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DEDICATION

The authors would like to dedicate this book to Dr. Ricardo Teles. Dr. Teles was an excellent periodontist, an inspiring teacher, and a gifted clinical scientist. In fact, he was a teacher, mentor, colleague, and friend to many of the contributors to this publication. His charisma, passion, brilliance, and enthusiasm were at the core of his excellence.

Ricardo loved teaching periodontology and considered the students his colleagues, just with less experience, and was genuinely happy with the success of his students and peers. He really wanted to make an impact in the field and ultimately improve the way we treat patients. And he wanted to do that by better understanding the biology of periodontal diseases and shaping the next generation of periodontists. We hope that this book bring us one step closer to his goals.

Flavia Teles

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1

Examination and Diagnosis

† Deceased

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Case 1

Examination and Documentation

CASE STORY

A 44-year-old Caucasian female presented with chief concern "I have pain on my upper left molar, which has gradually increased. I would like to fix my gum diseases. I would like to receive dental implants to replace my missing teeth also."

LEARNING GOALS AND OBJECTIVES

- The patient's chief complaint
- Medical and dental history
- Soft tissue and gingival examination
- Periodontal charting
- Radiographic interpretations
- Periodontal diagnosis

Medical History

- ASA classification 1
- Vital signs: blood pressure 130/80 mmHg
- Medication: none
- Supplement: daily multivitamin
- Allergy: none

Dental History

- The patient brushed three times daily and flosses daily.
- The patient had received routine dental prophylaxis at her general dental practitioner's office. Recently, the patient underwent extraction of her mandibular left first and second molars due to severe periodontal disease, and she would like to replace them with dental implants.
- The patient denied any smoking habit and had never smoked.
- The patient's father suffered from periodontal disease and ended up receiving complete maxillary and mandibular removable dentures.
- Patient was extremely motivated for dental treatment.

Soft Tissue and Gingival Examination

Extraoral examination did not reveal any significant findings. Intraorally, generalized gingival edema and erythema were noted (Figure 1.1.1), which were more pronounced on #3 buccal, #8 buccal, #8 palatal, interproximal papilla between #8 and #9, interproximal papilla between #9 and #10, buccal gingival margin and interproximal papillae in mandibular incisors; rolled buccal gingival margins were noted on #3 mesiobuccal and #8 mesiobuccal aspect.

Comprehensive Periodontal Examination

A comprehensive periodontal examination (Figure 1.1.2) revealed localized deep probing depths of 10–12 mm on tooth #3 mesial aspect with grade I mobility and grade II mesiopalatal furcation involvement. Tooth #14 exhibited localized deep probing depths of 7 mm on its distal aspect with grade II distopalatal furcation involvement. Teeth #2, #8, #10, and #15 also exhibited localized probing depths of 5 mm. Teeth #2 and #15 exhibited Class I mesiopalatal furcation involvement. Otherwise, the remaining dentitions exhibited generalized probing depths of 1–4 mm. There was generalized bleeding on probing. Furthermore, localized areas with gingival recession were noted in some posterior teeth.

Figure 1.1.1 Complete series of intraoral photographs.

is ~0.2% in Caucasian populations and ~2% in those of African descent [15,16]. Molar/incisor pattern periodontitis may also start in the primary dentition [17,18]. The proportion of affected males and females is similar [19,20].

F. Nonmotile Gram-negative anaerobic rods such as *A. actinomycetemcomitans, P. gingivalis* [21–24], and red and some orange complex species [25] are the most numerous and prevalent periodontal pathogens in molar/incisor pattern periodontitis and are present in most of the diseased sites compared to healthy sites. The microbiomes of molar/incisor pattern periodontitis may vary among different ethnic groups, but *A. actinomycetemcomitans* (especially serotype b) was found in higher numbers and frequency, at least in the early stage, when compared with other pathogens [21,26]. *Aggregatibacter actinomycetemcomitans* produces a leukotoxin that affects the antibacterial function of neutrophils. The heightened antibody responses to *A. actinomycetemcomitans* may also be responsible for the localized periodontal destruction [27].

The exact reason why the disease is localized to first molars and incisors with such early onset in young adults is still debatable. However, those young patients' hormonal changes and the fact that the first molars and incisors are the first permanent teeth to erupt may alter the microbial environment in some unique way that causes the periodontal destruction [14].

G. The general treatment methods should be similar to those used for periodontitis, including oral hygiene instruction/reinforcement, plaque control, scaling and root planing, and occlusal adjustment (if necessary).

Additional treatments that may be required in certain patients include the following.

- General medical evaluation to determine the presence of any systemic diseases. Consultation with the physician may be indicated.
- Counseling of family members.
- Adjunctive use of amoxicillin combined with metronidazole [28]. Tetracycline is contraindicated in young patients due to the problem of tooth staining. Systemic administration of amoxicillin 500 mg plus metronidazole 250 mg three times daily for seven days with maintenance every three months resulted in significant clinical improvement and reduced levels of key periodontal pathogens in the long term [29].
- Periodontal maintenance with short interval may be needed.

Teeth with poor prognosis are usually extracted mostly in phase 1 or sometimes phase 2 of periodontal therapy. Most of the intrabony defects that result from molar/incisor pattern periodontitis and that are amenable to regeneration are surgically treated using either guided tissue regeneration (GTR) [30] or enamel matrix derivative (EMD) with xenografts/allografts [31,32] (Figure 1.5.9). See the appropriate chapters in this textbook for more details on these surgical techniques. Limited studies have shown that the adjunctive use of local subgingival antimicrobials does not result in additional improvement of clinical parameters.

H. Scaling and root planing in combination with amoxicillin 375 mg and metronidazole 250 mg (t.i.d. for seven days) in patients with *A. actinomycetemcomitans*-associated periodontitis improved clinical parameters and suppressed A. actinomycetemcomitans below cultivable levels in most of the patients for up to two years with supportive periodontal therapy once every three to six

Figure 1.5.9 Classical intrabony defect affecting a mandibular first molar in another patient with localized aggressive periodontitis (top left). Guided tissue regeneration (GTR) was performed to regenerate the periodontal defect using bone grating and membrane (top right). Periapical radiographs depict the vertical bony defect before (lower left) and after (lower right) GTR therapy. Significant radiographic bone fill was obtained after GTR therapy.

Figure 1.6.1 Clinical presentation of the case at initial visit. Source: courtesy of Dr. Eduardo Sampaio and Dr. Marcelo Faveri.

Initial Exam

Facial																
PD		8 3 4	5 3 4	7 2 5	4 2 4	4 2 3	5 1 3	3 1 4	4 1 2	3 1 3	4 1 4	4 1 6	5 2 6	6 2 6	6 2 7	
FGM		-2 2 1	1 2 1	-1 1 -1	-1 1 -1	-2 0 0	-1 0 0	0 0 -1	-2 1 1	0 0 0	-1 0 -2	-2 1 -2	-1 1 -2	-2 2 -1	-1 1 -2	
AL		6 5 5	6 5 5	6 3 4	3 3 3	2 2 3	4 1 3	3 1 3	2 2 3	3 1 3	3 1 2	2 2 4	4 3 4	4 4 5	5 3 5	
Bleed		1 1 1	1 1 1	1	1 1	1	1	1	1		1	1 1	1 1 1	1 1 1	1 1 1	
Lingual	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PD		8 2 7	7 2 6	7 2 5	5 2 5	4 3 4	5 4 4	3 2 3	3 3 3	4 3 4	3 3 3	3 2 4	4 2 7	6 3 7	7 3 8	
FGM		-2 0 -2	-2 1 -2	-2 0 -2	-2 0 -2	-2 -1 -1	-1 -1 -1	-1 0 -1	-1 0 0	0 0 -1	-1 0 -1	-1 -1 -1	-1 0 -2	-2 0 -2	-2 -1 -2	
AL		6 2 5	5 3 4	5 2 3	3 2 3	2 2 3	4 3 3	2 2 2	2 3 3	4 3 3	2 3 2	2 1 3	3 2 5	4 3 5	5 2 6	
Bleed		1 1 1	1 1 1	1 1 1	1 1 1	1	1 1 1	1 1 1	1 1 1	1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	
Lingual																
Bleed		1 1 1	1 1 1	1 1 1	1 1 1	1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1	1 1 1	1 1 1	1 1 1	1 1 1	
AL		0 0 4	4 3 3	3 2 2	2 1 0	1 1 2	2 3 4	4 4 4	5 6 6	6 4 3	2 0 1	3 2 3	4 1 3	2 0 4	4 1 0	
FGM		-4 -2 -2	-2 -1 -2	-2 -2 -2	-2 0 -2	-2 0 -1	-1 1 2	2 3 3	3 3 2	2 1 0	-2 -1 -2	-1 0 -2	-2 -2 -2	-2 -2 -2	-2 -2 -2	
PD		4 2 6	6 4 5	5 4 4	4 1 2	3 1 3	3 2 2	2 1 1	2 3 4	4 3 3	4 1 3	4 2 5	6 3 5	4 2 6	6 3 2	
Facial	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Bleed		1 1	1 1	1									1 1	1 1	1 1	
AL		0 2 1	3 2 3	2 1 2	1 3 1	2 1 2	2 1 3	3 1 4	4 1 4	2 1 1	0 1 1	1 2 0	1 2 1	1 1 2	2 2 1	
FGM		-3 0 -2	-2 1 0	-1 0 -1	0 2 -1	0 0 1	1 0 2	2 0 2	2 0 2	1 0 0	-1 0 0	0 1 -1	-1 1 -1	-1 0 -1	-1 1 -2	
PD		3 2 3	5 1 3	3 1 3	1 1 2	2 1 1	1 1 1	1 1 2	2 1 2	1 1 1	1 1 1	1 1 1	2 1 2	2 1 3	3 1 3	

Figure 1.6.2 Periodontal chart at initial visit. Source: courtesy of Dr. Eduardo Sampaio and Dr. Marcelo Faveri.

Figure 1.8.1 Clinical examination.

Figure 1.8.5 Follow-up views six weeks post treatment.

tissue is modest, while for others the contribution is not supported by clear evidence [6].

Although there is moderate evidence showing a reduction of hyperglycemia in uncontrolled type 2 diabetes following periodontal treatment, there is insufficient evidence to support the converse view [7–9]. However, there is evidence that periodontitis can negatively affect glycemic control in diabetes mellitus, supporting the bidirectional relationship between the two diseases [10].

Patients with diabetes should be informed that they are at increased risk of periodontitis. If they are affected by periodontal disease, their glycemic control may be more difficult and they are at higher risk for other complications like cardiovascular and kidney disease. Of all the clinical features of diabetes mellitus, chronic hyperglycemia has attracted the most attention because of its direct and indirect influences on the development of periodontal disease [6]. The pronounced inflammation and elevated production of inflammation-related end products in patients with hyperglycemia has been linked with a variety of systemic inflammatory diseases, including periodontitis [11–13]. The hyperinflammation elevates the release of proinflammatory cytokines, giving rise to changes in the host response to bacterial invasion and wound healing impairment in the oral cavity [13]. The accumulation of advanced glycation end products (AGEs) and of their binding receptor (RAGE) have been highlighted for their potential role in hyperglycemia-related complications [14]. Patients with periodontal disease manifest higher levels of circulating AGEs and expression of RAGE, leading to triggered production of interleukin (IL)-1, IL-6, and tumor necrosis factor (TNF)-α [15]. However, all these findings should be interpreted with caution because of other confounding systemic diseases, including obesity and hypertension [12].

The most important step is to diagnose both systemic diseases and treat them concurrently. Uncontrolled diabetes is associated with increased progression of periodontitis [16]. Early diagnosis of diabetes can reduce the risk of complications. A good relationship with the patient's PCP or endocrinologist needs to be established to monitor the patient from both the dental and medical point of view. The patient needs to be motivated with oral hygiene maneuvers as well as diet counseling and habit

Figure 1.9.4 Full-mouth series taken a year prior to initial evaluation.

Figure 1.9.5 Panoramic radiograph taken six years previously.

and subgingival calculus was removed using hand scalers and curettes. All exposed tooth surfaces were polished. Home care was reviewed and reinforced with the patient, along with a demonstration of appropriate brushing and flossing techniques.

At two-month reevaluation, a gingival flap was raised in the lower right quadrant to provide open access and debridement of subgingival calculus for the purpose of pocket reduction, followed by the same procedure in the lower left quadrant at four-month reevaluation. Both quadrants healed without incident.

Currently the patient is wearing an occlusal guard to control his parafunctional habit (bruxism). Extraction of tooth #2 was recommended due to severe distal bone

loss. Sinus augmentation for implant treatment planning for site #3 was recommended.

Cone-beam computed tomography (CBCT) scan of the maxilla (Figures 1.9.6–1.9.9) was used to evaluate the edentulous site #3. Findings from the CBCT data included generalized mild to moderate periodontal bone loss with localized severe periodontal bone loss associated with teeth #2, #12, #14 and #15; severe disuse atrophy of edentulous site was noted in the scan.

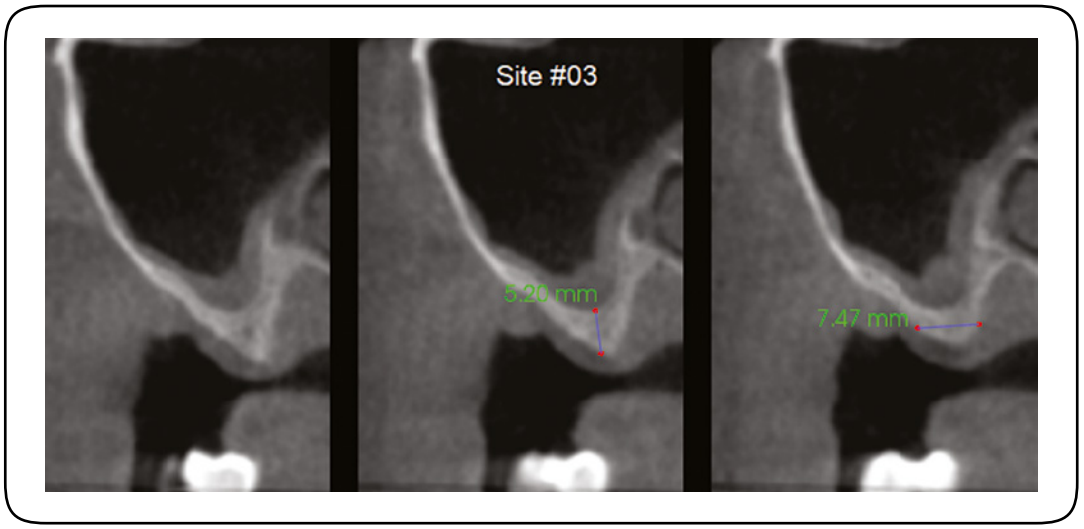


Figure 1.9.6 Cross-sections of severe disuse atrophy (Siebert Class III defect) of edentulous site #3.

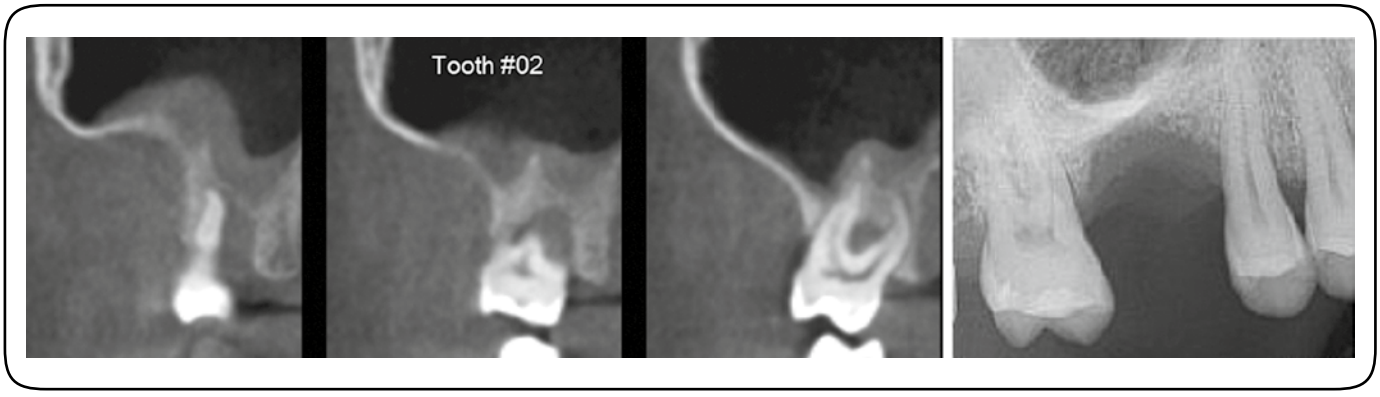


Figure 1.9.7 Comparison of cross-sections from CBCT and periapical radiographs: angular bone loss of tooth #2.

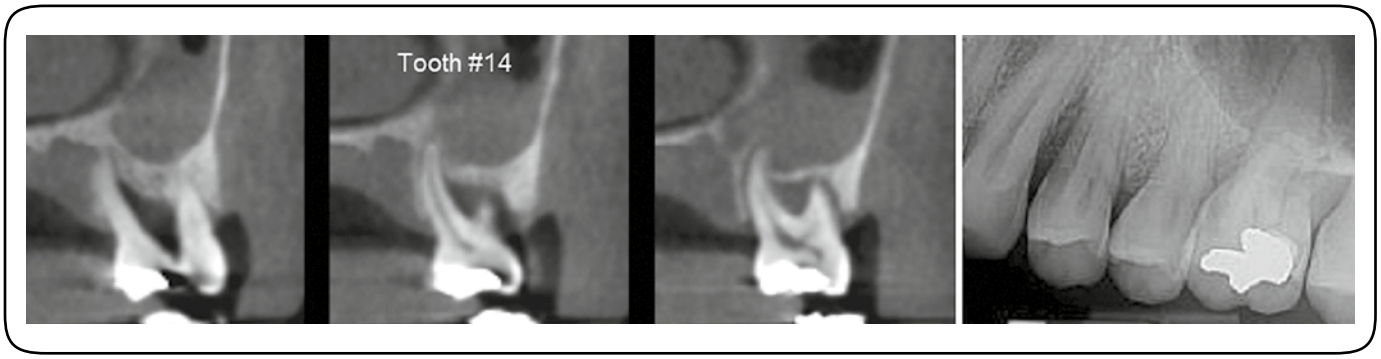


Figure 1.9.8 Comparison of cross-sections from CBCT and periapical radiographs: angular bone loss of tooth #14.

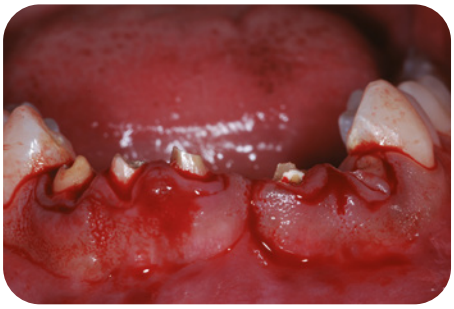


Figure 3.2.10 Submarginal incisions.

Figure 3.2.11 Gingivectomy.

Figure 3.2.12 A full-thickness flap is elevated and cortical bone is exposed.

achieve 2–3 mm of gingivectomy (Figure 3.2.11). Buccal and lingual full-thickness flaps were elevated beyond the mucogingival junction to expose the cortical bone of the mandibular anterior sextant (Figure 3.2.12). Ostectomy was carried out to expose at least 4 mm of sound tooth structure above the crestal bone and allow for 2 mm of biologic width and at least 1.5 mm of ferrule. Osteoplasty allowed the removal of widow's peaks, ledges, and bony irregularities (Figure 3.2.13). Odontoplasty was performed as needed when the embrasure space was too narrow (Figures 3.2.14 and 3.2.15). The buccal and lingual flaps were apically positioned and stabilized with vertical mattress sutures (Figure 3.2.16). The temporary FPD was cemented back (Figure 3.2.17). Postoperative instructions including oral

Figure 3.2.13 Ostectomy and osteoplasty allow a greater exposure of sound tooth structure.

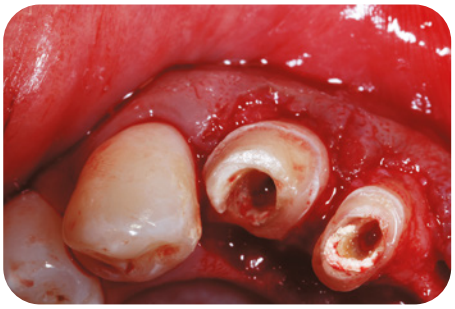


Figure 3.2.14 The embrasure between #21 and #22 is narrow.

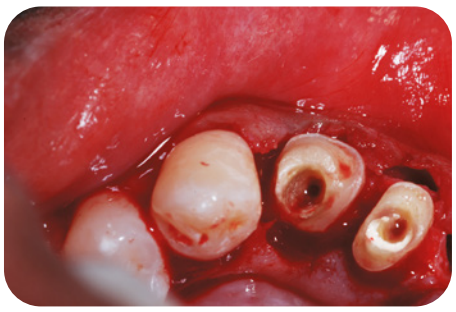


Figure 3.2.15 Odontoplasty of the distal surface of #22 is performed to open the embrasure between #21 and #22.

Figure 3.2.16 The flaps are apically positioned and stabilized with vertical mattress sutures.

Figure 3.3.6 (A–L) Intraoral surgical photos.

The surgery was uneventful. The patient was seen for postoperative visits at one week to remove the sutures and at six weeks. She did not complain of significant postoperative tooth sensitivity that may occur due to the exposure of root cementum. Following three months of healing a permanent acrylic night guard was provided for the patient.

After six months, periapical and bitewing radiographs were taken to assess this region (Figure 3.3.7). Since regenerative periodontal procedures were performed elsewhere, the radiographs allowed us to assess these areas as well (i.e. opposing arch).

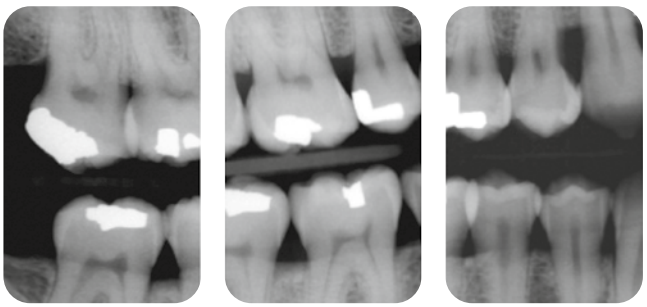


Figure 3.3.7 Vertical bitewings following six months of healing.

Self-Study Questions

A. What is the rationale for performing a FOS?

B. What are the techniques employed?

C. What other procedures are often required at the time of FOS?

D. What are the determinants of success of FOS?

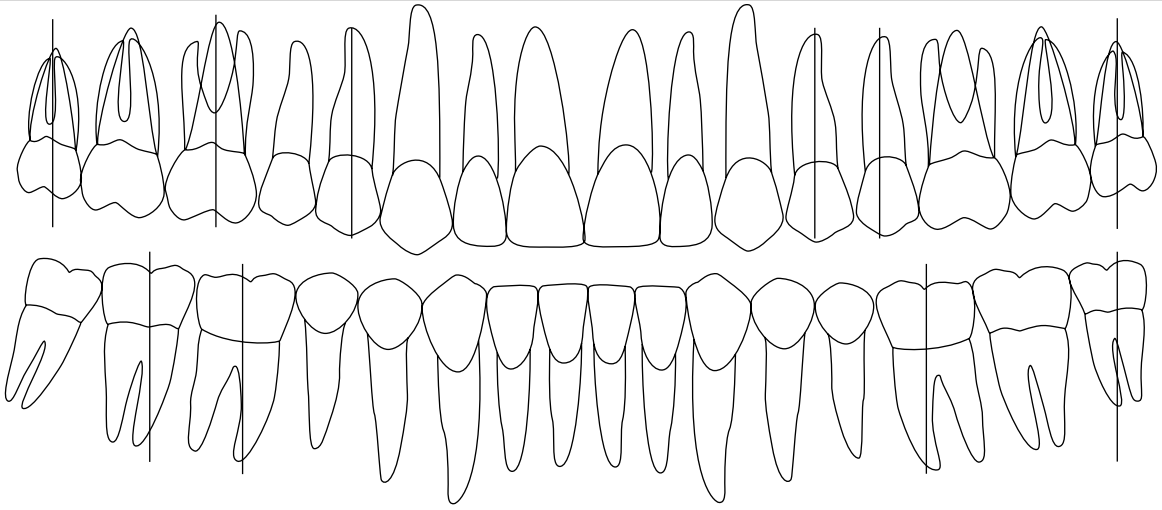
E. What alterations in technique are required due to unique anatomy? How do you manage these?

F. What are the possible major complications associated with FOS? How do you manage these complications?

G. What are the possible minor complications associated with FOS? How do you manage these complications?

Answers located at the end of the chapter.

Buccal	225	223	325	523	222	223	323	324	323	333	
Palatal	223	223	524	323	322	222	323	324	325	522	



Buccal	323	323	423	322	222	222	222	222	323	213	323	323
Lingual	323	322	323	333	212	222	213	213	333	212	223	322

Figure 3.4.1 Periodontal charting.

Figure 3.4.2 Intraoral initial visit. (A) frontal view; (B) maxillary view; (C) mandibular view; (D) right lateral; (E) left lateral.

Radiographic Examination

Figures 3.4.3 and 3.4.4 show part of the radiographic examination.

Diagnosis

Using the 2017 Classification of Periodontal and Peri-Implant Diseases and Conditions, the patient exhibited stage 3, grade B periodontitis, recession Cairo type 2 and type 3 (RT2, RT3) defects, and evidence of occlusal trauma (attrition and wear facets). Tooth #14 exhibited an over-contoured crown.

Treatment Plan

Additional consultations were as follows

1. Consultation with the patient's general dentist regarding general restorative needs and specifically the restoration of tooth #14 following root resection therapy.
2. Endodontic evaluation of tooth #14 to confirm the integrity of the existing root canal therapy.

Figure 5.3.11 (A, B) FGG after implant placement, but prior to implant restorations to re-create lost attached gingiva and deepen the vestibule.

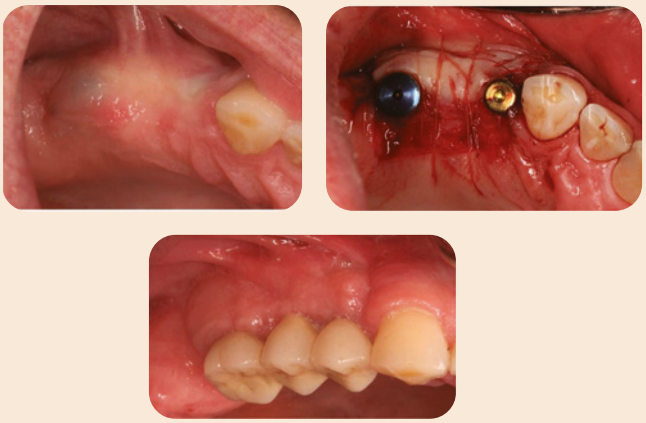


Figure 5.3.12 Epithelio-connective tissue palatal pedicle graft performed during second-stage implant: preoperative, immediate, and five-month postoperative photographs.

In general, the best area to harvest keratinized tissue for grafting is the hard palate. Because of anatomic constraints, this tissue could be limited (H). To date, reconstruction of a lost interdental papilla could not be achieved with an FGG.

G. In the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions [24], recession defects were classified using the system delineated by Cairo et al. [6].

- Recession type 1 (RT1): recession with no loss of interproximal attachment. Interproximal CEJ is clinically not detectable on the mesial and distal aspects of the tooth; 100% root coverage can be achieved (Figure 5.3.15).

Figure 5.3.13 Connective tissue used as a free graft. (A) Recession associated with mucogingival involvement on the buccal of #23–26. (B) Recipient site prepared. (C) Connective tissue harvested from palate and used as a free graft; 2–3 mm of margin of keratinized tissue. (D) Harvest site on palate sutured. (E) Suturing of graft to recipient site. (F) Healing with keratinization and significant root coverage.

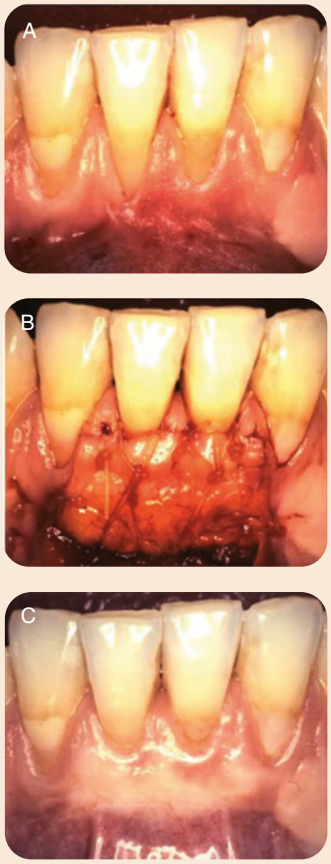


Figure 5.3.14 Connective tissue used as a free graft. (A) Recession associated with mucogingival involvement on the buccal of #24 and #25. (B) Connective tissue harvested from palate and used as a free graft. (C) Healing with keratinization and significant root coverage. Note the approximately 40% shrinkage of the vertical height of the graft but minimal horizontal shrinkage.

- Recession type 2 (RT2): gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the depth of the interproximal sulcus/pocket) is less than or equal to the buccal attachment loss (measured from the buccal CEJ to the depth of the sulcus/pocket). Full root coverage may be possible but presently not predictable.
- Recession type 3 (RT3): gingival recession associated with loss of interproximal attachment greater than the buccal attachment loss. Full root coverage is not possible.

The above classification has replaced the Miller classification [5] of marginal tissue recession

Figure 5.3.15 Root coverage with FGG. (A) Recession and mucogingival involvement #24 and #25. (B) Site healed at eight weeks with root coverage, and elimination of mucogingival defect.

which has been in use since 1985 and is outlined below.

- Class 1: recession does not extend to mucogingival junction, no interdental bone or soft tissue loss; 100% coverage expected.
- Class 2: recession to or beyond mucogingival junction but no interdental bone or soft tissue loss; 100% coverage anticipated.
- Class 3: recession extends to or beyond mucogingival junction; loss of interdental bone or soft tissue, apical to the CEJ but coronal to the level of the recession defect; partial root coverage anticipated.
- Class 4: recession extends to or beyond mucogingival junction with loss of interdental bone or soft tissue apical to the level of the recession defect; no root coverage can be anticipated.

H. The surgeon must be completely familiar with the anatomy of the palatal donor as well as recipient sites for appropriate surgical treatment. Reiser et al. [25] found variations in the size and shape of the hard palate and identified the average location of the neurovascular bundle from the CEJ of the maxillary premolars and molars to vary with the palatal height:

- High palatal vault to 17 mm
- Average palatal vault to 12 mm
- Shallow palatal vault to 7 mm

Additionally, the same authors using cadaver dissection demonstrated that the surgeon can gain substantial donor tissue thickness in the area from the mesial line angle of the palatal root of the first molar to the distal line angle of the canine. Palatal

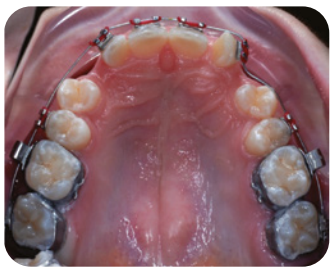
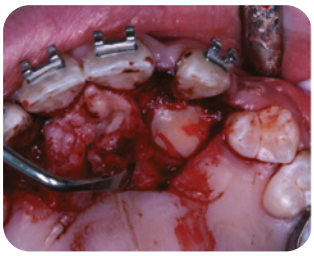


Figure 6.3.8 Start of orthodontic treatment.

Figure 6.3.9 Four weeks later.



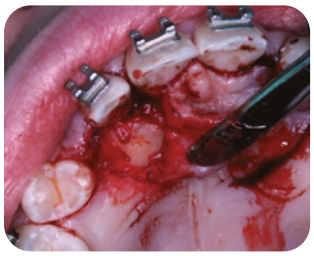


Figure 6.3.10 Canine exposure.

Figure 6.3.11 Gold chains attached to exposed canines.

buttons were bonded to the exposed canines, and gold chains were attached to these buttons. The free ends of the gold chains were then ligated to the maxillary archwire. The exposure site was then covered with a periodontal pack (Figures 6.3.10–6.3.15).

Four weeks after exposure of the maxillary arch canines, the mandibular arch was bonded (Figure 6.3.16). Three weeks after the mandibular arch was bonded, the maxillary first premolars were extracted. Following the extractions, the patient was

Figure 6.3.12 Gold chains ligated to the maxillary archwires.

Figure 6.3.13 Periodontal pack placed over the exposure.

Figure 6.3.14 One-week follow-up.

Figure 6.3.15 Two-week follow-up.

seen periodically at four-week intervals and the maxillary canines were retracted into the premolar extraction space using power chains. The orthodontic treatment mechanics to align and level in the mandibular arches were continued simultaneously. Periodic orthodontic treatment was continued for 16 months, at which point the canines were fully retracted into the extraction space in the maxillary arch (Figure 6.3.17).

The next step in orthodontic treatment would be to retract the maxillary anterior segment (lateral incisor to lateral incisor) to obtain class I canine occlusion and good intercuspation of the buccal occlusion. This would then be followed by finishing and retention phases.

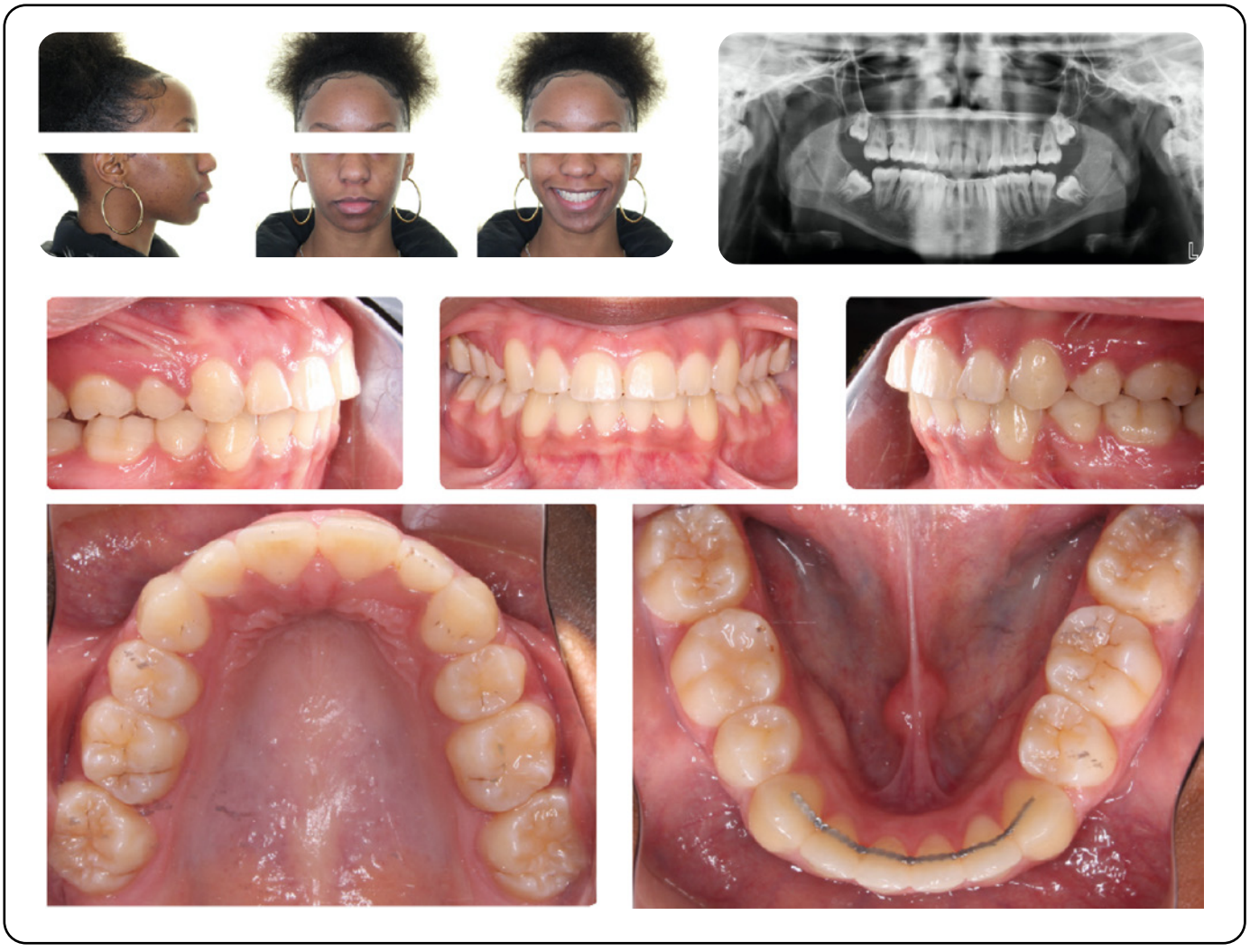


Figure 6.4.5 After orthodontic treatment.

Self-Study Questions

A. What is the influence of tooth movement on the periodontium?

B. What is the relationship between tooth alignment, oral hygiene, and periodontal disease?

C. When should gingival augmentation be considered in a child or adolescent?

D. What are types of bone graft are available and why was a combination used in this case?

E. What are the advantages and disadvantages of using a tunneling procedure in this particular situation?

Answers located at the end of the chapter.

Figure 8.3.4 After extraction, note preservation of buccal plate.

Figure 8.3.5 Pointed trephine to mark implant location precisely.

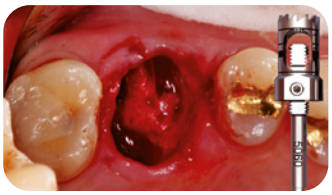


Figure 8.3.6 ASBE trephine to go 1 mm below estimated sinus floor.

Figure 8.3.7 Slow speed is used with ASBE trephine.

Figure 8.3.8 After ASBE trephine.

Figure 8.3.9 Bone core removed.

Figure 8.3.10 Flat diamond bur to expose sinus membrane.

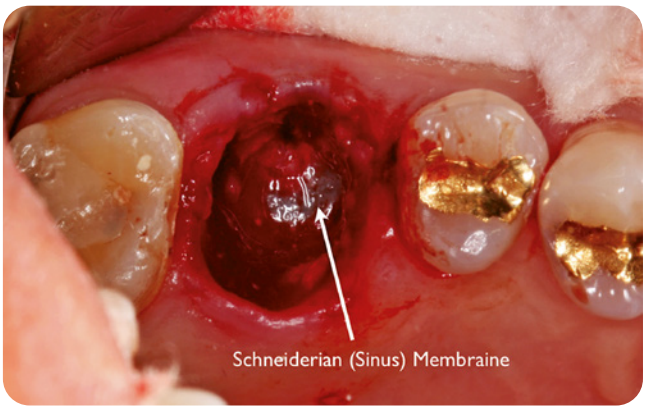


Figure 8.3.11 Sinus membrane exposed.

Figure 8.3.12 Series of mushroom elevators used to detach and elevate sinus membrane.

Figure 8.3.13 Mushroom elevators are also used to make crestal window larger by pulling sinus floor away from membrane.

grind away the sinus floor without perforating the Schneiderian membrane (Figure 8.3.10). Cold saline should be used to clean the socket, visualizing the Schneiderian membrane. The cold temperature reduces blood flow to the socket, thereby improving visibility of the crestal window (Figure 8.3.11). A series of mushroom elevators were used to elevate the sinus membrane (Figure 8.3.12) as well as pry away bony tips from the sinus floor, thus further enlarging the crestal window (Figure 8.3.13). A Cobra instrument was used to further elevate the sinus membrane (Figure 8.3.14), but this

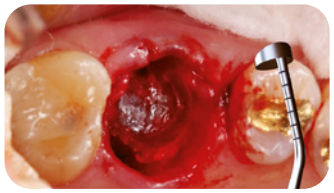


Figure 8.3.14 Cobra instrument is used to further elevate the sinus membrane.

Figure 8.3.15 Movement of sinus membrane is verified to check if membrane perforation has occurred.

Figure 8.3.16 FDBA is introduced to sinus window as well as to socket.

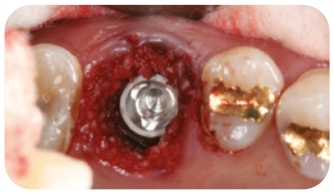


Figure 8.3.17 Implant, MegaGen Rescue 6.5 × 10 mm is placed slowly.

step can usually be skipped if the sinus membrane is thick (white color). The patient was asked to breathe in and out via her nose to verify that the membrane was not torn (Figure 8.3.15). An intact membrane moves up and down, whereas expelled air can be detected with a perforated membrane. Then, 1.5 ml of freeze-dried bone allograft (FDBA) was packed into the sinus and around the socket (Figure 8.3.16). A wide-diameter implant (MegaGen Rescue Implant 6.5 × 10 mm) was inserted slowly with good initial stability (>20 N·cm) (Figure 8.3.17). If poor initial stability is achieved, then a greater diameter implant insertion is recommended (e.g. 7.0 or 7.5 mm). A super-wide diameter healing abutment is used to seal the socket (Figure 8.3.18) to retain the bone graft material and to achieve primary closure.

Figure 8.3.18 An 8-03 healing abutment is placed to seal the socket and retain bone graft material.

Figure 8.3.19 A 4-0 gut suture is used to further tighten and seal the socket to prevent loss of blood clot and bone graft materials.

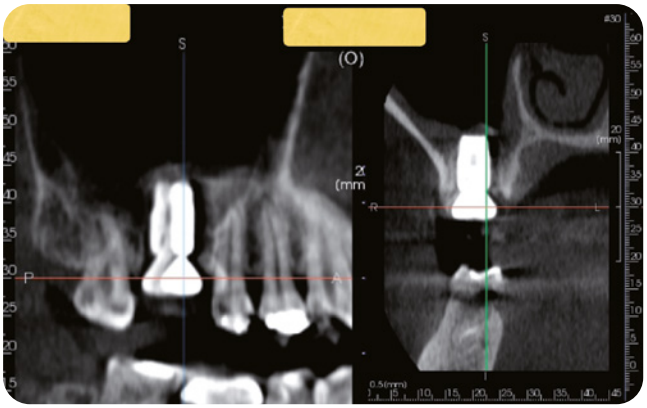


Figure 8.3.20 Postoperative CT scan showing bone graft intact under the Schneiderian membrane.

Simple interrupted sutures or continuous locking sutures are recommended with 4-0 gut chromic to further tighten and seal the socket (Figure 8.3.19). A postoperative radiograph should be taken to verify that bone graft material is retained below the Schneiderian membrane (Figure 8.3.20).

Discussion

As mentioned earlier, most crestal approaches are "blind" techniques. In contrast, this technique is not a blind technique [1]. It is especially useful in extraction of multirooted teeth, because elevation of the sinus can be achieved via the socket without laying any flap.

The average buccolingual dimension of a molar tooth is 11 mm. Therefore, the crestal approach can be done with a 5- to 6-mm window via the septum of the molar

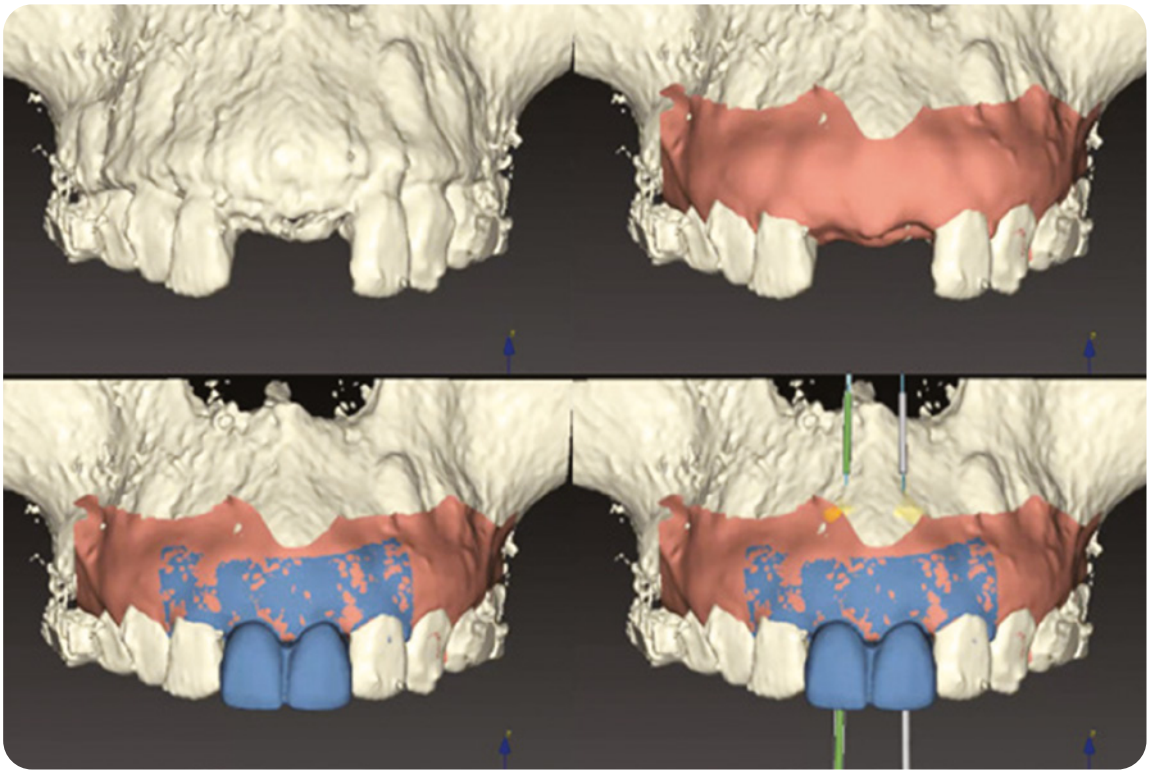


Figure 8.4.5 Digital implant planning after import of all files into planning software. STL file from intraoral scanning of the partially edentulous patient superimposed on the DICOM file and the STL file from scanned wax-up.

Imaging and Communication in Medicine) file generated from the CBCT scanning were imported into a commercially available planning software (Nobel Clinician; Nobel Biocare, Kloten, Switzerland) and superimposed for digital implant planning (Figure 8.4.5) [1].

After digital implant planning was completed, a stereolithographic surgical template was fabricated and two implants were planned to replace the two missing maxillary central incisors (Figure 8.4.6).

Figure 8.4.6 Stereolithographic surgical template in place (occlusal view).

On the day of implant placement, after obtaining profound anesthesia at the surgical site using local anesthetic solution, osteotomy drilling was performed through the surgical template guided by the metal sleeves. After osteotomy preparation, two moderately rough surface dental implants (NP Nobel Replace Conical Connection; Nobel Biocare) were placed in a flapless approach with tissue punches (Figure 8.4.7). Implant

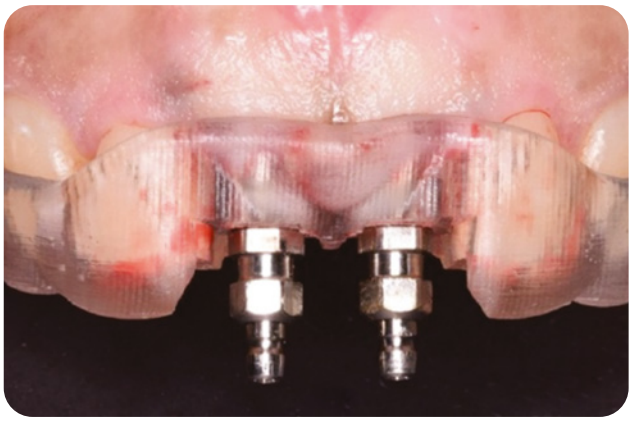


Figure 8.4.7 Implant placement in an ideal prosthetically driven position with a flapless approach due to sufficient keratinized mucosa.