VERIFIABLE CPD PAPER

Is the shortened dental arch still a satisfactory option?

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In brief

Highlights that the shortened dental arch (SDA) continues to be a simplified approach which can maintain adequate function at minimal cost.

Points out that the SDA can improve accessibility of the remaining teeth for oral hygiene and enhance their prognosis.

Suggests that there is a lack of evidence to reject the use of the SDA concept.

Aims Dental practitioners may hold the view that missing posterior teeth should be replaced to ensure a healthy masticatory system and satisfactory oral function. However, the shortened dental arch (SDA) concept is still in use, but after 35 years is it acceptable? This review searches the literature for the evidence and opinions regarding the suitability of the SDA as a current treatment modality. **Methods** Medline and PubMed databases were searched for relevant terms, all the abstracts were assessed and articles selected according to the pre-set exclusion and inclusion criteria. **Results** The search yielded 1,895 articles and after the assessment of the abstracts and application of the exclusion and inclusion criteria, 44 articles were selected for this review. These included 11 cohort studies, two longitudinal studies, two animal studies, three cross sectional studies, eight clinical studies and 18 case control studies. There appears to be a trend over the past three decades for more papers to be opposed to the SDA concept. **Conclusion** Evidence that the SDA causes pathology is lacking. Clinicians, healthcare authorities and patients have shown favourable attitudes towards the SDA and this continues, although there is an increase in studies opposing the concept and some are dissatisfied with this option. The concept remains viable particularly for the medically compromised patient or where restorations are considered unsuitable but further more specific studies are warranted.

Introduction

Clinicians may hold the belief that all the missing teeth should be replaced to ensure a satisfactory oral function and a healthy masticatory system, as the loss of molar support may lead to temporomandibular joint dysfunction, occlusal instability and impairment of mastication.[1,2] However, the hypothesis that tooth loss will result in sub-optimal oral function and comfort has often been questioned.[3] Some posterior teeth may be important to the aesthetics of the smile and there may be other emotional factors associated with tooth loss. While more patients seek the prosthetic replacement of the anterior teeth more than for a posterior teeth,[1] replacing a missing premolar may well be requested for aesthetic reasons. In many cases, the cost and the actual need for the restoration of the complete dental arch should be carefully considered.[4]

Another common concept is that missing teeth should be replaced to prevent the potential detrimental effects on the dentition.[5,6] However, there is a substantial difference between the professional's assessment and the patient's perception of need for prosthetic rehabilitation.[5–8] Patients adapt to a new dental condition and they may be satisfied with less than 28 teeth.[5,6]

Aesthetics appears to be the main reason for prosthetic treatment in general and patients with missing anterior teeth are less satisfied with their oral condition and have higher perceived need to replace the missing anterior teeth.[5,8–10] However, not all patients with missing anterior teeth will seek prosthetic treatment and financial constraints are the most common reason for non- replacement of the missing teeth.[7,8]

In 1981 Kayser proposed the concept of the 'shortened dental arch'.[11] Clinical studies conducted by Kayser and his colleagues, concluded that for sufficient masticatory function and a healthy occlusion, four occlusal units are needed. One occlusal unit has been defined as one pair of occluding premolars and one pair of occluding molars are considered to be two occlusal units.[2] The shortened dental arch (SDA) can be defined as the type of dentition with reduced or even absence of the molars and/or premolars.[4,12] However, a frequent application is for a compromised dentition absent of all the molar teeth.

In 1992, the World Health Organisation stated that a functional and aesthetic dentition requires no less than 20 well distributed teeth.[13] The shortened dental arch concept remains

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controversial despite 35 years since its initial discussion and the aim of this review was to examine current opinion and evidence regarding the shortened dental arch as an approach to patient care.

Methods

The published literature was searched using Medline and PubMed as search engines and then a manual electronic search was performed. The first search ('tooth loss') was performed in December 2014 and located articles dated between 1965 and 2014. The second search ('shortened dental arch') was then conducted and found further articles between 1951 and 2015. A further search which included 'occlusion and temporomandibular joint problems' revealed an additional 160 articles of which an assessment of the titles and the abstracts provided 52 articles connected to the topic.

The electronic search was followed with the manual search of the bibliography which contributed 24 articles associated with the subject. All the duplicate articles were found and separated from the search. As a result, 44 articles were selected in total which included 11 cohort studies, three cross sectional studies, 18 case control studies, two longitudinal studies, two animal studies and eight clinical trials.

Table 1 lists the inclusion and exclusion criteria used in the literature research. In total 44 articles were used for the critical appraisal. The remaining articles were review papers that helped with the background section and this review. Figure 1 lists the types of studies that were review. As part of the assessment each paper was scored in favour or against the SDA concept.

Table 1 Represents the inclusion and exclusion criteria of the literature research

Inclusion criteria	Exclusion criteria
Articles in English language	Articles before 1975
Longitudinal clinical studies	Case reports
Experimental clinical studies	Implant studies
Prospective studies	
Retrospective clincal studies	
Randomised controlled clinical trials	
Non-controlled clinical trials	
Review articles	

Fig. 1 Type of studies that have been used for the critical review

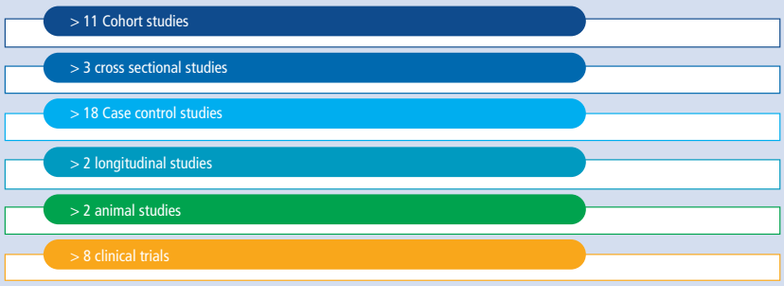
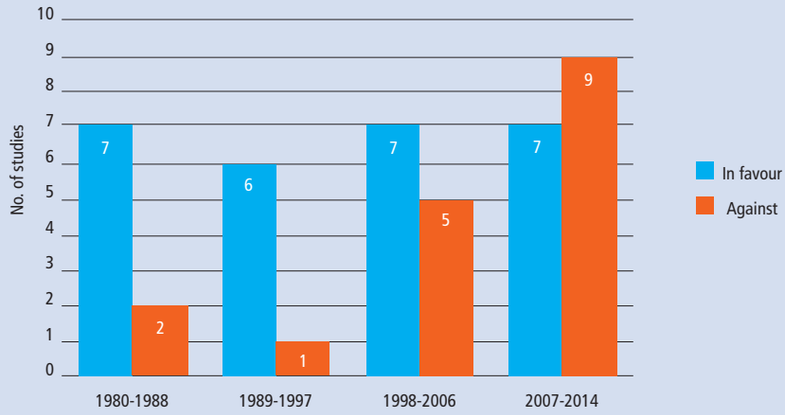


Fig. 2 Studies for and against SDA every 9 years between 1980 and 2014



Results

A total of 100 papers were assessed and 44 studies, conducted between 1980 and 2014, were used for this review. The number of papers on the SDA topic appear to be increasing as time passes from its first introduction suggesting that it is still under consideration. They were grouped into the following categories:

- Shortened dental arch and masticatory function N = 10
- Shortened dental arch and temporomandibular joint N = 9
- Shortened dental arch and occlusal stability N = 5
- Shortened dental arch and prosthetic rehabilitation N = 7
- Shortened dental arch and dentist's attitudes N = 4
- Other N = 9.

As an overview, 17 studies are against the concept of the shortened dental arch and 27 are in favour of this patient management approach. Consequently, the majority of the studies over the past 35 years appear support this concept but the trend illustrates a shift in attitude. Figure 2 illustrates the number of the studies which are against and in favour of the shortened dental arch between the years 1980 and 2014 in '9 year' intervals. It can be observed that the number of studies that are in favour of the SDA concept remained fairly constant. It is the number of the studies which are against the SDA which showed variation with the number of the studies opposing SDA increasing from two between 1980–1988 to nine from 2007–2014.

Discussion

The main purpose of this review was to evaluate the long-term success of SDA as treatment modality. During the years 1981–2014, increasing attention has been given to the concept.

Shortened dental arch and masticatory function

It has been concluded in many studies that the loss of teeth is associated with reduced masticatory performance and some of these studies were reviewed.[14–20] The number of teeth and, in particular, the number of the occluding pairs have been found to be crucial for the masticatory performance.[14–20] This may be explained by the reduction in teeth decreasing the occlusal surface area and reducing the maximum bite force.[14,16,20] The loss of the posterior teeth may decrease the capacity to break down food and it can reduce the chewing efficiency by 50%.[15,18] Subjects with SDA carry out 70% more chewing cycles.[18,19] In addition, the reduced dentition can be related to insufficient nutritional intake in vitamins and fibres with adverse effects on the health status with a preference for more soft food and confectionaries than vegetables.[17,21] Krall *et al.*[17] found that impairment dentition is related with insufficient nutrient intake with adverse effects on health status, while others report that chewing efficiency and the nutritional intake in vitamins and fibres is related to the number of posterior teeth and others that the masticatory performance is related to the number of the remaining teeth.[14–16] Fueki *et al.*[20] found that the reduction of the occlusal platform may reduce the bite force and Kreulen *et al.*[18] demonstrated that subjects with SDA have 50% less chewing efficiency.

The position of the remaining teeth and the number of the occlusal contacts have a significant influence on the masticatory performance and are more critical for the chewing performance than the actual number of remaining teeth.[11,22–28] Missing molars with bounded spaces are more obvious to a patient than a free end saddle and can be the reason behind chewing discomfort.[29] The loss of molars have a limited impact and it can be compensated by larger food particles for swallowing and larger number of chewing cycles before swallowing.[23–25]

The SDA as a treatment modality has been considered to be successful when 20 well distributed teeth are present.[23–25] Research by Kayser[11] demonstrated that the masticatory function may be reduced when the occlusal units are less than four in a symmetrical position or less than six in asymmetrical position and others have confirmed that the number of the occlusal contacts are more important than the number of teeth for the chewing performance.[23–25] Subjects with 20 well established teeth can adapt to the gradual loss of teeth,[22] can eat almost all types of food[30] and are satisfied with their masticatory function.[27]

Shortened dental arch and temporomandibular joint

Despite many investigations there is no clear causal relationship between the SDA and temporomandibular joint dysfunction (TMD) although tooth extraction itself can be a factor in causing trauma to the TMJ. The loss of the posterior teeth has been shown to predispose the dysfunction of the temporomandibular joints[31] as well as cause histological changes within the joint, displacement of the disc, degenerative changes as well as accelerate the development of existing pathology and TMD.[32]

On the contrary, a small number of studies have concluded that the SDA does not provoke any mandibular dysfunction[33,34] as the stomatognathic system and the TMJs can adapt to changes of the dentition.[33] Loss of posterior teeth is not correlated with TMJ overloading as the neuromuscular regulatory mechanism prevents this.[35] Studies showed that SDA can result in increased tooth grinding or clenching habits[33] but TMD was mild or infrequent there were no signs and symptoms of craniomandibular joint dysfunction.[33–35] Others have shown that unilateral loss of posterior teeth does not produce any intra articular pathological changes and it can aggravate only existing pathology of the temporomandibular joint.[36] Therefore, there continues to be evidence for and against the effect of the SDA on the multifactorial TMJ conditions including TMD.

Shortened dental arch and occlusal stability

Many studies have concentrated on the occlusal stability of the SDA as tooth migration is a well-known feature in incomplete dentitions.[37–39] Consequently, the loss of the teeth and tooth movement may result in changes in the occlusal contacts, the interdental spacing and the alveolar bone support although these changes are usually minor and remain stable over time.[37–39] Therefore, they have been described as more adaptive than pathological and they lead to a new equilibrium.[38] Other studies report that the spacing may increase and be unstable[37] and can have a negative impact on existing periodontal disease.[40] Several studies demonstrated that tooth loss does not increase tooth wear, and subjects with SDA often have increased interdental spacing but it does not necessarily indicate a pathological condition as these changes are adaptive character.[37–39,41]

Shortened dental arch and prosthetic rehabilitation

The presence of one occluding pair of molars and an intact premolar region or 20 well distributed teeth seems to be sufficient for chewing function[42,43] although this may be due to longer chewing periods.[44] The bilateral or unilateral free end removable partial denture does not improve the masticatory function and the patient's satisfaction or provide oral comfort;[42–45] a denture may also have adverse effects on the soft and hard tissues[45,46] whereas the SDA may be preserved for over 27 years.[46] However, the free end removable partial denture maybe be favourable in cases of extreme shortened dental arch where the oral function has been severely impaired.[42,44]

The resin bonded bridge may be a useful tooth replacement in some clinical cases and has been shown to result in less plaque accumulation, better oral comfort and more patient satisfaction than the removable partial denture in many clinical situations which may be applicable to the SDA.[47–50]

Dental implants offer a popular alternative option to the SDA and are a more conservative long-term option than long span bridges, with the additional benefits of preserve bone and providing better posterior support than dentures.[51] However, a UK study of 140 cases of SDA in the UK revealed that 67% were restored with a chrome framed RPD, 26% with an acrylic RPD, and only 6% restored with an implant restoration and 1% with RBBs.[52] Current trends show an increasing in popularity in the use of dental implants for many reasons but it is recognised that many factors need to be considered and taken into account.[53] There are many systems available but few guidelines for clinicians.[54]

Shortened dental arch and dentists' attitudes

Only a limited number of studies have tried to evaluate dentists' attitudes towards the SDA concept although it has been widely accepted

and has an important place in contemporary dentistry.[55–58] While many dentists consider the chewing function, aesthetics and oral comfort in SDA to be satisfactory, the concept is not widely implemented and the majority of the dentists tend to rehabilitate the SDA with removable partial dentures.[56,57]

Clinical considerations

When considering the prosthetic rehabilitation of patients, all the advantages and risks of any treatment options should carefully assessed as there are numerous options including fixed and removable prostheses, using implants, and adhesive dentistry; however, any prosthetic treatment incurs a biological price.[59]

The minimally invasive resin bonded bridge, where clinically possible, may be considered reversible, inexpensive, not time consuming and patients may easily adapt to it.[59,60] Implants, which can result in unpredictable soft tissues aesthetics, remain the most expensive treatment.[59,60] The removable partial denture is a non-invasive and low-cost treatment option for the prosthetic rehabilitation of patients with compromised dentition.[60,61] It may be an excellent method for the replacement of the posterior teeth and missing soft and hard tissues although creates an increased risk of caries and periodontal breakdown,[60–62] although adequate oral and denture hygiene with regular recall appointments will decrease the damage on the remaining teeth and the periodontal tissues.[60–63]

Problems and complexities of treating older patients

Older patients are increasingly retaining their natural dentition until later in life and tooth loss remains a reality in the geriatric population.[64,65] The problems regarding treatment of older patients should be carefully evaluated and be part of long-term treatment planning as impaired vision, reduced tactile sensation and other factors related to ageing means that patients are less able to clean their teeth or prosthetic work, particularly implant retained restorations.[64,65] Medical conditions may play an important factor in decision making, such as the suitability for implants,[53] and there may be problematic oral conditions, such as dry mouth, which make prosthetic rehabilitation and in particular tooth replacement unsuitable.[66] In such cases, the SDA should be considered as a treatment strategy to avoid the undesirable risks and side effects of the insertion of fixed or removable prostheses.

There is an increase in the numbers of studies not supporting the SDA, as shown in Figure 2, for the period 20072014. This includes papers showing increased eating difficulties as the number of occluding teeth reduce,[16,18,67–69] as well as reduced bite force[20] and increased risk TMD.[31] An interesting paper by Shoi *et al.* showed reduced cerebral activity during eating with RPDs rather than teeth due to the oral soft tissues being covered.[47]

Conclusions

The SDA continues to be a simplified approach that can maintain adequate function, minimise cost and improve accessibility of the remaining teeth for oral hygiene and enhance the prognosis of the remaining teeth. Increasing attention has been paid to the SDA in recent years and has been widely accepted by the clinicians, patients and healthcare authorities due to an increasing elderly dentate population and the ongoing economic changes that affect patients with limited financial resources. There are an increasing number of publications regarding SDA with a trend towards more publications being against the concept. While there is a need for more studies of longer duration and with more specific inclusion criteria, it seems that the SDA concept deserves to remain as a treatment option in the absence of evidence against its use.

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