International Journal of Paediatric Dentistry 2006; **16:** 381–387 DOI: 10.1111/j.1365-263X.2006.00768.x

The impact of malocclusion and its treatment on quality of life: a literature review

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Summary. *Aim*. The aim of this paper is to review the literature relating to the impact of malocclusion, and the treatment of malocclusion, on physical, social and psychological health (i.e. quality of life, QoL).
Design. English-language papers, including cross-sectional studies, retrospective and prospective longitudinal studies, randomized controlled trials, and reviews and meta-analyses were reviewed to determine the impact of malocclusion and its treatment on QoL.
Results. Malocclusion and its treatment can affect physical health in terms of pain (e.g. temporomandibular disorders, and dental and gingival trauma), speech and mastication. In terms of psychological health, malocclusion and its treatment is reported to affect self-concept. Socially, malocclusion and its treatment can affect perceived attractiveness by others, social acceptance and perceived intelligence. However, the evidence is conflicting owing to differences in study designs, population's studied and methods of assessment of psychical, social and psychological health.
Conclusion. Much controversy exists about the impact of malocclusion and its treatment on QoL. There is a need for a more comprehensive and rigorous assessment of the impact of malocclusion and its treatment on QoL, employing standardized, valid and reliable data collection instruments.

Introduction

Malocclusion is one of the most common oral disorders and its prevalence is high in most countries [1,2]. Moreover, malocclusion traits remain remarkably stable if patients do not receive orthodontic treatment [3]. The high prevalence of malocclusion is thought to be related to a host of genetic and environmental factors, and is believed to be more common now compared with prehistoric times [4]. Within the past few decades, most countries have reported an increase in the need and demand for orthodontic treatment that can not be explained by clinical oral health status alone [5–9].

Greater understanding of the physical, social and psychological effects of malocclusion is important on many fronts, since it provides an insight into the consequences of malocclusion for people's lives [10,11]. Moreover, it provides greater understanding of the demand for orthodontic treatment beyond clinician parameters [9]. In addition, since the physical, social and psychological effects are key reasons why orthodontic care is sought, it can be argued that the best measure of outcome from orthodontic treatment is its improvement in physical, social and psychological health [12,13]. The physical, social and psychological aspects of oral health encompass what has been referred to as oral-health-related quality of life (QoL), and these provide an insight into how individual oral health status effects life quality and how oral health care brings about improvements to QoL [11,14]. The aim of this paper is to review the literature relating to (1) the physical, social and psychological impacts of malocclusion, and (2) changes to physical, social and psychological status following orthodontic treatment.

To identify studies which explored the relationship between malocclusion, orthodontic treatment and QoL, a computerized Medline literature search (from 1966 to 2004) was performed. 'Malocclusion' or 'orthodontic treatment' was searched in the subject heading and cross-referenced with 'physical health', 'social health', 'psychological health', 'quality of life' and 'oral health related quality of life'

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(OHQOL). Abstracts were reviewed and screened by study type, i.e. meta-analyses, randomized controlled trials, longitudinal prospective studies, retrospective studies, cross-sectional studies and case studies. All meta-analyses, randomized controlled trials, longitudinal prospective studies and retrospective studies were retrieved, and the strength of their evidence was assessed. Where evidence was inconclusive, cross-sectional studies were retrieved with priority given to random, population-based epidemiological studies. For completeness, articles referred to in the reference lists of papers which had not previously been captured by the computerized search were obtained. Where any confusion of terminologies existed, the authors consulted an encyclopaedia of related disciplines.

Physical impact of malocclusion

Pain is a common symptom that can impact on QoL [15]. The aetiology of orofacial pain is multifactorial, and while malocclusion *per se* does not cause orofacial pain, it can give rise to pain indirectly by leading to temporomandibular disorder (TMD), and dental, gingival and mucosal trauma [16–20].

Temporomandibular disorder is a collective term used to describe a group of disorders which affect the muscles of mastication, the temporomandibular joint and occlusion [21]. The prevalence of TMD has been reported to be high, and ranges from 10% to 70% in the general population [22,23], with a greater prevalence in older people [24]. Other studies have suggested that TMD is higher in the mixed and early permanent dentition than in the permanent and primary dentition [22].

It has been suggested that malocclusion may play a role as a contributing factor for the development of TMD. Several reviews involving primarily cross-sectional studies in general and patient populations have suggested a weak, if any, association between TMD and malocclusion [25–27]. However, this does not imply a cause-and-effect relationship. Evidence from the few longitudinal studies which exist suggests that subjects with malocclusion over a long period of time tend to have a greater prevalence of TMD. Certain types of malocclusion, such as open bite, Class II malocclusion with a large overjet and deep bite, and Class III malocclusion with posterior crossbite and lateral crossbite, may contribute to TMD in the long term [18,28,29]. However, the evidence of the correlation between TMD and different types of malocclusion is generally weak, although a unilateral crossbite appears to be a factor in some individuals [29]. One study reported that overjet and overbite had no relationship with TMD [30]. Just as the relationship between malocclusion and TMD is not confirmed, the relationship between orthodontic treatment and TMD is not confirmed, either [31–33]. Moreover, there is no convincing evidence that orthodontic treatment, by altering occlusion affects TMD [18,29,31,32].

Another way in which malocclusion can give rise to pain is by increasing the likelihood of dental trauma. Trauma to maxillary incisors is associated with falls, collisions, occlusal characteristics and adverse psychosocial environments, and has an estimated prevalence as high as 34% among children [17,20,34,35]. Several cross-sectional and prospective studies have reported that malocclusion is associated with dental trauma, particularly among children with untreated Class II, division 1 malocclusions. Where maxillary incisors are proclined, particularly upper central incisors, there is a high risk of trauma [17,19,20]. Several studies have reported that incisor trauma is correlated with increased overjet among children [20,36], and a meta-analysis of the relationship between overjet size and dental trauma suggested that children with an overjet greater than 3 mm were almost twice as much at risk of injury to the incisors as children with an overjet of less than 3 mm [37]. However, several studies have reported no significant relationship between dental trauma and overjet [34,38]. A randomized controlled study suggested that early correction of protruding upper incisors may have some effect on the incidence of trauma, but the treatment must be carried out early, i.e. soon after the eruption of the maxillary incisors [19].

Malocclusion may also give rise to pain by causing gingival and mucosal trauma. The relationship between gingival inflammation and malocclusion is controversial [39]. Although several cross-sectional studies have found that occlusal trauma may be important in the development of periodontal disease, it is now regarded as a cofactor that may accelerate the rate of development of an existing periodontal disease [40,41]. Patients with large overjets and deep overbites are more likely to experience periodontal disease associated with incisal contact [16]. In some cases of very deep overbite, direct trauma to the gingiva from the incisal edges of the mandibular inci-

sors may result in palatal recession in the region of the maxillary incisors. Similarly, in severe Class II, division 2 malocclusions, retroclined maxillary incisors contacting with the gingiva of lower incisors can lead to marginal recession of the labial gingiva of the mandibular incisors [16]. A randomized controlled clinical trial has shown that orthodontic treatment may reduce the incidence of trauma by correction of an increased overbite and overjet [19].

A long-standing area of research has been to determine the effects of malocclusion on mastication, including both masticatory efficiency (as assessed by laboratory tests) and masticatory ability (as assessed by self-assessments of chewing ability). Several cross-sectional (patient- and population-based) studies have reported on differences in masticatory efficiency and masticatory ability between subjects with malocclusion compared with those with 'normal' occlusion [42–44]. Furthermore, it has been reported that subjects with Class III malocclusions have the poorest masticatory efficiency and ability, followed by those with Class II and Class I malocclusions, respectively [42]. In addition, a review of eight studies suggested that malocclusion may affect diet in terms of choice of food and nutritional status [45]. However, others have found either no, or very weak, associations between malocclusion and masticatory function [44,46]. When malocclusion was corrected by orthodontic treatment (employing activator appliances), chewing efficiency was not found to be improved [47], but in other studies, masticatory ability was improved by undertaking orthodontic treatment combined with orthognathic surgery [48,49].

Another physical effect of dental and occlusal abnormalities is on speech, which has also been investigated for many years. In cross-sectional studies, researchers have observed a strong association between the type of speech disorder and the kind of dentofacial abnormality (population- and patient-based) [50,51]. Findings from longitudinal studies suggest that there is a significant but weak association between speech disorder and malocclusion, although the samples studied were small in number [44,52]. In particular, patients with a large overjet and deep bite have a trend to pronounce sibilants such as /s/, /z/, /j/ and /ch/ differently [53–55]. Chinese individuals with a Class III relationship may distort the consonants /zh/, /ch/, /sh/ and /z/ [56]. An anterior open bite is rarely associated with articulation disorders, but if it is combined with other malocclusions, especially a Class II occlusion, it may cause pronunciation disorder [57]. However, other studies have shown no difference in speech in relation to the type of malocclusion [50,58], and moreover, irrespective of the severity of the incisor malocclusion, that patients can have perceptually normal speech [59,60]. Several studies have suggested that combined surgical and orthodontic treatment can result in positive changes in articulation for most patients [55,59].

It is difficult to draw firm conclusions on the correlation between malocclusion and speech disorder, as one review on speech and malocclusion concluded [61]. The reason for this is that speech is a complex process for putting thought into words that involves several organs, such as the brain, teeth, lips, tongue and muscles. These organs can compensate mutually to ensure that pronunciation is correct [61].

Psychological impact of malocclusion

Self-concept is defined as the perception of one's own ability to master or deal effectively with the environment, and is affected by the reactions of others towards an individual [62]. Self-concept is a broad-ranging concept relating to personal self-concept (facts or one's own opinions about oneself), social self-concept (one's perceptions about how one is regarded by others) and self-ideals (what or how one would like to be) [63]. Several cross-sectional studies have reported that people who are satisfied with their facial appearance seem to be more self-confident and have higher self-esteem than those who are dissatisfied with their facial appearance [64]. As a part of facial structure, the dentition plays an important role in facial appearance because people are frequently concerned with dental arrangement, alignment, and appearance [65,66], and malocclusion can impact on the overall facial appearance [67]. Moreover, some patients who have a severe malocclusion report that they feel that they are useless, shameful and inferior [68], and the more severe the malocclusion, the greater the embarrassment felt by the individual [49,69]. Longitudinal studies have suggested that malocclusion may adversely affect self-concept not only during adolescence, but also in adulthood [65].

Given the reported evidence that malocclusion has an impact on the self-concept of children, recent studies have explored how orthodontic correction can improve one's self-concept. Several studies have

reported that there is no strong evidence that orthodontic treatment in children results in significant changes in self-concept or an increase in self-esteem [62,70,71]. Although patients are very satisfied with their post-treatment appearance, they frequently do not report a high level of self-confidence about their facial appearance, as one 10-year, post-treatment study observed [72]. Perhaps the damage to one's self-concept and image has already occurred at an early age and this cannot be reversed. However, O'Brien [73] found that orthodontic treatment of Class II, division 1 malocclusion with a Twin-Block appliance resulted in an increase in self-concept, specifically self-esteem. Several studies have suggested that the self-confidence of patients improves after orthognathic surgery [69,74].

Malocclusion and social well-being

Bullying is common in schools nowadays [75]. Numerous population-based studies have suggested that children with certain malocclusions are more likely to be the victims of bullying, such as teasing, name-calling and physical bullying [71]. Although most of the teasing is carried out by boys, an equal number of boys and girls are victims [76]. Retrospective studies have shown that adults with severe malocclusion are given nicknames related to their facial deformity in childhood [49,69]. Ironically, milder deviations in tooth position tend to evoke ridicule and teasing, whereas severe deformities will elicit strong emotional reactions such as pity or revulsion. It has been suggested that bullying experiences can impact not only concurrent psychosocial action, but also future psychosocial action [77,78]. Victims are liable to play a more submissive role in social interaction, rarely initiate prosocial behaviour and have inferior social skills [79]. A meta-analysis on the social effects of bullying associated with malocclusion has suggested that victims are often socially isolated and suffer psychological problems including anxiety and depression [75]. However, after orthodontic treatment, there is little evidence of a marked improvement in the social well-being of the patients [71].

Because dental aesthetics is an important element of facial appearance, poor dental appearance such as severe crowding in anterior teeth, or a median diastema, might negatively influence the general dentofacial appearance [52,67,80]. As a consequence, as numerous population based studies have suggested, it will impact on social attractiveness, which is, to a large extent, based upon 'first sight' (facial appearance) [67,80,81]. Several meta-analyses have found that facial appearance is very important in social interaction, and a positive relationship also exits between facial attractiveness and interpersonal popularity, as well as others' favourable evaluation of one's personality, social behaviour and intellectual expression [82,83]. Attractive children are judged and treated more positively, and will behave more positively and possess more positive traits than unattractive children [82]. Facially attractive adults are reported to fare better than their facially unattractive counterparts in a variety of job-related outcomes [83]. However, one longitudinal study has suggested that there is no relationship between malocclusion and work [65].

The dentofacial appearance not only impacts on social acceptance, but also on the assessment of perceived intelligence [82,83]. Some studies have suggested that incisor crowding and median diastemas have the greatest negative impact on perceived intelligence and beauty, and people with crowding and median diastemas are judged to be from a lower social class than those with ideal occlusion [67]. Attractiveness is also related to perceived academic potential [82,83]. Teachers frequently judge students' intelligence and future academic potential based on their facial appearance [83]. Attractive children are treated more warmly than unattractive individuals in various social settings (even by their parents), and this may have implications for their academic performance [84]. However, Shaw and Humphreys [85] reported that there is no bias in the rating of attractive or unattractive students based on facial appearance.

Conclusions

In summary, conflicting evidence exists about the physical, social and psychological effects of malocclusion and its treatment. The different interpretations as to what physical, social and psychological oral health mean, and the lack of standardized approaches with which to assess these constructs make it difficult to compare the impact of malocclusion on QoL and/or the impact of orthodontic intervention across studies. However, there is general acceptance that it is because of the physical, social and psychological effects of malocclusions that patients are motivated to seek orthodontic care. A greater understanding of the

physical, social and psychological consequences of malocclusion is required, and this should be applied in an appropriate and rigorous manner. Significant advances have been made in the past 2 decades in the assessment of the physical, social and psychological consequences of oral health, i.e. oral-health-related QoL [14]. A plethora of valid and reliable measures already exist for use among adults, and promising research is emerging on the use of such a measures among children [86,87]. These oral-health-related QoL measures have the potential to provide a greater understanding of the consequences of malocclusion, the effects of malocclusion if left untreated, and also the benefits of orthodontic care. There is a need for more longitudinal cohort studies of the effects of malocclusion and the treatment of malocclusion in terms of their physical, social and psychological effects, and these must be conducted in a standardized way.

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