

Extention of alveolar ridge without raising the mucoperiosteal flap using minimally-invasive dental implant surgery – a new step in effective implantology

R. Šmucler,^{1,2} P. Barták²

Implantologie Journal, 2/2007

Introduction

It is not surprising that minimally-invasive flapless implant surgery has become a hit in the past years. With this method a dental implant is inserted without raising the mucoperiosteal flap. With regard to aesthetics, the benefits of flapless implant surgery are: reduced post-operative pain, less surgical and overall treatment time, faster healing and lower costs¹.

This method has its origin some 5,500 years ago² and it has been re-appearing regularly ever since, being particularly progressive at the end of the 19th and start of the 20th centuries before being overshadowed by the two-phase implant insertion, which was considered at the time to be safer³. At the present time, since the 1990s, the method of minimally-invasive flapless procedure has been dramatically expanding - as it has been shown that its results are comparable, providing that the correct protocol is followed, with the two-phase method. In such cases where bone augmentation is not required - either to ensure implant stability or to achieve a good aesthetic result - the method of flapless implant surgery has multiple advantages for the patient as well as the surgeon. Its many benefits are:

a/ morphological - as the anatomy of the alveolar ridge is not disturbed

b/ nutritive - as the periosteum is left intact and the blood supply to the site maintained, healing is faster and the likelihood of crestal bone resorption and soft tissue inflammation minimized

c/ a reduced risk in medically-disadvantaged patients, i.e. patients with diabetes and reduced immunity (thanks to the reduced trauma and smaller wound size)

d/ a reduced need for the use of analgetics – the reduced risk of inflammation and damage to the nerves brings about less pain

e/ psychological – the single-phase operation and the reduced overall treatment time makes it more acceptable to patients

f/ financial – a less complex protocol reduces the operation time and makes the treatment cheaper, thus accessible to a wider range of patients.

There are, nonetheless, disadvantages as well as advantages associated with this method:

a/ Despite being a seemingly simple operation – it nevertheless requires a highly-experienced dental surgeon as the implant has to be inserted into the bone without direct visual checking of its position in the bone. The flapless procedure thus demands a surgeon who has considerable previous experience with flap surgery.^{4,5}

b/ In the case of an unsatisfactory anatomy of the alveolar ridge (with regard to aesthetics or stability), conventional methods of alveolar ridge augmentation need to be employed.^{6,7}

With the minimally-invasive procedure, implants are inserted without raising the periosteal flap, by employing one of the following procedures:

a/ immediate implantation – placed somewhere intermediately between a flapless and an augmentation procedure – the implant is inserted immediately after tooth extraction

b/ punch incision – a cylindrical punch hole is made using trephine, the bone is then examined and the implant inserted

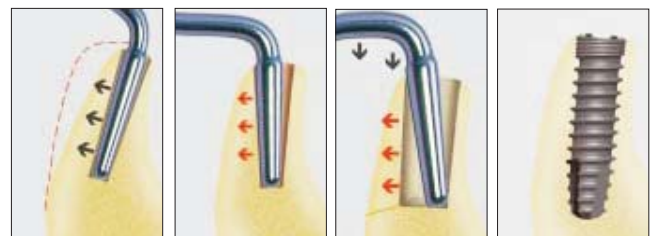
c/ transmucosal – implants are inserted directly through the mucoperiosteum.

When inserting the implant surgeons choose from the following procedures to guide them when inserting the implant.

a/ clinical examination – implants are inserted without any further instrumentation other than using tactile orientation; this method can only be used in cases of abundant tissue, especially soon after tooth extraction when orientation is easier thanks to the structure of the alveolar socket

b/ drilling templates – derived from laboratory modelling of the future denture and the reconstruction of the real bone shape using invasive instruments (caliper, endodontic instruments) for mapping the bone width, and tomography (CT scan); or possibly by reconstruction of the probable bone shape on a cast model - this is the most commonly-used method

c/ navigation using a CAD/CAM method which includes CT-based implant planning and fabrication of a CT-scan-designed surgical template or possibly an individual implant abutment – this is, without doubt, the safest method but requires more preparation time and the cost is higher (CT-scan, fabrication of surgical template)^{8,9}. Also not all dentists have access to a CT-scan.



Figs. 1-4: Use of Horizontal Control System

¹ Dental Clinic of the General Faculty Hospital and the 1st Faculty of Medicine of Charles University, Prague, Czech Republic

² ASKLEPION, Prague, Czech Republic

Our indications for minimally-invasive implantology and results in its use

The use of the minimally-invasive implant procedure is limited in particular by the alveolar width. To comply with the widely-accepted recommendation, an implant should be surrounded by a minimum of 1 mm of bone. The method is used and is most suitable for alveolar ridges, which are of a generous height and width^{4,10,11}.

Our dental surgery has offered minimally-invasive dental surgery since 1995 and with our increasing experience we have set up two indication groups based on alveolar width and implant diameter:

a/ safe indications – the diameter of the alveolar ridge is in all directions and along its whole length larger by 4 mm than the diameter of the used implant. Our criterion is based upon the widely accepted requirement of 1 mm of intact bone surrounding the implant plus 2 mm as a cover for possible surgical inaccuracies (i.e., a 5 mm STI-BIO-C implant, LASAK Ltd., Czech Republic, would be inserted into an alveolar ridge of 9 mm width or more). A criterion of 4 mm is an arbitrary one and much depends on the surgeon's skill. For a trainee surgeon just beginning (practical dentists) we would suggest to increase that level to 5 mm, whilst for an experienced surgeon (specialised dental surgeon) 2-3 mm of alveolar width over the implant diameter might suffice. More than 50 % of patients in general clinical practice, (in our case, more than 60 % as we are specializing in more complicated cases), are not suitable for this type of implant procedure. Under this indication, between 1994–2006, we have inserted 486 implants, all of them having been loaded for a minimum of six months up until today. From this total number, 11 implants were lost (four of which were in one patient who lost all implants inserted due to a suspected systemic cause), and 8 implants had an extended healing period (in all these cases the implants had been inserted too close to one of the alveolar walls which resulted in bone fracture and exclusion of bone sequestrum). Out of this total number, we inserted 234 Impladent implants (LASAK Ltd., Czech Republic) and 252 Straumann implants (Straumann AG, Switzerland). We did not find significant differences in treatment success between these two implant systems; however, an exact comparison is not possible, as the Straumann implants, thanks to the conical shape of the TE system, were used in all cases of immediate implantation and inner sinus-lift operations, whilst the Impladent system was used in all other indications. The total success rate was 97.7 % with 1.7 % cases having healing complications. Due to the fact that many patients with medical contraindications (such as diabetes, moderate to heavy smoking, immunodeficiencies, liver disorders) were included, we consider these results comparable to the conventional treatment.

b/ risky indications – when the diameter of the alveolar ridge is smaller than the safe indication and the augmentation of the alveolar ridge indicated was not performed (refused by the patient, due to medical complications, financial contraindication). In all such cases, patients were always informed about the advantage of having augmentation done. Since 1999, we have been using osteoplasty as developed by Tatum. It involves implant insertion without the use of rotating instruments; the bone is opened with the use of a bone scalpel and subsequently the alveolar bone along with the mucoperiost is widened using bone spreaders to obtain

the shape and diameter required for a given implant (it is necessary for the mucoperiost to remain intact). Despite the fact that the system was developed by Hilt O. Tatum^{12,13} for his own special implants, thanks to the calibration of bone instruments it can be used with other implant systems too. Osteoplasty is accompanied by bone condensation: bone not being removed but rather prepared for implant insertion. This allows for a predictable placement of a 5 mm Impladent implant into 2 mm bone. The weakness of this method is that it is difficult to reproduce and, thus, results are highly dependent on the skills of the surgeon employing it. It has been observed that some surgeons cannot achieve predictable results using this method, whilst others can in specific indications (such as narrow but high alveolus) achieve even better results than when using the conventional bone-augmentation method.

New methods of closed alveoplasty

In recent years, several new systems have evolved that enable highly reproducible alveoplasty not only in the horizontal direction but also in the vertical direction¹⁴. The most complex system that we have used is the Bone Management System (Meisinger, Germany), that has a number of sub-systems, enabling both vertical as well as horizontal bone augmentation. Despite the fact that this system has been recommended by the manufacturers to be used for open alveoplasty, i.e. smoothing out the bone after the alveolar ridge has been exposed, we employed it, using our previous experience, for a minimally-invasive procedure using the systems of Horizontal-Control (authors Fuchs, Cierny) and Split-Control (authors Streckbein, Hassenpflug). This enabled us to perform even a closed, minimally-invasive osteoplasty. Later on, we modified the system in such a way as to enable the immediate loading of inserted abutments. The Horizontal-Control System consists of a calibrated series of conical instruments of increasing diameter that, when being inserted, themselves model the alveolar bone. The Split-Control System achieves a similar effect using spreaders with increasing diameters. The use of the Split-Control System leads to good bone condensation but it is not so good at bone modelling, whilst the Horizontal-Control System is just the opposite, so used together there can be a suitable control of both systems.

In spite of the Bone Management System being designed for use with the Meisinger system, it also works well with Impladent implants too (Lasak Ltd., Czech Republic). Only in complicated indications – e.g. in a maxillary alveolar ridge of low height in the distal reach which required an inner sinus-lift to be performed - did we use Straumann implants (Straumann AG, Switzerland), TE system; these show, with sinus-lifts, a higher stability due to their conical shape which prevents the screws entering the jaw cavity.

To ensure good primary stability, we left a minimum of 4 mm and 6 mm, respectively, of intact bone in the vertical direction, when using implants of 5 mm and 3.7 mm in diameter, for preparation of the bone cavity with the use of calibrated drills with incomplete preparation (i.e. the final drill was inserted coronally by 2 mm in order to enhance primary stability). The aim was to gain primary stability in a deeper and wider reach of the bone (corpus mandibulae) using a conventional method, whilst the coronal implant part (processus alveolaris) would lean against the bone widened by alveoplasty. The criteria for the bone length in mm were set based on our own experience and literature sources. The necessary lengths for different preparation types will certainly be a subject of further research.



Fig. 5: Flapless in lower jaw following alveoplasty



Fig. 6: Flapless in upper jaw following alveoplasty

In our study of primary loading following alveoplasty, solely Impladent implants (Lasak, Czech Republic) were used. Twenty patients with a total number of 58 implants were treated: 29 alveoplasties were performed on one side of stereodefected jaws, employing the Bone Management System without raising the mucoperiosteal flap. Only patients with a suitable alveolar bone, i.e. with a minimum height of 10 mm and width of at least 4 mm on the side were included in the study. (In experiments conducted outside this presented study, we were successful even with a bone width of only 2 mm). The Horizontal-Control System enables, after the preparatory drilling, a series of conical angle modulators with increasing diameter to be subsequently used to widen the alveolar ridge to obtain a suitable diameter and shape. In our case, we always used modulators of a diameter that was less than the implant diameter, i.e. in the case of a 3.7 mm implant we created a

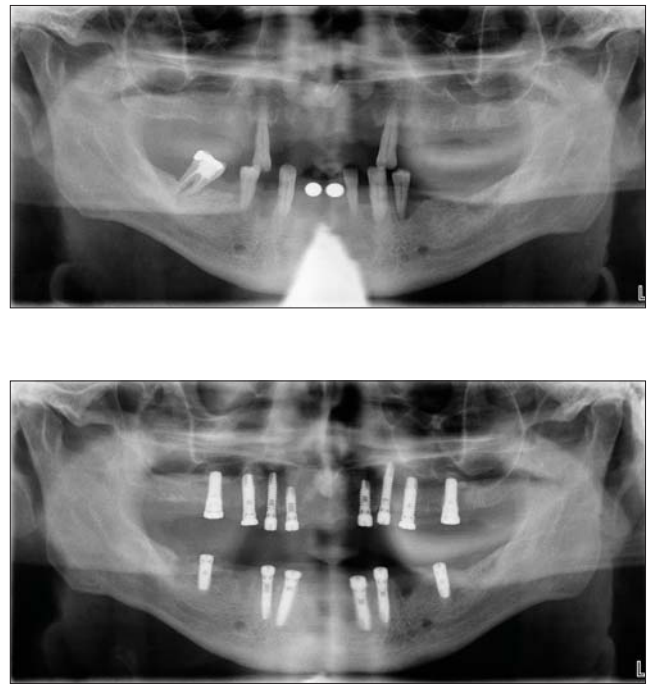


Fig. 7 and 8: X-ray one month before and after alveoplasty

cavity of 3.1 mm in diameter, and in the case of a 5 mm implant a cavity of up to 4 mm in diameter. The final alveolar shape was created by bone spreading when the self-tapping screw was being inserted.

Implants were inserted in the above-described procedure and immediately loaded. If all implants on one side of the jaw could be loaded, we preferred to use a fixed bridge made from resin and placed on temporary abutments from the manufacturer. If only one implant at the side was available, we used a temporary, screw-retained prosthesis fixed on a ball attachment from the manufacturer. The requirement of a torque of at least 35 Ncm⁻¹ was achieved for all implants in the study.

On the opposite side, which was used as a control, implants were inserted either by a two-phase bone augmentation procedure, where necessary, or by using a minimally-invasive procedure without immediate loading. The objective and subjective results were then evaluated. As for the objective results, all 30 implants on the research and control side were successfully loaded. On the research side an average loss in bone height of 0.3 mm ± 0.8 mm was measured whilst on the control side, where either augmentation or a minimally-invasive-procedure without immediate loading was performed, a bone gain of 1.1 mm ± 1.8 mm was measured. Thus, augmentation proved to bring a bone gain in many cases; the results, however, are highly variable.

The disadvantage of the pilot study was that it was not homogeneous. Nevertheless, it could be said that a minimally-invasive procedure implemented along with alveoplasty and subsequent immediate loading does not cause a higher risk of implant loss. Its big advantage is its much shorter treatment time. As far as evaluation of the treatment by patients goes: all patients preferred to have minimally-invasive treatment without alveoplasty but such a treatment could only have been offered to four patients (with sufficient alveolar bone width)

out of twenty involved in the study. Minimally-invasive treatment with alveoplasty (although some patients initially feared the widening of the implant cavity) was the preferred choice over a two-phase implant insertion procedure with bone augmentation. As reported in the literature, the latter was found to be more painful - causing swelling - and had a longer healing time.

To conclude, the Bone Management System of Meisinger and Impladent implants (Lasak, Czech Republic) can be successfully used in flapless alveoplasty - even for cases that would have been contraindicated in the past. In addition, in cases of sufficient bone availability (height of 10 mm and width of 4 mm) and satisfactory primary stability, the immediate loading of implants can be recommended.

Literature

1. Whitehouse JA. Adopting a new philosophy: minimal invasion. *Dent Today*. 2006 Jun;25(6):102, 104-5.
2. Irish JD. A 5,500 year old artificial human tooth from Egypt: a historical note. *Int J Oral Maxillofac Implants*. 2004 Sep-Oct;19(5):645-7.
3. Ring ME. A thousand years of dental implants: a definitive history--part 1. *Compend Contin Educ Dent*. 1995 Oct;16(10):1060, 1062, 1064 passim.
4. Becker W, Goldstein M, Becker BE, Sennerby L. Minimally invasive flapless implant surgery: a prospective multicenter study. *Clin Implant Dent Relat Res*. 2005;7 Suppl 1:S21-7.
5. Becker W, Wikesjo UM, Sennerby L, Qahash M, Hujoel P, Goldstein M, Turkyilmaz I. Histologic evaluation of implants following flapless and flapped surgery: a study in canines. *J Periodontol*. 2006 Oct;77(10):1717-22.
6. Buser, D., Belser, U., Wismeijer, D. ITI Treatment Guide, Vol I: Implant Therapy in the Esthetic Zone for Single-Tooth Replacements Quintessence, 2006.
7. Oh TJ, Shotwell JL, Billy EJ, Wang HL. Effect of flapless implant surgery on soft tissue profile: a randomized controlled clinical trial. *J Periodontol*. 2006 May;77(5):874-82.
8. Balshi SF, Wolfinger GJ, Balshi TJ Surgical planning and prosthesis construction using computer technology and medical imaging for immediate loading of implants in the pterygomaxillary region. *Int J Periodontics Restorative Dent*. 2006 Jun;26(3):239-47.
9. Engelke W, Capobianco M. Flapless sinus floor augmentation using endoscopy combined with CT scan-designed surgical templates: method and report of 6 consecutive cases.
10. al-Ansari BH, Morris RR. Placement of dental implants without flap surgery: a clinical report. *Int J Oral Maxillofac Implants*. 1998 Nov-Dec;13(6):861-5.
11. Chen ST, Wilson TG Jr, Hammerle CH. Immediate or early placement of implants following tooth extraction: review of biologic basis, clinical procedures, and outcomes.
12. Tatum H Jr, Lebowitz M, Borgner R. Restoration of the atrophic, edentulous mandible. *J Oral Implantol*. 1994;20(2):124-34.
13. Tatum H Jr. Endosteal implants. *CDA J*. 1988 Feb;16(2):71-6.
14. Gaggl A, Schultes G, Rainer H, Karcher H. The transgingival approach for placement of distraction implants. *J Oral Maxillofac Surg*. 2002 Jul;60(7):793-6. *Int J Oral Maxillofac Implants*. 2005 Nov-Dec;20(6):891-7.