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Immediate restorations with a reduced number of implants

Conceptual background and clinical results

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Foreword

The authors of this book are well known in Germany and indeed throughout Europe. I have had the privilege of working with Dr Georg Bayer on more than one occasion, so a text written for such a specific subject must be of importance and interest to any forward-thinking implant dentist.

Populations in the developed world are getting older: this trend has characterized the aging demographic for over 100 years in the UK and most of the developed world. Population aging is defined as the process by which older individuals, that is, people aged 50 or over, make up a proportionally larger share of the total population over a period of time.

In the UK in 1901, nearly one person in seven (approximately 15%) was aged 50 and over. This increased to one in three by 2003 and is still rising. By 2031 it is projected that over 40% of the total population will be aged 50 and over[1].

The implication of the aging population is the ever increasing requirement for reconstructive dentistry in the partially or fully edentulous patient. The requirement for better quality dentistry is driven by the population of "baby boomers", whose expectations are higher than those of their forbears. Indeed, the provision of acrylic full dentures is almost an anathema to some. The production of this book will guide the way to achieving the fixed restorations that an increasing number of patients will demand.

Traditionally, the ability to reconstruct seriously damaged hard and soft tissue required multiple interventions, and a high degree of experience from the operators and a great deal of time. The authors have managed to link together the modern techniques of treatment planning using CT/DVT imaging, a well-tried implant system in the blueSKY system, a surgical approach well documented by people such as Paulo Maló and, above all, the SKY fast & fixed system, which allows for an immediate fixed solution as desired by the aging population. It is also important to point out that this treatment can be achieved for the patient at a greatly reduced cost compared with traditional reconstructions due to considerably reduced chair time and healing intervals.

The text is written in almost a step-by-step way, which will help the less experienced implant dentist, beautifully illustrated with numerous color photographs, and includes a host of practical tips. It also covers the role and scope of the dental technician in the construction of fixed restorations.

I recommend this book for all dentists and technicians who want to learn and gain experience in this technique; would that there had been guides like this when I was trying to learn implant dentistry in the mid-80s. Ultimately, this will benefit your most important person, your patient!

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Preface

“The real secret of success is enthusiasm.” (Walter Percy Chrysler, automobile manufacturer, April 2, 1875 – August 18, 1940)

For almost 25 years, our practice has focused on implantology. During this period, we have seen a number of implantological treatment approaches come and go. A slightly skeptical, wait-and-see attitude to ideas that are trumpeted as revolutionary was, and still is, certainly appropriate. However, we quickly became enthusiastic about immediate restoration. And we have remained so.

There are good reasons for our enthusiasm. Using the conventional methods of implantology, patients with reduced dentition could rarely receive implants without bone augmentation. As a result, many patients chose classic restorations instead.

The approach presented in this book, involving the insertion of angled distal implants that can immediately receive a functional load, is different. With this therapeutic approach, dentists can often offer their patients individualized treatment tailored to their wishes, oral situation and financial resources.

As is the case with any number of other fundamental innovations, the history of immediate loading has been written by dentists in private practice and by practicing university professors. Such innovations arise from chance occurrences, a high level of surgical skill or a mixture of both. Brånemark’s discovery of osseointegration, Schulte’s call for load-free healing, Ledermann’s principle of splinting, Maló’s idea of angled distal implants – the list of colleagues who made valuable contributions could go on.

But however different their ideas, the reactions from their colleagues and the industry remained the same: skepticism and reserve were the milder responses with which the innovators were confronted. When the authors first presented the fast & fixed approach seven years ago, some colleagues dismissed the procedure by commenting that the dentists at Georg Bayer’s practice probably could not insert implants other than at an angle.

Innovative approaches and concepts often get a cold reception by the major dental suppliers as well. Perhaps this is because research and development do not immediately sell a product and require committed investments, on more than the financial level. It takes time for developments to become marketable. And it takes partners who have the courage and stamina to professionally and appropriately implement the new concepts. It also takes trust in the developers. Listening to them, understanding their vision, collaborating with them in making corrections, changing plans and starting afresh: the willingness to do so is more often found in owner-managed small or medium-sized businesses. For the fast & fixed method, this company was Bredent in Senden, Germany. We would like to expressly thank the company for placing confidence in us and for their support with modified implant components.

Such support is crucial to success since it is impossible to completely avoid setbacks and failures. This was also true with immediate loading. The initial euphoria has abated and been replaced by a sober, scientifically founded assessment. Experienced colleagues have always greeted initial claims of treatment success with a healthy dose of skepticism. Biology cannot be "tricked". Not everything is predictable, even if many marketing departments would like to suggest otherwise.

Immediate loading on distal angled implants with a splinted superstructure has become an established therapeutic approach and is sufficiently documented in scientific studies. The function, longevity and esthetics of the restorations meet high expectations. The treatment results are generally predictable, providing that the dentist, dental technician and patient strictly observe the necessary precautions. Thanks to these facts, we have remained enthusiastic supporters of this method for years.

It is certainly not always easy to convince patients who believe that they still have a full set of good teeth that the truth is otherwise. The disclosure that their teeth are no longer worth saving and must be extracted is generally not met with immediate acceptance. At this point, it is therefore all the more important to spark the patient's enthusiasm and to offer realistic, quality solutions.

Dentists who are able to communicate this solution to patients in an understandable manner and with sincere enthusiasm are in the best position to motivate patients to choose an immediate restoration with a reduced number of implants.

If this book sparks your enthusiasm for immediate restorations with fewer implants and thereby increases your patient load, it has fulfilled its purpose.

In closing, we would like to express our thanks to our team and especially to the colleagues without whom this book could not have been written: Fabian Sigmund for collecting the follow-up examination data, Dr Freimut Vizethum for his support in analyzing the FEM examination and Dr Michael Weiss for the use of the novel digital implant planning techniques.

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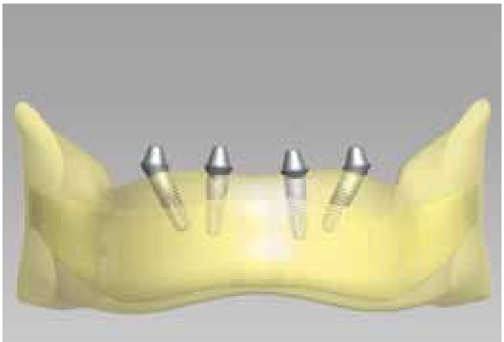

Fig 1-42 FE model with four implants in the mandible.

Fig 1-43 Positioning of the implants in a typical angled position in the area of the mental foramen.

1.5.1 Investigative approach

A model consisting of an edentulous mandible, implants and a superstructure was created using the FEM program Ansys 10.0 (Ansys, Canonsburg, PA, USA) to compare the influence of implant angulation and load conditions. Four implants were modeled in the bone, and the two insertion directions “straight” and “angled 45 degrees” were chosen for the distal implants (Fig 1-44). The load was applied on the superstructure 9 mm above the level of the bone. The model was segmented for calculation purposes. The modulus of elasticity values used were 106,000 MPa for the implant, 10,000 MPa for cortical bone and 700 MPa for cancellous bone. Two load situations where investigated, namely immediate loading and the loading of osseointegrated implants. To simulate the transmission of force under conditions of immediate loading, a predetermined maximum displacement of 100 µm of the implant surface was assumed at the interface with the bone under load. The resulting loading and stresses were calculated to imitate the fixation of a rigid superstructure. In a state of osseointegration, a force of 280 N was transmitted at an angle of 45 degrees to the occlusal plane, and no shifting between the bone and implant was permissible in this case. The calculated results (shown in Table 1-1) were expressed as a percentage of the maximum values around the distal implant, which was either inserted vertically or at an angle. The maximum loads on the cancellous bone, cortical bone and implant were used as criteria in each case.

1.5.2 Results

Under immediate loading, there was no noteworthy difference in stress in the cancellous bone when comparing vertical and angled insertion, but angled implants exhibited greater stress in the cortical bone as well as in the implant/abutment, where stress rose from 280 to 620 N/mm^2. During the osseointegration phase, implant angulation was associated with a slightly increased peak stress in cancellous bone, cortical bone and implant. Figures 1-45 to 1-47 show the maximum stress levels when comparing straight and angled implants: During the immediate loading phase, the maximum stress was 14% higher in angled than in vertical implants. After osseointegration, the peak stress was up to 35% higher in the cancellous bone for angled implants. The calculated peak

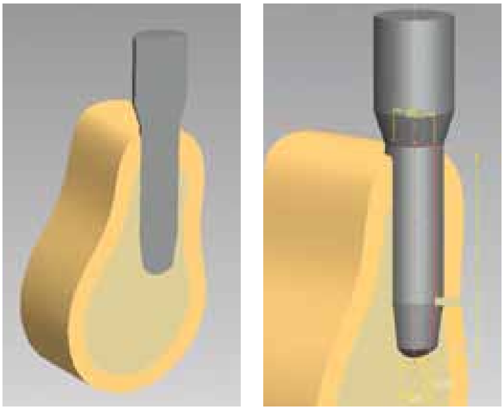

Fig 1-44 Positioning of the implants in a cortical bone and spongiosa model.

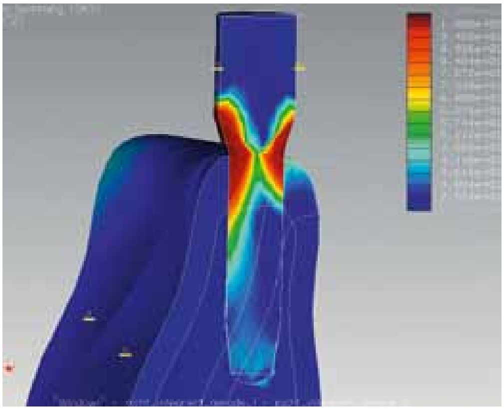

Fig 1-45 Distribution of stress in a straight, non-osseointegrated implant.

stress value in the cortical bone around angled implants was 24% higher than the corresponding value for vertical implants. The maximum strain levels were analyzed and compared with the maximum values around straight implants as well. The maximum strain values were found around angled implants and under immediate loading; in cortical and cancellous bone, they were 4% to 16% higher than for implants inserted vertically. The maximum bone strain after osseointegration in cortical and cancellous bone was 17% to 40% higher for angled implants than for vertically inserted implants.

When angled implants in a stable, rigidly blocked superstructure are subject to immediate loading, the maximum stress and strain are up to 16% higher than in vertically inserted implants, as confirmed by other authors[177]. After osseointegration is achieved, the peak stress level is up to 35% higher in cancellous bone and 24% higher in cortical bone when compared with vertically inserted implants; this situation could result in locally increased bone remodeling[128] (Table 1-1, Fig 1-48).

This analysis did not account for that potential mechanism, so the results may overestimate the effects of implant angulation on the stress exerted on the bone. If the super-

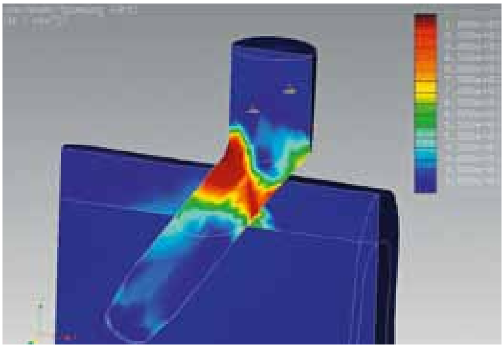

Fig 1-46 Distribution of stress in an angled, non-osseointegrated implant.

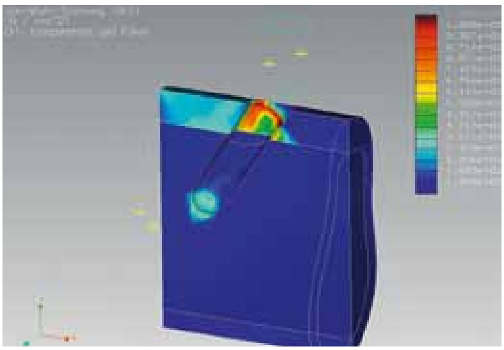

Fig 1-47 Distribution of stress in the cortical bone around the angled, non-osseointegrated implant.

Fig 3-7 A wax prosthetic setup tried in the patient and coordinated with the patient's wishes.

Fig 3-8 The waxup converted into barium sulfate teeth with basal contact as a model for the plastic template.

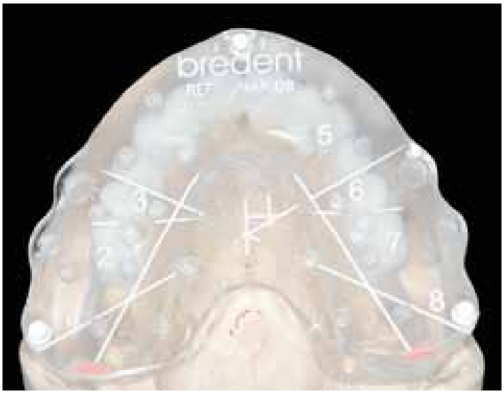

Fig 3-9 Plastic template fitted onto the SKYplanX reference plate and trimmed.

Fig 3-10 For CB-CT imaging, the scan template is intraorally affixed to the reference implants.

ning implants, it will serve as a reference for the later implant positions in the SkyplanX implant planning software and support the correct transfer of the planning data to the SKY5X transfer table. This completes the preparation for the 3D scan.

3.2.3 The surgical guide

During surgery, surgical guides aid in implementing the virtually planned implant positions. When surgical guides are created with the aid of two-dimensional radiographs, however, the prosthetically optimal implant positions can rarely be surgically implemented without problems[118]. 3D diagnostics in combination with planning programs and the option of

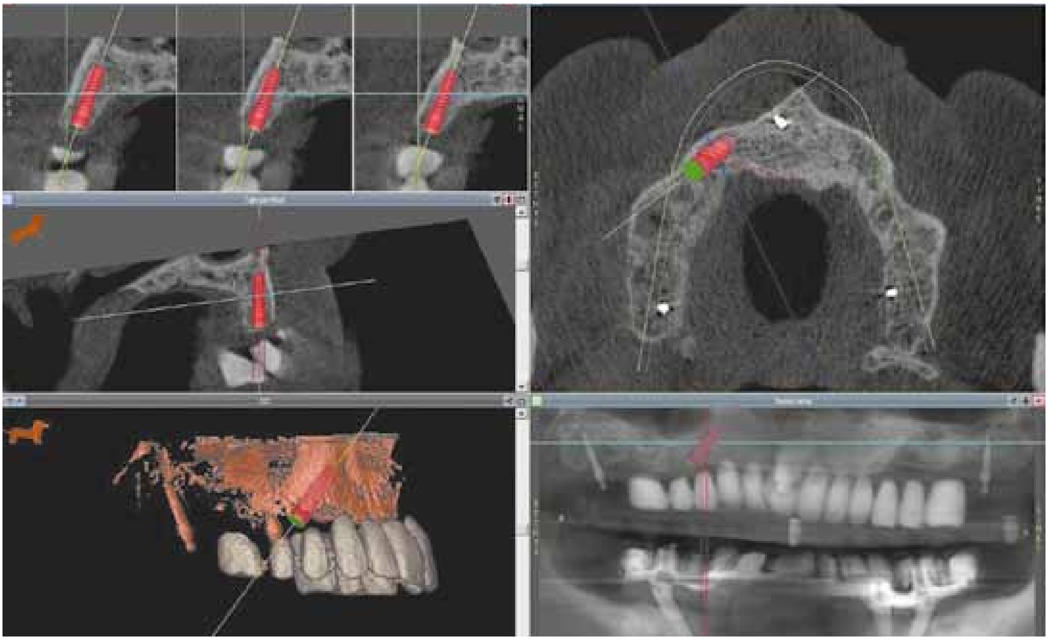

Fig 3-11 The datasets converted into the planning program provide a realistic reproduction of the intraoral situation.

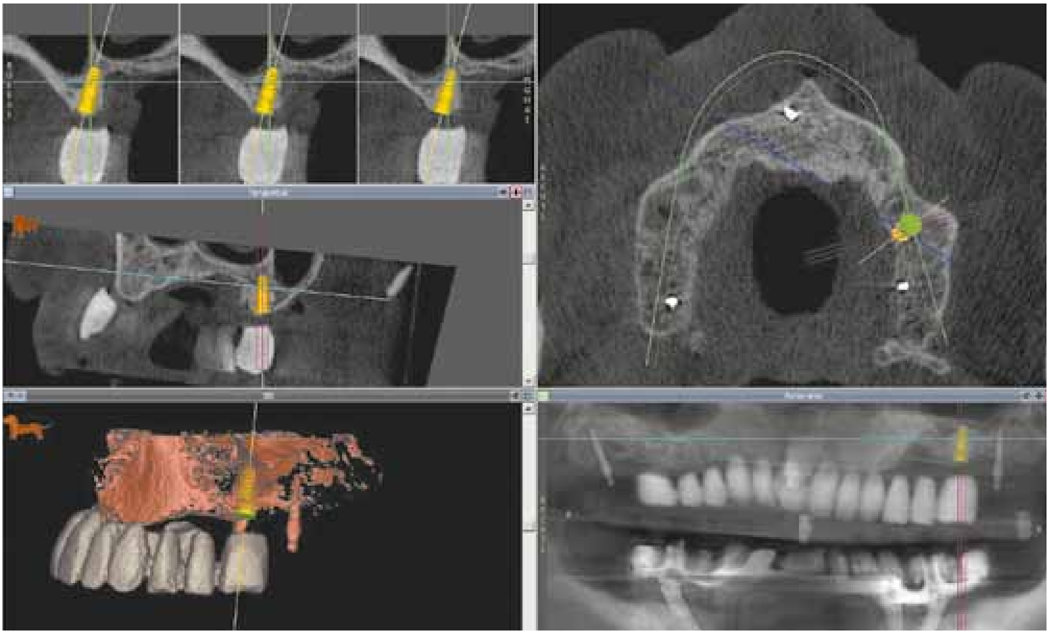

Fig 3-12 Tooth by tooth, the positions of the implants that best accommodate the prosthesis are planned according to the crestal conditions.

Fig 3-23 In navigated implantation, the temporary restoration can be prefabricated on the master model using the drilling template data without requiring previous impression taking.

Fig 3-24 The teeth are set up with veneers using the matrix fabricated over the initial waxup.

Fig 3-25 One prosthetic coping is set in polymerizing resin, and the positions of the others are kept exposed using tubes; the setup is cast using denture acrylic.

Fig 3-26 The provisional acrylic bridge with the set prosthetic coping at position 22.

Fig 3-27 The provisional is affixed using the coping that is already in place, and the remaining copings are encased with resin in situ with passive fit.

Fig 3-28 The incorporated maxillary provisional in occlusion with the definitive mandibular restoration.

3. The cavity is enlarged for the cylindrical core of the implant using appropriate drill bits corresponding to the bone quality (D3/D4 drill bits for soft and medium-hard bone, D1/D2 drill bits for hard bone).
4. Finally, the coronal part of the cavity is given a conical-cylindrical shape. In this process, no stress arises in the cortical bone. The bored hole extends approximately 0.5 mm beyond the length of the implant (Fig 3-29).

3.3.5 Surgical procedure in the mandible

The posterior support of the planned superstructure requires a stable and wide prosthetic base, extending from anterior to posterior[84]. The distal mandibular implants are therefore inserted at an angle over the mental foramen so that they emerge from the mucosa at position 05/06 rather than 03/04. This shifts the prosthetic support toward the second premolar, achieving the required broad prosthetic support[93,123] (Fig 3-30).

1. Once the midline is established, the positions of the two mesial implants are determined and the pilot holes are drilled (the distance from each of the two implants to the midline should be as equal as possible). The cavities for the two mesial implants are finalized corresponding to the bone quality, following the surgical protocol for the SKY implant system and taking into account the anatomical structures. The implants achieve primary stability after being inserted in just a few turns thanks to the double thread, so it is important to prepare the depth precisely to achieve an optimal implant position with high primary stability for immediate loading.

2, 3. The distal implants are positioned to create a polygonal shape, spaced at approxi-

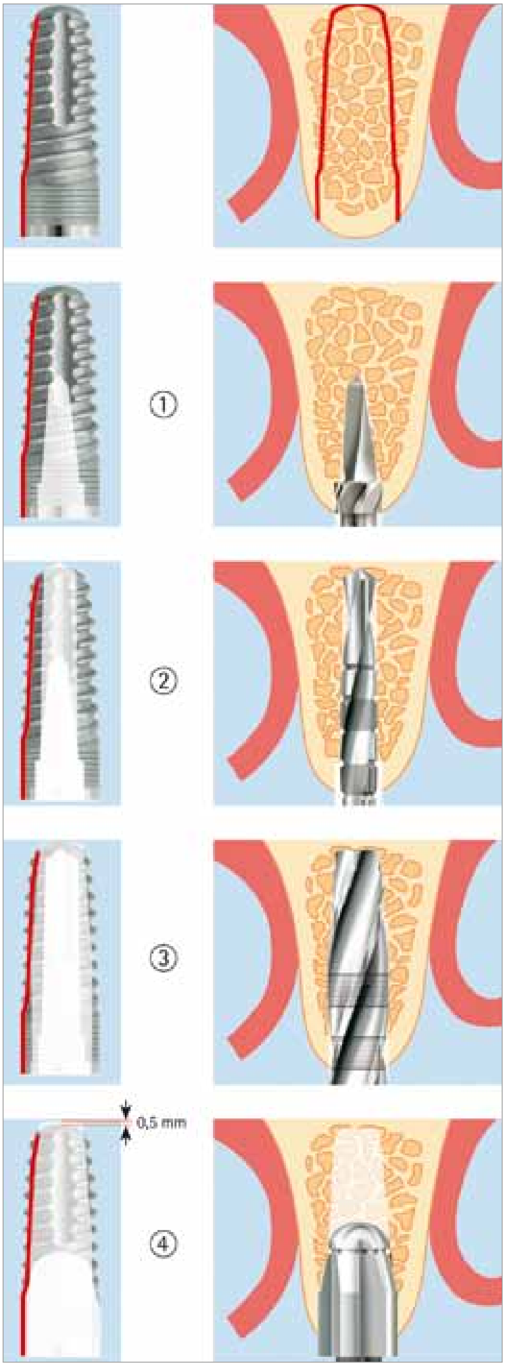

Fig 3-29 The cavities are prepared in only four steps.