Fast, precise and cost-efficient

A New Treatment Concept for the Edentulous Mandible

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Various treatment concepts exist for rehabilitating the edentulous mandible that have demonstrated a good clinical prognosis for many years [1,2]. A removable denture generally requires four, at a minimum two implants in the intraforaminal area. The superstructure can be connected to the implants and their abutments using bar, magnetic, ball or telescope attachment. In the conventional technique, the implants are uncovered three months after insertion and restored. But as early as in the 1980s, Ledermann found that immediate restoration using a bar attachment supported by four implants has the same chance of success [3,4].

Thanks to innovative treatment methods and technologies in oral implantology, of which 3D diagnostics deserve special mention, further improvements and shorter treatment times have become possible [5-7]. Today's patients expect their implant-supported restorations to be available more quickly and in better quality at the lowest possible cost. In addition, it is highly desirable for the components to be interchangeable, independently of the implant system used, and to carry a low risk of complications.

In cooperation with the Foundation of the Medical University of Poznan, Poland, we have developed an innovative method for rehabilitating the edentulous mandible that meets the requirements outlined above. The method benefits from 3D diagnostics, allowing implants to be inserted transgingivally using a surgical stent. Prefabricated prosthodontic components facilitate direct restoration on the same day, considerably reducing treatment cost (by approximately 50 percent). The method requires a well-preserved alveolar ridge and a functional mandibular denture containing no metal parts.

Step 1: Preparing the surgical stent based on the existing denture

The treatment as described here presupposes an existing denture that is still functional and contains no metal components. If this is not the case, a new denture must first be fabricated for this purpose. The clinical examiner should check whether the alveolar ridge between sites 33 and 43 is sufficiently high and wide and reasonably level (Fig. 1); the wider and the more regular the alveolar ridge, the easier the insertion of the implants. Sufficient vertical space (at least 40 mm) is required in the open mouth to facilitate proper implant handling. Once all requirements have been met, the existing denture can be duplicated. Prior to duplication, it is recommended to extend the anterior aspect of the denture base using autopoly-

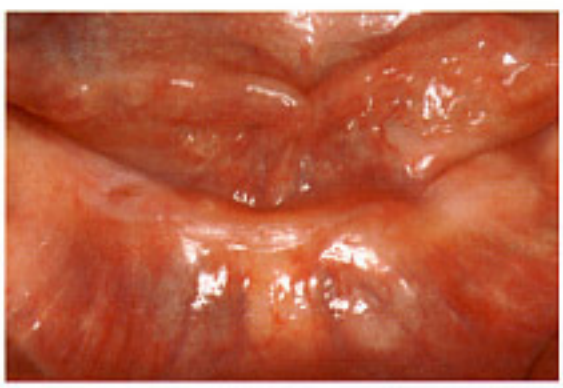

Fig. 1 The method presented here requires a wide and regularly shaped alveolar ridge (plateau).

Fig. 2 Relining extension expression prior to duplicating the denture.

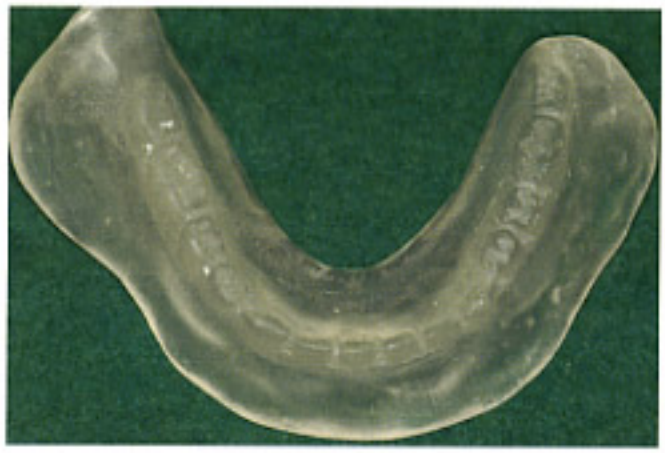

Fig. 3 The stent is based on the duplicated denture.

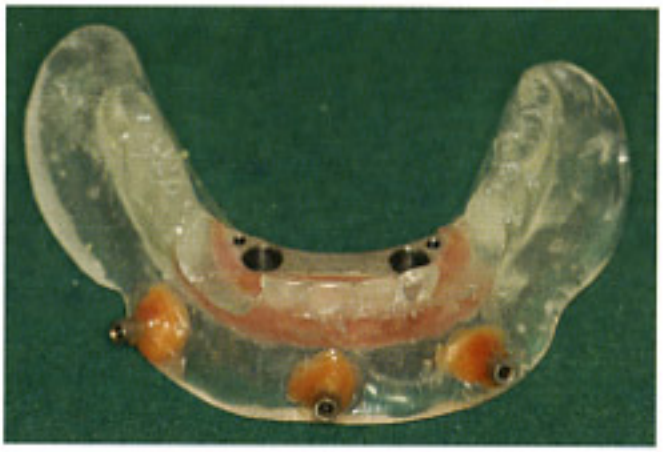

Fig. 4 The housing replica and the horizontal sleeves are attached to the stent using modelling wax.

Fig. 5 Bite index.

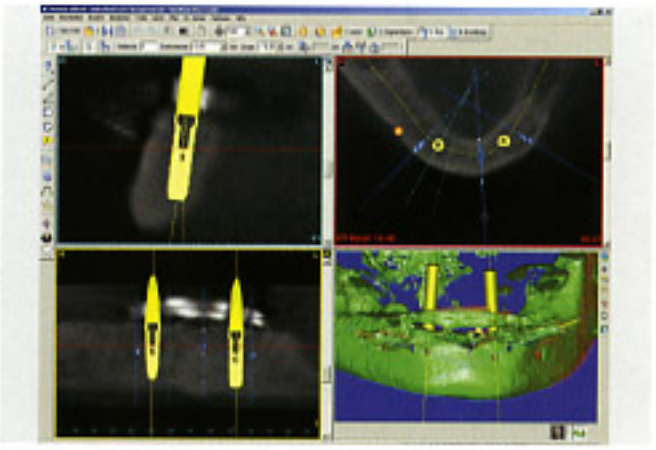

Fig. 6 3D control of the planned implant positions.

merizing resin and to take the relining impression to improve denture retention. The impression is taken in the closed-mouth position with the jaw inserting slight pressure on the tray (Fig. 2).

The relined denture is duplicated in the laboratory in a transparent resin material to yield the surgical stent (Fig. 3). After placing appropriate bores in the surgical stent, a bar housing replica is centred above the alveolar ridge and secured within the stent with modelling wax. The implant beds are prepared through the housing replica such that the long axis of each implant bed is located centrally in the bone as seen in a cross-section. Because the surgical stent is supported by the soft tissue, it must first be secured to the jaw, which is achieved using three horizontal sleeves in the stand located vestibularly at the midline and near sites 34 and 43. The sleeve axes must not collide with the implant axes and must keep a minimum distance of 3 mm from the mental foramina. The housing replica and all three sleeves should be firmly attached and integrated into the stent using modelling wax (Fig. 4).

Step 2: Tomographic control (DVT or CT)

Prior to the tomographic imaging procedure, the stent is placed in the patient's mouth and checked for stability with the jaws closed. As a precautionary measure, it is recommended to take a bite index using a stable material (e.g. Quick Bite) that ensures the correct occlusal relationship with the maxillary teeth or denture (Fig. 5). The tomography itself (DVT or CT) is performed with both the stent and the bite index in place and the jaws closed. The purpose of this radiological control is to check the position of the housing replica and the sleeves relative to each other and relative to the anatomic structures. The sleeves must allow the pins to be anchored inside the jawbone. The most important aspect, however, is the position of the future implants within the bone. As seen on cross-sectional images, they should be centred within the jaw, being covered by an intact bone layer 2 mm or more in thickness both on the vestibular and on the lingual aspect (Fig. 6). This can be checked in all three spatial dimensions using 3D planning software (e.g. SimPlant).

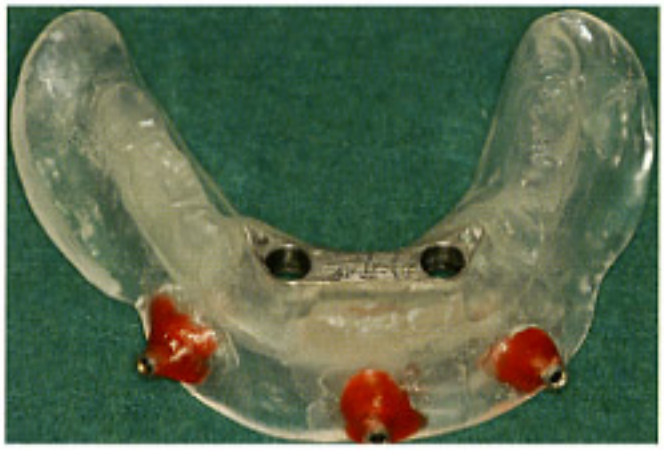

Fig. 7 Finished surgical stent.

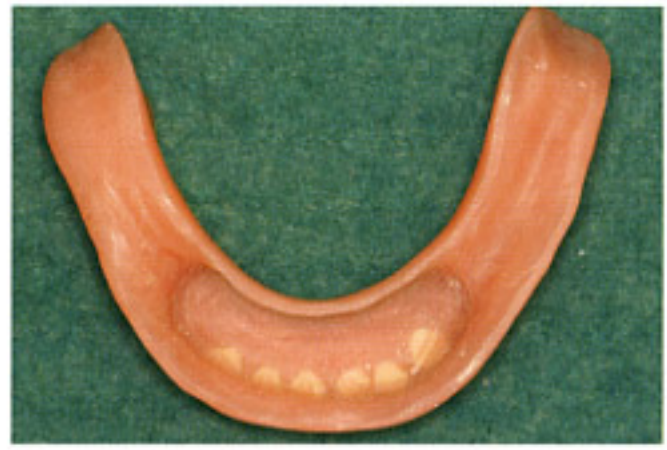

Fig. 8 The denture is modified to serve as an impression tray.

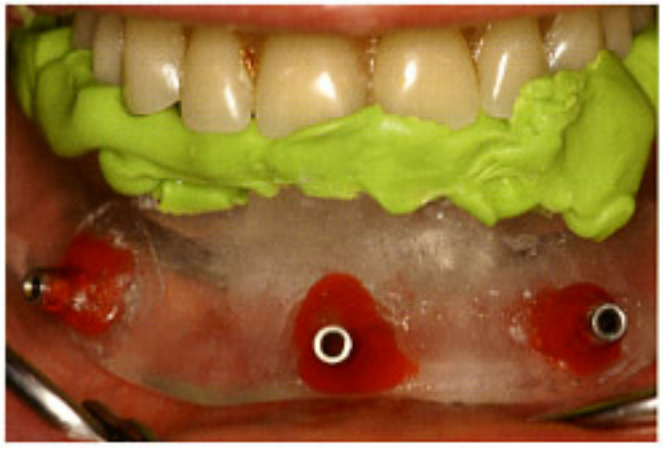

Fig. 9 Stabilizing the surgical stent on the jaw.

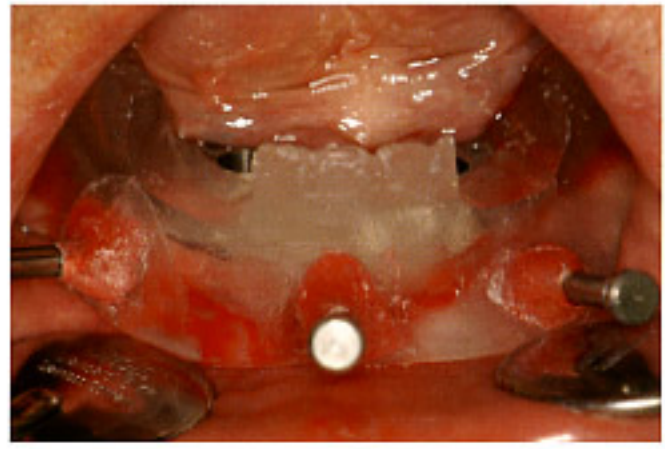

Fig. 10 Anchoring the stent within the jawbone using three horizontal pins.

In the procedure described here, all parameters of the future implants are determined during the planning stage. Our standard implant is the Neoss implant (4 mm in diameter, 17 mm in length). If the tomographic control shows that the position of the components (housing replica or sleeves) within the stent is suboptimal, this can and must be corrected in wax, potentially requiring a new tomographic control.

Once the result of the tomographic control is satisfactory, the surgical stent can be finalized. Care must be taken to ensure that replacing the modelling wax with acrylic resin does not change the positions of the components. For additional ease of handling during implant surgery, resin teeth 33/34 and 43/44 can be ground down to the level of the housing replica. Both the incisors and the molars, however, must remain intact in order to lend stability to the surgical stent as it is positioned in the mouth (Fig. 7). Before surgery, the denture must be prepared for taking the impression by relieving it to accommodate the abutments and the bar attachment (Fig. 8).

Step 3: Implantation

Prior to insertion of the implants, the mandible must be anaesthetized from site 35 to site 45 by bilateral block anaesthesia and infiltration anaesthesia or by infiltration anaesthesia alone. A few minutes following infiltration anaesthesia, the surgical stent complete with bite index is placed in the mouth, and the patient is advised to firmly keep the jaws closed for three to five minutes to counteract the thickening of the gingiva following injection of the anaesthetic (Fig. 9). At the end of this period, the jaws should be kept only slightly closed so the stent rests firmly on the jaw, allowing the horizontal poles to be drilled through the sleeves using a 1.5-mm twist drill. Three pins are inserted into the resulting holes as far as they will go, the patient is instructed to open his or her mouth. The bite index and – where applicable – the maxillary denture is removed and the surgical stent checked for firm seating (Fig. 10).

The implant beds are prepared through the apertures within the housing replica integrated in the

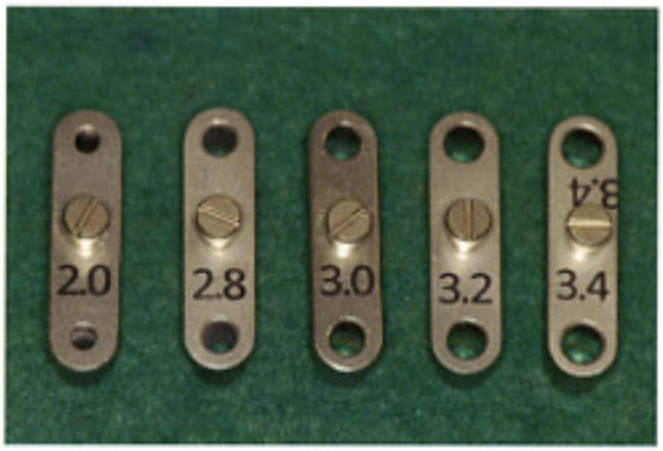

Fig. 11 Dual drilling bars are available for the preparation step.

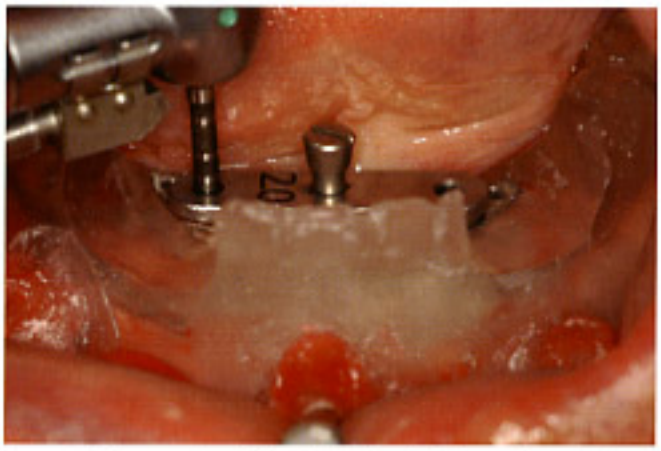

Fig. 12 Initial preparation of the first implant bed through the drilling sleeve using the 2.0-mm twist drill.

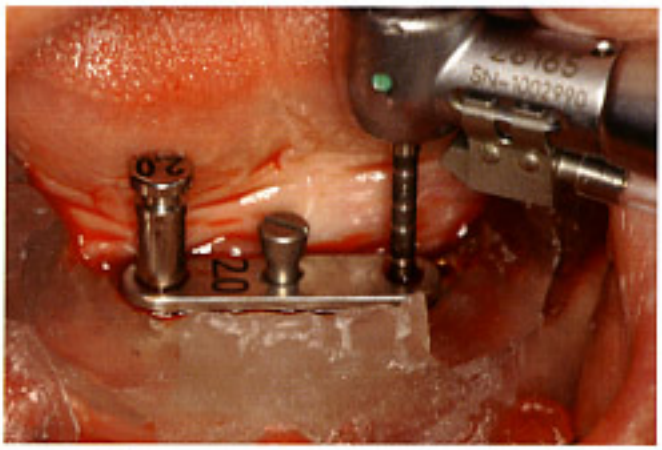

Fig. 13 Stabilizing the drilling sleeve for the initial preparation of the second implant bed by inserting a 2.0-mm vertical pin.

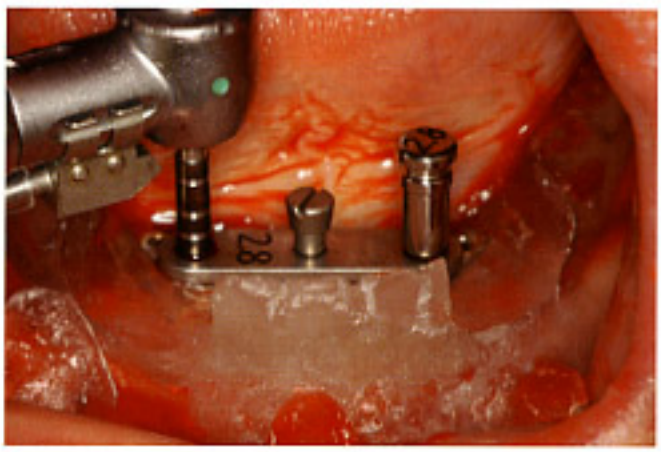

Fig. 14 Additional surgical stents through the stabilized sleeve.

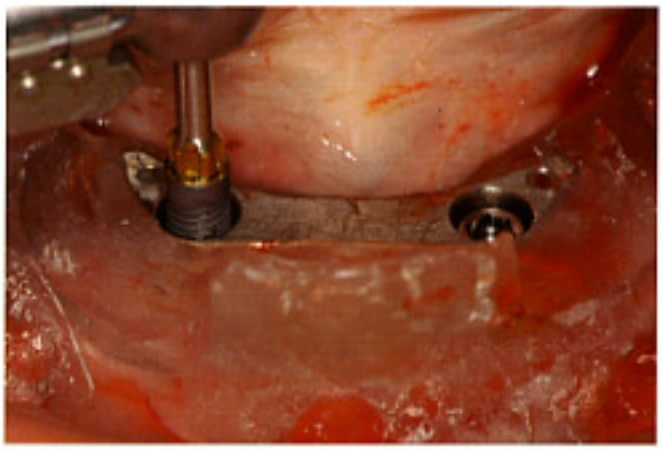

Fig. 15 Inserting the implants.

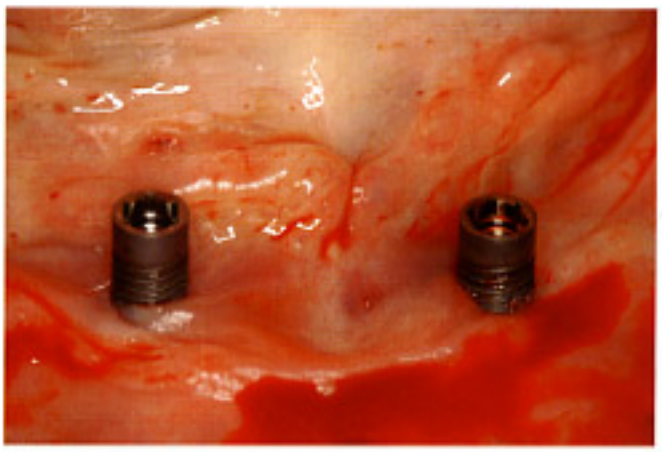

Fig. 16 Implants anchored within the bone after removal of the surgical stent.

surgical stent. The system used features separate drilling bars for twist drills of diameters 2.0, 2.8, 3.0, 3.2 and 3.4 mm, which are applied in sequence (Fig. 11). The initial hole is drilled through the corresponding bar hole using the 2.0-mm drill (Fig. 12). It is a good idea to place a vertical pin 2.0 mm in diameter into the borehole to improve the stability of the drilling bar while drilling the initial hole for the second implant bed (Fig. 13). Subsequent drilling steps are performed in the same way (Fig. 14). If the bone turns out to be rather hard, the thread is pre-tapped to a depth of 10 to 12 mm. In softer bone, implants can be inserted directly through the stent, up to a torque of 20 Ncm (Fig. 15).

The surgical stent is then removed (Fig. 16), and the implants are screwed in using direct vision, down to

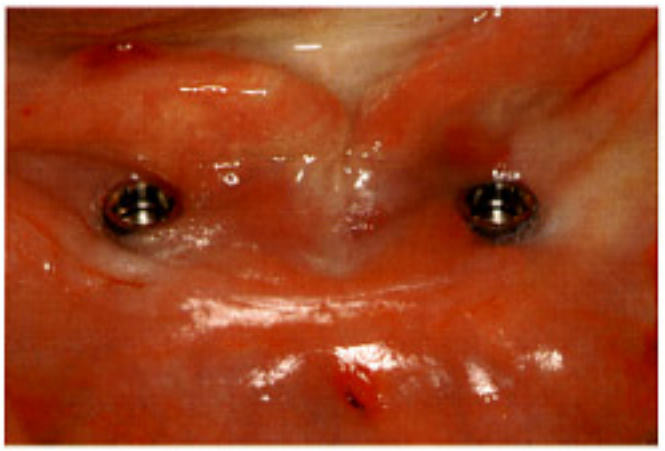

Fig. 17 Implants in their final positions.

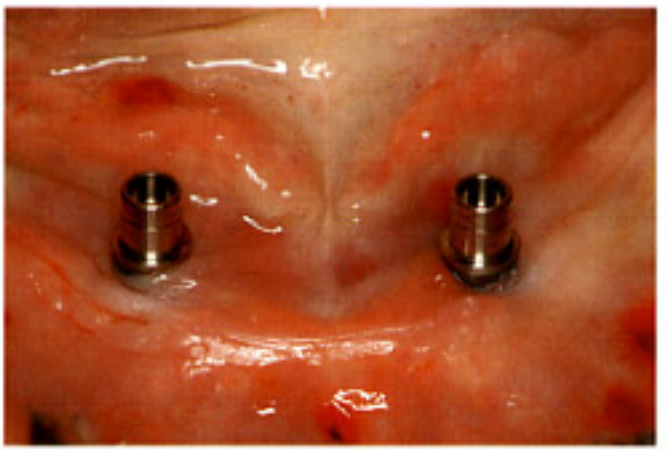

Fig. 18 NeoLink abutments connected to the implants.

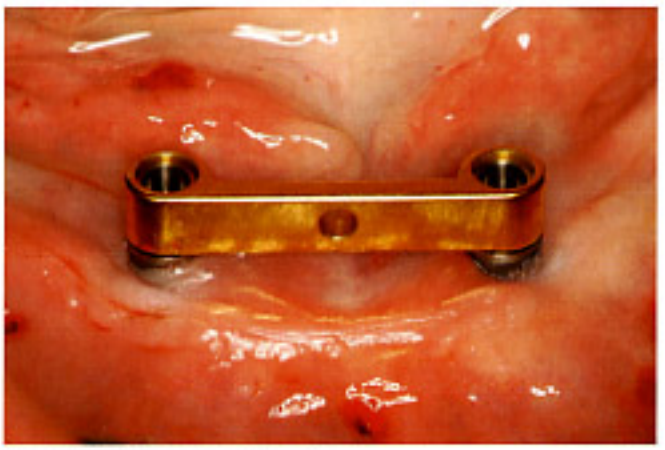

Fig. 19 Bar try-in on the abutments.

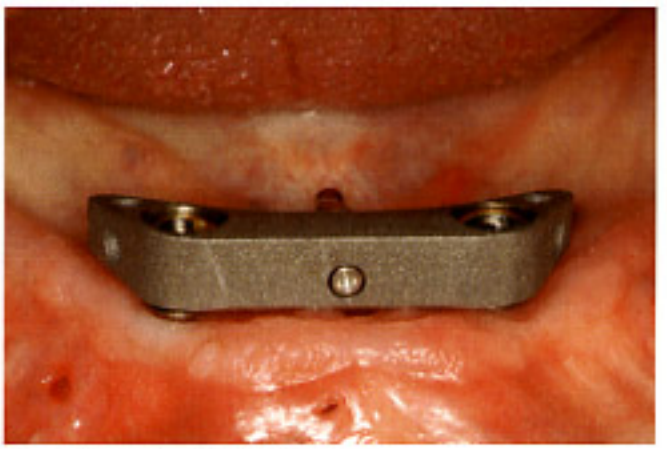

Fig. 20 Intraoral try-in of the bar housing.

the level of the gingiva or 0.5 mm below. It is important that both implants, once they have attained their final position, are at the same level (Fig. 17). NeoLink Multi abutments with a transgingival height of 0.7 mm are then connected to the implants (Fig. 18). Once all abutments are in place, the decisive moment has come – we can now see whether the bar can be placed without complications and whether it is correctly seated on the abutments and well adapted to the gingival level (Fig. 19).

In the event of an inexact fit, the abutment screws can be loosened slightly and the bar placed on the abutment afterwards, followed by re-tightening of the screws. If an implant was inserted too low or too high or if the bar impinges on the gingiva, the position of the affected implant must be corrected after removing the abutments. For didactic purposes, the housing may be placed on the bar at this point and locked with its corresponding lock (Fig. 20). The bar will assume its pre-determined final position within the sleeve, which is completely secured by the closed lock (Fig. 21). However, the housing must be removed before taking the impression.

Next, the position of the bar is transferred to the working cast. Before taking the impression, care must be taken to relieve the denture serving as a tray to ensure that sufficient space is available for the bar and abutments (see Fig. 8). The impression is taken with the denture/tray filled with a highly viscous impression material (e.g. Impregum) with the mouth slightly open, such that the bar is retained by the impression compound (Fig. 22). The impression is poured at the laboratory to produce a master cast containing the original bar. The bar housing must be integrated into the superstructure. For better spatial orientation, it is a good idea to temporarily attach the denture to the maxillary cast within the articulator. The bar housing is then placed on top of the bar, relieving the denture so it is not in contact with the housing at any point (Fig. 23). The space between the housing and the denture should be filled such that the lock can move freely and the denture can be removed from and replaced on the cast (Fig. 24). A vestibular access to the lock is prepared, and the lingual aspect of the lock is trimmed and smoothed accordingly. The completed denture is finished and polished (Fig. 25).

Fig. 21 Gingival view of the attachment system: housing and locked bar.

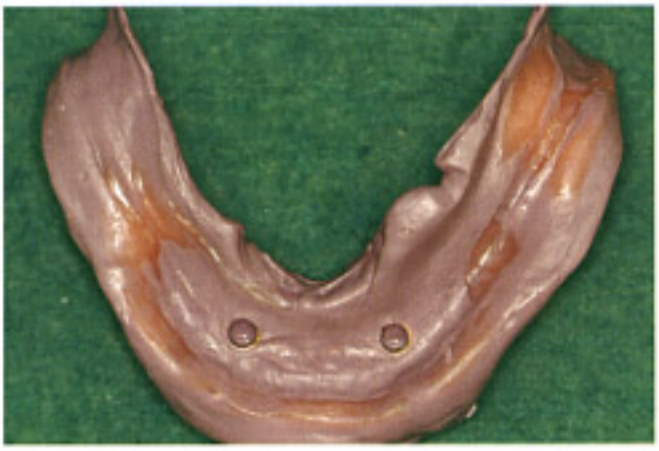

Fig. 22 Diagnostic impression with the bar in place.

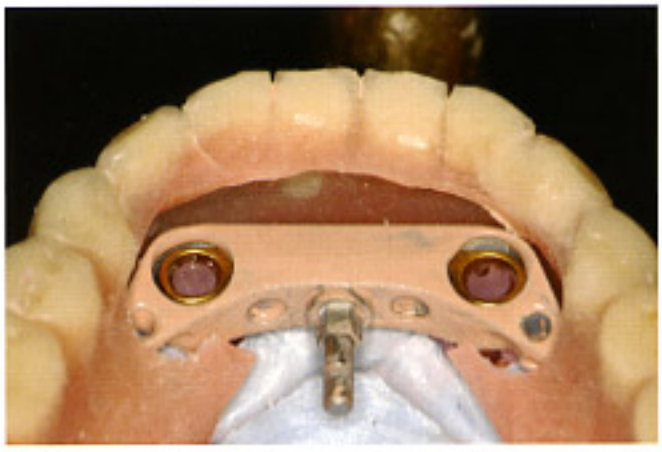

Fig. 23 Integrating the housing into the denture.

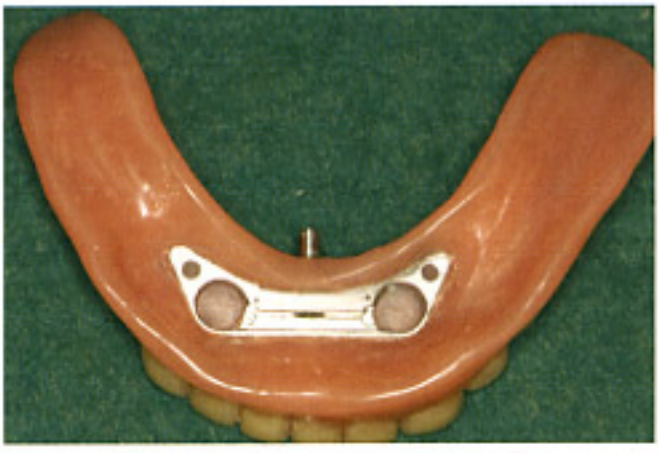

Fig. 24 Tissue side of the finished denture.

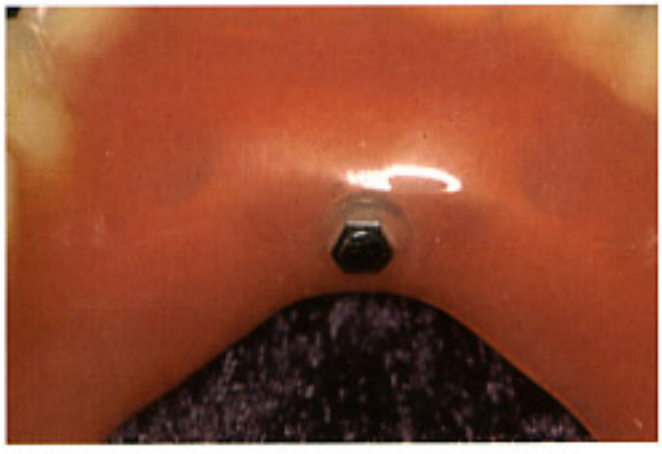

Fig. 25 Smooth transition from lock to base on the lingual side.

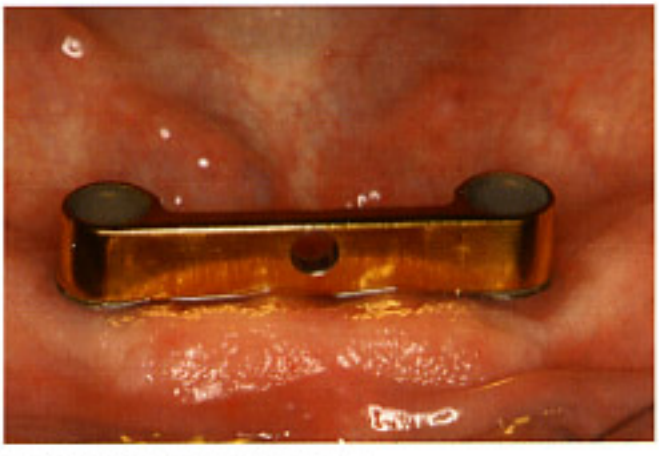

Fig. 26 Mounted bar in its final position.

Step 4: Delivery

It is advisable to try in the bar and denture prior to the definitive delivery. Experience has shown that adjustments will rarely be necessary. After drying, the bar is connected to the abutments using a special adhesive (e.g. AGC Cem), making sure that the vertical and vestibular/lingual position of the bar is 100 percent correct. After removing excess adhesive, the abutment screws should be tightened to a torque of 20 Ncm. The access holes are sealed with a provisional resin (e.g. Clip) to prevent food impaction (Fig. 26).

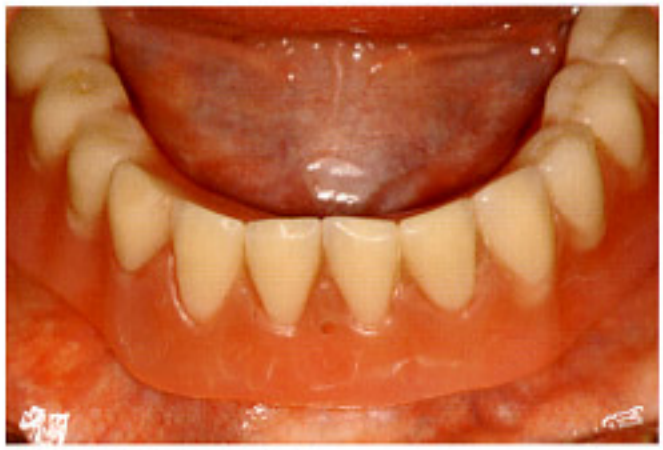

Fig. 27 Completed denture in situ.

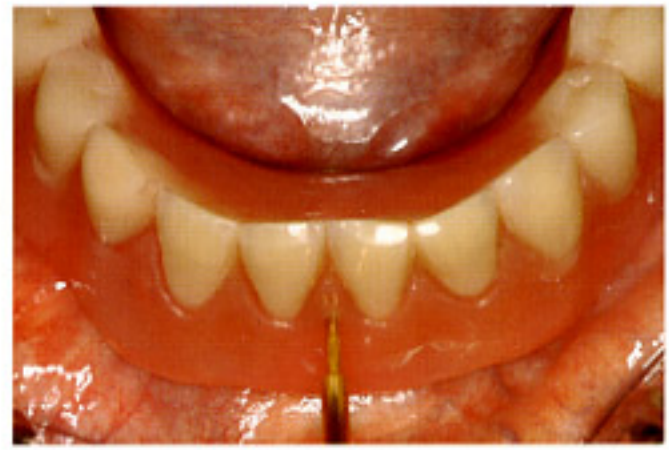

Fig. 28 Opening the locking mechanism.

After delivery, the patient should be made familiar with the function of the lock and be trained to insert and lock/unlock and remove the denture so he or she can subsequently do this unassisted (Figs. 27 and 28).

Conclusion

The method presented here offers the following benefits:

1. The retention system is compatible with most leading implant systems such as Neoss, Brånemark System, Replace, Straumann, 3i and generic implants.
2. Prefabricated components offer excellent quality and a high precision of fit that is almost impossible to achieve in traditional prosthodontics.
3. Locking the denture onto the bar ensures excellent wearing comfort and affords protection against any undesirable loss of stability.
4. The entire treatment can be performed on a single day.
5. The implant procedure itself is a nearly atraumatic surgical procedure that takes approximately 15 minutes and is associated with only minimal swelling and postoperative pain.
6. The cost is approximately 50 percent lower than for a conventional procedure.
7. The denture is easily handled by dentists and patients alike.
8. The incidence of mechanical or biological complications (ranging from source to implant loss) is minimal.

Acknowledgements

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