AMERICAN COLLEGE OF PROSTHODONTISTS®

SPECIAL SECTION

The Social Solution—Denture Esthetics, Phonetics, and Function

Eleni D. Roumanas, DDS

Professor, Division of Advanced Prosthodontics, Biomaterials & Hospital Dentistry, Director, Advanced Prosthodontics Residency Program, UCLA School of Dentistry, Los Angeles, CA

Keywords
Complete dentures; overlay dentures; edentulous jaws; edentulous/psychology/rehabilitation; dental esthetics; patient satisfaction; mastication; speech; dental implants; treatment outcome.

Correspondence
Eleni D. Roumanas, UCLA School of Dentistry, PO Box 951668, Los Angeles, CA 90095-1668. E-mail: eroumanas@dentistry.ucla.edu

Presented as part of the FDI 2008 World Dental Congress: "Facing the Future of Edentulism: 21st Century Management of Edentulism—A World of Challenges in a Universe of Helpful Technologies." September 26, 2008, Stockholm, Sweden.

Accepted November 21, 2008

doi: 10.1111/j.1532-849X.2009.00440.x

Abstract

Tooth loss and rehabilitation with dentures can have tremendous patient impact and social implications. In an image-conscious society, dentures restore a sense of normalcy and allow the patient the ability to interact with others. The most frequent denture complaints include chewing discomfort and objectionable esthetics and phonetics. Determining patient expectations and their influence on patient satisfaction with treatment is critical. Current evidence on functional outcomes, patient satisfaction, and cost-effectiveness of treatment with conventional dentures versus implants are important factors to consider during treatment planning for the edentulous patient. The purpose of this article is to review some exemplar literature for the successful treatment of the edentulous patient.

The causes of edentulism are varied. Although age is a primary predictor of tooth loss, edentulism is not necessarily a part of the normal process of aging. Tooth loss varies widely between countries and is influenced by a variety of economic and social factors.[1] Although edentulism is declining at a rate of about 1% per year in most industrialized countries, these statistics are countered by an increase in average life expectancy so that overall the number of edentulous patients is remaining stable or slightly increasing. In the United States, it is predicted that there will be approximately 38 million edentulous elderly adults by the year 2020.[2]

Edentulism is a chronic disability, and many edentulous patients have difficulty performing essential tasks such as eating, speaking, and socializing.[3,4] Some patients may experience increased social and psychological problems in coping with these impairments. There are also physical consequences to tooth loss, such as atrophy of the supporting alveolar structures, loss of support of the facial musculature, and decreased bite force and masticatory efficiency.[5] Tallgren, Atwood, and others have demonstrated that residual ridge resorption is a continuous process following extraction of teeth that eventually results in unfavorable jaw anatomy and inadequate support for dentures.[6-8] This is especially true for the lower ridge, and the mandibular denture is often the focus of frequent patient complaints such as instability, pain, and inability to chew. A denture wearer's ability to comminute food during mastication is markedly reduced to 1/4 or 1/7 that of adults with natural dentitions depending on the ages of the subjects and the types of food.[9,10] Investigators have further noted that with loss of masticatory efficiency, patients tend not to compensate by prolonging or increasing the number of chewing strokes; they merely swallow larger food particles. Chewing is a selective process, and edentulous patients seem to lack appropriate discriminatory ability.[4]

Despite all the shortcomings and functional deficits, edentulous patients are by and large satisfied with their complete dentures, with less than 10% expressing complete dissatisfaction.[11] Patient satisfaction with treatment is highly influenced

by patient expectations. Some patients may have very unrealistic expectations, while others may have very low expectations. Satisfaction with dentures is impacted by factors such as denture quality, the available denture-bearing area, the quality of the dentist-patient interaction, previous denture experience, and the patient personality and psychological well-being.[12] No single fabrication technique for dentures has been proven to be superior, and the technical quality of dentures accounts for less than half the total treatment success. A dentist must realize the importance of interpersonal management skills, patient preparation, and understanding of denture function and denture limitations. A major role of the dentist is to guide and educate the patient through the process of complete denture therapy. The psychological aspects of treatment need to be appreciated by the dentist and cannot be minimized.[13]

Esthetics

In our image-conscious society, dentures restore a natural appearance leading to increased patient confidence and ease in social interactions. The mass media has tremendous influence on the esthetic tastes of our patients. Messages of health, power, and attractiveness are often linked to movie stars with prominent, white smiles. For many patients who have experienced problems with their teeth during their life, the denture is a way to be reborn with beautiful teeth. There is often a difference of opinion concerning esthetics between dentists and technicians on one hand, and patients on the other.[14] Poor esthetics is one of the primary reasons for nonsuccess of maxillary dentures.[15] A dentist must attempt to create an appropriate smile and appearance that suits the patient's physical character and esthetic needs.

Denture esthetics does not begin and end with the selection of denture teeth. Factors such as impression technique, occlusal plane, vertical dimension, and centric relation also significantly impact denture esthetics. The orbicularis oris and other facial musculature are supported by the alveolous and teeth. Loss of teeth and resorption of the alveolar ridge result in facial collapse. Careful consideration of proper lip support begins in the border-molding stage of impressions. If the denture border is not adequate, the folds of the cheeks are accentuated, and the lips are too thin. Arbitrarily adding resin to the finished denture does not always give the desired result. Overbulking the denture flanges in an attempt to remove wrinkles that are part of the aging process of the skin is also not recommended.

Correct placement of the occlusal plane is important with respect to denture stability, function, and esthetics. The location of the occlusal plane is critical to achievement of a natural appearance. The teeth should gradually rise along the occlusal plane toward the back to follow the smile line and give an impression of distance.[16] This may be difficult to accomplish in a balanced occlusal scheme. The occlusal vertical dimension is responsible for the harmony between the lower third of the face and the face as a whole. With loss of vertical dimension there is also an acquired antero-rotation of the mandible. Vertical dimension and centric relation are closely interrelated, and loss of vertical dimension results in a more exaggerated class III occlusion and facial appearance. Immediate repositioning on the mandible is not always possible.

Finally, we arrive at considerations for anterior tooth selection. There are no rules of thumb with respect to anterior tooth selection; however, there are anatomic landmarks and manufacturer aids that can be used as guides in the process. The size, morphology, color, placement, and characterization of teeth are all factors to be considered. If we are fortunate to have access to preextraction records such as diagnostic casts, photos, or existing dentures, the process may be less complicated. If the patient presents with existing dentures, careful evaluation is essential in opening a dialogue and defining the patient's perception of his/her appearance and esthetic requirements.

Frush and Fisher developed a concept that integrated the selection of teeth into an esthetic system governed by the sex, personality, and age of the patient.[17,18] Manufacturer guides attempt to correlate face contour to tooth form, the most basic forms being square, tapering, and ovoid. Others contend that a relationship exists between the inner canthus of the eyes or the inter-ala distance, and these measurements can be used to select the proper size of the maxillary anterior teeth. Selection of an appropriate tooth size is probably the most critical factor in anterior tooth selection. The teeth must harmonize with the face, physical body, and arch size of the patient. Any disproportion in arch size influences the length, width, and position of the teeth.

The wax rim is often used to determine the size of the maxillary anterior teeth. The wax rim is contoured to provide appropriate lip support and should extend 0 to 4 mm below the lip line, consistent with the patient's age and sex.[19] The canine lines are then marked at the commissures with the lips at rest, and the position of the high lip line is recorded as the patient smiles. These measurements provide information about the gingivo-incisal length and mesiodistal width of the maxillary six anterior teeth. The selected teeth should be long enough to minimize display of the denture base.

Traditionally, denture teeth were selected to harmonize between the color of the skin, hair, and eyes; however, the current practice of tooth bleaching and television shows such as *Extreme Makeover* have dramatically shifted the esthetic norms. Denture teeth with bleached shades are now available and frequently requested by the patients. This is often an area of difference of opinion between the dentist and patient, but ultimately patient demands prevail.

Phonetics

Sound is produced by the larynx and further shaped by muscular changes in the oropharynx to create speech. The interaction of the tongue, palate, lips, teeth, and jaws is integral to the valving and articulatory process that modifies the flow of air to produce speech sounds. A denture that significantly alters the position of the teeth or palatal contours can affect or interfere with speech articulation and intelligibility. Sounds that are frequently affected include bilabial ("p," "b"), labio-dental ("f," "v"), linguo-dental ("th"), and linguo-palatal ("s") sounds. The "s" sound is made by the contact between the tongue tip and the palate at the rugae area with a small space created for the

escape of air. If this space is too small, a whistle usually results. If the space is too broad and thin, "s" is replaced by "sh," which sounds like a lisp.

Phonetics can also be used to assist in determining correct anterior tooth position. In production of "f" and "v" sounds, the incisal edges of the upper teeth contact the posterior inner third of the lower lip, referred to as the wet-dry line. During the production of "s" sounds, the incisal edges of the mandibular incisors come into close proximity to the incisal edges of the maxillary incisors. The "s" sound is often used to determine anterior tooth position and vertical dimension.[20–22]

Measures to improve comfort and prevent or slow ridge resorption

The process of alveolar ridge resorption begins with the extraction of the teeth and continues throughout the life of the patient. Some patients, for reasons that are not clearly understood, may be more prone to this process than others.[23,24] Well-adapted and properly extended dentures with well-designed and -executed occlusion may reduce trauma to the supporting structures and thus minimize bone resorption. Retention of residual tooth roots or placement of osseointegrated implants has proven useful in stimulating the adjacent bone and absorbing occlusal loads, thereby preventing compression and subsequent resorption of the underlying bone.

Implant treatment planning for the edentulous patient

In addition to conventional prostheses, a variety of implant treatment options are now available for the restoration of the edentulous patient. These include implant-assisted and -supported overlay dentures, hybrid prostheses, and fixed porcelain-fused-to-metal or all-ceramic restorations. The treatment planning process is dictated by the age of the patient, psychological demands, esthetic needs, need for hygiene access, anatomic limitations, degree of ridge resorption, inter-occlusal space, and finally, cost of treatment.

There are those who have suggested that implant overdentures should be the standard of care for the edentulous patient.[25] Are dentures based on dentals implants the "best" treatment for the edentulous patient? Often, the latest, greatest treatment may not be in their best interest. How do we justify the treatments that we recommend or provide for our patients? How do we ensure appropriate care and safety, as we attempt to restore function? How do we determine cost-effectiveness?[26] Patients with financial limitations, third-party payers, and government agencies must establish priorities for expenditures to maximize use of scarce health care dollars.

Clinical experience of the dentist will always be an important guide in the selection of treatment options; however, true clinical efficacy can be established only through well-designed clinical trials. Until now, limited studies have evaluated the objective and subjective effects of implant-retained overdentures. Results indicate that dentists cannot rely solely on asking denture wearers about chewing problems for predicting patients' masticatory abilities.[27,28] Improvements in fit of existing conventional dentures or fabrication of new dentures often result in improvements in perceived chewing function by most patients. This is in sharp contrast to the lack of improvement often recorded with standardized masticatory performance tests.[29]

Prospective clinical trials indicate that two implant overdentures result in increased patient satisfaction and improvements in masticatory performance, but only in those patients with severely resorbed ridges who experience persistent problems wearing conventional dentures.[30,31] The same results are not evidenced in average denture patients with more favorable ridges.[32,33]

As the numbers of implants are increased, one might expect a proportionate increase in masticatory performance, satisfaction, and subjective or patient-based perceptions of chewing ability; however, a number of studies have demonstrated no significant differences between implant-retained versus implant-supported restorations.[34,35] Other studies have demonstrated no changes in function with increased implant support, but some perceptual changes were reported by the patients.[36] In an interesting crossover study where patients experienced both a fixed bridge (hybrid) prosthesis and an implant-supported overdenture, half the patients chose to keep the fixed prosthesis, and the other half chose the removable overdenture.[37,38]

It has been speculated that some of the unexpected results with mandibular overdenture therapy might be related to the opposing maxillary complete denture. Studies looking at the maxillary overdenture demonstrate high general satisfaction with the maxillary implant-supported prostheses irrespective of the design; however, the ratings given to the implant prostheses were not significantly higher than for new conventional maxillary dentures.[39]

Data with respect to fixed implant restorations are very limited and confounded by study design variables. A recent study looking at progressively increasing the amount of implant support in both arches concluded that additional support and retention provided by maxillary and mandibular implant overdentures and fully implant-supported dentures can lead to increases in masticatory function, but only with specific food types.[40]

Conclusions

Tooth loss will continue to be a problem and require prosthetic restoration for the immediate future. Complete dentures restore esthetics and function to some degree. A majority of edentulous patients adapt well to their disability and their prostheses, while others experience a great deal of functional and psychological disturbances. These maladaptive patients may benefit from implant therapy.

Neither conventional, implant-assisted, nor implant-supported mandibular and/or maxillary dentures restore function to dentate levels and there appears to be only limited advantages of one treatment over the other. Despite all the positives, implant treatment cannot be generalized to the entire edentulous population for various economic and patient-related factors.

TIPS FOR THE PRACTICING DENTIST

1. The psychological aspects of denture therapy are as critical as the technical. It is important to establish appropriate dentist–patient rapport at the onset of treatment.
2. The dentist must understand patient expectations prior to initiation of treatment.
3. Implants do not lessen the technical demands of denture therapy.

References

1. Mojon P: The world without teeth: demographic trends. In Feine JS, Carlsson GE (eds): Implant Overdentures. The Standard of Care for Edentulous Patients. Chicago, IL, Quintessence, 2003
2. Douglass CW, Shih A, Ostry L: Will there be a need for complete dentures in the United States in 2020? J Prosthet Dent 2002;87:5-8
3. Fiske J, Davis DM, Frances C, et al: The emotional effects of tooth loss in edentulous people. Br Dent J 1998;184:90-93; discussion 79
4. Chauncey HH, Muench ME, Kapur KK, et al: The effect of the loss of teeth on diet and nutrition. Int Dent J 1984;34:98-104
5. Tallgren A, Lang BR, Miller RL: Longitudinal study of soft-tissue profile changes in patients receiving immediate complete dentures. Int J Prosthodont 1991;4:9-16
6. Tallgren A: The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed-longitudinal study covering 25 years. J Prosthet Dent 1972;27:120-132
7. Atwood DA: Reduction of residual ridges: a major oral disease entity. J Prosthet Dent 1971;26:266-279
8. Atwood DA, Coy WA: Clinical, cephalometric, and densitometric study of reduction of residual ridges. J Prosthet Dent 1971;26:280-295
9. Kapur KK, Soman SD: Masticatory performance and efficiency in denture wearers. 1964. J Prosthet Dent 2006;95:407-411
10. Slagter AP, Olthoff LW, Steen WH, et al: Comminution of food by complete-denture wearers. J Dent Res 1992;71:380-386
11. Smedley TC, Friedrichsen SW, Cho MH: A comparison of self-assessed satisfaction among wearers of dentures, hearing aids, and eyeglasses. J Prosthet Dent 1989;62:654-661
12. Berg E: Acceptance of full dentures. Int Dent J 1993;43:299-306
13. Carlsson GE: Clinical morbidity and sequelae of treatment with complete dentures. J Prosthet Dent 1998;79:17-23
14. Carlsson GE, Wagner IV, Odman P, et al: An international comparative multicenter study of assessment of dental appearance using computer-aided image manipulation. Int J Prosthodont 1998;11:246-254
15. Kotkin H: Diagnostic significance of denture complaints. J Prosthet Dent 1985;53:73-77
16. Lombardi RE: The principles of visual perception and their clinical application to denture esthetics. J Prosthet Dent 1973;29:358-382
17. Frush JP, Fisher RD: Introduction to dentogenic restorations. J Prosthet Dent 1955;5:586-595
18. Frush JP, Fisher RD: The dynesthetic interpretation of the dentogenic concept. J Prosthet Dent 1958;8:558-581
19. Vig RG, Brundo GC: The kinetics of anterior tooth display. J Prosthet Dent 1978;39:502-504
20. Pound E: Let /S/ be your guide. J Prosthet Dent 1977;38:482-489
21. Silverman MM: Determination of vertical dimension by phonetics. J Prosthet Dent 1956;6:465
22. Pound E: Controlling anomalies of vertical dimension and speech. J Prosthet Dent 1976;36:124-135
23. Atwood DA: Bone loss of edentulous alveolar ridges. J Periodontol 1979;50:11-21
24. Nishimura I, Garrett N: Impact of Human Genome Project on treatment of frail and edentulous patients. Gerodontology 2004;21:3-9
25. Feine JS, Carlsson GE, Awad MA, et al: The McGill Consensus Statement on Overdentures. Montreal, Quebec, Canada. May 24-25, 2002. Int J Prosthodont 2002;15:413-414
26. MacEntee MI, Walton JN: The economics of complete dentures and implant-related services: a framework for analysis and preliminary outcomes. J Prosthet Dent 1998;79:24-30
27. Slagter AP, Olthoff LW, Bosman F, et al: Masticatory ability, denture quality, and oral conditions in edentulous subjects. J Prosthet Dent 1992;68:299-307
28. Tsuga K, Carlsson GE, Osterberg T, et al: Self-assessed masticatory ability in relation to maximal bite force and dental state in 80-year-old subjects. J Oral Rehabil 1998;25:117-124
29. Garrett NR, Kapur KK, Perez P: Effects of improvements of poorly fitting dentures and new dentures on patient satisfaction. J Prosthet Dent 1996;76:403-413
30. Geertman ME, Boerrigter EM, van't Hof MA, et al: Two-center clinical trial of implant-retained mandibular overdentures versus complete dentures-chewing ability. Community Dent Oral Epidemiol 1996;24:79-84
31. Boerrigter EM, Geertman ME, van Oort RP, et al: Patient satisfaction with implant-retained mandibular overdentures. A comparison with new complete dentures not retained by implants–a multicentre randomized clinical trial. Br J Oral Maxillofac Surg 1995;33:282-288
32. Garrett NR, Kapur KK, Hamada MO, et al: A randomized clinical trial comparing the efficacy of mandibular implant-supported overdentures and conventional dentures in diabetic patients. Part II. Comparisons of masticatory performance. J Prosthet Dent 1998;79:632-640
33. Fontijn-Tekamp FA, Slagter AP, van't Hof MA, et al: Bite forces with mandibular implant-retained overdentures. J Dent Res 1998;77:1832-1839
34. Geertman ME, van Waas MA, van't Hof MA, et al: Denture satisfaction in a comparative study of implant-retained mandibular overdentures: a randomized clinical trial. Int J Oral Maxillofac Implants 1996;11:194-200
35. Geertman ME, Slagter AP, van Waas MA, et al: Comminution of food with mandibular implant-retained overdentures. J Dent Res 1994;73:1858-1864
36. Tang L, Lund JP, Tache R, et al: A within-subject comparison of mandibular long-bar and hybrid implant-supported prostheses: evaluation of masticatory function. J Dent Res 1999;78:1544-1553
37. Feine JS, de Grandmont P, Boudrias P, et al: Within-subject comparisons of implant-supported mandibular prostheses: choice of prosthesis. J Dent Res 1994;73:1105-1111
38. de Grandmont P, Feine JS, Tache R, et al: Within-subject comparisons of implant-supported mandibular prostheses: psychometric evaluation. J Dent Res 1994;73:1096-1104
39. de Albuquerque Junior RF, Lund JP, Tang L, et al: Within-subject comparison of maxillary long-bar implant-retained prostheses with and without palatal coverage: patient-based outcomes. Clin Oral Implants Res 2000;11:555-565
40. Garrett NR, Ancowitz S, Sze S, et al: Effects of implant/tissue support of dentures on masticatory performance. J Dent Res. 2008:625