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Systematic Review

Oral Health Related Quality of Life (OHRQoL) Following Orthodontic Treatment: An Updated Systematic Review

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Abstract

Oral Health Related Quality of Life (OHRQoL) is an essential tool for decreasing the burden of these problems whenever an orthodontic-related procedure is performed. We aim to assess the impact of OHRQoL among adolescents. For that, a systematic electronic database search was conducted for relevant studies published from 2010 and till 18th June 2020 in seven databases. Finally, 12 studies were included in this systematic review. Most of the included studies showed a significant improvement in OHRQoL following orthodontic treatment, at the last follow up point. This improvement includes the domains of physical pain, psychological wellbeing, psychological disability, emotional impact, and social impact. Moreover, there was an initial reduction in OHRQoL scored during the starting phase of orthodontic treatment, due to a combination of physical pain, psychological discomfort and physical disability. On the other hand, a few studies showed a slight (not statistically significant) or no improvement in OHRQoL following orthodontic treatment. In conclusion, improved OHRQoL was significantly associated with orthodontic treatment during adolescence. Although some studies showed fluctuations in the OHRQoL along with the different phases of treatment, the overall improvement was statistically significant at the end of the treatment period. There is a need for large-scale studies with more enhanced inclusion criteria, longer follow-up durations, and using validated OHRQoL assessment measures.

Keywords: *Oral Health Quality of Life; OHRQoL; Orthodontic Treatment*

Introduction

Orthodontic therapy aims to treat a malocclusion that is characterized by teeth and/or maxilla misaligned and mandible abnormality. Recently, the responses of patients to the treatment are influenced by both aesthetic and psychosocial aspects rather than their oral health state [1,2]. Function and aesthetics improvement is supposed to psychosocial welfare better and more stable [3]. In this context, orthodontists have to understand which oral health-related factors affect a patient's quality of life (QoL), therefore, Oral Related Quality

Of Life (OHRQoL) is known as the functional and psychosocial impact of oral health on patients' lives [4-6]. The indictors of OHRQoL will provide great help to the physicians in assessing the patient's desires and expectations and will support physicians' decisions regarding the treatment plan concerning patient's concerns [7,8].

Dental malocclusion is a prevalent disorder in adolescents worldwide. The World Health Organization (WHO) reported that malocclusion is the third disorder of all buccodental diseases, following dental caries, and periodontal disorder [9]. Mostly, adolescents seek orthodontic therapy for just esthetic reasons [10]. A lot of studies have reported OHRQoL variations before, after, and during orthodontic therapy [5,11,12]. But most of those studies had limitations regarding patients' age heterogeneity, follow-up duration, or focusing on only one phase of orthodontic therapy [5,9,12,13].

Recent systematic reviews discussing OHRQoL results have been reported evidence that malocclusions have a negative impact on OHRQoL [11,14]. When adolescents seek orthodontic therapy, they usually suffer from a masticatory problem, displeasure with their appearance, speech or swallowing disorder, dysfunction of temporomandibular joint, facial trauma, and/or dental caries [15].

Knowing malocclusion prevalence among the general population and its effect on oral health, as well as assessing patient QoL has a great impact on orthodontic therapy when determining patients' needs and expectations [16]. OHRQoL is an essential tool for decreasing the burden of these problems whenever an orthodontic-related procedure is performed. For that, this systematic review aims to assess the impact of orthodontic treatment on the oral health quality of life among adolescents.

Methods

Search strategy and study selection

The study process was conducted following the accepted methodology recommendations of the PRISMA checklist for systematic review [17]. A systematic electronic database search was conducted for relevant studies published from 2010 and till 18th June 2020 in seven databases including Google Scholar, Scopus, Web of Science (ISI), PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Embase and CINAHL using keywords, medical subject (MeSH) terms. In databases not supporting MeSH terms, combinations of all possible terms were used. Moreover, We conducted a manual search of references from the included articles by searching the primary studies that had cited our included papers and scanning references of the relevant papers in PubMed and Google Scholar to avoid missing any relevant publications [18].

We included all original relevant studies, published within the last ten years, which are discussing the oral health-related quality of life among adolescents following orthodontic treatment. Papers were excluded if there was one of the following exclusion criteria: pilot studies, duplicate records, data could not be reliably extracted or incomplete reports, abstract only articles, thesis, books, conference papers. Title and abstract screening were done independently by four reviewers. Then, three independent reviewers performed a full-text screening to ensure the inclusion of relevant papers in our systematic review. Any disagreement was resolved by discussion and referring to the senior author when necessary.

Data extraction

Two authors developed the data extraction sheet using the Microsoft Excel software. Data extraction was performed by three independent reviewers using the excel sheet. The fourth independent reviewer performed data checking to ensure the extracted data accuracy. All the disagreements and discrepancies were resolved by discussion and consultation with the senior author when necessary.

Quality assessment

Three independent reviewers evaluated the risk of bias in the included studies. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to determine the quality of the included studies, according to their study design. This scoring system is representing 8 items in three categories Selection, exposure, and comorbidity. Each study can get maximum one star for each item, expect "comparability," which is scored with two stars, making the maximum score is nine stars [19]. The criterion was judged as following; a score of 7 to 9 was good, 4 to 6 was fair, and studies scoring ≤ 3 are considered of poor quality. Any discrepancy between the reviewers was solved through discussion.

Results and Discussion

Search results

We identified 788 related articles after excluding of 602 duplicates using the Endnote software version X9. Title and abstract screening resulted in 44 records for further full-text screening. Manual search relieved no other papers. Finally, 12 studies were included in this systematic review (Figure 1).

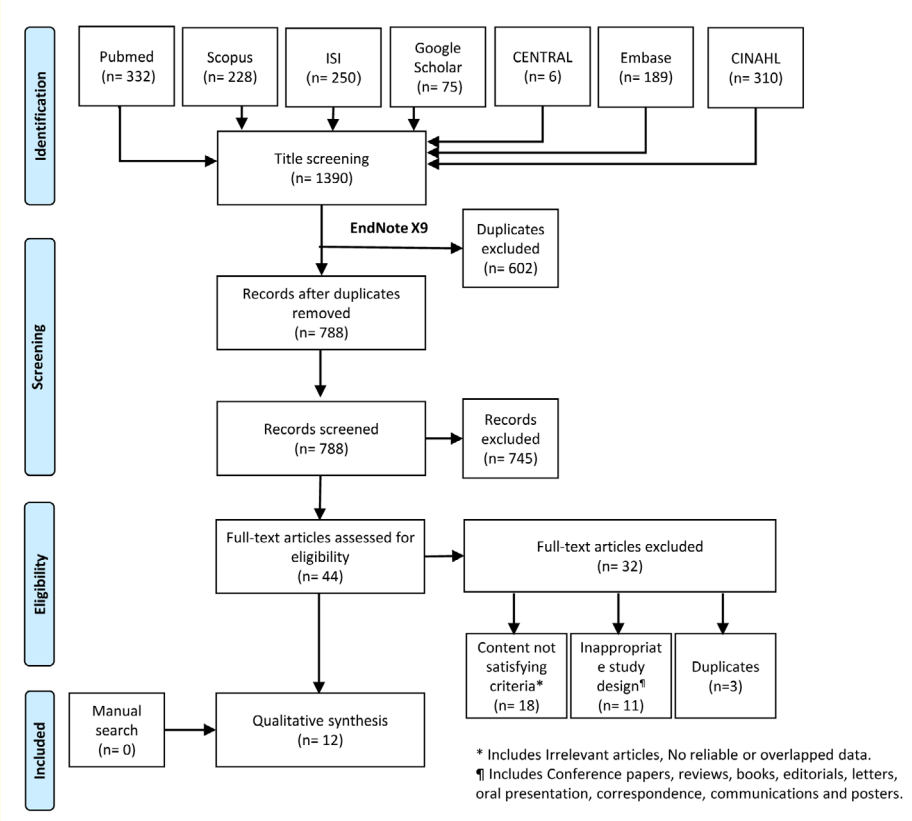

Figure 1: *The PRISMA flowchart of the search and screening process.*

Study characteristics and quality of the included studies

The included population in each study ranged from 27 to 497 patients. The male percentage ranged from 32.6% to 56.7% and their mean ages ranged from 12.6 to 20.8 years (Table 1). The quality of the included studies was variable where ten studies have a good quality, two studies have a fair quality, and no papers with poor quality (Table 2).

Author, year	Country	Study design	Sample size	Male %	Age mean (SD)	Intervention	Score	Aim	Main conclusion
Agou, 2011 [20]	Canada	Prospective longitudinal study	45	40	12.6 (±1.4)	Conventional orthodontic fixed apparatus.	CPQ11-14	To assess OHRQOL outcomes in orthodontics while controlling for individual psychological characteristics	The results of this study support the postulated mediator role of psychological well-being when evaluating OHRQOL outcomes in children undergoing orthodontic treatment.
Antoun, 2015 [10]	New Zealand	Prospective longitudinal study	30	56.7	14.5 (±1.9)	Orthodontic fixed apparatus on one or both arches.	Oral Health Impact Profile (OHIP-14)	To investigate the effect of orthodontic treatment on oral health-related quality of life (OHRQoL) in groups of standard patients with severe malocclusions; cleft lip, cleft palate, or cleft lip and palate patients; and orthognathic surgery patient	The effect of orthodontic treatment on OHRQoL varies for different patient groups even after adjusting for age and sex. The greatest improvement in OHRQoL occurred in adults with a need for orthognathic surgery, whereas the least improvement seemed to occur in adolescents with cleft lip, cleft palate, or cleft lip and palate.

Benson, 2015 [27]	UK	Cohort	374	32.6	11-12 years	Conventional orthodontic fixed apparatus.	CPQ 11-14	To examine the relationships between dental appearance, characteristics of the individual and their environment, and oral health-related quality of life (OHQoL) in young people over time.	OHQoL improved in young people over time, whether they gave a history of orthodontic treatment or not. Individual and environmental characteristics influence OHQoL and should be taken into account in future studies
Chen, 2010 [21]	China	Cohort	222	33.3	15.7	Conventional orthodontic fixed apparatus.	Oral Health Impact Profile, Chinese version (OHIP-14)	To determine changes in oral health-related quality of life (OHRQoL) during fixed orthodontic appliance therapy in Chinese patients	Patients' OHRQoL was better after they completed the orthodontic treatment than before or during treatment
Chen, 2015 [16]	China	Prospective longitudinal study	190	42.6	20.8 (±2.5)	Conventional orthodontic fixed apparatus.	Oral Health Impact Profile, Chinese version (OHIP-14)	To assess oral health-related quality of life (OHRQoL) in young adult patients with malocclusion and to measure the association between orthodontic treatment need and OHRQoL	Malocclusion has a significant negative impact on OHRQoL. This is greatest for the psychological discomfort and psychological disability domains
Feu, 2013 [22]	Brazil	Prospective longitudinal study	87	51.1	12-15 years	Conventional orthodontic fixed apparatus.	Oral Health Impact Profile (OHIP-14).	To assess changes in oral health-related quality of life (OHQoL) in children undergoing fixed orthodontic treatment and compare it to that of two groups not receiving treatment	Fixed orthodontic treatment in Brazilian children resulted in significantly improved OHQoL after 2 years

Healey, 2016 [1]	New Zealand	Cohort	174	35.6	13.5 (±1.3)	Conventional orthodontic fixed apparatus.	CPQ 11-14	to describe the changes in both malocclusion and OHRQoL with orthodontic treatment	Malocclusion affects orthodontic patients' OHRQoL before treatment. A temporary increase in symptomatic impacts seen by the debond stage appears to ameliorate with time, with the benefits of orthodontic treatment for OHRQoL manifesting themselves some months later
Jaeken, 2019 [23]	Belgium,	Cohort	497	47.99	13.2 (range 11.0–17.0 years)	NA	CPQ11-14	To investigate the changes in oral health-related quality of life (OHRQoL) before, during, and after orthodontic treatment, determine the relationship with the original treatment need and evaluate the influence of self-esteem (SE).	OHRQoL ameliorates after orthodontic treatment. High baseline SE works as a protective factor for OHRQoL
Jamilian, 2016 [24]	Iran	Cohort	100	33	19.2 (±3.93)	fixed orthodontic therapy	Oral Health Impact Profile (OHIP-14)	To assess whether orthodontic treatment of adolescents with malocclusion had any association with their oral health-related quality of life (OHRQoL).	This study showed that oral health-related quality of life improves with the treatment of malocclusion.

Jena, 2020 [28]	India	Cohort	68	50	16.41 (±1.58)	NA	Oral Health Impact Profile (OHIP-14)	To evaluate the effects of non-extraction and all first premolar extraction modalities of orthodontic treatment on oral health-related quality of life (OHRQoL) among adolescents.	The severity of OHRQoL deterioration was similar in both modalities of orthodontic treatment, but recovery from negative impacts was relatively slower in the first premolar extraction subjects.
Seehra, 2013 [25]	UK	Prospective longitudinal study	27	48	14.6 (±1.5)	Interceptive orthodontic apparatus (fixed, functional, and retainers).	CPQ 11-14	To measure the self-reported frequency and severity of bullying in orthodontic patients previously identified as being bullied, who have commenced interceptive orthodontic treatment, and to investigate the effect on an individual's self-esteem and oral-health-related quality of life (OHRQoL)	Orthodontic treatment may have a positive effect on adolescents experiencing bullying related to their malocclusion and their OHRQoL.
Zheng, 2015 [29]	China	Prospective longitudinal study	81	49.38	aged (15-24)	Conventional orthodontic fixed apparatus.	Oral Health Impact Profile (OHIP-14)	To investigated changes in OHRQoL among patients with different classifications of malocclusion during comprehensive orthodontic treatment	The impact of comprehensive orthodontic treatment on patients' OHRQoL do not follow the same pattern among patients with different malocclusion

Table 1*: Study characteristics and quality of the included studies.*
CPQ: Child Perceptions Questionnaire.

Author, year	Selection				Comparability		Outcome			Total	Overall quality
	1	2	3	4	5a	5b	6	7	8		
Agou, 2011 [20]	*	*	*		*	*		*	*	8	Good
Antoun, 2015 [10]	*	*	*		*	*		*	*	8	Good
Benson, 2015 [27]	*	*	*		*	*		*		7	Good
Chen, 2010 [21]	*	*	*		*			*		7	Good
Chen, 2015 [16]	*	*	*		*	*		*	*	8	Good
Feu, 2013 [22]	*	*	*		*	*		*	*	8	Good
Healey, 2016 [1]	*	*	*		*	*		*	*	8	Good
Jaeken, 2019 [23]	*		*		*	*		*		5	Fair
Jamilian, 2016 [24]	*	*	*		*	*		*	*	7	Good
Jena, 2020 [28]	*	*	*		*			*	*	6	Fair
Seehra, 2013 [25]	*	*	*		*			*	*	7	Good
Zheng, 2015 [29]	*	*	*		*	*		*	*	8	Good

Table 2: *Quality of the studies on the newcastle-ottawa quality assessment scale for cohort studies. Criteria: (1) Representativeness of the exposed cohort. (2) Selection of the non-exposed cohort. (3) Ascertainment of exposure. (4) Demonstration that outcome of interest not present at start of study. (5) Comparability of cohorts on the basis of the design or analysis, (5a) for one factor and (5b) for additional factor. (6) Assessment of outcome. (7) Duration of follow-up period. (8) Adequacy of follow-up.*

Oral health-related quality (OHRQoL) following orthodontic treatment

Most of the included studies showed a significant improvement in OHRQoL following orthodontic treatment, at the last follow up point [10,16,20-25]. This improvement includes the domains of physical pain, psychological wellbeing, psychological disability, emotional impact, and social impact [10,25]. Moreover, there was an initial reduction in OHRQoL scored during the starting phase of orthodontic treatment, due to a combination of physical pain, psychological discomfort, and physical disability [21; 23]. The effect of orthodontic treatment was variable in different malocclusion classes, where class II malocclusion patients greater changes in the items psychological discomfort and psychological disability during the space closure phase, while class I malocclusion patients exhibited similar changes during the first phase [26].

On the other hand, a few studies showed a slight (not statistically significant) or no improvement in OHRQoL following orthodontic treatment [1,27]. This negative effect was similar when comparing different modalities; non-extraction and first premolar extraction orthodontic treatments had a temporary bad impact on OHRQoL [28]. However, the recovery from this reduction in the OHRQoL score was relatively faster in the non-extraction subjects [28] (Table 3).

Study	Follow up duration	Assessment points	Oral health-related quality of life (OHRQoL)
Agou, 2011 [20]	Treatment duration was 28 months.	First: Before treatment initiation.	Orthodontic treatment was associated with substantial and significant improvement in OHRQoL.
		Second: The first visit following treatment.	

Antoun, 2015 [10]	Mean treatment time was 25.2 (±6.4) months.	First: Before treatment initiation. Second: Following treatment with a maximum time margin of 3 months after the end of treatment.	Orthodontic treatment was associated with improvement in OHRQoL. This includes the domains of physical pain, psychological wellbeing, and psychological disability.
Benson, 2015 [27]	The follow-up period was 3 years.	First: at 11-12 years of age. Second: at 14-15 years of age.	Orthodontic treatment was associated with a slight improvement in OHRQoL (was not statistically significant).
Chen, 2010 [21]	Mean treatment duration was not Specified.	First: Before treatment initiation. Second: 1 week following placement of apparatus. Third: 1 month following placement of apparatus. Fourth: 3 months following placement of apparatus. Fifth: 6 months following placement of apparatus. Sixth: Following treatment.	Orthodontic treatment was associated with improvements in OHRQoL following 1 month. The worst OHRQoL scores were after 1 week, due to a combination of physical pain, psychological discomfort, and physical disability.
Chen, 2015 [16]	Mean follow-up duration was not specified.	First: at treatment initiation. Second: at the end of treatment.	Orthodontic treatment was associated with significant improvement in OHRQoL.
Feu, 2013 [22]	Follow-up duration was 2 years.	First: at treatment initiation. Second: 1 year following treatment initiation. Third: 2 years following treatment initiation.	Orthodontic treatment was associated with significant improvement in OHRQoL.
Healey, 2016 [1]	Mean follow up duration between treatment start and the end was 25.8 (±7.6) months and between post-treatment and a follow-up visit 21.3 (±9.7) months.	First: before treatment initiation. Second: immediately after debonding. Third: 1-month post-treatment check-up, approx 21 months after treatment.	No substantial improvement in OHRQoL was observed following orthodontic treatment.
Jaeken, 2019 [23]	Mean duration of treatment was 32.9 months (range 11.4–72.9 months; median 32.2 months).	First: before treatment initiation. Second: 1 year following treatment initiation. Third: 1 month after the end of active orthodontic treatment.	Orthodontic treatment was associated with significant improvement in OHRQoL. However, the OHRQoL slightly worsens during treatment.
Jamilian, 2016 [24]	Mean treatment duration was not Specified.	First: Before treatment initiation. Second: Following treatment.	Patients with orthodontic treatment were associated with significant improvement in OHRQoL, compared to subjects with moderate to severe malocclusion with no history of orthodontic treatment.

Jena, 2020 [28]	The mean total duration of treatment in group I (non-extraction) and II (first premolar extraction) subjects was 16.19 6 3.49 months and 23.79 6 3.02 months, respectively.	First: Before treatment initiation. Second: 1 month after the start of orthodontic treatment. Third: 3 months after the start of orthodontic treatment. Fourth: 6 months after the start of orthodontic treatment. Fifth: 1 year after the start of orthodontic treatment. Sixth: 1 week after the completion of orthodontic treatment	Both non-extraction and first premolar extraction modalities of comprehensive orthodontic treatment had a temporary negative impact on OHRQoL. Moreover, the recovery from negative impacts was relatively slower in the first premolar extraction subjects.
Seehra, 2013 [25]	Mean duration was 962.6 (±161.2) days.	First: Before treatment initiation. Second: Following treatment.	Orthodontic treatment was associated with significant improvement in OHRQoL. More significant reductions were found in the domains emotional impact and social impact
Zheng, 2015 [29]	Mean treatment duration was not Specified.	First: Before bracket and band bonding. Second: after alignment and leveling. Third: after molar correction. Fourth: at the end of treatment.	The orthodontic treatment effect was inconsistent among different patients. Patients with class II malocclusions underwent greater changes in the items of psychological discomfort and psychological disability during the space closure phase, while class I malocclusions patients experienced change during the first phase.

Table 3: *Oral health-related quality (OHRQoL) following orthodontic treatment.*

Discussion

Almost all reports about OHRQoL improvement after orthodontic treatment investigated adolescent patients only. This is because the majority of patients seeking this kind of treatment lies withing this age although the number of adults has been increasing, recently [30]. As caring about facial appearances has increased, QoL has been heavily affected. Social and psychological concerns resulting from using orthodontic treatment have been aroused [1]. Moreover, alongside the social and emotional problems, physical problems arousing from bullying has been reported [31]. Therefore, OHRQoL is an essential tool for decreasing the burden of these problems whenever an orthodontic-related procedure is performed.

The documentation of OHRQoL has been effectively assessed by using various, validated, and widely-used measures. In this study, the Child Perception Questionnaire (CPQ) and the Oral Health Impacts Profile (OHIP) measures were the most widely used in assessing the OHRQoL. The CPQ 11 - 14 was used in six studies [1,20,23,25,27,32] of which four studies [1,23,25,27] had patients that were older than the tool's age limit. Moreover, the OHIP measure was reported to be simple, sensitive, valid, reliable, and one of the most used instruments for assessing the quality of OHRQoL [10,21,26].

The findings of this review are consistent with other previously published reviews and meta-analysis that studied the effects of orthodontic treatment on OHRQoL but with different inclusion criteria [33-35] and updated study selection [9]. In 2014, a systematic review concluded that OHRQoL moderately improves after the end of the treatment [36]. Another review concluded that almost all studies showed a significant improvement between pre and post-treatment phases [9]. A meta-analysis conducted by Javidi., *et al.* [34], included both studies with longitudinal assessments and control groups. It indicates that orthodontic patients underwent a moderate improvement in the OHRQoL, however analysis of cross-sectional data revealed no significant difference between orthodontic and non-orthodontic subjects.

In this study, most of the reviewed studies did not compare patients based on orthodontic exposure. They depended mostly on frequently monitoring their patients throughout the different phases of treatment between the pre and post-treatment phases and, consequently, eradicating the need for control groups [1,5,10,16,21,23,25,26,28,32]. On the other hand, only four of 13 included studies assigned patients into exposed and non-exposed groups [20,22,24,27]. Previously published systematic reviews [36, 37] did not study the significance of orthodontic treatment on OHRQoL along the treatment course. Limiting the assessment to pre and post-treatment only can be biased, therefore, some authors assessed the OHRQoL throughout the orthodontic treatment. Chen *et al.* repeated the assessment for six months, among which significant differences between the start and the first month, and between three and six months were detected [21] while Zheng., *et al.* repeated it four times noticing significant changes in psychological changes among class I patients after the alignment and leveling phase and in physical limitations after correction of molar relationship and space closure phase [26]. Moreover, Feu., *et al.* reported the most significant changes at the end of the second year after assessing the quality of OHRQoL three times from the start for two successive years [22]. Jena., *et al.* showed that patients' OHIP scores significantly increased at one and three months from the start to have decreased gradually reaching a significant reduction after one year [28]. On the other hand, Johal *et al*. showed no statistical significance between the start and after six months, and post-treatment phases [5]. In addition, Benson *et al.* recorded a small increase in the CPQ 11 - 14 scores in orthodontic patients with no statistical significance [27]. On the other hand, Jaeken *et al.* reported a significant increase between the start and after one year to be significantly decreased one month after the treatment with a significant improvement in the OHRQoL [23].

In this study, we reviewed the updates on the changes of OHRQoL in adolescents before and after orthodontic operations. Most of the included studies [1,10,16,20-26,28,32] showed that OHRQoL significantly improves after orthodontic procedures in adolescent patients. Only Benson., *et al.* reported that the improvement was not statistically significant before and after treatment phases. Moreover, Johal *et al.* reported that the quality of OHRQoL deteriorated in the first months after installing the apparatus to be improved rapidly (to the pre-treatment phase) in the following months [5]. Among all included studies, three studies specifically mentioned the way of performing the orthodontic treatment. These include the use of fixed apparatus by Antoun., *et al.* [10], and fixed apparatus alone or in combination with a functional apparatus by Seehra., *et al.* [25] and Jena., *et al.* [28].

Like other studies, limitations to our study are various and should be accounted for. The first one is the age range of the study participant despite falling in the same age period (adolescence) as included studies differ in their criteria. Another one is concerning the sex variable: Although the distribution was fair for both genders, some studies [1,5,16,21,23,24,27,32] included more females. This is logical as the demand for having orthodontic treatment has increased among females seeking improvement of facial appearance [38]. Moreover, loss of follow-up is one other limitation that should be put into consideration as most of the included studies performed longitudinal monitoring with long-term follow-ups. Therefore, patients were lost easily as some moved, failed to attend for questionnaires, died, or due to lack of compliance to treatment [5,20,22-25,27,28]. The final one is using different assessment measures for assessing the quality of OHRQoL. As we mentioned before that the most validated, reliable, and widely used instruments are the OHIP and CPQ [32; 26; 39; 40]. However, not all studies stuck to it. Besides, the quality of the included studies (moderate) may play a negative role against the evidence of the association between the OHRQoL and orthodontic treatment. According to the Newcastle-Ottawa Scale criteria, the reasons behind this moderate-quality include that the investigated outcome was not present at the start of the study as all of them depended on longitudinal monitoring with no randomization.

The limitations depicted show the need for further studies about improving OHRQoL in adolescents with more enhanced inclusion criteria such as more defined age groups, more balance between males and females, decreasing the losses in follow-up, and using validated OHRQoL assessment measures.

Conclusion

Improved OHRQoL was significantly associated with orthodontic treatment during adolescence. Although some studies showed fluctuations in the OHRQoL along with the different phases of treatment, the overall improvement was statistically significant at the end of the treatment period. There is a need for large-scale studies with more enhanced inclusion criteria, longer follow-up durations, and using validated OHRQoL assessment measures.

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Conflicts of Interest

No conflicts related to this work.

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