A Tripodal Mandibular Subperiosteal Implant

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Abstract

A 40 yrs. old female patient affected by insulin-dependent diabetes since the age of 5 had lost all her teeth over the years. Due to a severe bone atrophy, the last total dentures were dramatically unstable, particularly in the mandible.

The department of maxillofacial surgery of the Ospedale Fatebenefratelli in Roma as well as other surgeons advised this patient against any kind of bone graft surgical procedures because of the degree of bone atrophy, of the volumes of bone to be grafted, and of course because of the type and degree of diabetes.

The patient, well informed that a subperiosteal implant approach would be the only remaining option, was addressed to Dr. G. Cortese in Torino.

The CAT scans and the stereolithographic model of the patient's mandible induced Dr. G. Cortese to choose a subperiosteal tripodal implant according to L.I. Linkow as the most adequate implant to solve her problems. Both the surgery and the construction of the final prosthesis proved to be almost totally uneventful.

The following reasons motivated the choice of a tripodal subperiosteal implant (TSI) according to L.I. Linkow, with minor modifications by applying recent innovative technology:

1 Raising three separate short surgical flaps in order to insert three separate meshes is less invasive compared to one single flap uncovering the entire body of the mandible from angle to angle to insert one full-arch mesh.

2 This approach significantly reduces the incidence of dehiscences in the soft tissues of a patient with diabetes while the sutures are present and until their removal because the traction exerted by muscle fibres and tendineous ligaments is minimal compared to a full-arch flap.

3 Three separate meshes, one placed in the intraforaminal chin area between the two inferior alveolar nerves, and two distal meshes close to the right and left angle of the

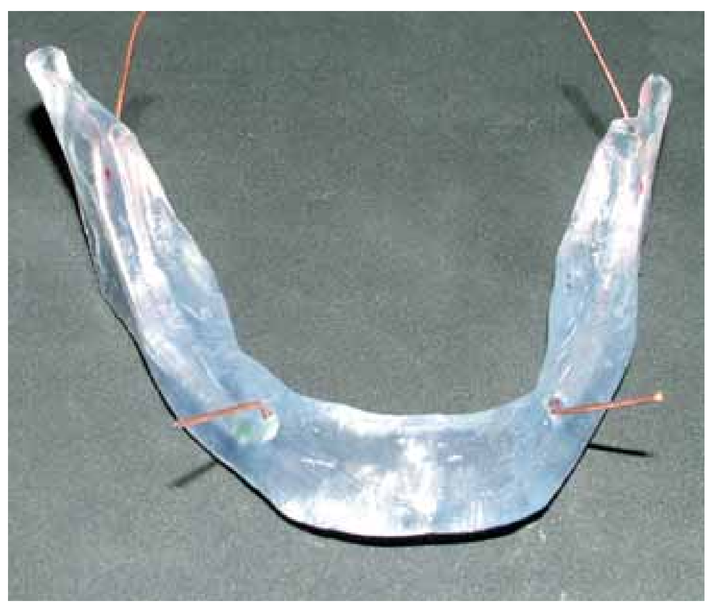


Figure 1: STL model of atrophic mandible with verticalization of the inf. alv. nerves through the foramen

Figure 2: Designing the three meshes of the TSI.

Figure 3: The meshes casted in Ti.

mandible respectively, make the surgery faster and less complex. The bone surface remains exposed for a minimal time, significantly reducing the risk of bacterial infection.

4 Three separate meshes, compared to a full-arch single mesh, better respect the residual elasticity of the atrophic mandible against flexing forces.[1] This reduces the impact of the mesh on bone remodeling and bone resorption: fewer if no micromovements at all in the mesh-cortical bone interface also contribute to eliminate local inflammatory factors and the risks of bacterial infection in a patient with diabetes. Due to the reasons mentioned above, a mandibular bone growth induced by a TSI has been reported to occur in an atrophic mandible.[2]

5 The primary mesostructure connecting the transmucosal posts is obtained by laser melting in a Co-Cr alloy, hence no oxides, a perfectly dense and homogeneous metallic structure, with no tensions generated at the end of the melting process. This means that the mesostructure is totally passive and that no tensions are exerted among posts, mesh, cortical bone, mandible.

6 Two locks sliding horizontally are used to anchor the final removable denture instead of the common Teflon-retained balls which work on the vertical axis. These locks exclude any vertical traction forces when the patient removes the denture for oral hygiene.

Materials and Methods

As a first step, the patient is fitted with two technically impeccable new dentures by Dr. E. Moglioni and by technician F. Lico in Roma. These dentures and their master models are the strategic starting point to establish all the morphological and functional parameters leading to the construction of the mesh, of the mesostructure and of the final denture.

The original stereo lithographic (STL) resin model (Figure 1) (Materialize system) is duplicated into gypsum master models. Once the final design of the three meshes (Figure 2) is accomplished on a first model by Dr. G. Cortese, a 5-micron Durolan spacing blue varnish is applied (Lab. P. Villa, Torino) to a second model to smoothen the surface by filling up the microscopic sulci created by the stratification process, which are not present in the real bone.

The three meshes are prepared by technician R. Santini (Lab. Masoero S.r.l., Torino) by applying Redfire light-curing resin and wax on the smoothened blue model. The four posts must be made parallel to one another and show coherent conical sections. Each of the posterior meshes has but one post; the intraforaminal mesh in the chin area has two posts at each end and is shaped to have two holes on the lower buccal side for the fixation screws. Positioning, and inclination, of the distal posts is responsible for the dissipation of the functional loads exerted by the mesh on the angle of the mandibular bone.

The meshes are casted in Ti grade 5 (Figure 3); the posts are then given final conicity by parallelometer milling. Each chamfer line is different for the four posts, the soft tissue around it presenting different thickness and contour.

Two sets of four metallic transfer cups are casted in a Co-Cr alloy (Lab. Masoero S.r.l., Torino) and numbered to safely transfer position and shape of the four posts after surgery in order to prepare the final denture. To be ready to take direct bone impressions if needed, three individual autoclavable resin spoons are prepared and sterilized by enveloped cycle (Lab. Masoero S.r.l., Torino).

Particular care is given by Dr. G. Cortese in establishing the best section of the primary mesostructure which connects the transmucosal posts of the TSI. The section of this mesostructure, from the anterior posts to the distal posts, is initially rectangular (2mm. base and 4mm height) and becomes oval at about 1.5 cm. before the distal posts.

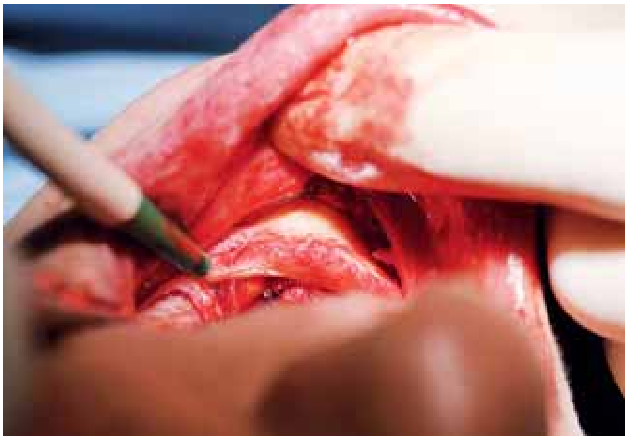


Figure 4: Uncovering the symphiseal bone.

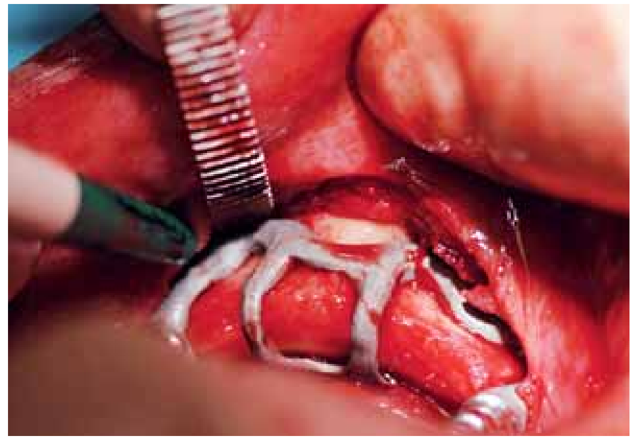


Figure 5: The intraforaminal symphiseal mesh before the two central brackets are cut off.

Figure 6: Cutting off the two short central brackets.

Figure 7: Mesh in situ and screw of osteosynthesis on the right side

Figure 8: Healing of the soft tissues around the posts of the TSI.

Mechanical Engineering[3] holds that if we double the vertical height of a rigid bar, its resistance to vertical flexure is four to five times greater than the resistance to the horizontal flexure. The first mesostructure must be absolutely rigid on its vertical axis and able to oppose any functional load without flexing; on the horizontal axis, a minimal degree of flexibility must be allowed in order to comply with the physiological flexure of the mandible. This happens for instance during extreme yawning when the condyles tend to approach each other.

Surgery

On Dec. 6th, 2013, at 9:00 a.m. the patient receives intravenous sedation with constant monitoring by Dr. P. Formia (Torino); local injections (optocaine 20mg/ml with 1:100.000 adrenaline) in the three surgical areas and bilateral truncular blocks are administered.

The symphyseal flap is raised intraforaminally well uncovering the bone (Figure 4) to allow the largest possible direct view of the implant site, keeping safely clear of the alveolar nerves. Two short brackets between the posts initially keep the mesh from being properly positioned (Figure 5). The mesh is then corrected by cutting off these brackets (Figure 6). The implant is then washed with antibiotic solution and the position tested again: this time

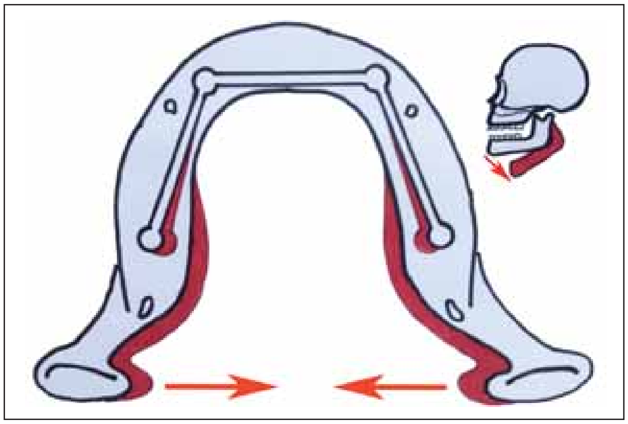


Figure 9a and b: Final denture with mesobar inside and the sliding locks opened. The distal mesial empty space is to let the distal part of the bar to flex lingually and converge towards the opposite side when yawning.

Figure 10: The primary mesobar cemented on the posts of the TSI.

Figure 11: The STI retained final denture with the sliding locks opened.

it sits perfectly into position (Figure 7). A gentle tappering on the posts with a surgical hammer proves that the final position has been reached. Two screws for osteosynthesis (Allmed, MI, 1,8 mm by 4.5mm) are then tightly secured to their buccal sites. This surgical area is washed with antibiotic solution, and the excess is removed by surgical suction.

The mesh on the right distal side also needs to be corrected and a short bracket is cut off before the final position is reached and the flap is sutured. On the left side, the surgery is completely uneventful.

Finally, the very same denture originally made is transformed into a provisional prosthesis and adapted to the four transmucosal posts of the TSI right after suturing, respecting the original vertical dimension and the correct occlusion with the opposing upper denture. This proves that the entire sequence of the preliminary measurements has been accurately performed.

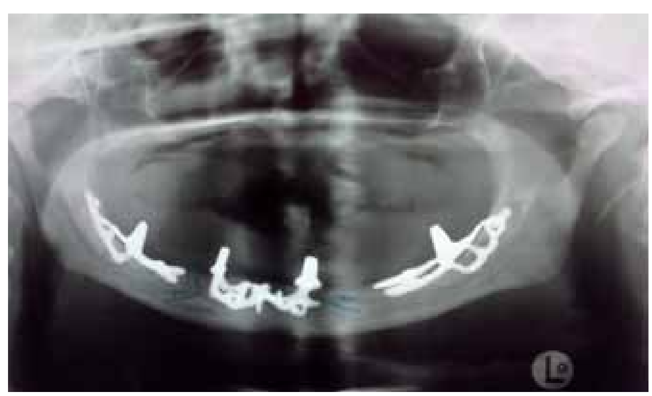
The patient is requested to return on the following morning for a routine post-op checkup and dismissed with antibiotics, anti-inflammatory, analgesics and ice bags prescription. A cold semi-liquid diet is recommended. The next morning, no bleeding, no edema or pain is reported.

On January 9th, 2014, i.e. 34 days after surgery, the patient is seen by Dr. G. Cortese in Torino for the first follow up. The tissues have healed nicely (Figure 8) and the provisional denture is reported by the patient to be very stable. All functional and aesthetic tests are performed using templates of the primary mesostructure and of the final denture.

Figure 12: The sliding lock closed on the right side.

Figure 13: Final smile and occlusion with the sliding locks closed.

PRE-OPorthopanthomography with radiopositive markers of the gingival thickness.



Immediately POST-OP orthopanthomography with the three meshes of the TSI in situ.

Radiological follow up thirty days after
the end of the clinical case

On January 24th , all the metallic frameworks are tested, the final occlusion and aesthetics established. On January 25th, the primary mesostructure is finally cemented to the posts (Figure 9, Figure 10). The patient now wears the final, perfectly stable denture (Figures 11, 12, 13).

Conclusion

In our opinion, this report of a complex and borderline clinical case proves that the operative evaluation of a surgical technique should not be dismissed "a priori" only because some consider it to be "dated".

On the contrary this report proves that an "old" technique, though "revisited" by applying recent innovative technologies, has provided an elegant, minimally invasive solution to a clinical case so extreme that the patient had either been rejected or frankly warned against any highly invasive, regenerative surgery.

In brief, a brilliant scientific conception is bound to win over the challenge of time, for those who really capture the quality of its essence and vision. ■

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