# Advances in Periodontal Surgery

## A Clinical Guide to Techniques and Interdisciplinary Approaches

Salvador Nares
*Editor*

Springer

EXTRAS ONLINE

# Advances in Periodontal Surgery

Salvador Nares
Editor

# Advances in Periodontal Surgery

## A Clinical Guide to Techniques and Interdisciplinary Approaches

Springer

*Editor*
Salvador Nares
Department of Periodontics
University of Illinois at Chicago, College Dentistry
Chicago, IL
USA

ISBN 978-3-030-12309-3 ISBN 978-3-030-12310-9 (eBook)
https://doi.org/10.1007/978-3-030-12310-9



This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

Like many aspects of health care, technological innovations in materials science, as well as development of new tools and techniques, drive advances in periodontal therapy. In this volume, I have attempted to provide the reader with a compilation of advanced knowledge of surgical periodontal therapy. In some respects, significant advancements are evident, such as the development of novel tools and surgical techniques for treatment of periodontal and mucogingival defects or as noted by advances in the use of laser energy to treat periodontal and peri-implant diseases. Conversely, other techniques, such as periodontal resective surgery, have changed very little over time. Here, I have compiled works from gifted clinicians specifically geared toward surgical treatment for the periodontal patient.

This volume is divided into five parts, each of which addresses a specific topic. Part I, *Key Considerations of Periodontal Surgery*, discusses patient-driven factors and practical ways both clinicians and patients can incorporate qualitative and quantitative patient information to monitor and self-motivate patients to help improve periodontal outcomes. This is followed by a decision tree-style discussion of resective versus regenerative therapy. This serves as an introduction to Part II, *Resective Techniques of Periodontal Surgery*, and Part III, *Regenerative Techniques of Periodontal Surgery.* Here, the discussion focuses on the use of technology-driven approaches (stem cells, lasers, videoscopes, biomimetics) as well as traditional approaches (resective surgery) in periodontal surgery. Next, Part IV, *Mucogingival and Periodontal Plastic Surgery*, shifts the focus to treatment of periodontal surgery associated with management of soft tissues. Finally, Part V, *Interdisciplinary Management of Periodontal Surgery*, discusses team management of patients requiring orthodontic, endodontic, or restorative dental care. Here, the reader will find useful and practical information related to interdisciplinary care of the periodontal patient.

My sincerest thanks and appreciation to each author for making this volume a reality. Despite the substantial demands of time and talent these experts face on a daily basis, it is humbling to witness their dedication to their craft and willingness to share their knowledge and experience with others.

Chicago, IL, USA — Salvador Nares

# Dedication and Acknowledgment

To Celia, my loving wife. As my late grandfather, Samuel said to me “Son, you hit the jackpot.” Thirty years later, I could not agree with him more. Her love, strength, patience, and understanding shine each and every day we spend together. I could not have asked for a better life companion. Here’s to another 30 years! To my precious daughters Monica, Marissa, and Melinda, gifts from Heaven. How quickly time passes, you’ve each grown into beautiful young ladies! You bring joy and energy and have enriched our lives more than you will ever know. To my parents Carmen and Ruben, who selflessly gave of themselves year after year for my brothers Ruben Jr. and Albert and me. Their smiles, hugs, wisdom, and sage advice are always welcomed and appreciated.

To Drs. Hallmon, Rees, and Iacopino whose patience, guidance, and discipline were and remain greatly appreciated. I could never repay them enough for all they did for me during my years of clinical and scientific training. Thank you.

To my current and former students and residents through the years. To quote Winston S. Churchill “We make a living by what we get. We make a life by what we give.” And although I thought I was the one “giving,” I was truly the one “receiving.” Thanks to these wonderful young women and men for the many smiles, trials, triumphs, and wonderful moments we have spent together. It has been my privilege to witness each of you blossom into talented clinicians and clinician-scientists. Our profession is in great hands going forward.

To all my friends and colleagues in the periodontal and scientific community, your dedication, passion, and ingenuity are truly inspirational.

Finally, I would like to thank the many gifted clinicians for their contributions in making this volume a reality.

# Contents

**Part I Key Considerations of Periodontal Surgery**

**1 The Miller McEntire Periodontal Prognostic Index (i.e., "The Perio Report Card") Usage in Practice** . . . . . 3
Robert A. Levine and Preston Dallas (PD) Miller

**2 Decision Trees in Periodontal Surgery: Resective Versus Regenerative Periodontal Surgery** . . . . . 23
Aniruddh Narvekar, Kevin Wanxin Luan, and Fatemeh Gholami

**Part II Resective Techniques of Periodontal Surgery**

**3 Periodontal Flap Designs for Access and Osseous Surgery** . . . . . 45
Antonio Moretti and Karin Schey

**4 Biologic Shaping in Periodontal Therapy** . . . . . 55
Danny Melker, Alan Rosenfeld, and Salvador Nares

**5 Lasers in Periodontal Surgery** . . . . . 71
Allen S. Honigman and John Sulewski

**Part III Regenerative Techniques of Periodontal Surgery**

**6 Videoscope-Assisted Minimally Invasive Surgery (VMIS) for Bone Regeneration** . . . . . 87
Stephen Harrel

**7 Regeneration of Intrabony Defects Utilizing Stem Cells Allograft** . . . 101
Richard T. Kao and Mark C. Fagan

**8 Management of Furcation Defects** . . . . . 117
Acela A. Martinez Luna and Fatemeh Gholami

**Part IV Mucogingival and Periodontal Plastic Surgery**

**9 Coronally Positioned Flaps and Tunneling** . . . . . 137
Homayoun H. Zadeh and Alfonso Gil

**10 Rationale for Gingival Tissue Augmentation and Vestibuloplasty Around Teeth and Dental Implants** . . . . . 157
Leandro Chambrone, Francisco Salvador Garcia Valenzuela, and Luciano Oliveira

**11 Mucogingival and Periodontal Plastic Surgery: Lateral Sliding Flaps** . . . . . 177
David H. Wong

**Part V Interdisciplinary Management of Periodontal Surgery**

**12 Crown Lengthening and Prosthodontic Considerations** . . . . . 193
E. Dwayne Karateew, Taylor Newman, and Farah Shakir

**13 The Adjunctive Relationship Between Orthodontics and Periodontics** . . . . . 207
Michael Schmerman and Julio Obando

**14 Surgically Facilitated Orthodontic Therapy** . . . . . 223
George A. Mandelaris and Bradley S. DeGroot

**15 Management of Endodontic-Periodontic Lesions** . . . . . 247
Bradford R. Johnson

# Part I

# Key Considerations of Periodontal Surgery

# 1 The Miller McEntire Periodontal Prognostic Index (i.e., "The Perio Report Card") Usage in Practice

Robert A. Levine and Preston Dallas (PD) Miller

## 1.1 Introduction

The Miller McEntire Periodontal Prognostic Index (MMPPI), which the authors like to term "the Perio Report Card," is a simple, powerful, evidenced-based, statistically validated, and accurate motivational tool [1] which can be used daily in clinical practice with all patients (Fig. 1.1). The current score sheet has undergone multiple modifications, and individual clinicians can make further modifications to suit their practice needs. Its usage is not limited to patients presenting with periodontitis but is routinely used with periodontally healthy patients which is reviewed below in Case #1. The *benefits to the patient* are that they better understand their long-term periodontal prognosis of 15 and 30 years. Accurate prognosis can be determined by scoring the most periodontally involved molar that you plan to keep. The strength of the MMPPI is that it translates clinical outcomes into patient value [2].

R. A. Levine (✉)
Pennsylvania Center for Dental Implants and Periodontics, Philadelphia, PA, USA

Kornberg School of Dentistry at Temple University, Philadelphia, PA, USA

University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

University of Illinois at Chicago, Chicago, IL, USA
e-mail: rlevine@padentalimplants.com

P. D. Miller
New York University School of Dentistry, New York, NY, USA


S. Nares (ed.), *Advances in Periodontal Surgery*,
https://doi.org/10.1007/978-3-030-12310-9_1

Miller-McEntire Periodontal Prognosis Index

| Tooth | # | # | # | # |
|---|---|---|---|---|
| Date | | | | |
| Furcation | | | | |
| Diabetes | | | | |
| Mobility | | | | |
| Probing Depth | | | | |
| Molar Type | | | | |
| Smoking | | | | |
| Age | | | | |
| TOTAL | | | | |
| 15 Year Prognosis | | | | |
| 30 Year Prognosis | | | | |

*Our goal is a score of < 5

| Score | 15 Year | 30 Year | |
|---|---|---|---|
| 1 | 98% | 94% | Excellent |
| 2 | 97% | 93% | |
| 3 | 96% | 89% | |
| 4 | 95% | 85% | |
| 5 | 93% | 80% | Good |
| 6 | 90% | 74% | |
| 7 | 86% | 66% | |
| 8 | 81% | 56% | Guarded |
| 9 | 75% | 45% | |
| 10 | 67% | 33% | |
| 11 | 53% | 22% | |

**Statistically, a score under 4.3 means you should never lose a tooth to periodontal disease**

**Smoking increases your chance of losing teeth to periodontal disease by 246%**

| Furcation |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |
| T-T = 3 "through & through" |

| A1C Levels |
|---|
| < 6 = 0 |
| 6.1 - 7.0 = 1 |
| 7.1 - 8.0 = 2 |
| 8.1 - 9.0 = 3 |
| > 9.1 = 4 |

| Mobility |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |

| Probing (mm) |
|---|
| < 5 = 0 |
| 5 - 7 = 1 |
| 8 - 10 = 2 |
| > 10 = 3 |

| Molar Type |
|---|
| Mand = 0 |
| Max 1st = 1 |
| Max 2nd = 2 |

| Smoking |
|---|
| Non-smoker = 0 |
| Smoker = 4 |

| Age |
|---|
| 1 - 39 = 0 |
| > 40 = 1 |

**Keys to Success:**

- Brush, floss, clean your teeth and tongue daily
- Complete recommended treatment
- Adhere to the recommended maintenance schedule
- Control your blood sugar (if diabetic)
- Stop smoking or at least cut back to under 5/day

**Fig. 1.1** MMPPI (Miller, Levine, Fava 2017)

## 1.2 Objectives and Application

**The *objectives* of using this index include:**

- Motivating the patient to accept treatment, complete treatment, and make the patient aware of the importance of complying with periodontal maintenance [3–5] defined as the "Keys to Success."
- To simplify scoring so that the score can not only be determined by the dentist but also by trained auxiliaries. If performed by auxiliaries, it takes no chair time from the dentist. *To help to train staff easily to score patients, it is recommended to review in a scheduled team meeting on the MMPPI (Parts 1 and 2)*[1].
- To encourage patients to make lifestyle changes to improve their overall health**.** This would include smoking cessation and blood sugar control [6, 7].
- To empower the whole "team" (dentists, dental assistants, dental hygienists, and case presenters) in its use in helping patients to attain better periodontal and systemic health as we are the "physicians of the mouth."
- To encourage the patients to refer family and friends.

For a better understanding of clinical scoring, the reader is referred to online videos and resources (see Footnote 1). Since smoking was the most significant factor, there is a video on smoking cessation on this site. Smokers should also be referred to support services for in-depth counseling and assistance.[2]

For patients with diabetes mellitus or who are suspected of having diabetes mellitus, HbA1c values need to be evaluated. An in-office HbA1c testing kit should be readily available. If the patient has not been diagnosed with diabetes mellitus and the in-office HbA1c score is elevated, the patient should be referred to a physician for the diagnosis, as this is a medical diagnosis and not a dental diagnosis. By following these objectives, we can become more of a physician of the mouth rather than just simply performing traditional dental procedures [8–10].

Based on the study by Miller et al. [1], seven patient factors are highlighted to be scored that include (Fig. 1.1):

1. **Furcation involvement of the molar to be scored**:
   - none = 0,
   - 1 total furcation = 1 (does not matter if it is a Class 1, 2, or 3)
   - 2 total furcations = 2
   - T-T (through and through) furcation = 3

   (*Note: Typically when furcations are charted, the severity is noted,* i.e.*, Class 1, Class 2, and Class 3. This index only scores the number of furcations present, not the class or severity).*
2. **HbA1c levels:**
   - <6% =0
   - 6.1–7.0% = 1

[1] See https://pdmillerswebtextbook.com/.

[2] For smoking cessation help: call 1-800-QUITNOW (784-8669).

- 7.1–8.0% = 2
- 8.1–9.0% = 3
- >9.1% = 4

*(Important note on scoring HbA1c: If the patient does not know their recent score, score the patient as a "2" until the patient's blood work is received. Using the MMPPI thus motivates the patient to better understand their HbA1c score and control their diabetes by lowering their blood sugar.)*

3. **Mobility of the molar to be scored:**
   - none = 0,
   - 1 = 1
   - 2 = 2
   - 3 = 3 (tooth is depressible)
4. **Deepest probing depth in millimeters (mm) of the molar to be scored:**
   - <5 mm = 0
   - 5–7 mm = 1
   - 8–10 mm = 2
   - >10 mm = 3
5. **Molar type: 0–2:**
   - Mandibular molar = 0 (either a mandibular first or second molar is not significant)
   - Maxillary first molar = 1
   - Maxillary second molar = 2
6. **Smoking: either you smoke or do not smoke:**
   - non-smoker = 0,
   - smoker = 4,

   *(Note: Of all categories scored, smoking was by far the most significant negative factor in determining periodontal prognosis. Using the Cox Hazard Ratio, statistically a score of 4 was assigned for smoking. The overall objective is to keep the MMPPI score below a 5. When the score is 5 or less, statistically patients never lose teeth to periodontal disease* [1]*. For example, if a smoker has a score of 9, they have a 75% chance of keeping their teeth for 15 years (Fig. 1.1). If the patient stops smoking, the score becomes a 5, and they will have a 93% chance of keeping their teeth for 15 years (Fig. 1.1). While immediate cessation is desired, many patients will only stop smoking over a period of time (see online video on smoking cessation))* (see Footnote 1).
7. ***Age has a minimal and limited factor on periodontal long-term prognosis:***
   - 1–39 years of age = 0
   - 40 or > years of age = 1

**Scoring and prognosis: our clinical posttreatment "target" goal is an MMPPI score of < 5:**

- Score of 1 to 4 has an "excellent" prognosis
- Score of 5 to 8 has a "good" prognosis
- Score of 9 to 11 or greater has a "guarded" prognosis.

### 1.2.1 **Keys to Success** (Bottom Right of Fig. 1.1)

It is important to realize that the keys to success are not a promise of success but a guideline that allows the patient to succeed. All of these keys are the responsibility of the patient and if followed will produce a long-term favorable outcome. Until recently, the importance of cleaning the tongue has not been emphasized. Ninety-five percent of the bacteria left after brushing and interdental cleaning are on the posterior third of the tongue. It is impossible to remove these bacteria with a toothbrush without causing the patient to gag. To achieve this, a metal tongue scraper is required. For proper technique, view the online video on the importance of cleaning your tongue (see Footnote 1). For more information on how to further disinfect the mouth, an online video is available on the most effective, least expensive mouthwash (see Footnote 1).

Emphasizing the keys to success is an integral part of the initial examination. The goal/objective of getting to an MMPPI score of <5 does not happen without complying with all 5 of the keys to success (Fig. 1.1). If at periodontal maintenance the MMPPI score is elevated, the keys to success need to be reviewed to see in what area the patient is not compliant. For example, has the patient started smoking again?

*Important Note on "Keys to Success"*: *As indicated in the title, this index is a periodontal report card. To further motivate the patient at the initial exam, taking a moment to give the patient a posttreatment target score has been found to be particularly motivational. The mnemonic phrase "If you want to keep your teeth alive, keep your MMPPI score below a 5" summarizes in lay-terms the objective of the target score. The patient should be scored at each maintenance appointment. Scoring even healthy patients demonstrates to the patient your concern for their overall oral health and reinforces the importance of periodontal maintenance in keeping their MMPPI stable. Thus the patient is more likely to accept aesthetically enhancing procedures such as veneers or periodontal plastic surgery. Although periodontal disease is a major cause of tooth loss, caries remains a significant factor, especially with the rising incidence of root caries. Today patients are on many more medications than in the past. Many of these medications cause dry mouth* (i.e., *medication-induced xerostomia, MIX), which is a major cause of root caries.*

## 1.3 Case Examples

### 1.3.1 Clinical Case Example #1: Using the MMPPI in a Periodontally Healthy Patient (Amy: MMPPI Score at Initial Exam = 1): See Figs. 1.2, 1.3, 1.4 and 1.5

Amy presents to our periodontal practice (RAL) as a healthy (HbA1c <6% = 0) non-smoking (non-smoker = 0) 32-year-old female (age < 39 = 0) and a history of good compliance to preventative periodontal care at every 6 months frequency with her


**Fig. 1.2** Case #1: patient presents upon referral as a 32-year-old healthy, non-smoker for periodontal plastic surgery for root coverage #24 and 25. Surgical treatment performed by Dr. Robert Levine

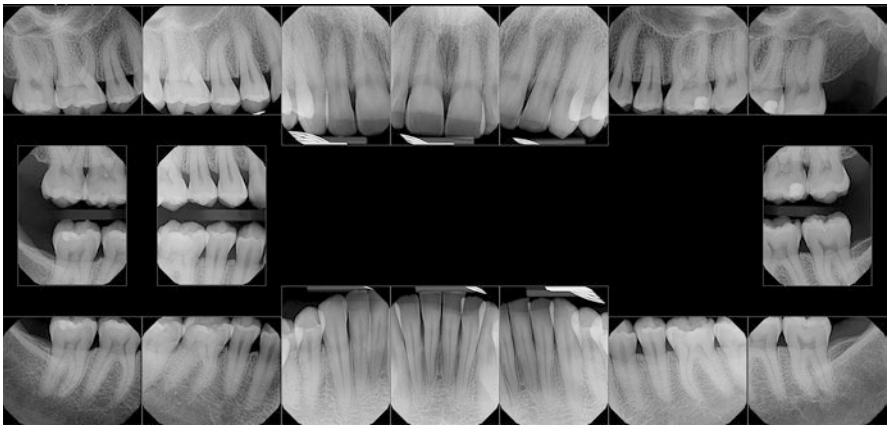

**Fig. 1.3** Case #1: FMX

restorative dentist. She was referred for periodontal plastic surgery for root coverage #24 (Miller Class 2) and #25 (Miller Class 1) [11–16] (Figs. 1.2 and 1.3). A complete periodontal charting was completed as part of the initial periodontal examination including probing depths, mobility of teeth, gingival recession, and occlusion. The summary of this visit is noted in her MMPPI that was reviewed "knee-to-knee and eye-to-eye" with her (Fig. 1.4). Her deepest periodontal probing depth was 4 mm on the distal of #3 (see Fig. 1.1: probing mm <5 mm = 0) with light bleeding upon probing. The scored tooth #3 had no mobility (zero mobility = 0), and a total MMPPI score was recorded as 1 (15-year periodontal prognosis of 98% and 30-year periodontal prognosis of 94%). As noted prior, the 15- and 30-year periodontal prognosis advised the patient of an excellent long- term prognosis of not losing her teeth *due to periodontal disease*. However, there is still the possibility of losing these two teeth due to continued attachment loss, root caries, and its sequela. The use of the MMPPI in Amy's case is *highly motivational for four reasons*: she leaves the initial visit with our office with positive news on her overall case

Miller-McEntire Periodontal Prognosis Index

| Tooth | # 3 | # | # | # |
|---|---|---|---|---|
| Date | 10/10/17 | | | |
| Furcation | 0 | | | |
| Diabetes | 0 | | | |
| Mobility | 0 | | | |
| Probing Depth | 0 | | | |
| Molar Type | 1 | | | |
| Age | 0 | | | |
| Smoking | 0 | | | |
| TOTAL | 1 | | | |
| 15 Year Prognosis | 98% | | | |
| 30 Year Prognosis | 94% | | | |

*Our goal is a score of less than 5

| Score | 15 Year | 30 Year | |
|---|---|---|---|
| 1 | 98% | 94% | Excellent |
| 2 | 97% | 93% | |
| 3 | 96% | 89% | |
| 4 | 95% | 85% | |
| 5 | 93% | 80% | Good |
| 6 | 90% | 74% | |
| 7 | 86% | 66% | |
| 8 | 81% | 56% | Guarded |
| 9 | 75% | 45% | |
| 10 | 67% | 33% | |
| 11 | 53% | 22% | |

**Statistically, a score under 4.3 means you should never lose a tooth to periodontal disease**

**Smoking increases your chance of losing teeth to periodontal disease by 246%**

| Furcation |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |
| T-T = 3 "through & through" |

| A1C Levels |
|---|
| < 6 = 0 |
| 6.1 - 7.0 = 1 |
| 7.1 - 8.0 = 2 |
| 8.1 - 9.0 = 3 |
| > 9.1 = 4 |

| Mobility |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |

| Probing (mm) |
|---|
| < 5 = 0 |
| 5 - 7 = 1 |
| 8 - 10 = 2 |
| > 10 = 3 |

| Molar Type |
|---|
| Mand = 0 |
| Max 1st = 1 |
| Max 2nd = 2 |

| Age |
|---|
| 1 - 39 = 0 |
| > 40 = 1 |

| Smoking |
|---|
| Non-smoker = 0 |
| Smoker = 4 |

**Keys to Success:**

- Brush, floss, and clean your tongue daily
- Complete recommended treatment
- Adhere to the recommended maintenance schedule
- Control your blood sugar (if diabetic)
- Stop smoking or at least cut back to under 5/day

**Fig. 1.4** Case #1: MMPPI at initial periodontal consultation visit shared with the patient

**Fig. 1.5** Seven month post-op of completed autogenous palatal subepithelial connective tissue graft for root coverage using a combination of the tunnel technique (#25) with lateral sliding pedicle flap (#24) and adjunctive patient's PRGF (plasma-rich growth factors) and Emdogain® (Straumann USA, Andover, MA). Near 100% root coverage was achieved with significant thickening of buccal soft tissues from #23 to 26. Surgical treatment performed by Dr. Robert Levine

prognosis from a periodontal perspective (MMPPI = 1); it reinforces her restorative dentist's referral for the recommended root coverage procedure; it motivates her to complete our combined recommendation of periodontal plastic surgical procedure for root coverage for teeth #24 and 25; and lastly it stresses the importance of continued periodontal maintenance visits with her dentist at his/her recommended frequency to keep her MMPPI below a 5. After discussing her MMPPI score of 1 and her excellent prognosis for 15 and 30 years, Amy shared with us that initially she thought that her "gum recession was the beginning of a cascading downhill course for herself from a dental standpoint." After presenting her an excellent case prognosis, we then gave her the solution to her site-specific periodontal problem with the benefits of thickening the gingival tissues, widening the zone of keratinized gingiva with attempts at partial to 100% root coverage, thus improving the long-term prognosis of #24 and #25 [11, 16]. The clinical goal of 100% root coverage in a Miller Class 1 or 2 is protecting these two teeth from future root caries and additional periodontal attachment loss while thickening the soft tissue which creates a more favorable barrier in preventing future gingival recession. Amy scheduled and completed the recommended treatment (Fig. 1.5). As part of discussion with Amy, we also shared the concerns that we see daily with medication-induced xerostomia (MIX) in our aging patient population. MIX relates to clinical concerns for recurrent caries or what we see frequently in the non-compliant patient of multiple areas of deep interproximal or buccal root caries. As our healthy patients age, many will be given medications for systemic diseases such as HTN, diabetes, anxiety, depression, asthma, etc. which will have significant detrimental effects on exposed root surfaces such as seen in Amy's case. Thus, this needs to be shared with a patient like Amy as their medical status may change as they grow older along with their

systemic health and medications. These medications will significantly increase their susceptibility to MIX and subsequent root caries. This concern is illustrated in Case #2. Sadly, many in the medical profession are unaware of the harmful oral side effects caused by numerous medications they routinely prescribe. In all patients we recommend and stress the importance of the "Keys to Success" (bottom right of the MMPPI form) with good compliance to plaque control and their recommended periodontal maintenance frequency which in Amy's case is twice a year with her general dentist [17–20].

### 1.3.2 Clinical Case Example #2: Using the MMPPI in a Beginning to Moderate Periodontitis Patient (Michael: MMPPI Score at Initial Exam = 7): See Figs. 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13 and 1.14

Michael presents to our periodontal practice (RAL) referred by his wife, who had completed periodontal therapy under our care (for generalized moderate to localized advanced periodontitis). *Michael's wife, who had initially scored MMPPI of 5, had recently completed full-mouth LANAP* (laser-assisted new attachment procedure) *therapy in one visit under local anesthesia. This underlines one of the major benefits of routinely using the MMPPI and the power that the MMPPI has with referral of family and friends* to your practice for the treatment of periodontal diseases. This is a win-win outcome. Michael is a 58-year-old (>39 = 1), generally healthy: ASA II and a HbA1C <6% (<6% = 0), non-smoker (non-smoker = 0) with generalized bleeding upon probing, and probing depths up to 6 mm in the maxillary posteriors and up to 7 mm in the mandibular molars (Fig. 1.6). Michael reports

**Fig. 1.6** Case #2: Michael, an RN, presents upon referral by his family member (wife) as 58-year-old generally healthy, non-smoker for initial periodontal therapy to treat generalized beginning to moderate periodontitis which was not under control per the patient as he was frustrated with his prior failing dental work and poor communication skills of his previous dentist and team members

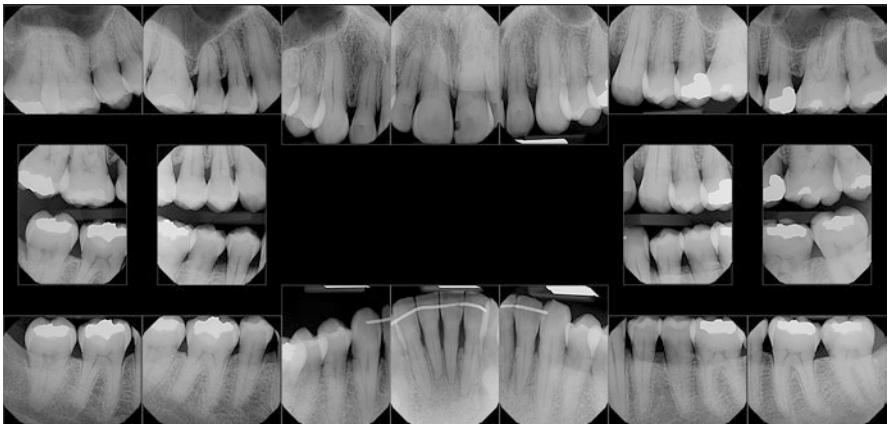

**Fig. 1.7** Case #2: initial FMX

a history of good compliance to preventative periodontal care at every 4–6 months with his restorative dentist's office but was very frustrated that his "gums do not feel or appear healthy" to him. Medically he presents with HTN, anxiety, obsessive-compulsive disorder (OCD), arthritis, seasonal allergies, and high cholesterol and premedicates for a recent knee replacement. He is a practicing RN at a local VA Hospital and is very health conscious. Michael is presently on six different medications to treat his systemic diseases that are all associated with MIX/dry mouth which he admits to (Lisinopril, HCTZ, Norvasc, Lorazepam, Benadryl, and Claritin). The only significant mobility in his mouth was tooth #2 which recorded a 1 degree mobility (mobility 1 = 1). Several areas of facial mucogingival recession with lack of attached keratinized gingiva were noted (buccal of teeth #11,20,21,28). Even though there were deeper probing depths of 7 mm in the interproximal areas of his lower molars from the lingual, it was decided to use tooth #2 to be scored (maxillary second molar = 2) as this molar presented with two total furcation invasions (furcations: 2 = 2): buccal (Class 1) and mesial (Class 2) along with a Class 1 mobility (mobility: Class 1 = 1). The next worst MMPPI score would be tooth #31 (mandibular molars = 0) and presented only with a buccal Class 1 furcation (furcation = 1), no mobility (mobility = 0) probing depth of 7 mm (5–7 mm = 1), and age at 58 (age, >39 = 1) for a total MMPPI score of 7. *As all mandibular molars have a 0 score at the outset, it is best to use a maxillary molar if it is involved periodontally and has any mobility and possible furcation(s) to have an increased initial score,* and thus hopefully with the patient adhering to the "Keys to Success," a more dramatic MMPPI score reduction will be seen posttreatment. Michael's recommended treatment plan involved full-mouth nonsurgical therapy (scaling and root planning) with local anesthesia in one visit with a registered dental hygienist (RDH), occlusal adjustment of #2, in conjunction with 1 week of oral antibiotics (amoxicillin 500 mg with metronidazole 250 mg for 1 week TID) [21]. The patient is seen posttreatment with an emphasis on plaque control

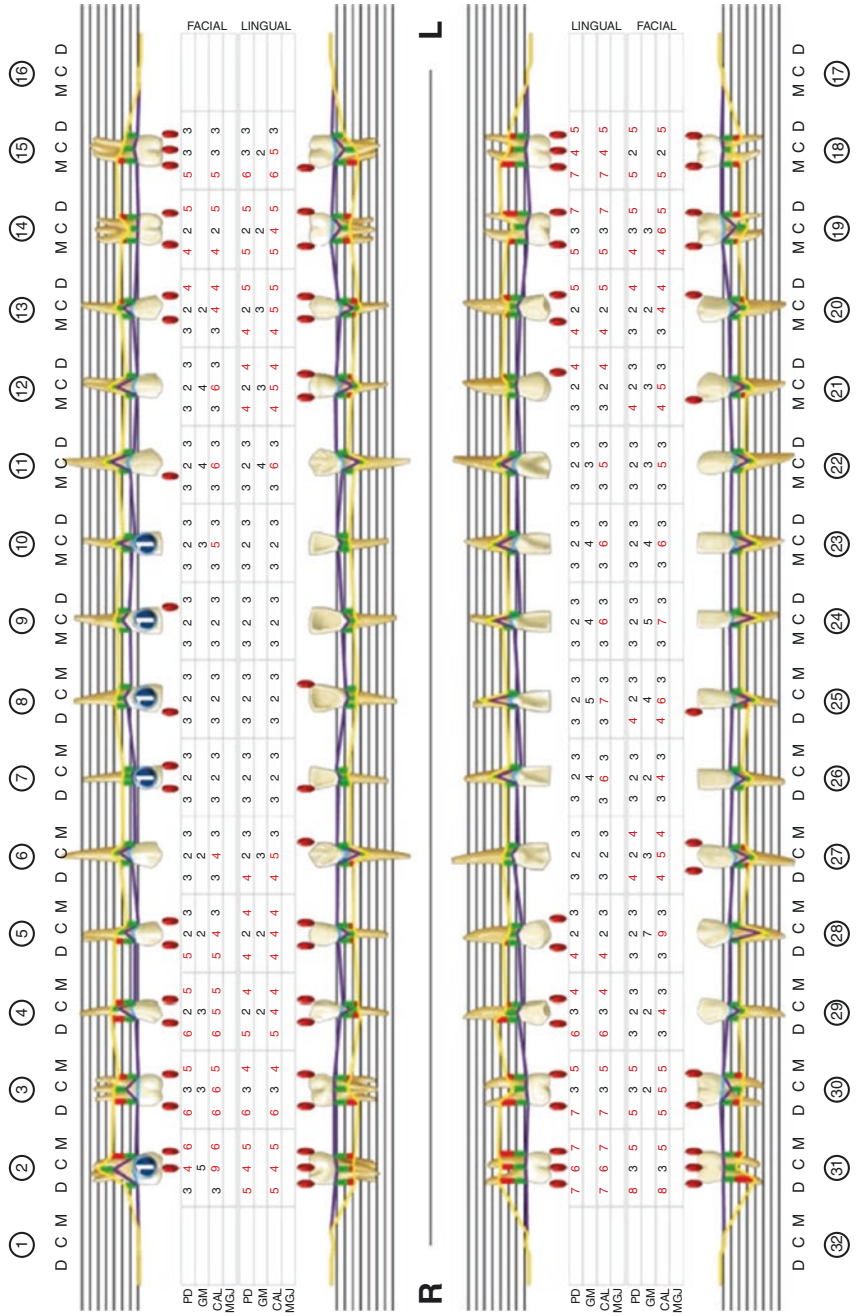


**Fig. 1.8** Case #2: initial periodontal charting

Miller-McEntire Periodontal Prognosis Index

| Tooth | # 2 | # | # | # |
|---|---|---|---|---|
| Date | 11/1/17 | | | |
| Furcation | 2 | | | |
| Diabetes | 0 | | | |
| Mobility | 1 | | | |
| Probing Depth | 1 | | | |
| Molar Type | 2 | | | |
| Age | 1 | | | |
| Smoking | 0 | | | |
| TOTAL | 7 | | | |
| 15 Year Prognosis | 86% | | | |
| 30 Year Prognosis | 66% | | | |

*Our goal is a score of less than 5

| Score | 15 Year | 30 Year | |
|---|---|---|---|
| 1 | 98% | 94% | Excellent |
| 2 | 97% | 93% | |
| 3 | 96% | 89% | |
| 4 | 95% | 85% | |
| 5 | 93% | 80% | Good |
| 6 | 90% | 74% | |
| 7 | 86% | 66% | |
| 8 | 81% | 56% | Guarded |
| 9 | 75% | 45% | |
| 10 | 67% | 33% | |
| 11 | 53% | 22% | |

**Statistically, a score under 4.3 means you should never lose a tooth to periodontal disease**

**Smoking increases your chance of losing teeth to periodontal disease by 246%**

| Furcation |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |
| T-T = 3 "through & through" |

| A1C Levels |
|---|
| < 6 = 0 |
| 6.1 - 7.0 = 1 |
| 7.1 - 8.0 = 2 |
| 8.1 - 9.0 = 3 |
| > 9.1 = 4 |

| Mobility |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |

| Probing (mm) |
|---|
| < 5 = 0 |
| 5 - 7 = 1 |
| 8 - 10 = 2 |
| > 10 = 3 |

| Molar Type |
|---|
| Mand = 0 |
| Max 1st = 1 |
| Max 2nd = 2 |

| Age |
|---|
| 1 - 39 = 0 |
| > 40 = 1 |

| Smoking |
|---|
| Non-smoker = 0 |
| Smoker = 4 |

**Keys to Success:**

- Brush, floss, and clean your tongue daily
- Complete recommended treatment
- Adhere to the recommended maintenance schedule
- Control your blood sugar (if diabetic)
- Stop smoking or at least cut back to under 5/day

**Fig. 1.9** Case #2: MMPPI at initial periodontal consultation visit; scored tooth #2 with initial MMPPI of 7

**Fig. 1.10** Case #2: posttreatment (ScRP w/ systemic antibiotics for 1 week) at 3 months

**Fig. 1.11** Case #2: posttreatment buccal mirror views noting several mucogingival concerns (especially #28) that are discussed with the patient as he presents with MIX and potential for root caries as he is on six medications that will contribute to dry mouth

**Fig. 1.12** Case #2: posttreatment buccal mirror views noting several mucogingival concerns (especially #28) that are discussed with the patient as he presents with MIX and potential for root caries as he is on six medications that will contribute to dry mouth

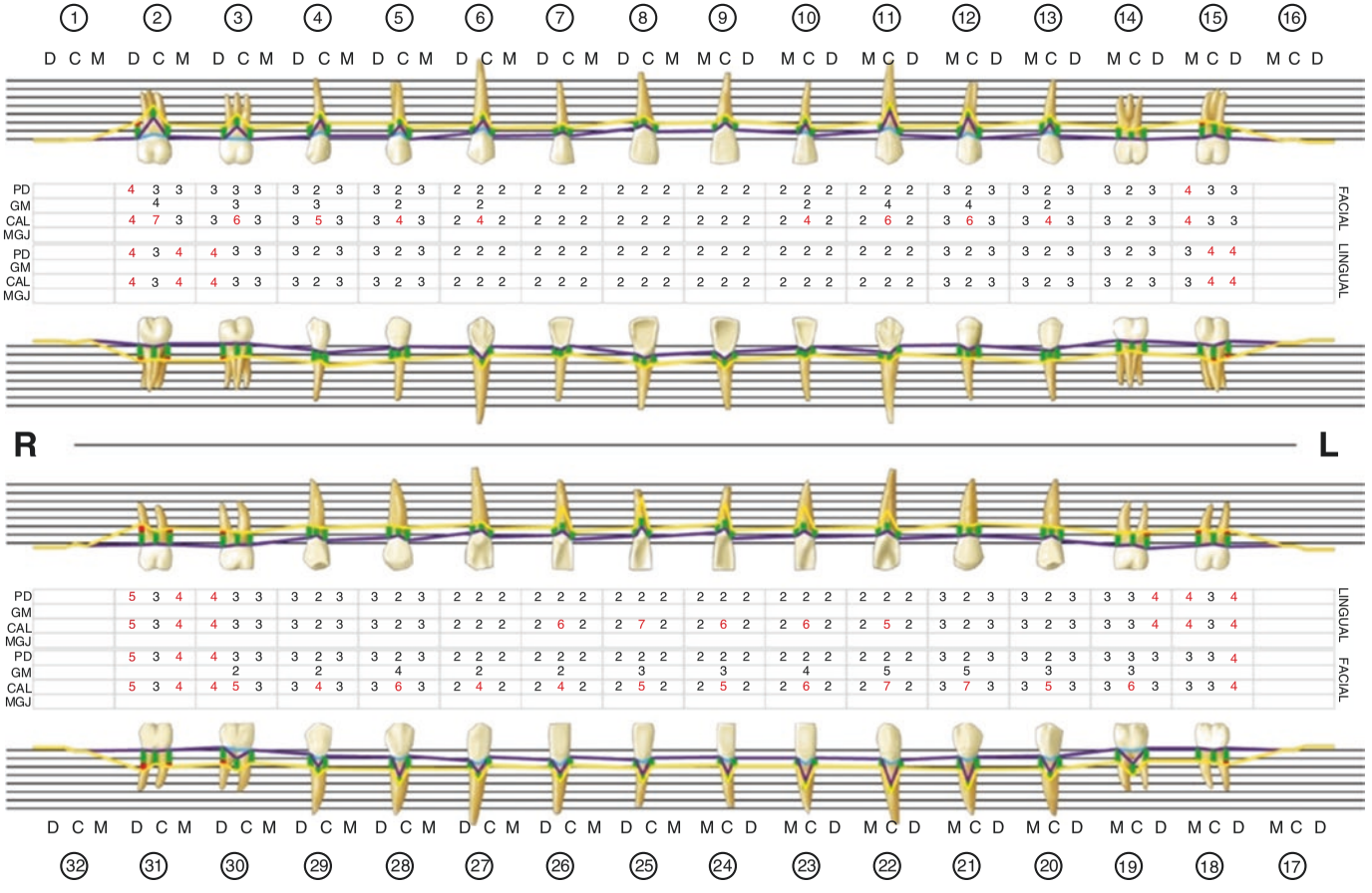


**Fig. 1.13** Case #2: posttreatment periodontal charting

Miller-McEntire Periodontal Prognosis Index

| Tooth | # 2 | # 2 | # 2 | # |
|---|---|---|---|---|
| Date | 11/1/17 | 2/7/17 | 7/11/18 | |
| Furcation | 2 | - | - | |
| Diabetes | - | - | - | |
| Mobility | 1 | - | - | |
| Probing Depth | 1 | - | - | |
| Molar Type | 2 | 2 | 2 | |
| Age | 1 | 1 | 1 | |
| Smoking | - | - | - | |
| TOTAL | 7 | 3 | 3 | |
| 15 Year Prognosis | 86% | 96% | 96% | |
| 30 Year Prognosis | 66% | 89% | 89% | |

*Our goal is a score of less than 5

| Score | 15 Year | 30 Year | |
|---|---|---|---|
| 1 | 98% | 94% | Excellent |
| 2 | 97% | 93% | |
| 3 | 96% | 89% | |
| 4 | 95% | 85% | |
| 5 | 93% | 80% | Good |
| 6 | 90% | 74% | |
| 7 | 86% | 66% | |
| 8 | 81% | 56% | Guarded |
| 9 | 75% | 45% | |
| 10 | 67% | 33% | |
| 11 | 53% | 22% | |

**Statistically, a score under 4.3 means you should never lose a tooth to periodontal disease**

**Smoking increases your chance of losing teeth to periodontal disease by 246%**

| Furcation |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |
| T-T = 3 "through & through" |

| A1C Levels |
|---|
| < 6 = 0 |
| 6.1 - 7.0 = 1 |
| 7.1 - 8.0 = 2 |
| 8.1 - 9.0 = 3 |
| > 9.1 = 4 |

| Mobility |
|---|
| None = 0 |
| 1 = 1 |
| 2 = 2 |
| 3 = 3 |

| Probing (mm) |
|---|
| < 5 = 0 |
| 5 - 7 = 1 |
| 8 - 10 = 2 |
| > 10 = 3 |

| Molar Type |
|---|
| Mand = 0 |
| Max 1st = 1 |
| Max 2nd = 2 |

| Age |
|---|
| 1 - 39 = 0 |
| > 40 = 1 |

| Smoking |
|---|
| Non-smoker = 0 |
| Smoker = 4 |

**Keys to Success:**

- Brush, floss, and clean your tongue daily
- Complete recommended treatment
- Adhere to the recommended maintenance schedule
- Control your blood sugar (if diabetic)
- Stop smoking or at least cut back to under 5/day

**Fig. 1.14** Case #2: posttreatment MMPPI; scored tooth #2 with MMPPI now reduced to 3

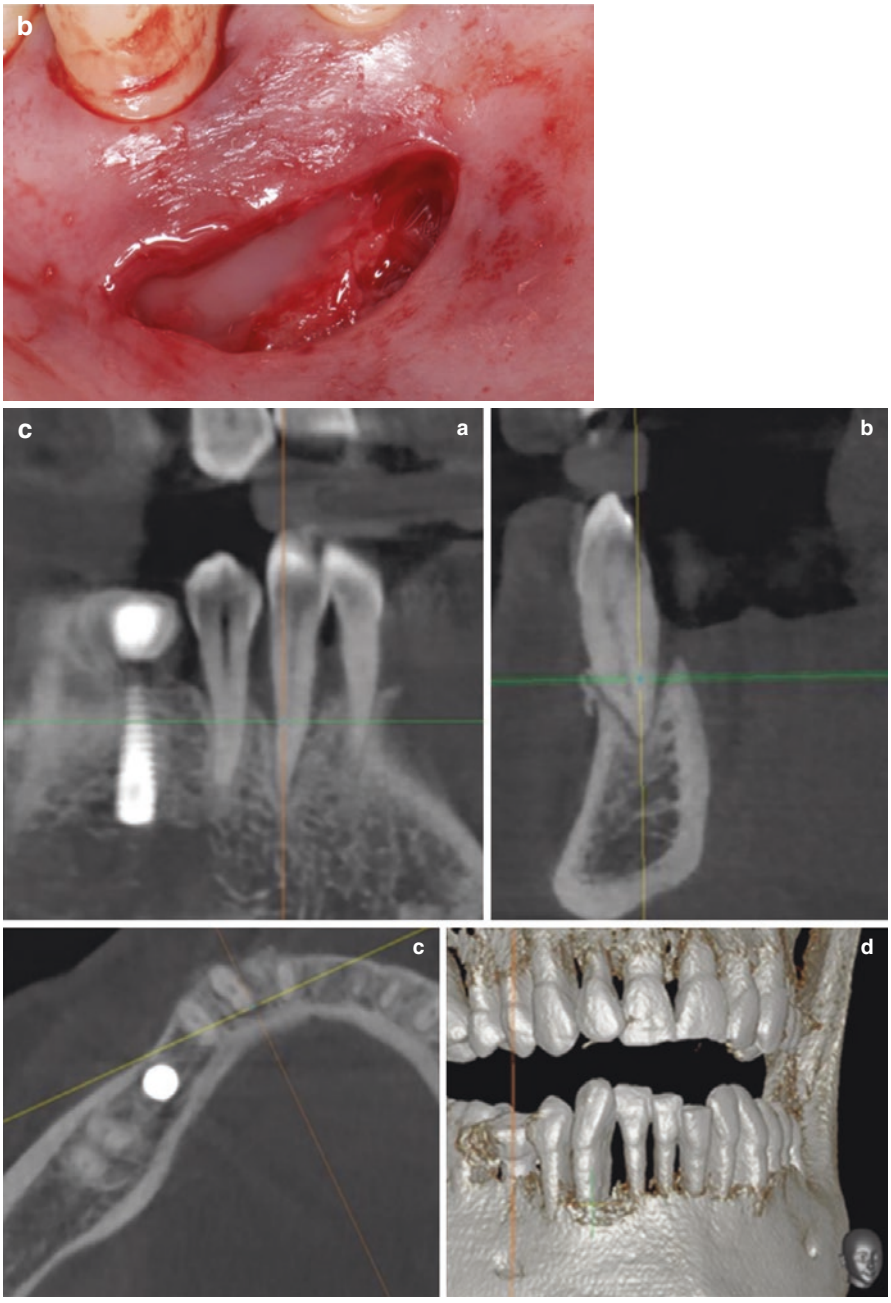


**Fig. 2.6** (continued)

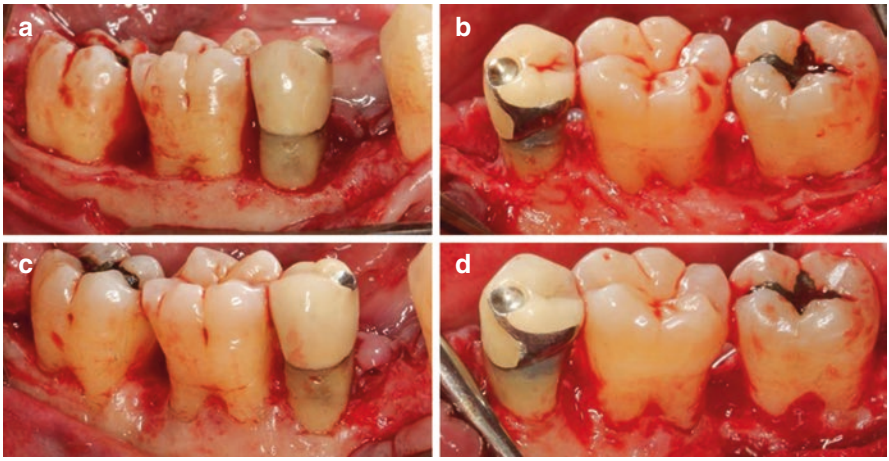


**Fig. 3.3** Periodontal patient treated with osseous surgery. (**a**) Facial and (**b**) lingual view after flap reflection. (**c**, **d**) Facial and lingual view after ostectomy and osteoplasty. Courtesy Dr. Acela Martinez


**Fig. 3.4** (**a**) Image of right central incisor prior to crown lengthening procedure. (**b**) Immediately after procedure and 14 days postoperatively (**c**), an increase in the clinical crown is noted

long-term gains in attachment. Figure 3.3 documents intra-surgical views of a case before and immediately after ostectomy and osteoplasty.

## Soft and Hard Tissue

### Crown Lengthening

The intersection of soft and hard tissue resective surgeries is seen in crown lengthening procedures. Utilizing any combination of the surgical techniques described above, crown lengthening surgery aims to gain access to the tooth surface for restorative purposes [8]. This topic is discussed with details in the chapter by Karateew et al., in this volume. Figure 3.4 gives a depiction of a crown lengthening procedure before and after surgery.

### Biologic Shaping

One of the main challenges of the profession is to have full access to the furcation area for proper debridement. Biologic shaping, as part of periodontal surgery, has

### 4.4.2 Case 2

Figure 4.5. (a, b) Upon removal of provisional restorations, a mesial concavity and calculus can be observed on the first premolar. For the patient and hygienist, this creates a non-cleanable environment that is at risk for continued periodontal breakdown. (c, d) Removal of the provisional restoration provides unimpeded vertical and visual access for the periodontist. Elimination of the concavity facilitates plaque removal for the patient and hygienist. Because the concavity is interproximal, it is critical that it not be accentuated as with buccal or lingual furcations. Rather, removal or blending of the line angles approximating the furcation should take place. The objective is to remove or flatten the concavity so floss and a hygienist's curette will achieve removal of plaque and calculus. (e) Minor ostectomy with a round diamond bur to create a parabolic bony anatomy. (f) Continuous suture provides primary closure (see supplementary figures for suturing technique). (g) At 14 weeks, a new restoration can be fabricated resulting in a biocompatible environment. Thereafter, the patient is placed on alternating 3-month recall with the restorative dentist.


**Fig. 4.5** Mesial concavity and calculus present on the first premolar. Biologic shaping eliminates the concavity and facilitates hygiene measures. Restorations by Dr. William Strupp Jr. See text for details (Reprinted with permission from General Dentistry, July/August 2012. © Academy of General Dentistry. All rights reserved. On the Web at www.agd.org. License # 54836)

membranes are placed, based on the practitioner's preference, and then the suture is closed [64].

In the REPAIR implant protocol (Biolase, Irvine, Calif., USA), a closed flap procedure, the area around the implant is de-epithelialized, a collar of tissue around the implant is removed (which may cause esthetic concerns in the anterior region), and then a radial-firing tip is used to decontaminate the implant surface with Er,Cr:YSGG laser energy. Decortication of the bone follows to allow blood to fill the site; the laser is used to assist with hemostasis, followed by compression of the surgical site for 3–5 min. As mentioned previously, the Er,Cr:YSGG laser does not provide the same level of coagulation as the Nd:YAG laser to achieve a stable fibrin clot. In the REPAIR implant protocol, removal of the restoration would seem to be essential, given the non-flexibility of the laser's glass tips, as implant restorations with multiple attachments or with large convexities may not be amenable to flapless procedures. This would mean that a flapped approach with bone grafts and other regenerative materials would be indicated. The advantage of the erbium laser is that it utilizes a water spray to help cool the implant during irradiation.

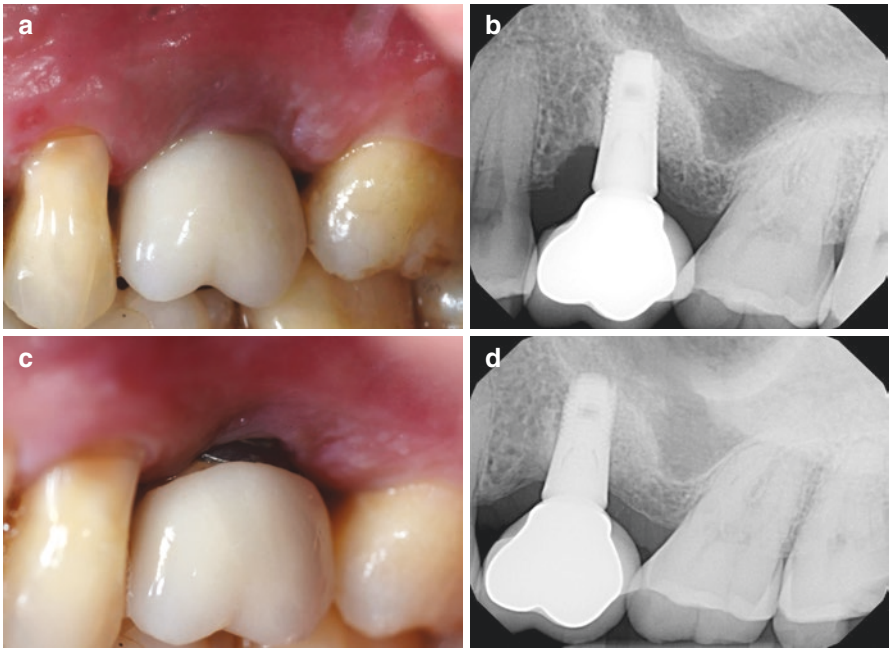


**Fig. 5.5** Clinical application of digitally pulsed Nd:YAG laser in periimplantitis treatment in posterior. The patient was 47-year-old male who was seen for discomfort and suppuration on the upper left first molar (**a**). Probing showed non-maintainable pockets. The X-ray showed vertical bone loss on upper left first molar (**b**). LAPIP treatment was performed on the same day as Fig. 5.4a, b. No removal of restoration was necessary, and he was kept on a 3-month periodontal maintenance. Once inflammation and swelling of the gingiva resolved, a buccal overhang of the restoration was noted, which probably contributed to the periimplantitis (**c**). The 44-month follow-up showed decrease in pockets to maintainable levels with no suppuration or BOP. The X-ray showed stable regeneration of bone (**d**)

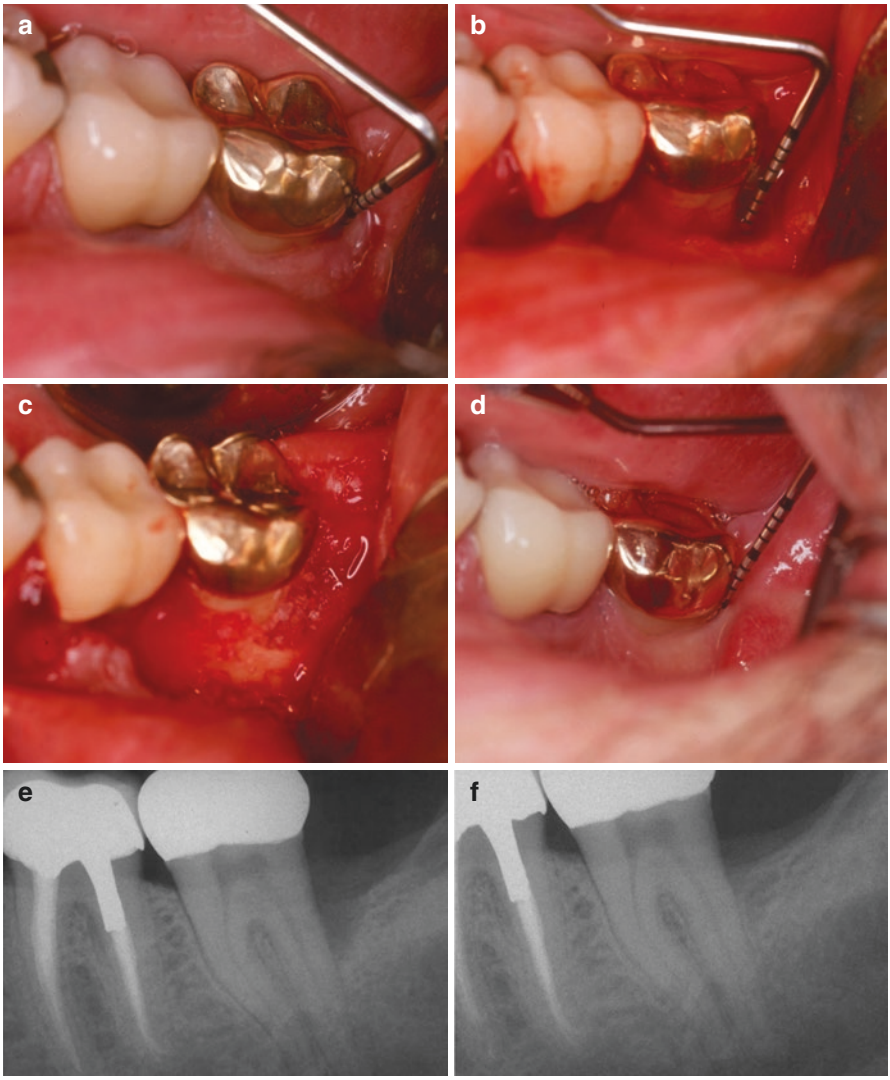


**Fig. 7.2** This is a representative case of a deep intrabony defect on the distal aspect of the mandibular left second molar (**a**, **b**). The defect was degranulated and grafted with MSCs or MSCs + rhPDGF (**c**). Clinical improvement was observed 12 months after surgical treatment (**d**). Pre-surgical (**e**) and 12 months posttreatment (**f**) radiographs are presented

The second clinical case involved a strategically important tooth for the patient. This tooth was the mesial abutment of a three-unit fixed prosthesis (Fig. 7.3). Although some may advocate extraction and implant placement, the patient elected to proceed with regenerative therapy due to financial reasons. The initial PD was 8 mm with radiographic presentation of an intrabony defect (Fig. 7.3a, b). Surgical

clinical attachment level (HCAL), vertical clinical attachment level (VCAL), reduction of pocket probing depth (PPD), recession increase (REC), horizontal bone level (HBL), and vertical bone level (VBL). The weighted mean differences for HCAL were 0.96 mm [CI: (0.60, 1.32), $p < 0.001$] and 0.55 mm [CI: (0.00, 1.10), $p = 0.05$] for VCAL gain. PPD reduction over 6 months was 1.38 mm [CI: (0.91, 1.85), $p < 0.01$]. The authors concluded that the clinical performance of conservative surgery, such as OFD, in the treatment of furcation defects may represent a valid cost-effective treatment solution for class II, particularly mandibular defects, mainly when other therapeutic options are not applicable either for anatomical or patient-related factors [29].

The current systematic review from American Academy of Periodontology (AAP) regeneration workshop assessed the available evidence for effectiveness of different regenerative approaches. Avila-Ortiz et al. selected 150 articles of which 6 were systematic reviews, 109 were clinical trials, 27 were case series, and 8 were case reports. In this review, they examined specific clinical scenarios and revealed that regenerative approaches are predictable treatment options for class II furcation (Fig. 8.2a–d) defects on the buccal, mesial, and distal of maxillary molars and

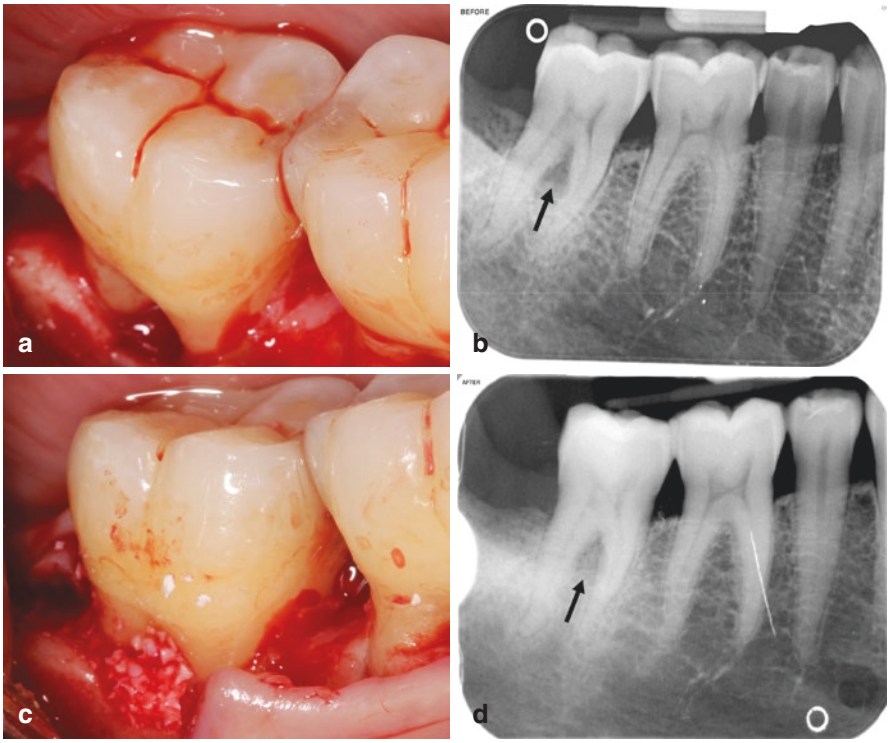


**Fig. 8.2** Regeneration procedure performed on a mandibular second molar with furcation involvement. (**a**) Preoperative radiograph and (**b**) flap reflection demonstrating class II furcation involvement. (**c**) Placement of EMD and xenograft. (**d**) Postoperative radiograph taken at 6 months demonstrating radiographic evidence of bone fill in furcation. Photos courtesy of Dr. Bruno Herrera

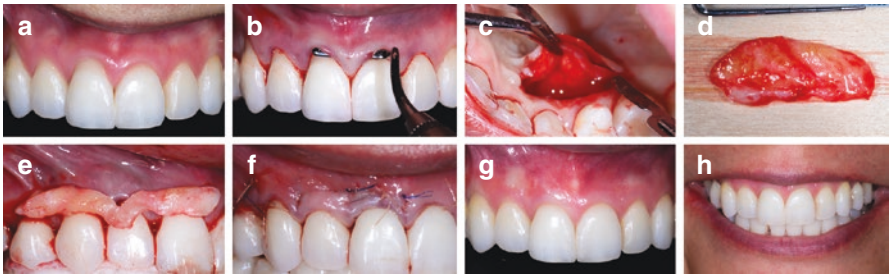


**Fig. 9.2** Clinical case of a patient with Miller Class I multiple recession-type defects in the esthetic zone (**a**). Scaling and root planning were performed to remove the biofilm. An intrasulcular tunnel was elevated split thickness from right first premolar to left central incisor (**b**). A connective tissue graft was harvested from the anterior lateral palate (**c**). The connective tissue graft was approximately 2 mm in thickness and 18 mm in length (**d**). A horizontal incision was made in the graft to cover the four teeth with recession defects (**e**). The graft was then inserted into the tunnel through the sulcus of the canine, which had the deepest recession, and secured in position with at the mesial and distal ends with resorbable PGA sutures. Single sling sutures were performed with 6.0 polypropylene sutures for coronal advancement of the final gingival margin (**f**). The 2-year follow-up shows stable gingival margins with complete root coverage (**g**). The patient was satisfied with the esthetic result of the root coverage procedure (**h**)

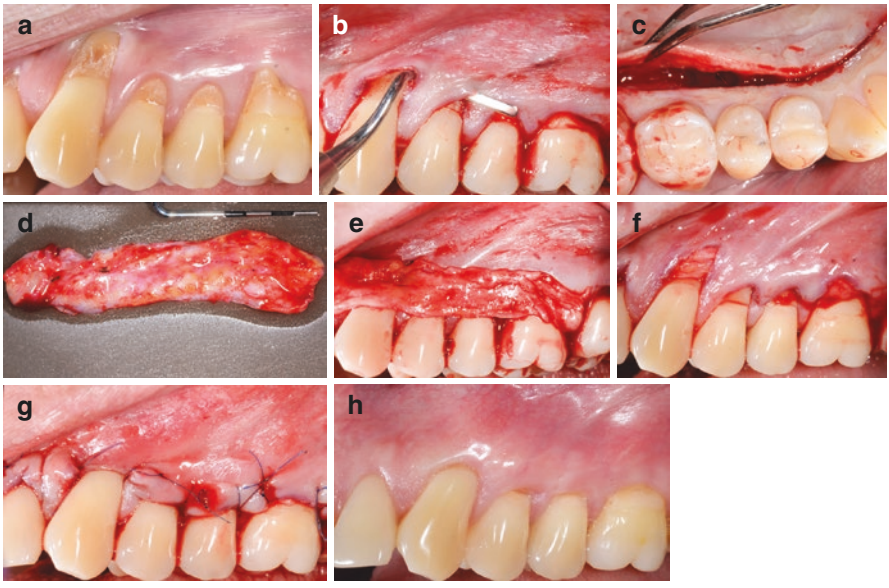


**Fig. 9.3** Clinical case of a patient with combination of Miller Class I and Class II recession defects (**a**). Following root preparation, which included scaling and root planning and removal of composite from root surfaces, subperiosteal tunnel was created from sulcular access (**b**). An initial partial-thickness flap was made on the palate to provide access to the subepithelial connective tissue (**c**), which was harvested (**d**). The dimensions of the subepithelial connective tissue graft extended slightly beyond the recession defects laterally and apically (**e**). The subepithelial connective tissue graft was inserted in the tunnel and was positioned at the level of the CEJ (**f**). Gingival margins were coronally positioned, using 6.0 polypropylene sling sutures (**g**). Postoperative results of the case after 3 years with 100% root coverage (**h**)

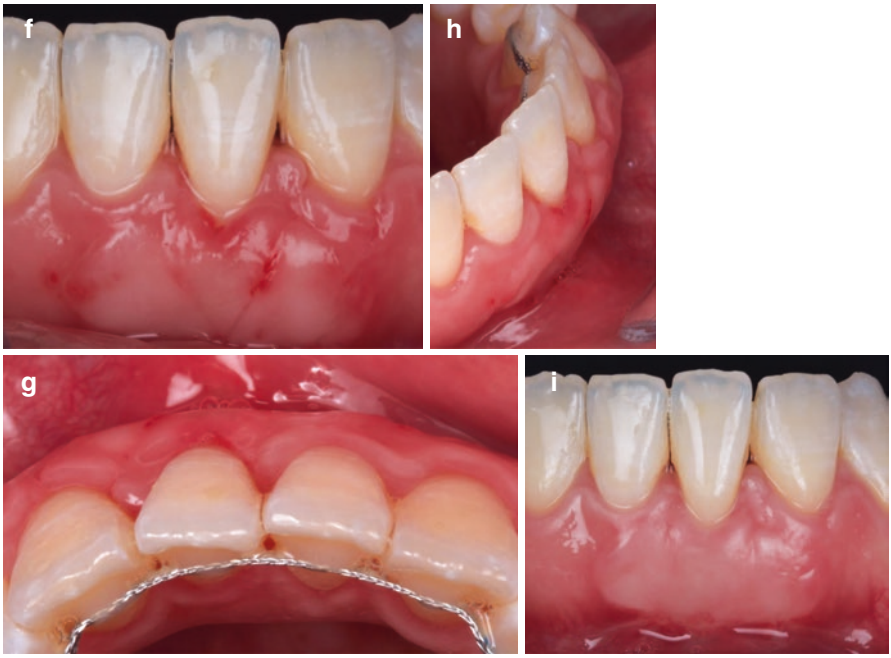


**Fig. 10.4** (continued)

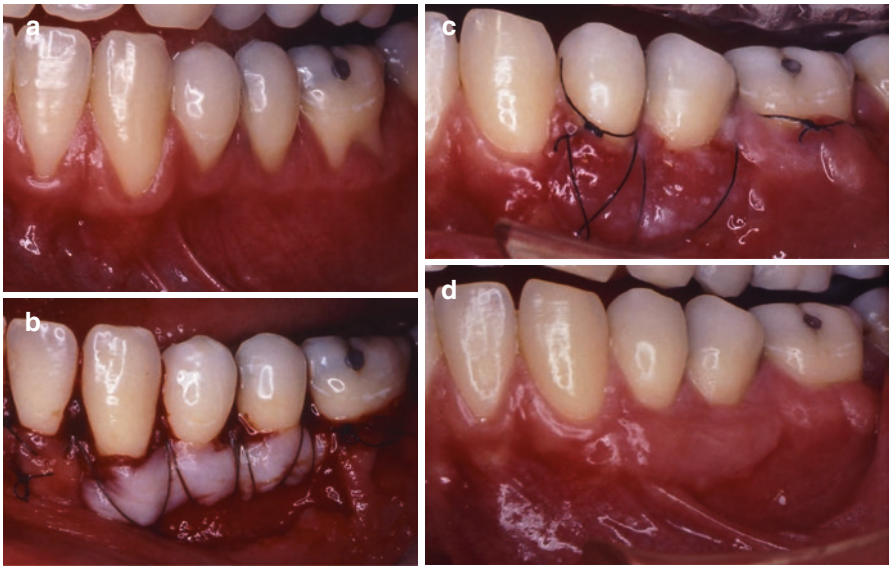


**Fig. 10.5** Mandibular site presenting multiple teeth with gingival recession and a thin periodontal biotype. A free gingival graft was used to decrease recession depth and to increase the width and thickness of keratinized tissue—(**a**) baseline; (**b**) graft sutured at recipient bed; (**c**) 7 days follow-up; (**d**) 3 months follow-up


**Fig. 12.4** Esthetic crown lengthening teeth #8/9 for management of APE. (**a**) Dental view: pre-surgery and 2 weeks postsurgery for treatment of altered passive eruption. (**b**) Facial view: pre-op and 10 weeks postsurgery for treatment of altered passive eruption

(c) Teeth with excessive retrograde wear where crown lengthening is required for adequate seating and retention of a full coverage restoration
(d) Teeth, due to super-eruption, which have insufficient interocclusal space for requisite restorative dentistry
(e) Altered passive eruption, where the gingival margin is coronal to the CEJ and the osseous crest is approximate to or at the CEJ (Fig. 12.4a, b)
(f) External root resorption involving the dental structures adjacent to the gingival margins and/or the osseous crest

An adjunctive or ancillary treatment modality to functional crown lengthening is the use of orthodontics for forced eruption. Orthodontic forces may be utilized to either slowly or rapidly erupt the tooth in an occlusal or incisal direction in an attempt to bring either the osseous crest and underlying periodontal structures more coronally [22] or to extrude the tooth from the dentoalveolar complex so that the fracture or caries is exposed. Subsequent surgical re-establishment in an apical direction of the periodontal complex may or may not be required. Further discussion of this treatment modality can be found in the chapter by Schmerman and Obando in this volume.

Contraindications to functional crown lengthening are well described. Jorgic-Srdjak et al. described several scenarios in which surgical crown lengthening is containdicated [23]. These include:

(a) Caries or dental fracture extending significantly apical to the osseous crest requiring excessing alveolar bone removal.
(b) Unesthetic outcomes projected as a result of surgery.

the tissue, tooth morphology and anatomy, and how much resection is required. The gingival tissues should be symmetrical and balanced. They provide a backdrop for esthetic restoration [33]. Additionally, ideal maxillary incisor dimensional relationships should follow the "golden proportions." The mesial-distal relationship between the dentition of the maxillary anterior group should be central incisor 1.6, lateral incisor 1, and mesial third of cuspid 0.6 [34]. Furthermore, Lee [35] proposed a classification for esthetic crown lengthening depending on the relationship of the alveolar crest and anticipated gingival margin.

Type I esthetic crown lengthening is categorized by the appropriate position of the alveolar crest, however an excess of gingival tissue. In this situation, it would simply require gingival recontouring or gingivectomy, preferably using a scalpel or a laser. Submarginal incisions are usually made at this point guided by a surgical stent.

Type II allows for gingival recontouring with additional need for ostectomy in order to re-establish biological width (Fig. 12.5a–h). These images presented in Fig. 12.5a–h represent a sequential study in the approach of contemporary crown lengthening


**Fig. 12.5** Sequencing the treatment of a Type II case. (**a**) Pre-treatment condition of the dentition showing significant retrograde wear. (**b**) Diagnostic wax-up and silicon index. (**c**) Presurgical provisionals on prepared teeth. (**d**) Surgical soft tissue scalloping. (**e**) Hard tissue scalloping and creation of the biologic width dimension on the root surface. (**f**) Provisional restorations 3 months after crown lengthening surgery. (**g**) Finalized case lateral view. (**h**) Final smile

**Fig. 14.7** Pre (top row)- and post (bottom row)-outcome at 1 year. Orthodontics by Dr Howard Spector (Chicago, IL, USA). Patient declined orthognathic surgery to correct the remaining right-side crossbite/transverse maxillary deficiency via surgically assisted rapid palatal expansion. However, if elected, SFOT has now simplified orthognathic surgery measures (unilateral SARPE vs. bilateral SARPE requirements), produced a more stable orthodontic result, and remarkably converted an "at-risk" periodontal phenotype to one with substantially less risk to recession-based attachment loss problems secondary to dentoalveolar and alveoloskeletal bone gain

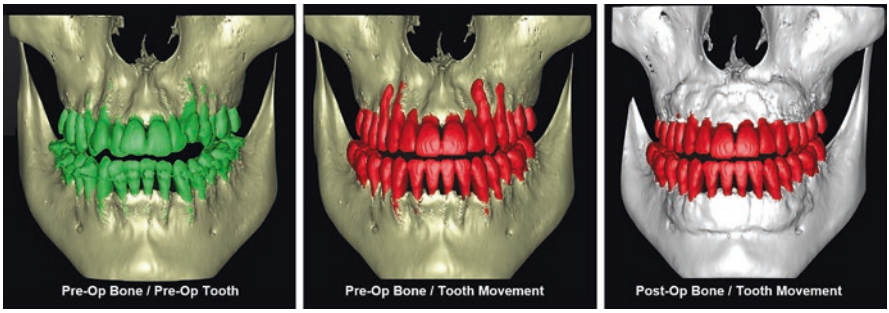


**Fig. 14.8** Before and after CBCT imaging and 3D reconstruction. 3D image on the left demonstrates initial regional anatomy phenotype prior to SFOT intervention. 3D image in the center demonstrates projected bone loss patterns if teeth were to be moved without consideration to the dentoalveolar complex. 3D image on the right demonstrates actual outcome post-SFOT treatment (1 year) from CBCT imaging after treatment. Dentoalveolar bone phenotype has been converted from thin crestal, thin radicular to thick crestal, thick radicular dentoalveolar bone phenotype via SFOT. Reprinted with permission from Mandelaris GA, Neiva R, Chambrone L. American Academy of Periodontology Best Evidence Consensus on Cone Beam Computed Tomography and Interdisciplinary Dentofacial Therapy. A Systematic Review Focusing On Risk Assessment of the Dentoalveolar Bone Changes Influenced By Tooth Movement. *J Periodontol* 2017; 88(10): 960–977

augmentation measures. Such surgery will increase hard tissue A and B point and allow for orthodontic expansion to occur subsequent to the increased orthodontic boundary conditions established by SFOT surgery. Decompensation efforts to optimize anterior protected articulation/coupling by means of labial root torque may be available to the orthodontist secondary to the bone augmentation.

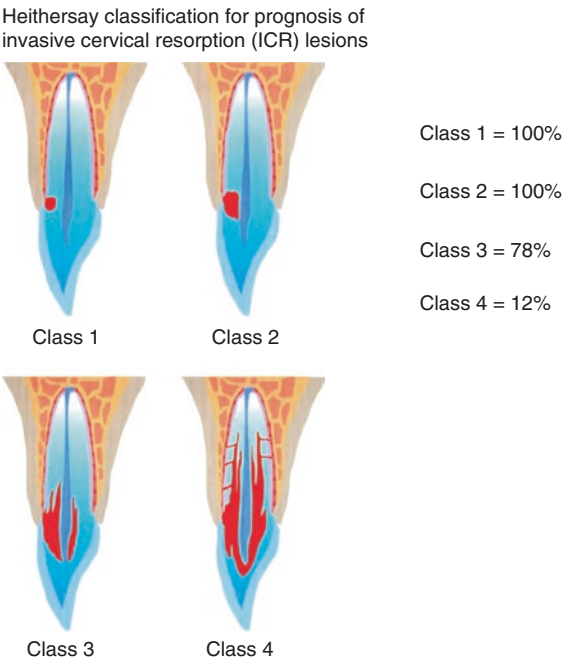


**Fig. 15.7** Heithersay's classification system for prognosis of ICR lesions (from: Heithersay GS. Quintessence Int 1999;30(2):96–110)

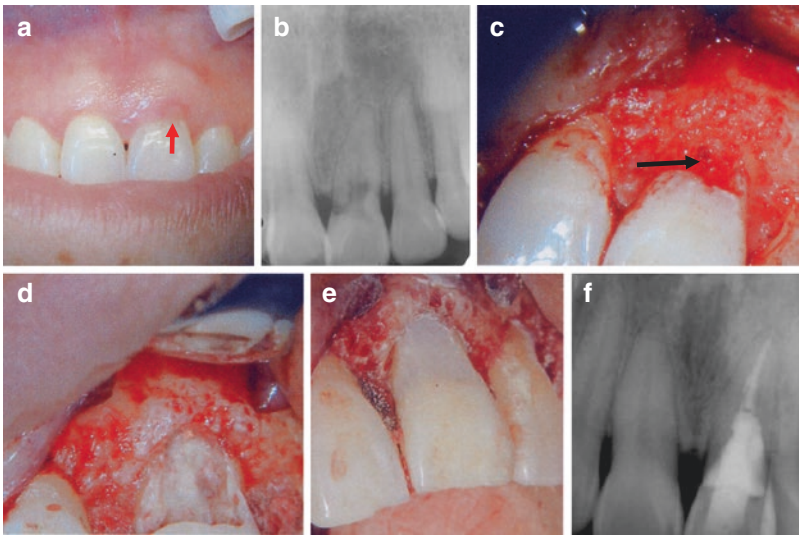


**Fig. 15.8** External root resorption and surgical treatment. (**a**) Image taken when the patient, a 25-year-old healthy female, presented for initial evaluation. Her only complaint was slight soreness to touch and mild bleeding when brushing associated with the maxillary left central incisor (red arrow points to inflamed gingiva). (**b**) Radiograph that demonstrates a moderately extensive ICR lesion (Heithersay Class 3). (**c**) A flap was reflected, exposing the inflamed granulation tissue in the facial defect (arrow). The granulation tissue was curetted and the tooth was treated with TCA (**d**). The defect was restored with a resin-modified glass ionomer material (**e**). (**f**) Is a radiograph of the restored tooth. The long-term prognosis is questionable