A Review of the Functional and Psychosocial Outcomes of Edentulousness Treated with Complete Replacement Dentures

• **Patrick Finbarr Allen,** BDS, PhD, MSc, FDS RCPS •
• **Anne Sinclair McMillan,** BDS, PhD, FDS RCPS, FDS RCS(Ed) •

Abstract

Loss of natural teeth has functional and psychosocial consequences that can, in many cases, be rectified with complete replacement dentures. However, the outcome of complete denture therapy is variable, and relies on patient factors, as well as the skill of the clinician and laboratory technician making the dentures. This article reviews recent literature on the outcomes of edentulousness and complete denture therapy.

MeSH Key Words: *denture, complete; jaw, edentulous/psychology; quality of life*

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Dramatic improvements in tooth retention by adults have been reported in a number of adult dental health surveys in industrialized countries.[1,2] The prevalence of edentulousness has decreased, but many older adults remain edentulous. A concern is that the burden of maintenance associated with aging dentitions is significant, and many older adults are likely to be rendered edentulous for the foreseeable future. In the U.K., for example, it is estimated that the prevalence of edentulousness will continue to decline and reach a floor level of 6% of the population by 2038.[2] This figure still represents millions of adults. A further consideration for the dental profession is the trend toward total tooth loss occurring later in life than in the past. This poses a major challenge, as older adults have a diminished capacity to adapt to the limitations posed by wearing complete dentures.

This article reviews recent literature on the outcomes of total tooth loss and complete denture therapy.

Attitudes towards Edentulousness

The attitude towards tooth loss is changing. Adults have greater expectations of their dental health than in the past. The recent national survey of adult dental health in the United Kingdom[2] reported that an increasing number of adults are concerned about the prospect of losing their teeth and find the prospect of total tooth loss upsetting. Furthermore, adults who had been edentulous for less than 10 years were more likely to have a denture-related complaint for which they would seek advice or treatment. This finding indicates that elderly experienced denture wearers are more likely to accept limitations of denture wearing than their younger counterparts, and suggests that older adults with a long history of denture wearing accept edentulousness as part of the aging process. Similar findings have been reported in cross-sectional studies of older adults.[3–6] It may be that, with time, many edentulous adults learn to cope with the limitations of complete dentures and adjust their expectations of oral function accordingly. This view is supported by studies indicating that there is a clear discrepancy between normative need and perceived need for complete denture services in elderly populations, particularly among institutionalized elders.[3,4,7]

The attitudes towards edentulousness, and satisfaction with complete dentures will, in the future, be influenced by current trends in adult dental health. As the proportion of adults retaining teeth into old age increases, the transition to the edentulous state will, for some, occur later in life. Because the ability to learn the complex series of reflexes required to control complete dentures diminishes with age,[8–10] denture-wearing complaints may increase in the elderly age groups.

Anatomical Changes Following Tooth Loss

The principle functions of teeth are to enable us to chew food, to facilitate speech and to enhance facial appearance. All of these oral functions are adversely affected by tooth loss. The anatomical changes that occur following extraction of natural teeth can be divided into intraoral and extraoral changes. These changes will differ between individuals who remain partially dentate and those who become edentulous. Following total tooth loss, the height and width of the alveolar bone decrease markedly (**Fig. 1**). Most of this change occurs in the first year following extractions, but remains an inexorable process throughout life. In a mixed longitudinal study over 25 years, Tallgren[11] demonstrated that bone loss in edentulous individuals was 4 times greater in the mandible than in the maxilla. Bergman and Carlsson[12] confirmed that bone loss is an ongoing process following tooth loss. In a randomized clinical trial of 74 patients treated with either complete mandibular overdentures on 2 canine teeth or complete immediate replacement dentures, Van Waas and others[13] demonstrated significant differences in bone loss between the 2 groups. They suggested that roots retained to support a denture helped reduce bone loss in all regions of the mandible. Despite extensive research, the reasons for inter-patient variation in bone loss remain unclear.[14] From the evidence currently available, it seems that postextraction alveolar bone loss is influenced by a combination of both local and systemic factors.[15] While the pathogenesis of alveolar bone loss remains unclear, there is no reliable way in which to predict the rate of alveolar bone loss on an individual basis.

Bone loss leads to a decrease in the size of the denture-bearing area. The decrease in alveolar bone height is associated with problems in denture stability, particularly in the mandible. Alveolar bone is occasionally replaced by fibrous tissue in the anterior maxilla, which can cause the upper denture to become displaced during function. As bone loss progresses, anatomical structures such as the mylohyoid ridge and genial tubercles may become prominent. Mucosa overlying these areas is thin and friable, and often incapable of withstanding functional stresses. Pain arising from these areas sometimes warrants surgical reduction of bony prominences and the use of resilient denture-lining materials. Some of these problems with denture stability are associated with oral pathologic conditions such as denture-induced hyperplasia and denture-induced stomatitis.[16]

Facial appearance is radically altered following total tooth loss (**Fig. 2**). The circumoral musculature is supported by natural teeth and the surrounding alveolar bone. Loss of teeth gives rise to a "dished-in" appearance. Occlusal face height, which is determined by teeth, also changes. The overall effect is that the chin approximates towards the nose, leading to a decreased face height or loss of "vertical dimension." The positional changes associated with complete dentures have been described by a number of authors.[17–19] The principle findings of these studies were that loss of face height and consequent mandibular prognathism were caused by progressive mandibular bone loss. These positional changes were not rectified by a relining of the mandibular denture. Tallgren[18] compared lateral cephalograms of edentulous subjects with a group of subjects who were edentulous in the maxilla and partially dentate in the mandible. In this 7-year follow-up study, the loss of face height was markedly greater in the edentulous group, indicating the benefit of retaining some natural teeth in the mandible. The loss of alveolar bone height and width also results in marked changes in soft-tissue profile, particularly in the first year after tooth extraction. Tallgren and others[20] used profile cephalometric radiographs to monitor changes in lip profile in patients receiving complete immediate dentures. During a 2-year follow-up period, continuing residual ridge reduction led to pronounced protrusion of the mandibular lip and chin. Loss of occlusal vertical dimension is also associated with poor maintenance of complete replacement dentures.

Figure 1: *Lateral cephelogram showing the edentulous jaws of a 62-year-old woman. Note how thin the lower jaw is following extensive loss of alveolar bone.*

Figure 2: *Facial profile of a 57-year-old edentulous woman without her complete dentures. Note the approximation of nose to chin and loss of lip support.*

Masticatory Ability

Ability to chew food can be assessed using objective tests of *masticatory performance* or subjective assessment of *masticatory ability*. In tests of masticatory performance, various test foods are given to subjects to chew and food particle size is analyzed using various laboratory techniques (e.g., fractional sieving). Variables assessed include the amount of chewing strokes required to comminute food to a certain particle size and bite force. While measurement of masticatory performance is useful, demonstrating a decreased masticatory performance may not in itself be clinically meaningful. For instance, a subject may not be able to chew a certain test food as quickly as a control

subject, but is nonetheless able to chew the food. Masticatory ability, which gives an indication of subjects' own perspective on their perceived ability to chew foods, may be more relevant. One problem with using this technique is that the subjects' responses may be influenced by food preference rather than any physical barrier to chewing food. For this reason, Slagter and others[21] suggest measuring both masticatory ability and performance to determine the ability of edentulous individuals to comminute tough foods.

Regarding masticatory performance, there is a general consensus in the literature that performance of edentulous individuals wearing complete dentures is significantly less than dentate individuals. Wayler and Chauncey[22] found that complete denture wearers experienced more difficulty in chewing hard foods than dentate subjects. This finding is similar to that reported by Osterberg and others[23] and Heath,[24] who found that masticatory performance of edentulous individuals was one-sixth of that achieved by dentate individuals. One caveat for these studies is that controls were young, dentate individuals. Decreased masticatory performance could be related to age as well as dental status. Nevertheless, the finding that masticatory performance is related to number of teeth seems to be consistent, and confirmed by other workers using different methodology.[25,26]

Bite force achieved by complete denture wearers has been assessed by Helkimo and others,[27] Haraldson and others[28] and Michael and others.[29] When compared with dentate subjects, the bite force of complete denture wearers is around 20% of that achieved by dentate controls. This may partly explain why edentulous subjects report difficulty in chewing tough foods.[22]

Masticatory ability has been assessed by structured questionnaires in a number of studies. Agerberg and Carlsson[30] used a questionnaire to determine perceived chewing ability of 1,106 dentate and edentulous individuals. Edentulous subjects tended to rate their chewing ability lower than dentate individuals. However, only 8% of the edentulous individuals rated their chewing efficiency as poor. A noteworthy finding was that individuals who were edentulous in one jaw only (i.e., complete denture opposed by a natural dentition) considered their chewing efficiency to be reduced to the same extent as individuals who were edentulous in both jaws.

Other studies have measured both masticatory performance and masticatory ability. In studies that evaluated the effects of new, optimal dentures, masticatory performance and ability were not significantly improved.[21,25,31,32] The results of objective and subjective assessments were only moderately correlated. As suggested by Boretti and others,[33] patient-assessed measures of chewing function tend to be more positive than objective measures of chewing function. This finding has implications for planning treatment, and indicates a need for a standardized index of chewing efficiency.

Dietary Selection

The loss of natural teeth is related to diminished nutritional intake, especially in older adults. Studies of nutrition of adult populations[34–36] report that adults wearing partial or complete dentures have poor-quality diets. The reasons for this could be difficulty in chewing hard foods such as raw vegetables and fruit and a decreased sense of taste. A further problem may be that oral tissues can become friable in poorly nourished individuals, such that the oral mucosa is unable to withstand trauma from dentures. In situations such as this, softer, more highly flavoured foods may be substituted. However, these foods frequently have a lower nutritional value. Evidence is emerging that improving the quality of complete replacement dentures does not radically alter dietary selection in edentulous patients.[37,38] In a report of the oral health of participants in a recent U.K. National Diet and Nutrition Survey of people aged 65 years and over, Steele and others[36] consistently found that dentate individuals had higher daily intake of protein, fibre, calcium, iron and vitamin C than their edentulous counterparts. The sampling strategy employed meant that the results could be considered nationally representative. Participants included both independently living and institutionalized groups of dentate and edentulous adults. The findings, derived from an analysis of food diaries, were confirmed by hematologic and biochemical analysis of nutritional status. These results have implications for general health in adults, as poor diet may lead to deficiency of nutrients and illnesses such as osteoporosis, atherosclerosis and bowel disease. However, the evidence to suggest that nutritional state relates to dental status alone is sparse; other strong influences on dietary selection and nutritional state include age, socio-economic status and general health. A number of reports have assessed whether dietary intake is related to denture quality[39] or improves after provision of either complete replacement dentures or implant prostheses for edentulous patients.[40,41] These studies used self-complete food diaries to assess dietary intake, and consistently found that edentulous patients had low fibre and high fat intake before and after treatment. Given this consistent trend, dental status can only be a co-factor with other factors such as socio-economic status. Nonetheless, poor nutritional status is apparent in elderly edentulous adults, particularly those living in institutions.[36] Some authors recommend that these patients receive dietary counselling as part of their prosthodontic rehabilitation.[38]

Psychosocial Consequences of Edentulousness

The World Health Organization has provided a classification of impairment, disability and handicap.[42]

Impairment is described as the loss of an anatomic body part; disability is defined as being prevented from partaking in everyday activities such as chewing and speaking; handicap describes broader social effects, such as minimized contact with other people. For some, the loss of all natural teeth leads to impairment, disability and handicap. The loss of natural teeth and associated alveolar bone leads to impairment. If dentures are unstable or unretentive, they may prevent proper chewing or speaking, thus causing disability. This state may also arise if the denture causes pain or a denture-associated pathology such as denture-induced hyperplasia. Impairment and disability are well recognized, and most denture techniques are directed at overcoming these problems. The broader issue of handicap associated with edentulousness has not received as much attention in the literature, perhaps because of the difficulties in assessing this state. This domain of health is difficult to measure and requires expertise beyond the dental disciplines.[43] Furthermore, tooth loss is a commonplace, nonfatal condition, which does not usually elicit sympathy from others. Some studies used psychological assessment measures to assess patient acceptance of complete dentures, but no convincing association was described.[44,45]

Many adults develop the skills required to overcome limitations of dentures and learn to accept these limitations with time. However, some patients do not cope well with the loss of natural teeth, and are classed as "maladaptive." Friedman and others[46,47] have described 3 classes of maladaptive responses to complete dentures:

- class 1: patients who can adapt physically but not emotionally;
- class 2: patients who cannot adapt physically or emotionally;
- class 3: patients who cannot and do not wear dentures, who are chronically depressed, and who isolate themselves from society.

Using a qualitative approach, the authors also describe 3 influences they believe have an impact on the maladaptive response. Parental influence may affect how individuals perceive themselves and their teeth. Teeth may also have a symbolic significance; loss of teeth may reflect impending loss of virility, loss of facial attractiveness and body degeneration. Finally, current life circumstances may strongly influence the adaptive response to tooth loss. If there are strong extraneous influences (e.g., recent bereavement, unemployment, diagnosis of life-threatening illness), the individual's ability to accept complete loss of natural teeth may be seriously compromised.

Another example of a qualitative approach used to assess the emotional effects of tooth loss has been reported by Fiske and others.[48] Using an unstructured interview technique, 50 edentulous individuals were invited to discuss their feelings about tooth loss, from the time of being rendered edentulous. The study sample was recruited from patients attending for conventional prosthodontic treatment at an undergraduate student clinic. There was no suggestion in the paper that any of the study subjects demonstrated maladaptive tendencies. Common themes that emerged from these interviews were feelings of bereavement, lowered self-confidence, altered self-image, dislike of appearance, inability to discuss this taboo subject, concern about dignity, behaving in a way that keeps tooth loss secret, altered behaviour in socializing and forming close relationships, and premature aging. The study concluded that tooth loss may profoundly affect the psychosocial well-being of patients, even those who are apparently coping well with dentures.

MacEntee and others have reported similar findings.[49] These authors advocate the use of qualitative methodology to fully explore the significance of the mouth in old age. The findings reported in these studies[48,49] should be interpreted with some caution, as subjects were recruited from specialist treatment centres. Many of these patients were referred from general practice for specialist advice and care, and as such may not be truly representative of the whole population.

Psychological response to tooth loss and denture wearing may be influenced by patient personality. Attempts to demonstrate that acceptance of complete replacement dentures is dependent on the quality of the dentures have yielded varying results. Van Waas[50] concluded that denture quality had little influence, whereas Fenlon and others[51] suggested there was a strong relationship between quality of the dentures and patient acceptance. Fenlon and others argued that previous studies used inappropriate statistical tests of association between denture quality and patient satisfaction. There is some evidence that patients with emotional problems tend to be dissatisfied with dentures.[52–54] In these studies, measures of emotional well-being such as the Eysenck Personality Inventory and Cattell's 16PF questionnaire were used to predict patient satisfaction with the outcome of treatment to provide complete dentures. In general, patient satisfaction was not associated with technical quality of the dentures. Silverman and others[55] used a focused interview technique to assess the impact of self-image on denture acceptance. They concluded that subjects with high morale and self-image (e.g., men, individuals employed or those of higher socioeconomic status) were more likely to accept complete dentures. Using a battery of measurement scales, including a denture satisfaction checklist, the Hopkins Symptom Checklist and the Dutch Personality Inventory, Vervoorn and others[56] found that overall denture satisfaction was not associated with personality traits. However, individual variables such as comfort of the mandibular denture were

associated with the personality trait "introversion-extroversion" and neuroticism. These associations, though statistically significant, were not strong. Other studies have not found this relationship.[57] Personality traits may affect denture acceptance, but individual variation exists. Fiske and others[48] suggest that even when there is an association between personality and dissatisfaction with complete dentures, it should not be assumed that the relationship is unidirectional. Rather, it could well be that tooth loss and consequent denture wearing have caused the personality or psychological problems. These authors exhort against dismissing patient dissatisfaction with complete dentures as a deficiency in personality.

Conclusion

Clinical practice in the management of edentulous patients is informed to a major extent by anecdotal evidence and limited research evidence. Research into the outcomes of total tooth loss and complete denture therapy has been hampered by lack of randomized clinical trials, questionable use of statistical tests and failure to include comparable control groups. The current evidence base needs to be supplemented with stronger evidence from a more rigorous study design, which will lead to a better understanding of the outcomes of tooth loss and complete denture therapy. ◆

Dr. Allen *is senior lecturer/consultant, department of restorative dentistry, University Dental School and Hospital, Wilton, Cork, Ireland,*

Dr. McMillan *is professor of oral rehabilitation, faculty of dentistry, Hong Kong University, Hong Kong.*

Correspondence to: *Dr. Finbarr Allen, Department of Restorative Dentistry, University Dental School & Hospital, Wilton, Cork, Ireland. E-mail: f.allen@ucc.ie.*

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