Using piezosurgery to harvest a block bone graft from the symphyseal region: a clinical case presentation

Jonathon Schofield and Amit Patel explain the clinical procedure they used in harvesting a block bone graft using piezosurgery and examine the outcomes

The placement of titanium implants in sites that are deficient of alveolar ridge width has always been unpredictable due the lack of bone around the implant. Implants placed into the available bone can often lead to a compromised aesthetic result due to poor positioning and direction of the implants, especially in the aesthetic zone. A number of surgical techniques have been proposed over the years to create adequate bone volume. These include the use of xenograft, alloplast and allograft materials with the use of resorbable or non-resorbable membranes (Garg, 1999). It has been shown that autogenous bone grafts are still the most predictable method to achieve good bone quality and quantity for the implant site (Garg, 1999).

Donor sites for autogenous bone include extraoral and intraoral sites. Extraoral sites allow for harvesting of large amounts of bone. These sites involve complex surgical procedures that usually require general anaesthesia with an increase in morbidity at the donor sites (Chiapasco et al, 1999, Sindet-Pedersen and Enemark, 1990). It has been shown that in the facial skeleton, membranous bone (such as that grafted from the mandible) undergoes less resorption than endochondral bone, such as the iliac crest (Zins and Whitacker, 1979).

The main advantage of an intraoral donor site is that harvesting of bone can be performed under local anaesthesia. There are two main intraoral donor sites for autologous bone grafting available to the implantologist (Triplett and Silhow, 1998). The choice of site is based on the size of the defect to be augmented and the type and quantity of bone needed and the access to the donor site (Raghoebar et al, 2001). Only a certain amount of bone can be harvested from the retromolar area. It has been observed that the amount of bone volume obtained from the retromolar area is half of what can be harvested from the symphyseal region (Misch 1997). Retromolar grafts are usually used for single tooth augmentations.

Following harvesting of symphysis bone grafts, some long-term neurosensory disturbances have been described (Nkene et al, 2001, Raghoebar et al, 2001). In a prospective study evaluating intraoral donor sites for bone grafting, it was reported that 29% of symphysis graft patients had altered sensitivity of their mandibular incisor teeth (Misch 1997). All findings were resolved within six months. The majority of studies illustrate a continuous improvement of tooth sensitivity over time.

The authors have audited 94 consecutive symphysis grafts performed over the last 10 years. All patients have reported some altered sensation in their lower incisors. The altered sensation lasted between three and six months in all but two cases. Of these two cases, one patient had altered sensation for 11 months. The other patient, on whom a very large chin graft was harvested, had some discoloration of her lower incisors. Despite this, sensitivity testing revealed normal results. The discolouration disappeared after four months.

In contrast, surgical access to the retromolar area might be compromised because of anatomy, i.e. the location of the mandibular canal and width of the ramus. This donor site appears to be associated with less permanent neurosensory disturbances (Nkenke et al, 2002).

When using conventional bone cutting instruments such as reciprocating microsaws or trephines, there is a risk of postoperative necrosis. Comparative histological studies have shown necrosis on cut bone caused by surgical burs, trephines and microsaws (Aro et al, 1981). Over the past five years, piezosurgery has been introduced as a new technique for osteotomy and osteoplasty using ultrasonic vibration. The piezosurgery blades allow for maximum intraoperative precision and minimal tissue damage, and the selective frequency of the scalpel minimises the risk to adjacent soft tissues. Histological studies have also shown minimal cellular damage to the resected bone margins, bony matrix and underlying marrow spaces. A recent study concluded that piezosurgery provided more favourable osseous repair and remodelling than with conventional surgical burs with surgical ostectomy and osteoplasty procedures (Vercellotti et al, 2005).

Case report

The patient was a 59-year-old female with no relevant medical history. She had a history of severe generalised chronic periodontal disease, which had been treated non-surgically. Teeth 11 and 12 were extracted, as they were severely periodontally involved, grade III mobile and drifting outside lip control. The extracted teeth were left for eight weeks, which allowed soft tissue healing to occur over the extraction sockets. This facilitated primary closure of the wound.

A pre-operative dental panoramic tomograph revealed adequate mental bone apical to the roots of the patient's lower incisors (Figure 1). The patient was consented for the operation and particular reference was made to the high incidence of altered sensation of the lower incisors.

The procedure

A broad based full mucoperiosteal flap was raised at the recipient site to confirm the size of bone graft that was necessary. Next, a horizontal linear incision was made from lower canine to lower canine just apical to the mucogingival junction. The mucosa and mentalis muscle were lifted from the bone using a periosteal elevator. The lower border of the mandible was identified but the mentalis was reflected to just short of the lower border in order to avoid 'witches' chin' which is a possible complication of this

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Figure 1: Pre-operative tomography revealing adequate mental bone apical to the roots of the patient's lower incisors

Figure 2: Harvesting a cortico-cancellous block. The piezosurgery blade has depth markers – the first at 6mm

Figure 3: Copious chilled isotonic saline irrigant was used to counter heat generation produced by the blade tip

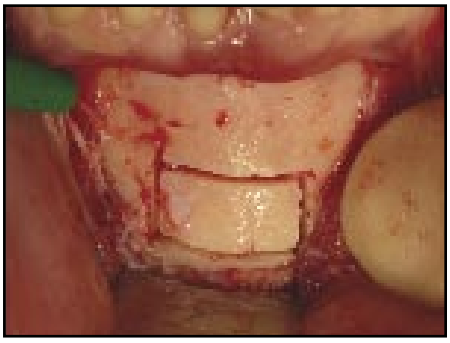


Figure 4: A check was made to ensure that the cut is through the cortical bone and into the cancellous bone

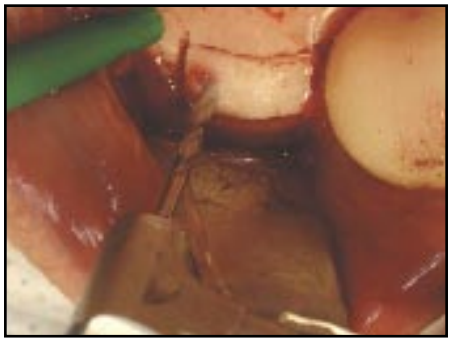


Figure 5: Screw holes are drilled before the block is harvested

Figure 6: The screw holes are sunk to avoid protrusion of the screw head

technique. The apices of the lower incisors were identified and the initial horizontal cut into the bone was made 5mm apical to the apices of the incisors (Von Arx et al, 2005).

The outline of the bone block was completed. The aim was to harvest a cortico cancellous block. The piezosurgery blade has depth markers. The first mark is at 6mm (Figure 2). Copious chilled isotonic saline irrigant was used to counter heat generation produced by the blade tip (Figure 3). A check was made to ensure that the cut is through the cortical bone and into the cancellous bone (Figure 4).

Next, the bone block osteosynthesis titanium screw holes were drilled. The authors find it is easier to drill the screw holes before the block is harvested (Figure 5). The screw holes are counter sunk to avoid protrusion of the screw head (Figure 6). The bone block screws were screwed into place only far enough to secure them in the cortical plate of bone and the block was mobilised using a curved chisel (Figure 7).

A block with a rich bed of cortical bone is essential as cancellous bone is revascularised rapidly which will preserve the osteogenic cells. The cancellous bone block is integrated by apposition of new bone to the existing trabecular framework. The autologous bone graft resorbs partially and finally heals as vital bone (Heiple et al, 1987, Nisbet et al, 1960).

Figure 7: The bone block screws were screwed into place only far enough to secure them in the cortical plate of bone and the block was mobilised using a curved chisel

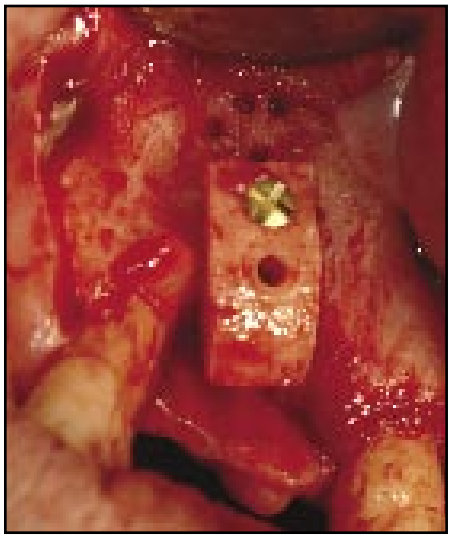


Figure 8: The block graft was fixed into position with the osteosynthesis bone screws to achieve buccal augmentation of the ridge volume

There is evidence to show that cortical bone grafts are only slowly revascularised and that they never completely repair (Burchardt 1987). For this reason using a solely cortical graft may have implications on the final amount of bone to implant contact in the integrated implant. Conversely, a purely cancellous bone graft is prone to early resorption and must be used with a barrier membrane. Thus a cortico-cancellous bone graft placed in conjunction with a barrier membrane will offer the best chance of minimising the resorption of the graft (Buser et al, 1996).

The chin wound was sutured in two layers. First the mentalis was sutured with internal interrupted sutures and then the overlying mucosa was closed with a 5/0 resorbable suture. The recipient site was perforated using a pin drill under copious saline irrigation so as to create multiple perforations through the cortical plate

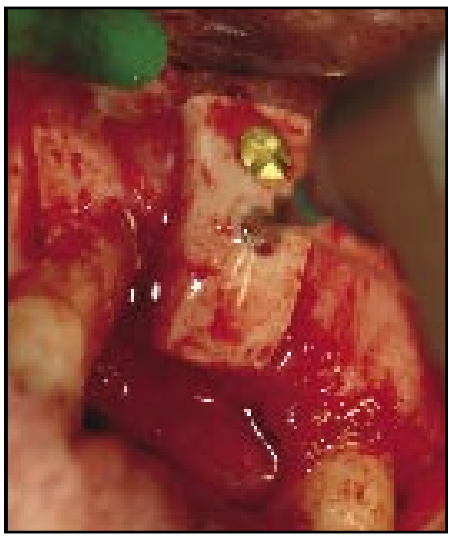
allowing communication from the marrow spaces (Buser et al, 1996). A small pin drill was used so that the anchor sites for the osteosynthesis bone screws were not compromised. The block graft was fixed into position with the osteosynthesis bone screws to achieve buccal augmentation of the ridge volume (Figure 8).

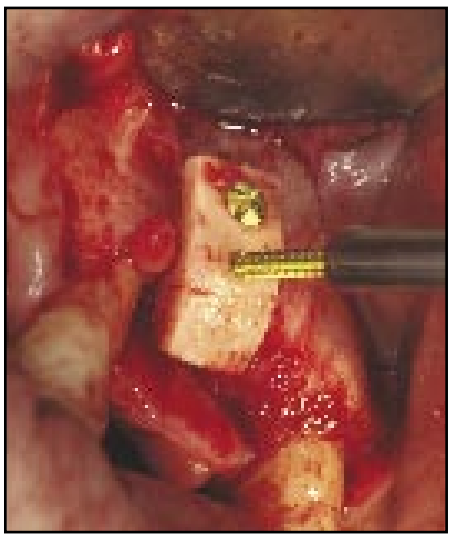
The second osteosynthesis bone screw was then reinserted to firmly secure the block graft. The screws were 12mm long (Figures 9 and 10). Next the edges of the block bone graft were smoothed using a large cross cut round surgical bur with copious chilled saline irrigant (Figures 11 and 12).

Further cancellous bone chips were harvested from the chin and mixed with deproteinised bovine bone and the patient's venous blood (Figure 13). As the venous blood clots it helps the bone particles to aggregate together to facilitate easier application of the graft material to the site (Figure 14).

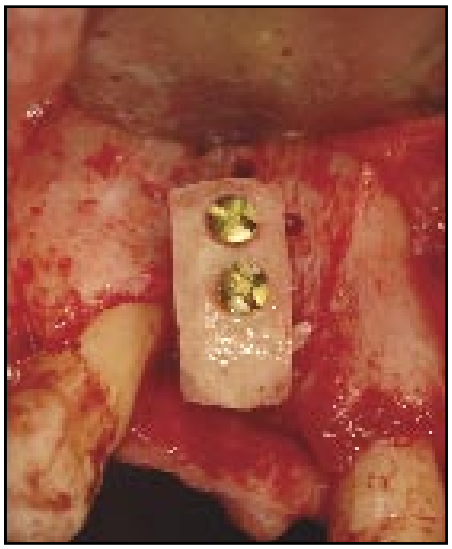
The mixture of cancellous bone chips and deproteinised bovine bone chips was applied over the block bone graft (Figure 15). Autogenous bone harvested can be mixed with a bone substitute material. Bone grafting materials may produce bone formation by osteoinduction or osteoconduction (Moy et al, 1993). A layer of resorbable collagen membrane was placed over the graft and stabilised with a second layer (Figure 16 and 17). The use of barrier membranes over particulate bone grafts seems to reduce the tendency for the bone graft to be resorbed during the healing phase, It must be emphasised that the tendency of bone grafts to resorb during the healing phase also occurs if the graft is protected by a membrane (Buser et al, 1996). The periosteum of the flap was relieved to facilitate a tension-free closure using a 5.0 resorbable suture (Figures 18-19).

One week late healing was uneventful and the sutures were removed. The mandibular sutures were left to resorb. The block bone graft was left to consolidate for a period of six months. At this stage, the site will be ready for the placement of titanium implants.





Figures 9 and 10: The screws were 12mm long



Figures 11 and 12: The edges of the block bone graft were smoothed using a large cross cut round a surgical bur with copious chilled saline irrigant

Conclusion

The authors find that the surgical control for the piezosurgery is easier than conventional methods for mobilising a block graft. The force necessary to produce a cut is much less compared to rotational burs, trephines or reciprocating microsaws. We have also noted that when a bur or trephine is use in bone of an increased density there is a consequent increase in hand pressure to compensate for the bone this results in a decrease in surgical sensitivity. The piezosurgery inserts vibrate within a width of 60-200mm at a modulated ultrasonic frequency. Therefore an increase in temperature is avoided, which ultimately reduces the risk of bone damage as a result of overheating.

A bur cut wastes a lot of bone and the resultant harvested block is often smaller than first intended. A trephine will make a very fine cut with very little bone wastage. However, it will only allow a circular cortico-cancellous block to be harvested, which is not ideal. The piezosurgery osteotomy makes a narrow cut with little bone wastage. It allows a block of bone to be cut to match the size of the recipient site. Within the authors' practice, the piezosurgery unit has added to the armamentarium to achieve the best results for patients with the minimum of trauma.

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Figure 13: Further cancellous bone chips were harvested from the chin and mixed with deproteinised bovine bone and the patient's venous blood

Figure 14: As the venous blood clots it helps the bone particles to aggregate together to facilitate easier application of the graft material to the site

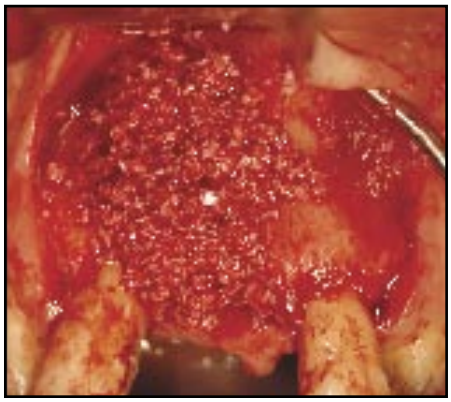
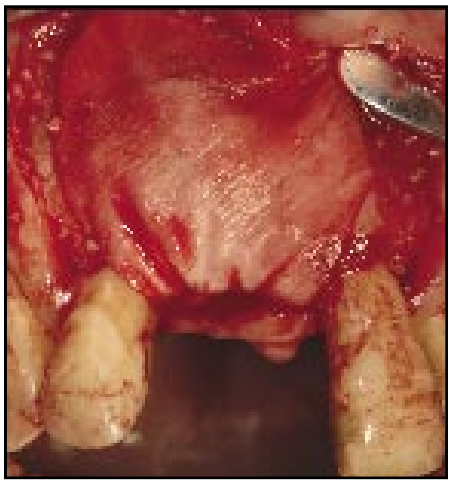


Figure 15: The mixture of cancellous bone chips and deproteinised bovine bone chips was applied over the block bone graft



Figures 16 and 17: A layer of resorbable collagen membrane was placed over the graft and stabilised with a second layer

Figures 18 and 19: The periosteum of the flap was relieved to facilitate a tension-free closure using a 5.0 resorbable suture

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