New tools for optimizing the implantological workflow

Result-driven 3D implant and bone planning

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Oral implantology has traditionally prioritized the placement of the implants and only then looked for compatible prosthetic solutions. Implant placement itself has now become less of a challenge, so more attention has been drawn to optimizing the individual restorative treatment outcome for a given patient. What is optimal has been defined in functional and aesthetic terms as measured by an imagined ideal situation. In clinical practice, however, problems still persist with regard to the reconstruction of bone defects and with aesthetic and functional implant positions and soft-tissue management. For situations where major rehabilitation is required, implant numbers and positions continue to be the subject of controversial professional discussion.

In addition, the treatment objectives should be achieved as simply as possible, using appropriate and conditionally reversible techniques. Tissue trauma should be kept to a minimum. However, the status quo ante is more easily achieved today. Whether the cost-benefit ratio is favourable will have to be determined individually for each case. We must distinguish between two sets of criteria for implant success – general criteria, valid for all implants, and specific criteria, valid for special indications. The enormous progress made by oral implantology has raised expectations enormously. Even if one goes with the recommendation of the scientific societies that "the best therapy in tooth loss is replacing every single lost tooth by an implant". Even taking into account the oft-cited mantra that we must always aspire to reconstructing the natural situation, one still has to admit that while this may be true for single-tooth replacement and also for the replacement of multiple single teeth, it does not automatically hold for every kind of implant treatment. Less than optimal outcomes can have many reasons, from prerequisites that are not met, which leads to greater treatment risks, to socioeconomic limitations. The highly individual nature of every single case would preclude simple algorithmic solutions.

Prosthetic outcomes depend not only on implant placement but also on the use of bone substitute. Looking at the field of augmentation, we see no general recommendations for any specific method. This is unsurprising, as there are many different methods in clinical use; many of them are used only in a small number of cases and can look back on only a limited time of clinical experience. What amounts to the gold standard for one treatment provider might be considered obsolete by another. Table 1 shows the actual protocol used for augmentations, updated since the last publication (*Ehrl PA*, 2003). In the event of deficiencies in both height and width, a two-stage procedure is invariably used. If only the width is deficient, the procedure chosen will depend on the thickness of the bone, on whether spongious bone is present, in order to decide whether relatively simple techniques such as bone spreading are appropriate or whether bone substitutes must be employed. The transition from one-stage to two-stage procedures is a gradual one.

Materials and methods

Cone-beam computed tomography (CBCT) has been increasingly used at our clinic since 2000; by 2008, it had been used for all implantological interventions. 3D diagnostics by themselves undisputedly provide added insights, increasing the quality of the treatment. But 3D planning also always supports prosthetically based planning in addition to analyzing the anatomical situation, whether using standard plaster casts or – as has been possible for some time – digitally. Even before the introduction of 3D technologies, the so-called "backward-planning" approach (*Kirsch* et al., 2008) had shown visualizations of the

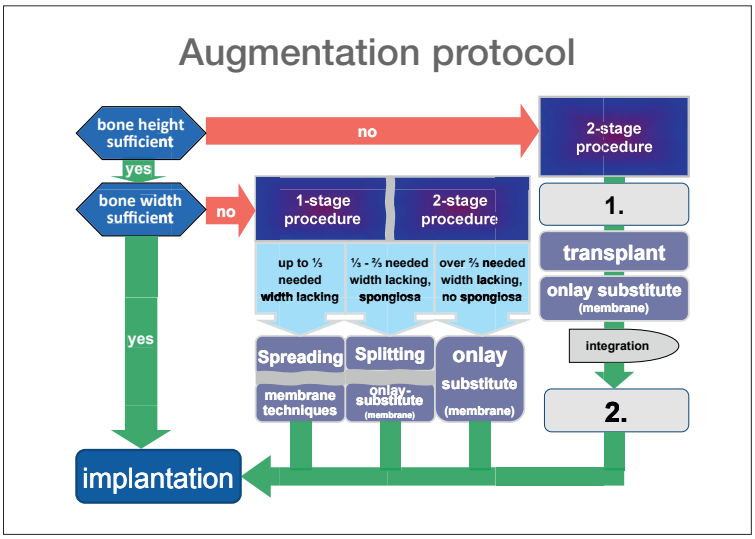

Table 1 Augmentation protocol.

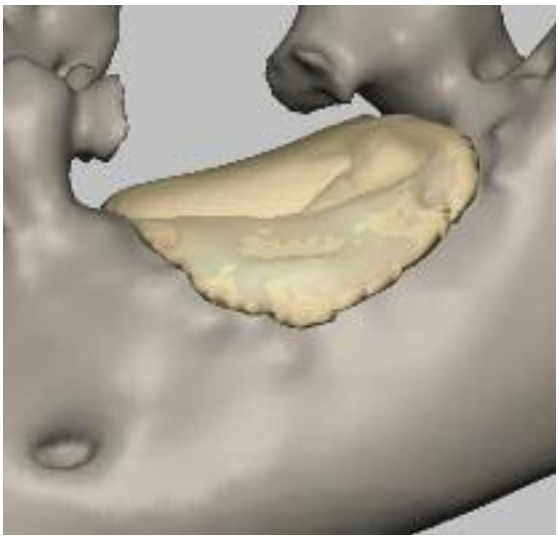

Fig. 1 Individual, digitally planned bone block, individually produced.

desired treatment result to be helpful. Here, too, we began by using 3D techniques and set-ups for more extensive procedures, but we eventually realized that it makes sense to use them even for simpler reconstructions such as single-tooth replacements.

Each of these two modes of treatment planning data – CBCT and analogue – is helpful in its own way, contributing to improve treatment results in the hands of an experienced implantologist. The logical next step now is to connect these two modes. One step that has already been implemented is the transition from the plaster cast and tooth set-up to digital models and digital reconstructions*. But while this approach is available today, it has not yet been sufficiently proven in clinical practice. The question still has to be answered as to which items on the nearly inexhaustible list of digital features are more suitable for the playful in mind and which ones are essentially useful in treating the patient.

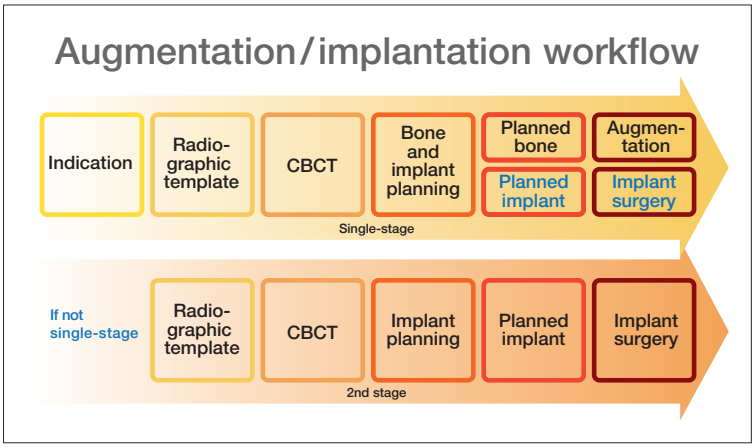

Table 2 Augmentation/implantation workflow.

Another aspect missing from the treatment planning process was that of anticipating the results of the bone augmentation process and – as a consequence – developing a suitable bone substitute in the first place. Today, the first steps in the right direction are being undertaken. It is now possible to create a digital model to calculate the required bone volume, regardless of what material is chosen. Within certain restrictions related to volume, bone blocks can be planned digitally and produced digitally** (Fig. 1).

What are the main features that characterize a 3D-based plan for implant placement and bone augmentation? Only by evaluating three-dimensional data can we anticipate preoperatively how the desired prosthetic result can be obtained. Having the final result firmly in mind constitutes a solid base for decisions related to whether and how to augment. Almost always, bone defects will be present whose extent must be evaluated. These have been described and categorized (*Fallschüssel*, *Atwood*, Cologne Classification of Alveolar Ridge Defects – CCARD), showing that the horizontal dimension is usually affected first, followed by a gradual loss of vertical height. But defect classifications are beginning to lose their importance, as 3D planning is capable of assessing individual situations. However, they are helpful in recommending certain reconstructive protocols (see Table 1). Table 2 shows the 3D augmentation and implantation workflow for one- and two-stage procedures.

** Sicat/Cerec, Optiguide procedure*
*** maxgraft bonebuilder (Botiss dental)*