Bone Management in Dental Implantology

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Foreword

Implantology represents a fascinating part of dentistry. Although most situations can be solved without major additional surgical procedures and the insertion of implants can thus be performed successfully, there are an increasing number of patients with atrophic or otherwise unsuitable jaws. Without bone there is no way to insert implants. Therefore, bone augmentation is an essential part of the armamentarium to overcome these atrophic anatomical situations and increase the availability of implants to the benefit of our patients.

Bone augmentation starts with simple bone grafts and ranges to the most complex bone augmentation with microsurgical composite bone flaps. Advanced techniques in GBR can be used to repair severe horizontal and vertical bone defects. Various biomaterials can be used to enhance bone formation; however autogenous bone is still the gold standard in dental implantology.

This book describes all the reader needs to know about bone augmentation in dental implantology. Advantages and disadvantages such as patient donor site morbidities are discussed. The key messages of this book are guided by both scientific knowledge and personal experience. Surgical procedures are illustrated with many case examples in colorful detail. This book is of great benefit for anybody interested in bone augmentation techniques to improve and widen the scope of their dental implantology.

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Preface

Writing a book is mandatory in academics for their students and colleagues. This is important to develop knowledge and exchange experience in a particular field of specialization.

The field of dental implantology in the past few years has expanded rapidly. Insertion of dental implant nowadays has been done not only to a patient with a good bone condition but also to those with severe bone defects. This has its own challenges to a clinician.

In the past few decades, many techniques and materials have been developed to be able to reconstruct bone defects. Even though there are a lot of controversions, the use of autogenous bone is still a gold standard in dental implantology. The application of an autogenous bone can be done in a form of pure autogenous bone or a combination of autogenous bone and guided bone regeneration (GBR) to decrease patient morbidity.

Expansion of rapid biomaterial, although have not replaced autogenous bone, cannot be denied have managed the operator to do a complex bone augmentation in a simpler way and less invasive. Complex bone augmentation procedures nowadays can be learned and applied easily by the clinicians. It can be applied with more predictable results with less complication.

This book discusses various techniques of bone augmentation in dental implantology, which according to the writer can be applied in daily practice.

Distinguished colleagues have contributed to the writing of several chapters relevant to their field of specialization. We would like to thank all the authors and contributors for their valuable contribution.

We would like also to express our gratitude to our teachers and role models in this field:

- Prof.Dr.Dr. K.-D.Wolff. Chairman Klinik für Mund, Kiefer und Gesichtschirurgie, Klinikum rechts der Isar, Technische Universität, München, Germany
- Prof.Dr.Dr. Frank. Hölzle. Chairman Klinik für Mund, Kiefer und Gesichtschirurgie, Uniklinik RWTH Aachen, Germany
- Dr.Dr. Christoph Pytlik, Germany
- Dr. Masykur Rahmat (+), Yogyakarta, Indonesia

Last but not least, we would like to thank our family, Dr. Juwana Budihardja (+), Dr. Katrin Liwoto, Devi, Keisha, Nathan, Debby, and Anita, for their patient, continuous support throughout the entire process of writing this book.

Tangerang, Indonesia — Andi Setiawan Budihardja
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1.1 Introduction

The most important determinant of success of treatment with dental implants is the availability of adequate bone structure. In order for dental implants to be successful, the bone must be both sufficient quantitatively (with regard to height and/or width) and qualitatively (ample vascularization) (Figs. 1.1 and 1.2).

A lack of adequate bone structure is a common deterrent to placing dental implants and also a common cause of failed implants after placement, both in the healing/osseointegration phase and in the restoration phase.

There are several circumstances that can lead to loss of bone, namely:

- Genetic defects (i.e., cleft lip/palate) (Fig. 1.3).
- Trauma.
- Tumor and postablative tumor surgery (Fig. 1.4).
- Bone atrophy.
- Infection.
- Periodontal disease.

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Fig. 1.1 Dental implant must be covered by a healthy bone and soft tissue. It should be placed in the correct 3-D position

Fig. 1.2 Dental implant insertion on healthy bone

Fig. 1.3 Ameloblastoma (benign tumor) of the anterior mandible resulting in severe bone destruction

Fig. 1.4 Alveolar bone defect on the patient with unilateral cleft lip and palate

Fig. 1.5 Resorption of the upper jaw in the centripetal direction and the lower jaw in a centrifugal pattern. This will lead to a pseudo-class III occlusion

1.2 Bone Quantity

Tooth loss means a loss of functional loading, which can lead to resorption and atrophy of the jaw. This situation can be further aggravated if the teeth are not replaced for a substantial time, if the patient uses dentures, and if there is any inflammation or infection after tooth extraction. Bone resorption begins at week 15 post tooth extraction and reaches approximately 60% within a period of 3 years (Fig. 1.5). Resorption of the mandible is fourfold faster than in the maxilla. Mandibular resorption occurs around 12 mm in the first year after extraction, from which point it increases by about 0.2 mm per year [1, 2]. Maxillary resorption is in a centripetal direction, whereas mandibular resorption has a centrifugal pattern (Figs. 1.4 and 1.6) [3]. For this reason, there are often discrepancies in the relationship between the upper and lower jaw. This can result in pseudo-class III malocclusion jaw relationship.

Changes in bone structure would also result in changes to soft tissue structure and ultimately would have an impact on the patient's profile. This is all too common a cause of aesthetic problems in patients.

Fig. 1.6 Resorption of the upper jaw in the centripetal direction and the lower jaw in a centrifugal pattern. This will lead to a pseudo-class III occlusion

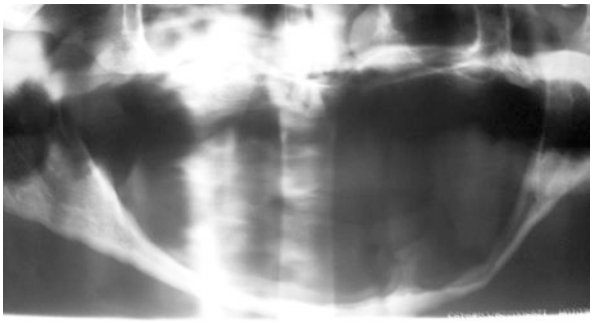

Fig. 1.7 Edentulous jaw with severe bone resorption. In such circumstances, the danger of mandibular fracture is considerable

Fig. 1.8 Insertion of four implants in interforaminal region in severely atrophic jaw. Inclination of the implants is too far to the lingual side because it was forced to match the prosthetic on the upper jaw. This patient has a pseudo-class III occlusion because of the jaw resorption on the edentulous upper and lower jaw. It is well described in the literature that such case can cause life-threatening complication because of the hematoma from the floor of the mouth and bleeding that can cause obstruction of the airway

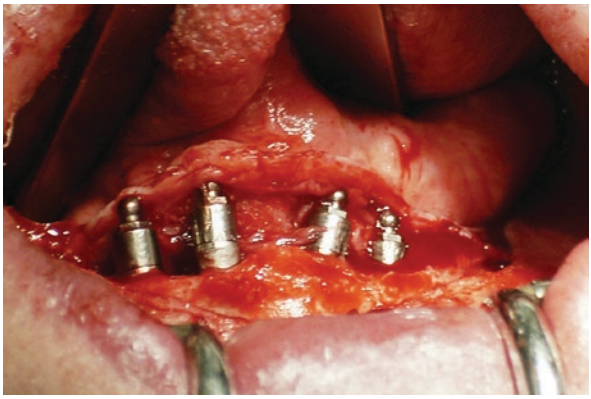

Fig. 1.9 Insertion of four implants in interforaminal region in severely atrophic jaw. Inclination of the implants is too far to the lingual side because it was forced to match the prosthetic on the upper jaw. This patient has a pseudo-class occlusion because of the jaw resorption on the edentulous upper and lower jaw. It is well described in the literature that such case can cause life-threatening complication because of the hematoma from the floor of the mouth and bleeding that can cause obstruction of the airway

Tooth loss, if not corrected in a timely fashion, not only causes changes in the hard tissue (bone) but also can lead to changes in the soft tissues, including the muscles of the face (Figs. 1.7, 1.8, and 1.9).

1.3 Bone Quality

Bone quality is a major prognostic factor for the success of dental implants. Bone vitality is determined by bone vascularity and intraosseous cellular components of the bone. Some comorbidities may cause interference with bone vitality, such as diabetes mellitus, osteoporosis, and other bone diseases (osteomalacia, postradiation malignancies, etc. (Fig. 1.10)).

The use of bisphosphonate drugs, whether administered intravenously or orally, has an inhibitory effect on osteoclasts, resulting in poor vitality. Patients treated with bisphosphonate therapy often have resultant osteonecrosis of the jaw after undergoing dental surgery (Figs. 1.11, 1.12, 1.13, and 1.14); there have even been several cases of osteonecrosis which occurs spontaneously, without prior surgery of any kind (e.g., due to prosthesis pressure or in cases of chronic periodontitis). However, patient under bisphosphonate therapy is not absolute contraindication for dental implant surgery and bone grafting. Several publications reported dental implant surgery and bone grafting could be done successfully in patient under low-dose oral bisphosphonate therapy [4, 5].

Fig. 1.10 Osteomyelitis of the maxilla post radiotherapy

Fig. 1.11 Patient with bisphosphonate-related osteonecrosis of the jaw. Osteonecrosis of the mandible occurs after tooth extraction. Patient received i.v. bisphosphonate therapy after breast carcinoma operation

Determination of these bony structures can only be made clinically and histologically. The use of CT scans (based on Hounsfield scale) can determine the degree of bone mineralization, but cannot measure the vitality and precisely discern the bone structure. This can only be accurately accomplished by histological examination. For this reason, using radiographic examinations to predict prognosis is considered inaccurate.

1.4 Principle of Bone Grafting

The main principle of bone grafting is to attempt to avoid having to do a bone graft. In other words, try to find a viable alternative before deciding to do a bone graft. Alternatives to this procedure are imperative, because although there are several techniques of bone grafting that have promising prognoses, bone grafting is nevertheless an invasive surgical procedure and as such carries risk of complications. In addition, bone grafting will incur considerable additional costs for the patient. Several strategies for avoiding the need for a bone graft are as follows:

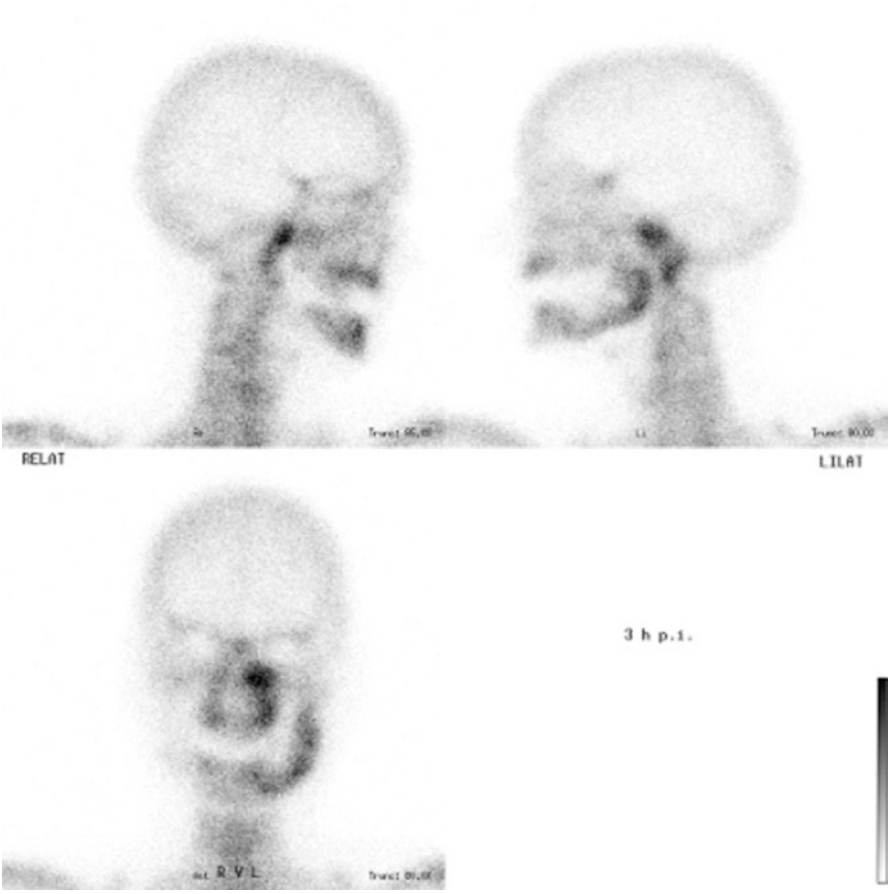

Fig. 1.12 Bone scintigraphy shows an area of osteonecrosis of the left mandible

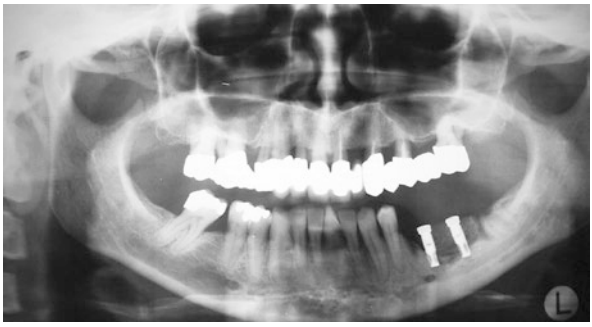

Fig. 1.13 Dental implants on the mandible were inserted in the patient with the history of taking i.v. bisphosphonate therapy for breast cancer. Implants failed to osseointegrate and have to be removed. Moreover, all necrotic bones have to be removed and local flaps are needed to close soft tissue defect