The Accelerated Implant Therapy With Parallel-walled Screw Implants Planning, Surgical and Prosthetic Aspects

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Introduction

The classical implant protocol recommending a healing time of three months in the mandible and six months in the maxilla has been developed on the basis of purely empirical data. New treatment concepts, technical innovations and evidence-based dentistry have required re-evaluation of the initial protocol. The aim of this poster is to define the biological, surgical and prosthetic parameters for a standard protocol in accelerated implant treatment. A consistent terminology has been established.

Terminology

The terminology covers the various aspects of a treatment protocol taking into consideration the time of implant placement, healing and prosthetic delivery. It is based on patient-specific, individual treatment concepts.

Classification according to the time of implant placement:

1. Immediate implant placement – implant placement immediately after tooth loss
2. Delayed immediate implant placement – implant placement before bone remodeling, after final epithelial wound healing
3. Late implant placement – implant placement after bone remodeling of the alveolus

Classification according to the mode of healing:

1. Submerged healing – healing under covered mucoperiosteal flap; second surgery required at uncovery of the implant
2. Non-submerged healing – transgingival healing with immediate exposition to the oral cavity. Primary soft tissue healing around the transgingival section of single stage implants or around pre-mounted gingival formers of two stage implants

Classification of implant protocol according to type and time of prosthetic restoration:

1. Immediate functional loading – functional loading within 48 hours after implant placement with temporaries, in occlusion
2. Non-functional loading – prosthetic restoration within 48 hours after implant placement with provisionals, out of occlusion
3. Early loading – prosthetic restoration within 3 weeks after implant placement with final prosthetic restoration, in occlusion
4. Advanced early loading – prosthetic restoration within 8 to 10 weeks after implant placement with temporaries, in occlusion
5. Progressive loading – stepwise, increased loading due to primary restoration with a temporary and final restoration after functional bone remodeling.

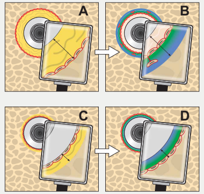
Anatomy

Over the past 25 years, scientific research and clinical studies combined with improved techniques have provided new data on the biological and physiological processes related to implant placement.

A dynamic equilibrium between tissue growth and resorption of the periimplant hard and soft tissue starts immediately as soon as implant-prosthetic load distribution is initiated. Basically, the integration at the implant-bone-interface results in contact osteogenesis, i.e. direct bone growth on the implant surface. This progress can be divided into three stages (Fig.1):

1. **Osseoconduction**: Migration of differentiating osseoinductive cells to the implant surface along a temporary fibrous matrix. Their attachment is influenced by bone morphology.
2. **De-novo bone synthesis**: The osteoblasts deliver non-collageneous proteins into the extracellular matrix, acting as an interface between the new and the old bone. A bony layer is formed on the implant surface in this matrix due to formation of calcium phosphate nuclei and their crystal growth with simultaneous collagene production and subsequent mineralization.
3. After this layer has been formed, the third stage of **bone remodeling** begins. New bone substance is built between the old bone and the implant surface based on the principles of de-novo bone synthesis.

It has been demonstrated that implants can be loaded early or immediately if micro-movements of more than 150 µm can be avoided during the osseointegration phase. Stronger movements would lead to soft tissue resorption at the interface rather than to the desired osseointegration. The remodeling process is influenced by diameter, length, surface and position of the implant related to the natural root [1,2].



Distance osteogenesis:

A. Osteogenetic cells line the old bone surface.
B. Bone recruites the old bone surface. (A results into B)

Contact osteogenesis:

C. Osteogenetic cells line the implant surface.
D. Bone recruites the implant surface. (C results in D).

Source: Davies J.E.[1]

local bone
newly-formed bone
interstitial fluid
matrix
connective tissue

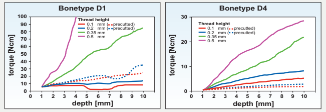
Fig. 1

Implant design and surgical concept

High primary stability has to be achieved after implant placement to avoid macro-movements during the healing phase. In addition, fast and safe osseointegration must be reached during the functional loading period. The threads of screw implants should cut bone atraumatically to ensure safe and gentle insertion of implants in all bone qualities. In order to meet the various requirements of all types of bone, it is of advantage to provide a synchronized thread geometry for the spongy and cortical sections of the implant site. An atraumatic pre-cutting performance of the threads in the cortical section is therefore guaranteed. At implant placement, a torque of 25 to 30 Ncm should be ensured for sufficient primary stability (Fig.2). The different elasticities of cortical and spongy bone have to be considered. Due to a reduced friction in class D3 and D4, the bony density of the implant site has to be improved by internal condensation (Fig.3) [7].

Long-term success is not only influenced by bone density and implant macro-design, but also by the implant surface [4,5]. The morphology, roughness and topography at the interface play an important role for primary stability and safe osseointegration.

Cell proliferation and differentiation, matrix synthesis and production of the tissue growth factor (TGF) are enhanced and lead to a tight bone-to-implant-contact. A cervically textured surface is advantageous for a hybrid implant design. The structure-polished implant collar favors the cellular orientation for attachment control. In the region of the gingival margin, it represents a diffusion barrier for bacteria between the oral cavity and the implant site (Fig.4).



Insertion torque related to thread depth in D1 bone quality. Insertion torque related to thread depth in D4 bone quality.

Fig. 2

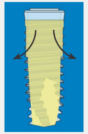


Fig. 3

Preparation of the cortical implant site according to bone density.

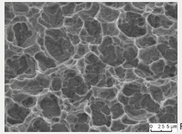


Fig. 4

REM picture 3000x. Bimodular grit-blasted and acid-etched FRIADENT Surface.

Prosthetics

The treatment concept described by P.D. Ledermann of immediately loaded four rigidly bar-splinted implants in the symphysis region has been accepted and proven as today´s standard protocol.

Pre-requisites for early or immediate function of implants:

- Sufficient number of implants for primary splinting
- Appropriate implant length of minimum 10 mm
- Absolute primary stability of implants at insertion
- Rigid, primary splinting of the implants with the superstructure to avoid uncontrolled macro-movements
- Anterior-posterior implant distribution to avoid rotation

Current prosthetic and laboratory protocols have shown good success rates for immediate function of implants beyond the indication of the edentulous mandible. Three different implant protocols can be distinguished from a prosthetic point of view:

1. Prosthetic restoration of the edentulous jaw

- functional immediate loading and splinting of *final* implants (evenly distributed in the edentulous maxilla or mandible) with a rigid provisional restoration
- functional immediate loading and splinting of *final* implants (evenly distributed in the edentulous maxilla or mandible) with a rigid provisional restoration
- functional immediate loading and bar-splinting of implants in the symphysis region with a final restoration

2. Prosthetic restoration of the partially edentulous jaw

- non-functional immediate loading (occlusal support through residual teeth) and splinting of minimum two implants with a rigid *provisional* overdenture in the maxilla or mandible
- functional immediate loading and splinting of minimum two implants with a rigid *provisional* restoration in the maxilla or mandible
- functional immediate loading and splinting of minimum two implants with a *final superstructure* in the maxilla or mandible

3. Prosthetic restoration of the single-tooth implant

- non-functional immediate loading of a single tooth implant (occlusal support through residual teeth) with a *provisional* restoration in the maxilla or mandible
- functional immediate loading of a single tooth implant with a rigid *provisional* restoration in the maxilla or mandible

The implant design and the surgical armamentarium have to address the anatomical requirements. There is a need for simple and safe system components for all accelerated implant treatment steps, beginning with implant placement, index registration and impression taking up to temporary and final prosthetic delivery.

Summary

Success and innovations lead to the change in paradigma currently experienced in implant dentistry. However, long-term studies are needed to define the exact parameters. The implant systems available have to address the changed requirements and new standard protocols have to be set up.

Literature

1. **Brunski J.B.**; Biomechanical factors affecting the bone-dental implant interface: Review paper. Clin Mater 1992
2. **Brunski J.B.**; Avoid pitfalls overloading and micromotions of intraosseous implants (interview). Dent Implantol Update, 1993; 4(10):77-81
3. **Davies J.E.**; Mechanisms of Endosseous Integration. Int J Prosthodont, Vol 11, 5: 391-401, 1998
4. **Größner-Schreiber B., Tuan R.S.**; Die Bedeutung der Oberfläche von von Titanimplantaten im Osteointegrationsvorgang. Deutsche Zahnärztliche Zeitschrift 46, 1991/10
5. **Kieswetter K., Schwartz Z., Hummert T.W., Cochran D.L., Simpson J., Dean D.D., Boyan B.D.**; Surface roughness modulates the local production of growth factors and cytokines by osteoblast-like MG-63 cells. Journal of Biomedical research, 1996, Vol.32: 55-63
6. **Nkenke E., Wiltfang J., Kloss F., Radon C., Neukam F.W.**; Klinische Ergebnisse nach Knochenkondensation im Oberkiefer. Frühjahrstagung der Deutschen Gesellschaft für Implantologie, 6.-8. April 2000, Hannover, Germany
7. **Summers R.B.**; A New Concept in Maxillary Implant Surgery: The Osteotome Technique. Compen Contin Educ Dent, Vol 15,2, 152-160, 1994

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