Localized Maxillary Ridge Augmentation Using Onlay Technique with a Xenograft Block for Dental Implant Placement: A Case Series

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ABSTRACT

Background: Xenograft bone blocks are made from animal derived bone, and are available as an “off the shelf” alternative to autogenous block grafting, in attempt to reduce post surgical morbidity. This case series of eight patients look at the success rate of using xenograft blocks for localised maxillary ridge augmentation for dental implant rehabilitation.

Methods: In 2011, 8 patients presenting with missing incisor teeth and advanced bony defects at the missing tooth area, necessitating block onlay grafting prior to their implant treatment were rehabilitated using xenograft onlay grafting technique to restore the bone volume before implant placement. These xenogenic bone blocks (SP OsteoBiol Spongiosa blocks by Tecnoss Ltd, Torino-Italy) are equine cancellous bone with preserved collagen content.

Results: 7 out of 8 patients (87.5%) healed with no complications and their blocks were well integrated allowing for uneventful implant placement at each site. One out of 8 patients (12.5%) reported with infection and a failed block.

Conclusion: These early results compare favourably with those from reports on the use of autogenous blocks when used in maxillary ridge onlay augmentation. However, this case series is limited to maxillary onlay grafting and reports on cases with a considerably short follow up. More well conducted clinical and histological studies are required to test the long term efficacy of the use of xenograft blocks in maxillary ridge augmentation.

KEYWORDS
Xenograft, Equine, Onlay, Maxilla, Grafting, Block.

INTRODUCTION

Dental Implant placement in the maxilla can be complicated sometimes by the lack of supporting bone. In such cases, where there is noticeable lack of bone volume in the maxilla, patients may not be able to receive standard dental implants without bone augmentation. Guided bone regeneration using a variety of bony particulates can be predictable in augmenting small bony defects. But, in other cases, where advanced maxillary bone resorption took place following severe trauma, infection or long term bone remodelling and progressive atrophy, a knife-edged deformity frequently develops, which complicates implant placement and stabilization, and a basic guided bone regeneration will be simply inadequate to repair the bone defect prior to implant placement.

Such cases require more advanced treatment involving bone block grafting to provide a scaffold for bone regeneration and stimulate osteogenesis. Up until recently, the “Gold Standard” for such therapy involved preparing an autogenous bone block from the patient’s chin, Ramus, Iliac Crest or other even more extreme donor sites.

However, it is not a pleasant experience for the patient as all of these require surgery at a second site, with several potential hazards including loss of sensation in the donor site (e.g. the so called “woody chin” following mental block preparation), post operative swelling and significant pain, which could last in some cases up to 5 years post-operatively. It is not an entirely pleasant procedure for the operator either, bearing in mind the additional stress involved, plus it adds additional time to the whole procedure.

Xenograft bone blocks have been introduced in the recent few years as an “off the shelf” alternative, which enables the operator to restore the horizontal and vertical bone volume but without the need for additional surgery for the patient. Several studies have reported on the predictable and successful use of equine collagenated blocks as inlay grafting for vertical bone augmentation. Very little was reported on the use of Xenograft bone blocks as onlay grafting. This report intends to describe localized maxillary augmentation using onlay technique with Xenograft bone blocks for dental implant placement.

METHODS

This article describes eight cases treated at Clarendon Dental Spa, Leeds- UK by the authors in which xenograft bone blocks were used to augment deficient localised...
recipient site had been perforated with a bur to ensure a good blood supply to the overlying bone graft, the OsteoBiol Spongiosa Block was held in position using a pair of Bone Block Clamps (Fig. 3,4). Holding the block securely in place, a passive hole was prepared within the block ready to receive the bone graft screw. A smaller pilot hole was then prepared in the underlying cortical bone of the recipient site. The Spongiosa Block was then fixed in situ with a 1.3mm diameter bone graft screw (Fig. 5), taking care not to over tighten the screw and run the risk of damaging the block. Any defects around the block were filled with hydrated xenograft bony particulates (Osteobiol Genos granules from Tecnoss Ltd, Torino-Italy) and then a porcine 30mmx30mm membrane (OsteoBiol Evolution Standard, Tecnos Ltd, Torino-Italy) cut to size and positioned to cover and protect the whole graft site. The tension free flap was then sutured in position using interrupted sutures (Fig. 6).

Once the Spongiosa Block had become fully integrated, after about six months, surgical exposure of the augmentation site under local anesthesia revealed a well- integrated block graft that was incorporated into the surrounding cortical bone. Minimal resorption was noted around the fixation screw, which was then removed (Fig. 8). An Astra Tech Tx 4.5x11mm dental implant (By Dentsply, Mölndal, Sweden) was then placed in the optimum position 3mm from the future cemento-enamel junction and 2mm from the labial contour of the future final restoration, following standard protocols,

**CASE 1**
A 28 years old male required augmentation in the Upper Right Central Incisor region. He was otherwise perfectly healthy and fit. The procedure was carried out under local anaesthesia, a remote palatal crestal incision was designed in the region of the edentulous ridge and extended intrasulcularly one tooth on each side of the implant site using surgical scalpel blade No.15C (by Swann-Morton Ltd.). Divergent releasing incisions were also used to assist with wound closure and blood supply. Relaxation of the flap was accomplished by incising the periosteum at the superior base of the flap. Once the augmentation site was exposed, the available bone volume was measured using Bone Mapping Calipers (Fig. 1).

The recipient bone was contoured to allow the graft to be mortised into position for maximum bony contact and graft stability. A 10x10x10mm Spongiosa Block (Fig. 2) was trimmed using rotary disc to fit the defect and then hydrated for 10 minutes in sterile saline. After the recipient site had been perforated with a bur to ensure a good blood supply to the overlying bone graft, the OsteoBiol Spongiosa Block was held in position using a pair of Bone Block Clamps (Fig. 3,4). Holding the block securely in place, a passive hole was prepared within the block ready to receive the bone graft screw. A smaller pilot hole was then prepared in the underlying cortical bone of the recipient site. The Spongiosa Block was then fixed in situ with a 1.3mm diameter bone graft screw (Fig. 5), taking care not to over tighten the screw and run the risk of damaging the block. Any defects around the block were filled with hydrated xenograft bony particulates (Osteobiol Genos granules from Tecnoss Ltd, Torino-Italy) and then a porcine 30mmx30mm membrane (OsteoBiol Evolution Standard, Tecnos Ltd, Torino-Italy) cut to size and positioned to cover and protect the whole graft site. The tension free flap was then sutured in position using interrupted sutures (Fig. 6).

The patient was reviewed at 7 days for removal of sutures and 2, 6 and 12 weeks as per standard procedure. No post operative complications or reactions were reported (Fig. 7).

Once the Spongiosa Block had become fully integrated, after about six months, surgical exposure of the augmentation site under local anesthesia revealed a well- integrated block graft that was incorporated into the surrounding cortical bone. Minimal resorption was noted around the fixation screw, which was then removed (Fig. 8). An Astra Tech Tx 4.5x11mm dental implant (By Dentsply, Mölndal, Sweden) was then placed in the optimum position 3mm from the future cemento-enamel junction and 2mm from the labial contour of the future final restoration, following standard protocols,
achieving 25Ncm insertion torque (Fig. 9). The bone in the region of the implant preparation was noted to be stable throughout the implant placement, and there was no evidence of graft separation or fracture. However, some additional bone supplementation was required using hydrated Genos granules (Fig. 10) and an Evolution Membrane (Fig. 11). A two-stage surgical technique was used to minimize load on the previously grafted implant site. A cover screw was placed, and the soft tissue was closed free from tension with 4-0 sutures (Vicryl Rapid, Polyglactin 910, Ethicon Inc) (Fig. 12).

After three months of submerged healing the implant was exposed and osseointegration was confirmed. A temporary abutment and provisional crown were attached to the implant. Six weeks later, a fixture level impression was taken and definitive abutment and permanent ceramo-metal crown were fitted. After 1 year of clinical loading, the implant and graft remained stable.

CASE 2
This case involved a 32 years old male requiring a bone supplement in the upper left central and lateral incisors region, in order to allow for placement of two standard sized dental implants. In this case the patient was consented to utilise a combination of autogenous bone graft from the chin with a xenogenic Spongiosa Block. (Fig. 13) shows the flap raised in the recipient site. (Fig. 14) shows the chin graft being prepared using a disk. The autogenous bone block was then fixed in situ in the recipient site using two bone graft screws (Fig. 15).

A pack of 10x10x10mm OsteoBiol Spongiosa Block was then opened, the block cut to size using a bur, hydrated for 10 minutes in sterile saline and then transferred to the recipient site using a bone block clamp (Fig. 16). It was then fixed in situ next to the autogenous block using a bone graft screw (Fig. 17).

The defects were filled with hydrated Genos granules, the whole area covered with a Standard Evolution Membrane and the flap repositioned and sutured free from tension (Fig. 18).

The patient was reviewed at 7 days for removal of sutures and then at 2, 6 & 12 weeks as per standard procedure. No post operative complications or reactions were reported.

Once the OsteoBiol Spongiosa Block and autogenous block had become fully integrated, after about six months, the site was re-entered (Fig. 19) and the bone grafting screws were removed (Fig. 20). It was virtually impossible to see any difference between the new bone in the OsteoBiol Spongiosa Block and autogenous block regions, and both were fully integrated to the recipient sites. Following standard protocols, two Astra Tech dental implants (By Dentsply, Mölndal, Sweden) were then placed in their optimum positions in the autogenous block at the upper right central incisor and into the Spongeosa block at the upper right lateral incisor (Fig. 21). The bone at both sites was noted to be stable throughout the implants placement, and there was no evidence of graft separation or fracture at either site. However, some additional bone supplementation was required using hydrated Genos granules and an Evolution Membrane was required at the upper right lateral incisor area. The flap was then repositioned and sutured in place free from tension (Fig. 22).
Three months healing period was allowed before exposing both dental implants, which showed full osseointegration and were stable enough for loading.

**CASE 3**

A 36 years old male presented with advanced bone loss at the upper right central incisor area (Fig. 23), necessitating a block grafting to restore the bone volume prior to his implant placement at this area. A 1 x10x10mm Spongiosa Block was used to augment the defect and fixed to the recipient site using a single 1.3mm diameter screw (Fig. 24 & 25). The block was covered with a single layer of a Standard Evolution Membrane and the flap repositioned and sutured free from tension (Fig. 26). The surgical site was left to heal for six months (Fig. 27) and a small field Kodak Cone beam CT scan (By 360 Visualise, Leeds- UK) was taken prior to surgery to check block integration and bone volume at the upper right central incisor area (Fig. 28). Virtual planning was also carried out (using MS Software, Amman - Jordan) to assist in the pre-surgical case planning and both revealed a minimal bone resorption of the SP xenograft bone block (Fig. 29).
Surgical placement of a 3.5x11mm Astra Tech dental implant (By Dentsply, Mölndal, Sweden) was placed within the prosthetic envelop following the confirmation of full integration of the xenograft block and removal of the fixation screw (Fig. 30-32). Xenograft bone particles with a resorbable membrane were used to fill the defects around spongiosa blocks and to the add to the labial contour (Figs. 33,34).

**CASE 4**

A 39-year-old man required horizontal ridge augmentation for correct prosthetic placement of implants in the maxillary left central incisor area. Treatment planning to replace the maxillary missing tooth utilizing an autogenous bone graft and dental implant was discussed, and the alternative option of using the xenograft bone blocks (OsteoBiol Spongiosa) was presented. The patient chose to have the xenograft to avoid a second surgical site for graft harvesting. A 10x10x10mm SP block was placed after preparation of the recipient site (Fig. 35) and secured using a 12mm bone graft screw and then covered by a xenograft membrane (OsseoBiol Evolution Standard). A temporary resin bonded Rochette bridge was used with no pressure on the grafted site. Four months following the graft surgery, the patient presented with wound dehiscence and exposed graft margins, however, there was no pain, tenderness or swelling at the graft area (Fig. 36). On examination, it was found that this xenograft block was mobile and none integrated and removal of the graft was carried out under local anaesthetics. This patient is now considering a 2nd bone grafting attempt using another SP xenograft block.

Four other cases were treated at Clarendon Dental Spa, Leeds-UK using SP OsteoBiol Spongiosa blocks (By TecnoS Ltd, Torino-Italy) uneventfully (Figs. 37-40). None of the above patients required more than four 400mg Ibuprofen tablets a day for more than four days following the grafting operation and all of the eight patients, including the failure case, have answered to the question “would you consider another xenograft block grafting again if required” by yes they would. (Table 1)

**DISCUSSION**

Different techniques e.g. onlay grafts,9 inter-positional grafts2 or distraction osteogenesis,10 and various bony materials e.g. autogenous, allograft, xenograft or alloplast grafting material2 have been used for the treatment of deficient alveolar ridges. Although it has been shown that it is possible to augment localised atrophic maxillary areas horizontally with autogenous bone blocks using different techniques, the number of complications following such augmentation procedures is still too high.

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This case series of eight patients was designed to present a novel technique for localized horizontal bone augmentation using a xenograft block made of collagenated equine bone as an alternative to the routinely used autogenous bone graft blocks. This biomaterial has a hard consistency and can be used as an alternative to autogenous blocks to graft localized deficient bony ridges. These blocks are manufactured in a patented process that avoids ceramatisation of the hydroxyapatite crystals, thus accelerating their physiological resorption and ensure a 100% conversion to new bone. These blocks are available off the shelf and come in different sizes to suite the clinical need. They have a firm honeycomb appearance and while they are easy to shape and use, a rotary cutting disc, bur, or a Piezosurgery bone preparation unit, will need to be used for trimming and shaping these blocks. They are then fixed securely in situ using bone grafting screws. For optimum results the manufacturers advocate perforation of the cortical bone in the recipient site to ensure a copious blood supply to the overlying Spongiosa Block. They also advocate using single bone grafting screw to avoid initiating micro cracks within the block. It is important not to apply too much pressure when fixing the screws otherwise the block might break up.

Thanks to their rigid consistency OsteoBiol Spongiosa Blocks are able to maintain the original graft volume over time, which is particularly important for large volume regenerations. Moreover, their collagen content facilitates blood clotting and the subsequent invasion of regenerative and repairing cells, thereby stimulating reconstruction and integration of missing bone.

Once the block is securely fixed in situ, it is recommended that the block is covered with a resorbable membrane such as the Evolution Membranes, which are made from equine pericardium and have a 5 Year Shelf Life. Finally the stress free flap is repositioned and sutured securely in place using an appropriate suture. The area is left for about six to eight months until it has fully integrated. At this point the operator can re-enter the area and proceed to the next stage.

Our experience in the xenograft blocks presented in this case series compare favourably with those from reports on the use of autogenous blocks when used in maxillary ridge onlay augmentation. This case series report on eight patients, seven out of which (87.5%) healed with no complications and their blocks were well integrated allowing for uneventful implant placement at each site. One out of 8 patients (12.5%) reported with infection and a failed block and alternative therapy was offered. However all patients were satisfied with their grafting procedures and reported that they would do it again if required as they have experienced very little post operative pain and oedema than expected.

While autologous bone has always been the material of choice, preliminary it is suggested that other grafting materials may represent an acceptable alternative. The equine collagenated block can be considered as a good material for bone regeneration in onlay grafting procedures in localized maxillary atrophic areas and may represent a less invasive alternative to autogenous bone grafting.

It is, however, worth mentioning that this report is only a case series on maxillary augmentation with a very short follow-up and reduced number of patients, and findings have to be approached with caution.

CONCLUSION

Within the limit of this case series report, the authors recommend that the use of xenograft onlay blocks by experienced surgeons might offer an appropriate, reliable and less invasive alternative to autogenous bone blocks. An alternative that is relatively quick and easy to use and relatively free from complications and unnecessary discomfort associated with traditional autogenous bone grafting procedures.

However, more well conducted clinical studies are required to evaluate the long term use of equine collagenated blocks in the maxilla and the ability to use them in the mandible.

REFERENCES