CHAPTER 7

General Discussion
A common complaint of edentulous patients wearing conventional dentures is the lack of stability and retention of their mandibular prosthesis. These problems can be solved by using endosseous implants to which an overdenture is attached. The literature is unequivocal on the advantages of the implant-anchored prosthesis. In particular, the two implant-retained overdenture is an established treatment option to improve the quality of life in edentulous patients.¹ In the past, a prolonged healing period was considered an important condition to achieve osseointegration.² It was recommended to keep the implants load-free during the healing period to prevent micromovement, which could jeopardize the success of the implants.³ Immediate loading was seen as a factor that could lead to micromovement, causing fibrous tissue encapsulation at the bone-implant interface, compromising osseointegration.⁴

More recent studies, however, indicated that implants can be loaded early or immediately if the micromotion lies within a threshold of 50 to 150 µm.⁵ A high value of insertion torque is therefore a prerequisite for immediate loading. It indicates a high degree of primary stability and therefore less chance of excessive micromovement that can lead to micro-gap formation, which could in turn cause significant changes of the crestal bone level. In our main study (chapter 4), it was not possible to achieve the required primary stability for immediate loading in all patients during implant insertion when treated with the standard-sized implants. Furthermore, at the time of fitting of the suprastructure the torque-control screwing of the synOcta abutments caused rotation of the implants in several cases, after which healing abutments were inserted and the dentures were relined with a soft relining material. In these cases, the immediate loading protocol was abandoned and a delayed loading protocol was adopted. The implants that were delayed loaded were successful in most patients, however, four implants in three patients failed to osseointegrate. The rotation of the implants during fastening of the synOcta abutments might have resulted eventually in soft tissue encapsulation. However, since it was also observed that these failed implants were placed rather soon after commencing of the study, we cannot exclude the possibility that the implant failures are attributable to the initial learning curve of the operator.

In this thesis we evaluated whether a relatively new treatment modality, the rehabilitation of the edentulous mandible with implant overdentures (IODs) retained by four mini dental implants (MDIs), could be an alternative to the existing therapeutic approaches. Although, the number and diameter of the implants used to support overdentures are important factors for the ultimate treatment outcome, our systematic review (chapter 2) showed that no recommendation could be made on the appropriate size of the implants with respect to the immediate loading protocols in the edentulous mandible. The vast majority of the studies included in the literature review used implants with a diameter equal to, or higher than 3.3 mm. An alternative to standard diameter implants in the edentulous mandible is the use of narrow implants or MDIs. The MDI is a one-piece implant that does not require a separate abutment. This simplifies the restorative phase and reduces costs for the patient. The literature review showed that the MDI has the potential to substitute
the current standard of care for the edentulous mandible (two standard-sized implant overdenture) and can be a viable alternative. In case of narrow ridges, utilization of MDIs could be an alternative to the augmentation of the ridge or to excessive alveoloplasty, which might otherwise be needed to provide adequate bone width for placement of conventional implants. If this treatment is sustainable in the long term, it might be a solution particularly suited for medically compromised patients. These patients would otherwise be excluded as a result of health problems that preclude extensive surgical procedures. Compared to an augmentation procedure, the use of MDIs is a significantly less invasive procedure, resulting in reduced bleeding, decreased postoperative discomfort and shortened healing time. The insertion technique could often be minimally invasive (flapless) resulting in the preservation of the peri- and endosteal blood supply, and thus in the enhancement of the osseointegration process. Avoidance of flap surgery might aid healing as the periosteum is left undisturbed. In the present study, however, we elevated in all cases a mucoperiosteal flap identifying at the same time the mental foramen. This might allow for a more favorable spread of the implants, compensating simultaneously for the potential presence of an anterior loop. In the literature there are insufficient data to suggest which is the best flap design. The limitations and risks of the flapless surgery should be considered, since the sharp and thin drills required might cause perforation of the cortical plate of the mandible or damage of important anatomical structures. Clinicians should decide whether to place implants flapless or not with a great deal of caution in relation to their own clinical skills and experience.

Undoubtedly, an implant-retained overdenture requires more meticulous treatment planning than a conventional complete denture. A thorough radiographic examination as part of the preoperative planning is essential to estimate the quality and quantity of the alveolar bone and to locate important anatomical structures. In our study (chapter 4), there were cases where the identification of the incisive canal on the cone beam computed tomography (CBCT) scans resulted in an adjustment of the length and/or the location of the implants planned to be inserted based on the information provided by the panoramic radiographs alone. However, this adjustment might have introduced a new problem, since the two failed MDIS were placed—in order to avoid potential damage to this structure—in a less optimal bucco-lingual position compromising possibly the osseointegration process. Ignoring the presence of the incisive canal and the associated neurovascular bundle can cause discomfort for the patient during preparation of the implant site and can contribute to postoperative pain. Dentists might generally be unaware of the importance of this anatomical structure, or they tend to underestimate it (chapter 6). The limitations of a panoramic radiograph with regard to detecting the route of the mandibular incisive canal were emphasized in a study by Jacobs et al in which this route could be detected in only 15% of the two-dimensional images. Therefore, it has been argued that CBCT images may enhance the visualization of important anatomical structures such as the incisive canal and the associated neurovascular bundles prior to implant placement in the anterior mandible.
Figure 1. MDIs: Implant insertion

Figure 2. MDIs: Postoperative radiographic view

Figure 3. MDIs: Postoperative clinical view at 1-year follow-up
An additional consideration during placement of the MDIs is the risk of implant fracture because of their reduced diameter and the insertion technique applied. In our study, in only one occasion the prosthetic head of an implant was fractured during placement. The remaining part of the implant was removed and another implant was placed at a distance of 2 mm. The risk of MDI fracture during placement is increased in cases where a high insertion torque is applied. Depending on the location of the implant fracture, it might be difficult to remove the residual parts of the fractured MDI. It is important therefore to follow the manufacturer’s instructions, especially in the presence of dense bone. By contrast, implant fracture during function is an uncommon event, because the overdenture is not only supported by the rubber O-rings, but also by the soft tissue. There is no immediate contact between the metal housing and the top of the ball attachment, preventing overloading of the implants. The reduced surface area of the MDIs necessitates, however, the use of more implants to prevent complications caused by the application of excessive loading forces. Clinical and radiographic views of the MDIs are shown in Figures 1, 2, and 3.

Another dilemma associated with immediately loaded MDIs to retain IODs is the technique of incorporating the attachment matrices into the intaglio surface of the overdentures. One approach is to pick up the matrices for the ball attachments intraorally and attach them into the fitting surface of the mandibular denture immediately after surgery. This is an important step and, if not performed correctly, it might influence the overdenture fit negatively or contribute to the dislodgement of the matrix from the overdenture. Before the attachment is picked up, the appropriate space in the intaglio surface of the denture should be created to ensure passive relief of the denture. In addition, all measures should be taken to prevent contact of the acrylic resin with the sutures and the surgical wound. An alternative protocol includes incorporation of the matrices into the overdenture in the dental laboratory. In our study, we followed the indirect prosthetic protocol since the laboratory facilities were available. In this manner, we could reduce the risk of errors during the pick-up procedure. Limitations of this method are that this service is not always available and there are extra costs associated with the laboratory work. At a clinical practice setting the direct protocol can be applied, provided that all measures are taken to ensure an accurate incorporation of the matrices, and to prevent any damage to the underlying soft tissue.

To determine success of implant therapy, radiographic monitoring of marginal bone loss (MBL) during function is mandatory. However, it is difficult to compare the reported implant success rates in the literature due to the limitations related to the methods of measuring marginal bone level changes. In general, either panoramic radiographs or intra-oral radiographs can be used to evaluate MBL around implants placed in the edentulous anterior mandible. In the pilot study (chapter 3) the MBL was assessed by means of panoramic radiographs. Although this method of measuring the MBL has been applied in many publications, the distortion that takes place in the interfurcal area of the mental symphysis may result in reduced accuracy and validity of this technique. Instead, intra-oral standardized radiographs are suggested to overcome the shortcomings of the
panoramic radiographs. In our main study (chapter 4) a customized jig was fabricated to acquire reproducible images. Still, obtaining serially identical radiographs is a challenging task. If a holder allows only a 1° variation in vertical angulation between films made in time, a false assessment of alveolar bone height could be recorded. Another possible limitation was the fact that the baseline radiographs were taken one week after insertion of the implants, although our initial plan was to make the radiographs at the time of implant placement. The reason was that because of the swelling present after implant placement, it was extremely uncomfortable for the patients to tolerate the film into the mouth. It can be argued however, that the observed changes in marginal bone level during this initial healing period of one week are only estimates.

It should be emphasized that implant therapy still requires to adhere to the basic principles for fabricating conventional complete dentures. IODs are implant retained but still a significant part of the support is provided by the supporting tissue due to the rotational movements during function. Therefore, it is important to provide maximum coverage of the edentulous alveolar ridge and proper functional adaptation of the prosthesis. When an overdenture is retained by two interconnected implants, rotational movements of the denture around the bar are present. The result might be a wider distribution of the masticatory forces, causing an increased resorption in the posterior region compared to the amount of resorption observed when four interconnected implants are used to support IODS. In the case of the MDIs, although a certain degree of overdenture rotation is permitted by the incorporated attachment system, the wider spreading of the implants might concentrate the forces over them, reducing the forces applied to the posterior region.

The positive clinical outcomes after conversion of conventional dentures to IODs were accompanied by a higher level of patients’ satisfaction and oral health-related quality of life (OHRQoL). This was evaluated by means of Visual Analogue Scales and an Oral Health Impact Profile (OHIP-20) questionnaire that were completed by the patients before implant placement, and three and twelve months afterwards (chapter 5). The improvement in the aforementioned patient-based outcomes was equally significant for both types of implants examined. The positive change was evident three months after fitting of the suprastructure and was sustained at the 12 months follow-up. These questionnaires provide a better insight into patients’ perception of how implant therapy contributes to their satisfaction and OHRQoL and should therefore be considered in clinical trials. In addition to their improved scores on the questionnaires, it was quite obvious from patients’ feedback during the follow-up appointments that they were highly satisfied with the implant treatment. An indirect proof for this might have been their post-treatment commitment to the follow-up appointments. Except for one patient who failed to attend the 6 and 12 months follow-up appointments, all other patients attended all the appointments throughout the observation period.
In the present study, although complete outcome data were available for all subjects, a direct comparison of the clinical and radiographic outcomes was not possible. The baseline measurements for the patients in the delayed loading group were done at the time of fitting the implant overdentures, which was at least three months later (or even longer in the cases implant failures were encountered) than in the immediate loading group. However, technical complications could be compared, assuming as a baseline for all patients the time of insertion of the IODs. A limitation of the study design was the inability to recruit the number of patients originally planned based on the sample size calculation. Adhesion to the inclusion and exclusion criteria resulted in rejecting patients for - among other - reasons such as inability to communicate properly because of language problems or uncertainty of whether they could attend regularly and predictably the follow-up appointments. Another possible shortcoming is that all surgical and prosthodontic procedures, including the clinical follow-up measurements, were executed by a single operator. This can raise questions about the reliability and validity of the measurements. It was, however, difficult to recruit additional observers available at all review appointments. The single operator calibrated himself and approached all patients in the same, predictable and systematic method, so that the surgical and prosthetic techniques applied as well as the measurement performed were to a great extent standardized.

Overall, clinical and radiographic outcomes of immediately loaded MDIs used for long-term stabilization of overdentures as an alternative to standard-sized interconnected implants are promising. Despite the limited scientific evidence on the long-term clinical performance, it is estimated that the demand for MDIs will increase, especially for specific groups of patients. Common complaints such as poor fit and retention, discomfort and soreness, and chewing difficulties can be solved to a great extent with implant overdentures retained by immediately loaded MDIs. Patients’ desire for more stability and comfort can also be fulfilled by this therapeutic approach. As with any treatment modality, aftercare and maintenance is vital if the overdenture is to be successful. The patients must be advised accordingly and reviewed regularly.

Although the results presented in this thesis are encouraging, longer follow-up periods are needed to confirm the outcomes of this short-term study. More well-designed studies are needed to evaluate the clinical performance and the treatment effect of mini dental implants as an anchorage to retain mandibular overdentures and to further substantiate this treatment modality. It is the author’s recommendation that when an immediate loading protocol is adopted, sound clinical judgments should be followed, initial primary stability of implants should be ensured, and biomechanical load distribution should be optimized via appropriate prosthodontic design and proper occlusal adjustment.
REFERENCES


