The Shortened Dental Arch-A Literature Review

Muhammad Haris Zia BDS

ABSTRACT: The Shortened Dental Arch (SDA) comprise of anterior and premolar teeth with missing posterior occlusal units. According to various literature resources the masticatory apparatus perform effectively in the presence of these teeth, however on the contrary other literary work states that the presence of molars is important for mastication. This is not necessarily the case as the evidence available to support this requirement is weak. As the SDA functions over time, occlusal instability has been noted. The treatment options for SDA vary among clinicians and are also based on patient’s personal choice and aesthetics. The aim of this review is to determine the oral functionality, masticatory efficiency, prosthodontic considerations, patient comfort and other treatment options available for the SDA patient. This was carried out through a review of the Medline and Cochrane Library databases Inclusion criteria included clinical or experimental trials and review documents published between 2005 and 2016.

INTRODUCTION

According to Nassani et al. (2013, p.251) a shortened dental arch (SDA) is “a dentition with a reduction of occlusal units starting posteriorly" with the term occlusal units referring to pairs of antagonist teeth, for example molars and premolars, which support the occlusion. The concept behind the SDA is that treatment should be focused on preserving any sound premolar and anterior teeth and extensive restorative treatments in the posterior, molar regions should be avoided. As such, missing posterior teeth are not replaced, but the remaining dentition needs to be rehabilitated and stabilised in their absence (Koyano et al., 2012, pp.514). Restorative dental treatment plans (Fueki et al., 2011, p.169). Furthermore, according to Nassani et al. (2011, pp.610), some patients are reluctant to leave the posterior region unrestored. Abduo and Lyons (2012, p.3) suggest that there are some situations where clinical trials carried out by Wolfart et al. (2014, pp.525-533), Gerritsen et al. (2013, pp.859-866), Nassani et al. (2011, pp.608-614) and Reissmann et al. (2014, pp.2159-2169) have shown that SDAs are proven in their capacity to ensure that the patient has adequate chewing ability, that they retain oral aesthetics, that their dentition is stable and that they have minimal temporomandibular joint pain, respectively. Nevertheless, the concept of the SDA often contraindicates any extension of the SDA needs to be considered, for example where the loss of the posterior teeth will cause chewing difficulties, aesthetic problems or occlusal instability. Nevertheless, Nassani et al. (2013, p.251) asserts that all treatment options for SDA patients have some unsatisfactory elements and choices for SDA patients have been termed a “prosthodontic dilemma” (Devlin, 1994, p.31) and, whilst the removable partial denture is the most popular treatment choice for the SDA patient (Nassani et al., 2010, p.85), it is not yet understood whether or not this treatment option contributes to the patient’s oral function (Ikebe et al., 2007, p.713). As such, the aim of this review is to determine the oral functionality, masticatory efficiency, prosthodontic considerations, patient comfort and other treatment options available for the SDA patient. This was carried out through a review of the Medline and Cochrane Library databases, using a keyword search with the following search terms, “shortened dental arch”, “oral functionality”, “masticatory efficiency”, “prosthodontic considerations”, “treatment options” and “patient comfort”. Inclusion criteria included clinical or experimental trials and review documents published between 2005 and 2016.

ORAL FUNCTIONALITY

A comprehensive review, by Gottfredson and Walls (2007, pp.35-45) was carried out in order to evaluate the required dentition to ensure adequate oral function. These authors focused on four specific areas of oral function. These were occlusal support and stability, aesthetics and psychosocial ability, masticatory function and tactile perception, taste and phonetics. In total, Gottfredson and Walls (2007, p.36), reviewed 83 previously published, medium to high quality studies (determined by the authors). From these, the authors found that masticatory ability and efficiency were both linked to the number of available teeth with a minimum of nine to ten pairs of contacting units being required to maintain adequacy. Any tooth numbers below that level yield impaired masticatory ability and efficiency. Any loss of anterior teeth significantly impacts aesthetics and patient satisfaction, with the latter being more likely to be retained in patients who retain premolar dentition (Gottfredson and...
Walls, 2007, p.38). However, higher satisfaction levels were also reported in patients who retained molar dentition, although this was not statistically significant. Occlusal support and stability are maintained in patients with three or four functional posterior units, providing there is a symmetrical pattern of tooth loss (Gotfredson and Walls, 2007, p.39). Tactile perception, phonetics and taste are all retained adequately with anterior dentition (Gotfredson and Walls, 2007, p.40). These authors therefore concluded that the World Health Organisation’s (2002) report, which stated that a dentition of not less than 20 teeth should be maintained, remains an acceptable target to ensure adequate oral function.

**Masticatory Efficiency**

Two studies carried out by Ueno et al. (2008, pp.337-344, 2010, pp.113-119) aimed to assess the masticatory efficiency of patients with non-rehabilitated tooth loss. These authors enrolled 2164 residents to assess the number of teeth and number of functional tooth units needed to maintain adequate mastication. Ueno et al. (2010, p.115) found that individuals who reported that they could chew any food item had an average of 23.4 teeth including 10.4 functional tooth units, therefore leading them to conclude that the WHO’s (2002) 20 teeth rule was adequate. However, these authors also found that the subjects who reported adequate chewing ability had an average of 12.6 posterior teeth, therefore questioning the viability of a SDA (Ueno et al., 2008, p.342).

A more recent study carried out by Singh et al. (2014, pp.146-149) compared the masticatory efficiency of SDA patients compared with those with complete dentition. These authors studied 28 subjects with 14 in the control group (complete dentition) and 14 in the SDA group. The two groups were age matched. Using roasted peanuts as a test food, Singh et al. (2014, p.147) evaluated the masticatory performance of the two groups based on the median particle size of the fragmented peanuts. The results showed that masticatory performance in the control group ranged between 60-70.5% whilst performance in the case group was much lower and ranged between 50.6 and 59%. However, the authors concluded that the masticatory ability of the SDA patients was within an acceptable range of the patients with complete dentition, despite not providing any details of how this conclusion was made.

Nevertheless, a study by Aras et al. (2008) supported these conclusions. Aras et al. (2008) enrolled 30 patients, with 10 patients in each of three groups; complete dentition (control), SDA or distal extension with removable partial denture. Using a similar method as Singh et al. (2014, p.147), Aras et al. (2008) found that there was no statistically significant differences in masticatory performance between the three groups, however, the SDA groups did show significantly lower contact areas and a lower occlusal force than the other two groups. Nevertheless, these authors concluded the same as Singh et al. (2014, p.148), by suggesting that the SDA is an acceptable alternative to restorative treatment.

**Prosthodontic Considerations**

Prosthodontic considerations for SDA patients include occlusal stability and wear, temporomandibular joint health and ensuring the correct vertical dimension. Zhang et al. (2014, pp.101-107) assessed the association between SDA and occlusal tooth wear in 150 SDA subjects compared to a control group of 65 randomly selected complete dentition subjects. Using the occlusal tooth wear index (OTWI), these authors reported that there was no significant effect from SDA on occlusal wear (Zhang et al., 2014, p.103). However, SDA premolars had a significantly higher OTWI scores that those in the complete denture control group. In addition, the authors reported that the fewer posterior occluding pairs in SDA patients resulted in higher OTWI scores in anterior teeth (Zhang et al., 2014, p.104).

De Oliveira et al. (2014, pp.460-465) completed an experimental study to establish the effect of SDA on occlusal stability. These authors used four, three dimensional mandibular and maxillary SDA models of different arch length and a complete dental arch as a control. Using computer simulations with loads up to 100 N, these authors reported that the SDA had significantly more risk of tooth displacement that the complete dental arch. Greater tooth changes were seen in the mandibular arches than in the maxillary arches. Overall, the study showed that decreasing numbers of occlusal units was directly proportional to increased amounts of tooth displacements, therefore, reduced amounts of occlusal stability.

Witter et al. (2007, pp.521-527) assessed the relationship between temporomandibular disorders (TMD) and SDAs. In this high quality, longitudinal study, Witter et al. (2007, p.522) followed 83 patients (42 SDAs and 41 complete dental arch) over a 9 year period with assessments of TMD including pain, restricted mobility and jaw clicking. Using covariate analysis revealed no significant differences between the two groups leading the authors to conclude that SDAs do not impact the severity or any fluctuations in the signs and symptoms of TMD when compared to those with complete dental arches.

**Patient Comfort**

There is a dearth of studies that focus directly on SDA patient comfort, and any studies that do report comfort outcomes do so in a mainly circumstantial manner (Gerritsen et al., 2007, p. 170; Gottfredson and Walls, 2007, p.38; Aras et al., 2009, p.6). A comprehensive observational cohort study carried out by Gerritsen et al. (2013, pp.859-866) reported that patients with SDAs that had been restored with RPDs reported higher levels of discomfort than patients with unrestored SDAs, however, the pain and discomfort were generally short lived and occurred only whilst the patient was adjusting to the RPD. Nevertheless, the same authors also reported that these RPDs rarely lasted as long as the non restored SDA, therefore, the RPD treated patients did experience more discomfort than the SDA group as they were required to adjust to new treatments more frequently.
Sarita (2012, p.92) reported that the majority of patients with SDAs treated with RPDs did not report any significant improvements in comfort with the RPD. Nassani et al. (2013, p. 254) also refer to this finding and report that the use of cantilevered fixed resin bonded bridges were considered a more comfortable treatment option for SDA patients when compared to RPDs.

**TREATMENT OPTIONS FOR SDAs**

A high quality, randomised, longitudinal study, which compared prosthodontic treatments from SDA, was carried out by Wolfart et al. (2005, pp.815-822; 2015, pp.525-533). The initial pilot study (Wolfart et al., 2005, p.817) provided detail on the study, which aimed to measure the effect of RPD with molar replacement of SDA patients with SDA patients who retained a premolar occlusion. These authors enrolled 34 patients into the pilot study and found that, when comparing oral health related quality of life (OHRQoL) outcomes before treatment then at 6 weeks, 6 months and 12 months post treatment, no significant differences were found between the two groups. The authors determined that this was likely due to the low sample size enrolled in the pilot study, however, the 5 year follow up study (Wolfart et al., 2015, pp.525-533), showed similar results. The initial cohort was increased to 152 patients with 81 patients being assigned to the RPD group and 71 to the SDA group. Both groups were age matched and had similar OHRQoL scores. Post treatment follow ups continued annually for 5 years following the original pretreatment, baseline, 6 week, 6 month and 1 year post treatment measurements. The results showed that both groups showed marked improvements in their OHRQoL scores from pretreatment to baseline and this improvement continued in the RPD group up until the 1 year post treatment measurement. However, no further differences were seen within the groups and there was no statistically significant differences seen between the groups. This led the authors to conclude that RPDs to replace missing molars are not necessary to improve OHRQoL in SDA patients.

An alternative randomised clinical study carried out by Sasse et al. (2014, pp.373-376) assessed abutment tooth prognosis with cantilevered fixed dental prostheses (CFDPs) in SDA patients. These authors enrolled 62 patients with a bilateral SDA up to the first or second premolar which equalled 124 quadrants. 67 quadrants were left with no treatment (control group) whilst 57 quadrants were treated with a CFDP. Follow up occurred annually for five years and the results showed that, using the Kaplan-Meier survival score, tooth loss and tooth fracture in the CFDP group was 93.9% and 94% respectively, whilst in the control group this score was 91.9% and 92.8% respectively. Statistical analysis reveals that this difference is not significant. Survival rate for the CFDP retainer was 92.1%. The authors therefore concluded that CFDPs are a viable treatment option of SDA treatment. However, they fail to address whether the patients actually derived any benefit from the restorative treatment. As such, it is considered that these results should be viewed with caution.

A comprehensive review of the literature, carried out by Nassani et al. (2013, pp.251-256) considered the efficacy of restoring SDA patient’s molar region with free end saddle RPDs. Although these authors describe the free end saddle RPD as a simple, cheap and non-invasive treatment option for SDA patients, the literature finds that the denture is unpredictable and problematic. In addition, Nassani et al. (2013, p.253) report that the contribution to oral function of the free end saddle RPD for SDA patients is also somewhat dubious, leading the authors to report that there is no significant benefit of the restoration.

Finally, a comparative study was done by Antunes JL et al. (2016.p.190) in patients having intact anterior region and without dental prosthesis. They assessed the differences in quality of life related to oral health. Their study showed that many adults, though having several missing teeth, may function well without dental prosthesis. The results of this recent study has challenged the traditional approach of placing a dental prosthesis in patients. They argue that more dental resources should be allocated to preventive and diagnostic services.

**CONCLUSION**

In conclusion, this literature review has shown that the SDA is still considered to meet the 20 tooth requirements outlined by the WHO (2002), however, some authors suggest that there is a requirement to have molar occlusal units in order to ensure masticatory ability. Nevertheless, the evidence in support of this requirement is weak. Prosthodontic considerations are more complex and authors have found that patients with SDAs are more prone to occlusal wear, particularly in the anterior region in patients with few molar occlusal units. In addition, occlusal stability is likely to be affected as increased pressure is placed upon the premolar regions, which is likely to result in tooth displacements. However, this was a computational study, so it is recommended that a full clinical study be carried out in this area to determine the value of these results. Whilst no direct studies have been carried out regarding patient comfort, studies have found that SDA patients do not have any increased prevalence for TMD that those with complete dentition. Finally, there is little evidence to suggest that there is any benefit of RPDs of CFDPs for the SDA patient, aside from for aesthetic or personal choice reasons.

**DISCLOSURE**

Declared none.

**REFERENCES**


