

# Dental and social effects of malocclusion and effectiveness of orthodontic treatment: a review

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**Abstract** - The relationship between malocclusion and the health of the masticatory apparatus is reviewed. While there is evidence that certain features such as traumatic deep overbite, unprotected incisors and impacted teeth may adversely affect the longevity of the dentition, the relationship of dental irregularity to periodontal disease, caries and mandibular dysfunction is less certain. Studies in the field of social psychology indicate that an unattractive physical appearance may evoke an unfavourable social response in many facets of social interaction but the place of dentofacial anomalies in this context has not been satisfactorily assessed. The individual's adjustment to his own imperfections in dental alignment is variable and there is no evidence that children with visible irregularities will in general be emotionally handicapped. Effectiveness studies have yet to be undertaken but the factors which will have to be taken into account in assessing the benefits of orthodontic treatment are the definition of treatment need, treatment standards, the disadvantages of treatment and the influence of other determinants of dental health. The need for further research is underlined.

**Key words:** dental health; malocclusion; orthodontic treatment; social implications.

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## PART I THE EFFECT OF MALOCCLUSION ON DENTAL HEALTH

### PERIODONTAL HEALTH

The standard text books, both for orthodontics and periodontology, regard malocclusion and malalignment of teeth as predisposing or aggravating factors in chronic gingivitis and chronic periodontitis (44, 50, 85). It is assumed that the mechanical removal of bacterial plaque, the major aetiological factor in the development of chronic gingivitis (80), from malaligned teeth demands greater patient dexterity, which may not be achieved under normal circumstances. Furthermore, excessive occlusal forces placed on maloccluded teeth may result in accelerated periodontal breakdown (123).

Unfortunately, studies examining the relationship between malocclusion and periodontal disease have produced conflicting results with some reports supporting a causal link (8, 54, 87, 97, 107), while others do not (10, 39, 41, 49, 65, 86, 110). The considerable variations in the study groups used and the criteria for measurement employed, make comparison between studies very difficult. However, it would appear that many of the conflicting and contradictory findings arise from these variations in study design. Thus the inclusion of dental students, with potentially high standards of oral hygiene, failed to show an association between malalignment of teeth and gingival and periodontal disease (8, 39, 55, 60, 107). Similarly, in the study of BEAGRIE & JAMES (10), where all patients for inclusion in the study had to exhibit perfect oral

hygiene, there was no correlation between posterior tooth irregularities and periodontal disease scores.

It has been suggested (4) that at the extremes of oral hygiene, the effects of tooth malalignment on gingival and periodontal disease will be masked. In this respect it is worthy of note that, in studies employing both patient and student groups, significant relationships between malaligned teeth and gingival inflammation were observed in the patient but not the student groups (8, 107). AINAMO (4), who found a significant relationship between malocclusion and gingival inflammation in a group of army recruits, suggested that in the presence of average oral hygiene, malalignment of teeth will be an aggravating factor in periodontal breakdown. Nevertheless, even in this study the effects of malalignment were only noted in the incisor and premolar segments, being non-existent in the molar areas. The studies of SANDALI (107) tend to confirm the potential detrimental effects which incisor crowding may have upon gingival and periodontal tissues.

A further problem with many studies has been the relatively crude measurement of malocclusion and the failure to take into account irregularities most likely to be associated with periodontal deterioration. Moreover, both gingival and malocclusion scores have tended to be recorded as averages of whole mouth results. For this reason SANDALI (107) used a contact point score and investigated only the mandibular incisor segment. The results indicated that when these scores were compared with gingival inflammation and pocket measurements, a significant relationship existed in all groups including dental students. In any future investigation it would seem pertinent to consider individual tooth irregularities in determining the relationship of malalignment to disease.

Specific malpositions of groups of teeth have been considered important, in particular increased overbite and overjet. However, again, their importance to periodontal disease has not been established (8, 41, 53) although some evidence has supported an association (34, 97). Of particular interest is the study of SERGL (111), where increased susceptibility to periodontal disease was found to be associated with a number of specific anomalies. These were Class III malocclusion, anterior crossbite and traumatic deep overbite. Crowding on the

other hand was not consistently associated with periodontal deterioration, though the tendency increased in more severely crowded cases. This approach should be considered in future studies.

Clinical studies indicate that gingival exposure produced by incompetent lips is associated with an increased inflammatory response (35, 62). Such a modifying effect appears, however, not to result from increased plaque accumulation (7, 62) but dehydration of the gingiva (62).

The role of occlusal forces in the initiation and progress of periodontal disease has been debated for many years; it has, however, been observed in research with animals that excessive reciprocal and lateral (jiggling) forces on a healthy periodontium, or one exhibiting chronic gingivitis, results in widening of the periodontal membrane but not pocket formation (36, 125). In a recent report which considered epidemiology, aetiology and prevalence of periodontal disease, it was stated that "Excessive occlusal forces in man may aggravate periodontal bone loss, especially in individuals with parafunctional occlusal habits such as bruxism. It appears, however, that occlusal forces are unable to initiate gingivitis or periodontitis" (131). In relation to this it is interesting to note that the supporting structures of teeth in crossbite do not suffer more destruction (42).

#### CARIES

Few studies have considered the relationship between malocclusion and caries and again the reports are inconclusive. Thus, a higher than normal incidence of caries has been found with certain malocclusions but a lower than normal incidence with others (2). MILLER & HOBSON (87), were unable to find an association in 12-year-old children but found at 14 years that the DMF rate was higher in the malocclusion group. Similarly, HIXON *et al.* (56) found that dental students with malocclusions had a higher DMF than those with excellent occlusions but the effect was limited to smooth surfaces and did not apparently apply to those areas of irregular interproximal contact. In contrast, KATZ (65), found that caries prevalence was significantly lower in incisors that were crowded than in those which were not.

The establishment of a causal relationship is complicated by the fact that primary or permanent tooth loss through caries may in itself lead to

malocclusion. Thus, care must be taken in drawing comparisons between ideal occlusion and malocclusion groups where caries susceptibility, independent of occlusal effects, may differ.

#### MANDIBULAR DYSFUNCTION

Occlusal interferences have been defined as occlusal contacts hampering or hindering smooth gliding harmonious jaw movements with the teeth maintaining contact (99). Such interferences are considered to predispose to bruxism, increased tonus of masticatory muscle and spasm from which pain may arise. Such temporomandibular joint dysfunction and parafunctional activity would appear to be multifactorial phenomena in which emotional anxiety may play a significant role (119).

Some experimental studies have demonstrated that dysfunctional symptoms may be precipitated by the placement of occlusal interferences (20, 100). Other studies, however, have failed to support such findings (30, 108) and YEMM (132) concluded on the basis of work with animals that bruxism has a central rather than peripheral origin.

More important than temporary interferences is the consideration of the constant presence of displacing contacts. Studies of bruxism have shown an association with occlusal disturbances in adults (14) and in 12-year-old children (77). Emotional and genetic factors have emerged as the important factors in other studies (78, 93). Studies on clinic populations have shown a high prevalence of a variety of occlusal disturbances when compared with a control group (3, 18, 40, 103) and epidemiologically, combinations of those occlusal interferences were significantly more frequent in individuals with, than in those without, dysfunction (88).

In several of the studies discussed, uncontrolled tooth loss rather than primary malocclusion per se have provided the occlusal interferences and it would seem likely that certain types of irregularity would be potentially more harmful than others. The situation is further complicated by the incidence of dysfunction syndrome in individuals with ideal occlusions. Longitudinal data on the association of occlusal interferences and TM joint dysfunction is not available.

#### INCISAL VULNERABILITY

It is well documented that prominent incisors are more liable to sustain accidental injury (64, 94).

JARVINEN (64) found the risk to be almost three times greater where the overjet was 6 mm, or more. Paradoxically, peak prevalence for injury appears to occur at an earlier age than that at which orthodontic treatment is normally initiated (43).

#### UNERUPTED TEETH

In certain circumstances, particularly where relieving extractions have not been performed, teeth remain unerupted. Radiographic surveys of dental school patients have shown the incidence in Caucasian adults to be around 15%, third molars in particular being involved (5, 29). Prophylactic space provision or removal of such teeth is generally considered preferable in the young, since resorption of adjacent teeth or cystic enlargement of the follicle may ensue; if removal becomes necessary in the elderly patient, the risk of surgical or anaesthetic complication is greater.

The prevalence of pathological sequelae is unknown, however, and although radiographic surveys of edentulous populations demonstrate that many symptomless unerupted teeth remain undetected (15), they tell nothing about patients where removal became necessary. AITASALO *et al.* (5) found a decrease in the prevalence of impacted third molars with an increase in age, due presumably to symptoms which had necessitated extraction. In contrast, the frequency of impacted canines was approximately the same in different age groups from 20 to 69, suggesting perhaps that these teeth may give rise to few problems in adult life.

#### SEVERE FUNCTIONAL DISABILITY

Even the most severe deformities of the jaws such as cleft lip and palate, skeletal open bite and mandibular prognathism appear to be associated with surprisingly little functional disability. Thus the general awareness that teeth are involved in the production of speech does not imply a causal relationship between malocclusion and speech problems (121). Similarly, almost no difference has been reported between subjects with excellent occlusion and those with most types of malocclusion in terms of masticatory efficiency (38).

In summary, therefore, there is little direct evidence that dental irregularities will be consistently associated with poor dental health. Even where associations can be demonstrated, the potency of the effect is uncertain since long-term influen-

ces have not been traced. Such cross-sectional data as have been presented do *not* support the view that malocclusion predisposes to premature loss of the dentition (31).

## PART 2

### THE EFFECT OF MALOCCLUSION ON PSYCHOLOGICAL WELL-BEING

There are two interrelated ways in which unaesthetic occlusal traits may operate against the psychological well-being of the individual, namely unfavourable social response and poor self esteem.

#### SOCIAL RESPONSE

There is a growing volume of literature which indicates that physically unattractive individuals make less favourable first impressions than attractive ones. In the main, evidence for the salience of appearance cues has been derived from studies involving little or no interaction, but even where this has taken place, differences in physical attractiveness continue to be systematically related to social acceptance (1). Research has highlighted the mutual uncertainty and unease which characterises interaction between a normal person and one who is stigmatised (26, 37, 69), and GOFFMAN (46) has provided a psychosocial framework for understanding how prejudice may operate against the deformed.

Research with children indicates that physical appearance is important in biasing judgements of social acceptability, ability and personality, whether the judges are adults or other children. It is consistently found that teachers have less favourable academic expectations in the case of unattractive children (9, 25), and rate their general behaviour and personality less favourably (102). Children themselves see peers who are physically attractive as more socially attractive (19, 32, 70), and unattractive children are more likely to be the victims of bullying (81). In many of the above studies bias occurred in the absence of any real differences in performance or conduct, and in one study children who differed in physical attractiveness were found to have equivalent IQ's (25). Yet there is evidence that unattractive children achieve less educationally (106) and a recent study with college students showed that the physically unattractive are not

only judged as less socially attractive but are in fact less socially skilled (47). Such findings suggest that prejudices against the unattractive determine not only the approval they will receive from teachers and peers but also their eventual behaviour, and are thus self-fulfilling prophecies (104). This might be predicted a priori on the basis of the considerable evidence for a causal relationship between social feedback and self image on the one hand and behaviour on the other.

The face, and oral region in particular, appears to be of primary importance in determining attractiveness (12, 28, 74, 126) and since individuals with deformities of the face may be placed at the lowest end of the attractive/unattractive continuum it might be predicted that they would suffer negative stereotyping to a considerable extent. Although there has been little experimental evaluation of the effect of facial deformity in a real life setting (23), verbatim accounts of facially deformed individuals testify to the difficulties encountered by them in social interactions (83). The specific relationship between dental appearance and interpersonal judgement is poorly defined at present. Attempts to evaluate the response of others to dentofacial traits have been made by SECORD & BACKMAN (109) and SERGL & STODT (112). SECORD & BACKMAN (109) identified certain dentofacial characteristics which may be important in impression information, though they also found that the salience of such characteristics was low with regard to the five stimulus individuals in their study. Their investigation, however, could only be regarded as exploratory in view of the limited nature of the experiment. In a carefully structured investigation, SERGL & STODT (112) found that minor variations in tooth position could be a significant determinant for the overall aesthetic impression of a face. The teeth also seem to be an important target for teasing and ridicule amongst school children, 7% of whom are teased about their teeth once per week or more (117).

#### SELF ESTEEM

There is a considerable weight of opinion that an individual's level of satisfaction with facial appearance may have important implications for his self esteem (17, 63, 82, 118, 120, 124, 129). However, there has been little in the way of systematic study of the area to shed light on the actual effects of

malocclusion on the individual's perception of self and in a recent American study there were no demonstrable differences in body-image and self-concept satisfaction between a prospective orthodontic patient sample, a treated group and a general population sample (71).

A number of investigators have examined the impact of cleft lip and palate on the social integration of individuals who possess such traits (24, 95, 122) and on the individual's adjustment to them (21, 22, 27, 73, 128). In general it would appear that as a group, children with cleft lip and palate are not typically maladjusted or seriously disturbed emotionally, although they may have some problems of social acceptance. As adults they marry and become steady wage earners but may be more restricted in their social life. It seems unlikely, therefore, that individuals with less extreme cosmetic oral defects will have serious emotional difficulties but the question remains to be more fully investigated.

In summary, there is no specific, direct evidence that unfavourable stereotyping operates against individuals with visible dental irregularities or that it interferes with personality development. It seems reasonable to suspect, however, that stereotyping may operate with unfavourable effect on at least some individuals, particularly those exhibiting gross variation from the norm. It is also likely there will be considerable variability of adjustment to different malocclusions, since the relationship between actual dental arrangement and self esteem will depend on a critical balance between the individual's perception of own dental appearance, social feedback and his constitutional strength and environmental supports.

### PART 3

#### THE EFFECTIVENESS OF TREATMENT

The effect on gingival health of realigning teeth, measured over a period of time, has not been investigated. The need for such extended studies has been recommended (49), particularly since a large amount of orthodontic treatment is carried out for reasons of periodontal health, and such beneficial effects have been inadequately established (68, 101). One study of the effect of treat-

ment on sociopsychological parameters has been published (105). This 5-year follow-up of individuals failed to demonstrate benefits from treatment in terms of social and personal experience when compared with an untreated control group with similar defects. This study must, however, be criticised since there was no pretreatment assessment to allow comparison of the attitudes and feelings of the groups initially. Although there are no further studies available for comment, we might consider factors which could complicate effectiveness studies.

#### ACCURACY OF DEFINITION OF TREATMENT NEED

Though there are grounds for suspecting that certain dental traits may possibly harm long-term dental health and psychological well-being, precise definition of need is difficult. Firstly, malocclusion is not a disease but a variation from "ideal". Even "ideal" arrangements may in an evolutionary sense be anachronistic since the rapid evolution of dietary habits with the discovery of fire and introduction of crop gathering has out-stripped dental evolution. Archaeological studies indicate that in the primitive state, the dentition was subject to a varying degree of attrition which rapidly altered the shape and interproximal relationships of the teeth (11, 113). There is also evidence to suggest that the dentition unaltered by attrition is more prone to caries and periodontal disease (91), and this may account in part for difficulties in determining the relationships between dental health and various present day dental arrangements including ideal occlusions. Tight, even interproximal, contacts are considered desirable for periodontal health but these are apparently not present for the majority of teeth within "normal" or orthodontically corrected occlusions (92), and it seems that uneven marginal ridges are of far less importance than the presence and extent of plaque (67).

Secondly, since only a minority of malocclusions can be regarded as seriously handicapping (90), decisions to provide and accept orthodontic treatment must be arrived at by a process of negotiation (6). Despite a lack of satisfactory data, it remains the responsibility of the profession to give advice on dental health matters on the basis of current beliefs and teaching. With regard to judgements of appearance, however, greater exchange of opinion is possible. It seems likely that dentists, and in

particular orthodontists, operate on a rather more critical dental-aesthetic scale than society in general (48, 59, 89, 98, 116), though there may be considerable variation between dentists in the extent to which these standards will be imposed in recommendations of treatment for the individual child. What does seem likely is that there will be relatively few occasions where the dentist or orthodontist will dispute the justification for treatment where this has already been proposed by an individual child or parent.

Thus, the aesthetic implications of malocclusion though largely unexplored should not be underestimated, for they provide perhaps the most important consumer motive for seeking treatment (33, 51). In fact, there is some evidence to suggest that adolescents may prefer straight teeth to healthy ones (45). It is of some concern, therefore, that self and parental judgements of dental appearance can be imprecise. On the other hand, there is an apparent low awareness of certain anterior irregularities. INGERVALL & HEDEGÅRD (59), for example, recorded a 67% objective frequency of maxillary incisor irregularity in a sample of 278 18-year-old males, but self-reported frequency was only 24%. Accuracy of self perception may be even poorer for younger individuals. When 10-12-year-old children were asked to choose a picture displaying teeth like their own from a series of facial drawings representing different dental arrangements (57), only 13% with anterior crowding identified correctly, only 11.1% with spacing identified correctly and only 7.5% with maxillary protrusion identified correctly.

Perceptual errors have also been demonstrated in the opposite direction. For example, in groups of adolescents with objectively good occlusions, between one third (58) and one half (76) reported dissatisfaction with their own teeth. Such subjective/objective discrepancy must presumably account in part for the poor correlation between objective orthodontic indices and oral self image (66). Parental awareness of malocclusion may also be imprecise and in the Child Dental Health Survey (127), almost half of the parents of children with upper anterior crowding seemed unaware of the condition. In a recent South Wales study, it was found that one third of a group of 200 12-year-olds and one third of parents were unable to identify a dental photograph of the child's own teeth when

this was placed among a group of decoy photographs (114).

#### TREATMENT STANDARDS

There are a number of reasons why the end result of orthodontic treatment may fall short of anatomically ideal tooth alignment. These include the operator's level of expertise, financial constraints and poor patient cooperation. Even treatments incorporating high levels of technical excellence are subject to recognised limitations (61). The results of a retrospective study of treatment changes in the U.K., indicate that orthodontic therapy in general reduces the severity of the irregularity rather than eliminating it (96).

#### DISADVANTAGES OF TREATMENT

Among the reported disadvantages of treatment are the cost to family or State, the possibility that the child may find the experience distressing (75, 84) and that cooperation will not be sufficient to allow satisfactory completion of treatment (52, 89). Orthodontic treatment may produce not only short term adverse change in both oral hygiene and gingival health (72, 101), but permanent losses in gingival attachment and alveolar bone height (133). There has been some speculation that orthodontic treatment may predispose to mandibular dysfunction problems (13). However, since the natural history of the condition has not been studied, incipient dysfunction may equally well be present in pretreatment individuals (130). This and the other points mentioned remain to be fully explored.

#### OTHER DETERMINANTS OF DENTAL HEALTH

Finally, effectiveness of treatment has to be judged over a long period of time since benefits regarding dental health in particular may only be realised by adulthood. Yet many other factors influence longevity of the dentition. Of particular relevance is the level of importance which the individual attaches to the retention of his dentition. Among the factors which may influence this are sex, social class, parental attitude, cultural, regional and national factors. Other influences are individual variations in susceptibility to dental disease, availability and uptake of dental services, and the impact of personal and public preventive measures, such as diet control, tooth brushing and water fluoridation.

In this respect, it may be something of a paradox that orthodontic treatment is generally reserved for children with higher levels of general dental care and oral hygiene. It is possible that dissatisfaction with dental aesthetics influences a premature request for tooth extraction and dentures and further, that individuals will be less likely to care for their teeth if they regard them as unattractive, though one study of toothbrushing found no improvement for subjects who had completed orthodontic treatment (79).

Thus, even in the event that associations between malocclusion and dental disease could be demonstrated conclusively, it would be premature to assume that the elimination of dental irregularities would necessarily increase the life span of the dentition. The magnitude of benefit conferred by orthodontic treatment would still have to be evaluated alongside all other determinants of dental longevity, especially successive improvements in preventive techniques.

## DISCUSSION

It is a matter of some importance for dentists to know whether irregularity of the teeth has an effect on the dental health and psychological well-being of the individual. At the present time, theory, assumption and clinical impressions form the basis for corrective treatment and the allocation of resources.

While it may seem likely that dental irregularities will have a causal association with periodontal disease and caries, recent investigations have produced conflicting results. This could be due to a lack of sensitivity in the assessment criteria adopted or merely to the fact that dental disease results from the interaction of more important factors which generally outweigh occlusal features. Similarly, the multifactorial aetiology of mandibular dysfunction syndrome makes the strength of its association with dental irregularity uncertain. In contrast, soft tissue injury from traumatic deep overbite demonstrates an unquestionable causal relationship, and there is evidence that lip incompetence in association with incisal prominence hastens periodontal destruction and increases the vulnerability of the anterior teeth to accidental injury. In addition, potential hazards associated with unerupted teeth, although ill-defined, are sufficiently serious to

invoke caution before accepting their long-term presence.

The emotional handicap imposed by an un-aesthetic dental appearance may have a significant impact on individual well-being, particularly for children who are stigmatised or ridiculed by their peers and come to view themselves as inadequate. On the other hand, minor imperfections in dental appearance may be of little real significance and the demand for cosmetic correction is unlikely to bear a simple relationship to the degree of anatomical deviation.

Since the effects of malocclusion have not been satisfactorily evaluated, the benefits of orthodontic treatment must remain in question. The British Dental Association Memorandum on Orthodontic Services (16) defined the aims of orthodontic treatment as being "to produce improved function by the correction of irregularities and to create not only greater resistance to disease, but also to improve personal appearance, which later will contribute to the mental as well as to the physical well-being of the individual." Some 25 years later, the merit of these aims remains unquestionable. With a small number of exceptions, however, definition of the occlusal characteristics to which these efforts should be directed remains vague and it is uncertain to what extent the high expectations of treatment outcome voiced by consumers (115) can be realised. Intensive research of the subject would seem overdue.

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