Practical Procedures in Implant Dentistry

Edited by

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Foreword

It is a true pleasure to be invited to write a foreword for this comprehensive new textbook on implant dentistry, a fast evolving discipline ranging from basic biological fundamentals to advanced clinical principles. The responsibility is large to write a new book on dental implants and to cover in detail topics such as digital planning, patient selection, implant and regenerative biomaterials, surgical and restorative steps, oral maintenance, follow-up, and the diagnoses of implant problems. The Editor has successfully managed to do so and has compiled a clear and practical guide for the clinician.

I welcome his timely efforts as the implant field has developed so rapidly that it is hard for any clinician, young or old, to stay abreast of new developments and not to forget the foundations that made this field possible. The master clinician behind the book is one of the true experts in implant dentistry. Dr. Chris Ho gained his extensive clinical and evidence-based experience over many years practising and teaching the field. He completed basic implant training as a general practitioner, then moved to advanced restorative training as a prosthodontist, and advanced surgical training with global experts in implant, bone, and soft tissue surgery. It takes that kind of discipline and devotion to master a complex field and enjoy the day-to-day implant practice, treating patients without stress and with consistent success. This book documents the task and will be a reference for many years to come.

I have gotten to know Chris as a dedicated and passionate clinician, educator, author, and friend over the many years that he has been vital to the gIDE Master Clinician Program. It is important for every dentist, from young graduate to experienced practitioner, to understand that it takes that kind of devotion to master a technique and become an implant expert. Many years of learning and training bring good and bad days, with learning curves that range from easy to steep, but the passion and discipline never disappears in the journey to become a Master Clinician in implant dentistry.

I believe that this book will be part of the journey for any dentist interested in improving and mastering their dental implant therapy.

Enjoy, train hard, and don't forget to have fun while learning.

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Introduction

Christopher C.K. Ho

The phenomenon of osseointegration has allowed for major improvements in both oral function and the psychosocial well-being of edentulous patients. The improvement in quality of life may be life-changing, allowing patients fixed replacement of teeth or, in cases of removable dental prostheses, significant improvement in retention and stability. In the 1950s, Swedish physician Per-Ingvar Brånemark conducted *in vivo* animal experiments studying revascularisation and wound healing using optical titanium chambers in rabbit tibia. On removal of the titanium chambers it was discovered that bone was attached to the titanium. Subsequently, Brånemark dedicated his research to the study of bony integration. He defined osseointegration as 'the direct structural and functional contact between ordered living bone and the surface of a load carrying implant' [1].

Since those early days, progress in implant treatment has been remarkable, with many innovative and technological advances, including three-dimensional (3D) imaging and computer-aided design/computer-aided manufacturing (CAD/CAM), new biomaterials, advances in implant configuration and connections, with surface modifications that have allowed improved surface reactivity for better bone–implant contact. Historically, specialist teams of surgeons and prosthodontist/restorative dentists undertook this therapy and achieved very high levels of success. However, with increasing numbers of implants and time *in situ*, as well as treatment by less-experienced clinicians, there has been an increase in the number of complications encountered.

When implant treatment fails or a complication arises it can be extraordinarily disheartening for patients and clinicians alike. As well as significant costs there is the surgical morbidity of carrying out implant insertion with considerable time involvement. This leads to disappointment if treatment fails and may even lead to medico-legal repercussions. No treatment is immune to failure, but proper management through comprehensive evaluation, diagnosis, and planning is paramount to success and minimising any complications. Along with careful case selection and planning, treatment should be performed with high levels of evidence-based protocols and professional excellence and followed up with regular continuing care.

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Since the introduction of moderately roughened implant surfaces and tapered, threaded implants the success of implants has become predictable, with very few failures occurring. The early failures are most likely due to surgical error, such as overheating of bone or not attaining sufficient primary stability due to over-preparation. Most late failures occur as a result of peri-implant infection or implant overload, and in the aesthetic zone due to insufficient soft or hard tissues around the implant. Extensive research has been conducted, combined with long-term patient experience, allowing us to refine and improve the treatment protocols. There have been major developments in knowledge that have allowed significant improvements, including the following:

- *A prosthetically driven approach*: Historically, a surgically driven approach was used in which implants were placed in the bony anatomy available. However, in cases of deficiency this resulted in final restorations that were compromised. A prosthetically driven approach is referred to as 'backwards planning'; the final ideal tooth position is planned, and augmentation may need to be performed to allow the final implant to be in the optimal position.
- *Radiographic imaging*: Cross-sectional imaging with cone beam computed tomography (CBCT) scans in combination with the use of planning software allows 3D positioning for the prosthetically planned approach. Improved safety and predictability in implant insertion has resulted. The use of surgically guided templates to provide precise implant placement with alignment in the correct axis enhances predictability and reliability in placing implants that are bodily within bone, and with access alignment that may allow screw retention. It also allows the clinician to diagnose whether augmentation may need to be undertaken in either a simultaneous or staged approach with implant placement.
- *Importance of the soft tissue interface*: It is now understood that the peri-implant soft tissues are paramount for long-term stability and predictability. The soft tissue interface is similar to that of natural teeth and a barrier to microbial invasion. Histologically, peri-implant tissues possess a junctional epithelium and supracrestal zone of connective tissue. This connective tissue helps seal off the oral environment, with the fibres arranged parallel to the implant surface in a cuff-like circular orientation. This arrangement may impact how the tissue responds to bacterial insult or cement extrusion into the sulcus. Natural teeth have gingival fibres inserting into cementum tissues, but because of the parallel arrangement of fibres around implants the tissues are more easily detached from the implant surface. This may lead to breakdown such as that seen in peri-implantitis or cement extrusion. This inflammatory breakdown is often seen at an accelerated rate compared to that of periodontitis. Literature has also demonstrated the presence of a 'biologic width' around dental implants, and understanding the influence of thick tissue will help prevent bone loss and provide improved stability [2, 3].
- *Implant design*: Both macrostructure and microstructure of implants have undergone continuous development to attain better primary stability, quicker osseointegration, and increased bone–implant contact. Micromotion may disturb tissue healing and vasculature, with micromotion greater than 100–150 µm

detaching the fibrin clot from the implant surface. Modern implant designs have focused on achieving enhanced primary stability, with manufacturers developing a tapered implant that allows for the widest part of the implant to engage the cortical bone at the crest, while the apical portion is tapered to allow the trabecular bone to be compressed. The original implant connections were an external hex, however modern implant designs have focused on platform-switched internal connections. These are often conical connections, with several manufacturers' designs approaching a Morse taper. This creates significant friction through the high degree of parallelism between the two structures within the connection. It has been shown to reduce the microgap size and distribute stress more evenly; there is also increasing evidence that it helps to preserve peri-implant bone and stabilise soft tissues. Extensive research into implant microstructure has established the optimal environment for bone–implant contact, with both additive and subtractive techniques used to develop moderately rough surfaces (Sa 1–2 μm). Most implant manufacturers produce this surface by using acid etching, grit blasting, or anodic oxidation. This roughness improves the osteoconductivity of the surface.

- *Digital implant dentistry – computer-aided design (*CAD*), computer-aided manufacturing (*CAM*), chairside intra-oral scanning, and 3D printing*: This area has undergone significant technological improvements in recent years, with implant planning software allowing accurate planning of dental implants using CBCT. The ability to print surgical guides through 3D printing is now commonplace, with many dental practices able to access this technology due to the reduced cost of printing. CAD/CAM fabrication of prosthetic abutments and implant bars allows customised designs that are passively fitting, economic, and homogeneous, with no distortion compared to that of cast metal frameworks. The many different materials dental clinicians have available to mill nowadays, including zirconia, ceramics, hybrid ceramics, cobalt-chrome, and titanium, allow the modern clinician to select appropriate materials for both aesthetics and strength when required.
- *Loading protocols*: The original protocols demanded an unloaded period of healing after implant surgery that ranged from three to six months. With the improved designs possessing better primary stability and roughened surface implants, these delayed loading protocols have been challenged, with immediate loading of implants providing immediate function in the first 48 hours. This has led to better acceptance of treatment, with reduced numbers of appointments and intervention. Survival rates are high for immediate loaded and conventional loaded implants, however immediate loading may pose a greater risk for implant failure if there is the possibility of micromotion.
- *Complications and long-term maintenance*: Because the original implant patients were treated over 50 years ago now, many patients have had implants for multiple decades. Complications are known. These can be mechanical in nature, such as screw loosening/fracture, veneering material fractures and wear, or biological complications with peri-implantitis and inflammation. Proper planning minimises such failure and complications. Patients should still understand that regular continuing care is required and that their implant treatment may require servicing and may even need replacement in the future.

We hope that this book provides the reader with information that allows their practice of implant dentistry to be successful and predictable, ultimately improving a patient's quality of life. The book has been formatted to ensure that the reader has access to relevant information in a recognisable format under the headings 'Principles, Procedures, and Tips'. This will give practising clinicians accessible information to learn new skills, and provides a continual reference for revision prior to performing procedures. We hope this will ensure that the clinician undertakes best practice within their dental office in the field of implant dentistry.

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Patient Assessment and History Taking

Christopher C.K. Ho

2.1 Principles

Careful patient selection, evaluation, and treatment planning are fundamental to the success of implant therapy and will help to avoid future complications or failures. Since Brånemark et al. [1] published research documenting successful osseointegration on endosseous titanium implants in 1969, the use of osseointegrated dental implants has increasingly become the treatment option for the replacement of missing teeth. Despite the predictability of dental implants, a small but significant number of patients continue to experience implant failure, and it is important to understand the risk factors involved. Informed consent is the process of communication between a clinician and a patient whereby a patient grants permission for the proposed treatment based on understanding the nature of the problem, the risks, and the benefits of the procedure and treatment alternatives, including no treatment.

The first objective is to gather all relevant information to plan treatment. It is essential to obtain appropriate information about the patient's dental and medical history, and to conduct a comprehensive examination in conjunction with diagnosis from radiographic imaging and study casts.

2.1.1 Medical History

The general health status of a patient should always be assessed prior to any surgical procedure. Although there is minimal association between general health status and implant survival [2], there are certain situations where implant procedures may risk the health of a patient or possibly be associated with higher failure rates of osseointegration.

Medical questionnaires are routinely used and, in addition, it is best practice to verbally ask specific questions about the health of patients. There are two basic questions that a clinician should ask prior to implant surgical procedures:

1) Is the patient fit medically to have the procedure done?
2) Is there anything in their history that would interfere with healing and the normal osseointegrative process?

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