**BTLock® Guided Expander Technique and minimally invasive surgery in implant dentistry. Technique description.**

Claudia de Carvalho Lopes PhD DDS¹, Carlos Eduardo Meira DDS², João Paixão DDS³, Alberta Barlattani DDS³, Luca Testarelli DDS⁴, Alberto Barlattani DDS.³

Claudia de Carvalho Lopes PhD, DDS is in private practice, in Prosthodontics and Implant Dentistry, at Av. Brig. Faria Lima, 1912, 5E, Sao Paulo, SP, Brazil, and is a Professor in the field of Oral Implantology in Cron-Om (Centro de Reestudos Ortodônticos Nacional – Ortopédico Maxilar – CFO 315/99).¹

Carlos Eduardo Meira DDS in private practice, in Prosthodontics and Implant Dentistry and is a Professor in the field of Oral Implantology in Cron-Om².

João Carlos Paixão DDS, is a Professor in the field of Oral Implantology and Prosthodontics in Cron-Om.⁴

Alberta Barlattani DDS, Professor by Tor Vergata University of Rome.³

Luca Testarelli DDS, Professor by La Sapienza University of Rome.⁴

Alberto Barlattani, Specialist in Stomatology, Medical Director of University Tor Vergata, Faculty of Dentistry, Rome. Professor of Prosthodontics in Tor Vergata University, Rome.³

Correspondence to: Prof. Dra. Claudia Lopes, Brigadeiro Faria Lima 1912, 5E 01423-907, Sao Paulo, SP, Brasil. Tel and fax: 0055 1138 129 222.

Email: ccl@usp.br
Abstract: Purpose: the specific aim of this study is to present a surgical-implant methodology, which is based on the minimal invasive surgery’s concept in order to streamline the working steps in the massive rehabilitations of edentulous maxillary and to increase the success’ probability. Materials and methods: one patient with superior edentulous maxillary is chosen. A mobile superior prosthesis is realized and then is duplicated to make a surgical template in radiopac material. The template has 3 mini cylinders as point of reference (2 in the molar area and one in the central area) (Fig.1) in order to have an interface between the surgical site and the image generated by CT-scan. The patient with the template into his mouth is put through Dentascan. By the use of a dedicated software (Co DiagnostiX®, IVS, AG) it is possible to perform a virtual surgery to place the implants at best. The results from this surgery, together with the points of reference in the template (Fig. 2-3), will provide the professional with all the necessary coordinates to drill the template in the prearranged points and inclination in order to place the guides, the surgical rings (fig.4), and the expanders (fig.5). All the information from the virtual surgery are transferred on the template. Once the surgical template is ready, the surgery is performed. The template has to be fixed by osteosynthesis mini-screws on the patient in a precise and steady manner. Results: amazing are the results we got: easiness in performing the surgical stage, high predictability of the results, speeding for the surgery, and great comfort both for the patient and the professional. Discussion: the diagnostic and the implant planning are the most important stages of this methodology. The data collection has to be very precise to realize a surgical template which is a true copy of the anatomic context where the surgery will be performed. The radiographic exam and the virtual surgery planning by
the dedicated software provides the technician with all the necessary data to drill the template and make it ready for the surgery. **Conclusions:** BTLock guided expander technique (fig.6-7) shows a signal effectiveness in simplifying and speeding up the surgical stage in complex implant and prosthetic rehabilitations. Further studies are necessary to provide an exhaustive assessment of this methodology but the path is surely traced.

**Key words:** dental implant, expanders, minimally invasive procedures, flapless surgery.

**Introduction**

The purpose of this paper is to report the BTLock® Guided Expander technique applied in minimally invasive surgical protocol in implant dentistry. The use of oral implants in dentistry has a high predictability in the rehabilitation of partially and fully edentulous patients. If there is an adequate bone volume to ensure the primary implant stability and resistance to functional load the osseointegration is achieved and maintained with a high success rate. One of the most important concerns in Implantology is the reconstruction of severely bone resorption, so the architecture of the host bone is critical to the implant success. In order to achieve and to change bone quality and volume a number of procedures have been developed such as autogenous bone graft alone and/or combined to processed bovine bone grafts, synthetic mineral grafts, homogenous bone grafts and more recently with platelet-rich plasma. Nonetheless, resorption of the bone grafting can lead to an insufficient bone volume and a poor bone quality. In addition to this, there is the morbidity and risk of complications of the donor site. Furthermore, some patients can not be exposed to major surgeries due to the health and economic conditions. Therefore, Bezerra et al. proposed to incline the
long axis of the implant providing a tridimensional ideal position avoiding anatomical structures and surgical grafts. Then again, bone quality and primary stability can be improved by bone condensers especially in maxillae\textsuperscript{6,7,8}.

More recently with the development of technology it is possible to formulate a pre-surgical plan involving image guidance and the manufacture of a custom template in order to submit the patient to a minimal invasive procedure with the finest implant position\textsuperscript{9}. In 2002, Steenberghe et al.\textsuperscript{10,11} proposed the use of a custom surgical template in order to immediate load implants in maxilla, latter the author adapted the technique to use with a flapless surgery by means of a minimally invasive procedure.

**Technique description**

The BTLock\textsuperscript{®} Guided Expander technique is indicated mostly for the edentulous maxilla that is more suitable to the use of the guided expanders.

The technique requires a pre-surgical plan concerning a computerized tomography scan (CT-scan), a navigation software (Co DiagnostiX\textsuperscript{®}, IVS, AG, Germany) and a surgical template.

Previous to surgery, impressions of both arches are made and the maxillo/mandibular relation transferred to the semi-adjustable articulator. The diagnostic wax up is performed by a laboratory and a provisory total prostheses prepared according to the patient’s mechanical, phonetics and esthetical profile. Next, the total prosthesis is duplicated to create a surgical template (acrylic copolymer, Dencor, Classico, Brasil) at the laboratory. Teeth are made with a radiopac material, so when the CT is performed, it will be highlighted guiding the implant position. Special care is made in the positioning the teeth on the fibro mucosa level.
Previous to the CT-scan, the surgical template receives a resin base template with three titanium pins inside, two in the molar and one in the middle region to serve as a reference points to create the interface between the surgical site and the CT image. The resulting template provides a base for the exact realization of the implant surgery plan using the navigation softer (Co DiagnostiX®, IVS, AG).

Then the patient is fitted in the CT machine, the template is positioned on place and the patient is asked to hold a closed position (pre established) therefore, the prosthesis remains stable in this position during the CT-scan assessment.

The tridimensional images are transferred to a computer and the navigation software (Co DiagnostiX®, IVS, AG) is used in order to perform a virtual surgery, so the surgeon can virtually place the implants in the finest position according to the teeth reference and avoiding anatomical regions. The software identifies the cylinders inside the platform (references) and calculates the distance between the bone crestal level and the fibro mucosa thickness (work distance) also the minimum distance among implants as well as implant length and diameter. The surgeon can virtually perform the surgery and determinate the best implant position avoiding bone reabsorption and critical anatomical regions.

On basis of the virtual surgery and the reference points (titanium pins) the software computes the coordinates for all planned implants and displays them in a protocol. With this protocol a technician can perform the drilling using the surgical template according to the implants directions and diameters. The drilling is performed with a special coordinate table (GonyX®, IVS, AG). The drilling diameter is larger than the implant diameter, so the technician is able to place a special ring inside the surgical template (BTLock surgical rings for the expander technique®, BTLock®, Vicenza, Italy). Latter
in surgery the rings will be changed accordingly to the expander diameter (BTLock guide expander®, BTLock®, Vicenza, Italy).

**Surgery procedure**

Antibiotic prophylaxis is followed (amoxicillin 500mg, 2 hours before surgery at first, and 5 days postoperatively).

Surgery is performed in order to place dental implants in edentulous maxilla and immediate load the implants. Under a local anesthesia the surgical template (Fig.8) is positioned and retained with screws (osteosynthesis screw, BTLock®, Vicenza, Italy)(Fig.9-10-11), care is taken to position the template according to the CT-scan exam. The surgery is performed according to the minimally invasive procedure, so no flap is performed. The initial bur (2.0mm) is used in order to perforate the fibro mucosa and to create a path to the expanders (Fig.12). The first cylinder inside surgical template has the same diameter of the bur, so the virtual surgery is transferred to the patient. Then the modified expanders are used according to the manufacture protocol using the straight surgical key (straight surgical key, BTLock®, Vicenza, Italy) or the ratchet (ratchet, BTLock®, Vicenza, Italy)(Fig.13). Bone expansion begins in 3,3mm diameter and can be done until the final diameter pre-established in surgical plan. The system is color coded, so it is very simple to visualize de diameter of the expander and change the cylinders inside the surgical template. As the expander diameters enhances the cylinders are changed to adapt the diameter of the expander, so the virtually surgery is transferred to the patient with a high fidelity degree. The work distance and the fibromucosa thickness were previously calculated by the navigation software, so the surgeon can precisely perform the bone expansion.
After each site is performed, implants are inserted under saline irrigation. Implants diameters are color coded, so it is very simple to match the expander with the implant diameter by the color association (BT-Tite one Line, BTLock®, Vicenza, Italy).

After the implant insertion, the mouths and the osteosynthesis screws are removed. So the surgical template can be safely removed from the mouth without changing implants position. The surgeon can check the implant level related to the fibromucosa and make little adjustments if necessary. Abutments (BTLock®, Vicenza, Italy) and the resin provisory prostheses are positioned. The resin provisory prosthesis is previously made by the laboratory according to the total prostheses used as reference to make the surgical template. The prosthesis is adapted to the abutments by adding small quantities of resin (Duralay®, Polidental). Occlusion is checked, provisory is polished and cemented with temporary cement (Temp Bond®, Kerr).

**Results**

The BTLock® Guided Expander technique combined with minimally invasive surgery is a predictable procedure for implant placement in maxilla.

**Discussion**

Computerized navigation system offers intraoperative guidance of the surgical instruments based on a pre-surgical plan. This technology has been used in medical specialties to facilitate minimally invasive procedures. Using this technology the surgeon is able to transfer a detailed pre-surgical implant plan to the patient\(^9\). Recent data suggests that a flapless surgery results in significantly higher contact at the bone/implant interface and a higher bone level around implants when compared to implants placed with a flap elevation\(^12\). Also, Huang & Song\(^7\) confirmed that the use of the edentulous ridge expansion technique can meet the requirements of aesthetics and
function and is applicable to implant placement in maxilla. The method is simple and valuable to clinical application according to the authors.

The guided expander technique proposed is in accordance with the literature. It is based on a pre-surgical plan established with a custom prosthetic device combine with a CT-scan image resulting in a reliable data to input in navigation softer. The navigation softer is calibrated according to the pins positioned inside the surgical template. The surgeon is able to perform a virtual surgery and transfer the information to the patient with a minimum error. The surgical template is the same used in the CT-scan exam, so there is no need to manufacture another template to perform the surgery. The flapless surgery provides a less surgery time, bleeding and postoperative discomfort to the patient.

**Conclusions**

Bone expanders are able to preserve bone structure and to enhance primary implant stability. BTLock® guide expanders are used with minimum stress to the patient because just one drilling is necessary and the expansion is made with ratchet or surgical key. Then again, literature shows that bone quality and primary stability can be improved by bone condensers especially in maxillae $^6,^7,8$

Minimally invasive implant surgery with immediate load is the cutting edge of implantology. Further research is needed to apply BTLock® Guided Expander technique to a higher number of patients as well as fully and partially edentulous jaws.

**Acknowledgements**

References


Fig. 1. Surgical template with the resin base template and the implant pins.

Fig. 2. Schematic representation of the surgical template with the osteosynthesis screws and surgical rings.

Fig. 3. Surgical template with osteosynthesis screws and surgical rings.

Fig. 4. BTLock surgical rings for the expander technique®. Color refers to the implant diameter.
Fig. 5. BTLock guide expanders®.

Fig. 6. Schematic representation of BTLock® guided expander technique.

Fig. 7. BTLock® guided expander technique.
Fig. 8: Surgical template for the guided use of the expanders.

Fig. 9: Preparation of the sites for the osteosynthesis necessary to block the surgical template.

Fig. 10: Insertion of the screws to fix the surgical template.

Fig. 11: Fixed template ready to be used.
Fig. 12: Guided preparation of the implant sites with pilot drill.

Fig. 13: Use of the expanders by guided technique and by surgical template.