



## Guest editorial

Oral rehabilitation of complete edentulism by means of implants is, and has been for decades, a predictable treatment option. It provides an improved quality of life, clearly superior to what can be achieved by mucosally retained dentures. But when the question is raised of how many implants one needs to properly deal with the rehabilitation of edentulous patients, opinions are sometimes country-specific, while science should be borderless.

The Foundation for Oral Rehabilitation (F O R) took up the challenge. Being a global network of experts and clinicians it always refers to scientifically sound and well-proven data, which are universally accepted. A number of reputed researchers and clinicians were selected to tackle the question of the number of implants needed, in a thoroughly scientific manner. Their selection was based on expertise, number of publications and their citation index related to this theme. Each one received a specific subject to critically review in the literature, and if data were sufficiently available to provide a meta-analysis. After exchanging their manuscripts, the experts met during 2 days at the University of Mainz. Travel and hotel expenses were taken care of by F O R, but no other compensation was provided.

For any elective surgery, the patient should be involved in opting among the wide range of treatment alternatives. All participants chose the patient-centred viewpoint as a starting point. For a removable overdenture, one can choose whether to have it on 2 or 4 implants in the mandible and 4 or more implants in the maxilla. Fixed prostheses are generally placed on 5 or 6 implants and sometimes even more in the maxilla.

When only a limited jawbone volume remains, it can be necessary to consider bone augmentation procedures to (optimally) place a sufficient number

of implants to support a fixed dental prosthesis with a long-term predictable outcome. The key question is whether a more limited number of implants, than the classical 5 to 6 and more, suffice. A more limited number of implants could avoid the invasiveness of bone augmentation/grafting procedures. A review of the literature (Nkenke and Neukam) underlined that, as an intraoral donor site for autologous bone grafting, the mandibular ascending ramus is preferable. The symphyseal area leads to the highest (incidence of) morbidities. The posterior iliac crest is a good alternative but implies mostly general anaesthesia.

Another meta-analysis (Al-Nawas and Schiegnitz) proved that the survival rate of oral implants placed in conjunction with augmentation procedures is as good with bone substitute material as with autologous bone grafts. Nevertheless, the bone augmentation procedure by itself is more invasive and more prone to postoperative pain and discomfort than the straightforward (flapless) placement of implants. Thus, if the treatment is patient-centred, avoiding bone augmentation should be considered. Patient satisfaction with graftless solutions is indeed very high and patients' preference to minimally invasive implant surgery well established (Pommer and Watzek).

The key question then becomes what should be the minimal/optimal number of implants to insure a reliable long-term outcome for the (fixed) prosthetic rehabilitation. Two decades ago (Brånemark et al<sup>1</sup>), it was shown in a large-scale retrospective study that the 10-year survival in edentulous patients of fixed dental prostheses on either 4 or on 6 implants was not significantly different. The tradition to insert at least 5 to 6 implants in edentulous jaws thus became questionable. Since very high survival rates are pres-



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The group of experts from left to right: Drs Gerry Raghoobar, Bernhard Pommer, Claudia Dellavia, John Brunski, Wilfried Wagner, Daniel van Steenberghe, Emeka Nkenke, Massimo Del Fabbro, Bilal Al-Nawas, Regina Mericske-Stern, Georg Watzek.

ently reached by implants with moderately rough surfaces, the concept of inserting supplementary implants just to avoid a revision surgery should one implant fail became more or less obsolete.

Furthermore, biomechanical calculations prove that with 4 implants to support a complete cross-arch fixed reconstruction, strains in the bone or at the bone-implant interface remain within the safe range (Brunski). Tilted implants, to insure a proper anterior-posterior spread, can even be subject to lower forces than axial ones (Del Fabbro and Ceresoli). Furthermore, the marginal bone level around tilted implants does not significantly differ from that around axial implants. The latter offers the possibility to achieve a good anterior-posterior spread with few implants.

Functional aspects of implant-supported rehabilitations have been investigated by different methodologies. The number of implants supporting the prostheses does not appear as a relevant factor in the functional qualities (Dellavia et al).

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When segmentation of the fixed cross-arch framework is necessary, more than 4 implants are needed (Mericske-Stern and Worni), which raises the treatment cost and can render a bone augmentation procedure indispensable. One may wonder why CAD-CAM technologies, which do reach the necessary precision of fit, are not used in these instances to keep the treatment less invasive.

We both feel privileged to coordinate this first F O R consensus conference. The multidisciplinary interactions favoured cross-fertilisation but nevertheless led to an iteratively written consensus document, which was unanimously approved.

The conclusions of this workshop should lead clinicians to also consider, for the benefit of their edentulous patients, less invasive procedures. Established scientific data, which should always prevail on traditions, do indeed prove that for complete edentulism, unless specific aesthetic and/or functional demands are pressing, 4 implants only can already provide a predictable anchorage for fixed prostheses.

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#### *Moderators of the Consensus meeting*

1. Brånemark PI, Svensson B, van Steenberghe D. Ten-year survival rates of fixed prostheses on four or six implants ad modum Brånemark in full edentulism. *Clin Oral Implants Res* 1995;6:227-231.