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The Art of Treatment Planning

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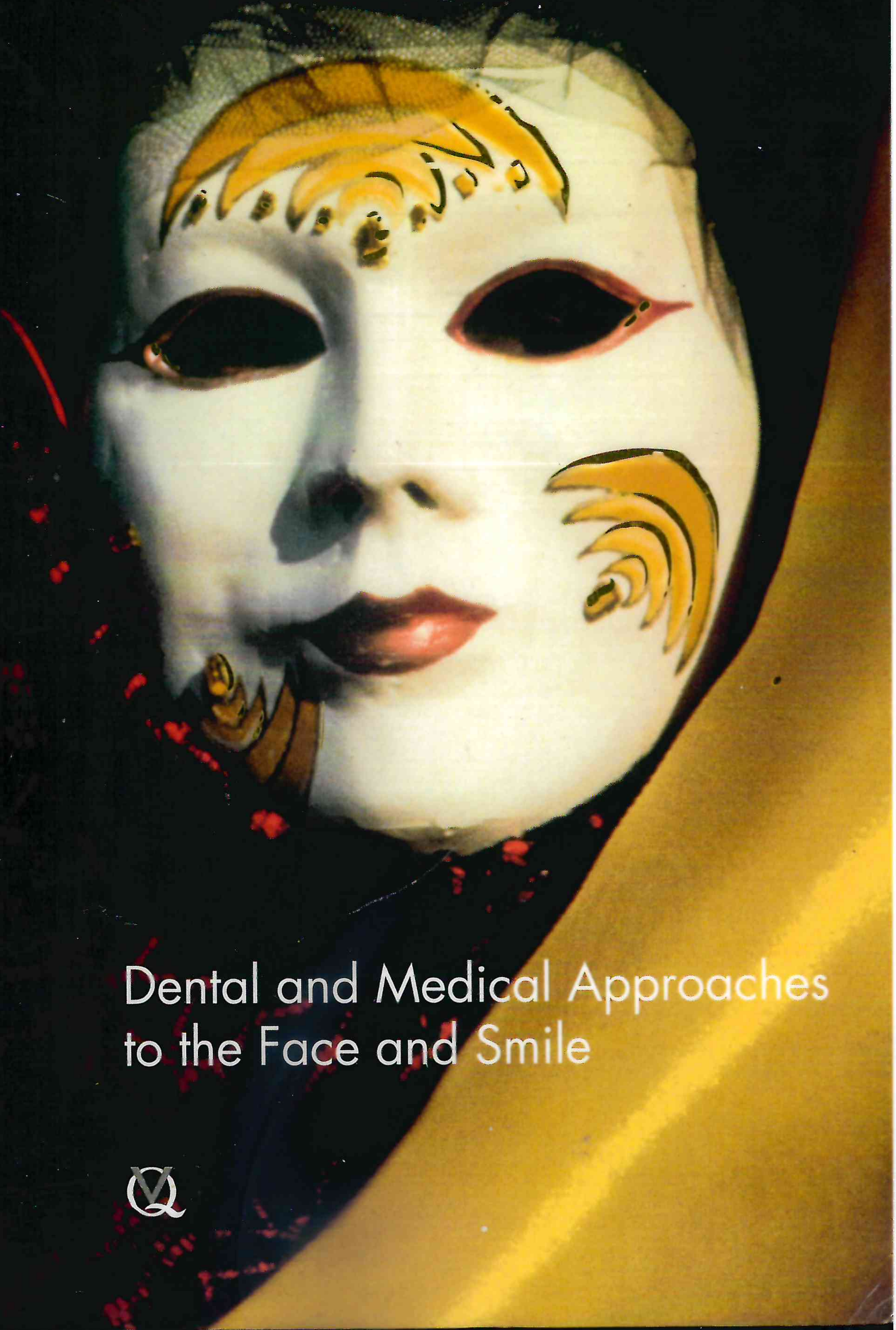

Dental and Medical Approaches to the Face and Smile

Soft and Hard Tissue Augmentation in the Posterior Mandible

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Cobi J. Landsberg, DMD

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The introduction of osseointegration and evolution of related biomaterials and surgical techniques have contributed to an increased application of dental implants in the restoration of partially and completely edentulous patients.

An examination of these patients often reveals soft and hard tissue defects resulting from various causes such as infection, trauma, or tooth loss. These defects are often responsible for an anatomic foundation that is less than favorable for ideal implant placement.

In prosthetic-driven dental implant placement, reconstruction of the alveolar bone through a variety of regenerative surgical procedures has become an option with a predictable outcome. To guarantee a good long-term prognosis for a restoration, hard tissue augmentation may be necessary either prior to implant placement or at the time of implant surgery. Hard and soft tissues with adequate volume and quality are required if the functional and esthetic goals of implant dentistry are to be fulfilled.

The predictability of the corrective, reconstructive procedures is influenced by the anatomy of the edentulous ridge at the operative site in addition to the quality of the remaining soft and hard tissues. A stable outcome also depends significantly on the technique and biomaterials chosen and the experience, knowledge, and clinical skills of the surgeon.

Through a series of clinical cases centered around patients with inadequate hard or soft tissues, this chapter aims to demonstrate the implementation of contemporary tissue augmentation techniques in the posterior region of the mandible. Proper analysis, thorough treatment planning, and knowledge of suitable materials in each case lead to predictable results that effectively address each patient's chief complaint.

Case 1: Guided Bone Regeneration

Overview

A 45-year-old woman was referred to the clinic for implant therapy on the posterior right mandible. The main problem was identified as inadequate conditions for implant placement due to horizontal ridge resorption. Guided bone regeneration (GBR) was the treatment of choice.

To date, there are insufficiently well-controlled evidence-based studies to substantiate a clear clinical advantage of one bone regeneration technique over another. The clinician's preference for using a specific technique is based mainly on personal experience. In any case, the decision as to which technique to implement must be preceded by a thorough study of the clinical and radiographic findings of the case.

In this patient, the highly positioned inferior alveolar nerve at both the donor and the recipient sites obviated the safe execution of other surgical techniques such as ridge splitting or onlay bone grafting. In contrast, although it is an extremely technique-sensitive procedure, GBR seldom jeopardizes the inferior alveolar nerve. Furthermore, in the author's clinical experience, grafting particulated autogenous cortical and cancellous bone under a stabilized titanium-reinforced expanded poytetrafluoroethylene (e-PTFE) membrane usually results in regenerated bone tissue that exhibits superior clinical properties. The ability to augment the ridge simultaneously with implant placement might be considered an advantage over other bone regenerative techniques, such as onlay bone grafts in which implant placement is delayed for about 5 months following bone grafting.

Procedure

Clinical examination of the patient revealed a severely horizontally resorbed edentulous alveolar ridge that extended mesially to the mandibular right first premolar. As is typical in this kind of situation, the quantity of remaining keratinized tissue at the crest of the ridge was minimal.

A computed tomography (CT) scan confirmed the significant resorption and revealed an inferior alveolar nerve canal in a high position. Consequently, ridge splitting or ramus onlay graft harvesting procedures were considered hazardous to the nerve, and a GBR procedure was determined adequate to augment the ridge (Figs 9-1a and 9-1b). A total of 6 mL of 2% lidocaine with 1:100,000 epinephrine was used in buccal and lingual infiltration for analgesia and hemostasis.

The plan for the flap design took the following factors into consideration:

- To accurately approximate flaps at the suturing stage, it is advantageous to have keratinized tissue on both buccal and lingual aspects. Accordingly, a midcrestal incision was performed, starting mesially at the distal aspect of the premolar and extending distally to the retromolar area.
- To provide optimal access and visibility, proper membrane placement, and coronal flap extension, the midcrestal incision was extended to the buccal and lingual sulci of the mandibular right canine and first premolar. Releasing incisions for the buccal flap were added vertically at the mesial line angle of the canine and in a lateral-posterior direction in the retromolar area (Fig 9-1c).
- To prevent lingual nerve or blood vessel damage, no vertical releasing incision was made on the lingual side.

The area intended for ridge augmentation was prepared with cortical penetrations to recruit bone-forming cells to the wound. Three implants

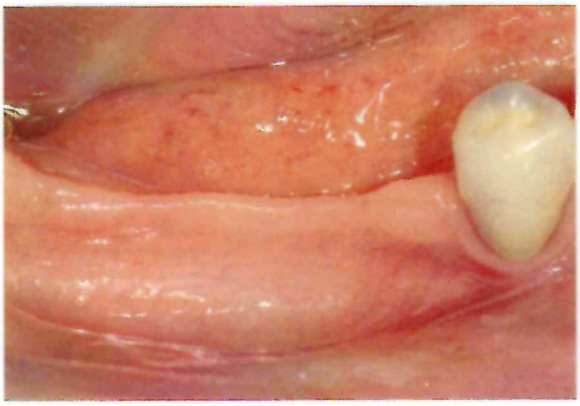


Fig 9-1a Clinical view of the edentulous mandibular region demonstrates extensive horizontal resorption.

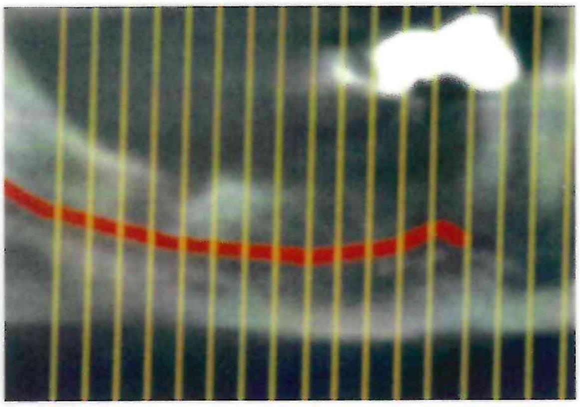


Fig 9-1b CT scan reveals that the inferior alveolar nerve was located high enough to present a considerable risk.

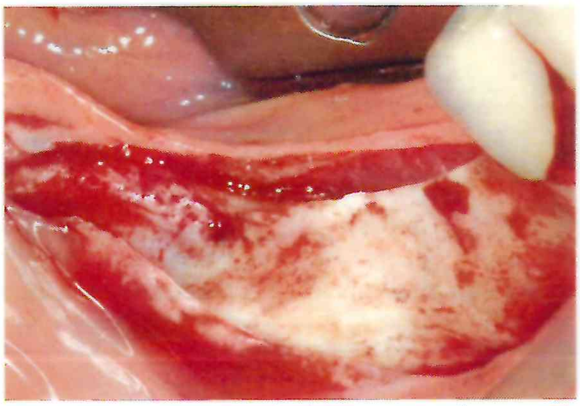


Fig 9-1c Midcrestal incision with releasing incisions allows optimal flap manipulation.

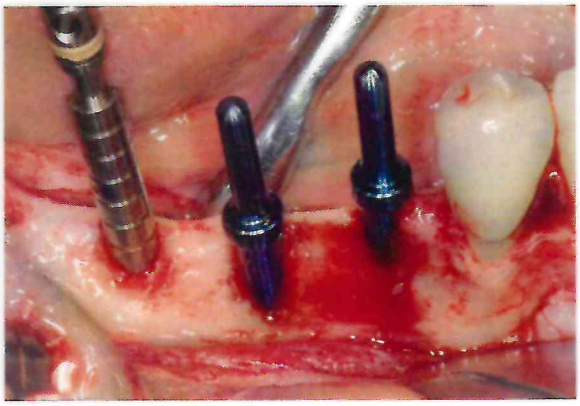


Fig 9-1d Three guide pins are inserted to ensure correct implant positioning.

were placed, with various amounts of their buccal and interproximal surfaces exposed. A space of 3 to 4 mm between the implants was ensured in order to maintain inter-implant bone (Figs 9-1d and 9-1e).

A titanium-reinforced e-PTFE membrane was then prepared. To do this, the membrane was first trimmed and adapted to the ridge and relieved in the area of the mental foramen to prevent any stress on the mental branches. A buccal extension was prepared on the mesial portion to minimize invasion of the connective tissue cells. The membrane was attached buccal-

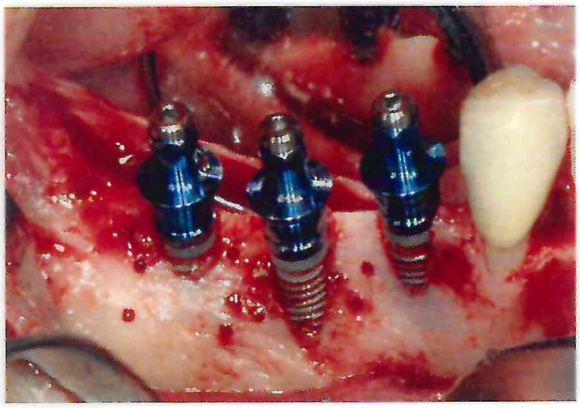


Fig 9-1e Three implants are placed with varying amounts of surfaces remaining exposed.

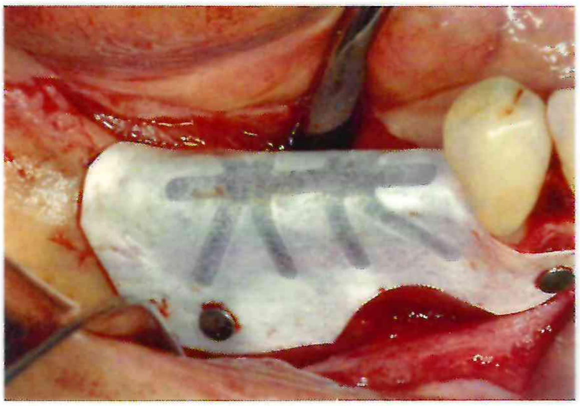


Fig 9-1f The e-PTFE membrane is placed and attached with two tacks.

Fig 9-1g Autogenous bone chips are grafted underneath the membrane.

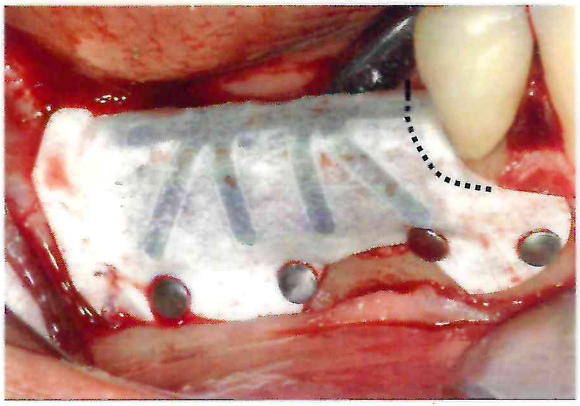


Fig 9-1h The membrane is reattached with two more tacks to hold the bone graft. The part of the membrane in contact with the root surface is removed with sharp scissors *(dotted line)* to facilitate connective tissue reattachment and to prevent bacterial invasion.

ly at the inferior border by two tacks, that provided sufficient initial stability yet allowed adequate flexibility for accurate placement of the bone graft to follow.

Autogenous bone chips were harvested from the posterior mandible and packed at the recipient site to cover the exposed surfaces of the implants. Care was taken to isolate the wound from any salivary contamination emanating from the floor of the mouth or the buccal vestibule. The membrane was repositioned, and two tacks were added in the center of the inferior border to ensure optimal isolation of the grafted bone. The part of the membrane in contact with the root surface was removed with sharp scissors to facilitate connective tissue reattachment and to prevent bacterial infection (Figs 9-1f to 9-1h).

An additional tack was placed on the lingual aspect to prevent membrane dislodgement, and excess membrane material was removed with a surgical blade. To release muscle tension and to facilitate coronal flap extension, the periosteum on both buccal and lingual flaps was dissected anteroposteriorly to a minimum depth by the tip of a no. 15 scalpel blade.

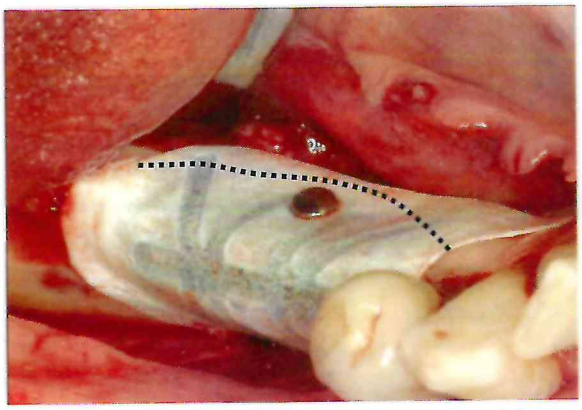


Fig 9-1i A lingual tack is added to improve membrane stabilization. Extra membrane on the lingual side *(dotted line)* is removed with scissors and a surgical blade.

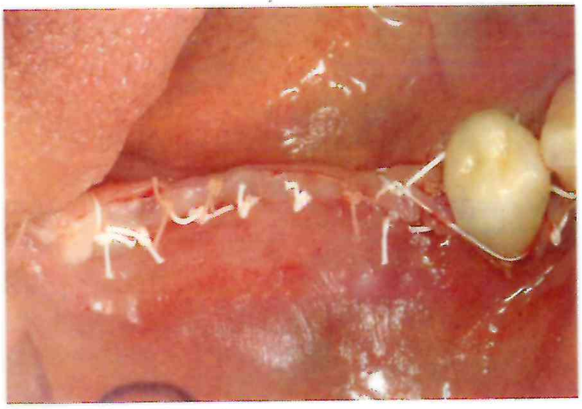


Fig 9-1j Flaps are sutured.

Fig 9-1k Healing after 6 months. Complete membrane isolation has been successfully maintained.

Flaps were sutured as follows:

1. Horizontal mattress 5-0 e-PTFE sutures were used for flap eversion and approximation to facilitate immediate broad contact between the flaps.
2. Simple interrupted 5-0 vicryl sutures were added between the horizontal mattress sutures to ensure tight flap adaptation.
3. An anchoring sling 5-0 e-PTFE suture was wrapped closely around the premolar to ensure intimate contact between the flaps and the tooth. This would help prevent bacterial plaque contamination of the underlying membrane.

During the 6-month healing period, the membrane remained completely covered by the soft tissues, and there were no signs or symptoms of infection. At the end of this period, a visible gain in ridge width had been achieved (Figs 9-1i to 9-1k).

A second surgical procedure removed the membrane and exposed the implants. A thin layer of fibrous tissue is normally interposed between the membrane and the underlying bone. Following removal of the membrane and the fibrous layer, the previously exposed implant surfaces were found to be fully embedded in newly regenerated bone. The healing abutments were connected, and the flaps were reapproximated using 6-0 monofilament polyamide sutures (Figs 9-1l to 9-1n).

After a 6-week healing period, the peri-abutment tissue was confirmed as mature, and the patient was referred for the restorative phase. The definitive restoration consisted of a cement-retained metal-ceramic fixed partial denture (FPD). Despite the thin band of peri-implant keratinized mucosa, soft tissue health had been maintained. Periodic follow-ups in cases like this are essential to assess the need for future soft tissue augmentation (Figs 9-1o to 9-1q).

Case 2: Ramus Onlay Bone Graft

Overview

A 51-year-old woman was referred to the clinic for implant therapy on the posterior right mandible. She presented with inadequate conditions for implant placement due to horizontal ridge resorption. As mentioned earlier, the clinician's preference for a specific technique is based mainly on personal experience. After careful evaluation of the clinical and radiographic situation, a ramus onlay bone graft was chosen.

In this patient, unlike in Case 1, the lower position of the inferior alveolar nerve and the adequate dimensions of the ascending ramus allowed for safe implementation of an onlay bone augmentation procedure, in which the ascending ramus is the donor site.

Because a potentially infection-provoking tooth (mandibular right canine) remained at the border of the ridge defect, there was a clear advantage in using the onlay graft procedure versus GBR (which is much more sensitive to infection). When rigid fixation of the grafted onlay bone to the recipient site must be achieved, the author's preference is to maintain adequate space between the donor and the recipient bone. This provides adequate interpositioning of particulated bone material and encourages increased bone outgrowth from the recipient site. Thus, the ridge may recapture the preferred anatomic and physiologic qualities (namely, cancellous-type bone interpositioned between two cortical plates) for implant placement.

Procedure

Clinical examination revealed a severely horizontally resorbed edentulous alveolar ridge that extended mesially to the mandibular right canine. A moderate amount of keratinized tissue remained at the crest of the

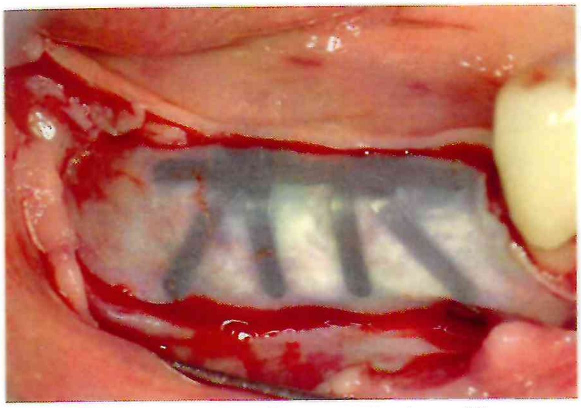


Fig 9-1l Uncovering of the grafting site. A thin layer of fibrous tissue is normally interposed between the membrane and the underlying bone.

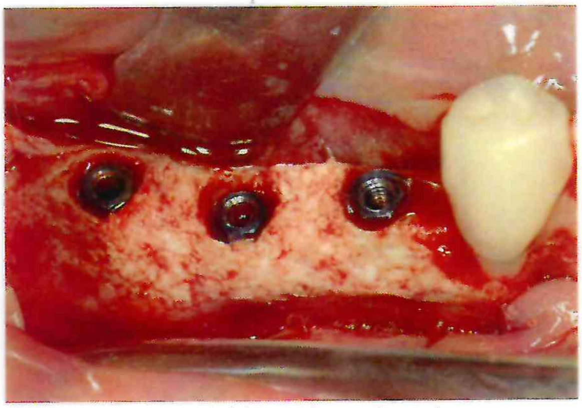


Fig 9-1m Upon removal of the membrane, the implants are seen embedded in the new bone tissue.

Fig 9-1n Healing abutments are placed, and flaps are sutured.

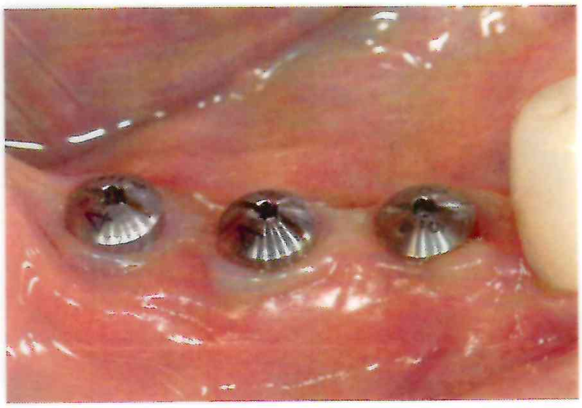


Fig 9-1o After an additional 6 weeks, the soft tissue surrounding the healing abutments is ready for the next phase.

Fig 9-1p Clinical view of the definitive restoration. (Restoration by Dr Joseph Azuelos, Tel-Aviv, Israel, and Mr Alex Copiit, Tel-Aviv, Israel.)

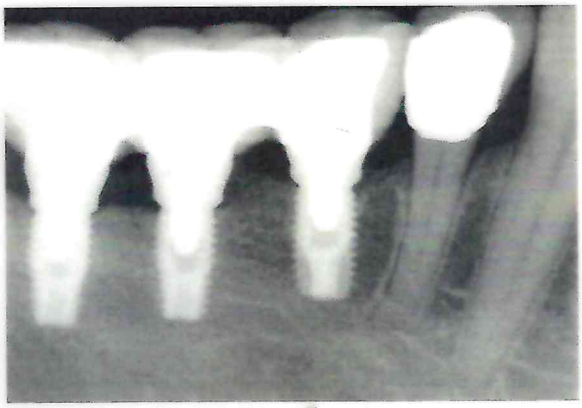


Fig 9-1q Final radiograph shows the stability of the hard tissues in the peri-implant region.

ridge. Due to the significant resorption of the ridge, a regenerative procedure was necessary before implant placement could be considered (Fig 9-2a).

CT scans demonstrated that the inferior alveolar nerve canal in the region of the posterior oblique ridge and the ascending ramus was located more than 10 mm inferiorly to the mandibular crest, and the width of the mandibular body in that area exceeded 10 mm (Fig 9-2b). In consideration of these dimensions, it was assumed that a ramus block harvesting procedure could be safely performed, and the placement of four or five implants was determined as adequate to restore posterior occlusal relationships.

A total of 7 mL of 2% lidocaine with 1:100,000 epinephrine was used for an inferior alveolar neurovascular block and as an analgesic and a hemostatic agent in buccal and lingual infiltration. A no. 15 scalpel blade was used to make a midcrestal incision through the right retromolar pad that extended approximately 1 cm posteriorly and obliquely into the buccinator muscle. The incision continued anteriorly around the intrasulcular area of the canine and lateral incisor, with a further oblique releasing incision into the buccal vestibule at the mesial line angle of the lateral incisor.

The full-thickness buccal and lingual flaps were then elevated to expose the entire ridge defect, the mental neurovascular bundle and foramen, and the angle of the mandible down to the inferior border. A large round bur and straight fissure burs were used to outline the recipient site for the monocortical block graft. The outline began distal to the canine and continued posteriorly for approximately 18 mm. The vertical extent of the decortication inferiorly from the crest of the ridge measured approximately 13 mm. A 0.8-mm round bur was used to penetrate the cortical plate for the recruitment of bone-forming cells (Fig 9-2c)

Harvesting of the bone block had begun at this point. With the aid of a 702L bur, a superior osteotomy was performed approximately 4 mm medial to the lateral surface of the body of the mandible, beginning opposite the area of the first and second molars and continuing posteriorly for a length of approximately 22 mm. Next, the vertical osteotomies were completed at the anterior and posterior extent of the previous osteotomy to a length of approximately 12 mm.

A no. 8 round bur was used to make the inferior score to connect the inferior aspect of both previous vertical osteotomies. A series of two bone spreaders was used to remove the block graft. The sharp edges of the donor site were smoothed with a large round bur, and a collagen-based hemostatic agent was used as a pack in the donor site area.

The edges of the block graft were contoured with a large bur, and the graft was secured in the recipient site with two titanium alloy screws 1.5 mm in diameter and 12-mm long. At this point, no attempt was made to fully adapt the bone graft to the recipient site (Figs 9-2d to 9-2f).

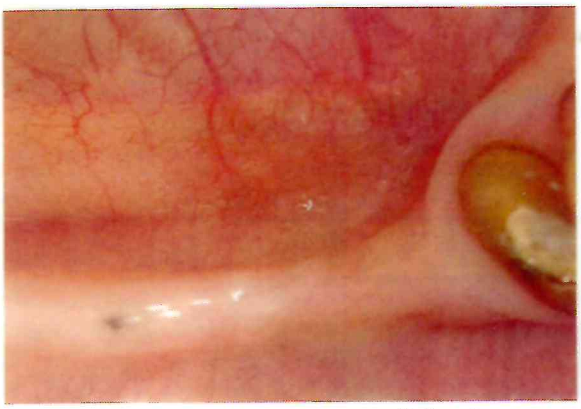


Fig 9-2a Clinical view of the edentulous mandibular ridge.

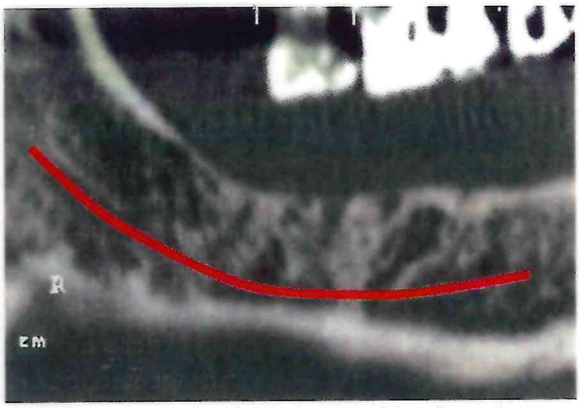


Fig 9-2b CT scan verifies that the location of the inferior alveolar nerve and the mandibular dimensions make the ramus a good donor site for a graft procedure.

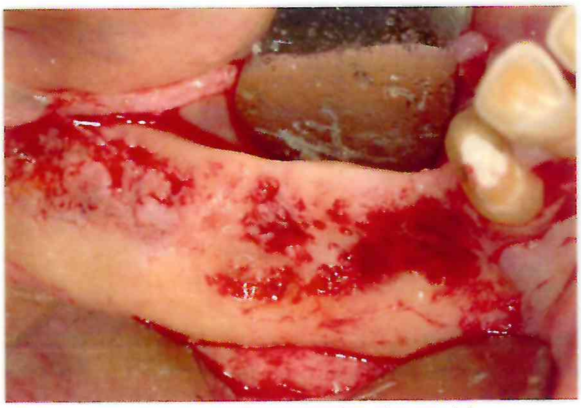


Fig 9-2c Flaps are elevated to expose the ridge, and the recipient site is decorticated.

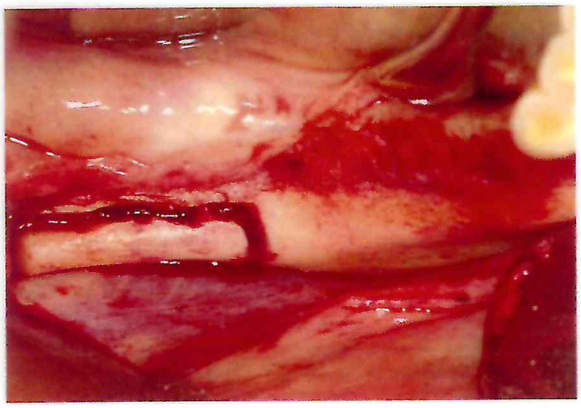


Fig 9-2d The donor bone is prepared using a series of bone burs and spreaders.

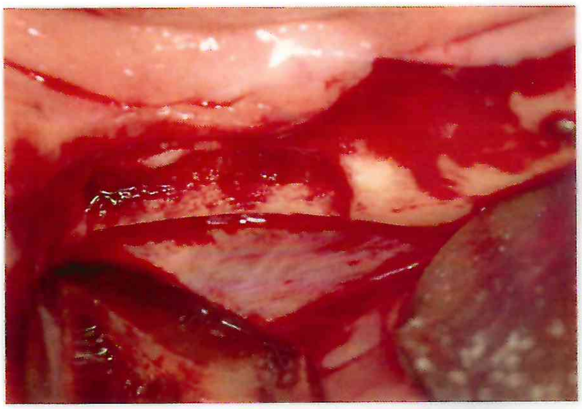


Fig 9-2e Donor site after edges have been smoothed down.

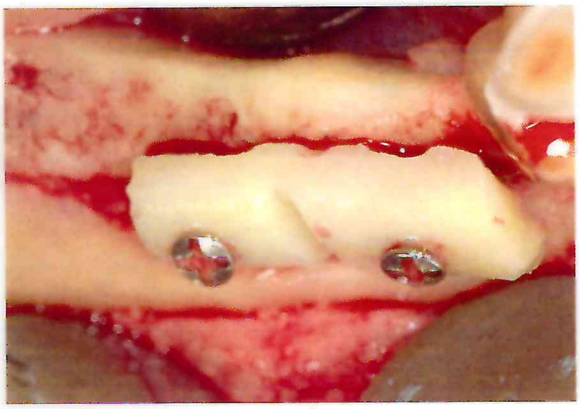


Fig 9-2f Block graft secured at the recipient site with titanium alloy screws. No attempt is made to achieve full adaptation.

Autogenous cortical bone shavings were collected by a bone scraper and placed in the spaces left between the block and recipient site (Fig 9-2g). The periosteum was scored inferiorly with a no. 15 scalpel blade to appropriately release a buccal mucoperiosteal flap, and a curved hemostat was used for muscle spreading. Then the periosteum was carefully scored with the tip of a sharp periosteal elevator to release the lingual flap. Primary closure of the recipient site was achieved with 5-0 e-PTFE horizontal mattress sutures, combined with 5-0 vicryl simple sutures in the posterior region (Fig 9-2h).

After a healing period of 5 months, the mucosa covering the bone graft appeared intact and free of any signs of inflammation. The little bump visible through the thin mucosa suggested that minor horizontal resorption around the fixation screw head had occurred (Fig 9-2i). A midcrestal incision that left 2 to 3 mm of keratinized mucosa in each flap was performed over the grafted area. To fully visualize the grafted area and the mental foramen, the midcrestal incision continued with a sulcular incision around the right lateral incisor and canine, ending with a vertical releasing incision on the mesial line angle of the incisor. The occlusal view demonstrated continuous bony texture of the healed ridge that suggested an organic union between the graft and the recipient bone. Slight horizontal resorption (0.5 mm) was evident around the screw heads (Fig 9-2j).

The following surgical steps were undertaken to prevent possible dislodgment of the graft during the preparation of the osteotomies:

- The process adhered to a strict sequential transition. A narrower drill was initially used, and the operator progressed to increasingly larger drills.
- The osteotomies at the premolar and first molar sites were carefully prepared slightly larger than necessary.
- To ensure smooth implant insertion, pretapping was used in all three osteotomies.

Finally, direction indicators were inserted to check for appropriate three-dimensional implant positioning, and the three implants were placed with their heads located approximately 0.5 mm supracrestally. The healing caps were immediately connected, and the buccal and lingual flaps were replaced and sutured (Figs 9-2k to 9-2m).

Two months later, the peri-implant mucosa had healed nicely. The canine, however, exhibited periodontal deterioration and hence was extracted and immediately replaced with an additional implant. A flapless approach was used for this final implant placement (Figs 9-2n and 9-2o).

Recall sessions to supplement meticulous home oral hygiene were scheduled every 2 to 3 weeks for hygiene that included bacterial plaque

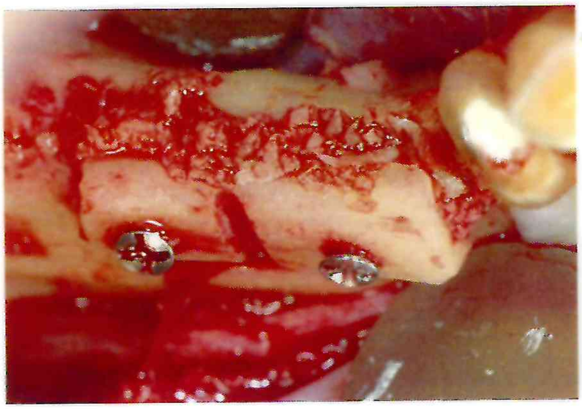


Fig 9-2g Autogenous bone shavings in place.

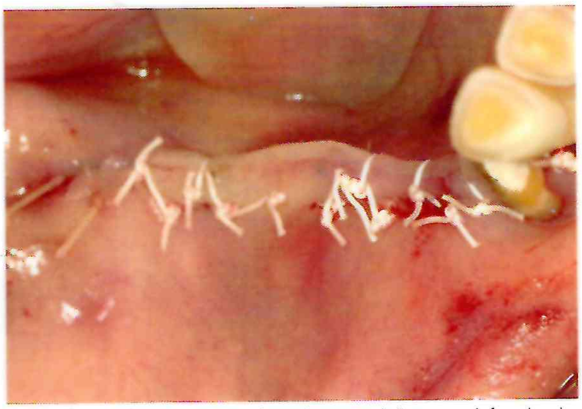


Fig 9-2h The flaps are sutured in place, and the site is left to heal.

Fig 9-2i The visible bump after 5 months of healing indicates that some resorption has taken place around one of the screw heads.

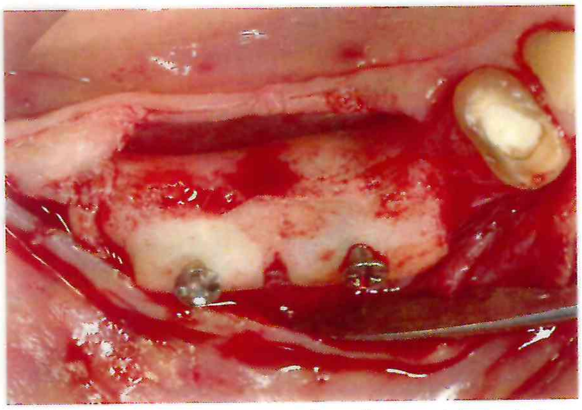


Fig 9-2j A midcrestal incision is performed to reveal the healed graft and minor resorption.

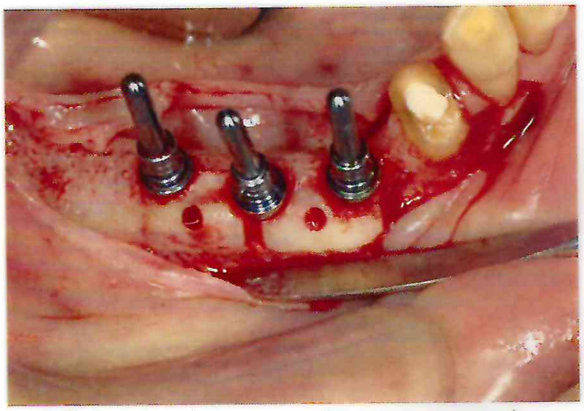


Fig 9-2k Direction indicators are used to ensure correct implant positioning.

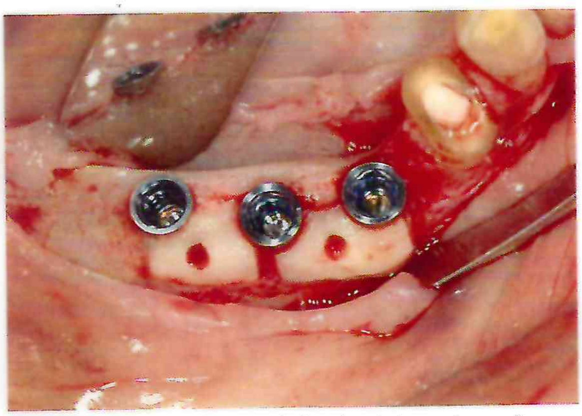


Fig 9-2l Implants are placed with their heads located partially above crest level.

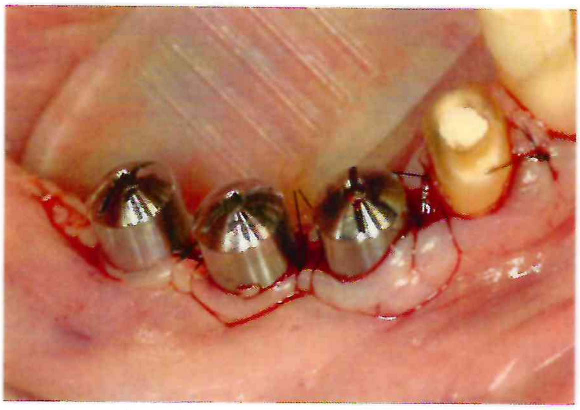


Fig 9-2m Healing abutments in place with sutured flaps.

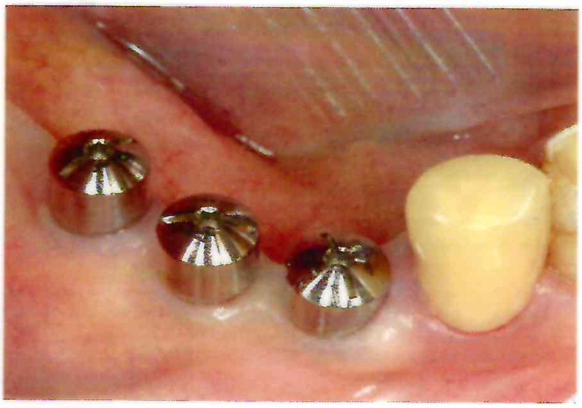


Fig 9-2n View of the healed site 2 months later.

Fig 9-2o Fourth healing abutment in place after extraction of the canine and immediate placement of another implant.

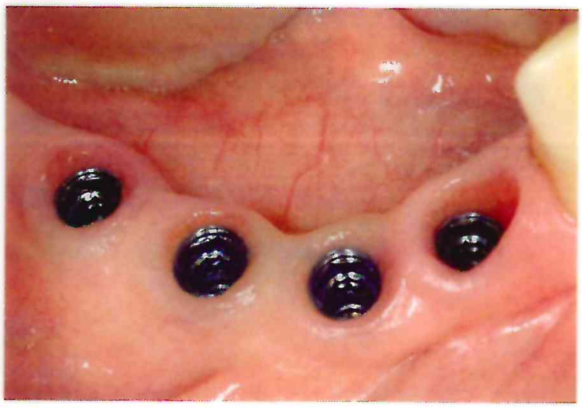


Fig 9-2p The peri-abutment soft tissues are kept clean and healthy.

Fig 9-2q View of the healed site 2 months after implant placement at the site of the canine.

Fig 9-2r Customized abutments are attached to the implants for the definitive restoration.

Fig 9-2s The metal substructure is checked.

Fig 9-2t Definitive metal-ceramic restoration in place.

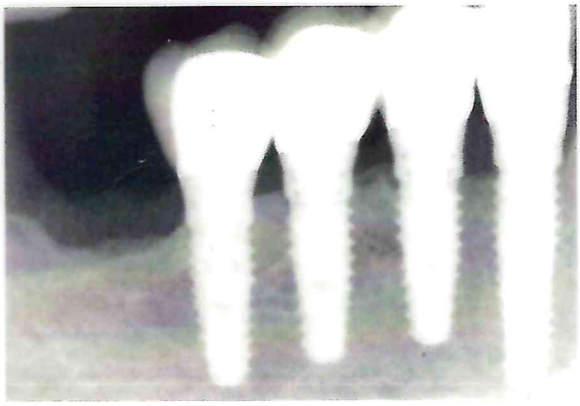
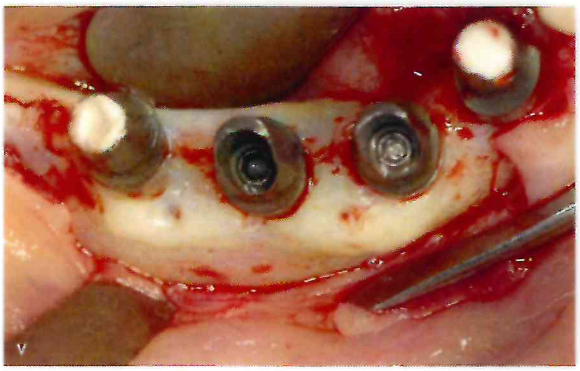


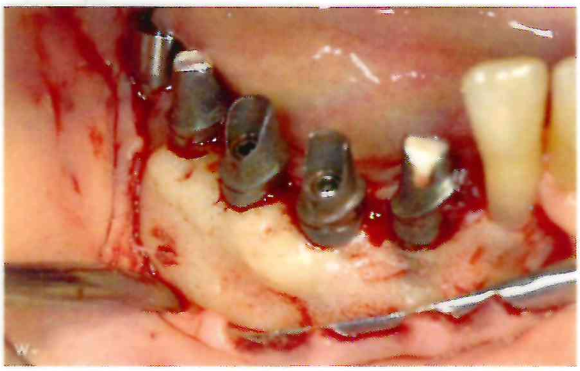
Fig 9-2u The final radiograph shows solid, well-preserved bony profiles.

and calculus removal. Occasionally, the healing caps were removed and the implants and peri-implant mucosa dipped in a disinfecting solution such as povidone iodine or chlorhexidine gluconate.

Two months after the implant for the mandibular right canine was placed, all implant sites demonstrated healthy peri-implant mucosa and adequate bony profiles. Customized anatomic titanium abutments were connected to the implants (Figs 9-2p to 9-2r), and a metal-ceramic FPD was cemented. All implants displayed solid and well-preserved bony profiles (Figs 9-2s to 9-2u).

After the patient was provided with the final fixed prosthesis, she requested an additional implant at the mandibular right second molar site to improve masticatory function. A full-thickness mucoperiosteal flap was elevated to allow adequate access for implant placement and to





Figs 9-2v and 9-2w Two years after bone grafting. Open-flap procedure to place an implant in the second molar site.

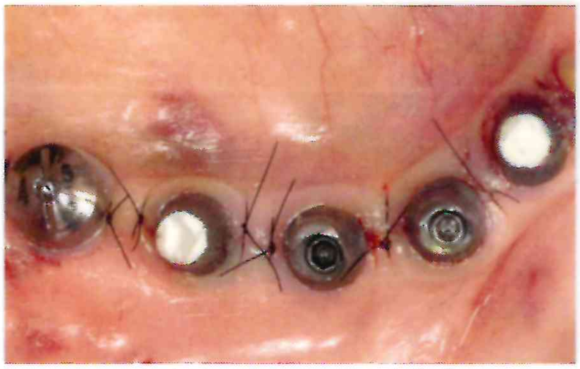
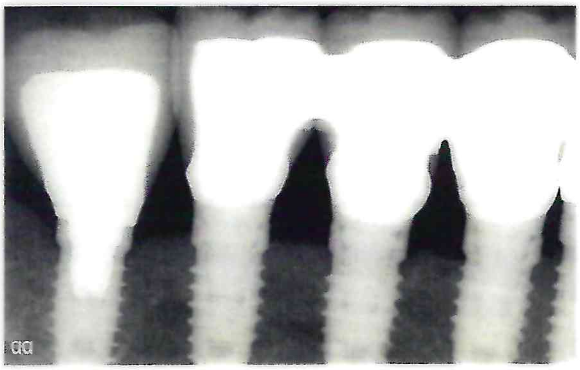


Fig 9-2x Once the healing abutment is placed, the flaps are secured around the abutments with polyamide sutures.

Fig 9-2y One week postoperatively, the tissues have healed, and the sutures can be removed.



Figs 9-2z and 9-2aa Final clinical view and radiograph of restorations showing good esthetics and support. (Restoration by Dr Elie Sawdayee, Tel Aviv, Israel, and Mr Yossi Pinto, Jerusalem, Israel.)

visualize and assess the bone block graft, which at this point had been performed a full 2 years earlier. It was evident that the bone graft had undergone slight remodeling, although no major volumetric changes had occurred except for minimal peri-implant crestal resorption, as is usually expected.

Once the healing abutment was connected to the mandibular second molar implant, the flaps were repositioned and adapted to all abutments by simple interrupted 6-0 monofilament sutures (Figs 9-2v to 9-2x).

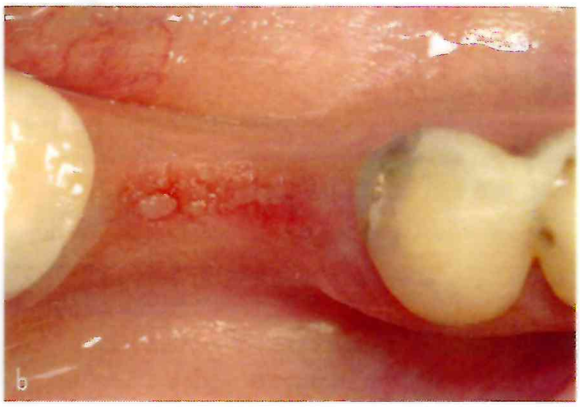
The peri-abutment tissues had healed nicely 1 week postoperatively, and the sutures were removed. Treatment concluded with an additional screw-retained restoration to replace the second molar. Final clinical photographs and radiographs demonstrated healthy peri-implant tissues (Figs 9-2y to 9-2aa).

Case 3: Hard and Soft Tissue Augmentation

Overview

A 43-year-old woman presented with an ill-fitting FPD in the right posterior mandible. A large pontic of a ridge lap design had prevented adequate plaque control and had resulted in thin and inflamed soft tissue at the alveolar ridge (Figs 9-3a and 9-3b). To replace the ill-designed pontic, an implant restoration in the mandibular right first molar site was planned. Due to ridge deficiency at this site, guided bone regeneration with simultaneous implant placement was implemented. It was noted that due to the poor quality of the lining mucosa, membrane coverage by the flaps was inadequate, and indeed, early membrane exposure had occurred. Although bone regeneration around the implant appeared to be successful, a complete loss of keratinized tissue at the buccal aspect of the implant had resulted. Lack of keratinized tissue around an implant restoration may lead to reduced plaque control, decreased resistance to infection, a tendency toward soft tissue recession, and peri-implant bone resorption.

An epithelialized free graft harvested from the palatal masticatory mucosa is relatively easily manipulated and may predictably increase the width of keratinized tissue at the recipient site. Its survival and satisfactory acceptance by the surrounding tissues depends significantly on the presence of a periosteum that is truly vascularized and attached to the bone. In the author's clinical experience, the reconstitution of such a periosteum may take 6 to 9 months post-initiation of the GBR procedure.



Figs 9-3a and 9-3b Clinical view of the fixed partial denture and inflamed tissue at the alveolar ridge.

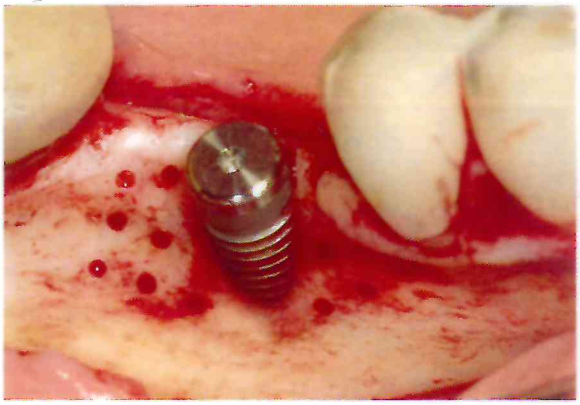


Fig 9-3c Full-thickness flap elevation reveals the exposed buccal side of the implant.

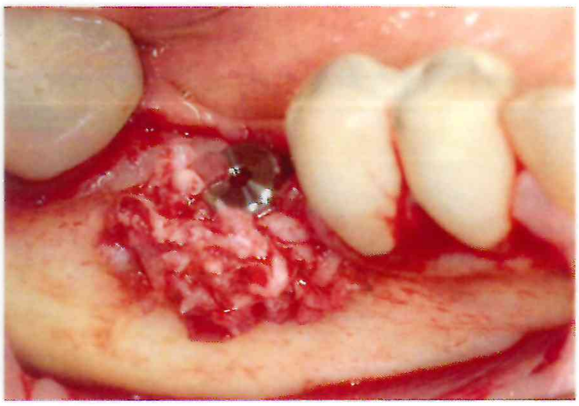


Fig 9-3d Autogenous bone chips are placed over the exposed implant surfaces.

Fig 9-3e Particles of deproteinized bovine bone are added as a second layer.

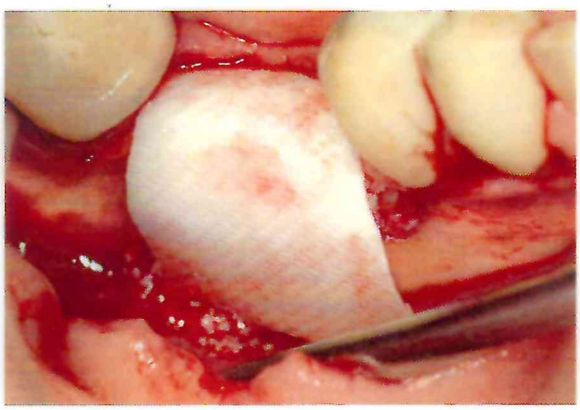


Fig 9-3f A slowly resorbable xenogeneic membrane is trimmed and placed over the layers of grafted bone.

Procedure

A midcrestal incision with a continuous sulcular incision and vertical releasing incision at the mesiobuccal line angle of the mandibular right first premolar facilitated the elevation of full-thickness flaps. This enabled an adequate inspection of the mental foramen so that the full extent of the residual defect could be discovered. Following transcortical penetration and osteotomy preparation, the implant was positioned according to prosthetic standards; however, almost its entire buccal surface remained exposed (Fig 9-3c).

Hard tissue augmentation was performed using the sandwich bone augmentation technique, as follows:

1. Autogenous bone chips, which potentially contained live bone cells, were harvested from the posterior mandible and placed as a first layer adjacent to the implant surface.
2. A second layer, composed of bovine bone mineral, was added to maintain ideal space for the regenerating bone.
3. A xenogeneic, slowly resorbable membrane was layered on top of the bone graft materials to isolate them from soft tissue elements. This particular membrane was preferred in this case because of its ability to resist infection even if exposed prematurely to the oral environment (Figs 9-3d to 9-3f).

Indeed, the poor quality of the covering mucosa dictated a complicated flap management procedure and suturing (Fig 9-3g) and, as expected, 1 week later some tissue sloughing occurred, resulting in minor membrane exposure. A meticulous maintenance program served as a safeguard to prevent contamination of the membrane, although part of the membrane over the cover screw had evidently been prematurely lost, leaving the cover screw completely exposed. This resulted in a very narrow band of keratinized mucosa on the buccal aspect of the implant (Figs 9-3h and 9-3i).

In an attempt to increase the width of keratinized mucosa, a free gingival graft procedure was performed 8 months after the augmentation procedure. Along with a horizontal incision placed immediately buccal to the cover screw, two vertical releasing incisions enabled a split-thickness miniflap elevation that left the periosteum attached to the regenerated bone. (A properly organized periosteum is necessary for soft tissue graft suturing and its initial revascularization. The periosteum is likely to be well reestablished and attached to highly vascularized bone that was regenerated via a GBR procedure. This is contrary to poorly vascularized grafted bone blocks on which periosteal-like tissue reformation is not predictable, even a few years postoperatively). The graft was accurately positioned and held in place by four simple sutures, and a

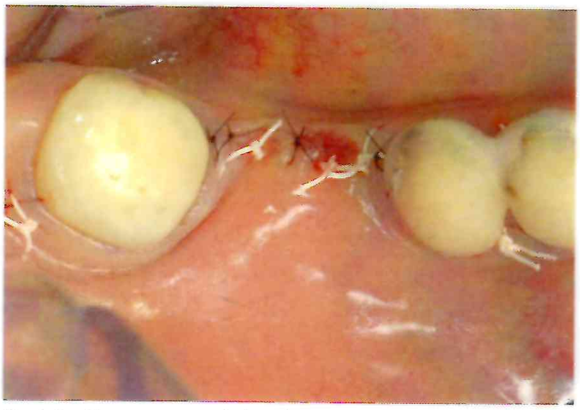


Fig 9-3g Flaps are sutured closed over the bone graft materials.

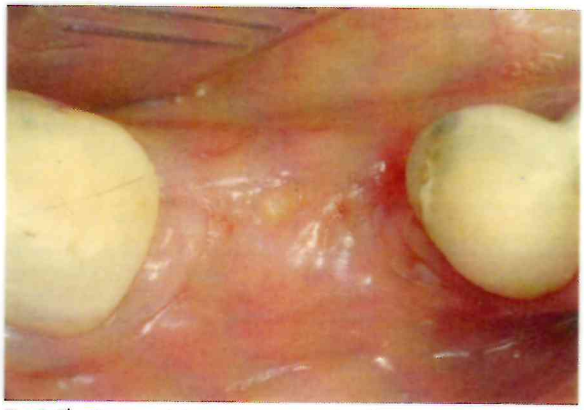


Fig 9-3h One week later, some tissue sloughing is evident.

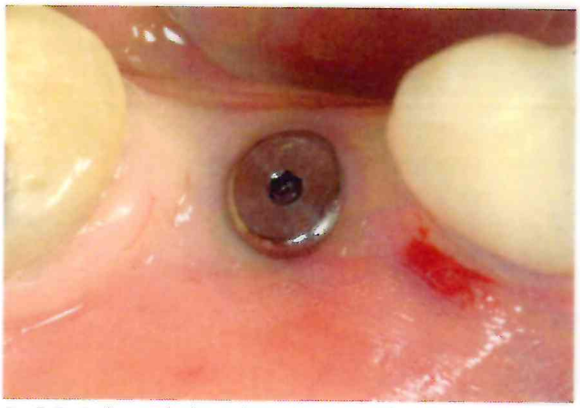


Fig 9-3i Eight months later, the coverscrew is found completely exposed with an inadequate narrow band of keratinized mucosa at the buccal aspect.

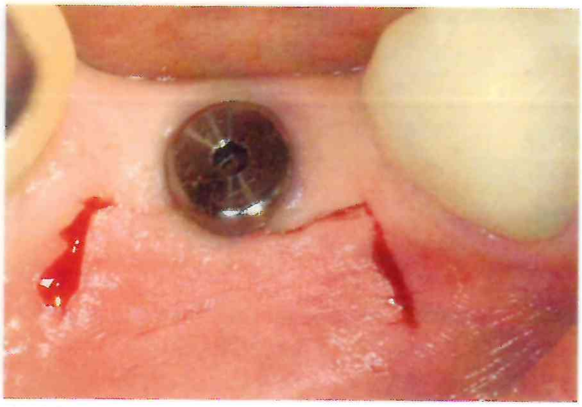


Fig 9-3j Two vertical incisions connected with a horizontal incision are made.

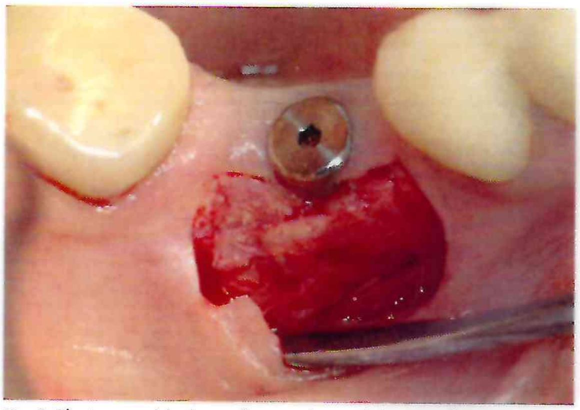


Fig 9-3k A partial-thickness flap is elevated, leaving the periosteum over the newly regenerated bone.

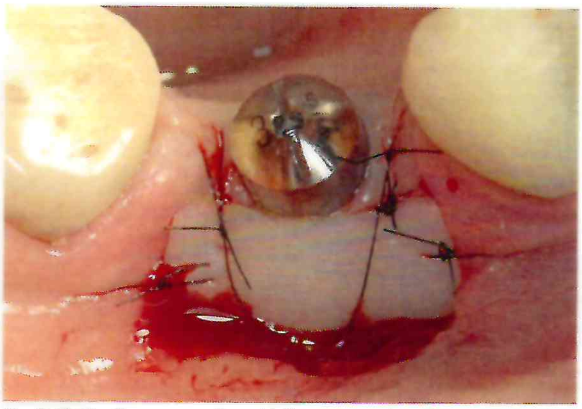


Fig 9-3l The flap is cut off and a free gingival graft adapted to the recipient site with sutures.

Fig 9-3m Clinical view of graft 4 weeks postoperatively.

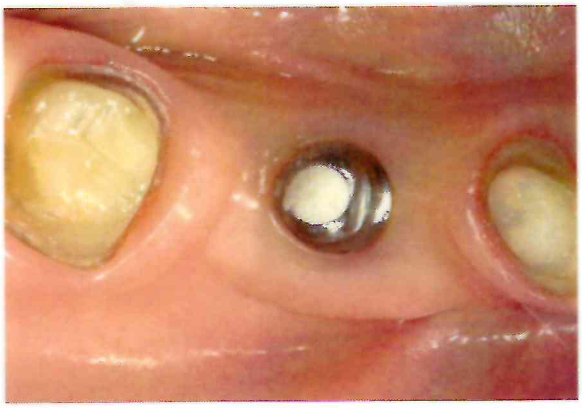


Fig 9-3n After 3 months of healing, the prosthetic abutment is placed.

Fig 9-3o An acrylic provisional crown is cemented. A slight exposure of the implant head is noted.

circumferential periosteal suture was added to enhance the stabilization and adaptation of the graft (Figs 9-3j to 9-3l).

Four weeks later, the graft was almost completely keratinized (Fig 9-3m). After increased maturation and keratinization was observed 3 months post–graft placement, a titanium abutment with a provisional crown was connected to the implant. Minor recession of the soft tissue was noted. The minimal exposure of the implant head that resulted had negligible functional or esthetic implications (Figs 9-3n and 9-3o). Approximately 9 months after grafting of the soft tissue, no further significant radiographic or clinical changes had occurred, and a metal-ceramic crown was cemented (Figs 9-3p and 9-3q).

Fig 9-3p Clinical view of the definitive restoration. (Restoration by Dr Joseph Azuelos, Tel-Aviv, Israel, and Mr Alex Copitt, Tel-Aviv., Israel.)

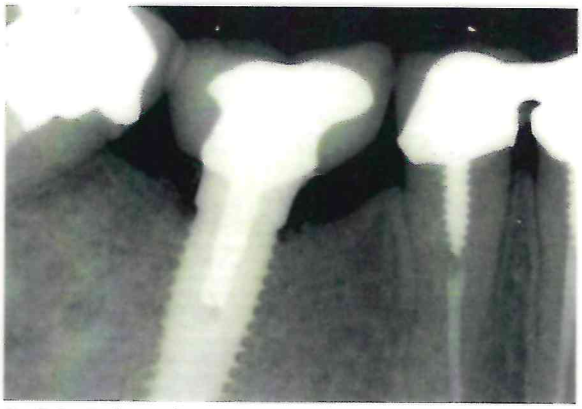


Fig 9-3q Radiographic appearance of the implant and surrounding bone.

Case 4: Split-Thickness Free Gingival Graft

Overview

A 61-year-old man presented to the office with a request to restore the right mandibular area with an implant-supported restoration. The central challenge here was the lack of adequate width of keratinized tissue presenting at the crest of the ridge, which could lead to implant restorations surrounded by nonkeratinized soft tissue. As noted in Case 3, a lack of keratinized tissue around an implant restoration may lead to reduced plaque control, decreased resistance to infection, a tendency toward soft tissue recession, and peri-implant bone resorption.

Keratinized tissue width can be relatively easily gained with an epithelialized mucosal graft, which should be performed prior to dental implant placement. This may allow the preservation of an adequate band of keratinized tissue in both buccal and lingual flaps during the implant surgery.

(A significant point to consider: Contrary to the present case, in bone augmentation procedures, the inclusion of previously grafted, thick, scar-like, keratinized tissue in the flaps may eventually lead to failure of the approximated flaps to fully unite. This may result from the decreased vascularized surfaces of the abutting flap margins. In such cases it might prove advantageous to maintain only a thin band of keratinized tissue in the flaps and perform the soft tissue grafting after the bone regeneration process has been completed.)

Procedure

The alveolar ridge at the site where the implants were to be placed was slightly horizontally resorbed but maintained sufficient width to allow