**TITLE PAGE**

**Title: RECENT ADVANCES IN IMPLANT OVERDENTURE**

**Type of article:** CHAPTER

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The development of modern implant dentistry has been extremely rapid. In past 20 years after introduction of osseointegration there have been rapid changes in implant dentistry. During early period, the Branemark group considered prosthodontic treatment associated with implants synonymous with fixed implant – supported prosthesis. Fixed implant – supported prosthesis is expensive & available to only a small portion of edentulous patients. Therefore when osseointegrated implants entered the international arena, other prosthodontic alternatives were introduced & tested. Implant supported or retained overdentures were described. This treatment modality has been investigated widely during the past few years, & reviews of the growing literature confirm that implant overdentures are a successful prosthetic treatment.

Even if there is consensus regarding mandibular implant overdenture, controversy persists concerning treatment concepts & indications. Some issues are still debated among clinicians, eg number of implants, anchorage design, patient satisfaction long term costs of different retention systems, & removable versus fixed prostheses. Efforts at finding evidence – based answers to these concerns will be important in the future of implant dentistry. Furthermore, new problems will appear. The solutions will be found in continuing research in close collaboration with clinical activity & development.

**Trends And Possible Goals For Mandibular Implant Overdentures**

**Patient Satisfaction & Masticatory Function**

 At a conference in Toronto in 1998, a critical review of literature on the patient – based out comes of implant therapy surprised the audience. The benefits of implant – supported prosthesis were questioned because most studies had design flaws that threatened their internal validity. The reviewer noted that, from strictly scientific point of view, the studies conducted up to 1998 provided little scientific more benefit to edentulous patients than alternative forms of treatment. It was concluded that further research was needed using randomized controlled trial (RCT) designs. Outcome measures need to be more carefully selected so as to reflect patient concerns. More recent studies have addressed patient satisfaction & verified that patients with implant overdentures had higher satisfaction scores that complete denture wearers, even in comparison with those who had prosthetic surgery to enlarge the denture – bearing area. In one recent study using patient-based assessments it was found that patients who chose complete dentures when implant supported denture were available reported significant improvement after treatment, as did those who received implant treatment. Both groups reported much greater improvement compared to the patients who received implants but received complete dentures. During the past few years, a series of RCTs have shown higher satisfaction and oral health related quality of life among patients with implant overdentures than among those with conventional dentures.

 Cross-over studies have been conducted for comparison of fixed versus removable implant supported prostheses. The removable design was selected (by half of the patients) for ease of cleaning, among other reasons, whereas the fixed prosthesis was chosen because it provided better stability & ability to chew. There was no difference in general satisfaction between the fixed & removable treatments, but patients found the fixed prosthesis to be better for chewing harder foods. Improvements in bite force & chewing efficiency following implant treatment in edentulous patients has been demonstrated for many years, & similar results for mandibular overdentures have been presented.

**NUMBER OF IMPLANTS43**

The theory that more implants will better support a heavy functional load may be true from a theoretical biomechanical point of view & it explains the early uncertainty about how many implants to use for supporting or retaining an overdenture. However, numerous clinical prospective studies up to 12 years have proven that two mandibular intraforaminal implants, splinted or unsplinted, retaining an overdenture provide successful treatment for edentulous mandibles.



**Fig. 12.1** Single implant inserted in mandibular midline area and serves as overdenture anchorage.



**Fig.12.2** View of ridge-facing surface of overdenture with rubber ring in attachment counterpart



**Fig. 12.3** Radiograph of standard threaded implant at 36 months after prosthetic loading. Minimal marginal osseous resorption at proximal aspects of implant



**Fig. 12.4** Orthopantomogram of patient with a symphyseal single-tooth implant placed in an atrophic mandible



**Fig. 12.5** Ball attachment in the symphyseal region



**Fig. 12.6** Mandibular complete denture with single attachment

A few studies compared mandibular overdentures supported by two, three, or four implants (fig12.1, 12.2, &12.3). Results indicate that two implants are sufficient in general & this seems to be the most common choice today. The recommendations to use more than two implants in special situations appear to be based on controlled clinical studies. Such studies would be desirable to provide a better decision making. However, there is consensus that, for great majority of edentulous patients, two intraforaminal implants are sufficient for a successful mandibular implant overdenture.

The possibility of reducing the number of implants to one has been tested in a 5 year prospective study of 21 elderly patients (fig 12.4, 12.5&12.6). None of the implants was lost during the follow -up period and “remarkable improvement of oral comfort and function was evidenced with the overdenture treatment”. Similar success was reported in a more recent investigation with fewer patients and a shorter observation period. The authors of both studies emphasized the benefit of their method, especially for geriatric patients with severe denture problems, because it is relatively inexpensive and is a surgically and prosthetically simple way of retaining a complete denture. In spite of these successful results, the method with only one implant doesn’t seem to have become more widely accepted. However this alternative deserves to be investigated using an RCT that compares the outcome of complete dentures to mandibular overdentures anchored to one implant.

**RETENTION SYSTEMS**

Several retention systems for implant overdentures have been described in the literature. However supported by two implants, the implants can be interconnected with a bar or remain unsplinted. The first implant overdentures used a bar clip attachment, but the use of unsplinted implants has increased. Currently, unsplinted implants with ball attachments are the most common system, but the choice of a specific system can be based more on subjective preferences than scientific evidence. In vitro studies have reported conflicting results regarding stresses and loading on implants and surrounding bone with different splinted and unsplinted retention systems. However a clinical longitudinal study has found no differences in implant survival and peri-implant variables.

If implant survival rates don’t differ among the retention systems, other factors may be important. Implant overdentures has been shown to require substantial prosthodontic maintenance, especially during the first year of service. Whether the splinted or unsplinted design requires more maintenance is controversial, and the literature is not conclusive regarding comparisons between barclip and ball attachments. Magnets on unsplinted implants also have to retain overdentures, but the retention is poorer which can influence patient satisfaction. A recent study demonstrated that ball attachments of three different implant systems required different amounts of maintenance, even if the overall prosthetic maintenance was similar. Two out of three patients required prosthetic maintenance in the first year and the matrices of two of the studied implant systems “showed problems of clinical significance”. Time and cost implications should be included in the economic aspects of the various treatments. One study estimated the cost for prosthetic and laboratory service at US $218per patient over a 3 year period.

**IMMEDIATE LOADING**

The extreme successful results with osseointegrated implants placed according to the two stage procedure have led to attempts to reduce healing time. Several studies have demonstrated immediate loading as a successful option for fixed prostheses. The optimal solution is probably the Branmark Novum technique, which allows patients to receive a mandibular fixed prosthesis supported on three implants on the day of implant surgery. Mandibular implant overdentures loaded immediately or after a short healing time have shown high success rates in a few short term studies indicating that this may be a promising treatment option.

**BONE PRESERVATION**

Complete denture wearers inevitably exhibit continuing bone resorption of the residual ridges. This can be substantially reduced if a fixed implant- supported prosthesis is placed and several studies claim that such treatment helps preserve the existing residual bony ridge. For patients with implant overdentures, the anterior bone adjacent to the implants resorbs very little; there are conflicting reports regarding the effect on the posterior residual ridge. A recent study concluded that patients rehabilitated with mandibular bone apposition in the posterior mandibular region, where as those with implant overdentures showed low rates of residual ridge resorption. Bone resorption does not appear to be a serious concern when mandibular implant overdenture are used but the restoration of some of the previously resorbed bone, as seen with fixed implant supported prostheses, is an exciting possibility.

**IMPLANT OVERDENTURES VERSUS FIXED IMPLANT PROSTHESES**

The literature provides strong evidence that an implant overdenture is a very successful treatment alternative for the edentulous mandible in comparison with complete dentures. Cost is the only factor that makes complete dentures more favorable. Even if the use of implant overdentures is growing rapidly, the concept is not yet universally accepted. In Sweden, for example, implant overdenture treatment is rare and fixed prostheses still are the most common implant therapy for edentulous mandibles. A survey of specialized prosthodontic clinics in Sweden found that several clinics didn’t perform this treatment at all, and the median number of overdentures provided per clinic in 2001 was 2, whereas the corresponding figure for fixed implant prostheses was one. Explanation is perhaps the preference for fixed rather than removable prostheses, which may be partly related to a favorable Swedish dental insurance system. The interpretation of available results regarding advantages and disadvantages of fixed and removable implant restorations may vary depending on, for example, economic and cultural background factors.

Determination of future directions for treatment of mandibular edentulism requires a comparison of the main alternatives. The traditional complete denture has been a fairly successful treatment for a majority of edentulous patients and most likely will continue into the foreseeable future in a global perspective. With respect to demographic changes such as the growth of the elderly population, which leads to an increased number of edentulous patients, conventional complete denture treatment continues to be important despite the decreasing rate of edentulism. The proven possibility of implants to overdenture several shortcomings of complete dentures will most probably result in a continuing increase of implant – anchored prosthesis. The international distribution of removable and fixed prostheses is not well known and more epidemiologic data are needed. The literature reveals that the use of implant overdenture is increasing in many countries whereas fixed implant prostheses are preferred in others.

In cases of advanced ridge resorption in which facial tissue support is needed from the flanges of the prosthesis or when a removable type of prosthesis is preferred by the patient, an implant-supported prosthesis is indicated. Electric discharge machining is often used in the fabrication of the bar for an implant-supported overdenture. This procedure is very costly and technique sensitive. Daniel F. Galindo discussed an alternative procedure to fabricate a milled-bar implant-supported overdenture. This procedure is simple and uses inexpensive equipment and materials. The milled-bar minimizes lateral and rotational displacement. The overdenture incorporates attachments that provide retention, minimizing possible movement along the path of insertion. This type of prosthesis is available to a broad patient population, especially those with advanced ridge resorption, providing an excellent result at a reduced cost.

There are two main objectives of computer-aided design (CAD), computer-aided machining (CAM): guided dental implant placement and restoration. The first allow the precise planning of implant positions on computed tomography scans, and the second is to generate an accurate surgical guide that permits the surgeon to place implants precisely into planned positions allowing the immediate prosthesis placement (Fuster-Torres et al., 2003).

 Rogelio Margonar stated that the guided surgery is an excellent option of treatment for patients with satisfactory bone quantity for implant insertion. The guided surgery can be indicated for complete and partially edentulous arches in the maxilla and/or mandible.

When properly prescribed and monitoring, the virtual planning and the guide surgery are excellent tools used in implantology to perform surgical procedures with more safety, comfort and predictability to the patient.

In addition to the clinical complications that are imposed by the replacement of a decaying multi-root tooth, when comparing the dental implant to the organ in consideration (natural dentition), several discrepancies are eminent from the functional and physical perspective. In contrast to other load-bearing endosseous implants where a function is being replaced; e.g. hip joint replacement or knee joint replacement a dental implant is replacing a complete organ which constitutes of a plurality of functions which drastically affect the well-being of a patient. One general discrepancy is the difference in micro-motion provided by a dental implant, when compared to natural teeth. A summary is portrayed in Table 1, extracted from (Misch, 2008), where a difference in functionality between natural dentition and dental implants is prominent due to a lack of initial movement (micro motion) in the latter.

A common complication in endosseous implants, the elasticity mismatch causes ”stress shielding” which results in disuse bone atrophy manifesting in crestal bone loss in the case of dental implants and a higher risk of implant loosening (Vaillancourt, et al., 1996).

Immediate loading and pre-fabricated provisional restorations are other advantages of CAD/CAM surgical guides. By using a CAD/CAM surgical guide, a pre-fabricated provisional restoration can be delivered immediately after implant placement, which increases the patients’ self-confidence dramatically. CAD/CAM technology has significantly improved the restorative aspects of implant dentistry as well. Implant restorations can be supported or retained by individual attachments, splinted with a bar for an overdenture, or splinted by a framework that supports a fixed restoration such as a hybrid. Prior to CAD/CAM, bars and frameworks had to be cast from gold alloy.

CAD/CAM applications have surged in the market over recent years. There are now multiple commercial sources that can produce purely CAD/CAM bars and frameworks, or copy-milled CAM structures for implant prostheses. Procera from Nobel Biocare, CAM Structure from Biomet 3i, and Vericore from Whip Mix are just a few examples. Most companies offer stock designs such as a Dolder bar or Hader bar that can be masked on a virtual master cast of the implant analogs and soft tissue contour. The stock design is then contoured to the arch form, and modifications can be made to idealize the bar design. A second scan of the wax denture can be overlaid in order to allocate adequate space for attachments and adequate thickness of the resin denture base. For ceramic frameworks, a scan of the full-contour wax-up can be matched to the virtual master cast, and a virtual cutback can be performed to allow adequate thickness for veneering porcelain.

CAD/CAM technology has revolutionized the field of implant dentistry. CAD/CAM surgical guides have greatly improved the predictability of implant surgery. CAD/CAM bars and framework have proven more accurate, less expensive, and less time-consuming to produce. All of this results in improved experience for the patient, decreased treatment time, and greater accessibility.

The future of dentistry is quickly approaching, Digital impression systems and CAMed models for tooth born restorations are rapidly expanding in the market. Virtual tooth libraries allow CAD/CAM of both provisional and final tooth-born restorations. Numerous implant companies have already designed abutments for compatibility with digital impression systems. Just on the horizon is virtual articulation and virtual tooth arrangement, thus completing the virtual relm of dental technology. It is clear that CAD/CAM technology has transformed all aspects of dentistry, not just implant dentistry.

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