Patient-centred rehabilitation of edentulism with an optimal number of implants

A Foundation for Oral Rehabilitation (F O R) consensus conference

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CONSENSUS TEXT

■ Edentulism

Complete edentulism is a common problem in many countries and can be a serious disability. It concerns about one-fifth of the adult world population, in some countries reaching 50% at the age of 50. The decline in the prevalence of edentulism is offset by the increase of the elderly population. This leads to an increasing demand for implant-based treatments by the potential population of the 150 million who are completely edentulous.

The members of the consensus conference agreed that, when surgery is considered as a treatment option for edentulism, it should be seen as elective surgery.

■ Elective surgery

Elective surgery can be planned, or eventually postponed, since there is no (vital) medical emergency. The impact of eventual complications and patient discomfort will thus be perceived differently than for acute surgery. In elective surgery, decision-making must be shared with the patient, and based upon robust clinical evidence. This kind of surgery carries a greater risk for litigation. Therefore, clinicians must have well-defined guidelines available to be able to provide an informed consent – not to be confused with a consent form – to the patient.

Explaining the invasiveness of treatment alternatives, the optimal number and size of implants needed, and the prognosis and the cost of treatment, are important parts of the treatment plan information. Optimal can be defined as most effective, favourable or desirable. While choosing among clinical alternatives, the clinician should also consider the concept of risk-benefit function. The latter does involve the financial costs, the 'cost' of pain, of the time spent on the treatment, and of the patient's unavailability to normal social/professional life. The financial cost of different implant-based treatments has not been analysed by the working group. However, a recent publication on two patient cohorts, one with a mean of 8 implants in the maxilla and 5 in the mandible, vs. a fixed prosthesis on 4 implants only (Babbush et al, Impl Dent 2014;23:218–224) confirmed that the latter treatment option is, on average, several thousand Euros cheaper and less time-consuming than the historical treatment with ≥ 5 or 8 implants.

■ Optimal number of implants needed

In the 1980s, Brånemark and co-workers proposed, for the rehabilitation of complete edentulism, the installation in an arch-wise mode of 6 implants as the gold standard of care. Completely edentulous patients sometimes lack a sufficient volume of bone of adequate quality to allow the installation of 6 implants with good primary stability. Various bone augmentation procedures have thus been performed to be able to reach that goal when the bone available was too limited.

The main focus of the present consensus meeting, which was based on a series of 8 individual critical reviews of the literature[1-8] and prepared by the members of the consensus group, addressed different aspects of patient-centred rehabilitation of edentulism. They analysed different treatment options and how many implants are really needed to carry/retain complete cross-arch prostheses, either removable or fixed. The impact of the number of oral implants, supporting/retaining the dental prosthesis, was assessed from different aspects: quality of life and functional aspects; biomechanics; survival rates; and marginal bone level changes. Furthermore, the side-effects of bone graft harvesting from different donor sites was analysed and the potential of bone substitute material in bone augmentation scrutinised. The latter two reviews, dealing with bone grafting and bone substitute materials, identify the assets and liabilities of eventual bone augmentation procedures in the rehabilitation of completely edentulous patients by means of implants.

Discomfort related to bone augmentation

While pain experience and/or consumption of painkillers following implant placement is low and limited to a few days (and even less when a flapless technique is used), for bone grafting procedures, the pain level seems generally higher. The morbidity is especially pronounced after horizontal and vertical crestal bone augmentation procedures, compared to the less invasive sinus inlay grafts.

Much depends on the graft donor site. For cortico-cancellous grafts of the iliac crest, pain can be moderate to high for several days. A disturbed gait is observed in rare instances. Unassisted ambulation can take a few days. For trephined bone samples from the iliac bone, or from other extraoral donor sites, this side-effect is more limited. Ambulatory intraoral graft harvesting is much less uncomfortable, with moderate pain experience for a few days only. The mandibular ramus area seems to be the preferred donor site. The symphyseal donor site leads to the most pain and other side-effects like (permanent) sensory disturbances.

Reliable placement of implants sometimes necessitates simultaneous or staged bone augmentation procedures. If such discomfort and even the remote possibility of more side-effects can be avoided, one should consider graftless treatment options. For example, different implant locations and inclinations, a reduced number and/or size of implants, etc., can offer a long-term predictable outcome. Bone augmentation in the anterior areas of patients with extreme maxillary resorption can lead to soft tissue dehiscence and other complications. Bilateral sinus lifting procedures, either with or without bone addition, with 2 to 3 implants on each side, seems a predictable approach to avoid anterior bone augmentation procedures.

The pros and cons of both approaches, invasive and less invasive, should be discussed with the patient before choosing the best individual adapted approach.

Data from literature

The available literature on the rehabilitation of edentulism remains generally below the highest levels of evidence. Randomised controlled trials are rare or the randomisation does not concern different treatment modalities. For the present analysis, such studies should then be referred as prospective.

Another problem when referring to the literature is that nearly all papers originate from centres of excellence. Since implant treatment, both surgical and prosthetic, is technique sensitive, the published results may have low external validity and may not reflect the daily practice outcome. The group advocates to encourage multicentre studies and to conduct, in cooperation with implant manufacturers, post-market surveillance studies.

Biomechanical considerations

The optimal number of implants must be chosen on the basis of patient cost and perceived patient benefit, besides local factors such as bone and soft tissue quantity and quality, primary implant stability and anterior-posterior spread of the implants. Limiting loading forces on implants and superstructures

are relevant, but the calculation of stresses in the surrounding bone is even more important. Managing loading and stresses so they are in a safe and effective range is a design goal.

Tilted implants show high survival rates, are not subject to more marginal bone loss than axial ones after 1 year and beyond, and help achieve a sufficient anterior-posterior distance when only 4 implants can be placed. Biomechanical model calculations in such 4-implant configurations indicate the merit of tilted implants. For example, the forces in the tilted configurations can be lower than for axial ones due to a greater anterior-posterior spread and more limited cantilever spans. Tilting also allows the use of longer implants and to avoid important anatomical structures such as the mental nerve.

The positioning of tilted implants is technique sensitive. Guided surgery may be an option to improve the precision of angulation and position.

Prosthetic aspects

It seems technically demanding if not impossible, if CAD-CAM technologies are not used, to achieve a perfect passive fit of the cross-arch prosthesis in cases where 6 implants are being deployed. In the lower jaw, additionally the mandible's flexion may encourage segmentation of the prosthesis. When segmentation of the fixed metallic framework is considered, the consequence is that more than 4 implants are needed.

Functional aspects

Besides biomechanical aspects, functional parameters on the different prosthetic treatment options to rehabilitate complete edentulism indicate that with the fixed prosthesis, one comes closer to the function of dentate patients than with removable (implant-supported) prostheses during clenching. However these improvements were not so relevant during chewing.

In the mandible, overdentures also enhance the jaw function and quality of life. Edentulous patients with implant-supported prostheses do not seem to adapt to the hardness of food. The number of implants supporting the fixed prosthesis has never emerged as a relevant factor in the literature on jaw function.

Optimal number of implants in mandible/maxilla for removable/fixed prostheses

In the mandible, 2 implants to retain an overdenture seems highly reliable and satisfactory. One can opt for 4 implants if a tilting prosthesis is not the best option (e.g. with young patients, considering the slow resorption of distal parts of the mandible). Some studies report that even one central implant can stabilise an overdenture in the mandible.

In the maxilla, 4 implants to retain an overdenture leads to high survival rates and very good patient satisfaction. To support fixed cross-arch prostheses, a wealth of clinical reports reveal that 4 and even, for the mandible, 3 implants can suffice. In the maxilla, the placement of two frontal axial implants and two distal tilted implants leads to high survival rates. The placement of supplementary implants, just to avoid revision surgery should a failure occur, does not seem reasonable anymore. Local anatomical factors such as poor/limited bone, aesthetic or phonetic arguments, or different prosthetic concepts may lead to ≥ 5 implants in the maxilla.

As a conclusion, if a fixed prosthesis is the best treatment option for a patient, in the maxilla 4 to 6 implants are appropriate numbers if their placement does not necessitate major bone grafting procedures. If bone grafting is being contemplated to allow 6 implants, it should be recalled that 4 implants of standard dimensions, with the two distal ones tilted, is a well-documented and reliable alternative treatment option.

An argument against using as many implants as possible in edentulous jaws is the fact that a minimal distance is necessary for soft tissue healing around each implant and to allow cleaning. Thus, the 1 implant per tooth treatment option has become questionable.

The reduced size of endosseous implants sometimes allows for the circumvention of the need for grafting procedures. The consensus group re-emphasises that, while previously short implants

meant <10 mm, more recently 'short' refers to ≤ 8 mm. Narrow implants are those of ≤ 3.5 mm.

Another technique to avoid the more invasive bone augmentation procedures is the use of extramaxillary anchorage places, such as the zygoma. The use of 2 to 4 zygomatic implants, with or without anterior implants, seems a reliable option to carry a complete fixed prosthesis.

General conclusions

Treatment options should be evaluated from the perspective of anatomical features and patient preferences, taking into account all risk-benefit aspects and especially the evidence from the scientific literature. Therefore a need for randomised controlled trials and comparative multicentre studies with good external validity clearly exists.

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