Tricortical stabilisation in severely atrophic buccal bone

A technique for immediate anterior aesthetic zirconia implant restoration

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A goal of implant placement is the provision of an osseointegrated fixture to support an aesthetic and functional restoration.[1] Imperative to the success of this treatment modality is ensuring optimal bone between the implant and periapical bone, bone–implant contact at the most coronal level and the least amount of buccal bone and soft-tissue recession or atrophy.[1]

However, a prolonged period of edentulism may result in extreme atrophy and resorption that compromise and complicate implant placement and restoration, particularly in the anterior maxilla.[2] A severely atrophied and resorbed maxilla may not present the requisite bone volume for achieving primary stability when conventional implant surgical techniques are undertaken.[2–4] As a result, conventional implant surgery techniques anterior to or below the sinuses are often contra-indicated because of insufficient bone mass.[2, 4]

Additionally, deficient buccal bone anatomy negatively affects aesthetics and is a significant causative factor of aesthetic implant complications and failures.[5] Inadequate buccal bone volume may cause a concavity in relation to

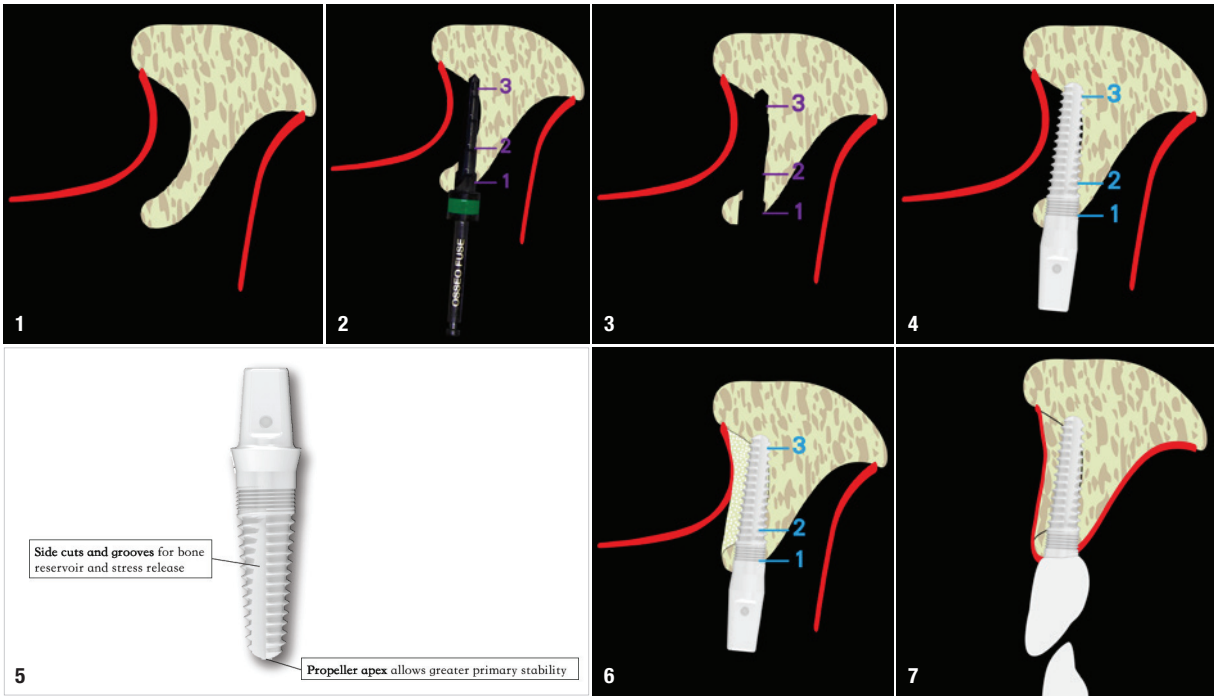


Fig. 1: Sagittal view illustration of a severe buccal plate undercut. **Fig. 2:** Sagittal view illustration of how an ideal osteotomy is made by first entering from the crestal plate, perforating the buccal plate and continuing into the apical portion of the buccal plate. **Fig. 3:** Sagittal view illustration of an osteotomy created with the tricortical stabilisation technique. **Fig. 4:** Sagittal view illustration of the placement and locking into position of the one-piece zirconia implant through three cortical plates (i.e. tricortical stabilisation). **Fig. 5:** The OsseoFuse® Z-40 (COHO Biomedical Technology) one-piece zirconia implant. **Fig. 6:** Sagittal view illustration of the implant placed with the tricortical stabilisation technique and placement of bone grafting material. **Fig. 7:** Sagittal view illustration of the anticipated definitive restoration results after six to eight months.

adjacent tissue levels, resulting in a dark shadow.[6] Furthermore, extraction procedures produce a gap between the buccal socket wall and implant, requiring pre-prosthetic grafting to maintain crestal bone levels and gingival crestal position.[5]

Conventional preservation techniques

Therefore, preservation and augmentation of the buccal plate are essential both to maintain gingival tissue position to prevent aesthetic compromises and to facilitate proper implant positioning and placement and, most importantly, primary implant stability and long-term osseointegration.[5] In cases with severe buccal resorption in the anterior region, this typically is accomplished by harvesting chin or ramus bone blocks, which are subsequently placed and stabilised with pins.[7, 8] Gaps remaining between the bone block and native bone are then filled with bone particulate and covered with a membrane. The goal in augmenting the buccal plate is to preserve the socket until maturation in order to facilitate implant stability and restoration aesthetics.[9]

Unfortunately, such conventional procedures require an eight- to 12-month healing period, after which an implant can be placed, providing all the bone has successfully matured. Ironically, creating the osteotomy requires drilling out approximately 50% of the grafted bone to house and stabilise the implant. Subsequently, an additional three to six months of healing is then required for osseointegration, after which yet another surgery is required to expose the implant and place an abutment.[5]

However, such currently accepted procedures are not immune to challenges. Harvesting autogenous bone through surgery at a donor site depends upon the presence of sufficient bone for harvesting, subsequent grafts are prone to resorption and the multiple surgeries required contribute to patient discomfort.[10, 11] The membrane may also be exposed, which could lead to membrane removal, incomplete bone growth and eventual treatment failure.[6] Additionally, failure of the bone block grafting technique can result from dehiscence, bone exposure and soft-tissue collapse owing to slow revascularisation.[6, 12, 13]

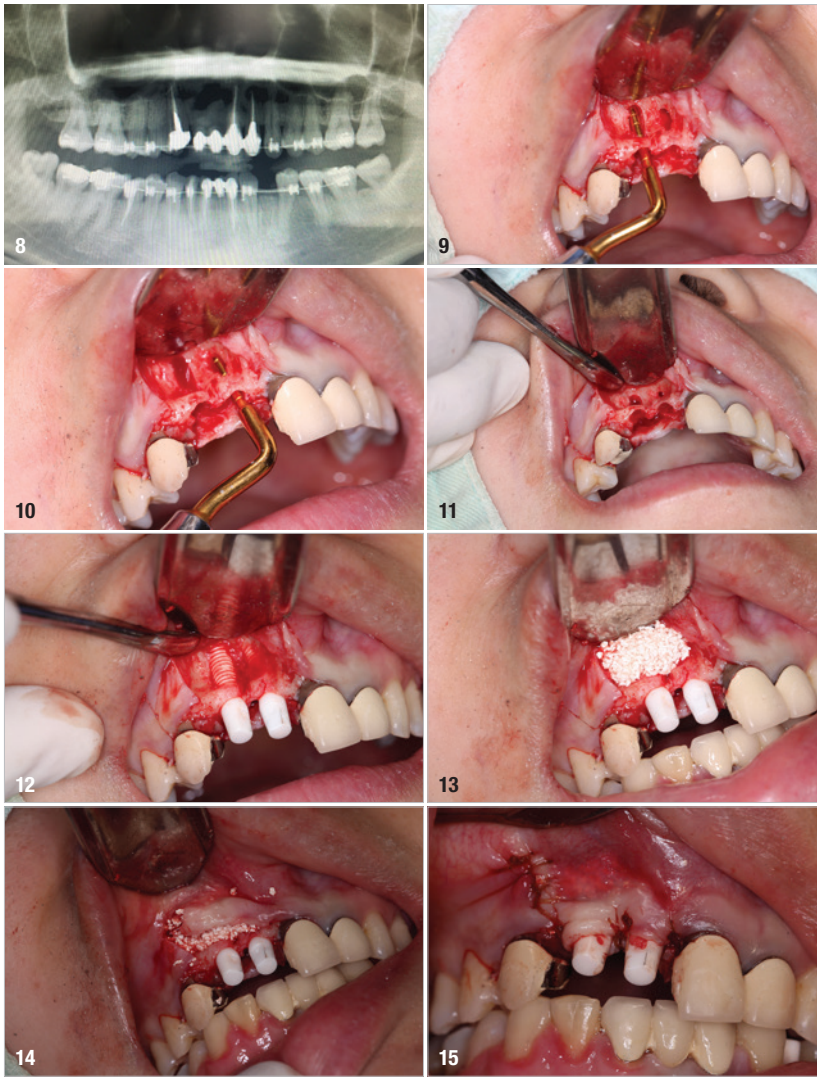


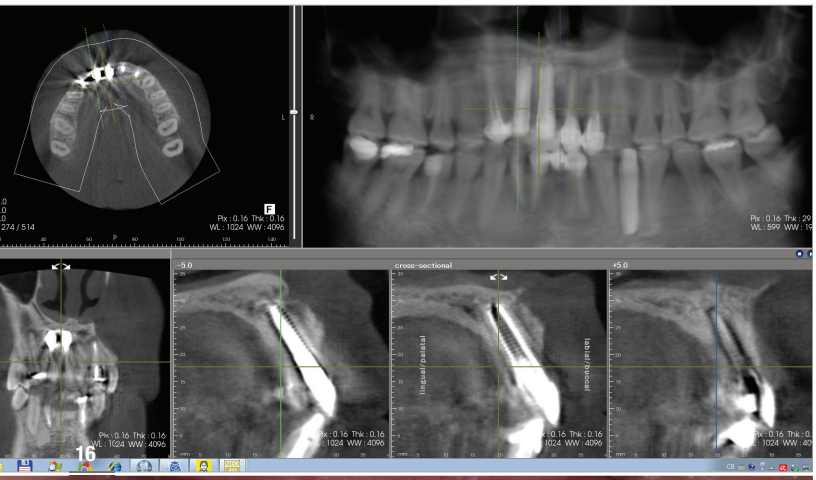
Fig. 8: Preoperative radiograph of the female patient whose maxillary right lateral and central incisors had been lost because of trauma 20 years earlier. **Fig. 9:** Buccal bone anatomy assessment using a condenser, revealing severe buccal undercuts at site #12. **Fig. 10:** Buccal bone anatomy assessment using a condenser, revealing severe buccal undercuts at site #11. **Fig. 11:** Osteotomy created with a preset drill according to the tricortical stabilisation technique. **Fig. 12:** Two implants placed. **Fig. 13:** Minimal bone grafting material filling the recessed buccal sites. **Fig. 14:** The buccal flap passively repositioned to cover the bone grafting material. **Fig. 15:** Primary closure.

Current advancements

Considering the time required for conventional implant treatment procedures, materials and techniques have been incorporated over the years to optimise bone augmentation, implant placement immediately after extraction (or when sites demonstrate severe resorption and atrophy), and implant osseointegration.[3, 5] These have included materials for bone replacement (e.g. osteoconductive xenograft materials and osteoinductive synthetic materials) for scaffolding, as well as cell migration, adhesion, proliferation and differentiation.[5–7, 14–16] Although these options have eliminated the need for some surgical procedures (e.g. harvesting from donor sites and separate surgery for implant placement after bone remodelling) and demonstrate varying degrees of success, they are not completely predictable or efficient for patients and dentists for implant restoration of the anterior maxilla that presents with severe buccal atrophy and resorption.[6, 7, 14–16]

Tricortical stabilisation technique

The tricortical stabilisation technique represents a clinically efficient and predictable means to place implants,



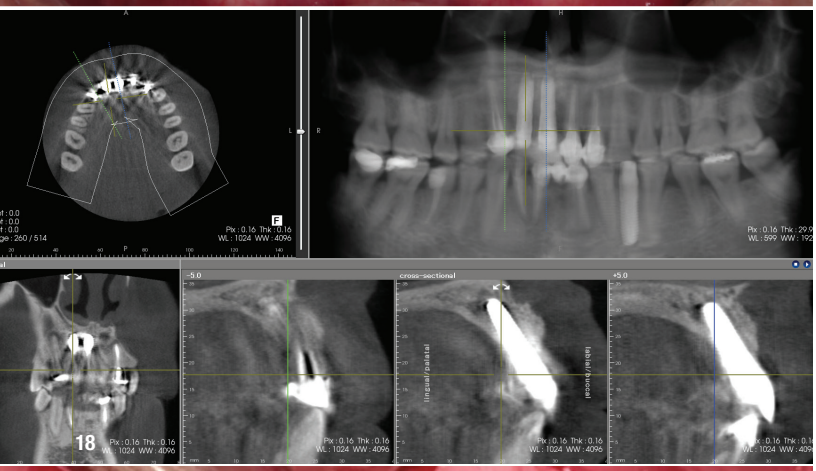


Fig. 16: Immediate postoperative panographic radiograph of the implants and bone grafting at sites #12 and 11. **Fig. 17:** Retracted view of the immediately placed provisional restorations on implants #12 and 11. **Fig. 18:** Four-month CT scan confirming buccal bone graft and implant integration at sites #12 and 11.

bone grafting material and provisional restorations at anterior sites demonstrating severe buccal plate undercuts and recessed and exposed buccal bone in one surgical appointment (Fig. 1). The cornerstone of the technique is the establishing of primary implant stability through three cortical plates (i.e. crestal plate, buccal plate and apical portion of the buccal plate) and filling remaining recessed buccal areas with bone grafting material at the time of implant placement.

After buccal plate recession and atrophy have been confirmed radiographically, a buccal flap is made (i.e. crestal incision and vertical incisions) to expose recessed areas, and a condenser is then used to evaluate buccal bone quality, paying special attention to determining the presence of severe buccal undercuts. A preset drill (OsseoFuse® One Drill® implant system) is used to create the ideal osteotomy by entering the site from the crestal plate, perforating the buccal plate and continuing into the apical portion of the buccal plate (Figs. 2 & 3).

To simultaneously promote primary stabilisation and contribute to procedural efficiency, the tricortical stabilisation technique then employs the one-piece zirconia implant OsseoFuse® Z-40 (COHO Biomedical Technology), which is placed and locked into position through the three cortical plates (Fig. 4). The one-piece zirconia implant is ideal for the tricortical stabilisation technique because it requires less maintenance and fewer procedural steps; it also effectively and tightly engages the tricortical bone to achieve the desired primary stability (Fig. 5).[17] Once primary stability has been

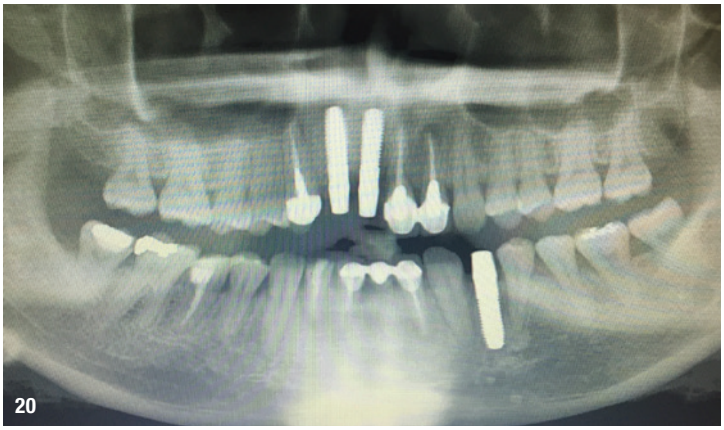


Fig. 19: Re-entry after 12 months, revealing completely intact and hardened bone grafting material. **Fig. 20:** Panographic radiograph after 12 months, confirming implant and buccal plate stability at sites #12 and 11.

achieved, only a minimal amount of bone grafting material is required, since it need only fill remaining recessed buccal areas not occupied by the implant (Fig. 6).

The main benefits of implementing the tricortical stabilisation technique include a single-stage surgical appointment, during which both implant placement and bone grafting material are placed; simultaneous fixed provisional restoration placement; and elimination of the need for bone block grafting, stabilisation pins and membranes, since the implant achieves optimal primary stability by locking into the three cortical areas. Additionally, because 50% of the recessed space is occupied by the implant itself, less bone grafting material is required. Overall, patients are relieved from undergoing multiple surgeries that typically span 18–24 months, as well as from wearing an uncomfortable removable provisional restoration. With the tricortical stabilisation technique, a definitive implant-supported restoration can be placed between six and eight months after the single surgical appointment (Fig. 7).

Case presentation

A 28-year-old female patient presented with a fixed partial denture replacing teeth #12 and #11 that had been placed 20 years earlier. These teeth were lost as a result of trauma incurred during a bicycle accident. She was interested in a more aesthetic, stable and permanent replacement for these teeth and specifically enquired about dental implants.

Thorough oral and medical histories were taken, and intra-oral and radiographic examinations were performed (Fig. 8). Although nothing was found to contraindicate implant restorations at these sites, atrophy at sites #12 and #11 had resulted in severe buccal undercuts and buccal plate recession that could have presented challenges when establishing primary and long-term implant stability, as well as for anterior aesthetics. After discussions with the patient about the advantages and disadvantages of multiple-stage implant surgeries and restoration procedures, it was determined that the tricortical stabilisation technique would be undertaken for this patient. Both sites #12 and #11 would be restored with 3.75 × 13.00 mm one-piece zirconia OsseoFuse® Z-40 implants and immediate fixed provisional restorations.

Clinical protocol

After the patient had been anaesthetized, a full-thickness buccal flap was created and elevated. A condenser was then used to assess the buccal bone anatomy, revealing severe buccal undercuts at sites #12 and #11 (Figs. 9 & 10).

Owing to the severe buccal plate recession at these areas, the osteotomies were performed using a preset drill (OsseoFuse® One Drill®) according to the tricortical stabilisation technique, using copious cold saline irrigation to minimise heat generation.[5] The drill first entered the crestal bone, continued through the exposed buccal plate and re-entered into the apical portion of the buccal plate (Fig. 11).

Two implants were then immediately placed into the tricortical osteotomies at sites #12 and #11 and achieved primary stability (Fig. 12). In this case, the selected implants were ideal because they enabled an efficient, minimally traumatic protocol, which subsequently contributed to patient comfort.[17]

Because the anatomy of the zirconia implants occupied most of the recessed areas and primary tricortical stabilisation had been achieved, only a minimal amount of an anorganic bovine bone grafting material (Geistlich Bio-Oss, Geistlich Pharma) was necessary to fill the remaining recessed buccal plate areas (Fig. 13). No barrier membrane was needed. The buccal flap was passively repositioned to cover the bone grafting material, and primary closure was achieved with #4/0 nylon suture thread (Figs. 14 & 15). An immediate postoperative radiograph was taken to confirm implant angulation and position (Fig. 16), after which fixed provisional restorations were placed on each implant (Fig. 17).

The patient returned four months later, after uneventful healing, at which time a CT scan confirmed maturation of the buccal bone graft, filling of the recessed and atrophied areas, and implant integration (Fig. 18). Excellent buccal volume and absence of inflammation around the implants were noted. Upon re-entry after 12 months, completely intact and hardened bone grafting material was observed (Fig. 19), and implant and buccal plate stability were evident radiographically (Fig. 20).

Conclusion

The tricortical stabilisation technique represents a clinically efficient and predictable method for placing implants, bone grafting material and provisional restorations in one surgical appointment at anterior sites demonstrating severe buccal plate undercuts and recessed and exposed buccal bone. The technique enables dentists to provide patients with a single-surgery treatment that demonstrates stability, functionality and aesthetics, rather than requiring them to undergo multiple procedures or endure discomfort for an extended time.[18, 19] By strictly following the protocol presented in this case report, an implant can be immediately placed and provisionally restored at atrophic and recessed buccal sites resulting from prolonged edentulism. Although future clinical studies are necessary to confirm the long-term validity of this approach, previous research suggests that such a technique will support buccal bone regeneration.[18, 19]

Literature

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