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CLINICAL REPORT

Fabricating a Mandibular Implant Supported Overdenture with a Suspended Framework

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Abstract The introduction of implant-supported overdentures as a clinical alternative has improved the quality of life of the edentulous population. Implant-supported overdentures have diminished many of the problems associated with conventional dentures by providing improved retention, stability, function, esthetics and physical and emotional health. Greater support and stability of the implant borne prosthesis is associated with improved bite force and oral function for overdentures when compared to conventional complete dentures. An adequate amount of restorative space is required when fabricating implant-supported overdentures. This space must accommodate a denture base of sufficient dimensions, appropriately positioned denture teeth, and an implant attachment system. Insufficient space may lead to reduced structural integrity of the prosthesis and/or compromised oral function. Typically a mandibular removable prosthesis is more vulnerable to fracture due to its shape and overall dimensions. Incorporation of a metal framework, metal reinforcing mesh, or woven or fiberglass-impregnated mesh have been recommended to improve resistance to denture fracture during function. This article presents a method for fabricating a framework that is specifically and predictably suspended within the denture base in order to decrease fracture susceptibility of implant-supported overdentures.

Keywords Implant · Denture · Overdenture · Framework · Fracture

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Introduction

Edentulism is considered a major health problem due to associated impairments and disabilities (WHO 2001) [1]. Complete dentures have traditionally been the standard of care for edentulous patients. Generally, the lack of predictable long-term retention and stability of complete dentures often results in dissatisfaction for a significant number of patients. [2, 3] Prolonged edentulism has been associated with progressive alveolar resorption and enlarged tongue dimensions making the mandibular prosthesis wear more challenging for the patients when compared to the maxillary complete dentures.

Prosthesis fracture is a concern for complete denture patients [4–6] Conditions related to denture fracture include occlusal disharmony, excessive occlusal forces, and denture base flexure leading to fatigue failure of the denture base. Other related conditions include alveolar resorption leading to poor prosthesis fit, thin regions of the denture base and catastrophic impact forces (*e.g.*, inadvertent dropping of the prosthesis on hard surfaces) [4, 7].

Discomfort, reduced masticatory efficiency and compromised esthetics may lead complete denture wearers to seek alternative therapy [7]. The introduction of implant-supported overdentures has positively impacted quality of life for many edentulous patients [8]. According to the

McGill Consensus Statement in 2002, the mandibular 2-implant overdenture should be considered a first-choice therapeutic alternative for edentulous patients [9]. Implant-supported overdentures have addressed many of the problems related to conventional dentures by providing patients improved function, emotional well-being, physical health and esthetics [7–9] One possible drawback of implant-supported overdentures, particularly in light of improved functional loading capability, is increased potential for prosthesis structural failure in thin denture base segments approximating overdenture attachments [6].

Compared with conventional complete dentures, implant-supported overdentures have been associated with the capacity for increased masticatory force generation [10–13] Retentive mechanisms (*i.e.*, attachment systems), used with overdentures, typically project both vertically and horizontally into available restorative space resulting in reduced denture base thickness. The diminished denture base dimensions required to accommodate implant attachment components render the prosthesis more susceptible to fracture. Mandibular implant-supported overdentures tend to be more vulnerable to fracture due to reduced cross sectional dimensions and compromised denture-bearing foundations when compared with maxillary prostheses [4–6].

Past reports suggests that the incorporation of metal frameworks may reinforce or strengthen removable prostheses [14–18] An ideal solution may involve fabrication of a sufficiently strong metal framework to structurally reinforce the overdenture and permit the denture to be easily adjusted and relined when necessary [5, 6].

This article describes modification of a laboratory technique, originally described by Morrow, [19] for fabricating a framework that is specifically and predictably suspended within the base of an implant-supported overdenture. Routine fabrication procedures are supplemented by a straightforward process of metal framework construction and incorporation into the denture base. The result is a structurally reinforced prosthesis with a resin intaglio surface that can easily be adjusted and relined when indicated.

Technique Step I–The Design Cast:

1. The wax trial denture is placed and evaluated for esthetics, phonetics, occlusal vertical dimension and centric relation.
2. Once approved, the wax trial denture is returned to the master cast and sealed to the cast with wax. A matrix indexing the denture teeth and buccal/facial cameo surface contours to the land area of the cast is fabricated using addition reaction silicon laboratory putty (Lab-Putty; Coltène/Whaledent, Inc, Cuyahoga Falls, OH). This matrix will help to re-establish the correct relationship of the denture teeth to master cast following metal framework fabrication.
3. The master cast and wax trial denture are duplicated using reversible hydrocolloid material (Concentrated Instaloid Dup Material, CMP Industries LTD, Albany, NY) in a duplicating flask.
4. A clear resin matrix is pressure formed on the duplicate cast using 1 mm thick acrylic resin sheet material (Copyplast, Great Lakes, Tonawanda, NY). This clear matrix indicates the relative three-dimensional relationship between denture teeth/denture base contours and the underlying implants/attachments.
5. Overdenture attachment abutments (Locators, Zest Anchors, Escondido, CA) selected clinically for each implant are screw fastened to the implant analogs in the master cast. Metal housings are placed on each attachment (Fig. 1). Undercuts related to the abutments/attachments are blocked out with wax.
6. Design of the overdenture metal reinforcing framework is considered, giving particular attention to available restorative space, denture base thickness, denture tooth position and implant attachment location within the proposed base. The proposed framework design is drawn on the master cast with a wax pencil (Fig. 2). In this case, the design indicates that the framework will be suspended precisely 2 mm above the edentulous ridge. This design has several advantages when compared to other methods for denture base reinforcement: (1) the overdenture will have a resin intaglio surface to facilitate denture base adjustments, reline procedures and repair processes when indicated, (2) the internal dwelling framework serves as a skeleton for structural reinforcement of the prosthesis, and (3) support struts extending from the framework on to the land area of the cast serve as "cast stops"[20, 21] prohibiting framework displacement

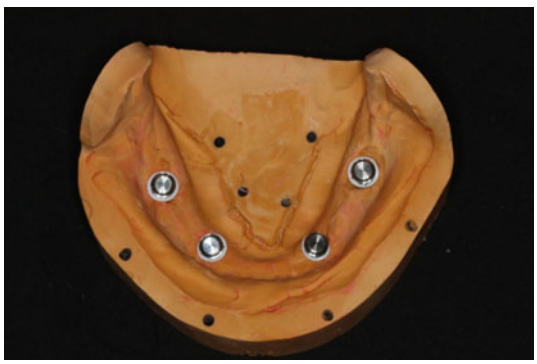

Fig. 1 Locator abutments and metal housings in place on implant analogs in the master cast. *Black dots* indicate areas where the framework support struts will contact the cast's land area

toward the cast during denture resin processing procedures.
7. Areas where the framework's support struts extend on to the land area of the cast are prepared to half the depth of a #8 round bur.
8. The master cast and clear resin matrix are sent to the laboratory for framework fabrication.

Technique Step II–Framework Fabrication:

1. With attachments in place, master cast undercuts are blocked out and 2 mm relief wax is applied to the edentulous ridge. The blocked out and relieved master cast is duplicated in refractory material.
2. With the aid of the clear resin matrix to provide three-dimensional reference for definitive prosthesis contours, a framework wax pattern is developed on the refractory cast (Figs. 3, 4).
3. The metal framework is invested, burned out, cast, divested, finished and polished. The framework is returned from the laboratory and evaluated for precision of design and fit on the master cast. (Fig. 5).

Technique Step III–Completion and Placement of Definitive Prosthesis:

1. The framework is properly positioned on to the master cast and denture teeth are re-approximated to the framework and cast using the silicone matrix trimmed to permit passage of the framework's support struts (Fig. 6).
2. Final denture contours are reestablished in wax (Fig. 7). Due to small arch size of the patient presented here, and to avoid placing teeth over the ascending ramus, second premolars and second molars were excluded from the definitive prosthesis. [22]
3. The waxed overdenture is invested following standard procedures. The framework is secured in the drag with

Fig. 2 Design of the framework. Note that Locator housings are relieved to indicate space requirements that must be accounted for in the design

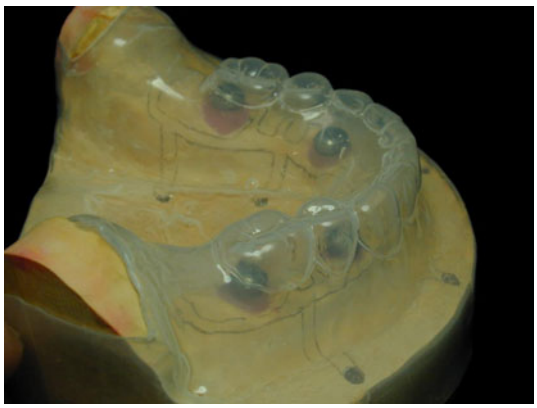

Fig. 3 Transparent matrix of cameo surface contours permits visualization of the restorative space defined by the planned implant-supported overdenture and aids the technician in framework design and fabrication

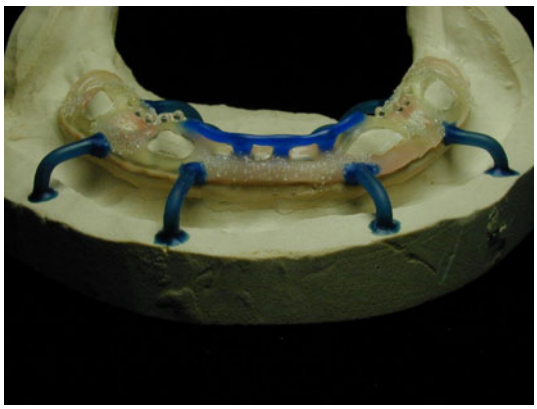

Fig. 4 Pattern wax-up of framework on the relieved and blocked-out refractory cast

Fig. 5 Metal framework with support struts extending on to the cast's land area

Fig. 6 Denture tooth silicone matrix is trimmed to accommodate metal support struts so that it completely seat on the cast's land area. The denture teeth are accurately repositions in preparation for final prosthesis wax-up

Fig. 7 Final overdenture wax-up, encapsulating metal framework, prior to investing and processing procedures

Fig. 8 Framework secured in the flask drag with dental stone investment

dental stone during investing (Fig. 8). The overdenture is processed, finished to its final form, and polished.

4. At this point, the esthetic appearance of the cut surfaces of the struts is considered. If the mandibular overdenture base is not visible during normal patient animation, the cut surfaces of the struts remain visible and are polished flush with the overdenture's cameo surface. If the mandibular overdenture base is visible when the patient animates, the struts may be reduced 1.0–1.5 mm deep into the cameo surface and the defect repaired with chemically-activated resin, finished and polished.
5. The overdenture is placed and adjusted for fit, form and function. Normal recall evaluations are scheduled and the patient excused (Fig. 9).

Fig. 9 Definitive prostheses in place. The cut surfaces of the support struts remain visible through cameo surface since they impose no esthetic encumbrance

Conclusion

Consideration of and accommodation for available restorative space is critical when fabricating implant-supported overdentures. These restorations are frequently involved in high functional loading rendering them susceptible to fatigue degradation and fracture. Use of the technique outlined here will aid in fabricating a structurally reinforced implant-supported overdenture with improved fracture resistance leading to improve longevity of the restoration.

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