imaging complications associated with the implant patient, factors associated with proper treatment planning, and the medical evaluation of the dental implant patient.
- **Part 2:** Surgical complications are discussed, which include the ideal positioning of implants in all planes along with the treatment of malpositioned implants. Additional chapters include bone grafting complications, the treatment and prevention of bleeding issues, the prevention of nerve injuries along with ideal management, incision line opening, intra-operative complications, and post-operative problems.

- **Part 3:** The Prosthodontic complications chapters include a detailed summary of fixed and removable complications. This encompasses all aspects of treatment planning, procedural, and post-prosthetic complications. An entire chapter is dedicated to dental implant occlusion, specific for various types of prostheses along with biomechanical factors.
- **Part 4:** The periodontal and maintenance chapter includes a detailed evaluation to the scientific basis of periodontal related complications. The etiology, management, and prevention of these complications is discussed.
- **Part 5:** The last chapter is dedicated to the possible medical-legal aspects of implant dentistry. The entire legal process from pre-suit to a trial is reviewed with unprecedented recommendations on the most common asked questions concerning the legal process.

In summary, ***Misch's Avoiding Complications in Oral Implantology*** is comprised of the most comprehensive, in-depth summaries of possible complications the implant clinician may encounter. This book is not meant to scare the implant clinician, but to educate them on what may possibly occur. My experience over the years has led me to understand that clinicians actually feel more confident about procedures when they are aware of the most significant pitfalls that may arise. The reader will build a strong foundation of knowledge to manage the complication with a fact-based protocol to decrease morbidity of the situation. Ideally, the implant clinician will obtain an understanding that the information in this textbook is meant to elevate the science and discipline of implant dentistry, as its focus is not specifically on how to perform a procedure, but how to overcome negative outcomes. As an added benefit, the text reviews a great deal of the fundamentals of implant surgery and prosthetic care, which only adds to a clinician's understanding.

My hope is that this book encourages clinicians to be conscious of potential complications, whether benign or life threatening, so they lead to better overall treatment outcomes for patients.

Randolph R. Resnik DMD, MDS

Acknowledgments

I would like to express my sincere gratitude to the many people that have supported me in the writing of this book. First, I would never have had the insight, ambition, and aspiration to write this book if not for the two mentors in my life, my late father, Dr. Rudolph Resnik and Dr. Carl Misch.

My father was the perfect father, role model, educator, clinician, and a true pioneer in the field of fixed prosthetics. He was my hero and my best friend, and the number one reason I am where I am today. His endless support and encouragement gave me the strength and motivation to succeed both personally and professionally. It is through his life-long example that I emulate his work ethic, tenacity, and drive by giving 110% in all that I do.

Dr. Carl Misch was not only my mentor, but also a very close personal friend and fellow colleague for 30 years. His endless energy and enthusiasm inspired me to take on and complete such a laborious task as writing this book. Carl, the true "pioneer of modern implantology", allowed me to be at the forefront of this challenging profession and carry on his unprecedented principles and teachings in the field of oral implantology.

This journey would not have been possible without the support of my wonderful family. First, I want to thank my wife Diane, she is my high school sweetheart, my best friend and number one fan. She has been my rock to lean on and with her unwavering support I have been able to become the best at what I do. I also want to thank my two wonderful children, Christopher and Allison, who have made me so proud of their accomplishments and have driven me to complete this book. Christopher, who is following in my footsteps, soon to enter a prosthodontic residency and Allison who is pursuing her dream in medical school. And last of all, my two furry companions, Charlie and Nellie, who sat by my side patiently for endless hours in the writing of this book.

I am sincerely appreciative to all the additional chapter authors for sharing their expertise with the writing of this book. Their dedication to implant dentistry, and especially their friendship and personal support to me, is greatly appreciated: Dean Jon Suzuki, Steven Caldwell, Robert Resnik, Glenn Jividen, Joseph Cillo, Jarrett Faust, John Preece and Frank DeLuca.

A special note of thanks to the staff at Elsevier for their energy, enthusiasm and creativity with the content of this book. In particular, Courtney L. Sprehe, Jolynn Gower, Kathy Falk, Jennifer Flynn-Briggs, and Abigail Bradberry for their dedication and long hours of work in the development of this book.

At last but not least, I would like to extend my gratitude to the thousands of doctors that have trained with Dr. Misch and myself at the Misch International Institute over the last 25 years. They have given us the desire to and ambition to write this book and take the academic level of implant dentistry to the next level.

Randolph R. Resnik DMD, MDS

In Memoriam

The world constantly teaches us lessons along the path of life, and one of its most bittersweet truths becomes apparent when we are put in the presence of a genius. Certain individuals enter this world and make such an impact that we are left in awe of their accomplishments. They truly make a mark on what we know of life. The last lesson they bring us regards the frailty of life's gift. These geniuses, like all beings, leave this life, and we are left to wonder what we will do without their guiding light.

Recently, the medical community at large has lost one of its true geniuses, Dr. Carl E. Misch. His passion and life-long dream was to elevate the standard of care in implant dentistry, and he worked tirelessly in the pursuit of that end. Through the development of various principles and classifications that have led to the origins of modern implant dentistry, he truly changed the lives of his students, colleagues, and patients. Along with his gifts as a highly skilled clinician was an uncanny ability to engage and teach fellow dentists what he had learned along the way. He unselfishly gave others the gift of his knowledge, as his true belief was to always “share what you have learned”. Carl Misch was, in the truest sense of the words, a pioneer, teacher, clinician, friend, and colleague.

During his dental school years, the inquisitive dental student became fascinated with the little known field of oral implantology, which was still considered a discipline on the fringes of contemporary dental practice. Regardless, Carl aggressively pursued is passion and placed his first implant as a 4th year dental student. Additionally, he was elected class president by his classmates and was awarded a main podium position as a dental student at an International Congress of Oral Implantology in Germany. His fascination for knowledge in oral implantology led him to travel the world, seeking knowledge and experience from any of the earlier founders of oral implantology. This led to his tenacious pursuit of acquiring experience from some of the true pioneers in implant dentistry include the likes of Leonard Linkow, Ken Judy, Hilt Tatum, Robert James, P.I. Branemark and Dr. Hans Grafelman.

In 1984, Dr. Misch founded the “Misch International Implant Institute”, which was one of the first hands-on, one-year continuums for dental implant

education. The Institutes scientific based curriculum became world-renowned and remains at the forefront today of implant dentistry through research, education, and its unique clinical applications. The Misch philosophy and teachings have evolved and expanded over the years, and has been taught in many cities in the United States, along with locations in Brazil, Canada, France, Italy, Japan, Korea, Monaco, Spain, and the United Kingdom. Through the years, six major universities have used the Misch Institute exclusively for the implant dentistry curriculum of their oral surgery, periodontal, or prosthodontic residencies. To date, over 5000 dentists have been trained by the Misch Institute and is known worldwide as the premier center for dental implant training.

Dr. Misch, in his life, was awarded numerous post-doctoral degrees and recognitions. He was bestowed two Ph.D. degrees (honoris causa) from the University of Yeditepe in Istanbul, Turkey, and Carol Davila University of Medicine and Pharmacy in Bucharest, Romania. He was awarded an honorary degree and member of Omicron Kappa Upsilon, the national dental honor society. Additionally, he has been presented with twelve fellowships in dentistry, including the American College of Dentists, International College of Dentists, Royal Society of Medicine, American Association of Hospital Dentistry and the Academy of Dentistry International. In 2014, the American Dental Association's Board of Trustees awarded the Distinguished Service Award to Dr. Misch. This is the highest honor conferred by the ADA.

In the 1990's, Dr. Misch authored the text, *Contemporary Implant Dentistry*, which is currently in its third edition and has become one of the most popular textbooks in dentistry. This book has been translated into 9 languages, including Japanese, Spanish, Portuguese, Turkish, Italian and Korean. Additionally, his prosthetic text, *Dental Implant Prosthetics (Elsevier)* is in its second edition. His books are used in dental schools throughout the world for graduate and postgraduate programs. In March 2017, the long-awaited textbook *Avoiding Complications in Oral Implantology* will be published by Elsevier, which is co-authored by myself and Dr. Misch. Dr. Misch authored over 250 articles and repeatedly lectured in every state in the United States as well 50 different countries throughout the world. Dr. Misch also held 16 patents in dentistry and was the co-inventor of the BioHorizons Maestro Implant System.

Dr. Misch held Diplomate status at the American Board of Oral Implantology / Implant Dentistry and served as Board President and

member of the examining committee. He also served as President of several implant organizations including the International Congress of Oral Implantologists, American Academy of Implant Dentistry, Academy of Implants and Transplants and the American College of Oral Implantologists. He was a past president and Co-Chairman of the Board of Directors of the International Congress of Oral Implantologists, the largest global implant organization. Other accomplishments include being deemed a "Knight" by the King of Sweden and a chevalier of La Confrérie des Chevaliers du Tastevin, an esteemed French wine society.

Dr. Misch had an unprecedented impact on the field of implant dentistry, as most techniques and procedures today are based on his original principles and classifications. In my opinion, one of the truest signs of a genius is the ability to foresee the need of technology well before the mainstream of society even recognizes the concept. He had more to do with the inception, evolution, and current principles used today in implant dentistry than any other practitioner in the field. Few people in the field have contributed more than Dr. Misch. He gave his life to implant dentistry; he had a singular focus towards the understanding that if properly utilized, dental implants could have significant positive impacts on the health of civilization at large. His passion was centered on perfecting that craft to ensure that his vision of implantology as a common treatment method became reality. He was a true pioneer, in a time that he went against the odds and encountered much resistance. He has stimulated a renaissance in implantology that will continue to touch everyone he met.

Dr. Misch will be remembered as the consummate clinician, researcher, professor, and father. He lived and taught what he believed, teaching right up to the end of his life. His fire for sharing his love of our profession pushed him on and gave him the energy continue, even under the most complicated of circumstances. That is the beauty of life. Certain geniuses come along with great gifts. The best of these decide to dedicate their lives to sharing those gifts with others. That is a great description of Dr. Carl Misch, and I, as well as the rest of our community, will never forget him. His legacy will live on in the clinicians he has educated, the teachers he has influenced, and the patients that will benefit from his tireless and profound work. Carl, rest in peace.

Randolph R. Resnik

Dedication

This Book is Dedicated in Loving Memory of my father

Rudolph Resnik DDS

1927–1990

1

Classification of Dental Implant Complications

Randolph R. Resnik

One of the main tenets of dentistry is the restoration of a patient to optimal form, function, and esthetics. In the history of the profession, few advancements have facilitated dentists in this pursuit more than the advent of the dental implant. Though historical evidence reveals humans were attempting to replace missing teeth with foreign materials since ancient times, the science of fully replacing teeth with biologically compatible materials has been a very recent phenomenon. Oral implantology, which encompasses the replacement of missing teeth and their supporting structures with biologically compatible materials, has drastically improved the quality of life for millions of individuals. Patients who were once hopelessly edentulous now have the opportunity to achieve a full restoration to full chewing capability. People who were once destined to undergo radical and continuous loss of the bone that supports esthetically vital facial muscles now have a chance to maintain a youthful appearance. Young patients who were born with congenitally missing teeth now can go through life with a normal esthetic presentation without having to cope with a removable appliance. Though the study of dental implants is a rather recent phenomenon compared to other medical subjects, the impact that the field has had on the quality of life for patients around the world is staggering.

Due to the work of the many pioneers in the field, oral implantology has become a highly successful and viable option for the treatment of edentulous areas. High success rates for implant treatment have been shown through numerous clinical studies. However, as more implants are being placed, the number of complications are increasing. Even with technologic advances in oral implantology, this type of treatment is not void of complications, even many years after completion. These complications appear both surgically and prosthetically, with varying degrees of severity in consequence. Prosthetic complications leave patients without the restorations they ultimately desire, due to functional and esthetic issues stemming from inadequate implant placement, improper diagnosis, or a lack of understanding about the forces

acting upon the prosthetic components. Surgical complications can lead to implant failure, neurosensory impairments, infections, significant bleeding episodes, and possibly death. As oral implantology grows as a discipline, the field of dentistry will be confronted with these complications, and knowledge of how to treat them is pivotal to the long-term success of the treatment.

Complication Studies

In review of the literature, many studies have evaluated the prevalence of complications, both surgically and prosthetically. McDermott et al., in a retrospective study, evaluated approximately 2400 implant cases and determined an overall complication frequency of 13.9%.[1] Jung et al. reported a 39% complication rate associated with fixed implant-retained restorations over a 5-year period.[2] Serrano et al. in a multi-center retrospective study found a 50% complications rate with removable implant prostheses.[3] Many other studies have evaluated the specific complications (Table 1.1).

TABLE 1.1

Summary of Complication Journal Articles

	Category	Study Findings
CBCT COMPLICATIONS		
Schneider (2009)[1]	Computer Generated Guide Accuracy	• Meta-regression analysis reported a mean deviation of 1.07 mm at entry point and 1.63 mm at the apex
D'haese (2012)[2]	Immediate Loading Guided Surgery	• Reviewed six papers with an average complication rate to 42% when stereolithographic guided surgery was combined with immediate loading
Arisan (2010)[3]	Guide Accuracy	• Bone-supported guides had the highest mean deviations (5.0° ± 1.66° angular, and 1.70 ± 0.52 mm and 1.99 ± 0.64 mm for implant shoulder and tip, respectively
Valente (2009)[4]	Template Guided Flapless Surgery	• Mean lateral deviations coronal (1.4 mm) and apical (1.6 mm). Mean depth deviation was 1.1 mm and mean angular deviation was 7.9 degrees
BLEEDING COMPLICATIONS		
Hong (2012)[5]	Coumadin	• Frequency of persistent bleeding (2%) with patients on Coumadin • Extractions + implant placement = bleeding increases to 4.8%
Balaguer Martí (2015)[6]	Mandibular Bleeding	• Most common area for heavy bleeding after implant surgery is in the mandible (canine > incisor > first premolar) • Most common artery is Sublingual artery, usually from lingual perforation
Zijderveld (2008)[7]	Lateral Window Bleeding	• 2% significant bleeding complications after lateral window preparation
Goodacre (2003)[8]	Postoperative Ecchymosis	• 24% of all dental implant sites manifest noticeable ecchymosis. The location of the ecchymosis is influenced by gravity
NERVE COMPLICATONS		
Burstein (2008)[9]	Mandibular Nerve Impairment	• Meta-analysis of implant placement nerve injury studies show a range of incidence from 0% to 13%
Bartling (1999)[10]	Mandibular Nerve Impairment	• An incidence of 8.5% nerve impairment was found at the first postoperative appointment
Libersa (2007)[11]	Temporary vs. Permanent Nerve Injury	• Evaluated transient vs. permanent implant-related nerve injuries with 75% of injuries being permanent
Pogrel (2000)[12]	Inferior Alveolar Block Nerve Impairment	• 1 : 26,762 inferior alveolar nerve blocks result in nerve impairment with 36% causing a dysesthesia
INFECTION COMPLICATIONS		
Powell (2005)[13]	Dental Implant Infection	• 1.14% infection rate after stage I and stage II surgery
Gynther (1998)[14]	Dental Implant Infection	• 0.7% infection rate after surgery
Greenstein (2008)[15]	Wound Dehiscence	• Incision line opening prevalence ranging from 4.6%–13.7%
Lekovic (1997)[16]	Wound Dehiscence with Membrane	• 30% prevalence of soft tissue dehiscence's was noted when barriers were placed as part of guided bone regeneration procedures
Urban	Sinus Graft Infections	• 2.3% developed a sinus graft infection post-surgery

(2012)[17]		
Sicilia (2008)[18]	Titanium Alloy Sensitivity	• Type IV hypersensitivity reaction (titanium alloy sensitivity) Ti allergy was reported with a 0.6% prevalence
Davies (1990)[19]	Air Embolism	• Report of three fatal cases of air emboli after implant placement
SURGICAL COMPLICATIONS		
Hämmerle (2002)[20]	Guided Bone Regeneration	• Retrospective studies reporting success or survival rates for implants in regenerated bone ranging from 79.4%–100% after 5 years
Levin (2007)[21]	Autogenous Onlay Grafts Complications	• Survival rate was 96.9%, marginal bone loss around implants ranged from 0 to 3.3 mm only 5% of the implants presented marginal bone loss 1.5 mm over the follow-up time
Chiapasco (2009)[22]	Allograft and Membrane	• In the postoperative period, 20% of the nonresorbable membranes and 5% of the resorbable ones underwent exposure/infection
Chaushu (2010)[23]	Cancellous Block Grafts	• Partial and total bone-block graft failure occurred in 10 (7%) and 11 (8%) of 137 augmented sites
Nkenke (2009)[24]	Sinus Graft Complications	• Sinus graft complications 0%–32%
Di Girolamo (2005)[25]	Benign Paroxysmal Positional Vertigo	• Osteotome sinus technique leading to benign paroxysmal positional vertigo (BPPV) with a prevalence of 3%
Schwartz-Arad (2004)[26]	Sinus Membrane Perforation	• Most common complication during sinus graft procedures is perforation of the Schneiderian membrane during its elevation is 40%
Chrcanovic (2009)[27]	Mandibular Fracture	• Mandibular fracture is most likely to occur in the very atrophic mandible with a prevalence of 0.2% of the patients with inserted implants in an edentulous mandible
Galindo-Moreno (2012)[28]	Implant Migration	• In 80% of the cases in the reported study was either performed as sinus augmentation via osteotome approach (33.3%) or no augmentation (46.7%) at all
PROSTHETIC COMPLICATIONS		
Kourtis (2004)[29]	Prosthetic Complications	• Prosthetic Complication frequency: Screw Loosening – 34%, Broken Screw – 13%, Uncemented Restoration – 20%, Fractured Prosthesis – 20%
McDermott (2003)[30]	General Complications	• 13.9% frequency of complications including inflammatory (10.2%), prosthetic (2.7%), and operative (1.0%)
Sadid-Zadeh (2015)[31]	Single Implant Restoration & Fixed Implant Prosthesis in Partially Edentulous	• Meta-analysis showing an overall incidence of technical or mechanical complications of 10.8% for single implant crowns and 16.1% for partially edentulous implants = over a 5 year period
DeBoever (2006)[32]	Screw Loosening	• 12% incidence of screw loosening within 3 years
Chaar (2011)[33]	Screw Loosening	• Screw Loosening – 4.3% less than 5 years, 10% between 5–10 years
K-T Yao (2011)[34]	Implant Screw Settling Effect	• 2%–10% of the initial preload is lost as a result of settling within the first few seconds or minutes after tightening
Goodacre (2003)[35]	Overdenture Complications	• 30% clip/attachment loosening, relines required 19%, overdenture fracture 12%
Pjetursson (2012)[36]	Fixed Implant Prosthesis	• 5-year – 34% of fixed prosthesis had complications • 10-year survival rate of 77.4% for the gold–acrylic fixed implant prosthesis • The survival rate of implant-supported fixed prosthesis (all types) was 95.4% after 5 years and 80.1% after 10 years of function
Sailer (2007)[37]	Fixed Implant Prosthesis	• Meta-analysis reported 5-year (94.3%) and 10-year (88.9%) survival rate
Schley (2010)[38]	Zirconia Restorations	• Zirconia Restorations – 5-year complication-free rate of 76.41% for technical complications
Albrektsson (2012)[39]	Technical and Esthetic Complications	• Despite high survival of single implant crowns, technical, biological and aesthetic complications were reported with a rate of 8.8%, 7.1%, and 7.1%, respectively
Albrektsson (2012)[40]	Single Crown Success Rate	• Single implant crowns reported a 5-year (96.3%) and 10-year (89.8%) survival rate of implants and prosthesis
Goodacre (1999)[41]	Phonetic Complication	• Phonetic complication after implant prosthesis in 4%–8% of patients
IMPLANT FAILURE COMPLICATIONS		
Pjetursson (2012)[42]	Implant Failure	• Meta-analysis revealed an estimated survival of implants supporting fixed prosthesis of FDPs 95.6% after 5 years and 93.1% after 10 years
Albrektsson (2012)[43]	Implant Survival	• 5-year implant survival rate was estimated to be 97.7% and based on four prospective studies and 10-year implant survival rate was estimated to be 94.9%
Goodacre (2003)[35]	Implant Loss in Poor Quality Bone	• 16% implant loss in poor quality bone (~D4 Bone)