Application of the Neutral Zone in Prosthodontics
Application of the Neutral Zone in Prosthodontics

Joseph J. Massad, DDS
Private Practice, Tulsa, OK, USA
Associate Professor, Department of Prosthodontics, University of Tennessee Health Center, School of Dentistry, Memphis, TN, USA
Adjunct Associate Professor, Department of Prosthodontics and Operative Dentistry, Tufts University School of Dental Medicine, Boston, MA, USA
Adjunct Associate Professor, Department of Comprehensive Dentistry, University of Texas Health Science Center, School of Dentistry, San Antonio, TX, USA
Adjunct Associate Professor, Department of Restorative Dentistry, Loma Linda University School of Dentistry, Loma Linda, CA, USA
Clinical Assistant Professor, University of Oklahoma College of Dentistry, Oklahoma City, OK, USA

David R. Cagna, DMD, MS
Professor, Department of Prosthodontics
Associate Dean, Postgraduate Affairs
Director, Advanced Prosthodontics Program
University of Tennessee Health Science Center, College of Dentistry, Memphis, TN, USA
Diplomate & Director, American Board of Prosthodontics
Fellow, American College of Prosthodontists

Charles J. Goodacre, DDS, MSD
Distinguished Professor, Department of Restorative Dentistry
Loma Linda University School of Dentistry, Loma Linda, CA, USA
Diplomate and Past-President, American Board of Prosthodontics

Russell A. Wicks, DDS, MS
Professor and Chairman, Department of Prosthodontics
University of Tennessee Health Science Center, College of Dentistry, Memphis, TN, USA

Swati A. Ahuja, BDS, MDS
Adjunct Assistant Professor, Department of Prosthodontics
University of Tennessee Health Science Center, College of Dentistry, Memphis, TN, USA
Prosthodontic Consultant, Lutheran Medical Center, New York City, NY, USA

WILEY Blackwell
Contents

Foreword ix
Preface xi
About the Companion Website xiii

1 Assessment of Edentulous Patients 1
   Introduction 1
   The Patient Interview 1
      Patient Interview: Age 2
      Patient Interview: Attitude 2
      Patient Interview: Expectations 2
      Patient Interview: Chief Complaint 3
      Patient Interview: General Health 3
      Patient Interview: Complete Denture Experience 3
      Patient Interview: Denture Remake Frequency 4
      Patient Interview: Patient Satisfaction 4
      Patient Interview: Photographs, Diagnostic Casts, and Radiographs 4
   The Facial Analysis 4
      Facial Analysis: Facial Tissue Tone 5
      Facial Analysis: Tooth and Denture Base Display 6
      Facial Analysis: Midlines 6
      Facial Analysis: Lip Mobility 7
      Facial Analysis: Lip Dimension 7
   Prosthetic Factors 8
      Prosthetic Factors: Vertical Dimensions 8
      Prosthetic Factors: Existing Dentures 8
      Prosthetic Factors: Skeletal Relationship 9
      Prosthetic Factors: Saliva 9
      Prosthetic Factors: Oral Tolerance 10
      Prosthetic Factors: Temporomandibular Joints 10
      Prosthetic Factors: Oral Cancer Review 10
   Oral Characteristics 11
      Oral Characteristics: Palatal Throat Form 11
      Oral Characteristics: Arch Size 11
      Oral Characteristics: Maxillary Ridge Height 11
      Oral Characteristics: The Palate 12
      Oral Characteristics: Maxillary Ridge Contour 13
      Oral Characteristics: The Maxillary Denture Foundation 13
      Oral Characteristics: Mandibular Ridge Height 14
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Characteristics: Mandibular Ridge Contour</td>
<td>14</td>
</tr>
<tr>
<td>Oral Characteristics: Mandibular Muscle Attachments</td>
<td>14</td>
</tr>
<tr>
<td>Oral Characteristics: Mandibular Denture Foundation</td>
<td>15</td>
</tr>
<tr>
<td>Oral Characteristics: Maxillary Tuberosity Curve</td>
<td>15</td>
</tr>
<tr>
<td>Oral Characteristics: Vestibule</td>
<td>16</td>
</tr>
<tr>
<td>Oral Characteristics: Frenula Attachments</td>
<td>16</td>
</tr>
<tr>
<td>Oral Characteristics: Pterygomandibular Raphe</td>
<td>16</td>
</tr>
<tr>
<td>Oral Characteristics: Denture Bearing Soft Tissues</td>
<td>16</td>
</tr>
<tr>
<td>Oral Characteristics: Retromolar Pads</td>
<td>17</td>
</tr>
<tr>
<td>Oral Characteristics: Maxillary Ridge Crest</td>
<td>17</td>
</tr>
<tr>
<td>to Resting Lip Length (Esthetic Space)</td>
<td>17</td>
</tr>
<tr>
<td>Oral Characteristics: Mandibular Ridge Crest</td>
<td>17</td>
</tr>
<tr>
<td>to Resting Lip Length (Esthetic Space)</td>
<td>17</td>
</tr>
<tr>
<td>Oral Characteristics: Maximal Oral Opening</td>
<td>17</td>
</tr>
<tr>
<td>Oral Characteristics: Retromylohyoid Space</td>
<td>18</td>
</tr>
<tr>
<td>Oral Characteristics: Tongue Size</td>
<td>19</td>
</tr>
<tr>
<td>Oral Characteristics: Tongue Position</td>
<td>19</td>
</tr>
<tr>
<td>Oral Characteristics: The Neutral Zone</td>
<td>20</td>
</tr>
<tr>
<td>Summary</td>
<td>21</td>
</tr>
<tr>
<td>References</td>
<td>21</td>
</tr>
</tbody>
</table>

2 Orthopedic Resolution of Mandibular Posture 25
   Introduction 25
   Conditioning Abused Tissues and Stabilizing the Existing Prosthesis 26
      Materials Properties and Technique 26
      Technique 26
   Re-establishing Orthopedic Mandibular Position 28
   Summary 33
   References 33

3 Definitive Impressions 35
   Preimpression Considerations 35
   Background 35
   Impression Fundamentals 35
   Impression Materials 36
   Edentulous Impression Trays 37
   Technique for Making Single Appointment Definitive Impressions for
   Conventional Complete Dentures 37
      Tray Selection and Tray Adaptation 37
      Fabrication of Tray Stops 38
      Border Molding the Impression Tray 39
      Final (Definitive) Impression 41
   Techniques for Making Single Appointment Definitive Impressions
   for Implant-Assisted Complete Dentures and Immediate Dentures 43
      Attachment Selection 43
   Implant-Retained Overdentures 43
      Tray Selection 43
      Impression Technique 44
   Implant-Retained and Supported Overdentures 45
   Immediate Dentures 46
4 Fabricating Record Bases, Occlusal Rims, and Mounting a Central Bearing Device 51
   Introduction 51
   Fabrication of Record Base and Occlusal Rims 51
   Fabrication of Maxillary Wax Occlusal Rim 52
   Fabrication of Neutral Zone Mandibular Occlusal Rim 56
   Technique 56
   Jaw Recorder Device (Central Bearing Device) 59
   Jaw Recorder Device Assembly 59
   Mounting the Jaw Recorder Device on Record Bases 59
   Mounting of the Jaw Recorder for Implant Overdentures 61
   Mounting the Jaw Recorder Device on Partially Edentulous Arches 61
   Procedure 62
   Summary 62
   References 64

5 Developing an Esthetic Blueprint 65
   Introduction 65
   Contouring and Shaping the Maxillary Occlusal Rim 65
   Summary 72
   References 72

6 Registering the Maxillo-Mandibular Jaw Relationship 75
   Introduction 75
   Facebow Recording 75
   Centric Relation Recording for the Edentulous Patient 76
   Centric Relation Recording for the Partially Dentate Patient 83
   Summary 86
   References 86

7 Neutral-Zone Registration 89
   Introduction 89
   Recording the Physiologic Neutral Zone for Edentulous Patients 89
   Technique 90
   Recording the Physiologic Neutral Zone for a Dentate Patient 94
   Technique 94
   Summary 96
   References 96

8 Second Laboratory Procedure: Selection and Arrangement of Prosthetic Teeth 99
   Introduction 99
   Indexing the Esthetic Blueprint Record 99
   Indexing the Neutral Zone Record 100
   Selection of Anterior Teeth 101
   Maxillary Anterior Teeth Arrangement 102
   Mandibular Anterior Teeth Arrangement 103
   Selection of Posterior Teeth 105
Mandibular Posterior Teeth Arrangement 106
Maxillary Posterior Tooth Arrangement 108
Tooth Selection and Arrangement for the Partially Edentulous Patient 109
Summary 111
References 111

9 Trial Placement Appointment 113
Trial Placement 113
Evaluation of Esthetics 113
Evaluation of Phonetics 114
Evaluation of Occlusal Vertical Dimension (OVD) 116
Evaluation of Centric Contact Position 116
External Impressions 117
    Technique 118
Summary 124
References 125

10 Denture Placement 127
Introduction 127
Placement of Immediate Dentures 127
    Placement Procedures 129
Evaluation and Adjustment of Intaglio Surface 129
    Technique 129
Evaluation and Adjustment of Denture Borders 131
Evaluating the Cameo Surface 133
Occlusal Evaluation and Correction 133
    Subtractive Correction Technique 135
    Additive Correction Technique 136
Patient Education and Instructions 137
    Technique for Adhesive Application 138
    Technique for Adhesive Removal 138
Home Care Instructions for Denture Patients 140
Postplacement Problems with New Dentures 140
    Retention Problems 140
    Soreness 141
    Sore Throat 141
    Speech Problems 141
    Gagging 141
Summary 142
References 142

11 Use of CAD/CAM Technology for Recording and Fabricating Neutral-Zone Dentures 145
Introduction 145
Registering the Neutral Zone during Impression Making 145
    Technique 145
Registering the Neutral Zone during Maxillo-Mandibular Records 147
    Technique 147
Registering the Neutral Zone during the Trial Placement 147
    Technique 147
Summary 150
References 151

Index 153
The Need to Understand Edentulous Patients

With persistent efforts towards improved oral care, the world is experiencing a decline in the number of edentulous individuals. Despite this, the need for complete denture treatment is still in demand. In fact, dentistry continues to offer innovative denture services, such as computer-assisted design, computer-assisted manufacturing, better-controlled resin processing methodologies, and new materials. Recent developments in denture therapy largely reflect the evolving mindset of patients around the globe. Dentistry has come a long way from the days of vulcanite and ivory teeth. The evolving thoughts, perceptions, and expectations of patients are underpinning denture evolution and denture service delivery.

A major shift in demographics has fueled this evolution. Developing countries have witnessed a steep increase in life expectancy. In Japan life expectancy is now 83.7 years, and in the United States 79.3 years. The same is true in developing nations like India, where life expectancy is now 68.3 years. These changes are related to improved medical care. Individuals living longer and previous dental neglect, combine to create a cohort possessing complex dental problems that require specialized prosthodontic management.

Improved economic stability, resulting from monetary and insurance reform, also influences changing attitudes on dental rehabilitation with complete dentures. Again this trend is clearly evident in developed nations, but also significant in developing countries. More than ever before, patients are electing to invest in enhanced denture services.

Continuous movement of populations across borders has heightened awareness of the benefits of oral health worldwide. Dentists regularly encounter patients well versed in the importance of good oral health and treatment necessary for its maintenance, to include the full range of prosthodontic services. Dentures are no longer seen as a “taboo.” Patients appreciate oral health as a gateway to improved general health, and insist on the optimal replacement of missing teeth.

The improved lifestyles of modern populations catalyze the demand for optimal denture services. The desire to elevate personal image and social acceptance, regardless of age, drives patients seeking esthetic dental rehabilitation. Lost facial support leading to an aged appearance, encourage patients to seek esthetic improvements through quality denture services. Likewise, replacing old complete dentures that fail to provide esthetic advantage occurs more frequently today than ever before in dentistry.

Changing dietary patterns and food selections, with greater emphasis on foods requiring efficient masticatory function, lead patients to appreciate well-functioning prosthetic replacement of missing teeth and to seek high-quality denture service. With
edentulism and/or inadequate complete dentures, patients are at risk of suboptimal nutritional intake due to compromised masticatory ability. This too is a common complaint from patients seeking high-quality denture services.

In the face of this increased demand, it is important to revisit the classic dictum put forward by Dr. Muller M. DeVan1 so many years ago, “The dentist should meet the mind of the patient before he meets the mouth of the patient.” Unless we understand our patient, his motivations, and the road he traveled to edentulism, any dental rehabilitative effort will be compromised at best. The patient may be elderly, reporting to the dentist as a result of tooth loss over several decades of organized personal hygiene neglect. He may be middle aged and suffering from masticatory inefficiency as a result of anodontia, hypodontia, ectodermal dysplasia, or some similar disorders, or due to traumatic tooth loss. A thorough understanding of the motivations driving these dramatically different patients may provide insight to both mindset and expectations. Unrealistic expectations are all-too-often therapeutically insurmountable, requiring that the patient be made aware of treatment and prosthesis limitations. Frequently, older patients lack tolerance for, and compliance with, the long appointment times required for optimal prosthodontic treatment. When successfully detected during the first patient interview, this important consideration will likely influence appropriate treatment selection.

In summary, it is paramount to “meet the mind” of edentulous patients so that rehabilitative dental therapy can be optimized. Several considerations introduced in these few introductory paragraphs, and further detailed throughout this important text, will aid enthusiastic and meticulous dentists in greater appreciation of edentulous patients in order to offer sound solutions in the management of their concerns.

Prof. (Dr.) Mahesh Verma
Director – Principal, Maulana Azad Institute of Dental Sciences, MAMC Complex, BSZ Marg, New Delhi, India

Dr. Aditi Nanda
Senior Research Associate, Department of Prosthodontics, Maulana Azad Institute of Dental Sciences, MAMC Complex, BSZ Marg, New Delhi, India

Reference

The concept of the neutral zone is by no means original and was discussed in 1933 in a textbook titled *The Principles of Complete Dentures*, authored by Sir Wilfred Fish. In 1973, Dr. Victor Beresin and Dr. Frank Schiesser published a textbook titled *The Neutral Zone in Complete Dentures*. The neutral zone concept was initially intended for edentulous patients; however, in 1978, Beresin and Schiesser published a second edition titled *The Neutral Zone in Complete and Partial Dentures*.

Even though complete dentures are not ideal replacements for natural dentition, they should not be noticeable or feel like a foreign object in the patient’s mouth. Incorporating the actions of the surrounding muscles of facial expression, speech, and mastication is often overlooked in the fabrication of maxillary and mandibular complete dentures. All oral functions that include chewing, swallowing, speaking, laughing, and sucking, involve the harmonious action of the lips, cheeks, tongue, and the floor of the mouth. These actions have an influence on prosthetic design and can be recorded by a functional method. Failure to acknowledge these functions can affect tooth positions, border extensions, the occlusal plane location, and the contours of the polished surface, which may result in unstable and unsatisfactory prostheses. The concept of the neutral zone takes into account the neuromuscular functions that contribute to denture stability. This book will discuss and illustrate a step-by-step method to identify and record the neuromuscular actions that help to define appropriate tooth positions and develop cameo surface contours which feel more normal to the patient. This method has been expanded to include the dentate patient preparing for immediate dentures, implant-supported overdentures, and fixed complete dentures (hybrid implant prostheses). Complete dentures fabricated by the methods described, can become a guide for optimal placement of implants within the confines of the prosthesis contours.

Successful complete denture therapy is often a considerable challenge for the less-experienced practitioner, so many dentists choose to limit, or not offer, this service in their practice. The number one denture problem reported by dentists globally has been fit and stability, followed closely by occlusal disharmony and compromised esthetics. This book is similar to others on this subject in that it will cover all phases of complete denture records and fabrication. It reviews a step-by-step assessment and examination protocol, designed to deliver an accurate diagnosis and prognosis prior to committing to treatment. It also describes a very predictable “impressioning” procedure that can be accomplished in a single appointment with a level of accuracy that is similar to, or better than, conventional methods. It discusses the severely vertically closed patient and the resolution of this condition, and describes the techniques of making maxillo-mandibular jaw relationship records to accommodate optimal treatment results.

The problem of esthetics, one of the most critical issues plaguing the dental practitioner,
can be avoided. As esthetics is on most patients’ minds today, we have dedicated a portion of the first chapter to the identification and hopefully the elimination of any unrealistic patient demands. In this textbook, we have utilized the concept of “anticipating failure in order to avoid it.” Lack of knowledge and failure to recognize the patient’s desires and needs can and will have a disastrous effect on the prognosis of any prostheses. However, if we understand human nature and ask the right questions of each of our patients, then it becomes much easier to understand their actual requirements and allows them to be part of the process in building the esthetic result.

The primary objective of this book is to describe current procedures in the fabrication of complete dentures by blending multiple clinical procedures and philosophies to create a contemporary recipe for optimal outcomes. The intent is to identify fundamental applications that can be related to various prosthodontic procedures practiced today. Another goal is to empower the reader with additional knowledge, confidence, and practical applications in the provision of prosthodontic services.

To begin the journey, I would like to thank all those who have assisted me in becoming a more astute, compassionate and learned practitioner; particularly my mentors Drs. Frank Schiesser, Kenneth Rudd, Thomas Shipmon, Lindsay Pankey, and John Frush. I am very grateful to have highly respected co-authors, Drs. David Cagna, Charles Goodacre, Russell Wicks, and Swati Ahuja, and contributing author Mahesh Verma. A special thank you to Dr. Ahuja for compiling all the information from all the authors to complete this manuscript. I want to add my sincere thanks to my multiple reviewers for their suggestions as to the content of this manuscript. They are Drs. Mahesh Verma, Tony Daher, David Little, William Davis, Mostafa ElSherif, Richard June, William Lobel, Samuel Strong, and Joseph Thornton. It is also very important to me to thank Mr. Todd Heilmann for his expertise in taking and preparing all the photographs and illustrations.

A thank you to Kenneth Waldo, Ron Johnston, Eric Newnum, Craig Nelson, and Zarko Danilov, my dental prosthetic technicians, who worked tirelessly in preparing actual patient cases so that I could demonstrate vital aspects of this manuscript. Also a thank you to William Knowles for his engineering of the dental devices we used in treating our patients. I want to thank Dr. John Gordon who invited me to Jamaica to begin writing this manuscript in isolation while his sister, Glass, typed every word as I dictated for four long days.

I dedicate this textbook to my lovely wife Darlene, and my wonderful children Jolene, Jordan, Joshua, Jodain, and Joslyn.

Joseph J. Massad
About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/massad/neutral

The website includes:

- Video clips
- Student handouts for download

Your password for the site is **ghx19cb354e**.

Instructors can also gain access to a companion website with the above materials and instructional PowerPoints, which are for faculty use only and should not be distributed to students. To access this site, please go to the book’s page on wiley.com and navigate to the Instructor Site; you can then register your information to gain access.
Assessment of Edentulous Patients

Introduction

A critical and somewhat perplexing aspect of the management of the edentulous condition is the prediction of therapeutic outcomes and patient satisfaction. The most fundamental factor determining a precise prognosis is a thorough and accurate pretreatment examination [1–3]. Even though patients may receive the best therapy, the treatment will fail if underlying conditions remain undiagnosed.

This chapter reviews a method for the pretreatment evaluation of edentulous patients and existing prostheses to arrive at a sound understanding of factors that will affect therapy and the probability that the treatment’s objective can be achieved. Using appropriate assessment tools, the practitioner can better determine if the patient’s expectations can be met.

Much has been published in the dental literature regarding anatomic [4, 5] and psychological variations [6, 7] in edentulous patients. Before considering management of these challenging patients, objectives include thorough examination, diagnosis of existing conditions, consideration of available therapy, and assessment of the prognosis of each available treatment option [1, 2]. Both subjective and objective patient factors must be taken into consideration [1]. A rational stepwise pretreatment protocol will help to prevent critical diagnostic information from being overlooked. Detailed documentation of findings is essential from a dento-legal standpoint.

The pretreatment protocol provided is relatively easy to follow, quick to perform, and easy to reproduce. It yields summary findings that correspond with specific prognostic conclusions. The protocol is divided into: (i) patient interview; (ii) examination of existing facial characteristics; and (iii) examination of edentulous conditions, i.e., anatomic, morphologic, and muscular status.

The Patient Interview

Successful therapy is facilitated by the provider coming to know the patient, from both personal and logistical perspectives; this includes how the patient arrived in the practice. If the patient was referred, the referral source should be known and contacted, and the reason for the referral noted. If the patient arrived due to marketing of the practice, care must be taken to investigate if the patient’s needs are consistent with therapy provided by the practitioner.

The initial patient interview permits the patient and the practitioner to know one another [8]. Quality time spent at the beginning sets the stage for an optimized patient-provider relationship. Both the physical and psychological status of the patient should be triaged during the first appointment [8]. Anticipation of communication problems and interception of commonly encountered interpersonal
problems are frequently as important as clinical findings. Discerning the primary etiology of existing patient dissatisfaction is essential for breaking the cycle of unsuccessful treatment attempts. Complaints and expectations expressed by the patient, and treatment obstacles encountered by previous dentists, can provide a critical influence on the acceptance of the patient into the practice and the treatment offered.

Be aware that the pretreatment protocol provided might initially appear to consume an inordinate amount of time and effort. Some might say that this is financially unjustifiable. However, once understood and skillfully conducted, the protocol reduces overall management time, permits appreciation of the treatment rendered, and significantly contributes to overall therapeutic success.

Some patients may be fearful, nervous, or shy, and inadvertently fail to respond directly to questions. Recognition of these individuals early in the interview process is critical. In many cases, a dental auxiliary can better elicit patient responses than the practitioner. Obtaining honest and accurate patient responses will affect outcomes. The pretreatment protocol and associated electronic documentation presented incorporate data-gathering processes designed to elicit thorough, concentrated, and accurate answers from patients.

Patient Interview: Age

The patient’s chronological age should be critically compared with general physical health and existing oral conditions. Older patients may be afflicted with poor neuromuscular coordination [9, 10], suboptimal nutritional status [11, 12], diminished adaptability [9, 10], and salivary secretion (both quantity and quality) [11], and highly vulnerable denture-bearing tissues [10, 11]. These factors adversely influence aging edentulous patients’ ability successfully to tolerate and function with conventional complete dentures, which should be discussed prior to initiating treatment [8]. Analogies such as “when dentures move and there’s limited saliva, the pink plastic acts like sand paper against your gums creating irritation” help patients to understand better the problems that they face.

Patient Interview: Attitude

Coming to appreciate patient attitude may be as simple as presenting nonleading questions and permitting the patient time to respond. Questions that may be used to gauge patient attitude include:

- How are you feeling today?
- How was your experience with the previous dentist that treated you?
- What do you think about your current and previous dentures?

Based on patient responses and ensuing discussions, qualifications of patient attitude as good, average, or poor may be made. Of course, additional questioning may be necessary to arrive at a reasonable determination.

Patient Interview: Expectations

If not thoroughly investigated prior to initiating treatment, patient expectations may not be apparent until problems unexpectedly emerge in the course of therapy, and the patient’s demeanor begins to decline [9, 13]. Direct and specific questioning of the patient regarding expectations will permit documentation of responses and qualification of expectations as high, medium, low, or still unsure. Patients can also be asked the following questions to understand further the nature of their expectations:

- What kind of improvement in appearance do you expect from your new dentures? In response to this question, a 50-year-old patient may provide a picture of an 18-year-old celebrity stating, “I want my teeth to look like hers.” This would indicate that the patient possesses unrealistic expectations. A subsequent patient may suggest, “I want perfect teeth,”