New possibilities – avoiding bone grafting with short implants

Soheil Bechara, ***Kwang Bum Park***, ***Ričardas Kubilius*** and ***Algirdas Lukošiūnas*** present case studies where implants were placed in 3-4mm of residual bone under the sinus without bone grafting

Implant placement in the posterior regions can be limited due to anatomical conditions.

One of the most problematic areas is the posterior maxilla, presenting in most cases with a limited bone height due to the pneumatisation of the maxillary sinus, and poor bone quality.

Another complicating factor in posterior regions is the general exposure to greater masticatory loads than in anterior regions.

Recent clinical studies on short implants with rough surfaces have reported survival rates similar to implants in general. Those studies were on implants of 7mm or less in length. These authors only took into consideration articles reporting on implants of 6mm or less in length – some of them reported similar success rates using 5mm short implants, in comparison to longer implants placed in augmented bone.

The authors are currently preparing a clinical study protocol to place implants on patients with only 3-4mm available bone under the sinus, without any bone grafting. A bone height of 3-4mm may be enough to place implants without sinus bone graft.

Soheil Bechara DDS is an assistant professor at the faculty of dentistry, department of oral and maxillofacial surgery, at the Lithuanian university of science and health, Kaunas, Lithuania

Kwang Bum Park DDS MS PhD is the main surgeon and director of MIR dental hospital in Daegu, Korea. He is also the president of the MINEC organisation.

Ričardas Kubilius DDS PhD is a professor in the faculty of dentistry, department of oral and maxillofacial surgery, at the Lithuanian university of science and health, Kaunas, Lithuania

Algirdas Lukošiūnas MD PhD is part of the faculty of dentistry, department of oral and maxillofacial surgery at the Lithuanian university of science and health, Kaunas, Lithuania Direct any correspondence to s.bchara@hotmail.com

ANYRIDGE IMPLANT SURFACE AREA

THREAD	Length (mm)	5.0 Anyridge (mm^2)	5.5 Anyridge (mm^2)
1st	1.0	15.739	15.739
2nd	1.8	41.299	45.013
3rd	2.6	72.262	84.771
4th	3.4	102.739	123.85
5th	4.2	132.213	161.697
6th	5.0	160.362	197.971
7th	5.8	187.153	232.633
8th	6.6	212.613	265.709
9th	7.2	230.851	289.492
10th	8.0	253.937	319.185
Apex	8.8	265.953	331.263

Short implants

The use of short implants with deep threads is a predictable treatment method for an implant restoration, even in difficult anatomical situations, to avoid complicated augmentation procedures.

In the case reports presented here, short implants with deep threads showed good clinical results while being engaged only 3-4mm with the residual bone. It has been suggested that this is a result of the special thread design (Figure 1), which can increase the bone-implant contact (BIC) and primary stability dramatically, having a large surface area in contact with bone, even in very low alveolar ridges (3-4mm in height). This article presents two case studies using a new implant with a novel macrostructure and thread design, which have proved to give excellent results in compromised bone situations. A three-dimensional bond between bone and implant is achieved; bone in-growth between the threads (Figure 2) increases the implant resistance to occlusal and shear forces.

Clinicians often face challenges when placing dental implants in areas of insufficient bone height. This problem is encountered mostly in the posterior mandible, because of the mandibular nerve canal, and in the posterior maxilla, due to the pneumatisation of the maxillary sinuses and poor bone quality.

The conventional treatments for these cases are various bone grafting procedures (sinus lift, vertical bone augmentation, GBR). These procedures have good predictable results, but they are related to high complication rates and cost, increased post-operative morbidity and stress to the patients, as well as a longer treatment period. These procedures should only be carried out by an experienced surgeon – which is an essential factor for successful treatment. Short implants (of 6mm or less) were introduced as a potential alternative to bone augmentation procedures in cases of

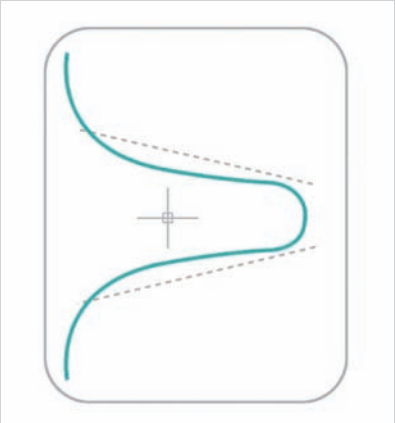


Figure 1: Short implants with deep threads are designed to offer increased cutting efficiency during insertion, excellent initial stability, increased resistance to compressive forces, minimised occurrence of shear forces, and higher bone-implant contact (BIC)

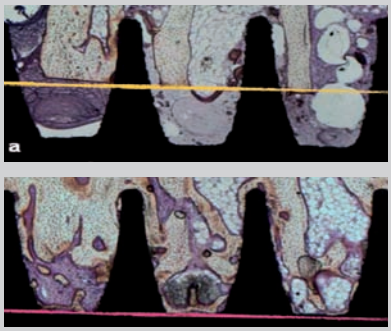


Figure 2: Bone ingrowth test for Anyridge with 1mm deep threads, in vivo results. Histological sections of implants with the deeper thread at insertion day (A) and four weeks after implantation (B) in rabbit femurs. Source:Megagen Implant Institute of Science & Technology, 2010

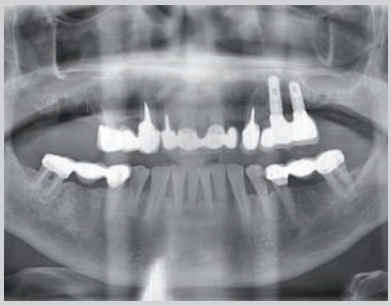


Figure 3: Male, 69-year-old patient. Planned treatment was to insert short implants at UL6, UR6, and UR7 without sinus augmentation. The implants would be loaded four months after insertion.

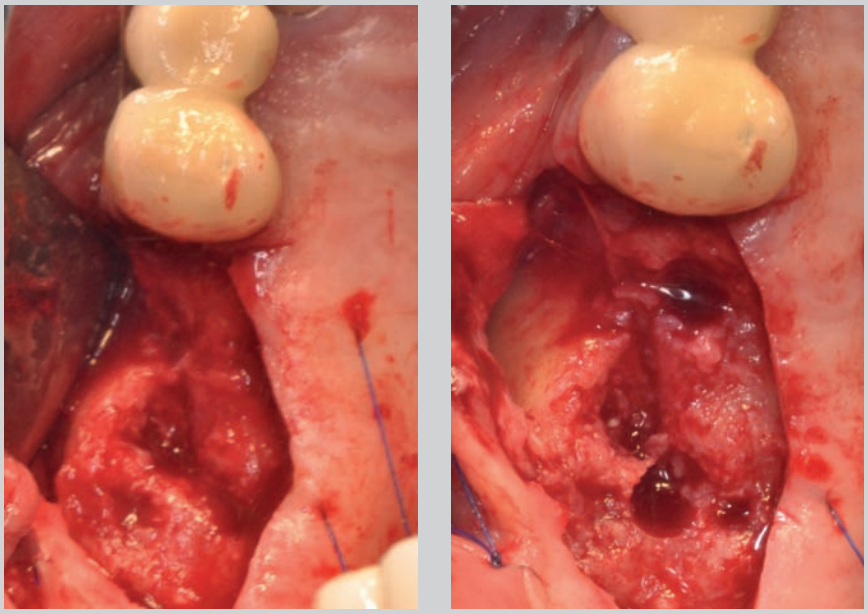
insufficient bone height. Relatively few implant systems available on the market today offer implants of 6mm or less.

The following case histories document the use of a new implant that has been presented in the past few years.

The implants were chosen principally for their macro-structure. The implant consists of pure titanium (grade 4) and has a conical shape. The deep thread pattern, according to the evidence presented, should increase the BIC and resistance to shear forces, leading to effective function even when the implant is engaged only 3-4mm with the residual bone.

The deep threads generate a significant increase in the surface area (Figure 1 and Table 1) and provide a very strong mechanical connection between bone and implant.

This factor can simplify the treatment for many patients presenting with vertical bone deficiency and allow more general dentists to perform implant surgeries on patients presenting with similar cases. In these case reports the implants were placed in the posterior maxilla, and only engaged in the residual jaw bone by 3-4mm.



Figures 4a and 4b: Osteotomy preparation using a single trephine bur. The bone from the trephine measured about 3mm in length

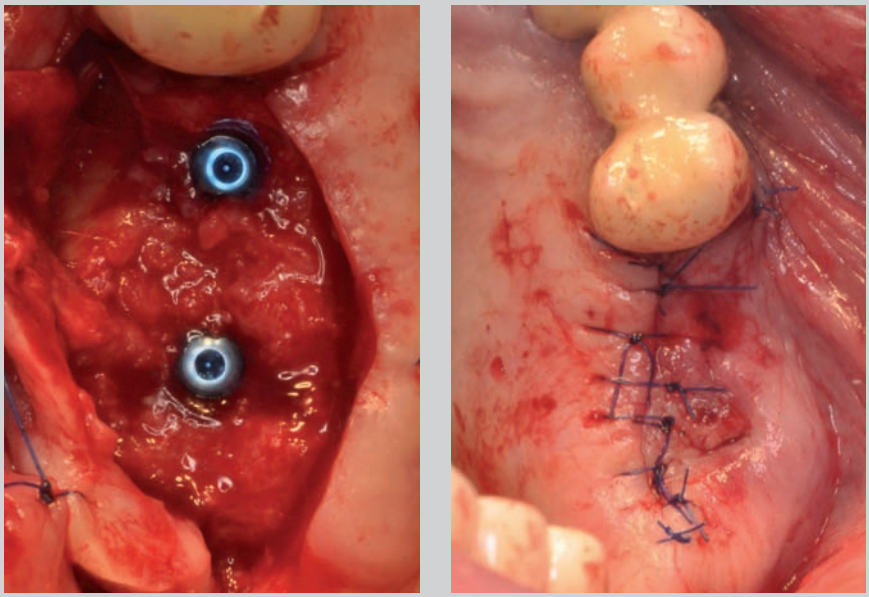
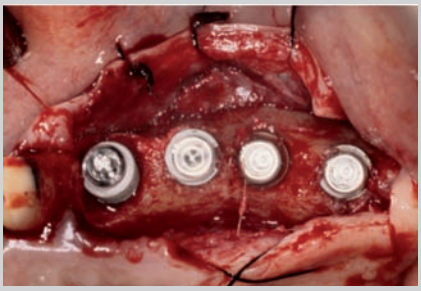


Figure 5a and 5b: Anyridge implants (5x6mm) placed

Figure 6: Postoperative panoramic X-ray

Figure 7: One year after loading. No marginal bone loss, good stability of the prosthesis, and a good functional and aesthetic result

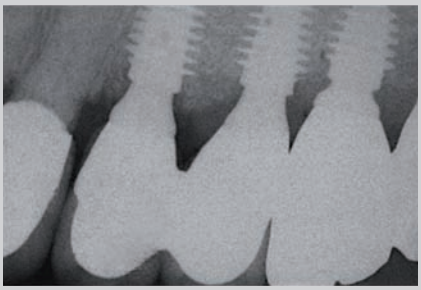
Figure 8: The subantral bone height was 3-4mm

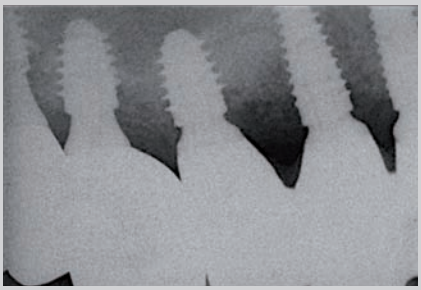


Figures 9a and 9b: Short (6mm) Anyridge implants were inserted without any sinus augmentation. They were engaged only 3-4mm in the ridge bone

Figure 10: Postoperative panoramic X-ray

Figure 11: Six months after loading





Figures 12a and 12b: One year after loading – no crestal bone loss

Case report 1

A 69-year-old man who was taking warfarin and medications to control arterial fibrillation and high blood pressure presented with missing posterior teeth in the distal parts of right and left maxilla in UR6, UR7, and UL6 (Figure 3). He desperately wanted to avoid wearing a removable prosthesis and was anxious to undergo implant treatment.

The patient wanted to avoid invasive procedures, as these would prolong the treatment and impose a greater risk for complications and would likely require modification of his medication intake. CT measurements showed a ridge height of 3.2mm at UR7 and UL6, and 6mm at tooth UR6. All areas had sufficient width for placement of wide diameter 5.5x6mm implants, meaning the implant at area UR7 and UL6 could only engage up to 3.2mm with the residual bone.

At the time of surgery, the patient's blood pressure was low enough to proceed with the intended treatment. The surgery was minimally invasive. A trephine bur was used to create the osteotomies; the bone obtained from the trephination was measured to confirm the residual ridge height (Figures 4a and 4b).

Three implants (5.5x6mm) were inserted in both, right and left maxillae during the same appointment (Figures 5a and 5b). All three implants reached excellent primary stability despite having only between 3.2 and 4mm contact with the subantral residual bone (Figure 6).

After four months of healing, implant-supported fixed restorations were cemented in the upper right and upper left quadrants respectively. This minimally invasive approach reduced surgical trauma and expedited treatment in this otherwise challenging situation (Figure 7).

Case report 2

A 74-year-old female with good general health presented with pain on the upper right prosthesis, which was a bridge connecting teeth UR3, UR4, and UR5. Clinically, the bridge showed extreme mobility.

On the panoramic X-ray extensive bone resorption was noted around the roots. Teeth UR3, UR4, UR5 and UL4 required extraction. The patient was left with distal defects in the first and second quadrants, and the panoramic X-ray measurements revealed only 3-4mm subantral residual bone in both left and right sinus areas (Figure 8).

The patient was offered two treatment plans. One was a sinus lift with immediate placement of long implants, while the alternative was placement of short implants with deep threads without any sinus augmentation. The patient was reluctant to accept the sinus lift because of her age and the high cost, as well as the possible complications of the procedure.

The surgery was performed during a single visit on both sides due to the suggested minimally invasive protocol. Nine implants were placed in the maxilla – six of them were 6mm in length, engaged only 3-4mm in the subantral bone.

After four months of healing, implant-supported temporary restorations were screwed in the upper right and left quadrants. At five months, the final restorations were delivered, and successful rehabilitation was obtained with a minimal intervention. This minimally invasive protocol reduced both surgical trauma and treatment time in this challenging clinical situation. The implants (6mm short Anyridge) were placed without any sinus augmentation, and were engaged only 3-5mm in the ridge bone.

Discussion

Over the past decade, studies have shown conflicting results concerning the treatment outcome and long time survival of short implants. One of the main problems faced during evaluation of these articles has been the lack of fixed definition for the term 'short implant'. Most of the studies and articles considered a short implant as being less than 10mm, while very few studies have included implants of 6mm in length or less.

The older studies describe implants with machined surfaces, mostly placed in posterior regions with higher loads and softer bone compared with implants placed in more anterior regions.

More recent studies look at shorter implants with more commonly-used surfaces in clinical situations and the results are promising (Esposito et al 2012).

Surgeons usually prefer to insert the longest implant possible at the recipient site in order to maximise the BIC area. This is based on the principle that longer implants provide better biomechanics and better initial stability, due to their increased surface area.

However, after integration and loading takes place we should distinguish between total surface area and functional surface area. The biomechanical rationale behind the use of short implants is that the crestal portion of the implant body is the most involved in load-bearing, whereas very little stress is transferred to the apical portion (Lum, 1991) and an increase of implant length from 7mm to 10mm does not significantly improve its anchorage (Bernard et al 2003). Therefore, implant length may not be a primary factor in distributing prosthetic loads to the bone implant interface.

It is for these reasons that the length of the implant is no longer widely seen as the sole consideration when looking for the optimal solution for a patient.

Treatment planning is an essential factor for a successful rehabilitation with short implants. The most important factors that need to be taken into consideration are the bone quality (density), prosthesis type, crown to implant ratio, excessive occlusal forces, and cantilever.

Without careful planning and consideration of all factors, the treatment results may be compromised. Other parameters are related directly to the implant macro and micro design. In these cases we considered that the sharp and deep threads on the implants used provided an excellent initial stability, an increased BIC and resistance to shear forces considering the poor bone quality and vertical deficiency. All this lead to a successful rehabilitation with short implants in patients with 3-4 mm of residual bone under the sinus, without bone grafting.

Conclusion

Short implants (5 mm) can be successfully loaded in maxillary bone with a residual height of 4-6mm, but their long-term prognosis is unknown (Esposito et al 2012).

Some studies report similar results comparing short implants versus longer ones placed in augmented bone with follow ups of up to three years (Pieri F et al 2012).

Choosing the right implant system, that has the design features mentioned above, might be a key factor in a successful treatment, allowing the use of short implants for patients with residual bone height as low as 3-4mm.

The results from our cases are promising. Treatment according to this suggested protocol could make rehabilitation with dental implants a more acceptable procedure for the patients because of lower morbidity, shorter treatment time and lower cost.

Randomised controlled trials and prospective studies with longer follow-up times and larger samples are necessary to confirm the current findings. **IDT**

REFERENCES

Academy of Osseointegration (2010). Guidelines for the provision of dental implants and associated patient care. *Int J Oral Maxillofac Implants* **25:** 620-627

Albrektsson T, Zarb G, Worthington P, Eriksson AR (1986). The long-term efficacy of currently used dental implants: a review and proposed criteria of success. *Int J Oral Maxillofac Implants* **1:** 11-25

Andersen E, Saxegaard E, Mork Knutsen B, Haanaes HR (2001). A prospective clinical study evaluating the safety and effectiveness of narrow diameter threaded implants in the anterior region of the maxilla. *International Journal of Oral & Maxillofacial Implants* **16:** 217-224

Anitua E, Orive G(2010). Short implants in maxillae and mandibles: a retrospective study with 1 to 8 years of follow-up. *J Periodontol* **81:** 819-826

Anner, R, Better H, Chaushu G (2005). The clinical effectiveness of 6mm diameter implants. *Journal of Periodontology* **76:** 1013-1015

Aparicio C, Orozco P (1998). Use of 5mm diameter implants: periotests values related to a clinical and radiographic evaluation. *Clinical Oral Implant Research* **9:** 398-406

Åstrand P, Engquist B, Dahlgren S, Gröndahl K, Engquist E, Feldmann H (2004). AstraTech and Brånemark system implants: a 5-year prospective study of marginal bone reactions. *Clin Oral Implants Res* **15:** 413-420

Bahat O (1993). Treatment planning and placement of dental implants in the posterior maxillae: report of 732 consecutive Nobelpharma implants. *International Journal of Oral & Maxillofacial Implants* **8:** 151-161

Bahat O (2000). Brånemark system implants in the posterior maxilla: clinical study of 660 implants followed for 5 to 12 years. *International Journal of Oral & Maxillofacial Implants* **15:** 646-653

Bahat O, Handelsman M (1996). Use of wide implants and double implants in the posterior jaw: a clinical report. *International Journal of Oral & Maxillofacial Implants* **8:** 379-386

Becktor JP, Isaksson S, Sennerby L (2004). Survival analysis of endosseous implants in grafted and nongrafted edentulous maxillae. *International Journal of Oral & Maxillofacial Implants* **19:** 107-115

Berglundh T, Abrahamsson I, Lindhe J (2005). Bone reactions to longstanding functional load at implants: an experimental study in dogs. *J Clin Periodontol* **32:** 925-932

Bernard JP, Belser U, Szmuckler S, Martinet JP, Attieh A, Saad PJ (1995). Intérêt de l'utilisation d'implants ITI de faible longueur dans les secteurs postérieurs: résultats d'une étude clinique á 3ans. *Médecine Buccale, Chirurgie Buccale* **1:** 1-18

Bernard JP, Szmukler-Moncler S, Pessotto S, Vazquez L, Belser UC (2003). The anchorage of Brånemark and ITI implants of different lengths. I. An experimental study in the canine mandible. *Clin Oral Implants Res* **14:** 593-600

Brocard D, Barthet P, Baysse E, Duffort JF, Eller P, Justumus P, Marin P, Oscaby F, Simonet T, Benqué E, Brunel G (2000). A multicenter report on 1022 consecutively placed ITI implants: a 7-year longitudinal study. *International Journal of Oral & Maxillofacial Implants* **15:** 691-700

Buser D, Mericske-Stern R, Bernard JP, Behneke A, Behneke N, Hirt HP, Belser U, Lang NP (1997). Long-term evaluation of nonsubmerged ITI implants. Part 1: 8-year life table analysis of a prospective multicenter study with 2359 implants. *Clinical Oral Implants Research* **8:** 161-172

Cannizzaro G, Felice P, Leone M, Viola P, Esposito M (2009). Early loading of implants in the atrophic posterior maxilla: lateral sinus lift with autogenous bone and Bio-Oss versus crestal mini sinus lift and 8-mm hydroxyapatite-coated implants. A randomised controlled clinical trial. *Eur J Oral Implantol* **2:** 25-38

Chiapasco M, Zaniboni M, Boisco M (2006). Augmentation procedures for the rehabilitation of deficient edentulous ridges with oral implants. *Clin Oral Implants Res* **17(Suppl 2):** 136-159

Chiapasco M, Casentini P, Zaniboni M (2009). Bone augmentation procedures in implant dentistry. *Int J Oral Maxillofac Implants* **24(Suppl):** 237-259

Cochran DL, Nummikoski PV, Schoolfield JD, Jones AA, Oates TW (2009). A prospective multicenter 5-year radiographic evaluation of crestal bone levels over time in 596 dental implants placed in 192 patients. *J Periodontol* **80:** 725-733

Comfort MB, Chu FCS, Chai J, Wat PYP, Chow TW (2005). A 5-year prospective study on small diameter screw-shaped oral implants. *Journal of Oral Rehabilitation* **32:** 341-345

Del Fabbro M, Testori T, Francetti L, Weinstein R (2004). Systematic review of survival rates for implants placed in the grafted maxillary sinus. *International Journal of Periodontics and Restorative Dentistry* **24:** 565-577

Deporter D, Pilliar RM, Todescan R, Watson P, Pharoah M(2001). Managing the posterior mandible of partially edentulous patients with short, porous-surfaced dental implants: early data from a clinical trial. *Int J Oral Maxillofac Implants* **16:** 653-658

Deporter D, Ogiso B, Sohn DS, Ruljancich K, Pharoah M(2008). Ultrashort sintered porous-surfaced dental implants used to replace posterior teeth. *J Periodontol* **79:** 1280-1286

Eckert SE, Choi YG, Koka S (2003). Methods for comparing the results of different studies. *Int J Oral Maxillofac Implants* **18:** 697-705

Felice P, Pellegrino G, Checchi L, Pistilli R, Esposito M (2010). Vertical augmentation with interpositional blocks of anorganic bovine bone vs. 7-mm-long implants in posterior mandibles: 1-year results of a randomized clinical trial. *Clin Oral Implants Res* **21:** 1394-1403