



# Impact of self-esteem on the relationship between orthodontic treatment and the oral health-related quality of life in patients after orthodontic treatment – a systematic review

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## Abstract

**Objective.** The treatment protocol in the modern health care paradigm has shifted considerably towards enhancing the quality of life in the last decade. This is particularly important in cosmetic and elective treatments, and hence the interest in oral health-related quality of life (OHRQoL) also has increased. OHRQoL always been measured by endogenous, functional, social, or psychological determinants. Self-esteem (SE) is one of the internal factors that affect the perception of malocclusion and hence OHRQoL before and after treatment. The purpose of this review is to assess whether there exists any correlation between the Oral Health-Related Quality of Life, Self-esteem (SE) in patients following orthodontic treatment.

**Methods.** A literature search was confined to the English language using Medical Subject Heading terms (MeSH) in *PubMed*, *Cochrane Library*, and *Ovid®* covering the period from January 1, 1951 to May 15, 2020. Search in *Google Scholar*, grey literature, and hand search on cross-references was performed to find additional data. The studies found to be suitable were selected based on the predefined inclusion and exclusion criteria. The quality of assessment and risk of bias for the included studies were evaluated independently by two invigilators utilizing “The Cochrane Collaboration’s tool for assessing the risk of bias” and “Modified version of the Newcastle Ottawa scale” for Randomized Controlled Trials (RCTs) and non-randomized trials respectively.

**Results.** A total of 7688 studies were retrieved from all the sources. After screening all the titles and excluding the duplicates, 28 studies were finally included for text review, and all of them were fit for quality appraisal. The design of the final studies included comprised of 3 RCTs, 14 cohort studies, 9 cross-sectional studies, and 2 case-control studies.

**Conclusion.** There is moderate evidence to show that fixed orthodontic treatment improves OHRQoL and SE in children. OHRQoL also increased in adolescents and adults. However, there is a weak correlation between SE and OHRQoL. More evidence-based studies are needed to analyze the relationship.

**Keywords:** aesthetics. oral health-related quality of life, orthodontic treatment, perception, self-esteem

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## Introduction

The World Health Organization (WHO) in 1948 defined “Health as a state of complete physical, mental and social well-being and not only the absence of disease or infirmity”. Quality of life (QoL) was described as “patients’ attitudes of their condition in being in the context of culture and value ways in which they exist and concerning their goals, expectations, standards, and concerns” [1]. Quality of life (QoL) can be affected by poor oral health [2] and assessing Oral Health-Related Quality of Life (OHRQoL) helps professionals to clarify the role of oral health status on the overall quality of life [3].

Orthodontic treatment is disparate from most of the distinct medical interventions by that it aims to correct malocclusion from an arbitrary norm [4]. Besides enhancement of dentofacial aesthetics, orthodontic treatment restores occlusal function. It also improves the psychosocial well-being, which, in turn, results in the betterment of oral health-related quality of life in particular and overall health related quality of life in general [5,6].

The assessment of OHRQoL is recommended in orthodontics for plenty of reasons: to study treatment needs and outcomes, efficiency of the therapy and impact during the stated period of treatment, and as part of clinical trials to potentially enhance the quality of care. Furthermore, understanding patients’ expectations of therapy can help detail the parameters for informed consent as well as help patients develop coping methods for dealing with treatment sequelae [5].

Consequently, the interventions in the modern healthcare systems should be directed to address the patient’s health complaints, taking into consideration the impact of patients’ illness on quality of life (QoL) [7]. Most of the modern dental procedures endeavor to improve patient quality of life [8]. Although improvement of quality of life considered to be the primary goal of orthodontic treatment, it was observed that OHRQoL worsened during the initial part of the treatment [9]. However, a considerable improvement was observed later during the course of the treatment [10-12]. This is particularly true with adolescents wearing fixed appliances than those using removable or either of the kinds of appliances simultaneously [13].

Global self-esteem (SE) refers to the feeling and appraisal of oneself as a person. In contrast, specific self-concepts attribute to the beliefs and values in different domains, such as school competence or close friendship [14]. The concept of self-esteem refers to a person’s feeling of self-worth [15]. Higher self-esteem is associated with better dental Health practice [16]. Contrary to OHRQoL, self-esteem is assumed to be a relatively stable trait [17]. Self-esteem was described as a multidimensional concept, for which Harter developed a tool to measure feelings of both global and specific self-worth [18,19].

The escalating emphasis on the necessity for evidence-based health services claims that the evaluation of the effectiveness of orthodontic treatment outcome measures

is essential to the patient and the clinician [20-23]. Thus, investigating the OHRQoL in orthodontic patients may provide information that will help clinicians and public health planners in enhancing the quality of orthodontic care as suggested by WHO [20,24]. Evidence of negative impact of malocclusion on OHRQoL was observed in previous systematic reviews [25,26]. The influence of orthodontic treatment on the OHRQoL have also been reviewed in some other studies [27,28]. Few studies have shown that the orthodontic treatment influences the level of self-esteem, with a marked improvement at the end of treatment [29,30] and while others have found no differences in self-esteem after the completion of orthodontic treatment [31]. The specific results of orthodontic treatment in improving self-esteem are not consistent across these studies. Therefore, to evaluate the possible role of orthodontic treatment in influencing self-esteem after treatment still needs clarity. The present review attempts to explore the relation between these two components.

Self-esteem (SE) influences the Oral health-related Quality of life [10,32], although its specific role, as well as its relation to oral health perceptions, lacks in evidence. The study by Jung [33] on Korean adolescent female population indicated a direct relation between the severity of malocclusion and OHRQL and SE scores. Some studies [34-36] found a significant correlation between OHRQoL and SE. However, the authors were not comprehensible regarding the direction of the association. Although a few systematic reviews discussed the impact of orthodontic treatment on OHRQoL of the patient, till now no systematic review interpreted the relation between the patient’s self-esteem and orthodontic treatment. And no review evaluated the correlation between patient’s oral health-related quality of life and self-esteem (SE). So, the present systematic review aims to traverse the current literature to identify the changes in the OHRQoL as well as in the self-esteem of the patients following orthodontic treatment procedures. Further, this review assesses the correlation of OHRQoL and SE in the orthodontic patients after treatment.

## Methodology

### Protocol registration

The protocol for the present study was registered with the PROSPERO international prospective register (PROSPERO 2020: CRD42020191310) for systematic reviews.

### Eligibility criteria

The selection criteria based on the PICO-s format was applied in this review (Table I).

### Information sources, search strategy, study selection and data extraction

An extensive database search was performed in *PubMed*, *Cochrane Library* and *Ovid®* covering the period from January 1, 1951 to May 15, 2020. The search was expanded and tapered using Medical Subject Heading terms (MeSH) including the terms “children”, “adolescence”,

“adult”, “orthodontic treatment”, “fixed appliances”, “removable appliances”, “myofunctional appliances”, “oral health-related quality of life”, “self-esteem”, or by using free text words and their synonyms with multiple combinations using Boolean operators (“or” and “and”) and truncations in the English language. A supplementary search was performed in Google scholar and in grey literature. Manual search of the cross-references in the published reviews on the topic were also assessed and studies that met the inclusion criteria were added to the data base. However, the narrative and systemic reviews themselves were not included.

### Exclusion criteria

Studies in which treatment is incomplete, patients assessed for OHRQoL in malocclusion patients without orthodontic treatment or treatment history, surgery patients, cleft palate and cleft lip cases excluded and studies involving adjunctive orthodontic treatment were excluded. Narrative reviews, systematic reviews, conference abstracts and letters to editors were excluded for the present review before the final eligibility.

Two researchers (**GS and SR**) independently scrutinized the titles of the studies that were retrieved initially from the databases and hand searches. Abstracts of the studies for final review were included after removing the duplicates and irrelevant titles. All the abstracts that satisfied the inclusion criteria were put forth for further full-text review. If there were any unresolved issues regarding the inclusion of a study for the review after full-text phase, a consensus judgment was taken by employing a third evaluator (**PM**) who was not involved in the initial screening of the studies. None of the invigilators are blind to the procedure of the study. All the studies which met the criteria were read and evaluated for final eligibility independently by both the researchers.

### Data items and collection

Data extraction was performed independently in a

similar method that was utilized for initial evaluation. A piloted electronic excel spreadsheets were utilized to record the data. The following demographic information was recorded: author and year of publication, country, sample size and age, type of study design, type of orthodontic treatment and questionnaire employed.

### Method of quality assessment and risk of bias in individual studies

The quality analysis and risk of bias of the included studies was evaluated independently and in duplicate using the same methodology as outlined for selection and data extraction. The “Cochrane risk of bias tool” [37] for randomized controlled trials and “Modified Version of the Newcastle Ottawa scale” [38] for non-randomized trials were utilized respectively. The Cochrane Collaboration tool assess the risk of bias judgment (high, low, or unclear) of included randomized studies for individual elements from five domains (selection, performance, attrition, reporting, and other). After evaluating each key domain, the overall assessment for each study was determined as; “low” if all domains were low; “some concern” if at least one domain was judged to have some concern; and “high” if at least one domain had high or multiple domains were judged to have some concerns in a way that substantially lowered confidence in the result. The modified version of the Newcastle Ottawa scale was designed for case-control studies, cohort studies, and cross-sectional studies. This tool evaluates the studies based on eight domains that were divided into three broad criteria: patient selection, comparability of study groups, and the outcome assessment. A star system for quality assessment was used, whereby high-quality studies at low risk of bias could receive a maximum of 9 stars, studies with 8, 7, or 6 stars are designated as moderate quality, and the studies with low quality were assigned with 5 stars or fewer.

**Table I.** Selection criteria applied for this review - PICO-S format.

**Participants (P):** Patients of all age groups undergoing orthodontic treatment. (children, adolescents, adults)

**Interventions (I):** Any form of orthodontic treatment provided during preventive, interceptive and comprehensive corrective phase of orthodontic treatment. Studies involving treatment either with Fixed or removable orthodontic appliances.

**Comparator (C):** Studies that included assessment of either of both of OHRQoL and SE during pre- and post-orthodontic treatment. Studies that included a comparison group of subjects who are due for orthodontic treatment and those who have not undergone any form of orthodontic treatment.

### Outcome measures (O):

1. The main outcome was to measure the OHRQoL and Self-esteem after orthodontic treatment and
2. The secondary outcome was to assess the co-relation between OHRQoL and SE after orthodontic treatment.

The OHRQoL was determined using a validated measures such as the Child Perception Questionnaire (CPQ), Oral impact on daily performance (OIDP), Oral health impact profile (OHIP) and Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ). Self-esteem was measured using the Rosenberg scale, the Dutch adaptation of the Harter’s Self-Perception Profile and the Global Negative Self-evaluation.

**Study design (S):** Randomized clinical and control trials (RCT), prospective cohort studies, and cross-sectional or case-control studies with data collection after orthodontic treatment.

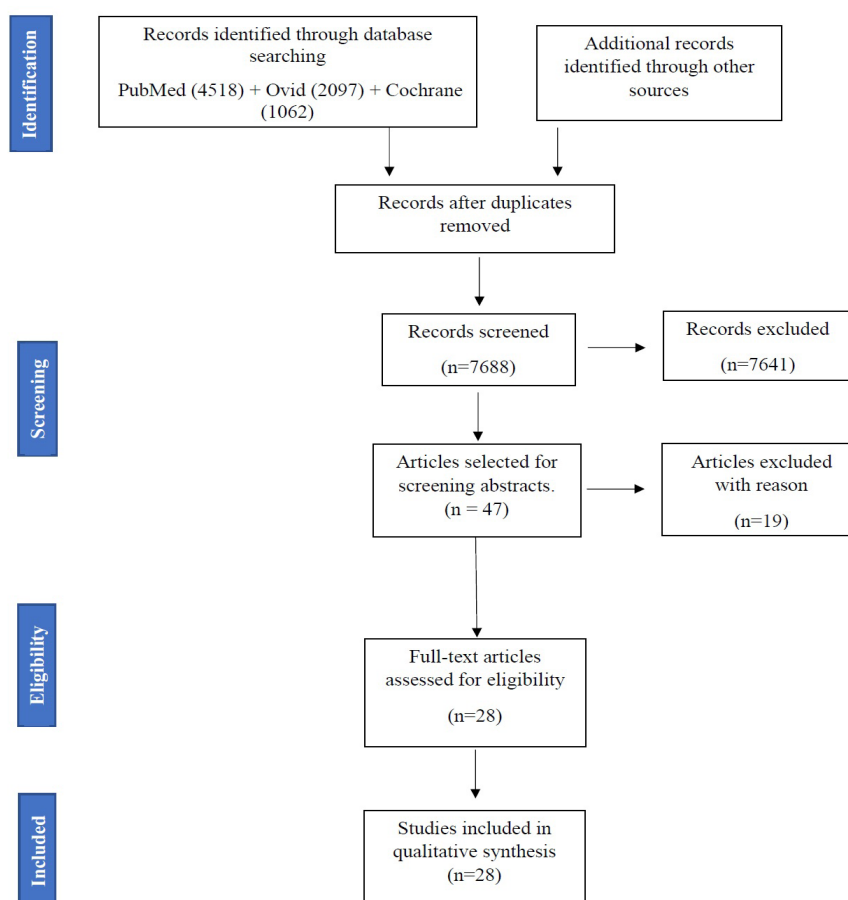


Figure 1. PRISMA flow chart of the included studies.

## Results

A flow diagram explains the retrieval, screening, and selection of articles for the present systematic review (Figure 1). A total of 7688 studies were retrieved after removal of duplicates from all the sources. After screening all the titles, 47 potentially relevant articles were included for the abstract phase from which 19 studies were excluded. Twenty-eight studies were included for text review, and all of them were included for the quality appraisal. The characteristics of the studies such as: author and year of publication, country, number of participants (N), sex, age, the study design (3 randomized control trials, 14 cohort studies, 9 cross-sectional studies, and 2 case-controls studies), questionnaire used were depicted (Table II).

### Quality assessment and risk of bias in individual studies

The sample sizes in the studies reviewed varied between 28 and 4508 patients. Different studies analyzed different age groups (children, adolescents and adults).

In most of the studies the treatment was done with fixed appliances.

### Quality of the studies

The methodological quality scores, derived from the Newcastle-Ottawa scale, are given in Table III. Overall, 15 studies were considered to have moderate level of quality and 10 studies were judged to be of low quality. None of the studies were assessed to be having high quality since the maximum of 9 stars was not reached even by a single study. Thirteen studies achieved 3 stars and twelve studies scored two or fewer stars for selection of the study groups. Most studies failed to justify their sample sizes; and in less than half of the studies, selection of the control group (or non-respondents for cross-sectional studies) was deemed to be not adequate. Fourteen studies achieved a maximum of 2 stars for the comparability of the study groups. Regarding the ascertainment of the outcome of interest, 2 stars were scored for 21 studies, 1 star scored for 4 studies.

**Table II.** Details of the studies analyzed in the Review.

S.No	Author and year/ Country	Participants details	1. Study design/ 2. Type of orthodontic treatment 3. Questionnaire/Instrument
		N (losses), % Sex (n), Mean age (SD), Age range	
1	De oliveira [39] (2004), Brazil.	n=1675(-); 56.8% Female (F) (951), 43.2% Male (M) (724);15-16 years	1. CSS, 2. FOA 3. OIDP and OHIP-14
2	Taylor [40] (2009), Washington.	pre comprehensive group (PC) (n = 93) F-45, M- 48; Mean age =12.5 (61.1). Post interceptive group (PI) (n = 44), F- 21, M -23; Mean age=12.5years (61.1); comparison group (C) (n = 156) F-76, M-80; Mean age=12 years 9 months (61.1).	1. CSS 2. FOA 3. CPQ11-14
3	Chen [41] (2010), China.	n=28 (-), 66.6% F (148), 33.3% M (74), 15.7 years.	1. Cohort, 2. FOA, 3.OHIP-14
4	Agou [35] (2011), Canada.	n=199 (81), 50% M (59), 50% F(59), 12.9 (±0.98) years at T1,11-14 years.	1. C-C, 2. FOA, 3. CPQ 11-14
5	Navabi [20] (2012), Iran.	n=302 (-),case group- 150, control Group-152; F (62.25%), M(37.75%); mean age -21.71±3.49 years.	1. CSS 2. FOA 3. OHIP-14
6	Nathalia B. Palomares [42] 2012, Brazil.	n=200 (-), M-63 men, F-137; Mean age of 22.3 years; Divided into 2 groups- treated n=200 and non-treated n=200 in each group:	1. CSS 2. FOA 3. OHIP
7	Feu [21] (2013), Brazil.	Treatment (ttm) group- n=87 (5), M -47, F- 45, Mean age- 12-15 years: Waiting group- n=101 (23), M -60, F-64; Mean age -12-15 years: School Group- n=96(6), M-42,F-60; Mean age -12-15 years:	1. Cohort 2. FOA 3. OHIP-14
8	Jang-Mi Kang [43] (2014), Brazil.	n=860 (-), M-378, F-482; Mean age- 25.92 ± 5.30 years.	1. CSS, 2. FOA, 3.OHIP-14 and PIDAQ
9	Yu Zhou [44] (2014), China.	n=150 (-), M-58, F-92; Mean age of 15.6 ± 1.8 years. Divided in to two groups, self-ligating (n=75) and conventional bracket. (n=75)	1. Cohort, 2. FOA, 3. OHIP-14
10	Chen [45] (2015), China.	n=190 (30), M -81,F-109; Mean age of, 20.8 (±2.5)years.	1. Cohort, 2. FOA, 3.OHIP-14
11	Zheng [46] (2015), ShanDong, China.	Angle class I group n=35 (4); M -17, F -18; Div- 15-20 years-n=20, 20-25 years-n=15: Angle class II group n=32 (5); M -15, F -17; Div- 15-20 years-n=19, 20-25 years-n=13: Angle class III group n=14 (0);M -8, F -6;Div- 15-20 years-n=9, 20-25 years-n=5:	1. Cohort 2. FOA 3. OHIP-14
12	Abdolreza Jamilian [47] (2016), Iran.	n=100 (-); Div- Experimental group-50, control group- 50; Age range of 17 to 21 years	1. Cohort, 2. FOA, 3. OHIP-14
13	Kolenda [48] (2016), Germany.	n=57 (-), M -37, F -30; Age range 20-57 years.	1. Cohort 2. FOA 3. OHIP-G14
14	Healey [6] (2016), New Zealand.	Start of treatment: n=174 (0); M -62, F -112; Mean age-13.4 (±1.3) years. End of treatment: n=104 (0); M-32, F -72; Mean age-13.5 (±1.3)	1. Cohort 2. FOA 3. CPQ 11-14
15	Emad EM Alzoubi [49] (2017), Malta.	Fixed appliance n=98(-); M-20, F -29; Mean age -16 years Functional appliance n=98(-); M-20, F -29; Mean age -10 years	1. RCT 2. FOA/ROA (functional) 3. OHIP-16
16	Miamoto [50] (2018), Brazil.	Total n=30 (-): Group I- n=15; M -11, F -4; mean age was 9.07 ± 0.79 years. Group II- n=15; M -7, F -8; mean age was 9.00 ± 0.84 years.	1. RCT 2. ROA 3. CPQ8-10

**Table II.** Details of the studies analyzed in the Review (continuation).

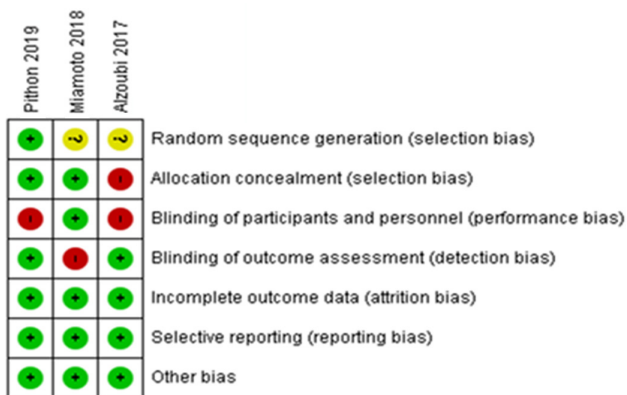
S.No	Author and year/ Country	Participants details	1. Study design/ 2. Type of orthodontic treatment 3. Questionnaire/Instrument
		N (losses), % Sex (n), Mean age (SD), Age range	
17	Pithon [51] (2019), Bahia, Brazil.	n=80 (-), M -19, F-21; Age range 8-10 years/	1. RCT 2. FOA 3. CPQ8-10
18	Demirovic [52] (2019), Herzegovina.	n=178 (-); Mean age -range 22.71 years; experimental group n= 90, control group n= 88 untreated subjects.	1. C-C 2. FOA 3. OHIP-14
<b>OHRQoL and SE</b>			
19	Arrow [53] (2011), Australia.	Orthodontically treated (n= 155); Non orthodontically treated (n= 286); Age approximately 30 years.	1. Cohort 2. FOA 3. OHIP-14 and Rosenberg Scale
20	Seehra [54] (2013), UK.	n=27 (16) ;M -13, F -14; mean age was 14.6 ( $\pm$ 1.5) years	1. Cohort 2. FOA, functional and retainers 3. CPQ 11-14 and Harter's Self Perception Profile
21	Brosens [55] (2013), Belgium.	n=27 (16) M -50, F -59; Age range- 11–16 years.	1. Cohort 2. FOA 3. CPQ and Harter's Self- Perception Profile.
22	Johal [56] (2015), UK	n=61 (1), the mean age of 41.2 years	1. Cohort 2. FOA 3. Rosenberg Self-esteem scale, OHIP-14
23	Benson [36]. (2015), UK.	Group I n=374 (30), M-122, F -252; Age 11-12 years. Group II n=217 (41), M-61, F-156; Age 14-15 years.	1. Cohort 2. FOA 3. CPQ11–14 and CHQ-CF87
24	Choi [57] (2017), Korea.	n=66(-), M-20, F-36; Mean age - 24.2 $\pm$ 5.2 years.	1. CSS 2. FOA 3. Rosenberg self-esteem scale and OHIP-14
25	Jaeken [58]. (2019), Belgium.	n=497(173), M-239,F-259; Mean age - 12.7 years.	1. Cohort 2. FOA 3. CPQ11-14, Harter's Self- Perception Profile.
<b>SE</b>			
26	Jung [29]. (2010), Korea.	Total n=4509 (-), M-1565, F-2944; Middle school aged,10-13 years.	1. Cohort 2. FOA 3. Rosenberg's scale
27	Romero [59]. (2015), Spain.	n=170 (-), M-70, F-100; Mean age - 29.80 -+9.55 years	1. CSS 2. FOA 3. Rosenberg's scale.
28	Avontroodt [60] (2019), Belgium.	n=326 (-), M-154,F-172; Mean age - 13.1 $\pm$ 1.18 years at T0	1. Cohort 2. FOA 3. Dutch adaptation of the Harter's test and treatment Need.

Participant characteristics - Male (M), Female (F); Instrument/Questionnaire- Child Perception Questionnaire (CPQ), Oral health impact profile (OHIP) Oral impact on daily performance (OIDP), Psychosocial Impact of Dental Aesthetic Questionnaire (PIDAQ); Type of study- Cross sectional study (CSS), prospective cohort studies (Cohort), case control study (C-C), Randomized control trial (RCT);Type of Appliance - Fixed orthodontic appliance (FOA), Removable Appliance (ROA), Debonding (DB).

**Table III.** Quality assessment for non-randomized studies: Modified Newcastle Ottawa scale.

S. no	Author (year)	Selection (****)				Comparability (**)		Outcome (***)			Total score
		1	2	3	4	5a	5b	1	2	3	
<b>OHRQL</b>											
1	De oliveria [39] (2004)	*	*	*		*	*		*	*	7
2	Taylor et al [40] (2009)	*	*	*		*	*		*	*	7
3	Chen [41] (2010)		*	*		*			*	*	6
4	Agou [35] (2011)	*	*	*		*	*		*	*	7
5	Navabi [20] (2012)	*	*	*		*	*		*	*	7
6	Palomares [42] (2012)	*	*	*		*	*		*	*	7
7	Feu [21] (2013)	*	*	*		*	*		*	*	7
8	Jang-Mi Kang [43] (2014)		*	*		*	*		*	*	6
9	Yu Zhou [44] (2014)			*			*		*	*	4
10	Chen [45] (2015)	*	*	*		*	*		*	*	7
11	Zheng [46] (2015)	*	*	*		*	*		*	*	7
12	Abdolreza Jamilian [47] (2016)	*	*	*		*	*		*	*	7
13	Jana Kolenda [48] (2016)			*			*		*	*	4
14	Healey [6] (2016)	*		*			*		*	*	5
15	Demirovic [52] (2019)	*	*	*		*	*		*	*	7
<b>SE &amp; OHRQL</b>											
16	Arrow [53] (2011)	*	*	*		*	*		*	*	7
17	Seehra [54] (2013)		*	*			*		*	*	5
18	Brosens [55] (2013)	*		*			*		*	*	5
19	Johal [56] (2015)	*		*			*		*	*	5
20	Benson [36] (2015)	*		*			*		*		4
21	Choi [57] et al. (2017)	*		*			*		*	*	5
22	Jaeken [58] et al. (2019)	*		*			*		*		4
<b>SE</b>											
23	Jung [29] (2010)	*	*	*		*	*			*	6
24	Romero [59] (2015)	*	*	*		*	*		*	*	7
25	Avontroodt [60] (2019)	*		*			*		*		4

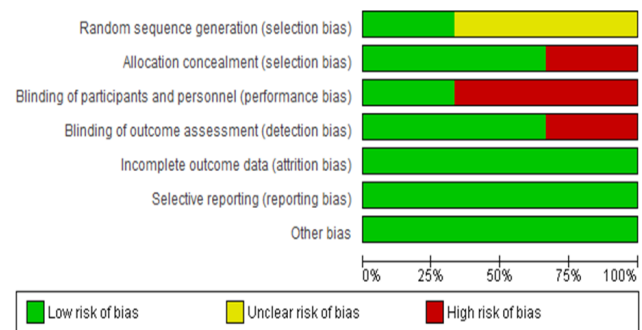
High-quality at low risk of bias could get a maximum of 9 stars, articles achieving 8, 7, or 6 stars have moderate quality, and articles with 5 stars or fewer signified low quality.



**Figure 2.** Risk of bias summary: review authors’ judgments about each risk of bias item for each included study.

The methodologic quality scores, derived from the Cochrane risk of bias tool for RCTs are shown in (Figure 2 and Figure 3). It can be inferred that two of the studies

can be rated of low quality. Trials conducted by Alzoubi [49] and Miamoto [50] had high selection bias and detection bias. Random sequence generation was unclear in these two studies and the study of Python [51] reflected an acceptable quality (only performance bias was high).



**Figure 3.** Risk of bias graph: review authors’ judgments about each risk of bias item presented as percentages across all included studies.

### Measuring tools used

The instrument used for outcome measurement of OHRQoL was the Child Perception Questionnaire 11-14 in 9 studies [6,36,40,35,50,51,55,56,59] and the remaining 16 studies [21,22,39,41-49,52,53,56,57] utilised the Oral Health Impact Profile-14 (OHIP-14) or the Oral Impacts on Daily Performance (OIDP) instrument. The self-esteem outcome measure used in 4 studies [54,55,58,60] was the Harter's Self-Perception Profile, five studies [29,53,56,57,59] used the Rosenberg's self-esteem scale and 1 study used CHQ-CF87) [36].

### OHRQoL, SE and OHRQoL+SE relation OHRQoL

The studies in which OHRQoL assessed were twenty-five, out of which 22 studies showed an increase in OHRQoL, and three studies showed no improvement in OHRQoL after orthodontic treatment).

**Self-esteem** was evaluated in 10 studies [29,36,53-60] (4 studies showed a decrease in SE while equal number of studies showed an increase in SE and one study showed no change in global SE).

**SE and OHRQoL:** The correlation between SE and OHRQoL was analyzed in 7 studies [36,53-58] (4 studies showed negative correlation, two studies showed a positive correlation, and 1 study showed an increase in OHRQoL but no change in SE, inferring that no relation exists between OHRQoL and SE. Negative correlation implies that as the OHRQoL increased, there was a decrease in SE by the end of treatment. Whereas, positive correlation concludes that both OHRQoL and SE increased after appliance therapy.

### Age factor

**Children:** Of the 28 studies evaluated, 8 studies [22,36,35,49-51,55,58] included child population (only OHRQoL analysed in 5 studies, both SE and OHRQoL examined in 3 studies, so totally 8 studies analysed OHRQoL). In all of these studies, children exhibited an increase in OHRQoL and SE in all the studies after orthodontic treatment.

**Adolescence:** In this age group, 11 studies [6,29,39-41,44,46,47,52,54,60] were analysed. The only OHRQoL was examined in 8 studies, only SE in 2 studies, both SE and OHRQoL in 1 study; so totally OHRQoL was examined in 9 (8+1) studies, SE in 3 (2+1) studies, both SE and OHRQoL in 1 study. In adolescents, there was an improvement in OHRQoL in seven of the studies [39,41,44,46,47,52,54] and 2 studies [6,40] showed no change in OHRQoL after therapy. Regarding the SE in adolescents, One study [29] displayed improvement in SE, where as another study [60] showed no improvement in overall global SE. However, females showed a decrease in SE, and males showed an increase in SE.

**Adults:** The adult population was analyzed in

eight studies [21,42,43,48,53,56,57,59] (only OHRQoL in 4 studies, only SE in 1 studies, both SE and OHRQoL in 3 studies; so totally OHRQoL in 7 (4+3) studies, SE in 4 (1+3) studies, both SE and OHRQoL in 3 (1+2) studies and a single study [45] included young adult where only OHRQoL was analyzed. In adults, six studies [21,42,43,48,56,57] displayed an increase while as one study [53] exhibited negative trends in the OHRQoL after orthodontic treatment. In all the adults, SE increased after treatment. In young adults, an increase in OHRQoL [45] after orthodontic treatment was observed.

### Gender factor

One study on young adolescents, middle school aged (10-13 years) came across an increase in SE in males compared to females [29] while as another study reported entirely the opposite trend [60].

### Fixed vs. Removable appliances

Of the 28 studies included in the study, 26 studies used fixed appliances, whereas two studies used removable devices (1 research: myofunctional and another study: removable appliance with digital springs). The two studies in which were used removable appliances [49,50] were of low quality in quality assessment, whereas in a total of 23 studies analyzed for OHRQoL, fixed appliances showed increase in quality of life in 20 studies [21,22,35,36,39,41,42-34,51,54-58] and no improvement of QoL in 3 studies [6,40,53]. Three of the studies [29,59,60] assessed self-esteem in which only fixed appliances were used; no study was present to analyze the SE with removable appliances. The results extracted from the studies included are summarised (Table II).

### Discussion

OHRQoL and SE assessment are the essential components of any treatment, and accomplishment of the same is necessary for any preventative or therapeutic treatment. The evaluation should be done while treating a malocclusion because of the significant psychosocial aspects involved in treating malocclusion. The patient-reported outcome measure (PROM) is "any declaration of the status of a patient's health condition that comes straight from the patient, without interpretation of the patient's response by a doctor or anyone else". In the future, PROMs will be the standard of outcome assessment compared to clinical and peer review or caregiver assessment. Patient-reported experience measures were also used as quality indicators of patient care and safety [61].

The current systematic review was set out to summarize the evidence for changes in the OHRQoL, SE of children, adolescent and adults in treatment with fixed and removable appliances and the correlation between SE and OHRQoL in patients at the end of orthodontic treatment. This systematic review focused on the results of OHRQoL, SE separately and both in combination



after treatment in all age groups. The review attempted to identify the relation between SE and OHRQoL after orthodontic treatment. This which makes the present review unique as compared to the previous studies in this context.

From the review of the studies, it can be concluded that orthodontic treatment utilizing fixed appliances produces a significant improvement in both the self-esteem and oral health-related Quality of life in children. However, there is ambiguity in the evidence whether there is an increase or decrease in SE in the adolescents and the adult patients by the end of the treatment. A positive association was found between OHRQL and SE in orthodontic treatment in children. Individually self-esteem and oral health-related quality values increased post orthodontic treatment (fixed and removable appliances). Utilizing removable appliance [49,50] showed significant improvement in OHRQoL in children by the end of treatment, and no study for self-esteem has used removable appliances.

There are diagonally contradictory reports from two studies available based on gender assessment [29,60]. Both these studies were done in young adolescents between 10-16 years. A study by Jung [29] on Korean mid school going adolescents unveiled that after fixed orthodontic treatment, the girls had higher self-esteem than the untreated malocclusion group compared to boys. Further the study revealed that the malocclusion had significant effects on the self-esteem of females where as in boys it has no effect. Whereas, the study by Avontroodt [60] in Belgium revealed a decrease of SE in females, whereas in males SE increased after orthodontic treatment. This might have been due to differences in the demographic characteristics of the samples under the individual study.

The findings of the present review should be viewed in the clinical context. The self-perception of the dentofacial esthetics influence psychological development from early childhood to adulthood. The self-perception can boost the self-concept and hence the self-esteem. In recent decades, QOL has been used to evaluate patient perspective in the form of subjective awareness, with a particular focus on patient-reported outcome measures (PROM). In general, self-esteem or one's overall evaluation or appraisal of one's own value is associated with greater life satisfaction. It is reasonable to assume that the relationship between reported OHRQoL and malocclusion and treatment effects is most likely mediated by innate psychological attributes, such as self-esteem SE, in predicting the effect of health conditions on the quality of life. The evidence from the present review supports the mediator role of SE when evaluating OHRQoL in children. So within reasonable limits, it can be recommended that the early treatment of malocclusion should be carried out if possible.

The findings of the current systematic review

concur with earlier studies which have concluded that improvements in OHRQoL were associated with orthodontic treatment [20,59]. Concerning the overall results of the studies, Benson and colleagues [36] found a moderate increase in CPQ11-14 scores among patients with orthodontic treatment history. However, the relationship between the history of orthodontic treatment and the QoL improvement was not statistically significant [36]. It is essential to note the systematic review and meta-analysis published by Javidi and co-workers, [28] as qualitative analysis obtained similar results to our study. However, the earlier review suggested no significant differences between patients who underwent orthodontic treatment and those who did not. A systematic review conducted by Ferrando-Magraner and co-workers [62] concluded that there is a positive relationship among oral health-related quality of life and orthodontic treatment and in tandem with the present review. Thus, it can be summarized that OHRQoL is improved with fixed mechanotherapy, however sufficient quantity of studies were not available to compare the same with the removable appliances.

There are certain methodological limitations in interpreting the results of this systematic review. The level of the evidence is based on the type of studies. Unfortunately, due to specific methods used in Randomised Clinical Trials, it is not possible to have an interventional and a comparable control group to assign and follow up the subjects for a long time due to ethical concerns. This is reflected in the present review by very little evidence documented in the form of RCTs in response to the research query. This may handicap the level of evidence to the research question. The quality and methodology of the non-randomised control studies incorporated in the present systematic review is questionable and point towards the need for further quality research so as to analyze the correlation between SE and OHRQoL in patients undergoing orthodontic treatment, particularly with the removable appliance. Second one is the outcome measurements OHRQoL and SE were pooled and analyzed. Different questionnaires were used in these studies to evaluate OHRQoL and SE. The individual questionnaires may mediate different domains of importance. The individual domains are not analysed in the present study. Besides there are certain inherent limitations when analysing the systematic reviews on the orthodontic treatment. The Orthodontic treatment is unique because of varied manifestations of malocclusions. The data cannot be analysed based on the individual type of malocclusions. Further studies should be conducted with clearly defined age ranges, balanced distribution of gender, longitudinal follow-up, with reduced loss of follow-up, and using uniform validated and reliable assessment instrument and should be analyzed after treatment but not during the individual phases of the treatment procedure.

## Conclusions

From the analysis of the present systematic review, it is reasonable to conclude that there is moderate evidence showing that fixed orthodontic treatment improves OHRQoL in all the age groups. There is definite increase in the SE in children, but not positively consequential in adults and adolescents. The age and gender affect the domain of self-esteem in young adolescents, but the direction of the effect based on gender is not clear. From the available data the relation between OHRQoL and SE in inclined slightly towards negativity.

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