Diagnosis and Treatment in Prosthodontics

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Twenty-eight years have elapsed since I came across the first edition of this superb text. I had at the time already made my personally decisive journeys to two renowned US institutions of graduate education in my chosen field of interest. And just like many other would-be clinical academics—both then and now—I benefitted enormously from my extraordinary teachers’ experience and their commitment to clinical excellence. However, my acquired and presumed ability to address the bigger picture of diagnosis as well as treatment in the discipline of prosthodontics had to be acknowledged as an incomplete one. I had gradually realized that the rigor and focus that underscored the era’s guidance in specialized dental education was not automatically reconcilable with patients’ systemic determinants and individualized needs. Dental treatment planning tended to be overtly hegemonic because handicraft and anecdotal traditions in the discipline were dominant. Moreover, the additional objective of treatment interventions to restore orofacial function was rarely determined by the exacting standards today’s treatment outcome demands.

It was inarguably an opportune time for a text that sought to provide a synthesis of what was even more essential and comprehensive for optimal management of the prosthodontic patient, and this book’s first edition addressed that big picture need in the scholarly manner that admirably reflected the Mayo Clinic’s distinguished authorship pedigree. It quickly became a de rigeur assignment for graduate students in the specialty as well as new graduates who were considering prosthodontics as their career pursuit. But it also preceded the osseointegration era; and the intervening years between the two editions were overtaken by the remarkable speed and excitement of the relevant scientific changes—biologic, behavioral, social, technologic—that have now come to dominate the discipline.

The editors are therefore readily forgiven for making us wait so long for this very welcome second edition. It significantly expands the original book’s scope by its recruitment of those essential topics such as genetics, adjunctive laboratory examinations, psychologic concerns, imaging techniques, etc, that have informed and revised the entire profession. It also makes it far clearer than ever before that the discipline has not only benefited from the information explosion but that it has also convincingly embraced it. The net result is a renewed and elegant confirmation of the conviction that good prosthodontics is simply not reducible to tidy formulas or rigidly ordered credos, that it demands scrupulous and eclectic observational skills, and that this approach remains a wise and essential strategy to avoid what might very well be unnecessary and misguided interventions.

This text makes a compelling case for prosthodontics as a clinical dental specialty in the best scholarly tradition. I cannot think of a better one to make the profession appreciate what the discipline is really all about.

George A. Zarb
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Editor-in-Chief, *International Journal of Prosthodontics*
Since publication of the first edition, many changes have occurred in the clinical practice of prosthodontics. While the human patient and related oral/perioral problems remain physically unchanged, psycho-social attitudes [AU: Ok?] toward dentistry and care deliverers have been altered as a result of shifts in societal values and priorities. An enlightened and entitled generation now places more emphasis on personal appearance, early relief from pain and inconvenience in a timely manner, as well as cost and cost sharing by third-party contributors.

Hard and soft tissue substance continues to be altered by disease and dramatic injury with genetic overlay imposed occasionally by racial commingling and natural evolutionary processes. However, the clinical management of tooth and bone loss and acquired and congenital oral and perioral defects has changed dramatically as a result of improved technical and procedural modalities and materials. The introduction of Brånemark’s concept of osseointegration in North America in 1982, with its accompanying biocompatible titanium hardware, has resulted in remarkable developments and approaches to restorative treatment with versatility of application and predictable outcomes.

In addition to implant-support opportunities, probably more than any other phase of restorative dentistry, the advances in ceramic options and materials have contributed to satisfying patient demands for more esthetic treatment outcomes. These applications relate primarily to fixed restorations, which now have more durability and a more lifelike appearance.

Electronic technology has provided for an improved diagnostic and treatment-planning capability. Imaging techniques and equipment have evolved that provide more extensive and accurate information, which assist the clinician in decision making prior to and during treatment. Compared to two-dimensional or flat-screen images, newer three-dimensional imaging and modeling have significantly enhanced the planning and delivery of surgical restorative treatment.

In response to these developments, this second edition required the solicitation of additional knowledge and expertise from experienced prosthodontic specialists and competent representatives from related contributing disciplines. [AU: Okay to delete about Dr Gibilisco?] These relevant additions have provided an enhanced scope and depth of subject matter on topics pertinent to prosthodontics.

Acknowledgments

The authors would like to acknowledge their colleagues in oral and maxillofacial surgery, radiation oncology, and otolaryngology/head and neck surgery for their dedication in helping compile the subject matter. Additional thanks are extended to the secretarial support section of the Department of Dental Specialties at Mayo Clinic for helping with portions of the manuscript. Further acknowledgments are extended to the authors’ wives and families for their understanding of the time needed to accomplish this important project.
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The field of genetics has undergone rapid growth in recent years and greatly affected all areas of medicine. The completion of the Human Genome Project, which identified the three billion base pairs of DNA that compose a human genome, was a landmark event of the end of the 20th century. Genetic information is now being incorporated into all areas of clinical medicine, changing even basic concepts in evaluation of and therapy for patients. While science has yet to reach full comprehension of all gene functions and protein interactions, we remain optimistic that opportunities soon will be developed to predict, prevent, and cure human diseases through methods such as personal genetic fingerprinting and routine gene therapy. Staying up to date on recent genetic developments and applying this knowledge to patient care will become a necessary skill for most clinicians.

Genetics in Clinical Medicine

The role of genetics in human disease is well-known. Some conditions are caused by single genes and inherited in a Mendelian pattern; the diagnosis, risk assessment, and counseling for the family are usually simple for these conditions.1,2 In other cases, recognition of an underlying genetic trait may be a challenge, and multidisciplinary evaluations and complex diagnostic testing are often needed. Common questions that general clinicians should ask include the following:

- Does this patient have a hereditary disorder?
- Does this patient have a simple condition or a complex disorder underlying the symptoms?
- Is there a need for evaluation of other family members?
- What is the risk that the patient’s children or siblings will inherit the condition?
- Could the disease be managed or stopped in its early stages if a timely diagnosis is made?

The answers to these questions can significantly affect a patient’s life. For example, if a patient with Marfan syndrome presents with dental irregularities (eg, crowding), recognition of a generalized connective tissue abnormality would typically lead to a series of preventive measures including screening for aortic root dilatation. In this patient, early diagnosis and appropriate treatment might be life-saving. Another example is a patient with osteomata of facial bones, dentigerous cysts, or supernumerary teeth—possible signs of familial adenomatous polyposis. Early identification of this hereditary disorder in the patient and his or her family would lead to necessary surveillance for colon cancers or even preventive colectomy, thereby transforming a uniformly malignant and lethal condition into a manageable one. The dental specialist often may be the first to see a patient with an unrecognized, complex medical problem; a high index of suspicion and appropriate referral may dramatically influence the well-being of a patient and his or her relatives.
Cleft Lip and Palate

Cleft lip, with and without cleft palate, and isolated cleft palate are serious birth defects that affect approximately 1 in every 600 newborn babies worldwide. The incidence of cleft lip/palate by race is 2.1 per 1,000 in Asians, 1 per 1,000 in whites, and 0.41 per 1,000 in blacks. Isolated cleft palate is less variable, presenting a fairly constant ratio of 0.45 to 0.5 per 1,000 births. It is common for patients with clefts to exhibit other congenital anomalies: 7% to 13% of those with isolated clefts and 11% to 14% of those with cleft lip/palate are additionally affected. There are several classifications of cleft lip and palate combinations (Fig 15-4).

Clefts often have pathologic consequences, such as nutritional deficiencies, resulting from impaired feeding, reduced hearing from recurrent ear infections, abnormal speech development, and diminished facial growth related to surgical interventions. Although the bony defect is a critical focus of surgical intervention, the muscular and soft tissue pathology have the greatest impact on the functional result of management. The region is a complex arrangement of six muscles, three of which are critical to palatopharyngeal function: the uvula, the levator veli palatini, and the superior pharyngeal constrictor. In a cleft palate, the muscle considered most significant to palatopharyngeal competence is the levator veli palatini.

Management

Management of cleft lip or palate is a multidisciplinary team effort that requires coordinated care initiated soon after birth, continuing throughout subsequent years. In the past, the prosthodontic contribution to the team occurred at earlier stages of care than is generally the current practice. This change is largely a result of more acceptable surgical options that are now available to address basic speech and swallow needs of the developing infant and child.

Currently, prosthodontic management includes consideration for restoration of missing teeth within the anterolateral alveolus or prostheses to provide palatopharyngeal closure for unsuccessful or unattempted surgical management. Additionally, nasoalveolar molding may be offered as an adjunct to early intervention in some team approaches.

The literature reveals a lack of an accepted universal clinical protocol to guide management of this patient population. Because of this situation, the prosthodontist should consider the management options that can be provided to this patient population and work within the team approach to support the overall management needs.

Historical and background considerations

Early descriptions of surgical closure techniques were followed by considerations of the influence of operative closure on palatal function and subsequent anatomical development. The concern regarding the influence of the surgical wound on motor control in soft palatal speech movements in the developing child, in addition to its influence on nasomaxillary growth, has been at the heart of technique refinements. This evolution is reflected in the statement that “the challenge in the art of modern palatoplasty is no longer successful closure of the cleft palate but an optimal speech outcome without compromising maxillofacial growth.” This evolution of treatment goals has aroused controversies related to speech and maxillofacial growth that dispute the effectiveness of numerous treatment protocols. Developments in prosthodontic management can also be seen in the impact of alveolar bone grafting techniques in the mixed dentition. This option has also allowed arch discontinuity to be restored at a time when orthodontic movement can potentially obviate the need for prosthodontic intervention in select situations.

Multidisciplinary intervention

A World Health Organization (WHO) report on the global impact of craniofacial anomalies (CFA) proposed that treatment of CFA has not benefited from contemporary health technology assessment; consequently, optimal management cannot be universally defined for even the most common conditions. For each of the many subgroups of
Cleft Lip and Palate

CFA, the attainment of homogenous samples of adequate size for randomized trials and long-term follow-up presents a formidable challenge.35 Where care is available, multiple providers are necessary for appropriate management.36

A major contribution of orthodontics is its ability to limit facial growth distortion with the use of corrective orthodontic alveolar ridge positioning and tooth movement (see chapter 2). As previously stated, the benefit of alveolar bone grafts during the mixed dentition stage is that they allow the opportunity to position adjacent teeth within the graft for optimal esthetics and function.37

With the establishment of cleft palate teams and centers, the clinical management of large numbers of patients led to the accumulation of data that suggest the merit of staged treatment initiated soon after birth. Earlier surgical and orthodontic intervention for most patients has resulted in less complex problems in the adolescent and adult years. Because of the better results achieved through earlier treatment, the role of the prosthodontist in the multidisciplinary team has changed somewhat in recent years. The need for fabrication of obturators, replacement of missing teeth, and speech-bulb stimulators in preschool children with clefts continues, but the volume of patients for whom prosthodontic services are indicated has diminished significantly. The prosthodontist now appears to be involved mainly in the later phase of active treatment, when fixed and removable prostheses are needed to definitively restore missing teeth, stabilize aligned arch segments, restore occlusal function, provide facial support and dimension, and assist in speech (Fig 15-5).

The changing role of the prosthodontist does not imply that his or her services are no longer needed in the early phases of treatment. Because some situations exist in which prosthodontic services may be indicated early, active participation in the group decision-making process is encouraged. Most patients with cleft palate require some type of prosthesis. Mazaheri has estimated that in approximately 95% of the patients in whom a cleft involves the alveolar ridge, either a fixed or a removable prosthesis will be needed.38 It has also been suggested that about 60% of all cleft palate patients need some type of prosthesis by the age of 30 years.

Other than tooth-supported restorations, the most common prosthesis required for the patient with cleft palate is an RPD (Fig 15-6). In patients with distorted jaw relationships, closed vertical dimension of occlusion (VDO), complicated occlusal or esthetic problems, or

Fig 15-5 (a) A 12-year-old girl with cleft palate. (b) Intraoral defect. (c) Base prosthesis processed with wire extension. (d) Tracing of defect with modeling plastic compound. (e) Final tracing with mouth temperature wax. (f) Radiographic verification with pharyngeal extension adjacent to level of atlas. (g) Intraoral view with seated interim prosthesis.

Fig 15-6 (a to c) Adult with unilateral cleft lip/cleft palate restored with RPD-based prosthesis with palatal and pharyngeal obturators.
sulcus, for nonyielding mucosa such as that found over tori, and for sublingual slopes that deviate from vertical. Adjustment of the metal framework may be provided, but the magnitude of adjustment is quite limited. Major connector design should avoid encroachment upon functional musculature or frenae. Major connectors that are placed too close to gingival margins will permit accumulation of food adjacent to the remaining teeth and could result in gingival or periodontal complications. When encountered, overextended major connectors may be shortened in the areas of tissue ulceration. If major connectors are less than 4 mm from the gingival margin, they must be narrowed to provide self-cleansing areas, or the partial denture framework may need to be remade. Remake is also necessary should adjustment result in a flexible metal framework. When excessive beading is encountered, it can be corrected through selective adjustment.

It is not unusual for the patient to encounter tooth pain or mobility following placement of a removable partial denture. The potential causes for this include the following:

- Pulpitis
- Return of function of the tooth that had previously been nonfunctional
- Traumatic occlusion
- Bruxing or clenching habits
- Rigid retainer
- Tooth movement
- Failure of partial denture to seat fully

Occlusal and partial denture stress on a tooth that has been out of occlusal function for an extended period may make the tooth sensitive to percussion. In many instances, pulpitis is reversible; however, if the tooth remains symptomatic, endodontic therapy may be necessary. Defective occlusal contacts related to the abutment tooth, partial denture frame, or the prosthetic teeth may be detected by visual examination, articulating paper, or occlusal indicator wax. Occlusal adjustment should be performed to address these discrepancies.

If excessive pressure is needed to place or remove a removable partial denture, it may be indicative of excessive rigidity of the direct retainers. This situation can be addressed through the tapering of the retentive clasp arms or by careful movement of the retentive tip closer to the survey line. In some instances, it may be necessary to replace the retentive arm with a wrought-wire clasp. Tooth movement may occur between impression-making procedures and prosthesis insertion. Unfortunately, this situation can only be addressed by remaking the metal framework. Failure of the removable partial denture to seat fully may be caused by acrylic resin or metal impingement on the natural teeth. This situation should be easily identified with disclosing wax or pressure-indicator paste and can be addressed with simple adjustment of the prosthesis.

Complications of Obturator Prostheses

Obturator prostheses exhibit many of the same complications seen with removable partial dentures. However, some unique complications need to be considered.

Difficulties with proper speech are sometimes encountered with obturator prostheses (see chapter 19). These may be caused by insufficient obturation, excessive obturation, or resonance or articulation errors. Speech difficulties generally are more common in patients with congenital defects. Insufficient obturation initially should be identified through nasal emission of air, which causes hyponasality. Increased obturation of the defect can correct this. Should modification be delayed, patients may exhibit muscular activity in the infratemporal area to compensate for the lack of defect obturation. Excessive obturation can be detected by the hollow hyponasal quality of speech and by difficulty with nasal breathing. This may be corrected through judicious reduction of the size of the obturator. Patients with large oral or perioral defects may experience resonant sounds, this issue is sometimes secondary to the need for appropriate insertion and drainage requirements of the obturator prosthesis. Articulation errors may be identified through subjective analysis of speech, but these are best evaluated and treated by a speech pathologist who can address the articulation concerns with a variety of therapeutic methods.
Patients may experience occasional passage of food and liquids above the obturator prosthesis. This situation may develop secondary to a lack of peripheral seal of the obturator portion of the prosthesis. Normally, this lack of seal can be evaluated visually. In addition, in some instances, the musculature of the soft palate may return to its presurgical level, which could reduce contact between the muscular structure and the obturator prosthesis. Either of these situations could be treated through the addition of mouth temperature wax to the periphery of the prosthesis. Once the seal is reestablished and confirmed, autopolymerizing resin may be applied to replace the mouth temperature wax. Patients who complain of passage of fluids or food should be observed while drinking water to ensure that the patient’s head position facilitates swallowing. Patients should be instructed to hold the head level or even to tip it posteriorly to encourage the passage of food into the oropharynx.

Irritation beneath the obturator portion of the prosthesis may be caused by impingement of the prosthesis on either the static or movable tissues. Impingement on the static tissues can be easily identified with pressure-indicator paste, and the prosthesis can be adjusted accordingly. If impingement occurs on movable tissue, pressure-indicator paste still may be beneficial, but the clinician is encouraged to respond to patients’ complaints of difficulty with head movement, mandibular movement, or swallowing activities. Impingement of the obturator prosthesis on the respiratory mucosa could result in tissue ulceration or excessive secretions of the respiratory mucosa. The clinician is advised to eliminate all contact between the prosthesis and the turbinates, nasal mucosa, or orbital contents (Fig 20-11).

### Fixed Dental Prostheses

Dental prostheses may be rigidly connected to teeth or dental implants. Each approach carries unique potential complications and demands specific considerations regarding long-term maintenance (Table 20-1).

When prostheses are connected to natural teeth, a number of short-term and long-term complications may be observed. Short-term complications generally relate to the health of the dental pulp, occlusal scheme, and gingival periodontal health. Long-term considerations include all the short-term factors plus biologic and biomechanical complications that may occur over time.

Tooth preparation for full or partial veneer crowns causes trauma to the pulp of the tooth (Fig 20-12). In most instances, this results in transient irritation known as reversible pulpitis, which may manifest as thermal or osmotic sensitivity. The health status of the pulp may be assessed through vitality testing, although such test results are not entirely reliable and may not predict the future course of pulpal health.

### Table 20-1

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<td>Staining</td>
<td>Ultrasonic debridement/polishing</td>
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<td>Repeated fracture of denture base</td>
<td>Repair and reassess occlusal factors</td>
<td>Redesign with reinforcement or modify supporting tissues</td>
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<td>Worn teeth</td>
<td>Lamination of teeth with composite resin</td>
<td>Replacement of prosthetic teeth</td>
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<td>Inflamed soft tissues</td>
<td>Determine cause and adjust tissue condition or reline</td>
<td>Monitor progress and determine repeated need for recall and intervention</td>
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<td>Unstable denture base</td>
<td>Reassess adaptation and positionally reline</td>
<td>Regular recall examination with or without intervention</td>
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<tr>
<td>Chronic Candida infection</td>
<td>Routine care for infections with antifungal agent; disinfection of prosthesis</td>
<td>Determine underlying contributing factors and intervene as necessary</td>
</tr>
</tbody>
</table>

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### References

- Fig 20-11 (a and b) Patient presenting with slight irritation of soft tissues after postsurgical changes.
- Fig 20-12 (a) Full veneer preparation of one nonvital and two vital teeth. (b) Subsequent restoration with all-ceramic restorations.
- Table 20-1 Common complications of new prostheses and their short-term and long-term solutions.