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Review

Effects of removable dental prostheses on masticatory performance of subjects with shortened dental arches: A systematic review

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ABSTRACT

Objective: To synthesise data on the effects of distal-extension removable dental prostheses (RDPs) on masticatory performance of subjects with (extreme) shortened dental arches ((E)SDAs).
Data: Search terms were: 'masticatory' respectively 'chewing' combined with 'performance', 'efficiency', or 'ability'.
Sources: An electronic search restricted to the years 2003–2014 in PubMed, Medline, Cochrane Library, Embase, and Science Direct databases.
Study selection: Studies exposing data on subjects with SDA (3–5 posterior occluding pairs) or ESDA (0–2 posterior occluding pairs) and on masticatory performance with RDP were included.
Results: Four studies provided data on comminution, three on mixing ability, and one on both tests. Comminution or mixing ability in subjects with (E)SDA was 28–39% lower compared to that of subjects with complete dentitions. In two studies, comminution outcomes when chewing with an RDP ranged from 2% to 32% reduction, indicating better chewing function (smaller X_{50}) compared to comminution without the RDP. One study reported 28–83% lower mixing ability when chewing at the RDP side than chewing at the dentulous side. Generally, more artificial teeth (or longer occlusal platform) in experimental RDPs resulted in better comminution and better mixing ability (significant in four out of five studies), indicating a 'dose–effect' relationship.
Conclusions: (1) Subjects with (E)SDA had a 30–40% reduced masticatory performance; (2) distal-extension RDPs could compensate this reduction partially (some 50%); and (3) more artificial teeth in RDPs resulted in better performance.
Clinical significance: Distal-extension RDPs in subjects with SDA partially compensate reduced masticatory performance.

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1. Introduction

The main goal of the rehabilitation of reduced dentitions is to restore impaired esthetics and masticatory function by replacing missing teeth. Conventional treatment in partially dentate people generally involves replacement of missing teeth with fixed (FDPs) or removable dental prostheses (RDPs). Today, implant-supported prostheses are applied in large numbers and a continuing growth of implant treatment is expected.[1] However, traditional RDPs are still being widely used for various reasons. In contrast with the traditional approach of replacing all missing teeth, the shortened dental arch (SDA) concept aims to restore the strategic parts of the dentition only.[2] In this approach, missing posterior teeth are only replaced if they are considered strategic for appearance or function. An SDA classically comprises 20 occluding teeth (all upper and lower incisors, canines, and premolars), but there are many variations. In practice, it may be regarded as a dentition with a reduction of teeth starting posteriorly comprising of 3–5 posterior occlusal pairs.[3] Dentitions with a reduction of teeth starting posteriorly comprising of 0–2 posterior occlusal pairs are classified as extreme shortened dental arches (ESDA).[2] Whereas extension of ESDA is considered effective to improve oral functions, extension of so-called moderate SDAs (3–5 posterior occlusal pairs) is still a controversial issue. Arguments brought up for extending SDA are improvement of chewing function and rehabilitation of posterior support.[4–8] Arguments for not extending SDA with distal-extension RDP are potential risk for deterioration of abutment teeth, not contributing to long-term stable occlusion, and perceived limited 'added value' resulting in not wearing the RDP.[9–12] It has been estimated for the United Kingdom, that some 30–50% of patients never or only occasionally wear their RDP.[12]

Regarding masticatory ability, only approximately 10% of subjects with moderate SDA reported complaints on chewing function, mainly for chewing hard foods.[13–15] From studies using objective measures for masticatory performance and from swallowing threshold studies, it is known that subjects with moderate SDA compensate a reduced food platform area by chewing longer time and more chewing cycles before swallowing, with particle sizes when swallowing comparable to those with complete dentitions.[16,17] Whilst prevalence of complaints on chewing function is low and compensation mechanisms for decreased chewing function seem to be adequate,[17] it is unclear to what extent tooth replacement with RDP re-establishes masticatory function.

For the assessment of chewing function, a wide variety of subjective and objective methods have been described in the dental literature.[18–21] Amongst the assessment of self-perceived subjective chewing function, questionnaires including oral health-related quality of life (OHRQoL) instruments have been developed to assess the self-perceived chewing function and patients' satisfaction with chewing. Apart from these subjective measurements, objective methods and indicators have been used to assess masticatory performance. In most studies on masticatory performance, the degree of breakdown of a test food has been determined by sieving the comminuted food.[18,19] Comminution tests have been evaluated by determining the particle size distribution after a given number of chewing strokes with natural foods (for example peanuts or raw carrots) and standardised artificial test foods based on silicones such as high viscosity polysiloxane materials. Another method to determine masticatory performance is to assess the ability of subjects to mix and knead a food bolus. For these mixing ability tests, two-coloured chewing gums, (paraffin) wax, colour-changeable chewing gums, and jelly gummy have been used.[18]

Due to the variety of study methodologies and materials used for assessment of masticatory performance, it is difficult to comprehensively appraise the outcomes of these studies. The aim of this systematic review was to synthesise the available knowledge from the dental literature about the effects of distal-extension RDPs on the masticatory performance of subjects with moderate or extreme SDA.

2. Materials and methods

2.1. *Search strategy and study selection*

The Cochrane Library revealed no systematic reviews on possible relationships between partial RDP and masticatory performance. Subsequently, we searched the databases PubMed, MEDLINE, Cochrane Library, Embase, and Science Direct from January 2003 to July 2014 for primary articles on masticatory performance. A broad search strategy was applied to capture as many relevant studies as possible, using the following keywords: (1) masticatory performance, (2) masticatory efficiency, (3) masticatory ability, (4) chewing performance, (5) chewing efficiency, or (6) chewing ability. The keyword searches were limited to Medical Subject Headings and free text fragments. Search limits were set for: human studies, adults (aged 18 years and older), and publication in English. Duplicate references retrieved from the searches in the five databases were eliminated.

Two trained reviewers independently screened titles and abstracts of the identified records for relevance (SL and NHJC). Included were studies that described: (1) subjects from the general population and (2) the method for assessing masticatory performance. Records were excluded that reported on (1) specific patient groups (e.g. Parkinson's disease, dementia, etc.), (2) temporomandibular joint disorders (TMDs) or bruxism, and (3) masticatory performance after surgical procedures (e.g. orthognatic surgery). Also studies (4) reporting electromyography outcomes and (5) studies that used qualitative research methods were excluded. In case of doubt and/or if an abstract was not available, a full-text copy of the article was examined. Cohen's Kappa was used as measure of inter-observer agreement and disagreement were resolved after discussion. If necessary a third reviewer (DJW) acted as a mediator and if unresolved, the record was included. In a second step, studies reporting on edentulous subjects only were excluded. Studies with subjective outcomes only, such as questionnaire-based studies, and validation studies were excluded in following steps. Again, in cases of doubt, copies of the full-text articles were examined.

Subsequently, full-text articles of potential relevant studies were then retrieved and re-assessed for eligibility. Each article was scrutinised and categorised according to the method of masticatory performance assessment described: