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SPECIAL SECTION

Edentulism and Comorbid Factors

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Abstract

Introduction: Complete edentulism is the terminal outcome of a multifactorial process involving biological factors and patient-related factors. It continues to represent a tremendous global health care burden, and will for the foreseeable future. The purpose of this review is to determine what comorbid factors exist for the completely edentulous patient.
Methods: This literature review evaluated articles obtained via the National Library of Medicine's PubMed Website, using keywords of edentulism with various combinations of the terms comorbidity, incidence, health, nutrition, cancer, cardiovascular health, diabetes, osteoporosis, smoking, asthma, dementia, and rheumatoid arthritis. Abstracts were selected and screened, and selected full-text articles were reviewed. Articles were limited to those with adequate patient cohorts and a minimum of 2-year follow-up data.
Results: Edentulism was found to be a global issue, with estimates for an increasing demand for complete denture prostheses in the future. Completely edentulous patients were found to be at higher risk for poor nutrition, coronary artery plaque formation (odds ratio 2.32), to be smokers (odds ratio 2.42), to be asthmatic and edentulous in the maxillary arch (odds ratio 10.52), to being diabetic (odds ratio 1.82), to having rheumatoid arthritis (odds ratio 2.27), and to having certain cancers (odds ratios varying from 1.54 to 2.85, depending on the type of cancer). Chronic residual ridge resorption continues to be the primary intraoral complication of edentulation, and there appear to be few opportunities to reduce bone loss in the edentulous patient.
Conclusions: While the completely edentulous patient seems to be at risk for multiple systemic disorders, whether development of these disorders is causal or casual has not been determined. To minimize the loss of residual alveolar ridges, exemplary complete denture therapy, along with the establishment of routine recall systems, should be the ultimate goal of treatment of this patient cohort.

Edentulism is defined as the loss of all permanent teeth,[1] and is the terminal outcome of a multifactorial process involving biologic processes (caries, periodontal disease, pulpal pathology, trauma, oral cancer) as well as nonbiologic factors related to dental procedures (access to care, patient preferences, third-party payments for selected procedures, treatment options, etc.). Chronic oral disease represents an enormous global health care burden that is often neglected in developed and developing countries; because of its economic impact, and association with other life-threatening entities such as coronary artery disease, stroke, and cancer, the treatment of chronic oral diseases, including the completely edentulous condition, should not go unnoticed. The distribution and prevalence of complete edentulism between developed and less-developed countries may be associated with a complex interrelationship between cultural, individual, access to care, and socioeconomic factors. World Health Organization databanks indicate that caries is still prevalent in the majority of countries internationally, with some reporting 100% incidence in their populations; severe periodontal disease is estimated to affect 5% to 20% of the population, and the incidence of complete edentulism has been estimated between 7% and 69% internationally.[2] However, estimates of the impact of total tooth loss on overall health, and the estimated costs associated with long-term treatment and maintenance of edentulous patients, are lacking. While chronic periodontal disease and caries are regarded as the leading contributors to edentulism, one cannot say for certain whether the cumulative damage on the systemic health of individuals who have been subjected to chronic periodontal disease or caries partially persists in the edentulous patient.

Comorbidity

In medicine, the term comorbidity relates to one or more disorders (diseases) in addition to the primary disorder or disease, or the effect such additional coexisting conditions might have on

the individual. The Charlson Comorbidity Index[3] is the most widely accepted, validated method for quantifying the effects of the additional diseases/disorders on the individual. The Charlson Index predicts the 1-year mortality for a patient who may have a wide variety of comorbid conditions, such as heart disease, cancer, or AIDS, with a total of 22 possible conditions. These 22 conditions are weighted with scores of 1, 2, 3, or 6 depending on the risk of the patient dying with the additional condition. The scores for an individual are summed, and given a total score, which is used to predict mortality. While the incidence of mortality has not been linked directly to the loss of teeth, emerging studies deal with the specifics of a multitude of conditions that may either contribute to, or be related to complete tooth loss. The purpose of this review article is to identify those clinical conditions that can coexist with, or contribute to, complete edentulism, and to alert the practicing dentist to the relationship between these conditions and the lack of a functional natural tooth complement.

Methods

This review evaluated literature obtained via searching the National Library of Medicine's PubMed Web site. Keywords included the following, in combinations to include edentulism and comorbidity, edentulism and clinical trials, edentulism incidence, edentulism and health, edentulism and nutrition, along with combinations of the term edentulism and tooth loss with cancer, cardiovascular health, diabetes, osteoporosis, smoking, asthma, dementia, and rheumatoid arthritis. Available abstracts were reviewed, and full-text articles of selected abstracts obtained online or via the inter-library loan program at the UNC Health Sciences Library. Additional information was obtained through the US Centers for Disease Control Web site, and others as noted. Except where otherwise noted in the article, all articles selected had to include patients who were completely edentulous in at least one arch, have adequate patient cohorts for examination (>30 patients), and contain follow-up data recorded for a minimum of 2 years.

Incidence of edentulism

Tooth loss in the United States

According to Oral Health–Healthy People 2010: Objectives for Improving Health,[4] 26% of the US population between the ages of 65 years and 74 years are completely edentulous. The rate of edentulism is estimated at 30% for African Americans, American Indians, or Alaska Natives for this age group, 26% for Caucasians, and 24% for Hispanics.[5] Low-income adults aged 65 years and older had the highest rate of edentulism (48% in 1993),[6] and there were dramatic differences between similar populations in the 50 States (13% in Hawaii to 47% in Kentucky are edentulous).[7] Low education levels have been found to have the highest and most consistent correlation with tooth loss.[8] Early loss of teeth has shown to be a significant factor leading to complete edentulism, with 7.4% of dentate Americans experiencing early tooth loss becoming edentulous within the next decade.[9] And, while reports indicate a 6% reduction in total edentulism between 1988 and 2002,[10] significant growth in the US population, along with declining access to dental care, has other authors predicting a steady state or growth of edentulism in one or more dental arches over the next two decades.[11] These authors predict that edentulous patients will need or demand an increase of approximately 230,000 units of complete dentures per year.

International edentulism rates

Complete edentulism is an international problem, particularly in the 65 years and older age groups; the condition does not appear to be concentrated in developing countries, as Ireland (48.3%), Malaysia (56.6%), the Netherlands (65.4%), and Iceland (71.5%) report some of the highest levels.[12] While women have been reported to lose all their teeth at a higher rate (approximately 3% higher in the United States) than men, this trend appears to be very country-specific.[13–15] The rate of edentulism appears to be inversely related to education,[16,17] with the relative risk being approximately twice as great for those with little education compared to those with higher levels of education.[18,19] Additionally, the rate of edentulism appears to be inversely proportional to one's income level;[20] however, while government subsidies of dental care should abate disparities between income levels, one study of two countries with government-sponsored dental care subsidies showed dramatic differences in rates of edentulism, irrespective of income levels, with one country exhibiting twice the edentulous level as the other.[21] Where one lives in his/her country may be an indicator of the levels of edentulism, as several countries have demonstrated a correlation of edentulism rates to rural versus urban location; perhaps the edentulism rates (which vary from two to three times higher in rural areas) can be attributed to differences in the dentist/patient ratios between the areas.[22,23] All these studies suggest that edentulism appears to be multifactorial, and that the known predictors of edentulism, that is, gender, income, and education levels, appear to be reasonable prognosticators of edentulism rates, while other socioeconomic factors such as culture, dental aptitude, and access to care, may be more difficult to quantify.

Consequences of edentulism on overall health

According to World Health Organization criteria,[24] people with no teeth are considered physically impaired. Edentulous patients could also be considered *disabled*, due to their inability to eat and speak effectively, which are two of the essential tasks of life; they could be considered *handicapped*, as they tend to avoid eating and speaking in public.[25]

Diet, nutrition, and overall health

Having a functional masticatory system is critical for the individual to replace the body's nutrients and maintain optimal overall health. Studies have demonstrated that edentulous patients have a poorer diet than their dentate counterparts.[26] In this NHANES III study, 3794 individuals were studied, of which 36% were completely edentulous. Denture wearers were found to be older, African-American, female, of lower socioeconomic

status, smokers, and were found to not take daily vitamins or dietary supplements, when compared to their fully dentate counterparts. In a follow-up study of 6985 patients,[27] the authors found that patients with less than a full complement of teeth had reduced intake of carrots, salads, and dietary fiber than did fully dentate patients, with reductions in serum levels of beta carotene, folate, and vitamin C. In another investigation, denture wearers were found to be at a nutritional disadvantage, and consumed statistically fewer carrots and tossed salads than the fully dentate.[28] Additionally, these authors demonstrated significantly reduced intake of dietary fiber and foods with adequate levels of beta carotene, folate, and vitamin C than did dentate patients. Other studies have indicated that edentulous patients have more difficulty chewing foods, with resultant reduced intakes of Vitamin B_6 and carbohydrates than dentate patients.[29] A study of institutionalized elders compared physical activity and mortality between groups of edentulous patients without dentures to the partially edentulous patient (> 20 teeth); in this 6-year study, edentulous patients with no replacement dentures experienced a decline in physical ability and an increase in mortality rates.[30] While a third group of patients with complete dentures was not studied, the necessity to replace missing teeth in the edentulous population seems apparent. The Healthy Eating Index (HEI) has been used as a measure of the overall quality of an individual's diet.[31] The HEI score is a measure of ten components, with a maximum combined score of 100; a score of less than 51 is deemed a poor diet, a score of 51 to 80 is categorized as "needs improvement," and one above 80 is considered a good diet. In a study of nutritional status of patients with and without opposing pairs of posterior teeth or those wearing dentures, those with fewer than four pairs of opposing posterior teeth were statistically at risk for poor nutrition. Interestingly, those with complete dentures scored better (but not statistically) than those with no posterior replacement teeth or those with 1 to 4 opposing pairs of posterior teeth, but the edentulous patients were still at risk for poor nutrition.[32] A study by Slade investigated dentate and edentulous patients' chewing capacity. He found that 58.6% of edentulous patients reported difficulty in chewing various food groups, compared to 6.1% of patients with fewer than nine missing teeth; higher rates of complete edentulism were found in older, female, less-educated Australian-born individuals.[33] Finally, a study of body mass index (BMI) in Great Britain suggests a strong correlation with the number of remaining teeth and a maintenance of a normal BMI.[34] This study found that patients with fewer than 21 natural teeth were three times more likely to be obese than those with 21 to 32 teeth, and those patients who were completely edentulous had the same likelihood of being obese than those with 21 or fewer teeth. The longitudinal effects of obesity on the overall health of the public are an enormous global health care burden that requires immediate attention in both developed and developing countries.

Systemic comorbid factors

Osteoporosis

Osteoporosis is an increasingly common skeletal condition that affects middle-aged and older individuals.[35] The condition is characterized by bone loss, leading to fragility of the skeleton.[36] The measurements of bone mineral content (BMC) and bone mineral density (BMD) are used to diagnose and monitor the condition. Both parameters are used to determine peak bone mass when an individual has matured, and the loss of bone following maturity. Osteoporosis is assumed to occur when both parameters are greater than 2.5 standard deviations below the reference value established for a given patient.[37] In osteoporosis, the degree of bone resorption typically exceeds bone formation, with a net result of generalized bone loss. Several studies have found a significant correlation between the severity of osteoporosis and height of the residual mandibular ridge,[38-40] but two other studies failed to demonstrate a similar correlation.[41,42] Finally, a recent literature review of 11 publications[43] suggests that, at best, there is weak evidence to suggest a correlation between the severity of osteoporosis and any alteration of the oral tissues in the completely edentulous osteoporotic patient. Of greater concern may be the relationship between the long-term use of several pharmaceutical regimens for the treatment of osteoporosis (long-term use of bis-phosphonates) and potential for adverse effects.

Hypertension and coronary artery disease

Periodontal disease and tooth loss have been associated with an increased risk of several vascular-related conditions such as coronary heart disease,[44] cerebral vascular disease,[45] and peripheral arterial disease.[46] In a recent study of age-matched postmenopausal women with and without missing teeth, Taguchi et al demonstrated a statistically significant association between the incidence of hypertension and tooth loss.[47] Unfortunately, their patient cohort compared those with some missing teeth (mean of 22 remaining teeth) to those with no missing teeth (mean of 0 missing teeth); whether any correlation can be made to the edentulous population is purely speculative. However, tooth loss is known to change people's diet and nutrition, which may have a direct effect on the risk of coronary artery disease and cerebrovascular diseases.[48] Desvarieux et al studied over 700 subjects with no history of stroke or myocardial infarction. Adjusting for conventional risk factors such as age, sex, smoking, diabetes, systolic blood pressure, cholesterol levels, race-ethnicity, education, and physical activity, they found that tooth loss is a marker of past periodontal disease in this patient cohort, and that tooth loss is related to subclinical atherosclerosis (carotid artery plaque formation), which could provide a pathway for subsequent clinical complications.[49] Those patients who were completely edentulous were 2.32 times more likely to have carotid artery plaque formation than patients missing fewer than nine teeth; however, the authors are quick to point out that, like all cross-sectional studies, the relationship between tooth loss and carotid artery plaque formation, while robust, should not be interpreted as causal. An investigation by Schwahn et al studied the relationship between periodontal disease, complete edentulism, and increased levels of plasma fibrinogen, a known marker for inflammation with regard to cardiovascular disease.[50] Their study of 2738 subjects between 20 and 59 years of age, and a corresponding group of 52 completely edentulous patients, indicated a 1.88 increased risk for those partially edentulous

patients with periodontal disease for increased plasma fibrinogen levels compared to the edentulous cohort; however, as plasma fibrinogen is an indicator of inflammation, one might speculate that there would be minimal inflammation associated with the edentulous patient. While a direct correlation between periodontal disease and coronary artery disease appears likely, the long-term cumulative effects of periodontal disease leading to complete edentulism on coronary artery disease is speculative at this time.

Smoking and asthma

Smoking has been identified as a major risk factor in a multitude of systemic and oral conditions, including heart disease, lung cancer, respiratory disease, peripheral vascular disease, and chronic periodontal disease leading to tooth loss. In an analysis of 33,777 Canadians aged 18 years and older, 48% of current smokers aged 65 years or older were edentulous, compared to 30% in the nonsmoking cohort.[51] Current smokers were least likely to use dental services, regardless of degree of tooth loss. Unfortunately, as in previous cross-sectional studies, no causal inferences between smoking and tooth loss could be made. Xie and Ainamo studied the association of various systemic factors to complete tooth loss in ambulatory elders living at home in Helsinki, Finland in 124 completely edentulous compared to 169 dentate (in at least one jaw) patients.[52] All subjects were 75 years of age or older. Adjusting for age and gender, they found that those who smoked were 2.42 times more likely to be completely edentulous, and that bone fracture (a possible predictor of osteoporosis) was more prevalent in the edentulous elderly. When evaluating the edentulous maxilla, they found that, in addition to smoking and bone fractures, those with asthma were 10.52 times more likely to be edentulous in this arch than nonasthmatics. The authors postulated that those with inhaled corticosteroids could experience both systemic and local effects on the maxillary bone, resulting in suppression of bone formation, accelerated bone loss, and tooth loss resulting ultimately in edentulism of the maxilla. In another study of 177 edentulous subjects aged 76 or greater, Xie et al found that elderly with asthma were six times more likely to experience severe reduction of the mandibular ridge than nonasthmatic controls.[53] After adjustments for length of time edentulous and age, elderly women experienced a greater amount of mandibular ridge loss than men.

Patient satisfaction/perception and quality of life measures

Tooth loss associated with periodontal disease and caries has an apparent impact on an individual's quality of life, and has been associated with lower levels of satisfaction with life and a lower morale.[54-56] In a 10-year prospective cohort study of 1992 rural Americans, Klein et al reported that 68% of the sample was missing some teeth, and an additional 15.3% were completely edentulous. Of the sample population, 10.7% reported they could not enjoy some foods due to problems associated with their teeth. Those with missing teeth were more likely to have poorer self-related health issues than those with teeth.[57]

Diabetes

The US Centers for Disease Control and Prevention estimates that 7% of the US population (20.8 million) has diabetes; approximately 171 million are believed to be affected worldwide in estimates by the WHO. Diabetes is projected to become one of the world's main killers and disablers within the next quarter century;[58] however, studies on the relationship between diabetes and complete edentulism are sparse. One such study investigated the relationship of complete edentulism to diabetes in Mexico.[59] The National Performance Evaluation Survey 2002-2003, was a collaborative effort between the WHO and the Ministry of Health of Mexico. In this study of nearly 14,000 people, the rate of complete edentulism in 20 of 32 states of Mexico was found to be 10.2% of the total population; it was 30.6% of those above the age of 65 years. Additionally, age, smoking, diabetes, gender, marital and health insurance status, and wealth index were positively correlated with edentulism. The edentulous patient had a 1.82 times greater risk of having diabetes than then dentate patient. The relationship of adequate salivary quantity and flow to the retention of complete dentures is well known. A study by Moore et al has shown the relationship between Type I diabetes and complications associated with salivary production (xerostomia and/or hyposalivation) in the dentate population; while the edentulous patient cohort was not evaluated, the potential impact of diabetes on maxillary complete denture retention can be assumed.[60] Additionally, a cross-sectional study of 370 patients revealed that functionally edentulous older men had a 4.06 times greater risk for developing non-insulin-dependent diabetes mellitus, regardless of age or race, than those with partial or complete dentitions.[61] Clearly, additional longitudinal studies of the relationship of diabetes to the completely edentulous patient cohort need to be conducted.

Neuropathy and dementia

As one might expect, patients suffering with dementia are more likely to experience poor oral health than those with normal cognitive functions;[62-64] however, studies that assess whether becoming edentulous can contribute to any subsequent risk of developing cognitive impairments or dementia are sparse. A study by Riviere et al[65] suggested, in a postmortem examination of brain tissues, that oral microbes may spread to the brain via branches of the trigeminal nerve. One recent study[66] examined dental records of 144 Roman Catholic Nuns residing in Milwaukee, WI. These individuals had 12 years of longitudinal assessments of their cognitive abilities coupled with 40 years of dental records from a single provider. Of the study participants, 22% had one or more copies of the Apo lipoprotein E4 allele, a major genetic risk factor for Alzheimer's disease. Completely edentulous patients were compared to those with varying degrees of partial edentulism. Cognitive function was assessed by trained gerontologists, and 118 of the study participants received postmortem examination of their brain tissues by a neuropathologist blinded to their cognitive function scores. In this prospective longitudinal study, the authors found a direct correlation between the numbers of missing teeth and the incidence of dementia. The authors suggested that complete edentulism may be a predictor for dementia later in life.

Rheumatoid arthritis

Rheumatoid arthritis (RA) is a potentially debilitating chronic inflammatory disease characterized by synovial inflammation that can result in considerable destruction of joint tissues. Additionally, due to similar characteristics with periodontal disease (cytokine profiles, inflammatory markers, association with IL-1beta and TNF-alpha), several clinical studies have suggested a possible association of RA between periodontitis and tooth loss,[67,68] while others have not found a positive association.[69,70] A recent investigation by de Pablo et al evaluated 4461 individuals aged 60 years or older as part of the NHANES III patient cohort.[71] The authors found a statistically higher incidence of edentulism in RA patients (56%) than in the non-RA cohort (34%), with the RA patients having 2.27 times greater risk for edentulism than the non-RA cohort. Adjusting for age, sex, race-ethnicity, and smoking, the risk increased to 3.34 times (9.64 times the risk for periodontal disease). Overall, RA patients sought dental care on a less frequent basis. Although causality was not established, the authors conclude that RA, and in particular seropositive RA, was clearly associated with periodontal disease and complete edentulism.

Cancer

The association between tooth loss and an increased risk of esophageal and gastric cancers,[72–74] and pancreatic cancer[75,76] has been reported. Recently, Hiraki et al compared tooth loss and 14 common cancers in 5240 cancer subjects with 10,480 age- and sex-matched non-cancer control patients. The authors found a statistically significant correlation between tooth loss and risk of head and neck, lung, and esophageal cancer, when adjusted for confounding variables. Patients who were completely edentulous were 1.54 times more likely to get lung cancer, 1.68 times more likely to get head and neck cancer, 2.36 times more likely to get esophageal cancer, and 2.85 times more likely to get bladder cancer than those with 21 or more remaining teeth. Additionally, those patients above the age of 70 years were more likely to get the same cancers than those who were 70 years of age or younger. The authors suggest that maintenance of tooth number, especially before old age, might prevent these disorders.[77]

Oral-facial comorbid factors

Reduction of the residual ridge (RRR)

Perhaps the most noticeable response to the removal of all the teeth is the hard and soft tissue changes following extraction. This has been termed residual ridge resorption and is used to describe the diminishing quantity and quality of the residual alveolar ridge after teeth are extracted.[1] Classic studies on the longitudinal loss of residual ridge height have demonstrated that once the teeth are extracted bone loss is a continuing process, and that the mandibular edentulous ridge may resorb at approximately four times the rate of the maxillary edentulous ridge.[78,79] Factors responsible for RRR have been reported as either local factors or systemic factors. Local factors include the length of time edentulous, the size of edentulous ridges, the amount of occlusal stress transmitted through removable prostheses to the underlying hard and soft tissues, the number of dentures previously worn, 24-hour wearing of dentures, and a previous history of wearing removable partial dentures. Systemic factors include age and gender, presence of asthma, reduced calcium intake, osteoporosis, thyroid disease, smoking, obesity, and others.[80,81] While two factors postulated to accelerate RRR are poorly fitting removable prostheses and the use of denture adhesives, little definitive evidence exists to support these premises; however, one study suggests a direct correlation between BMI and resorption of the residual ridges beneath complete dentures in edentulous Finnish women. The study of 128 postmenopausal women who had been edentulous in both jaws for a mean of 23 or more years suggested that women with larger residual ridge mass (more height and width of the mandibular ridge) had less chewing difficulty due to loose dentures than those with more associated residual ridge loss. The authors postulated that the patient's size may play an important role in the impact of RRR.[82] A study at the University of Iowa suggested that RRR was associated with the length of time edentulous in women, but no corresponding association was found in the male patients studied.[83] Similar findings were reported by Xie et al.[53] For comprehensive reviews of the literature on RRR, see Jahangiri and colleagues[84] and Kingsmill.[85] Despite the volume of materials published on RRR, no single dominant causative factor has emerged, and clinical or biologic therapies aimed at reducing or slowing the chronic loss of bone are sparse. One such study evaluated 230 postmenopausal women taking part in a 5-year study on osteoporosis in Finland. All patients were edentulous in the maxillary arch, and 128 were completely edentulous (mean term of edentulousness was 26.9 years in the maxilla and 22.8 years in the mandible). The use of fluoridated water for more than 10 years in this patient cohort was found to positively correlate with improved retention of the residual ridges in both dental arches. A subsequent preliminary study of 35 edentulous patients suggested a positive correlation between total serum calcium levels and retention of residual mandibular edentulous ridge height irrespective of length of denture use.[86] It appears that additional studies of fluoride and calcium uptake for patients anticipating complete denture therapy may be warranted. And, while not the focus of this review article, it appears that the use of dental implants to retain maxillary and mandibular overdenture prostheses not only enjoys high levels of success, but may dramatically reduce the loss of alveolar bone in the overdenture patient population, as emerging 10-year data strongly suggest (Table 1).

Esthetics and soft tissue profiles

Several classic prosthodontic articles have outlined the consequences of long-term edentulism and complete denture wear on the underlying hard and soft tissues,[87,88] the relationship between the maxilla and mandible,[89] and occlusal relationships of the removable prostheses.[90] Within a 2-year period of tooth extraction and immediate denture placement, there is sufficient loss of bone to result in anterosuperior rotation of the mandible, and associated soft-tissue profile changes, leading to protrusion of the chin and pronounced lip and chin displacements.[91] Each of these changes on the individual's facial proportions

Table 1 Seven- to 15-year data on implant-retained overdentures

Reference	Trial length (years)	Number of patients	Maxillary or mandibular prostheses	Retention type	Success rate (%)	Implant type	Comments
Naert et al IJOMI 2004[93]	10	36	Mand	Bar and ball	100%	Nobel	Splinting = freestanding
Bergendal & Engquist IJOMI 1998[94]	7	49	Max (18) Mand (32)	Bar and ball	74% max 100% mand	Nobel	
Visser et al IJP 2006[95]	10	29	Mand	Bar	92%	IMZ and Nobel	ODs require more maintenance over time
Quirynen et al COIR 2005[96]	10	37	Mand (25 OD, 12 FPD)	25 bars, ball, & magnets	100%	Nobel	Both OD and FP have good outcomes
Attard & Zarb IJP 2005[97]	15.5	45	Mand (42) Max (5)	NA	90%	Nobel	Requires pros maintenance
Meijer et al COIR 2004[98]	10	61	Mand		93% (IMZ) 86% (Nobel)	IMZ and Nobel	No worsening outcomes after 10 years
Deporter et al CIDRR 2002[99]	10	52	Mand	Ball	92.7%	Endopore	

and profile appearance can have a dramatic effect on a patient's appearance and self-esteem.

Other intraoral responses

While not the focus of this article, other intraoral responses to complete denture use, such as soft tissue and mucosal reactions, hyposalivation or xerostomia, or temporomandibular dysfunction can exist as a consequence of tooth loss and complete denture fabrication. For a review of such consequences, see Carlsson.[92]

Summary

Edentulism continues to represents an enormous global healthcare burden that is often neglected in both developed and developing countries. At a time when global economic conditions are faltering, access to adequate care for the completely edentulous patient, or for the partially dentate patient with a terminal dentition, may lead to a growing need to provide prostheses and other dental services to completely edentulous patients in the future. It does not appear that the necessity for complete denture therapy, and by extrapolation, complete denture education, will disappear over the next four or five decades. While the consequences of complete edentulism on the oral and facial structures are well known, criteria for predicting the long-term effects of tooth removal on any individual patient are currently lacking. While the effects of chronic periodontal disease have been closely linked to tooth loss and other systemic conditions, whether the cumulative effects of this inflammatory disease have long-range clinical implications for the completely edentulous patient remains speculative; however, it appears that the completely edentulous patient may be at risk for development of other comorbid conditions, including diabetes, cardiovascular conditions, dementia, cancer, asthma, and others, but whether these comorbid conditions are casual or causal has not been clearly determined. Additional research is needed to determine the relationship of these various systemic diseases with the removal of all teeth. And, while the long-term effects of tooth extraction on residual ridge resorption is well known, the prognosis for maintenance of the edentulous ridge height and width without dental implant therapy appears to be poor at this time. To minimize bone loss, chronic mucosal irritation, and functional problems for the denture patient, provision of exemplary complete denture therapy and low-cost dental implant therapies, along with establishment of routine recall systems for these patients, should be the ultimate goal for the dental professional.

TIPS FOR THE PRACTICING DENTIST

1. Whether casual or causal, edentulism is related to several comorbidities. Keep the overall health of patients in mind, particularly their ability to maintain a balanced and nutritional diet.
2. To minimize bone loss, chronic mucosal irritation, and functional problems, edentulous patients must be provided exemplary denture therapy.
3. Place all edentulous patients, regardless of therapy, on strict, regular recall schedules.
4. When treatment planning patients who are contemplating removal of their natural teeth, advise them of the potential for development of comorbid systemic conditions that are associated with tooth removal and tooth loss.

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