# Two-Implant Mandibular Overdentures: Simple to Fabricate and Easy to Wear

## (Prothèses hybrides inférieures sur 2 implants : simples à fabriquer et faciles à porter)

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## Sommaire

*Les implants dentaires en titane, mis en place dans la portion antérieure du maxillaire inférieur, obtiennent un taux de succès très élevé. Pour cette raison et à cause des coûts moins élevés de ces appareils, il est fréquent de traiter les patients édentés en utilisant seulement 2 implants avec ancrage à boule pour maintenir la prothèse hybride, plutôt que 4 implants et une barre. Nous décrivons dans le présent article la fabrication de prothèses hybrides sur 2 implants. Lors d'un essai clinique contrôlé (dont les résultats seront publiés ailleurs), 30 sujets ont reçu une prothèse hybride sur 2 implants au maxillaire inférieur et une prothèse classique au maxillaire supérieur. Chez les 30 patients témoins, des prothèses complètes classiques ont été mises en place dans les 2 maxillaires. La stabilité des prothèses hybrides s'est révélée excellente, et les dimensions linguales de la prothèse ont pu être réduites au niveau de la ligne mylo-hyoïdienne, laissant ainsi plus de place pour la langue. Chez les patients dont la musculature labiale était tendue ou dont la gencive attachée était limitée, il a été important d'élever l'épaulement de l'implant et le pilier de la boule au-dessus du niveau gingival, pour éviter les problèmes péri-implantaires. Enfin, les prothèses hybrides inférieures ont nécessité beaucoup moins de visites de suivi, pour corriger les points de pression après la mise en place, que les prothèses inférieures classiques.*

***Mots clés MeSH :*** *dental implants; dental prosthesis, implant-supported; jaw, edentulous/rehabilitation*

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One of the most important aims of oral implantology is to improve retention of complete mandibular dentures, which are often associated with problems in jaws with advanced ridge resorption.[1–4] During the past 20 years, placement of a bar-retained 4-implant overdenture in the front region of the mandible has become the treatment of choice in overdenture prosthodontics.[5] The relatively high number of implants gives the construction some reliability, because incidental loss of 1 or even 2 implants does not necessarily endanger prosthetic function. However, because the success rate of implantation in the anterior mandible is now very high, use of only 2 or 3 implants for overdenture retention has proved successful.[4,6]

In this paper the fabrication process for 2-implant overdentures is described and illustrated, and solutions are presented for problems that arose during the fabrication process. The 30 patients who received the experimental treatment were participating in a controlled clinical trial. They did not undergo surgical measures for improving the implantation bed before the procedure, but instead represented typical edentulous patients looking for low-cost improvement of denture retention. The 30 control patients received conventional complete dentures for the mandible. All 60 subjects received a conventional complete denture for the maxilla.

Problems occurring after overdenture placement and the number of pressure spots in the 2 groups (up to 1 year after the procedures) are also reported. A comparison of the major

treatment outcomes of the clinical trial, in terms of patient satisfaction, nutritional status, and other aspects, will be reported elsewhere.

## Materials and Methods

All subjects were participants in a controlled clinical trial conducted in the faculty of dentistry, McGill University, Montreal, Que. Sixty patients were selected for the project from a cohort of healthy subjects over 65 years of age who responded to newspaper advertisements. All subjects had been edentulous in both jaws for at least 10 years and needed new dentures. Thirty of the patients were randomly assigned to receive implant overdentures, and the other 30 subjects were assigned to receive conventional complete dentures. In this report, the groups are compared only in terms of the occurrence of postinsertion pressure spots; need for adjustments or repairs to the implant components are not reported here. The same protocol was used for fabrication of the implant overdentures and the conventional complete dentures in terms of preparation of impressions, determination of the occlusal relationship, and placement of the dentures; the schedule for follow-up visits was also the same for both groups.

### *Surgical Phase and Healing Period*

For each of the 30 experimental subjects, two 4.1-mm diameter ITI solid screws (catalogue no. 043.03xS, Straumann AG, Waldenburg, Switzerland) were implanted in regions 33 and 43 or as close as possible to these locations (**Fig. 1**). A generally accepted surgical protocol, recommended by the manufacturer, was followed.[7]

Before implantation, none of the patients received any grafts or other treatments for improving the anatomy of the implantation site.

For 2 weeks after the implantation procedure, the patients were not allowed to wear the old mandibular denture. After removal of the sutures, the old denture was adjusted for use.

To determine the exact locations of the healing caps under the denture, a strip of warmed boxing wax was inserted under the anterior region of the denture and lightly pressed against the healing caps on the implants. The denture base was relieved above the healing cap to avoid unfavourable loading of the implant. After verifying occlusion and easy seating of the prosthesis in the mouth, soft relining of the old denture was performed (Trusoft lining material, Harry J. Bosworth Co., Skokie, Ill.). The imprints of the healing caps in the relining material were bevelled with a scalpel to lessen lateral loading of the implant during healing.

During the healing period, 1 of the 60 implants was lost. This early loss was perhaps due to inappropriate tightening of the healing abutment of the implant with the ratchet and thus might have been avoided. The lost implant was replaced with a new one 6 weeks later.

### *Impressions*

Preliminary impressions were taken with alginate in stock trays (Jeltrate, Dentsply, L.D. Caulk Division, Milford, Del., and Coe, GC America Inc., Alsip, Ill.) $2^1/_2$ months after implantation. The custom trays were fabricated with a 1-mm wax spacer, by leaving the spacer about 3 mm short at the borders to allow the margins of the custom tray to act as a stopper zone.

The healing caps on the implants were removed and the housings of the implants rinsed with water and dried by means of a regular 3-way spray from a dental unit. Retentive ball anchors (catalogue no. 048.439) were inserted and tightened at 35 Newton centimeter (Ncm) torque with a prosthetic ratchet and torque control device (catalogue nos. 046.119 and 046.049, Straumann AG). Soft relining of the old denture was performed again.

The custom trays were border moulded in the mouth with light-curable acrylic (Triad, Dentsply, Trubyte Division, York, Pa.) that had been presoftened in a hot water bath (60°C). At this point the lingual aspect of the mandibular denture was maximally extended to correspond to that of conventional complete dentures.

Final impressions for the mandibles were taken with light body polyvinylsiloxane material (Aquasil red, Dentsply, L.D. Caulk Division). Implant analogues (catalogue no. 048.109, Straumann AG) were inserted into the impression to ensure stability. If the analogue was unstable, the impression was "relined" by inserting a small amount of bite registration material (Blue-Mousse, Parkell Products Inc., Farmingdale, NY) on one side of the ball imprint in the impression and reseating the impression into the mouth for setting. This material was selected because of its short setting time.

### *Construction of Occlusion*

Jaw relation records were fabricated on master casts, and the relationship of the jaws was determined with centric relation as the reference position. Vertical dimension was adjusted with the intent of creating 2–3 mm of freeway space. The jaw relation records were fixed together in the mouth, and the master casts were mounted into a semiadjustable articulator (Whip-Mix, Whip Mix Corp., Louisville, Ky.) according to average settings for the inclination of the condylar path (35°) and the Bennett angle (15°).[8]

Teeth set-up (Trubyte Classic, Dentsply, Trubyte Division) was performed according to the principles of lingualized occlusion of the posterior teeth and zero-degree incisal guidance.[8]

After a trial of the tooth set-up, the prostheses were created in Lucitone 199 acrylic (Dentsply, Trubyte Division) with an injection-moulding technique. Gold matrixes (catalogue no. 048.410, Straumann AG) were mounted on the implant analogues before acrylic was injected into the muff. No metal frames or other reinforcements were used.

### *Placement and Follow-up*

During the placement visit, the patients were given thorough instructions for cleaning the dentures. Possible pressure spots were disclosed by means of pressure indicator paste (PIP, Mizzy Inc., Cherry Hill, NJ) and feedback from the patient.

After retention of the mandibular denture was verified and discussed with the patient, the lingual flanges of this denture

***Figure 1:*** *Two implants in the mandibular canine region in a patient with healthy peri-implant tissues.*

***Figure 2:*** *Mucosal inflammation and swelling around a 43 implant.*

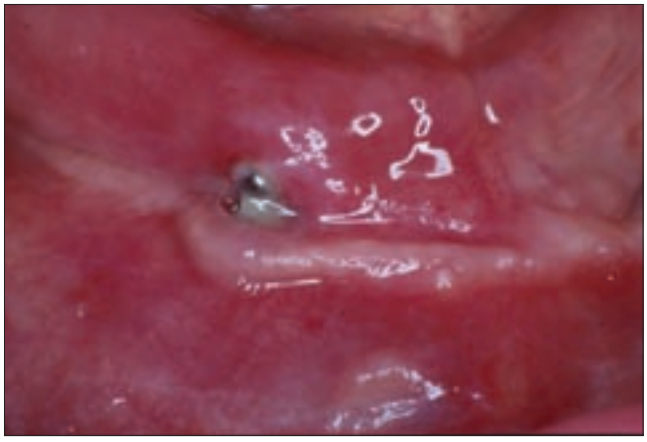

***Figure 3:*** *Pericoronitis type of peri-implantitis.*

***Figure 4:*** *Mucosal cylinders prevent soft-tissue overgrowth and impingement (same patient as in* ***Fig. 2****).*

were adjusted. Eight patients preferred to keep the lingual flanges fully extended into the undercuts of the submylohyoidal region. In all other patients the lingual flanges were reduced to the level of the mylohyoid line to allow more space for tongue movement.

Points of occlusion were selectively ground during the placement visit after the prostheses were remounted into an articulator. The relationship of the jaws was re-determined with 2 narrow strips of wax (Aluwax, Aluwax Dental Products, Grand Rapids, Mich.) in the canine–molar region on both sides of the mandible.

The first follow-up visit was scheduled for 1 week after placement of the dentures. Possible pressure spots were relieved and occlusion was verified. If no further problems were found, the next appointment was set according to the follow-up schedule of the clinical trial (i.e., 2 months after placement).

## Problem-Solving and Adjustments

During the healing period, the lack of attached gingiva around 7 of the implants (12%) in a total of 6 patients (20%), combined with tight labial tissues that fell over the healing abutment, caused soft-tissue irritation (5 implants) or a pericoronitis-type soft-tissue inflammation (2 implants) (**Figs. 2** and **3**, respectively). In 2 patients (3 implants) the inflammation developed immediately after the healing abutment was replaced with a ball anchor because the now-exposed lower shoulder of the implant allowed overgrowth of the irritated soft tissue. Three patients (4 implants) were treated by gingivectomy combined with systemic antibiotic (penicillin V) therapy and chlorhexidine mouth rinse (0.12%, 10 mL twice daily for 2 minutes). After soft-tissue healing the patient with 2 affected implants received mucosal cylinders (catalogue no. 048.428, Straumann AG) to increase the height of the abutment and prevent soft-tissue irritation and formation of hyperplasia. The2 other patients, each with a single affected implant, did not require any measures other than the gingivectomy, antibiotics and mouth rinse. In 3 cases (3 implants) gingivectomy was not performed, but mucosal cylinders were added (**Fig. 4**).

After creation of the acrylic denture, seating of the overdenture was not completely satisfactory in 7 (23%) of the experimental patients; instead, the denture rocked about one or more of the ball anchors. In all of these cases, the front

region of the overdenture, anterior to the fulcrum axis, was relined with light-curable relining material (Triad relining material).

Of the 8 patients in whom the lingual flanges of the overdenture remained fully extended during denture placement, the extension became permanent in 6 and was reduced in 2.

In a total of 5 implants (8%) in 4 dentures, the gold matrixes detached before the 1-year follow-up visit. Two of these matrixes were remounted at chairside by deepening the housing of the matrix in acrylic and adding drops of runny pattern acrylic (Duralay, Reliance Dental Manufacturing, Worth, Ill.) into the hole. The matrix was then placed on the ball anchor and the denture seated in the mouth. However, these matrixes detached again in a couple of weeks, after which the dentures were sent to the laboratory for remounting of the matrix. The impression was made with a small amount of bite registration medium (Blue-Mousse) in the ball anchor housing of the denture.

In 5 patients (17%), problems resulted because the retentive force of the abutments was too strong. Poor motor skills or weakness of the fingers made it difficult for these patients to remove the overdenture from the mouth. In the worst case, a satisfactory level of retention was not attained until the third follow-up visit about one month after placement.

The retentive force of the gold matrixes was individually adjusted during the placement and follow-up visits, but 9 patients (30%) needed reactivation of the matrixes at the 2-month or 1-year follow-up visit or at some time between these 2 visits. Two patients needed such reactivation twice.

After placement of the dentures, 4 patients reported poor retention of the maxillary conventional complete denture. The extension and seal of the borders and post-dam, as well as the occlusion, were re-examined and adjustments made if necessary. The patients were also advised to use a denture adhesive, to chew only small pieces of food and avoid overexertion during mastication, and to be patient in waiting for their motor skills to adapt to the new situation.

During the first year after placement of the prostheses 18 (60%) of the patients who had received implant overdentures but only 4 (13%) of those who received conventional complete dentures did not need adjustment of the mandibular denture because of pressure spots. In all, there were 22 adjustments for pressure spots among the 30 implant overdentures (mean 0.7 per patient), and 70 for the conventional dentures (mean 2.3 per patient) (2-tailed Mann–Whitney test, $p < 0.001$).

## Discussion

In this clinical trial the experimental and control groups were treated with the same clinical technique except for the implants. However, the scope of this article is limited to a description of the fabrication process, of which follow-up visits are an essential component; therefore, the only statistical comparison between groups presented here relates to adjustments for pressure spots under mandibular prostheses. Also, because extensive data are not presented, the conclusions discussed here should be considered as suppositions requiring further study.

According to numerous reports, the prognosis for implants does not depend on attached gingival tissue.[4,9] In contrast, according to ten Bruggenkate and others,[10,11] the absence of a buccal fold or keratinized attached mucosa may be an indication for palatal mucosa transplantation. Although 20% of the patients in the experimental group experienced implant mucositis during the prosthodontic phase, no additional periimplant problems arose after placement of the prostheses and up to the 1-year follow-up visit. To avoid soft-tissue problems in mandibular overdenture treatment with ball attachments, the amount of attached gingiva, as well as the pressure of the lip and the grade of alveolar atrophy, should be carefully assessed during treatment planning. Although the problem can be solved by placing the implants higher or by adding mucosal cylinders, it may be worthwhile to consider mucosal soft-tissue grafting (e.g., from the palate) with or without bar retention, in which case the shoulder of the implant would be covered by the coping of the bar. After this study was completed, the component manufacturer introduced a set of ball anchors in which the shoulder is 1, 3 or 5 mm high. Using these components would naturally be recommended in cases where an elevated shoulder is indicated.

It was no surprise that the requirement for adjustment visits to alleviate pressure spots was only about one third as great among the patients who received new mandibular overdentures as it was among those who received conventional treatment, and indeed this observation has been reported previously.[12,13] However, the overdenture group had other kinds of problems, most of which were related to the matrixes. Attaching a detached retentive matrix to a denture with acrylic, with or without a hole through the denture, is extremely difficult and subject to contamination with saliva. Taking a local impression of the ball attachment was much easier and more reliable. In most cases the denture will be sent to a dental laboratory for conversion to acrylic, but avoiding recurrent detachment is more profitable for both the patient and the dentist.

After placement of a stable retentive mandibular complete denture, the paradoxical feeling of looseness of the maxillary denture is a complication that must be taken seriously. During the planning phase, when preparing the patient for the surgical measures and the prosthetic phase, discussion of possible complications should cover this detail. Therefore, when there is advanced atrophy of the maxillary alveolar ridge, if the patient suffers from dry mouth or if there is some other factor that might impair retention of the maxillary prosthesis, it is recommended that implants be placed in both jaws. This recommendation has been made previously.[14]

Using 2 implants and retentive anchors for the retention of a mandibular complete denture is, in terms of immediate costs, one of the most affordable implant procedures. With ideal placement of the implant, the stability of the prosthesis is excellent and the lingual dimensions of the denture can in

some cases be reduced to the level of mylohyoid line, providing more space for the tongue and greater comfort than with conventional complete dentures. However, if the labial musculature is tense or the amount of attached gingiva is limited, the implants should not be placed too deep or too labially, which might prevent gingival growth over the abutments. In those cases, ball anchor abutments with elevated shoulders can be used to improve implant anatomy. ➧

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