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Review

Rehabilitation of oral function with removable dentures – still an option?

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SUMMARY **Tooth loss is a chronic disability, which makes it difficult for patients to perform essential tasks such as eating, communicating with others and socialising. Numerous studies have revealed and addressed the recent rapid development of various prosthodontic materials and treatment patterns. Oral rehabilitation with dentures exerts a great influence on people's daily life and has tremendous social implications. Dentures help to restore an individual's sense of normality and ability to interact normally. With the introduction and progression of implant technology, many troublesome issues can now be solved simply. Nowadays, more and more attention has been paid to new trends (implant-assisted restoration and fixed prostheses). However, removable dentures may be a more appropriate solution under some circumstances, such as if they are a patient's preferred option, if remaining oral tissues are in poor condition, or if they provide the most cost-effective form of treatment. Thus, removable dentures are still an option for the rehabilitation of oral function. The purpose of this article was to retrospectively review the applications of removable dentures and to emphasise their indispensable status.**

KEYWORDS: **rehabilitation, removable, dentures, oral function, human**

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Introduction

Oral functions consist of masticatory, swallowing, aesthetic, sensory and phonetic components. Oral function pathologies could result from many causes, such as tooth loss (1, 2), muscular parafunction, tumours, trauma and temporomandibular disorders. Patients with these impairments may experience increasing social and psychological difficulties (3–5). Application of various restorations, of which removable dentures have long occupied a place, provides a means to solve those problems. The most frequently demanded characteristics for a denture to restore oral function include masticatory, aesthetic and phonetic properties (6). Patient satisfaction and the cost-effectiveness of treatment with conventional removable dentures versus later developments such as implants are important factors to consider during treatment planning. The purpose of this article was to provide an insight into rehabilitation of oral function with removable dentures.

Literature search

An online database search was performed to identify relevant publications that assessed oral function after rehabilitation with dentures. The search was conducted through PubMed, ScienceDirect Online, SPRINGER and BlackWell, and all were for the period 1960 through 06 February 2014. The keywords used in the search were as follows: oral functions, rehabilitation, removable, denture and human. Articles describing the use and development of removable dentures and rehabilitation of oral functions

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(masticatory, aesthetic and phonetic functions) by removable denture were eligible for this review. The review that follows is not intended as a systematic review of all past findings. Instead, it focuses on the advantages and disadvantages of removable dentures and provides information to readers which will help them make a proper treatment plan for partially edentulous subjects under current trends of fixed dentures and implant prostheses.

Review of traditional removable dentures

Tooth loss has many effects on quality of life, not only because of its physical and functional consequences, but also the ensuing social and psychological problems (7). Removable partial dentures (RPD) and complete dentures are the traditional removable dentures that play an important role in restoring oral functions and systemic health (8), as well as occupying a significant position in prosthodontic history. Despite the limitations of conventional removable dentures, satisfactory restorations that can rehabilitate appropriate oral functions can be fabricated if careful attention is paid to every step involved (9). Indications for removable dentures have been described in several articles (10–12).

Masticatory function

One crucial oral function is chewing, which has significant effects on general health status (13). Chewing problems may be the main reason for impaired oral health, resulting in demands for treatment (14). Any problems in the masticatory system, temporomandibular joints, muscles, teeth or motivational control cortex result in masticatory dysfunction.

Tooth loss is one of the most common causes of reduced chewing ability. Many studies have indicated that wearing removable dentures to replace the lost teeth can greatly improve masticatory functions although without restoring normal chewing ability compared to complete dentition (15–19). Edentulous patients showed improvements in terms of overall patient satisfaction and health-related quality of life including masticatory function when they received complete dentures (20). One study demonstrated that the average efficiency of a removable denture rose immediately after the restoration was placed, and reached maximum efficiency gradually in approximately 1 month (21). Another study also reported that the masticatory efficiency and the subjective evaluation of masticatory performance increased significantly after the lost teeth were restored with removable dentures (17, 18). Mastication in patients with extremely shortened dental arches rehabilitated with a removable partial denture (RPD) was assessed in one study (15). Removable partial denture wearers showed improved masticatory performance and ability and shorter chewing time than when not wearing the prostheses or compared to those who had not received any therapy.

Dietary choices and nutritional intake are affected by chewing ability and therefore have a critical effect on general health (22). Some researchers collected dietary data concerning the food and nutrient intake of 49 501 male healthy subjects and found that edentulous participants consumed fewer vegetables, less fibre and carotene, and more cholesterol, saturated fat and calories than those with 25 or more teeth. Longitudinal analyses suggested that tooth loss may lead to detrimental changes in diet (23). One study revealed that a major benefit of wearing an RPD for those who had lost their posterior teeth was improved masticatory performance (18).

Improvements in masticatory function must be on the basis of fitting dentures. Garrett (24) reported that patients with poorly fitting dentures suffered oral dysfunction; however, almost all patients perceived an improvement in masticatory function after they were issued with a new, better-fitting removable denture, in terms of chewing comfort, chewing ability, less difficulty eating hard foods and eating enjoyment. When quantifying the security of mandibular dentures in edentulous patients using a visual analogue scale, relining 'loose' dentures gave higher scores in their assessments for 21 of 23 patients (25). To maintain functionally stable dentures, static–dynamic concepts of framework design that stress the distribution of vertical and horizontal forces between abutments as well as abutments and mucosa should be considered (26). Duplicating favourable features of the previous denture, especially the polished surface shape, facilitated the adaptation process and resulted in better functional performances (27, 28). Some materials were used to develop high-quality and innovative removable dentures with good functional and adaptation properties, including reinforcement of PMMA denture bases with fibres and thermoplastic materials

(29–31). One study demonstrated that mean daily nutrient intakes did not differ between subjects with well-fitting dentures and those with natural teeth (32). Studies comparing changes in masticatory function in complete denture wearers before and after relining with a soft liner showed that a soft lining material improved masticatory function with no adverse effects on muscular tasks (33–35). For example, in one clinical study, two sets of complete dentures were fabricated with and without a soft liner for 20 patients (36). They found that masticatory performance in patients wearing complete dentures with soft liners was improved by 5% compared to patients fitted with dentures without soft liners. Soft liners can also be used in removable partial dentures, especially for the distal extension dentures (37). In addition, denture adhesive can also contribute to reducing denture movement and improving chewing function (38–41). Some deleterious effects on dental and supporting tissues are known to be caused by removable dentures, such as caries, periodontal disease and mucosal lesions. However, if a maintenance programme is undertaken, including oral hygiene instruction and motivation as well as regular check-ups by a dentist, all those may be mitigated (42–44). Meanwhile, removable dentures need to be paid periodic attention at least as often as natural teeth.

Aesthetic function

Dentures restore a natural appearance and allow patients to regain their confidence to interact with others in our image-conscious society (6). Aesthetic function is mainly determined by the clinical and technical procedure used as well as the choice of patterns and materials (45). Manufacturers correlate the dentures to face contour and tooth form according to the concept developed by Frush and Fisher (46, 47) that integrates tooth selection into an aesthetic system governed by sex, personality and age. Even interim removable dentures can provide aesthetic relief and essential functionality before the final prosthesis (48). For partially edentulous individuals, an RPD replaces the missing teeth, and for edentulous patients, complete dentures also provide them with an appropriate smile and normal appearance, suiting their physical character and image needs. Thus, removable dentures fulfil the aesthetic requirements to some degree, although the satisfaction varies enormously which may be affected by personality type (48), psychological factors (49, 50) and other factors in addition to technical excellence (51).

Restorative technology develops so fast that more and more effort has been expended to improve masticatory function and aesthetics at the same time (52). Improvements in the aesthetics of removable dentures seem to be obvious. When the rotational path is properly designed and fabricated, patients can be pleased aesthetically (53, 54). Various advancements have improved the quality of removable dentures, improving an individual's quality of life. In framework design, the aesthetic considerations are concerned with keeping parts of the framework out of sight, by minimising the interproximal minor connectors, removing unnecessary clasps, adding indirect retainers distally and so on (26). Ancowitz (55) described six dental categories that assisted dentists in choosing RPD design concepts to avoid unaesthetic exposure, in addition to the utilisation of new materials. In addition, communication with patients plays an important role in ensuring satisfactory restorations by following the try-in procedure (56). Improvements in a patient's aesthetic appearance can be achieved to reach their aims using systematic approaches (57).

For complete dentures, three aesthetic concepts have been recommended: 'natural', 'supernormal' and 'denture look' (58). The dentogenic approach (described as 'natural') seeks to match anatomic determinants of sex, age and personality. A patient-centred approach (described as 'supernormal') permits changes from patients to achieve what they regard as beautiful. In clinical practice, no one approach is the best for every patient, it depends on each individual. For example, although a denture look is not acceptable for many prosthodontists, patients may be accustomed to this appearance and even prefer it (59–62). Specific decisions about tooth display, proportion, size, shape, arrangement, colour and position should be based on the aesthetic concept the patient and dentist have chosen. Sometimes, duplicating favourable features of a patient's previous dentures may produce a better aesthetic effect (6).

Phonetics

It is well known that the phonetic function is negatively affected by tooth loss and that this impairment

can be improved by restoration with an RPD (63). During denture fabrication, phonetic evaluation is frequently neglected (64, 65), while more emphasis is placed on other key elements, such as aesthetics, masticatory function and comfort. Speech sounds are produced by integrating the interaction of tongue, palate, lips, teeth and jaws; meanwhile, the valving and articulatory process can modify the air flow (6). Teeth and alveolar bone play an important role in an individual's speech intelligibility. Removable dentures can compensate for these problems caused by tooth loss, if only doctors evaluate the position of artificial teeth, make a phonetically beneficial construction of the denture base and create a removable prosthesis with a base which will restore the lost bone (66, 67). A denture that significantly alters the position of the teeth or palatal contours can affect or interfere with speech articulation and intelligibility. Particular phonemes are recommended to test the phonetic properties of removable dentures on the basis of different languages (6). To provide an optimal environment for the rapid, coordinate muscle movements requisite for acceptable speech, static positional concepts of incisor relationship and denture contours should be emphasised at the expense of dynamic considerations (68). One study evaluated the effect of dental prosthetic rehabilitation on speech intelligibility by means of an automatic, standardised speech recognition system. The results showed that significantly better speech intelligibility could be achieved using dentures compared to the original results without dentures inserted (69). After the loss of teeth, especially complete loss of teeth, speech production quality is significantly reduced. For edentulous patients, regaining speech quality seems to be an important part of oral rehabilitation by means of complete dentures (67). Another study which evaluated the adaptation of patients to RPDs in relation to articulation of Turkish phonemes revealed that problems in articulation either occurred or were ameliorated after the insertion of dentures, but in general, the problems were resolved after 1 week of use (70). Thus, in clinical practice, clinicians should draw the patient's attention to the fact that a certain period of time will be required to become accustomed to the new dentures and to master their speech perfectly (71).

Development of removable dentures

Implant-supported removable dentures show many advantages compared with conventional ones, providing a new concept for restorations. These include implant-assisted and implant-supported overlay dentures, hybrid prostheses and fixed porcelain-fused-to-metal or all-ceramic restorations. The treatment planning process is dictated by the age of the patient, psychological demands, aesthetic needs, requirements for hygiene access, anatomic limitations, degree of ridge resorption, interocclusal space and cost of treatment. For clinicians, the design and maintenance of distal extension partial dentures appears to be challenging as these types of dentures have produced complaints about lack of stability, minimal retention or unaesthetic clasps. Placement of implants in the distal region can convert denture patterns from Kennedy I or II to Kennedy III (72–74). More stable removable dentures with fewer implants may therefore be a cheaper and better choice for those with limited finance than the implant-supported fixed prostheses (75, 76). Another study verified that stable and durable occlusion improved oral function, which could be obtained by placing implants beneath the distal extension denture base of the RPD (77). Analysis of masticatory movements assessed by a tracking device and evaluation of the occlusal force and contact area by a T-scan system were also conducted in this study. The results proved that implant-supported removable dentures had greater force and greater area, and all the patients were satisfied with comfort, chewing, retention and stability. Although the classical treatment plan for edentulous patients is to provide a complete removable denture, choosing implants to support the denture may be one more suitable solution, especially in the mandibular region where the bearing area is relatively insufficient (78, 79). Chen (80) conducted a study comparing the comparative masticatory efficiency of mandibular implant-supported overdentures (ISOs) to tooth-supported overdentures (TSOs) and complete dentures (CDs). The results revealed that the ISO provided the greatest degree of efficiency, followed by the TSO and the CD groups. Awad (81, 82) evaluated the general satisfaction and function (comfort, stability, easing of chewing, speech, aesthetics) of implant-retained overdentures and concluded they were significantly higher among middle-aged or senior edentulous patients,

compared to conventional dentures. Implant-supported prostheses can improve the social and intimate activities in edentulous adults to a greater degree than conventional ones (83), can also reduce psychological distress (84) and can improve nutrition (85). However, a systematic review of 18 articles addressing masticatory performance with implant-supported dentures verified that objective benefits in masticatory performance of implant-supported dentures compared to conventional dentures were limited to implant-supported overdentures with a resorbed mandible and/or difficulty in fitting conventional complete dentures (86). A meta-analysis of randomised controlled trials evaluating implant-supported mandibular overdentures suggested that the magnitude of the effect was still uncertain although implant-supported dentures might be more satisfactory than conventional removable dentures (87). The cost of implant-supported overdentures remains higher than conventional dentures, but if necessary, an implant-retained (using two implants) overdenture seems to be a more cost-effective alternative than implant-supported (four implants) ones (88). Despite these positives, implant-assisted dentures cannot be provided to the entire edentulous population for economic and patient-related reasons (6). A recent study reviewed articles published from 1966 to 2007 and compared the masticatory performance of subjects with implant-supported or retained dentures with that of those with conventional dentures (89). The authors concluded that limited high-level evidence is available supporting advantages in mastication of implant-assistant dentures over conventional dentures.

Special applications of removable dentures

Dental agenesis is a common developmental anomaly and may have significant aesthetic and psychosocial, as well as functional implications. The prevalence of dental agenesis in North America in 2004 reached 3·91% (90), and that in Europe and Australia was even higher (91). Treatment of the adolescent patient requires special considerations among which facial growth is a prominent concern (92). For children with ectodermal dysplasia, periodic removable dentures may be the best choice in contributing to the rehabilitation of all the oral functions, development of normal dietary habits and rapid social integration (93, 94). Fixed prostheses are restricted not only because of the possibility of pulp exposure but also to allow jaw growth (95). Endosseous implants placed in young patients act as ankylosed teeth resulting in infraocclusion of the prostheses or cause jaw growth disturbance (98, 99). The application of implants in the developing maxilla should be avoided until early adulthood (98, 99). Removable dentures should be considered when fixed restorations are inadequate (100). Overdentures are a simple and reversible choice that can provide the means for restoring ideal occlusion, increasing the vertical dimension, improving facial aesthetics, restoring self-image (101) and stimulating the alveolar ridges (102). It is recommended that prosthetic rehabilitation must be performed as early as possible to overcome the handicap and allow the patient to integrate into society (103). Clinical observations reveal that overdentures do not impede growth of the jaws or eruption of the permanent dentition (104). Further, a long-term study of paediatric patients treated with overdentures verified that no TMJ-related complications occurred (105). Patients with oligodontia or other development defects treated with conventional or modified overdentures illustrated the value of removable prostheses as one approach to fulfilling the requirements of aesthetic rehabilitation (106).

Removable dentures play important roles in the procedure of occlusal rehabilitation. Occlusal reconstruction is one of the most demanding tasks and therefore needs to be considered carefully as the stakes are high and failure is costly (107). During the procedure of increasing the occlusal space, splint therapy, usually used for a trial period (109), reduces activity and relieves symptoms of muscle dysfunction (108). Thus, a right centric position can be recorded by de-programming and jaw manipulation procedures (110). For some complex patients, removable dentures make sense as a temporary prosthesis when restoring teeth in bad condition (111). In addition, removable dentures can be used as provisional restorations which are a good diagnostic instrument in full-arch oral rehabilitations in the process of achieving ideal results (112). Overlay removable partial dentures can be used instead of an occlusal splint to efficiently evaluate the vertical dimension of a patient's occlusion (113) and provide a reversible choice before transferring to a final restoration (114, 115). For financial reasons or general medical conditions, overlay removable partial dentures have some

advantages and provide a simpler and cheaper substitute compared to fixed prostheses (116, 117).

Conclusion

Although removable dentures are usually less appreciated due to concerns regarding their comfort, aesthetics, masticatory function, occlusal stability and maintenance of oral hygiene, more modified strategies are being developed and put into use, perfecting the application of removable dentures so that they are competitive as well as being non-invasive and cost-effective. With the geriatric population growing, there will be increase in the percentage of patients having edentulous or partially edentulous jaws. Our analysis shows that the use of removable dentures remains a viable and predictable treatment choice in clinical dentistry. An obvious shortcoming of this review is that it is not a systematic study, so that many facets cannot be addressed sufficiently and the results may not be considered as robust.

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