

Unlocking Oral Function: Understanding and Managing the Shortened Dental Arch

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Abstract

The shortened dental arch (SDA) is a dentition of no more than twenty teeth with an intact anterior region but a reduced number of occluding pairs of posterior teeth. The SDA concept is a valid treatment option in cases in which anteriors and premolars can provide adequate aesthetics, function, and occlusal stability. In 1992, the World Health Organization stated that a functional and aesthetic dentition requires no less than 20 well distributed teeth. This treatment option for the partially dentate patient may provide oral functionality, improved oral hygiene, comfort, and possible, reduced costs.

Keywords: Shortened Dental Arch; Oral Functionality; Unlocking Oral Functions; Aesthetics

Introduction

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 [1]. 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 [2]. In 1981 the concept of the 'shortened dental arch' was proposed by Kayser [3]. 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. The shortened dental arch (SDA) can be defined as the type of dentition with reduced or even absence of the molars and/or premolars [4,5]. 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 [6].

Shortened dental arch and masticatory function

A successful course of treatment depends on the patient adapting to alteration in arch length brought on by gradual tooth loss, even if masticatory efficacy and aptitude are important elements in oral functionality. According to the research, masticatory skill is closely related to tooth count, and it is hindered when a patient has less than 20 evenly spaced teeth [6]. Oral functionality depends on the patient's capacity to adjust to changes in dental arch length brought on by tooth loss. Masticatory efficiency and masticatory ability are two crucial aspects of it. Subjective and objective assessments can be utilized to classify the literature on masticatory efficiency

and ability during the past 50 to 60 years Interviews with patients who are assessing their own masticatory functionality are typically used to assess subjective masticatory function or masticatory competence. Measuring the patient's capacity to grind food is a standard part of an objective examination of masticatory function or efficiency. Overall, the body of research shows that masticatory function is decreased when there are fewer than 20 teeth that are uniformly distributed across the mouth. In a study, 118 patients were divided into 6 groups according to the length and symmetry of the shortened dental arch in a cross-sectional clinical investigation [1]. There were two patterns seen of change in oral function, the dentition had been reduced to 4 occlusal units in 1 group, masticatory efficiency altered gradually? Thereafter, it declined quickly. Masticatory efficiency gradually improved at a nearly consistent rate in the second group. The authors hypothesised that as long as at least 4 occlusal units-which must be symmetrically positioned-remain, patients have the adaptive capacity to retain acceptable oral function in shorter dental arches. Research by Kayser [3] 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. Subjects with 20 well established teeth can adapt to the gradual loss of teeth, can eat almost all types of food and are satisfied with their masticatory function [7].

Shortened dental arch and temporomandibular joint

Despite various researches, there is no clear causal association 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 [8] 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 [9]. On the contrary, a small number of studies have concluded that the SDA does not provoke any mandibular dysfunction [8] as the stomatognathic system and the TMJs can adapt to changes of the dentition. Loss of posterior teeth is not correlated with TMJ overloading as the neuromuscular regulatory mechanism prevents this [10]. Studies showed that SDA can result in increased tooth grinding or clenching habits [8] but TMD was mild or infrequent there were no signs and symptoms of cranio-mandibular joint dysfunction. 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 [11]. 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 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 although this may be due to longer chewing periods.

The resin bonded bridge may be an important tool in tooth replacement in some clinical cases and has been shown to result in less accumulation of plaque, better oral comfort and more patient satisfaction compare to removable partial denture in many clinical situations which may be applicable to the SDA. A popular alternative option to the SDA is dental implant. They are a more conservative long-term option as compare to long span bridges, with the additional advantage of preserving bone and providing better posterior support than dentures [12]. 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 [13]. A dental arch can be extended to obtain a functional level with one of the following options [14]:

- Removable partial denture (RPD).
- Cantilever bridges.

- Overdentures: The traditional prosthodontic treatment of the partially edentulous jaw or SDA tended to be the removable partial denture (RPD) to substitute the missing teeth for optimum function and aesthetics. The RPD has been regarded as a predictable treatment option, but it can cause the breakdown of periodontal tissue supporting the remaining teeth and bone resorption underneath the denture base [15].

Recent therapeutic options in the treatment of SDA have been suggested:

- Replacement with a fixed restoration to the second premolar.
- The use of implants in combination with a fixed partial denture Several factors in the restoration of a SDA clinical scenario were tested by Witter, *et al.* [8] including:
 - Masticatory ability.
 - Occlusal factors.

Clinical considerations

While considering the prosthetic rehabilitation of patients, all the advantages and risks of any treatment options should carefully be evaluated as there are various options including fixed and removable prosthesis, using implants, and adhesive dentistry; however, any prosthetic treatment incurs a biological price [16].

The minimally invasive resin bonded bridge, may be considered reversible, inexpensive, where clinically possible, not time consuming and patients may easily adapt to it. Implants, which can lead to unpredictable soft tissues aesthetics, remain the most expensive treatment option [6]. The removable partial denture is a non-invasive and low-cost treatment option for the prosthetic rehabilitation of patients with compromised dentition. 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, although adequate oral and denture hygiene with regular recall appointments will decrease the damage on the remaining teeth and the periodontal tissues [6].

In a long-term nine-year follow-up study the SDA clinical scenario did not result in occlusal collapse [17]. The occlusal changes in a SDA were self-limiting and adaptive, leading to a new equilibrium and so extending the SDA by prosthetic devices was not necessary to prevent occlusal collapse. Also, no statistically significant differences were detected between restoration with an RPD or not to an SDA scenario in a randomized multi-centre study. Within both treatment options, an improvement of Oral Health Quality of Life index was achieved. Out of these studies it was concluded SDA can maintain oral functions, prevent temporomandibular joint (TMJ) dysfunction, and provide long-term occlusal stability even when compared with complete dental arches. Although the restoration of a SDA has a sound biomechanical rationale it requires conditions such as healthy supporting tissues of the remaining teeth, and no parafunctional habits such as heavy bruxism [15]. There was, however, a discrepancy between the theoretical and practical acceptance of the restoration of SDA among dentists in many countries in that the option was widely accepted.

Probable advantages of SDA are

Although SDA has been suggested as being preferable to maintaining a complete dentition, it may not be advisable or feasible in all situations [6].

- Simplification of extensive restorative management.
- Easier maintenance (subsequent to the SDA) for both the patient and the dentist.
- Simplification of oral hygiene maintenance.
- Good prognosis for the remaining teeth, if the patient learns to maintain his/her own dentition.

According to Kayser, SDA may be appropriate for patients meeting the following criteria [18]:

Contra-indications to SDA would include [19]:

- Progressive caries and periodontal disease confined mainly to the molars.
- Good long term prognosis for the anterior teeth and premolars.
- Financial and other limitations to dental care.

The prognosis of the SDA depends on [6]:

- Severe maxillomandibular discrepancy (e.g. Severe angle class II and class III relationship).
- Anterior open bite.
- Parafunctional habits.
- Pre-existing craniomandibular dysfunction.

Classification of shortened dental arch

A classification for the shortened dental arch, suggested by Kayser, 20 groups patients according to the number of teeth remaining in the arch and the symmetry of the shortening. This includes i) anatomically complete dental arch ii) symmetrically shortened dental arch iii) extremely shortened dental arch. A system considering occlusal units as premolar equivalents was also developed in which a molar is equivalent to two premolar units and a premolar is equivalent to a single occlusal unit. Thus a single arch of four molars and four premolars would account for 12 occlusal units.

Varying opinions regarding the influence of a shortened dental arch on the masticatory system have been reported. A major objection to the replacement of bilaterally distal edentulous spaces was poor patient acceptance of a traditional removable partial denture; however, the success of implant-borne prostheses has provided a viable alternative treatment modality for the shortened dental arch situation [20]. The occlusal preservation target was developed to differentiate the dental arch into strategically important regions. The anterior and premolar regions are functionally and esthetically indispensable throughout life and are considered a priority in rehabilitation. The molar regions play important roles in mastication and stabilization and are usually restored once satisfactory rehabilitation of the anterior segments is completed. In essence, the shortened arch concept allows for treatment and maintenance of strategically important segments before segments of secondary importance are restored [21].

Shortened dental arches and oral function

The functional capabilities of SDA were assessed by chewing tests based on the release of light-absorbing materials when chewing raw carrots. The chewing tests showed a highly significant correlation between masticatory capacity and the number of occlusal units. With a decreasing number of occlusal units, the numbers of chewing strokes needed before swallowing increased [22].

The subjects started complaining about their masticatory function when the number of occlusal units was less than four in symmetrically shortened arches and less than six in asymmetrically shortened arches.

The preliminary conclusion was that there is sufficient adaptive capacity in SDA when at least four occlusal units are left, preferably in a symmetrical position, and this assumption has not been disproved [23].

Conclusion

Dentists' attitudes to the SDA concept have shown that the concept is accepted; however, a rational treatment planning sequence for the SDA based on a thorough evaluation of functional, esthetic, and psychological needs is not widely practiced. Much of the opposition to complete restoration of the shortened dental arch has focused on the deficiencies inherently present in removable partial denture prostheses. Quality-of-life assessments have shown that improvements in function are not always associated with the use of removable prostheses. Studies have indicated that as much as 60% of the population of mandibular RPD wearers is dissatisfied with their prostheses. The long-term success of implant-borne prostheses to rehabilitate the partially and completely edentulous jaw has provided the profession with an alternative to removable prostheses; however, this treatment may not always be possible due to local and systemic factors.

The cost of new technology in dentistry places a primary burden on the patient and a widespread recourse to managed care has placed severe limitations on the number of patients that may be able to avail themselves of the treatment. The question of the shortened dental arch becomes less and less one of effectiveness of treatment and more of a financial decision.

As prosthodontists, we often spend hours agonizing over minor variables in the execution of treatment. Equally important, as health professionals, it is imperative that we evaluate our patients as individuals, requiring more than just a dentition but a well-functioning, if theoretically incomplete, masticatory system that serves to fulfill each person's varying needs [24].

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