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Is the shortened dental arch an underused treatment strategy in the Republic of Ireland?

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Objectives*:** To determine the proportion of Republic of Ireland 35-44 and 65+ year-olds currently satisfying the criteria for a classic shortened dental arch (SDA) of 20 anterior teeth. ***Research Design: Secondary analysis of data collected in the 2000/02 epidemiological survey of the oral health of Irish adults. ***Clinical setting:*** Participants underwent a clinical oral examination in health board dental clinics and completed a detailed interview pertaining to dental and general health. ***Participants:*** The analysis is based on a random sample of adults, aged 35 to 44 years (n=978), and 65 years and older (n=714). ***Main outcome measures:*** The SDA was measured as 20 teeth in the mouth in the positions normally described as from the left second premolar to the right second premolar in each arch. ***Results:*** Only one of the 35-44 year-olds and none of the 65+ year-olds had teeth in their mouths in positions normally described as a classic SDA. However, of the 35-44 year old age group only five patients who had at least a premolar dentition of 20 contiguous teeth had been provided with a removable denture compared to one patient from the 65+ years group. ***Conclusions:*** Very few older patients in the Republic of Ireland have a SDA based on the measure used. However, very few have been provided with removable dentures where they already possess at least a premolar dentition of 20 contiguous teeth. Suggested reasons for this may include limitations of the data recorded, patient preferences and economic factors.

Keywords: *shortened dental arch, dentures, edentulous, older adults, partially dentate*

Introduction

Oral health surveys indicate that dental health is improving, with a steady increase in the proportion of older adults retaining more of their natural teeth. The Republic of Ireland has seen a reduction in the proportion of edentate adults in the 35-44 year age group from 12% in 1979, 4% in 1989/90 to 0.9% in 2000/02. This pattern has been mirrored by adults 65 years and older, where the proportion edentate has decreased from 72% in 1979, 48% in 1989/90 to 40.9% in 2000/02 (Whelton *et al.*, 2007). A reduction in the number of edentulous persons and an increase in the number of individuals with functional dentitions (21 or more teeth), at ages 35-44 and 65-74 years, were described as global goals for oral health by the Fédération Dentaire Internationale, the World Health Organisation and the International Association for Dental Research, in 2003 (Hobdell *et al.*, 2003).

When teeth are lost due to caries, periodontal disease, or trauma patients may seek tooth replacement to maintain function and an aesthetically-acceptable appearance. A variety of options exist for replacing teeth including the use of removable partial dentures. However, evidence suggests that many patients are unhappy with the prospect of wearing removable partial dentures and that these can have a negative impact on the remaining natural teeth. Conversely, many patients do not seek prosthodontic replacement of missing teeth and maintain function simply with a reduced number of natural teeth. It has not been possible to quantify the minimum number of teeth needed to satisfy functional demands as these vary between individuals (Armellini and von Fraunhofer, 2004), and are related to the age of the patient (Käyser and Witter, 1985). According to Käyser and Witter (1985), factors which need to be considered in deciding how many teeth to save and restore are patient preference, the aim of dental services and the efficiency of treatment procedures.

The shortened dental arch (SDA) concept has been proposed to provide satisfactory oral function without the use of removable partial dentures. Käyser (1981) first described the SDA as "a dentition where the most posterior teeth are missing". The molar regions play important roles in mastication and stabilisation (de Sa e Frias *et al.*, 2004), however they are high-risk teeth for caries and periodontal disease, and possibilities for restorative treatment are often limited (Witter *et al.*, 1999). The concept of the SDA involves the direction of treatment efforts and resources towards preservation of the anterior and premolar teeth, which Käyser and Witter (1985) suggest are the 'strategic' part of the dental arch. In practical terms, however, it is impossible to maintain a natural shortened dental arch for all patients as some will have suffered trauma to anterior teeth, resulting in tooth loss and the need for prosthetic replacement. Others may be congenitally missing teeth and some teeth, particularly upper canines, do not erupt; potentially resulting in spacing (Gordon *et al.*, 1994).

The aim of this study is to determine the proportion of 35-44 year-olds and those aged 65 and over who satisfy the criteria for a shortened dental arch, or who could be successfully managed using the principles of the shortened dental arch concept. The study also aimed to survey patient attitudes towards wearing replacement dentures.

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Methods

The 2000/02 survey (Whelton *et al.* 2007) was conducted under the direction of the Oral Health Services Research Centre (OHSRC), University College Cork. It was funded by the Department of Health and Children and the health boards in Ireland, and the protocol was approved by the ethics committee of the Cork teaching hospitals before the study started. A stratified random sample of adults (persons aged 16 years and older on the date on which they were clinically examined) was selected from households based on electoral lists. Stratifying factors were age (16-24, 35-44 and 65+ year-olds), gender, and Medical Card status (possession of a Medical Card was used as a surrogate for disadvantage). The fieldwork, which involved a thorough clinical oral examination and a detailed interview pertaining to oral and general health, perception of oral health services and oral health related quality of life, was conducted by a team of 30 trained and calibrated health board dentists and 30 dental nurses.

This paper reviews the data collected in the 2000/02 national survey of adult oral health in order to determine what proportion of the 35-44 and 65+ age groups fulfilled the criteria for a 'shortened dental arch'. A tooth was recorded as 'present' if a permanent or deciduous tooth was present; a tooth was recorded as 'not present' if a permanent tooth was unerupted, extracted due to caries, periodontal disease or for unknown reasons, or if it was missing for other reasons. For the purpose of this analysis, the SDA is defined as 20 teeth in the mouth in the positions normally described as from the left second premolar to the right second premolar in each arch. Information was also collected regarding patients' attitudes to wearing replacement dentures. Percentages were weighted by gender, medical card status and age so as to be representative of the population as a whole.

Results

A total of 978 35-44 year-olds and 714 65+ year-olds were examined in the 2000/02 survey of the oral health of Irish adults: 99.1% of 35-44 year-olds and 59.0% of 65+ year-olds possessed at least one natural tooth (Table 1). Just 41.6% of 35-44 year-olds and 2.6% of 65+ year-olds had 20 teeth in the mouth in the positions normally described as from the left second premolar to the right second premolar all present, and may have had at least one first, second or third molar. Of these, 1.1% of 35-44 year-olds and 7.0% of 65+ year-olds had partial dentures. However, only one 35-44 year-old and no 65+ year-old had these 20 teeth only (i.e. excluding first, second and third molars) and could be described as presenting with a natural classic shortened dental arch. Also associated with satisfactory oral function is the presence of full upper dentures and retention of lower incisors and canines only: one 35-44 year-old and 13 65+ year-olds satisfied this condition.

Approximately 17.7% of dentate 35-44 year-olds and 62.1% of 65+ year-olds said that they had partial or full dentures; however, 6.8% and 5.8% of these 35-44 and 65+ year-olds, respectively, said that they never wore the dentures provided (Table 2). Over 80% of dentate subjects said they hoped to always retain some of their own natural teeth. In terms of attitudes towards dentures, 69.5% of 35-44 year-olds and 49.0% of 65+ year-old dentate adults in the sample found the thought

Table 1. Percentage with at least one natural tooth, with at least left second premolar to the right second premolar, and numbers with left second premolar to the right second premolar only, at least left first premolar to the right first premolar, and full upper dentures and lower incisors and canines only

		One or more natural teeth	*At least left 2nd premolar to the right 2nd premolar (a)*		*As (a) with partial dentures*		*Left 2nd premolar to the right 2nd premolar only*	*Left 1st premolar to the right 1st premolar only*	*Full upper denture and lower incisors and canines only*
Age	*n*	*%*	*%*	*n*	*%*	*n*	*n*	*n*	*n*
35-44	978	99.1	41.6	391	1.1	5	1	1	1
65+	714	59.0	2.6	20	7.0	1	0	1	13

Table 2. Percentage of dentate subjects according to answers to questions about dentures (edentate subjects in brackets where applicable)

	35-44 year-olds	*65+ year-olds*
n	978	714
Possess a partial or full denture	17.7 (100)	62.1 (96.8)
Never wear dentures provided	6.8	5.8
If subject does not possess a partial or full denture:		
Hope to always have some natural teeth	89.9	80.0
Find the thought of wearing a partial denture upsetting	69.5	49.0
Would feel upset if had to wear full dentures upper and lower	81.5	60.2

Source: Whelton *et al.* (2007)

of wearing partial dentures upsetting. Of the younger age group, 81.5% would feel upset if they had to wear full upper and lower dentures as would 60.2% from the older age group.

Discussion

Results show that only one subject satisfied the criteria used for a traditional SDA (upper and lower premolars, canines and incisors only). However, considering the SDA as simply 20 anterior teeth may be a limited definition of the concept. A more appropriate definition uses the number of occluding contacts present in the mouth; however this information was not recorded in the survey. By defining the SDA as 10 occluding contacts, we can include those patients who present with no teeth in one arch and a shortened dental arch in the opposing arch, for example natural lower anterior teeth occluding against a full upper denture (Allen, 2008). In addition, this definition would include patients with missing anterior teeth restored to achieve a shortened dental arch using fixed prosthodontic options including bridgework or dental implants. Fixed prosthodontic options can replace teeth without subjecting the patient to the maintenance burden of a removable partial denture and without the negative impact on remaining tissues. Studies have suggested that resin-bonded bridgework can be used successfully in such clinical situations with comparable survival rates to partial dentures and reduced maintenance frequency (Thomason *et al.*, 2007).

Käyser (1981) found sufficient oral function in SDA when at least four occlusal units remain, preferably in a symmetrical position. According to Käyser (1984), fewer than 12 front teeth and eight premolars results in a SDA with impaired oral function. Sarita *et al.* (2003) found that chewing ability decreased as occluding pairs of teeth decreased. They found that a SDA with intact premolar regions and at least one occluding pair of molars provided sufficient chewing ability, and that a SDA comprising 20 teeth (intact anterior region and four pairs of occluding posterior teeth) can provide satisfactory chewing ability for soft foods but not hard foods. In a study comparing subjects with a complete dental arch, interrupted dental arch and SDA, Montero *et al.* (2009) found that the impact of arch length on oral functionality is proportional to the number of absent occlusal units.

In a review of studies of the SDA concept, Kanno and Carlsson (2006) found that, although it was accepted by the majority of dentists, the concept was not widely practiced. It remains controversial for some dentists, and examples of criticism are that loss of molars is associated with reduced masticatory performance, and a SDA could cause functional overloading of the teeth and TMJ (*Temporomandibular Joints)*, however Hattori *et al.* (2003) found no evidence of this, and the literature indicates that the SDA can provide oral functionality and comfort (Armellini and von Fraunhofer, 2004; Kanno and Carlsson, 2006; Sarita *et al.*, 2003; Witter *et al.*, 1994, 2001). Routinely extending shortened dental arches with prosthetic devices, with the sole aim of preventing *Temporomandibular Joint Dysfunction* should be discouraged due to the possibility of further iatrogenic damage to existing teeth. According to Käyser and Witter (1985) when missing teeth do not cause chewing or aesthetic problems, their replacement may constitute overtreatment. The SDA may avoid the risk of overtreatment while still providing a high standard of care and minimising cost (Armellini and von Fraunhofer, 2004). There was very little evidence for overtreatment found within the Irish sample. Of the 35-44 year old age group only five patients who had in excess of 20 teeth had been provided with a removable denture. Within the 65+ group, only one patient with more than 20 teeth had a removable denture.

In the past, oral healthcare for older adults was dominated by tooth extraction and provision of dentures, and this may no longer be acceptable to older adults. A number of studies in the UK and the Netherlands have suggested that partially dentate adults are not happy with the prospect of wearing dentures to replace missing teeth. In this survey, almost half of dentate respondents aged 65 and older indicated that they would find the prospect of wearing a removable partial denture upsetting. Compliance with wearing partial dentures has proved to be variable, with non-wearing (or only occasional use) of dentures reported to be as high as 40% (Jepson *et al.*, 1995). A further concern has been the apparently high incidence of dental disease in partially dentate adults wearing removable partial dentures. Root caries is particularly problematic in partially dentate older adults, and presents a significant threat to the ideal of maintaining a functional natural dentition for life (Joshi *et al.*, 1993). Kanno and Carlsson (2006) recommend that the SDA concept deserves serious consideration in treatment planning for partially edentate patients.

Dental treatment, particularly in Ireland, can be expensive. Many older adults are eligible for state-funded dental treatment as part of the Dental Treatment Services Scheme (Medical Card scheme), which provides free basic dental treatment to eligible adults. However, under the scheme, the only option offered for replacement of teeth is the provision of a removable acrylic partial denture. Therefore, current funding and policy do not support the concept of the SDA. Policymakers appear to be out of step with the move towards functionally-orientated treatment, and still prescribe removable partial dentures for a population who do not enjoy wearing them. According to Witter and colleagues (1999), the SDA treatment plan has the advantages of being less complicated, less time-consuming and less expensive than treating the full dental arch. However, under current funding mechanisms, this option is not applicable to those patients who may actually benefit most.

Elderly Irish patients are retaining their natural teeth for longer and are more likely to present with decayed, periodontally involved, or missing teeth. However, without pragmatic and functionally-orientated treatment planning, clinical management of these patients can become challenging as patients require tooth replacement when they are older and less able to cope with the limitations of dental prostheses. As illustrated by the results in this study many patients do not wish to wear removable prostheses and find the prospect upsetting. The SDA concept provides such a functionally-orientated strategy without the need for a removable denture, with emphasis placed on maintaining the anterior teeth. This accounts for issues such as loss of manual dexterity encountered

by this population. The SDA will continue to be of importance as a treatment strategy in the management of reduced dentitions for middle-aged and elderly adults (Allen *et al.*, 1995). According to Steele and colleagues (1997), many of the principles of the SDA are consistent with good function and satisfaction in the elderly, which may be a more realistic goal than complete control of disease. However, the results of this analysis reveal that very few older patients in the Republic of Ireland have been restored to a SDA. Reasons for this may include the way that data has been collected in the Irish national oral health survey as well as patient and professional attitudes in addition to economic factors.

In conclusion, only one 35-44 year-old and no adult aged 65 and over satisfied the criteria for a classic SDA. Despite the advantages of the SDA philosophy not many patients in the Republic of Ireland have teeth which satisfy these criteria. Whilst not all patients are suitable for treatment using the SDA, barriers exist: these may include a lack of knowledge from patients, a tradition of extracting teeth and funding issues. The methods by which dental care is funded in Ireland often do not support the use of the SDA concept, but instead favour traditional tooth replacement with partial dentures, a prospect which many patients find upsetting. However, there was very little evidence of overtreatment whereby patients with 20 or more teeth were fitted with partial dentures.

Although the data collected in the national survey did not contain detailed information to analyse use of the SDA treatment plan, this paper provides a starting point for further analysis. Recommendations for future research include collection of data on occlusal units in future surveys of adult oral health, and an assessment of chewing function based on a structured interview.

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