Orthodontic treatment reduces the impact on children and adolescents’ oral health-related quality of life

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ABSTRACT

Context: Malocclusion is a chronic disability that is usually remedied by orthodontic treatment which can provide the patient with a satisfactory state of oral health.

Aim: To assess the current evidence in the literature concerning the impact of malocclusion treatment on the oral health related quality of life (OHRQoL) of children and adolescents.

Settings and Design: Systematic review.

Materials and Methods: Four databases (PubMed, Web of Science, Scopus and Virtual Health Library) were searched using specified indexing terms, including a manual search for of the references listed in the studies. The articles that met the inclusion criteria were classified regarding methodological quality and risk of bias in categories of high, moderate, or low.

Results: The electronic search produced 426 titles and abstracts, and the manual search of their references detected another 1 article. After excluding duplicate abstracts and applying the inclusion and exclusion criteria, 3 studies were eligible for quality assessment. Among these, 1 was classified as high methodological quality/low risk of bias and 2 as moderate methodological quality/moderate risk of bias. These 3 articles were included in the final qualitative synthesis.

Conclusions: Malocclusions treatment reduces the impact on children and adolescents’ OHRQoL based on evidence assessed in the literature. The level of evidence was moderate to high to detect changes in the impact after orthodontic treatment.

Key words: Malocclusion, oral health related quality of life, orthodontic treatment, quality of life
Methods to assess OHRQoL through a questionnaire have been developed by detailing the functional and psychosocial disadvantages of disorders and provide a more complete picture of an individual’s health. In such cases, the patient’s dental esthetic self-perceptions are valued, and should be included in a treatment plan that not only considers the clinical needs, but also the self-esteem of the patient, which is considered an important factor on the OHRQoL individuals seeking orthodontic treatment.

The Child Oral Health Quality of Life Questionnaire is a suitable measure to use when the aim is to assess changes in child OHRQoL and essential as clinical indicators to select therapies, to evaluate treatment progress and to assess the outcomes of therapies in context of research, clinical practice, or policy formulation. Therefore, the assessment on the health related quality of life is recommended in orthodontics to study treatment needs and outcomes.

The databases of bibliographies have articles evaluating children’s and adolescents’ QHRQoL change after orthodontic therapeutic interventions. A systematic evaluation on the level of evidence of such studies is important to allow or not recommend the use of a specific intervention and plan future researches.

Based on these needs, we conducted a systematic review for the following purpose: To assess the current evidence in the literature of the impact orthodontic treatment on the OHRQoL of children and adolescents.

MATERIALS AND METHODS

Search strategy
A systematic search was conducted on the PubMed, Web of Science, Scopus, and Virtual Health Library (VHL) (Medline, Scielo, Lilacs and BBO) databases. There was no restriction on language and articles published until May 2015 were screened. Initially to obtain the search expression, keywords (with synonyms) taken from the Medical Subject Headings were used resulting in the search expression: “Quality of life” or “OHRQoL” or QoL or OHRQoL and therapy or treatment or therapeutic and orthodontic or orthodontics and “orthodontic treatment.” A filter was applied for each database: Child (birth 18-year-old) in PubMed, Dentistry Oral Surgery in Web of Science and Dentistry subject area in Scopus. The electronic search was supplemented by a manual search of reference lists from the articles included.

Selection criteria
Inclusion criteria outline articles according to the population, interventions, comparisons, outcomes, and study design as follow:

- Population (P): Children and adolescents (up to age 18 years) receiving completed orthodontic treatment
- Interventions: Fixed or removable appliance, or interceptive orthodontic treatment
- Outcome measures: Changes in OHRQoL from baseline (pretreatment) to posttreatment, without restriction for the follow-up posttreatment
- Study design (S): Interventional studies, assessing the QHRQoL before and after orthodontic intervention and studies comparing groups
- Exclusion criteria were: (i) Lack of standardized measures in assessing malocclusions and/or orthodontic treatment need; (ii) studies not used validated OHRQoL instruments; (iii) case reports, review articles, book chapters, and theses; (iv) studies in patients with medical conditions such as systemic disorders, syndromes, and craniofacial anomalies; (v) studies that contemplated surgical treatment for malocclusion; (vi) studies that evaluated the relationship of quality of life during treatment.

Studies selection
Initially, the articles appearing in more than one database were removed. The articles were selected by title and abstracts according to the previously described search strategy. If the title and the abstract were inconclusive, the article was accessed in full and if the doubt persisted the author was contacted.

Subsequently, full-text articles were acquired and those that met the inclusion criteria were classified by two authors (EP and LAAA) according to the quality assessment. Any disagreement was discussed, and solved by consensus or by discussion with a third review author (LSA).

To evaluate agreement between authors (EP and LAAA), 10% of the publications randomly selected had their classification compared, and the Kappa statistic was 0.97.

Evaluation criteria of the quality assessment and risk of bias
The articles were evaluated considering the methodological quality criteria adapted by Antunes et al. and the risk of bias by Martins et al. Only one question of the methodological quality (Description of the instrument’s responsiveness: Was there any analysis or previous information about the instrument capacity to detect changes in quality of life?) was modified to “was the instrument applied in the paper?”

Each quality criterion was assessed as present (yes, score 1 point), absent or undetermined (no, score 0 points). Based on the score, the studies were classified into three categories:

- High methodological quality: Presenting 9 or more criteria, low risk of bias
- Moderate methodological quality: Presenting 5–8 criteria, moderate risk of bias
- Low methodological quality: Presenting 4 or fewer of the criteria evaluated, high risk of bias.
Considering the methodological quality and risk of bias (low, moderate, and high), the studies were also classified as studies with high, moderate, and low evidence, respectively. Only studies with high and moderate evidence were used in this systematic review.

Data extraction
The data-extraction was carried out independently by two reviewers (EP and LAAA) by reading the complete articles and considering the following categories: Author, year of publication, country, aim of the study, assessment of OHRQoL, assessment of malocclusions or treatment needs, sample (number and age), time of follow-up, mean score of OHRQoL instrument, and results/conclusion.

RESULTS
A total of 426 articles were initially identified in the electronic databases: 117 articles from PubMed, 150 from Scopus, 144 from Web of Science and 15 from VHL. After excluding duplicate abstracts and analyzing the titles and abstracts, 8 articles\cite{11,13,14,17-21} were selected. One study\cite{22} was added via manual search of reference lists. After detailed analysis based on the exclusion and inclusion criteria of these 9 articles, 6 were excluded and 3 were eligible for quality assessment. The reasons for exclusion were: One study\cite{17} did not use validated instruments, one study\cite{22} had inappropriate age group (over 18 years) and two studies\cite{18,19} to be a cross-sectional study. Two studies\cite{20,21} had insufficient information on minimum and maximum age of the sample and they were not selected because we did not received the authors’ answer. An overview of the literature search is shown in Figure 1.

The 3 eligible studies were classified according to quality assessment and risk of bias as follows: 1 article\cite{11} showed high methodological quality/low risk of bias and 2 articles\cite{13,14} showed moderate methodological quality/moderate risk of bias [Table 1]. All 3 studies were included in the qualitative synthesis.

![Figure 1: Flowchart of the search process and selection of research studies by using the items recommended for systematic reviews (PRISMA)\cite{28}](Image)
Data extraction (qualitative synthesis) from the articles selected is described in Table 2. The data extracted revealed the use of the OHRQoL instruments to evaluate the changes after orthodontic treatment. The questionnaires applied were: Child Perceptions Questionnaire–CPQ\textsuperscript{11-14}\cite{11,13}, Oral Health Impact Profile–14,\cite{14} parents perception questionnaire\cite{11}, and family impact scale.\cite{11} All studies reported the time of follow-up. From the results and conclusion, we observed that all studies\cite{11,13,14} showed improvement in OHRQoL after orthodontic treatment.

**DISCUSSION**

Scientific evidence can provide useful and current information for dental practitioners when preparing treatment plans. Thus, it is very important to evaluate the quality of the evidence demonstrated by articles that propose to detect changes in OHRQoL after orthodontic intervention, combining the patient’s treatment needs and preferences with the best available scientific evidence, in conjunction with the dentist’s clinical experience.\cite{23-25} Our findings provided helpful information for clinical practice, mainly in relation to the likelihood of psychosocial changes (emotional and social well-being domains) in OHRQoL of children and adolescents after orthodontic therapy.\cite{24}

The scientific evidence in this review was assessed detecting some potential risk of bias and limitations in the studies selected, mainly the lack of measurement of important technical properties in quality of life’ studies. Therefore, the instruments to be employed must have their versions and psychometric properties tested (validated and reliable), among specific populations and situations, some psychometric properties should be evaluated to be sure that the study is really evaluating what is intended to be evaluated.\cite{23,25,26} The questionnaire’s responsiveness is another psychometric property that should be evaluated to detect changes in quality of life in any measure used to evaluate a therapeutic intervention.\cite{11} Methodologically, it is not a rule but it is ideal to test the selected instrument in each sample so that homogeneity is assessed to understand...
the degree to which the items designated to measure the same concept are interrelated (internal consistency) and the instrument stability (test-retest). This is necessary because in similar populations and situations, even applying a validated instrument, the instrument may require fine adjustments for a particular study group. However, these properties were not well-established in the studies selected this review.

Although all studies in this review assessed the QHRQoL before and after orthodontic intervention, only one study[11] applied the instrument’s responsiveness and other studies[13,14] only providing previous information about the capacity of the instrument to detect changes in quality of life. It is imperative to establish this property to help health professionals interpret the meaning of changes in the scores derived from the measurements and thus help them to

### Table 2: Summary of main data extracted from the articles ranked with moderate methodological soundness

| Reference country | Aim | Instrument applied CPQ=Child Perceptions Questionnaire, OHIP=Oral Health Impact Profile, PPQ=Parents Perception Questionnaire, FIS=Family Impact scale Subscale of CPQ 11-14 SWB=Social well-being, EWB=Emotional well-being Dental Index, DAI=Dental Aesthetic Index, IONT=Index of Orthodontic Treatment Need, PAR=Peer Assessment Rating | Dental index of malocclusion | Sample (number and age) | Time of follow up | Mean score of OHRQoL instrument before and after orthodontic intervention | Results | Conclusion |
|-------------------|-----|-------------------------------------------------|-----------------------------|------------------------|-----------------------------|-------------------------------------------------|---------|------------|
| Agou et al., 2008 [11] Canada | To assess the ability of the COHQoL questionnaire to detect change following provision of orthodontic treatment | CPQ_{1-14} (adolescent) PPQ + FIS (parents/caregivers) | CPQ_{1-14} (adolescent) | DAI | PAR | 45 children (11 to 14 years old) 26 parents | 28 months (mean) | Before treatment CPQ_{1-14}=60.7 PPQ=53.8 FIS=20.7 After treatment CPQ_{1-14}=50.8 PPQ=46.3 FIS=17.6 | The provision of orthodontic treatment was associated with substantial and statistically significant improvements in scores on the CPQ_{1-14}, PPQ, and FIS (P<0.05). The COHQoL was found to be sensitive to change in the context of orthodontic treatment for children with malocclusion. | The results provide preliminary evidence of the sensitivity to change of the COHQoL questionnaires when used with children receiving orthodontic treatment. |
| Agou et al, 2011 [13] Canada | The aim of this study was to assess OHRQoL outcomes in orthodontics while controlling for individual psychological characteristics. | CPQ_{1-14} (adolescent) | DAI | | | 118 aged 11 to 14 years old divided into 2 groups: Cases=74 Controls=44 | 26 months (mean) | Before treatment CPQ_{1-14}=21.63 After treatment CPQ_{1-14}=16.16 | The treatment subjects had significantly better OHRQoL scores at follow-up. The results indicated a significant difference in overall CPQ_{1-14}, SWB, and EWB scores between the treatment and control subjects (P<0.05). OHIP-14 scores showed statistical significance (P<.001). At T1, the TG had an OHIP-14 score that was 1.9 times higher than that of the SG; however at T3, the TG score was 60% lower than the initial score of the SG. During the follow-up period, the TG showed significant improvement in OHRQoL, dental esthetics, and dental occlusion. | These results concur with other studies highlighting the positive effect of orthodontic treatment on OHRQoL. |
| Feu et al., 2013 [14] Brazil | To assess changes in oral health-related quality of life (OHRQoL) in children undergoing orthodontic treatment and compare it to that of two groups not receiving treatment. | OHIP_{1-14} (adolescent) | IOTN | | | 284 aged 12 to 15 years old divided into 3 groups: treatment group TG (n=87) waiting group WG (n=101) school group SG (n=96) | 2 years | Before treatment OHIP_{1-14}=10.4 After treatment OHIP_{1-14}=0.3 (fixed appliance removed-50.5%) OHIP_{1-14}=3.0 (no fixed appliance removed) | Fixed orthodontic treatment in Brazilian children resulted in significantly improved OHRQoL. | |
develop appropriate treatment plans. The measurement of changes in health status is particularly important, as self-reporting of health constitute one of the primary outcomes of a trial and can also provide the basis for sample size calculations for treatment efficacy studies.\textsuperscript{[11,27]}

To confirm the methodological quality we follow preferred reporting items for systematic reviews and meta-analyses recommendations to detect the risk of bias in studies.\textsuperscript{[26]} In this systematic review, the risk of bias was detected in the 3 studies selected.\textsuperscript{[11,13,14]} These results reveal the need for well-designed studies in which the risk of bias should be as low as possible to guarantee an excellence in methodological quality and establish the high level of scientific evidence.

One of the recommendations when selecting a quality of life’ instrument is to define the age group of the subjects under study. Measures designed for assessing adult OHRQoL may not be suitable for children.\textsuperscript{[26,29]} In this systematic review, one study\textsuperscript{[14]} did not apply the appropriate instrument for the population group, which may characterize a risk of measurement bias. According to the authors,\textsuperscript{[14]} at the time their study was begun, none of the available children’s OHRQoL instruments had been translated and validated into its language.

Sample size is an important for methodological quality assessment and its absence indicate a risk of design bias.\textsuperscript{[15]} Sample size calculations are required to obtain a reliable conclusion of the study and are virtually mandatory in clinical research protocols and relevant to the validity of any generalized inferences from the results.\textsuperscript{[30]} In our study, a design bias was found in all studies. Only Feu et al.\textsuperscript{[14]} determined a sample size and none of the studies described the randomization of the groups. Another risk of bias observed in the studies was drop out rates that can be considered a limitation for longitudinal studies. Waiting-list patients sought alternative care or relocated outside the city could be reasons for these losses.\textsuperscript{[13]} In addition, there are some inherent limitations relevant to most studies of orthodontic treatment, such as randomization, which is difficult to achieve in orthodontics, mainly due to ethical reasons of randomizing and not and not treating adolescents with malocclusion.\textsuperscript{[13,14]}

Although some studies\textsuperscript{[31]} suggests that orthodontics can moderately improve the OHRQoL of patients, the articles selected in our review improved OHRQoL of children and adolescents after orthodontic treatment. However, we detected some potential limitations in the studies selected, mainly a lack of measurement of important technical properties in quality of life’ studies. Hence, we suggest further longitudinal studies in children and adolescents with well-designed studies to guarantee an excellence in methodological quality and high level of scientific evidence to enable to recommend a particular clinical intervention and planning future research.

CONCLUSIONS

Orthodontic treatment resulted in significantly improved OHRQoL of children and adolescents based on high to moderate scientific evidence level of methodological quality/low risk of bias.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Tsilklaki A, O’Brien K. Do orthodontic research outcomes reflect patient values? A systematic review of randomized controlled trials involving children. Am J Orthod Dentofacial Orthop 2014;146:279-85.
2. Sardenberg F, Martins MT, Bendo CB, Pordeus IA, Paiva SM, Auad SM, et al. Malocclusion and oral health-related quality of life in Brazilian school children. A population-based study. Angle Orthod 2013;83:83-9.
3. Peres KG, Traebert ES, Marescens W. Differences between normative criteria and self-perception in the assessment of malocclusion. Rev Saude Publica 2002;36:230-6.
4. Almeida AB, Leite IC, Melaço CA, Marques LS. Dissatisfaction with dentofacial appearance and the normative need for orthodontic treatment: Determinant factors. Dental Press J Orthod 2014;19:120-6.
5. Marques LS, Ramos-Jorge ML, Paiva SM, Pordeus IA. Malocclusion: Esthetic impact and quality of life among Brazilian school children. Am J Orthod Dentofacial Orthop 2006;129:424-7.
6. Dimberg L, Arnup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: A systematic review of quantitative studies. Eur J Orthod 2015;37:238-47.
7. O’Brien C, Benson PE, Marshman Z. Evaluation of a quality of life measure for children with malocclusion. J Orthod 2007;34:185-93.
8. Agou S, Locker D, Streiner DL, Tompson B. Impact of self-esteem on the oral-health-related quality of life of children with malocclusion. J Orthod 2008;34:185-93.
9. 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.
10. Jokovic A, Locker D, Tompson B, Guyatt G. Questionnaire for measuring oral health-related quality of life in eight- to ten-year-old children. Pediatr Dent 2004;26:512-8.
11. Agou S, Malhotra M, Tompson B, Prakash P, Locker D. Is the child oral health quality of life questionnaire sensitive to change in the context of orthodontic treatment? A brief communication. J Public Health Dent 2008;68:246-8.
12. Cunningham SJ, Hunt NP. Quality of life and its importance in orthodontics. J Orthod 2001;28:152-8.
13. Agou S, Locker D, Muirhead V, Tompson B, Streiner DL. Does psychological well-being influence oral-health-related quality of life reports in children receiving orthodontic treatment? Am J Orthod Dentofacial Orthop 2011;139:369-77.
14. Feu D, Miguel JA, Celeste RK, Oliveira BH. Effect of orthodontic treatment on oral health-related quality of life. Angle Orthod 2013;83:892-8.
15. Antunes LA, Andrade MR, Leão AT, Maia LC, Luiz RR. Systematic review: Change in the quality of life of children and adolescents younger than 14 years old after oral health interventions: A systematic review. Pediatr Dent 2013;35:37-42.
16. Martins C, Buczynski AK, Maia LC, Siqueira WL, Castro GF. Salivary proteins as a biomarker for dental caries – A systematic review. J Dent 2013;41:2-8.
17. O’Brien K, Wright J, Conboy F, Chadwick S, Connolly I, Cook P, et al. Effectiveness of early orthodontic treatment with the Twin-block appliance: A multicenter, randomized, controlled trial. Part 2: Psychosocial effects. Am J Orthod Dentofacial Orthop 2003;124:488-94.
18. Bernabe E, Shelham A, Tsakos G, Messias de Oliveira C. The impact of orthodontic treatment on the quality of life in adolescents: A case-control study. Eur J Orthod 2008;30:515-20.
19. Taylor KR, Kiyak A, Huang GJ, Greenlee GM, Jolley CJ, King GJ. Effects of malocclusion and its treatment on the quality of life of adolescents. Am J Orthod Dentofacial Orthop 2009;136:382-92.
20. Chen M, Wang DW, Wu LF. Fixed orthodontic appliance therapy and its impact on oral health-related quality of life in Chinese patients. Angle Orthod 2010;80:49-53.
21. Seehra J, Newton JT, Dibiase AT. Interceptive orthodontic treatment in bullied adolescents and its impact on self-esteem and oral health-related quality of life. Eur J Orthod 2013;35:615-21.
22. Navabi N, Farnudi H, Rafiei H, Arashlow MT. Orthodontic treatment and the oral health-related quality of life of patients. J Dent (Tehran) 2012;9:247-54.
23. Ismail AI, Bader JD; ADA Council on Scientific Affairs and Division of Science; Journal of the American Dental Association. Evidence-based dentistry in clinical practice. J Am Dent Assoc 2004;135:78-83.
24. Joury E, Marcones W, Johal A. The role of psychosocial factors in predicting orthodontic treatment outcome at the end of 1 year of active treatment. Eur J Orthod 2013;35:205-15.
25. 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.
26. McGrath C, Broder H, Wilson-Genderson M. Assessing the impact of oral health on the quality of life of children: Implications for research and practice. Community Dent Oral Epidemiol 2004;32:81-5.
27. Abreu LG, Melgaço CA, Lages EM, Abreu MH, Paiva SM. Effect of year one orthodontic treatment on the quality of life of adolescents, assessed by the short form of the Child Perceptions Questionnaire. Eur Arch Paediatr Dent 2014;15:435-41.
28. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. J Clin Epidemiol 2009;62:1006-12.
29. Vale T, Santos P, Moreira J, Manzanares MC, Ustrell JM. Perception of dental aesthetics in paediatric dentistry. Eur J Paediatr Dent 2009;10:110-4.
30. Gardner MJ, Machin D, Campbell MJ. Use of check lists in assessing the statistical content of medical studies. Br Med J (Clin Res Ed) 1986;292:810-2.
31. Zhou Y, Wang Y, Wang X, Vollen G, Hu R. The impact of orthodontic treatment on the quality of life a systematic review. BMC Oral Health 2014;14:66.