

Malocclusion and its influence in the quality of life – A review

E. Nandakumar¹, R. Vignesh², Dhanraj Ganapathy^{1*}

ABSTRACT

Malocclusion is the improper positioning of the teeth and jaws. It is a variation of normal growth and development which can affect the bite, the ability to clean teeth properly, gum tissue health, jaw growth, speech development, and appearance. Malocclusion refers to any degree of irregular contact of the teeth of the child's upper jaw with the teeth of the lower jaw. This includes overbites and crossbite, as well as crowding of child's teeth. Most children seek treatment of malocclusion for cosmetic rather than medical reasons. Bullying is common in schools nowadays, 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. The main aim of this reviews the types of malocclusion.

KEY WORDS: Deep bite, Interarch, Intra-arch, Malocclusion

INTRODUCTION

A malocclusion is a misalignment or incorrect relation between the teeth of the two dental arches when they approach each other as the jaws close. The concept of oral health related quality of life corresponds to the impact of oral health or disease of an individual on the daily functioning, well-being or the overall quality of life.^[1] Facial esthetics plays an important role in the psychological and social development of an individual. The teeth are an important component of facial esthetics and influence the smile of an individual. Malocclusion or improper arrangement of teeth gives a less pleasing effect to the smile and the face. This can result in a loss of self-confidence in the individual. Malocclusion is the most well-known variables which influence a child's oral well-being.^[2] It causes an expanded gathering of plaque and calculus which additionally prompts gingivitis and periodontitis; it leads to cause of terrible oral hygiene. The smile has been observed to be the second most essential factor

in the impression of feeling by the overall public, after engaging quality of the eyes.^[3] The engaging of the smile is influenced by the arrangement of teeth. Previous studies have demonstrated that the majority of people are very much aware of their malocclusion. Malocclusion would also be able to influence the self-perception of a person over his engaging quality. Improperly arranged teeth can make an individual feel humiliated about his looks that may prompt bringing down of self-assurance and restricting their social life.^[4]

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.^[5] 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 lives.^[6-8] In addition, since the physical, social, and psychological effects are key reasons where the orthodontic care is sought, it can be argued that the best measure of outcome from orthodontic treatment is an improvement in physical, social, and psychological health.^[9,10]

Access this article online

Website: jprsolutions.info

ISSN: 0975-7619

¹Department of Prosthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, ²Department of Pedodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

*Corresponding author: Dhanraj Ganapathy, Department of Prosthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600 077, Tamil Nadu, India. Phone: +91-9841504523. E-mail: ghanrajmaganapathy@yahoo.co.in

Received on: 11-03-2019; Revised on: 15-04-2019; Accepted on: 17-05-2019

The term normal occlusion and malocclusion are used mainly to the static aspect of the form of the dentition. Within the past few decades, most countries have reported an increase in the need and demand for orthodontic treatment that cannot be explained by clinical oral health status alone.^[11-13] Greater understanding of the physical, social, and psychological effects of malocclusion is important on many people since it provides the consequences of malocclusion for people's life.^[14,15] The main aim of this review the types of malocclusion.

ETIOLOGY OF MALOCCLUSION

Malocclusion can occur due to a various number of possible causes. Malocclusion is caused either by the genetic factors or by the environmental factors. Comprehensive orthodontic management involves the identification of possible etiologic factors and an attempt to eliminate the same.^[16-19]

Development of normal dentition and occlusion depends on a number of interrelated factors that include the dentoalveolar, skeletal, and neuromuscular factors. Thus, localization of the possible etiology may be a very difficult task.^[20] Grabber has classified the etiological factors as local and general factors. The local factors responsible for malocclusion produce a localized effect confined to one or more adjacent or opposing teeth.^[21,22] The general factors are those that affect the whole body and greater part of dentofacial structures.

ETIOLOGY OF MALOCCLUSION

General Factors

1. Heredity
2. Congenital
3. Environmental
 - Prenatal
 - Postnatal
4. Predisposing metabolic climate and disease
 - Endocrine imbalance
 - Metabolic disturbances
 - Infectious disease
5. Dietary problems
6. Abnormal pressure habits and functional aberrations
 - Abnormal sucking
 - Thumb and finger sucking
 - Tongue thrust and tongue sucking
 - Lip and nail biting
 - Abnormal swallowing habits
 - Speech defects
 - Respiratory abnormalities
 - Tonsils and adenoids
 - Psychogenic tics and bruxism.

Local Factors

1. Anomalies of number
 - Supernumerary teeth, missing teeth (congenital absence, caries, etc.)
2. Anomalies of tooth size
3. Anomalies of tooth shape
4. Abnormal labial frenum
5. Premature loss of deciduous teeth
6. Prolonged retention of deciduous teeth
7. Delayed eruption of permanent teeth
8. Abnormal eruptive path
9. Ankylosis
10. Dental caries
11. Improper dental restoration.

TYPES OF MALOCCLUSION

Malocclusion can be broadly divided into: Intra-arch malocclusion, inter-arch malocclusion, and skeletal malocclusion.

Intra-arch Malocclusion

It includes variations in individual tooth position and malocclusion affecting a group of teeth within an arch.^[23] A tooth can be abnormally related to its neighboring teeth. Such abnormal variations are called individual tooth malposition. The individual teeth malposition can be abnormal inclination or tipping of the teeth or abnormal displacements. Abnormal inclination involves the abnormal tilting of the crown, with the root being in normal position. Bodily displacement involves the abnormal location of the crown as well as root in the same direction.^[24]

Intra-arch malocclusion can also include conditions such as spacing or crowding within the dental arch. Some commonly seen individual teeth malpositions are:

Distal inclination

This includes the condition where the crown of the tooth is tilted or slanted distally.

Mesial inclination

This includes the condition where the crown of the tooth is tilted or slanted mesially.

Lingual inclination

This is an irregular lingual or palatal tilting of the tooth. This condition is likewise called retroclination.

Buccal inclination

This includes labial tilting if there should arise an occurrence of front teeth and buccal tilting if there should be an occurrence of back teeth. This condition is additionally called proclination.

Mesial displacement

This condition refers to the tooth that is moved in a mesial way toward the midline.

Distal displacement

This condition refers to a tooth that is bodily moved in a distal direction away from the midline.

Lingual displacement

This is a condition where the entire tooth is displaced in a lingual direction.

Buccal displacement

This is a condition where the tooth is displaced bodily in a labial or buccal direction.

Infra version or infra occlusion

The terms infra version or infra occlusion refers to a tooth that has not erupted enough compared to the other teeth in the arch.

Supra version or supra occlusion

This condition occurs when the tooth is over erupted as compared to other teeth in the arch. It is also called supra occlusion.

Rotations

This condition refers to tooth movements around its long axis.

Distolingual or mesiobuccal rotation

This describes a tooth that has moved around its long axis so that the distal aspect is more lingually placed.

Mesiolingual or distobuccal rotation

This is a condition where the tooth has rotated around its long axis so that the mesial aspect is more lingually placed.

Transposition

This term describes a condition where two teeth have exchanged places.

Inter-arch Malocclusion

These malocclusions are characterized by an abnormal relationship of two teeth or groups of teeth of one arch to the other arch. These interarch malocclusions can occur in the sagittal, vertical or the transverse planes of space.^[12]

SAGGITAL PLANE MALOCCLUSION

This includes the conditions where the upper and the lower arches are abnormally related to each other in a sagittal plane.^[25]

Pre Normal Occlusion

This occurs in a condition where the lower arch is more forwardly placed when the patient bites in the centric occlusion.

Post Normal Occlusion

This occurs in a condition where the lower arch is more distally placed when the patient bites in centric occlusion.

VERTICAL PLANE MALOCCLUSION

These malocclusions include deep bite and open bite where an abnormal vertical relation exists between the teeth of the upper and lower arch.^[26]

Deep Bite

It is a condition where there is an excessive vertical overlap between the upper and lower anterior.

Open Bite

This is a condition where there is no vertical overlap between the upper and lower teeth. Thus, space may exist between the upper and lower teeth when the patient bites in centric occlusion. Pen bite can usually occur in the anterior or posterior region.

TRANSVERSE PLANE MALOCCLUSION

The transverse plane inter arch malocclusion includes various types of crossbites. The term cross-bite contains irregular transverse connection between the upper and lower arch.

SKELETAL MALOCCLUSION

The childhood birth defects in orofacial tissues are high due to the structural and developmental complexity of the face and the susceptibility to intrinsic and extrinsic perturbations. Skeletal malocclusion is caused by the twisting of the best possible mandibular and additionally maxillary development amid fetal development. These malocclusions caused due to abnormalities in the maxilla or mandible.^[27] The defects can be in size, position, or relationship between the jaws. The skeletal malocclusion can also occur in the three planes of space, namely, sagittal, vertical, and transverse planes. In the sagittal plane forward placement of jaws is referred to as prognathism and whereas the retrognathism refers to the more backward placement of jaws. These sagittal malocclusions may occur in one or both the jaws and can occur in various combinations.^[28]

Skeletal malocclusion in the transverse plane is usually a result of narrowing or widening of the

jaws. They can be described as narrow maxilla, wide mandible, etc. These transverse malocclusions are usually referred to as crossbites. In the vertical plane, abnormal variations in the vertical measurements of the jaws can affect the lower facial height.^[29]

CLASSIFICATION OF MALOCCLUSION

Angle's Classification of Malocclusion

Edward edge is presented by the arrangement of malocclusion in the year 1899. Edge's arrangement is still being used after nearly 100 years of its presentation in light of its effortlessness in the application. Angle's grouping depended on the mesiodistal connection of the teeth, dental curves, and the jaws.^[30] According to angle, the maxillary first permanent molar is the key to occlusion. Edward Angle based his classification on the relative position of the maxillary first molar. As indicated by Angle, the mesiobuccal cusp of the maxillary first molar ought to impede with the mesiobuccal groove of the mandibular first molar. The teeth should all fit in a line of occlusion. Any variation from this resulted in malocclusion which can be classified into three types.^[31]

Class I malocclusion

According to Angle the mesiobuccal cusp of the maxillary first permanent molar should occlude with the mesiobuccal groove of the mandibular first permanent molar. This is the most common type of malocclusion. The bite is normal, but the upper teeth slightly overlap the lower teeth. In Class I malocclusion patient may exhibit the dental irregularities such as crowding, spacing, rotations, and missing tooth.^[32] Class I malocclusion can be an inconsistency either inside the arches or in the transverse or vertical relationship between the arches. These patients' normal skeletal relation and also show normal muscle function. Local factors causing Class I malocclusion may also include displaced or impacted teeth, and anomalies in the size, number and the form of the teeth, and may also lead to a localized malocclusion.^[33] Another malocclusion that is most often categorized under Class I is a bimaxillary protrusion, in this condition where the patient exhibits a normal Class I molar relationship but the dentition of both upper and the lower arches are forwardly placed in relation to the facial profile.^[34]

Class II malocclusion

This group is characterized by the Class II molar relation where the distobuccal cusp of the maxillary first molar lies in the mesiobuccal groove of the lower first molar. This type of malocclusion is called retrognathism or overbite. It occurs when the upper jaw and teeth severely overlap the bottom jaw and

teeth. Angle has sub-classified Class II malocclusion into two divisions.

Class II, Division I

The Class II Division I malocclusion is characterized by proclined upper incisors with a resultant increase in overjet. A deep incisor overbite can occur in the anterior region.^[35] The lower lip Cushions the palatal aspect of the upper teeth, a feature typical of a Class II Division I is referred to as lip trap. The tongue occupies the lower posture, thereby failing to counteract the buccinator activity. The unrestrained buccinator activity results in narrowing of the upper arch at the premolar and canine regions, thereby producing a V-shaped upper arch.^[36] Another muscle distortion is a hyperactive mentalis movement. The muscle irregularity is created by a hyperactive buccinator and mentalis and an adjusted tongue position that complements the narrowing of the upper dental arch.

Class II Division II

As in Class II Division I malocclusion, Division II also exhibits a Class II molar relationship. The classic feature of this malocclusion is the presence of lingually inclined upper central incisors and labially tipped upper lateral incisors overlapping the central incisors. Variations of this form are lingually inclined central and lateral incisors with canines are labially tipped. In this condition, the patient may exhibit a deep anterior overbite.^[37]

The lingually inclined upper central give the arch as a squarish appearance, unlike the narrow V-shaped arch seen in Division I. The mandibular labial gingival tissue is often traumatized by excessively tipped upper central incisors. In this condition, the patient exhibits a normal perioral muscle activity. An abnormal backward path of closure may also be present due to the excessively tipped central incisors.^[38]

Class II subdivision

When a Class II molar relation exists on the one side and a Class I on the other side, it is referred to as Class II subdivision. Based on whether it is Division I or Division II it can be called as Class II, Division I, subdivision or Class II, Division II, subdivision.

Class III malocclusion

This malocclusion exhibits a Class III molar relation with the mesiobuccal cusp of the maxillary first molar impends in the interdental space between the mandibular first and second molars. This type of malocclusion is called prognathism or underbite.^[39] This occurs when the lower jaw protrudes or juts forward, causing the lower jaw and teeth to overlap the upper jaw and teeth. Class III malocclusion can be classified into true Class III and pseudo Class III.

True Class III

This is a skeletal Class III malocclusion of genetic origin that can occur due to the following causes:

1. Excessively large mandible
2. Forwardly placed mandible
3. Smaller than normal maxilla
4. Retropositioned maxilla
5. Combination of above causes.

The lower incisors tend to be lingually inclined. In this condition, the patient can present with a normal overjet, an edge to edge incisor relation or an anterior crossbite. The space available for the tongue is usually more. Thus, the tongue occupies a lower position, resulting in a narrow upper arch.

Pseudo Class II

This type of malocclusion is produced by a forward movement of the mandible during the jaw closure; thus, it is also called as the postural or habitual Class III malocclusion.

The following are the some of the causes of pseudo Class III malocclusion:

- a. Presence of occlusal prematurity may deflect the mandible forward
- b. In case of premature loss of deciduous posteriors, the child tends to move the mandible forward to establish a contact in the anterior region.
- c. A child with enlarged adenoids tends to move the mandible forward in an attempt to prevent the tongue from the contacting adenoids.

Class III, subdivision

This is a condition characterized by a Class III molar relation on the one side and a Class I relation on the other side.

Skeletal Classification of Malocclusion

Skeletal classification takes into account the classification of the facial skeletal pattern and its relationship with the teeth. There are three classes under the skeletal classification as well.

Class 1

The bones of the face and the jaw are in harmony with one another and with the rest of the head. The maxilla is slightly ahead of the mandible. The profile is orthognathic.

Class 2

Subnormal distal mandibular development in relation to the maxilla. Maxillary dental arch is narrower than mandibular, and there is crowding in the canine region, crossbite, and reduced vertical height. Protrusion of the maxillary anterior teeth. The profile is retrognathic.

Class 3

Overgrowth of the mandible and obtuse mandibular angle. The profile is prognathic at the mandible.

Simon's Classification of Malocclusion

In Simon's classification malocclusion can occur in the anteroposterior, transverse and the vertical planes. Simon had put forward a craniometrics classification of malocclusion that related to the dental arches in all these three planes. Simon's system of classification made use of three anthropometric planes that contain the Frankfort horizontal plane, the orbital plane, and the midsagittal plane. The classification of malocclusion was based on the abnormal deviations of the dental arches from their normal position in relation to these three planes.

Frankfort horizontal plane

This is a plane that contains the upper margin of the external auditory meatus to the infraorbital margin. This plane is used to classify malocclusions in a vertical plane. Two terms were used to describe any abnormal relation of the teeth to this plane. When the dental arch or part of it is closer than normal to the Frankfort plane, it is called attraction. When the dental arch or part of it is farther away from the Frankfort horizontal plane, it is called abstraction.

Orbital plane

This plane is perpendicular to the Frankfort horizontal plane, dropped down from the bony orbital margin directly under the pupil of the eye. According to Simon, this plane should pass through the distal third of the upper canine. This is called the Simon's law of canine. This plane is used to describe malocclusion in a sagittal or anteroposterior direction. When the dental arch or part of it is farther from the orbital plane, it is called protraction. When the arch or part of it is closer or more posteriorly placed in relation to this plane, it is called retraction.

Midsagittal plane

The midsagittal plane is used to describe the malocclusion in the transverse direction. When a part or whole of the arch is away from the midsagittal plane, it is called distraction. When the arch or part of it is closer to the midsagittal plane, it is called contraction.

Bennett's Classification of Malocclusion

Norman Bennett classified malocclusion based on its etiology

- Class I: Abnormal position of one or more teeth due to local causes
- Class II: Abnormal formation of a part of or whole of either arch due to developmental defects of bone
- Class III: Abnormal relationship between upper and lower arches, and lower arches, and between either

arch and facial contour or correlated to abnormal formation of either arch.

Ackerman Profit System of Classification

Ackerman and Profit in 1960 proposed a diagrammatic classification of malocclusion to overcome the limitations of the angle's classification. Salient features of classification include:

1. Transverse as well as vertical discrepancies can be considered in addition to anteroposterior malrelations
2. Crowding and arch symmetry can be evaluated
3. Incisor protrusion is taken into account.

This system of classification is based on the symbolic Venn diagram that identifies five major characteristics to be considered and described in the classification.

Step 1: (Alignment)

The first step involves assessment of the alignment and symmetry of the dental arch. It is classified as ideal, crowded, and spaced.

Step 2: (Profile)

It involves the consideration of the profile. The profile is described as convex, straight, and concave. The facial divergence is also considered that contains anterior or posterior divergence.

Step 3: (Type)

The transverse skeletal and dental relationship is evaluated. Buccal and palatal crossbites if any are noted. The crossbite is further sub-classified as unilateral or bilateral. In addition, differentiation is made between skeletal and dental crossbite.

Step 4: (Class)

This involves the assessment of the sagittal relationship. It is classified as angle's Class I, Class II, and Class III malocclusion. Differentiation is made between the skeletal and dental malocclusion.

Step 5: (Bite depth)

Malocclusion in the vertical plane is noted. They are described as anterior or posterior open bite, anterior deep bite or posterior collapsed bite.

CONCLUSION

With expanding information about orthodontic treatment, there is also an increase in demand for treatment. From the present investigation, it is seen that Class I malocclusion in both angle classification and skeletal classification was found behave more common occurrence. This study helped to create awareness about malocclusion among the general public. The study also provided vital information about the prevalence of malocclusion in rural areas.

REFERENCES

1. Sischo L, Broder HL. Oral health-related quality of life: What, why, how, and future implications. *J Dent Res* 2011;90:1264-70.
2. Balan S, Navaneethan R. Psychology of patient with malocclusion a questionnaire survey. *Int J Pharm Bio Sci* 2015;6:352-5.
3. Jenny J, Cons NC, Kohout FJ, Jacobsen JR. Relationship between dental esthetics and attributions of self confidence. *J Dent Res* 1990;69:204.
4. Khatri MP, Dinesh SP. Assessment of awareness about malocclusion among patients a questionnaire study. *Int J Pharm Bio Sci* 2014;5:112-6.
5. Helm S, Petersen PE. Individual changes in malocclusion from adolescence to 35 years of age. *Acta Odontol Scand* 1989;47:211-6.
6. O'Brien K, Kay L, Fox D, Mandall N. Assessing oral health outcomes for orthodontics measuring health status and quality of life. *Community Dent Health* 1998;15:22-6.
7. Cunningham SJ, Hunt NP. Quality of life and its importance in orthodontics. *J Orthod* 2001;28:152-8.
8. de Oliveira CM, Sheiham A. Orthodontic treatment and its impact on oral health-related quality of life in Brazilian adolescents. *J Orthod* 2004;31:20-7.
9. Wang G, Hägg U, Ling J. The orthodontic treatment need and demand of Hong Kong Chinese children. *Chin J Dent Res* 1999;2:84-92.
10. Burden DJ, Holmes A. The need for orthodontic treatment in the child population of the United Kingdom. *Eur J Orthod* 1994;16:395-9.
11. Mandall NA, Wright J, Conboy FM, O'Brien KD. The relationship between normative orthodontic treatment need and measures of consumer perception. *Community Dent Health* 2001;18:3-6.
12. Talapaneni AK, Nuvvula S. The association between posterior unilateral crossbite and craniomandibular asymmetry: A systematic review. *J Orthod* 2012;39:279-91.
13. Sidlauskas A, Lopatiene K. The prevalence of malocclusion among 7-15-year-old Lithuanian schoolchildren. *Medicina (Kaunas)* 2009;45:147-52.
14. Kolawole KA, Otuoyemi OD, Oluwadaisi AM. Assessment of oral health-related quality of life in Nigerian children using the child perceptions questionnaire (CPQ11-14). *Euro J Paediatr Dent* 2011;12:55-9.
15. Marques LS, Filogônio CA, Filogônio CB, Pereira LJ, Pordeus IA, Paiva SM, *et al.* Aesthetic impact of malocclusion in the daily living of Brazilian adolescents. *J Orthod* 2009;36:152-9.
16. Egger M, Juni P, Bartlett C, Hoenstein F, Sterne J. How important are comprehensive literature searches and the assessment of trial quality in systematic reviews? *Empirical study. Health Technol Assess* 2003;7:1-76.
17. Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G, *et al.* Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res* 2002;81:459-63.
18. Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, *et al.* Grading quality of evidence and strength of recommendations. *BMJ* 2004;328:1490.
19. Marques LS, Ramos-Jorge ML, Paiva SM, Pordeus IA. Malocclusion: Esthetic impact and quality of life among Brazilian schoolchildren. *Am J Orthod Dentofacial Orthop* 2006;129:424-7.
20. Feu D, de Oliveira BH, de Oliveira Almeida MA, Kiyak HA, Miguel JA. Oral health-related quality of life and orthodontic treatment seeking. *Am J Orthod Dentofacial Orthop* 2010;138:152-9.
21. Anosike AN, Sanu OO, da Costa OO. Quality of life of school children in Nigeria. *West Afr J Med* 2010;29:417-24.
22. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Int J Surg* 2010;8:336-41.
23. Köhler L, Holst K. Malocclusion and sucking habits of

- four-year-old children. *Acta Paediatr Scand* 1973;62:373-9.
24. Svedmyr B. Dummy sucking. A study of its prevalence, duration and malocclusion consequences. *Swed Dent J* 1979;3:205-10.
 25. Herkrath FJ, Rebelo MA, Herkrath AP, Vettore MV. Comparison of normative methods and the sociodental approach to assessing orthodontic treatment needs in 12-year-old schoolchildren. *Oral Health Prev Dent* 2013;11:211-20.
 26. De Baets E, Lambrechts H, Lemiere J, Diya L, Willems G. Impact of self-esteem on the relationship between orthodontic treatment need and oral health-related quality of life in 11 to 16-year-old children. *Eur J Orthod* 2012;34:731-7.
 27. Scapini A, Feldens CA, Ardenghi TM, Kramer PF. Malocclusion impacts adolescents' oral health-related quality of life. *Angle Orthod* 2013;83:512-8.
 28. Onyeaso CO. Orthodontic treatment complexity and need with associated oral health-related quality of life in Nigerian adolescents. *Oral Health Prev Dent* 2009;7:235-41.
 29. Andrade Ada S, Gameiro GH, Derossi M, Gavião MB. Posterior crossbite and functional changes. A systematic review. *Angle Orthod* 2009;79:380-6.
 30. Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR, *et al.* Early childhood caries and quality of life: Child and parent perspectives. *Pediatr Dent* 2003;25:431-40.
 31. Dini EL, Holt RD, Bedi R. Caries and its association with infant feeding and oral health-related behaviours in 3-4-year-old Brazilian children. *Community Dent Oral Epidemiol* 2000;28:241-8.
 32. Locker D, Jokovic A, Clarke M. Assessing the responsiveness of measures of oral health-related quality of life. *Community Dent Oral Epidemiol* 2004;32:10-8.
 33. Gherunpong S, Tsakos G, Sheiham A. Developing and evaluating an oral health-related quality of life index for children; the CHILD-OIDP. *Community Dent Health* 2004;21:161-9.
 34. Hallett KB, O'Rourke PK. Pattern and severity of early childhood caries. *Community Dent Oral Epidemiol* 2006;34:25-35.
 35. Chevitarese AB, Della Valle D, Moreira TC. Prevalence of malocclusion in 4-6 year old Brazilian children. *J Clin Pediatr Dent* 2002;27:81-5.
 36. Oliveira LB, Marcenes W, Ardenghi TM, Sheiham A, Bönecker M. Traumatic dental injuries and associated factors among Brazilian preschool children. *Dent Traumatol* 2007;23:76-81.
 37. Acs G, Shulman R, Ng MW, Chussid S. The effect of dental rehabilitation on the body weight of children with early childhood caries. *Pediatr Dent* 1999;21:109-13.
 38. Pahel BT, Rozier RG, Slade GD. Parental perceptions of children's oral health: The early childhood oral health impact scale (ECOHIS). *Health Qual Life Outcomes* 2007;5:6.
 39. Hamamci N, Başaran G, Uysal E. Dental aesthetic index scores and perception of personal dental appearance among Turkish university students. *Eur J Orthod* 2009;31:168-73.

Source of support: Nil; Conflict of interest: None Declared