

Use of mechanical devices for the intermaxillary registration in edentulous patients treated with implants

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This article describes the use of three devices that replace the wax rims in the registration of the intermaxillary position and of the vertical dimension of occlusion in completely edentulous patients who have been treated with Brånemark implants. The devices consist of a mechanical “tooth” that can be adjusted in all three dimensions of space and of two plates that support the registration material. The mechanical tooth is connected to an abutment in the anterior region and a contact is established with a tooth in the opposite jaw at the vertical dimension in which the patient will be restored. This allows the operator to position the mandible in the centric relation in a condition of neuromuscular deprogramming and in the absence of posterior interferences. The two metal plates are then fixed to the posterior abutments, one on each side, and support the wax and zinc oxide eugenol paste used to register the intermaxillary position just established. (*J Prosthet Dent* 1998;80:249-52.)

Completely edentulous arches can be rehabilitated with fixed prostheses supported by osseointegrated implants.¹ After placement of the implants and completion of the healing period, the definitive abutments are chosen and the prosthetic phase can commence. The most commonly described technique in the literature is the one initially proposed by Brånemark,¹ and then described with small variations by other authors.^{2,3}

According to this technique, an impression of the abutments is made, a working stone cast incorporating abutment replicas is poured and a resin base with a wax rim is then fabricated.¹ Provisions are made to connect the resin base to at least two abutments with the use of screws. The clinician, after having fixed the resin base to the abutments in the mouth, adjusts the height of the wax rim at the desired vertical dimension and moves the rim in the anteroposterior position where the teeth need to be placed. It is then possible to proceed with the registration of the correct intermaxillary position (centric relation).

The main disadvantages of this technique are as follows: (1) It is not possible to register the intermaxillary position during the same appointment when the impression is made because the dental technician needs several hours to pour the impression and fabricate the resin base with the wax rim. (2) It is not possible to make multiple registrations on the same rim to verify the correctness of the mandibular position. (3) The wax rims are bulky and not easily manageable during the repeated try-ins. (4) A relatively long time is needed to adjust the wax rim to the correct height and buccolingual position. (5) It is not possible to establish a unique anterior “point” of contact to deprogram the

neuromuscular system, but instead a “zone” of contact can be established at best.

A precise centric position should be recorded when performing extensive oral rehabilitation,^{4,5} but its registration in edentulous patients has been difficult.⁶⁻⁸ Studies of edentulous patients have demonstrated that those techniques that allow muscle deprogramming have been effective in facilitating the operator to actively guide the mandible into a more reproducible terminal hinge position.^{4,9-14} Some of these methods are based on the principle of a contact in the incisor region with posterior disclusion⁹⁻¹¹; however, they are not easily applicable to edentulous situations. Pound¹⁵ proposed the use of the maxillary and mandibular incisors rather than full arch wax rims to establish the intermaxillary position, but this technique requires great skill and time.

This article describes a technique to obtain easily and predictably an intermaxillary relationship in edentulous patients treated in at least one arch with implants avoiding the problems experienced with the use of wax rims.

DESCRIPTION OF THE DEVICES

The devices proposed by the authors have been constructed for use with the Brånemark system (Nobel Biocare AB, Göteborg, Sweden) or its clones. This system requires a two-stage surgical procedure. At time of implant exposure after the required time for osseointegration, screw the appropriate prosthetic abutments into the implants. After soft tissue healing, make an impression of the abutments to initiate construction of the final prostheses. During this same appointment, use the mechanical devices to find and register the intermaxillary position at the vertical dimension of occlusion where the patient needs to be rehabilitated.

The first of these devices is a mechanical “tooth”

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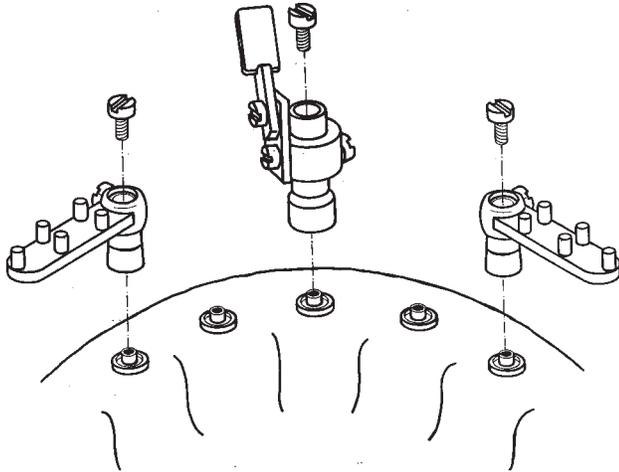


Fig. 1. Schematic representation of mechanical devices: Tubular components that are connected to abutments are prefabricated, whereas other parts are cast and assembled.

which is screwed to one of the most anterior abutments to obtain an anterior point of contact with the opposing arch at the desired vertical dimension. This device can be constructed in the laboratory by using commercially available components that will vary according to the prosthetic abutment selected for the patient. For the standard abutment (Nobel Biocare AB), the TC 300 component is used (Implant Innovations Inc., Palm Beach Gardens, Fla.); for the Estheticone abutment (Nobel Biocare AB), the CNC 30 component is used (Implant Innovations Inc.). Both components can be attached to the abutments with a standard gold screw (slot DCA 075, Nobel Biocare AB). A custom-made ring is cast to fit over the cylindrical portion of these components. (This ring has a screw that can lock it at different heights.) Fix a 5 mm long bar to the ring by means of another screw to support a tooth-shaped bar that can be locked in different positions with a third screw (Fig. 1).

PROCEDURE

1. Once the entire assembly is connected to one of the most anterior abutments, adjust the height and inclination of the tooth-shaped bar as if it was an incisor on a wax rim. (The vertical height can be arbitrarily decided by the prosthodontist. Alternatively, the vertical dimension of occlusion that the patient had with the removable prostheses worn up to this time can be maintained and reproduced by using extraoral points of reference.)
2. Have the patient find a mandibular position by closing on a single anterior contact, without any posterior interferences in a situation of neuromuscular deprogramming. (The proper technique can then be used to bring the mandible in centric relation.)
3. Once the position has been established, tighten all



Fig. 2. Devices applied to abutments in fully edentulous mandible treated with implants. Autopolymerizing resin has been applied to anterior mechanical "tooth" to lock components together after vertical dimension of occlusion is established. Space is available between posterior devices and opposing denture.

three screws with a slot screwdriver (DIB 048, Nobel Biocare AB) and then paint autopolymerizing resin (Pattern Resin, GC International Corp., Scottsdale, Ariz.) on the device by using the salt and pepper technique to lock the parts so that they cannot accidentally come loose (Fig. 2). (Some resin can also be placed on the tooth-shaped bar to capture precisely the position of the opposing incisor contacting it. If the patient's existing maxillary denture is displaced or dislodged by the anterior contact with the mandibular mechanical "tooth," a denture retention product [such as a paste or powder] can be used sparingly to enhance its retention during the registration procedures.)

4. Complete the intermaxillary registration by using the other two devices, which consist of a metal bar 20 mm long and 5 mm wide with five conical retention pegs on the top surface, for the registration wax (Fig. 1). (At one end of the bar there is a ring [TC 300, Implant Innovations Inc.], which fits around another prefabricated metal temporary component if the device has to be attached to a standard abutment, or the CNC 30 ring [Implant Innovations Inc.] if it has to be attached to an Estheticone abutment. Because of the ring, the bar can rotate around the metal temporary cylinder but it is not allowed to slide vertically.) Screw the devices to one of the posterior abutments, one on each side. Position the bars in a buccolingual direction so that they run parallel to the premolars and molars of the opposing arch, then tighten the retention screws. There should be no contact at this time between the posterior devices and the opposite dentition (Fig. 2).



Fig. 3. Heated Moyco Beauty Pink extra hard wax wafers have been placed on top of posterior bars and, once chilled, lined with ZOE paste.

5. Heat Beauty Pink extra hard wax (Moyco Industries, Philadelphia, Pa.) to 53° C, then apply the wax to each bar to register the intermaxillary position in centric relation. Subsequently, line the wax with ZOE paste (Super Bite, Harry J. Bosworth Co., Skokie, Ill.) to capture the details of the opposing occlusal surfaces (Fig. 3). (It is possible to take multiple wax records if deemed necessary or desirable by the clinician so that a comparison of the positions registered can be carried out with the split-cast technique.^{9,16} If it has not been done already, an irreversible hydrocolloid impression of the opposite arch can be taken and a face-bow transfer record is secured to mount the maxillary cast on a semiadjustable articulator.)

If a new maxillary denture needs to be fabricated at the same time as the mandibular prosthesis, the technique can be modified as follows.

- A. After making the final impression of the edentulous arch, construct a resin temporary base on the master cast and a wax rim is placed on the ridge crest.
 - B. Mount the two central incisors on the rim after establishing the patient's facial midline and incisal edge position both in a vertical and an antero-posterior direction.¹⁵ (The denture teeth can now be used as the anterior stop for the mechanical device connected to the implant in the anterior portion of the mandible.)
 - C. Posteriorly, make notches on both sides of the rim so that a definitive intermaxillary position can be captured by the registration material placed on the two metal bars connected to the posterior implants.
6. Once the registration is completed, remove all three devices from the mouth by unscrewing the screws that connect the temporary cylinders to the abutments.



Fig. 4. Mechanical devices positioned on corresponding abutment analogs on master cast. At this time, they can all rotate freely anteroposteriorly.

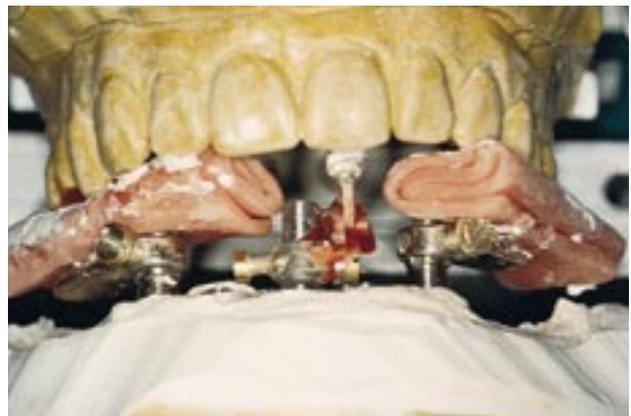


Fig. 5. ZOE-lined wax wafers have been glued to opposite cast with sticky wax and mechanical devices have been eased in indentations. There should be no rocking of casts and anterior device should contact palatal surface of maxillary incisor.

7. In the laboratory, attach the devices to the corresponding abutment analogs on the master cast (Fig. 4). Do not tighten the holding screw of the anterior device so the tooth-shaped bar can rotate until the exact interdigitation with the opposite arch is found.
8. Place the ZOE-lined posterior wax interocclusal records on the stone cast of the opposing dentition to check their adaptation. If necessary, carefully remove the thin projections of the ZOE paste with a sharp blade.
9. Fix the wax interocclusal records to the cast with sticky wax (Bellewax, Belle de St. Claire, Chatsworth, Calif.).
10. Loosen the two screws that lock the horizontal bars to the temporary cylinders so that the bars can rotate freely in a buccolingual direction. Articulate



Fig. 6. Mandibular cast stabilized with wooden sticks and sticky wax and ready to be mounted on articulator.

the two casts together to ensure that the conical retention pegs of the posterior devices fit in the appropriate indentations in the wax interocclusal records (Fig. 5).

11. Tighten all screws and hold the casts in position with wooden sticks glued on the sides with sticky wax. Mount the mandibular cast on the articulator (Fig. 6).
12. After the casts have been mounted, burn out the autopolymerizing resin placed on the anterior device. Clean and sterilize all mechanical components for use with the next patient.

DISCUSSION

There are a number of advantages of this proposed technique. It eliminates the costs involved with the fabrication of resin bases and wax rims for each patient; the mechanical devices can be reused endlessly. It allows the clinician to save a clinical appointment because the intermaxillary registration is carried out in the same setting as the final impression. The anterior device provides an easy way of getting to a condition of neuromuscular deprogramming through the establishment of a unique anterior point of contact. Because the devices are not bulky, they are less likely than the conventional wax rims to interfere with the recording of the correct mandibular position (centric relation). This technique allows the clinician to carry out multiple registrations for a verification of the intermaxillary position through the split-cast technique and it can be used regardless of which arch is edentulous.

However, there are some disadvantages to this technique as well. The mechanical devices described in this article are not commercially available; thus, they need to be fabricated and assembled in the dental laboratory. A minimum interarch space of 5 mm is needed between the top of the abutments and the opposing arch (occlusal plane) to accommodate the posterior devices. It is also difficult to lock into position all

mechanical components, both in the mouth and on the cast. The positioning of the anterior device is not easy when the patient has a skeletal Class II, Division I malocclusion with an edentulous maxillary arch rehabilitated with implants, or a skeletal Class III with either the maxillary or the mandibular edentulous arch rehabilitated with implants.

We were unable to find in the literature references to the role that the presence of relatively bulky temporary bases and wax rims have on altering the edentulous patients' ability to "slide into centric relation" and to perform effectively phonetic tests. However, our clinical experience has shown that the use of the mechanical devices just described greatly facilitates these procedures. This aspect, together with the advantages previously mentioned, makes the application of these devices highly indicated in the treatment of edentulous arches where implants have been placed.

We thank Mr. Emilio Balbo, CDT, for the assistance in the fabrication of the mechanical devices.

REFERENCES

1. Brånemark PI, Zarb GA, Albrektsson, T. *Tissue-integrated prostheses*. Chicago: Quintessence; 1985.
2. Hobo S, Ichida E, Garcia LT. *Osseointegration and occlusal rehabilitation*. Tokyo: Quintessence; 1991. p. 153-62.
3. Loos LG. A fixed prosthodontic technique for mandibular osseointegrated titanium implants. *J Prosthet Dent* 1986;55:232-42.
4. Celenza FV. The centric position: replacement and character. *J Prosthet Dent* 1973;30:591-8.
5. Gilboe DB. Centric relation as the treatment position. *J Prosthet Dent* 1983;50:685-9.
6. Yurkstas AA, Kapur KK. Factors influencing centric relation records in edentulous mouths. *J Prosthet Dent* 1964;14:1054-65.
7. Walker RC. A comparison of jaw relation recording methods. *J Prosthet Dent* 1962;12:685-94.
8. Graser GN. An evaluation of terminal hinge position and neuromuscular position in edentulous patients. Part I. Maxillomandibular recordings. *J Prosthet Dent* 1976;36:491-500.
9. Lucia VO. A technique for recording centric relation. *J Prosthet Dent* 1964;14:492-505.
10. Long JH. Locating centric relation with a leaf gauge. *J Prosthet Dent* 1973;29:608-10.
11. Long JH Jr, Buhner WA. New diagnostic and therapeutic mechanical device. *J Prosthet Dent* 1992;68:824-8.
12. Kantor ME, Silverman SI, Garfinkel L. Centric-relation recording techniques—a comparative investigation. *J Prosthet Dent* 1972;28:593-600.
13. Weinberg LA. The role of muscle deconditioning for occlusal corrective procedures. *J Prosthet Dent* 1991;66:250-5.
14. Tripodakis AP, Smulow JB, Mehta NR, Clark RE. Clinical study of location and reproducibility of three mandibular positions in relation to body posture and muscle function. *J Prosthet Dent* 1995;73:190-8.
15. Pound E. *Personalized denture procedures dentists' manual*. Anaheim (CA): Denar Corp.; 1973.
16. Needles JW. Mandibular movements and articulator design. *J Am Dent Assoc* 1923;10:927-35.

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0022-3913/98/\$5.00 + 0. 10/1/89868