

## **Masticatory performance and oral health related to quality of life before and after orthodontic treatment: a systematic review and meta-analysis**

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### **Abstract**

Masticatory performance is considered an important step in the beginning of the digestive process and considering the patient's aesthetic and functional factors, it is necessary to choose appropriate treatments. Based on the evidence during orthodontic treatment, the restoration of the physiological function of masticatory performance should not be neglected. The present study aimed to evaluate the association between orthodontic treatment and improved masticatory performance and oral health related to quality of life. In the present study, all articles published till the end of August 2023 were extracted by two trained researchers independently through a search in databases like PubMed, Scopus, Science Direct, ISI, Web of Knowledge, Elsevier, Wiley, and Embase, and Google Scholar search engine using keywords and their combinations. Data analysis was done using the fixed effects model in a meta-analysis, by STATA (version 17); a P-value of less than 0.05 was considered significant. Based on the results, the mean difference in masticatory performance between pre-treatment and post-treatment was 2.23 (MD: 2.23; 95CI, 2.17, 2.29.  $p < 0.01$ ;  $I^2 = 99.98\%$ ;  $p < 0.01$ ). The mean difference in oral health related to quality of life between pre-treatment and post-treatment was -32.23 (MD: -32.23; 95CI, -33.35, -31.11.  $p < 0.01$ ;  $I^2 = 97\%$ ;  $p < 0.01$ ). Orthodontic treatment had a positive effect on masticatory performance and improved the quality of life of patients after treatment.

**Key Words:** orthodontic treatment; masticatory performance; oral health; quality of life.

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Restoring masticatory performance is an important goal of orthodontic treatment. In the past, the sieving method was used to measure chewing performance.<sup>1</sup> Due to the complexity of this method, simpler methods are used today, one of which is measuring the amount of glucose while chewing gum jelly. Studies have shown a positive correlation between chewing performance and the new method, compared to the old method.<sup>2</sup> Another important consequence of dental care, especially during orthodontic treatment, is Oral Health-Related Quality of Life (OHRQoL).<sup>3,4</sup> Based on the results of the studies, patients experience difficulty in masticatory performance with the loss of teeth, and OHRQoL decreases. Orthodontic treatment can improve masticatory performance and increase OHRQoL to some extent.<sup>1</sup> The use of dental prostheses also has a significant impact on masticatory

performance and OHRQoL.<sup>5,6</sup> Since chewing is considered an important step in the beginning of the digestive process, and considering the aesthetic and functional factors of the patients, it is necessary to choose appropriate treatments.<sup>7</sup> Therefore, considering the importance of the subject, studies should reach a consensus to provide sufficient evidence in this field. The present systematic review and meta-analysis study aimed to evaluate masticatory performance and quality of life before and after orthodontic treatment.

### **Materials and Methods**

#### **Search strategy**

In the present study, articles related to treatment before, during, and after orthodontics, which investigated masticatory performance and OHRQoL, were examined.

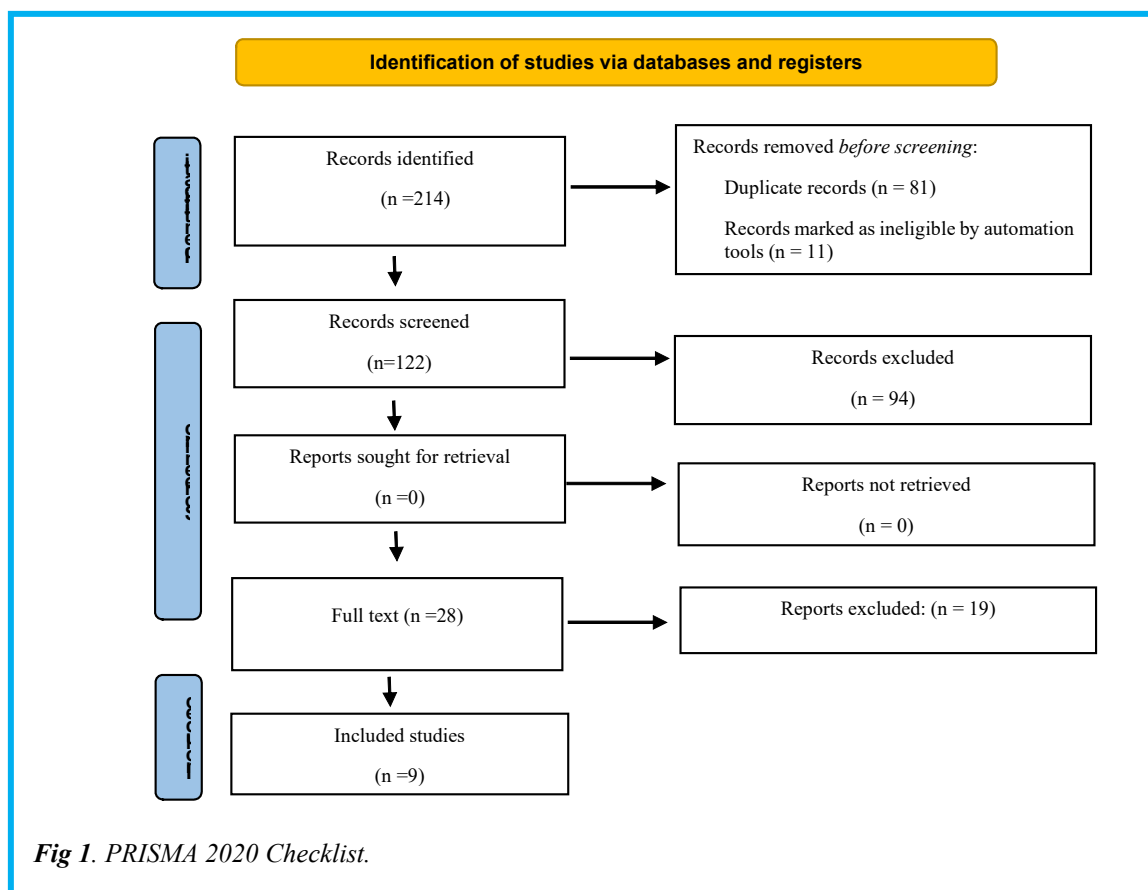


Fig 1. PRISMA 2020 Checklist.

Articles published in international databases such as PubMed, Web of Science, Scopus, Science Direct, Web of Knowledge, EBSCO, Wiley, ISI, Elsevier, Embase, and Google Scholar search engine were accessed. The search process until August 2023 was done using MeSH keywords: "Index of Orthodontic Treatment Need"[Mesh] OR "Index of Orthodontic Treatment Need/methods"[Mesh] OR ( "Index of Orthodontic Treatment Need/classification"[Mesh] OR "Dental Occlusion"[Mesh]) AND "Masticatory Muscles"[Mesh] OR "Mastication"[Mesh] AND " Masticatory efficiency" AND "Chewing ability" AND " Chewing efficiency" AND "Oral Health"[Mesh]), AND "Quality of Life"[Mesh].

**Study selection criteria**

**Inclusion criteria**

Randomized controlled trials, prospective studies, observational studies, before–after studies, studies published in the English language, and orthodontics treatment. Case report articles, cohort studies, case-control studies, review articles, systematic review studies with incomplete results, animal studies, and editorial articles were excluded.

**Data collection**

After searching the articles, the details of each selected article, including the author's name, type of study, year of publication, characteristics of participants, age of participants, and sample size were collected by two researchers independently, with blinding.

**Data analysis**

Meta-analysis was performed using effect size with a 95% confidence interval (CI). To estimate the heterogeneity of the studies, the index  $I^2$  (<25%: weak heterogeneity, 25-75%: moderate heterogeneity, and more than 75%: high heterogeneity) was used. The results were combined using the fixed effect model (Inverse-variance method) in meta-analysis. Publication bias was checked through the Egger test and data analysis done through STATA/MP. v17 software. A p-value of less than 0.05 was considered significant.

**Results**

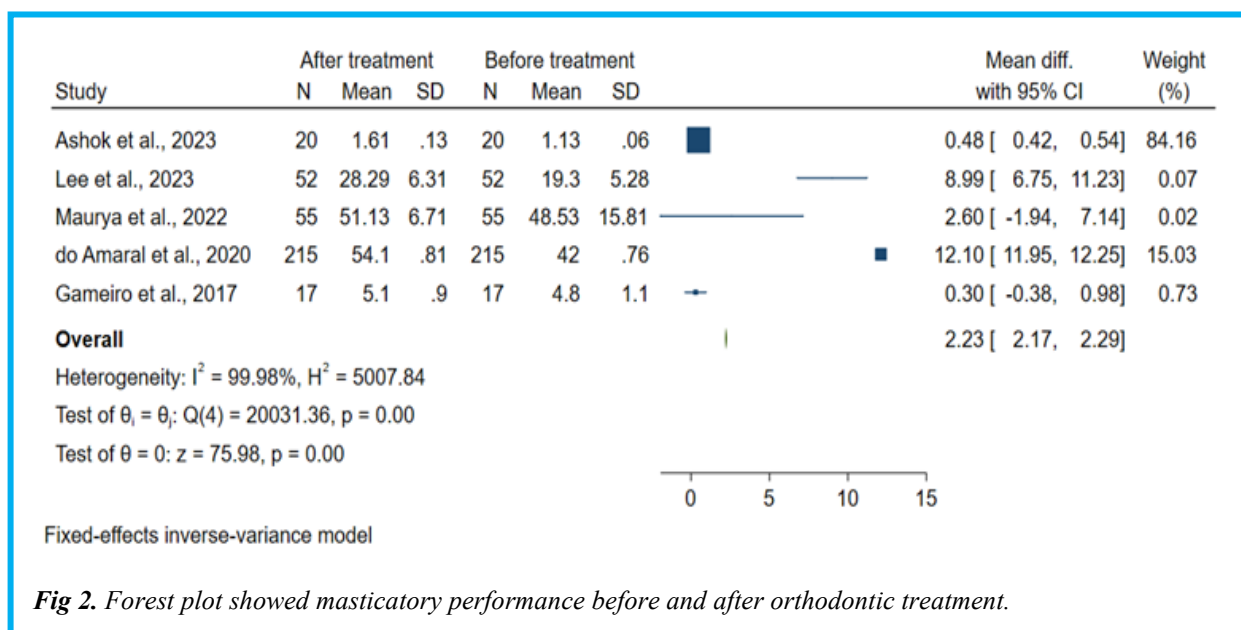
Through a search with the related keywords, 214 studies were identified. Endnote.X8 software was used to organize them. By using this software and reviewing the titles and abstracts of the articles, 81 duplicate studies were eliminated, while 11 articles were marked ineligible by automation tools. Then the researchers examined the abstracts of 122 articles. Ninety-four studies did not meet the inclusion criteria or were excluded due to weak or unrelated relevance to the study objective (if after reading the title and abstract, it was not possible to decide about the article, the full text was referred to). The full text of 28 articles was carefully reviewed by two independent researchers, and 19 studies were excluded due to the inconsistency with the study objectives; finally, nine articles were selected (Figure 1, Table 1).

**Table 1.** Overview of included studies.

Study. Years	Study type	Number of participants	Sex		Range or mean of age (years)	Types of orthodontic treatments	Malocclusion	Assessment
			Male	Female				
Ashok et al., 2023. <sup>8</sup>	Prospective study	20	9	11	12-16	Orthodontic treatment with functional jaw orthopedics	Class II	Masticatory performance
Lee et al., 2023. <sup>9</sup>	Prospective study	52	26	26	18-48	Fixed orthodontic treatment	Class I	Masticatory performance
Maurya et al., 2022. <sup>10]</sup>	Randomized controlled trial	55	22	33	NR	Fixed orthodontic treatment	Class I, II, III	Masticatory performance
do Amaral et al., 2020. <sup>11</sup>	Sectional study	215	110	105	15-19	Fixed orthodontic treatment	57.7%	Masticatory performance
Ni et al., 2019. <sup>12</sup>	Longitudinal study	21	11	10	24.51±0.61	Surgical orthodontic treatment	-	OHRQoL
Gameiro et al., 2017. <sup>1</sup>	prospective study	17	9	8	24.2 ± 6	Fixed orthodontic treatment	NR	Masticatory performance
Alanko et al., 2017. <sup>17</sup>	prospective study	22	6	16	18-54	Fixed orthodontic treatment	-	OHRQoL
Huang et al. 2016. <sup>14</sup>	prospective study	50	25	25	25.7±0.14	Surgical orthodontic treatment	-	OHRQoL
Antoun et al., 2015. <sup>15</sup>	Prospective study	29	14	15	19.4±4.3	Fixed orthodontic treatment	-	OHRQoL

The mean difference of masticatory performance between pre- and post-treatment was 2.23 (MD: 2.23; 95CI, 2.17,2.29.  $p<0.01$ ;  $I^2= 99.98\%$ ;  $p<0.01$ ). Masticatory performance after orthodontic treatment was lower than pre-treatment; it significantly improved post-treatment ( $p<0.01$ ) (Figure 2)

The mean difference of OHRQoL between pre-and post-treatment was -32.23 (MD: -32.23; 95CI, -33.35, -31.11.  $p<0.01$ ;  $I^2= 97\%$ ;  $p<0.01$ ). A decrease in OHRQoL after treatment showed that OHRQoL greatly improved after orthodontic treatment in the included studies (Figure 3).



**Fig 2.** Forest plot showed masticatory performance before and after orthodontic treatment.

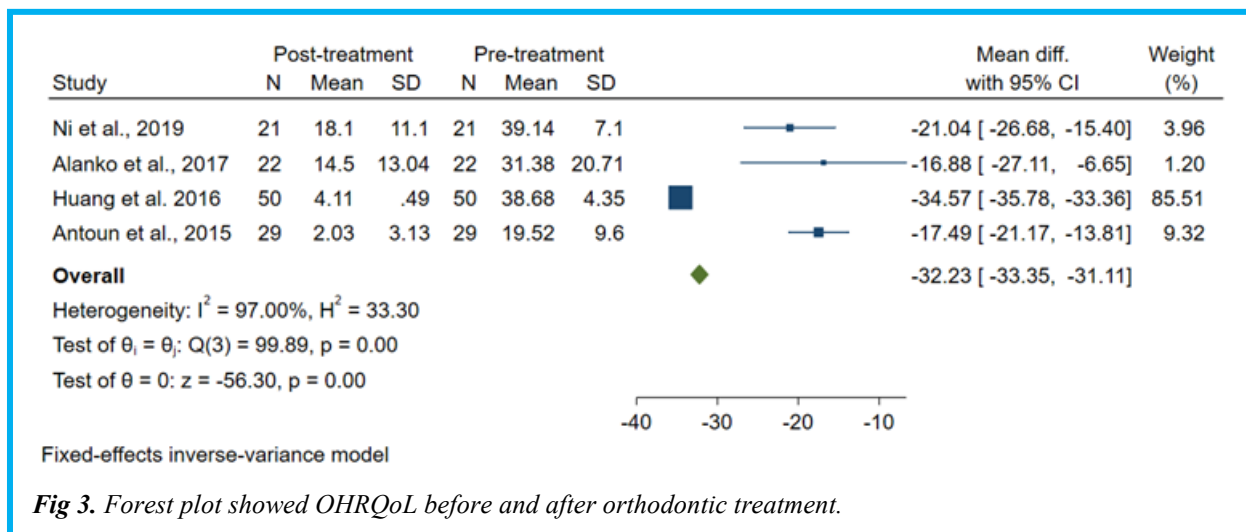


Fig 3. Forest plot showed OHRQoL before and after orthodontic treatment.

**Discussion**

Surveys have reported that in younger age groups and the young generation, concern regarding aesthetics is very high. This generation pays more attention to the beauty of the teeth and their teeth.<sup>1,12</sup> According to the findings, the inability to chew also makes people care about their teeth.<sup>8,9</sup> Studies have shown that orthodontics can be effective by correcting malocclusion on symmetry in chewing movements and improving masticatory performance.<sup>1,10,11</sup> Studies have also found that the quality of life increases after orthodontic treatment, with improvement in masticatory performance.<sup>12,13</sup>

Ashok et al. reported improved masticatory performance after orthodontic treatment in patients with class II malocclusion. This affected the beauty and performance of the patients, and consequently, the quality of life.<sup>14</sup> Lee et al. found increased masticatory performance immediately after orthodontic treatment. In this study, tooth extraction did not affect the improvement of masticatory performance after orthodontic treatment.<sup>15</sup> Another study observed that in all malocclusion groups, bite force improved after orthodontic treatment.<sup>16</sup> By examining the quality of life in a study, research has reported that before orthodontics, there quality of life in patients with class III malocclusion was low, but improved significantly after the orthodontic treatment stage.<sup>17</sup> Another study reported that orthodontic treatment supports psychological well-being, but the range of individual variation is wide.<sup>18</sup> Huang et al. concluded that orthodontic treatment affects the quality of life significantly and effectively.<sup>19</sup> The quality of life after orthodontic treatment improved compared to before treatment, with a significant difference observed therein between age and gender.<sup>20</sup> Studies that have shown the positive effect of orthodontic treatments on the masticatory system have reported that orthodontic treatment regulates muscle activity by training muscles for symmetrical function.<sup>17</sup> Orthodontic treatment facilitates and regulates muscle activity, as well as

masticatory performance.<sup>21,22</sup> Studies have reported the chewing performance of different malocclusions with mixed results. Patients were reportedly able to detect improvements in their chewing function during treatment.<sup>23,24</sup>

In conclusion, the findings of the present meta-analysis reveal that orthodontic treatment has a positive effect on masticatory performance and that orthodontic treatments can improve the patients’ quality of life after treatment. Therefore, patients should be provided with dietary instructions before starting the treatment to maintain the devices and avoid discomfort during the treatment. Considering the high heterogeneity observed between the studies, more studies should be conducted with the same cognitive method to study the aesthetic and physiological aspects.

**List of acronyms**

- ANOVA - analysis of variance
- CI- confidence interval
- OHRQoL - Oral Health-Related Quality of Life

**Contributions of Authors**

BS: Conception and design, methodology, data collection, analysis and interpretation of data, drafting the article, final approval; RB: Conception and design, drafting the article, final approval; AF: Analysis and interpretation of data, drafting the article, final approval; MS: Revising it critically, analysis of data, final approval; SMS: Revising it critically, analysis of data, final approval; BS: Methodology, drafting the article, supervision, final approval; RB: Conception and design, method

All authors read and approved the final edited typescript.

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### Conflict of Interest

The authors declare no competing interest.

### Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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