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Bridge design, part ten: removable bridgework on implants

By Paul Tipton, BDS, MSc, DGDP (UK)

In the latest part of his series, Paul Tipton discusses the milled-bar retained removable bridge implant-supported prosthesis

The maxillary overdenture is indicated for patients who have natural teeth or fixed or removable prostheses supported by implants and teeth in the mandible. However, studies by Jemt (1996) suggest a high failure rate of over 20% and a high degree of maintenance is required (Watson, 1996). Overdentures have often been prescribed for failing fixed prostheses (Palmquist, 1994), if adequate placement of enough implants to support fixed prostheses was not possible and for cost purposes. Oral hygiene procedures are better facilitated by removable prostheses and better aesthetics and phonetics often achievable. This paper will now deal with a rigid bar overdenture design called the 'Milled Bar Retained Removable Bridge' prosthesis.

PROSTHESIS DESIGN

To restore the correct lip support, the maxillary prostheses usually include a prosthesis flange. If such a restoration is fabricated as a direct cemented or screw-retained prosthesis, access for oral hygiene is limited. Prosthesis flanges, even if not fully extended, create ridge lap areas that can be cleaned only if they are removable by the patient. The maxillary ridge resorption pattern generally necessitates the fabrication of fully extended labial and buccal flanges in order to retain proper lip support. In a two-piece prosthesis (removable bridge), however, the infrastructure is attached to the implants, either directly or through the abutments, and is removable only by the dentist. It serves as the retentive mechanism for the superstructure - the prosthesis - which is removable by the patient. This style of removable prosthesis can be designed as the traditional bar or ball attached retained overdenture or as a precision-retained milled bar retained removable bridge prosthesis. Accurate fit between the infrastructure and superstructure ensures overall rigidity of the milled bar restoration which then functions as a one piece fixed restoration. This can be achieved by fabricating the infrastructure in the form of a milled bar with a similar overcasting (removable bridge) made of metal to fit over the top of the rigid, retentive bar.

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BAR DESIGN

A minimum of four to six implants is usually required for a maxillary overdenture prosthesis, whilst for the maxillary milled bar removable bridge restoration Misch (1993) suggests the minimum is usually six to eight. Once seated, the superstructure is secured to the infrastructure with rigid attachments to limit the micromovements during function and minimise the wear between the structures.

The infrastructure should be fabricated with a 2° taper as suggested by Prieskel (1996) and from an alloy that is biocompatible, has high yield strength, and can be readily sectioned and soldered. The metal component of the superstructure should be as thin as possible to provide space for the rest of the components. The attachments that stabilise the fully seated complex can be of different shapes and forms. Simplicity should be a major consideration in selecting the attachments to ensure the uncomplicated fabrication, maintenance and replacement.

With multiple implants, the maxillary overdenture becomes mostly implant supported regardless of the retention devise and bar design. Therefore, for multiple

Figure 1: Old dentures in place

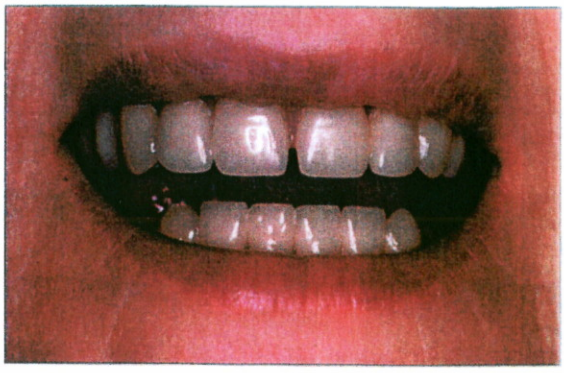

Figure 2: New trial set - wax try-in stage

implants rigid bars are always recommended and a cast framework must reinforce the denture base to ensure stability and stiffness (Mericske-Stern, 1998). With multiple implants the overdenture has a horseshoe design, which is well tolerated by patients from a psychological point of view because the feeling of wearing complete dentures is absent. An individually cast metal framework inside the denture is mandatory for the horseshoe design of the milled bar retained removable bridge (Mericske-Stern, 2000) and provides for adequate stiffness and rigidity of the removable bridge. The palatal seal is cast in metal with female bar retainers not soldered to the cast metal framework, but rather mounted in the acrylic resin base. This facilitates prosthetic services like tightening or renewing retainers.

Full coverage of the palate becomes necessary only when multiple implants are not used and implant placement is poorly spaced and when support is required from the palatal mucosal tissue.

TRIAL DENTURES

Once the vertical dimension has been established on trial wax dentures, selection of abutment heights, if required, is completed - usually in the laboratory from a cast poured from an impression of the fixture head. Consideration must be given to the inter-implant divergence or convergence. Bränemark transmucosal standard abutments used in screw-retained implant supported prostheses can accommodate this divergence up to 30-40°. Alternatively, if the implants have a reasonable degree of parallelism the restoration can be built directly onto the fixture head of the implant.

The impression can be made six to eight weeks following second stage surgery. All prosthetic parts are selected following the mounting of the master cast in the correct vertical dimension, aesthetic try-in and a thorough evaluation of the implant angulation on the master cast. A readily cleaned infrastructure with sufficient bulk for strength can be achieved only by precise utilisation of the available vertical space. The following two case studies illustrate the technique involved in the 'milled bar retained removable bridge implant supported maxillary prosthesis.'

CASE STUDY ONE

This middle-aged lady was referred to St Ann's Dental Clinic by her general dental practitioner in Altrincham, Cheshire. Her major complaint was one of poorly fitting complete dentures with associated loss of aesthetics and premature aging (Figure 1). A trial denture set up was completed in wax as previously described to assess vertical dimension and aesthetics prior to starting treatment (Figure 2). The new denture set up not only increased the vertical dimension but also gave better lip support, everting the upper lip and giving it greater fullness (Figures 3 & 4) and the patient a better profile and appearance (Figures 5 & 6).

These trial dentures formed the basis of the radiographic guides prior to the CT scan being completed and the surgical guides when implants were placed.

Figure 3: Poor lip support

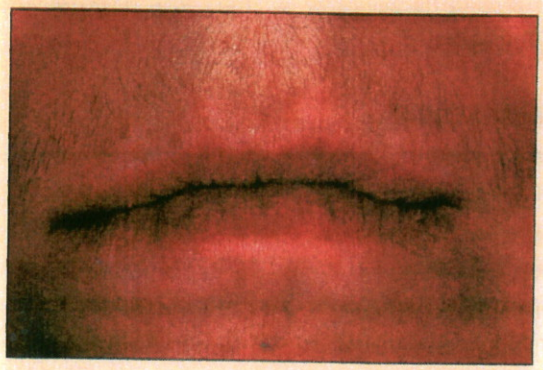

Figure 4: Extra lip support and increased vermillion border

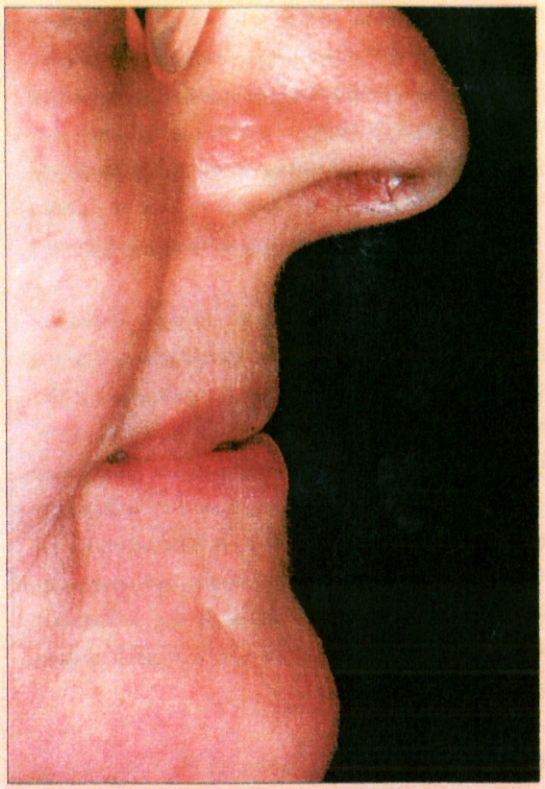

Figure 5: Facial support with old dentures - Class III occlusion

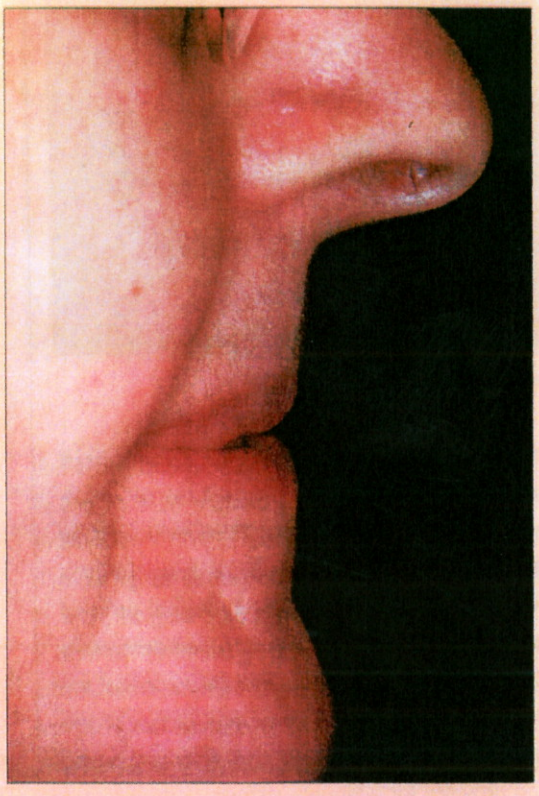

Figure 6: Increased vertical dimension - now Class I occlusion

IMPLANT PLACEMENT

Six maxillary and five mandibular 'Bränemark' implants (Nobel-Biocare) were placed and after an osseointegration time of six months were uncovered together during the abutment operation. After a period of approximately eight weeks for tissue maturation and stabilisation prosthetic treatment commenced. The treatment plan was for a milled bar retained removable bridge restoration in the maxilla and a traditional acrylic/gold screw retained implant supported bridge in the mandible.

PROSTHETIC TECHNIQUE

A pick up impression using 'Impregum' (ESPE) in a special tray was used to impress the head of the implants in both jaws. Klooster (1991) showed that the risk of permanent deformation of the impressions is reduced by increasing the time the impression materials are allowed to remain intraorally, however the inaccuracies of all impression techniques are well documented.

SOFT TISSUE CAST

Since the implant mating surfaces are subgingival reproduction of this area in dental stone might result in chipping of the master cast and so soft tissue simulated casts were utilised instead (Wilkinson, 1992). Using a material with properties that are different from the one used for the final impression ensures an easy recovery of the master cast from the 'Impregum' impression (ESPE).

RECORDING RAP

Mounting the master casts around retruded axis position (RAP) is essential so that the technician can produce an occlusal scheme whereby retruded contact position (RCP) is the same as inter-cuspal position (ICP) around RAP. An inaccurate jaw registration as well as potentially causing occlusal problems might also result in incorrect fabrication of the metal structures in the horizontal plane (bucco-lingual and mesio-distal). Utilising intraoral tracings in the form of a Gothic Arch Tracing is a well-documented and accurate technique of recording RAP (Winkler, 1988) (Figures 7 & 8).

TRY-IN STAGE

If implant supported or retained prostheses are to be used in both arches, it is advisable to use denture teeth with high wear resistance properties. The ability of resin to dampen the forces transmitted to the implant especially during implant loading is well documented. The trial set up is tried in and examined for correct RAP, aesthetics and phonetics. Once verified this set up serves as the sole

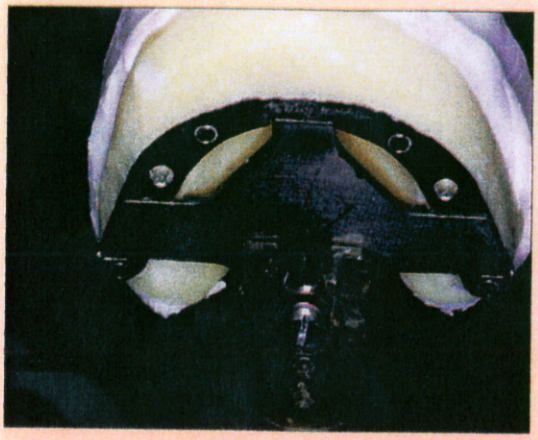

Figure 7: Gothic arch tracing plate - upper jaw

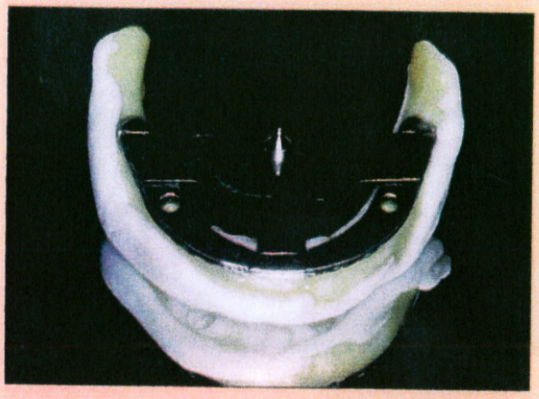

Figure 8: Gothic arch tracing central bearing point - lower jaw

guide for fabrication of the upper and lower frameworks.

SECTIONING AND SOLDERING

Since the impression is made directly from the head of the implant and because of the material itself, inaccuracies can be expected in the cast infrastructure. The use of machined components as opposed to cast components has been advocated by Goll (1991) because of their increased accuracy. However once invested and placed in the burnout oven these cylinders are supported only by investment material at their exposed ends and the central core. If a large framework is to be fabricated the large mass of molten metal might displace these cylinders.

The cast framework is milled to a taper of 2° with the correct 2° metal milling bur and then polished again with the correct 2° polishing bur. It is then tried in the mouth and sectioned where the fit is inadequate (Figure 9). The sectioned framework is then indexed and joined together with cold cure acrylic resin where necessary (Figure 10). Added support for the framework with coat-hanger wire is recommended when using this technique (Figure 11). The framework is then picked up in a further impres-

Figure 9: Upper framework sectioned

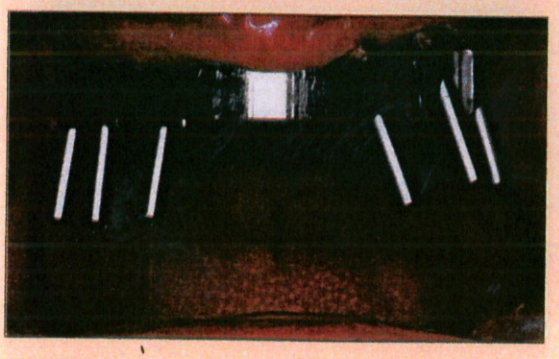

Figure 10: Duralayed together in the mouth

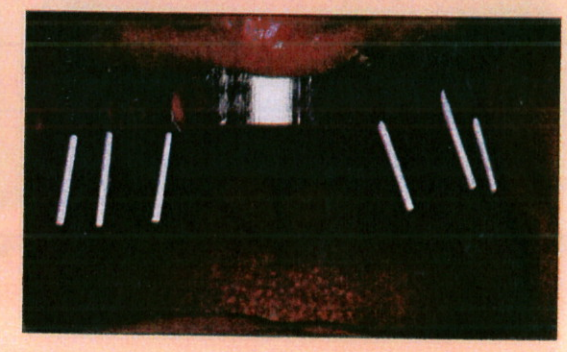

Figure 11: Coat hanger wire for added strength

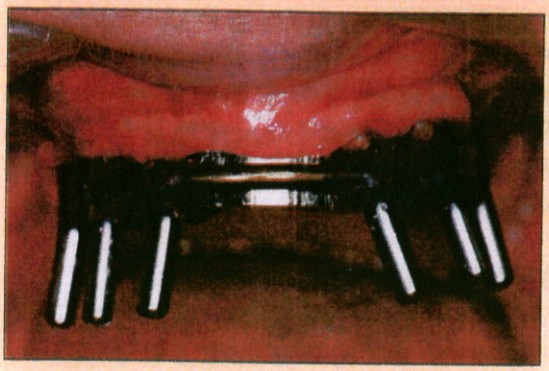

Figure 12: Pick up impression with Impregum

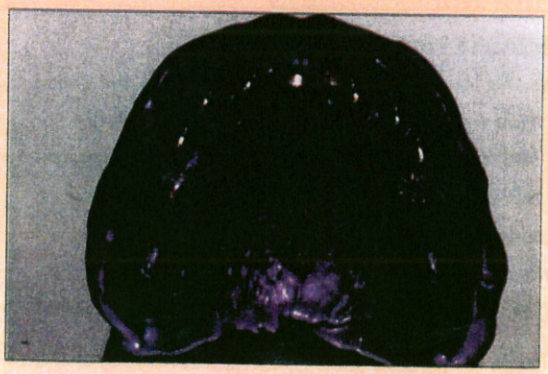

Figure 13: Soldered milled bar

Figure 14: Zero degree rods and ball attachments

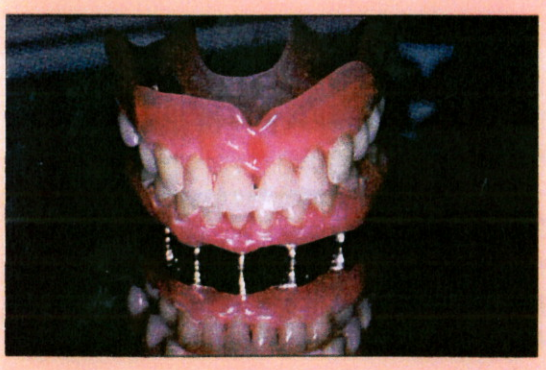

Figure 15: Overcasting against lower bridge

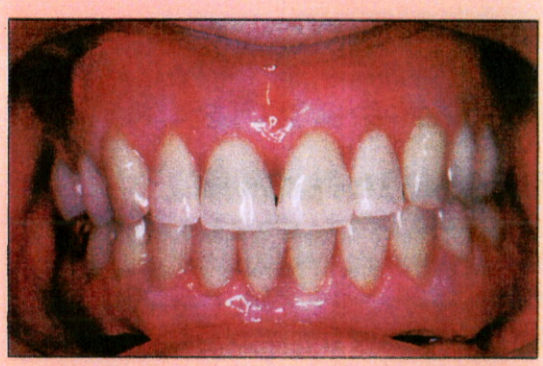

Figure 16: Final restorations in the mouth with staining

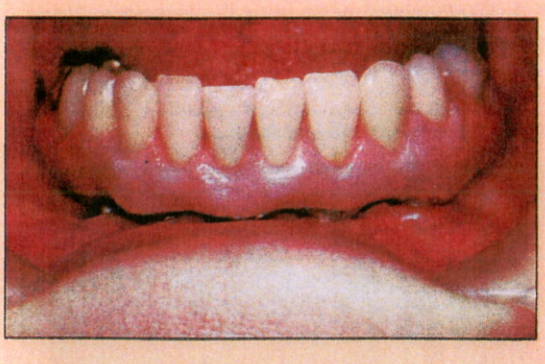

Figure 17: Close up of lower bridge with staining

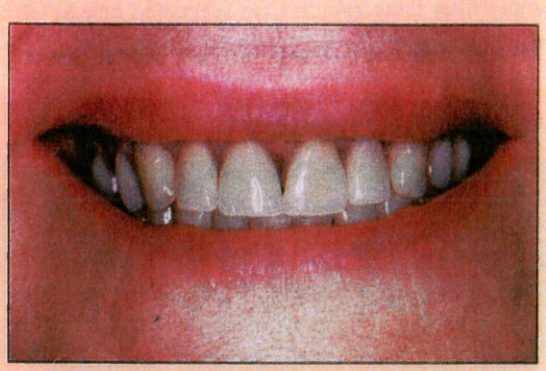

Figure 18: Final aesthetic smile

sion (Figure 12) before being soldered (Figure 13).

OVERCASTING

Once the framework has been verified for fit the overcasting is waxed and cast and incorporated with the fitting surface of the final milled bar retained removable bridge. Retention is established by the incorporation of retention devises such as retention rods of a 0° taper, ball attachments and the fit of the super structure (Figure 14). The final retention can be reduced if required by polishing or improved with time by electroplating (Figure 15).

FINAL RESTORATION

'Siicoater' (Kulzer CA) is used to gain a chemical bond between resin and the chrome denture base as recommended by Musil (1984). As can be seen the final restorations are aesthetically pleasing (Figures 16 & 17) giving correct lip support by incorporation of a labial flange, and access for easy oral hygiene procedures (Figure 18).

CASE STUDY TWO

This 39-year-old lady was referred to St Ann's Dental Clinic by her general dental practitioner in Oldham, North Manchester for restoration of her upper and lower

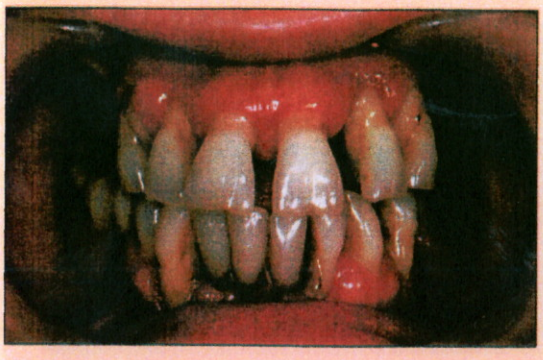

Figure 19: Poorly maintained mouth with lower partial denture

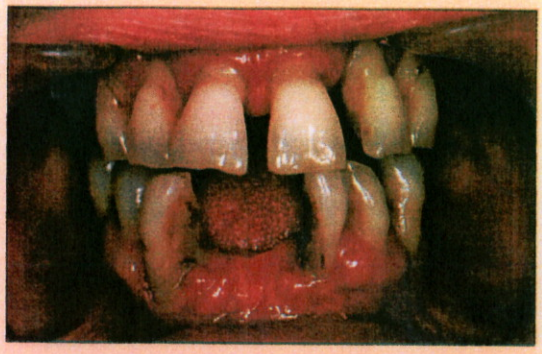

Figure 20: Partial denture removed

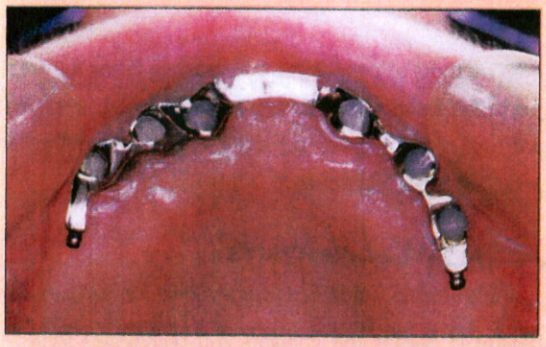

Figure 21: Upper milled bar in situ

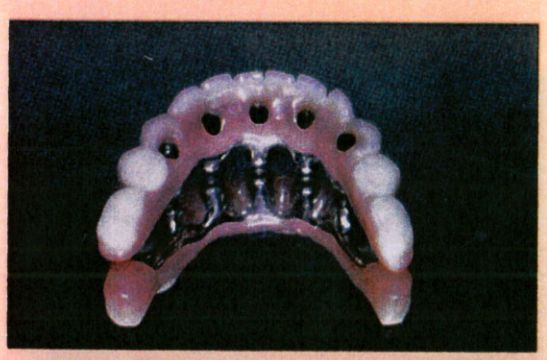

Figure 22 Lower bridgework

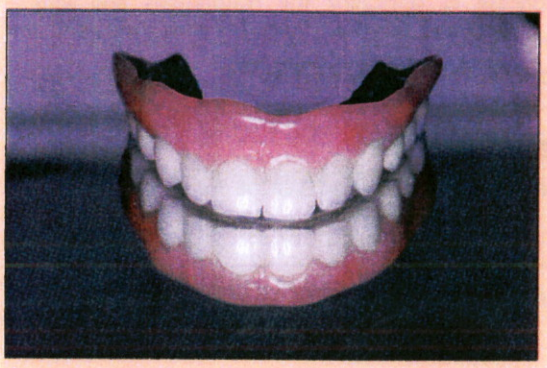

Figure 23: Composite/metal milled bar overcasting

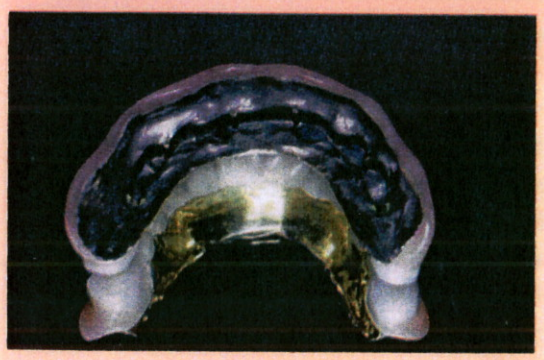

Figure 24: Fitting surface showing retention rods and rubber ball attachments

teeth. As can be seen (Figures 19 & 20) the patient had a very neglected mouth due to the fact that although she was a very fit (aerobics instructor) and attractive lady, she was a dental phobic.

TREATMENT

The same diagnostic procedures as in case one were employed including trial dentures to assess vertical dimension, and aesthetics, radiographic and surgical guides prior to and after CT scans for help in surgical placement of implants. As in case one, six maxillary and five mandibular implants were placed for the planning of a milled bar restoration in the maxilla (Figure 21) and traditional fixed bridge in the mandible (Figure 22).

VERTICAL DIMENSION

When accessing vertical dimension with the trial dentures it was noted that there was a lack of adequate vertical dimension for the fabrication of a traditional acrylic/metal milled bar overcasting on the gold framework because of a very short upper lip. It was decided therefore that the material of choice for the maxilla, where there was a short upper lip and reduced vertical space would be composite teeth and pink composite gingivae on a metal substructure (Figure 23).

RESTORATION

The restoration proceeded along the same lines as in case one with pick up impressions of the fixture head,

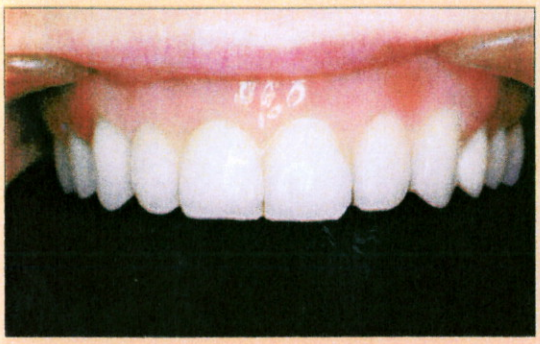

Figure 25: Close up of final upper restoration

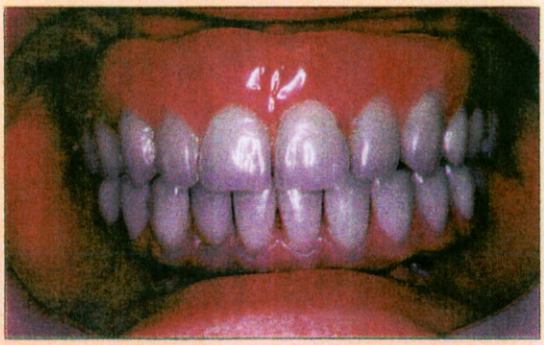

Figure 26: Final restorations in the mouth

Figure 27: Final smile showing short upper lip and pink composite

gothic arch tracings to record RAP, casting of the framework and milling to 2° taper prior to sectioning and soldering. Retention was in the form of ball attachments and retention was with a 0° taper (Figure 24). The final restoration re-establishes form and function and is aesthetically pleasing and very retentive (Figures 25 to 27).

CONCLUSIONS

Kent (1992) reviewed the literature studying the effects of osseointegrated implants on the psychological and social well being of the patient. He concluded that retrospective and prospective studies alike provide support for the claim that osseointegrated implants have positive effects on well being and quality of life. When indicated, the milled bar retained removable bridge implant supported prosthesis is a beneficial aid in treating the edentulous jaw. It improves masticatory and functional efficiency by stable anchoring of the removable bridge. The method is particularly useful to gain the aesthetic advantages of an overdenture, yet attains the stability of a fixed prosthesis.

The next article in this series will concentrate on a new method of providing a truly passive fitting full arch porcelain-fused-to-metal bridge on dental implants with a unique way of achieving maximum aesthetics and long term maintenance.

ACKNOWLEDGEMENTS

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