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SYSTEMATIC REVIEW

Evaluating the Effectiveness of Orthognathic Surgery on the Pre-existing Temporomandibular Disorders in Patients with Malocclusion: A Systematic Review and Meta-analysis

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Abstract

Objective: To evaluate the prevalence of temporomandibular disorders (TMDs) for those patients with dentofacial deformities, who underwent orthognathic surgery, and the control group. It also identified whether orthognathic surgery had a positive or negative impact on TMD symptoms by comparing TMD patients, who underwent orthognathic surgery, and people did not experience this surgery. Finally, this systematic review and meta-analysis aimed to evaluate the effectiveness of orthognathic surgery on the pre-existing TMDs in malocclusion patients. **Material and Methods:** MEDLINE, PubMed, Cochrane Library, Embase, ISI, google scholar have been utilized as the electronic databases for systematically reviewing the literature between 2001 and February 2019. Inclusion criteria were undergoing orthognathic surgery, patients with/without pre-existing TMDs, and physical disabilities. **Results:** A total of 669 abstracts and titles with potential relevance have been identified in the course of the manual and electronic searches. It has been found that five studies met our inclusion criteria for a systematic review. Temporomandibular disorders (TMDs) before orthognathic surgery in comparison to the controls (RR=0.02; 95% CI -0.08-0.13) and heterogeneity among the papers has been I2 = 42.86% (p=0.64). **Conclusion:** Malocclusion by orthognathic and orthodontics surgeries had a considerable rate of TMD compared to the controls.

Keywords: Malocclusion; Orthognathic Surgery; Temporomandibular Joint Disorders.

Introduction

The research confirmed that it is possible to characterize temporomandibular disorders (TMD) as an assortment of symptoms kept to temporomandibular joint (TMJ) and the pertinent structures. Therefore, such symptoms might incorporate tenderness of mastication muscles, headache, neck and facial pain, TMJ pain, limitations in the opening of the mouth, dentition wear, jaw locking, par-functional habits, and otalgia [1].

There was clashing information to the predominance of the TMD symptoms. Several studies showed the increased prevalence of TMD symptoms in patients with dentofacial distortion, changing between 40.8% and 97% [2,3]. Besides, some authors published a decreased rate in the range between 14% and 26.5% [2]. TMD prevalence in patients who experienced a particular dentofacial deformity (i.e., Class III and Class II) has a higher prevalence than the general population [4]. However, there are many debates on the affiliation between pre-existing TMD in patients with dentofacial deformities and their treatment with orthognathic surgical operation [2].

Some researchers claimed that orthognathic surgery would have an advantageous impact on the pre-existing TMDs [5], or at the slightest level did not irritate the pre-existing conditions [6,7]. Still, others claimed a combination of the pre-existing TMD by orthognathic surgery [8].

Furthermore, the authors discussed the effect of orthognathic surgery on TMD symptoms in maxillofacial and oral surgeries. A few research also detailed the diminished symptoms of TMD of the orthognathic surgery as a result of the improvements in the occlusal stability or lower emotional stresses [9]. Others demonstrated a declining [8] or lack of changes in the TMDs following the orthognathic surgery [7], negative or positive impact on TMDs symptoms [10], assessment of TMD pervasiveness for patients with dentofacial deformity who underwent the orthognathic surgery in comparison to the controls, and identification of the issue whether orthognathic surgery included negative or positive impacts on TMD symptoms via making a comparison between the TMD patients who underwent the orthognathic surgery and those who did not [2,11,12]. Therefore, the present systematic review and meta-analysis aimed at evaluating the effective orthognathic surgery on the pre-existing TMD in malocclusion patients.

Material and Methods

Search Strategy

MEDLINE, PubMed, Cochrane Library, Embase, ISI, and Google scholar have been utilized as the electronic databases for a systematic literature review between 2001 and February 2019. Therefore, Endnote X9, one of the commercially available software programs, has been utilized to manage the titles electronically. Hence, we searched the keywords of "Orthognathic Surgery," "Temporomandibular Disorders OR TMD," "Malocclusion," "Class III," and "Class II." Notably, this systematic review has been conducted based on the main consideration of the PRISMA Statement (the Preferred Reporting Items for Systematic Reviews & Meta-analysis) [13]. PICOS strategy showed in Table1.

Table1. PICOS strategy.

P	Patients	Patients were undergoing orthognathic surgery with various dentofacial deformities.
I	Intervention	Patients with/without pre-existing TMDs.
C	Compare	Patients with no congenital distortions, physical inabilities, previous jaw surgery, and great maxillomandibular relations and normal occlusion.
O	Outcomes	Report all Outcomes for TMD subgroups.
S	Study Design	Randomized controlled trials studies, prospective and retrospective cohort studies, and controlled clinical trials.

Selection Criteria

The following inclusion criteria were established: 1) The randomized controlled trials studies, prospective and retrospective cohort studies, and controlled clinical trials; 2) Studies conducted on humans; 3) Undergoing orthognathic surgery; 4) Patients with/without pre-existing TMDs; 5) Patients with physical disabilities; 6) Patients with earlier jaw surgeries; 7) Patients with suitable maxillo-mandibular relation and normal occlusion; 8) TMDs symptoms in the patients who underwent orthognathic surgery; 9) Studies with the control groups, and 10) Studies written in English.

The following exclusion criteria were established: 1) In-vitro studies, case reports, reviews, and case studies; 2) Animal studies; 3) Patients with mandibular condyle; 4) Patients with the treatments done for TMJ; 5) Patients with trauma or clefts; 6) Patients with the congenital malformation and craniofacial syndrome, and 7) Patients with systemic arthritis or muscular diseases.

Data Extraction and Method of Analysis

In this stage, data have been extracted from the research, which involved study, years, study design, follow-up period, sample size, male or female ratio, range and mean of age, dentofacial deformities, outcomes, and conclusion. A study that included all the domains was classified as having a low risk of bias, a study that was missing one of these domains was classified as having a moderate risk of bias. When two or more domains were missing, the study was considered to have a high risk of bias. Moreover, the risk ratio (RR) have been analyzed by meta-analysis. RR of signs and symptoms of TMDs before and after orthognathic surgery. Distribution of various symptoms of TMD was divided into nine subgroups (One or more subjective symptoms, Joint clicking, Joint crepitation, Muscle palpation tenderness, Joint pain on palpation, Limited opening, Deviation on mouth opening, Headache, Grinding). The risk ratio with corresponding 95% confidence intervals (95% CIs) and effects model with 95% confidence intervals [CI] was performed. Then, the forest plots have been evaluated with Comprehensive Meta-Analysis Stata/MP 16.0.

Results

While electronically and manually searching, we discovered a total number of 669 potentially pertinent abstracts and topics. In the course of the first phase of the study selection, 606 investigations were excluded based on abstracts and titles. Then, full-text papers of other 54 studies have been fully assessed. It has been found that 49 articles should be excluded due to lack of the satisfaction with the inclusion criteria of this review. Ultimately, five researches met our inclusion criteria to conduct a systematic review (Figure 1).

Five studies (prospective) have been included in this review, including a total of 627 patients (Group 1 = 350 and Group 2 = 277) with a mean age of Group 1 that equalled to 25.78 years and Group 2 equalled to 24.54 years. The Follow-up period ranged from 1 week to 24 months. Dentofacial deformities have been in Class III (159), Class II (43), and Class I (24) (Table 2). Table 3 presents the risk of bias in the studies selected for meta-analysis.

TMDs before orthognathic surgery compared to the controls, there was no significant difference between the two groups. The risk ratio was (RR = 0.02; 95% CI -0.08-0.13) and heterogeneity among the papers has been I2 = 42.86% p=0.64 (Figure 2). In addition, the risk ratio for TMDs after orthognathic surgery compared with a control group has been -0.03; 95% CI -0.10-0.04; Furthermore, the heterogeneity among these papers equaled I2 = 0 %; p= 0.41 (Figure 3).

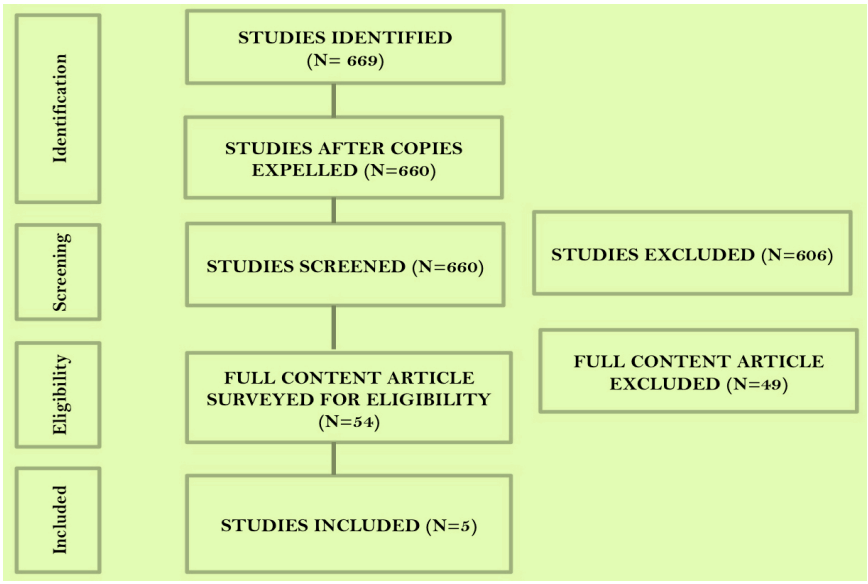

Figure 1. Study attrition diagram.

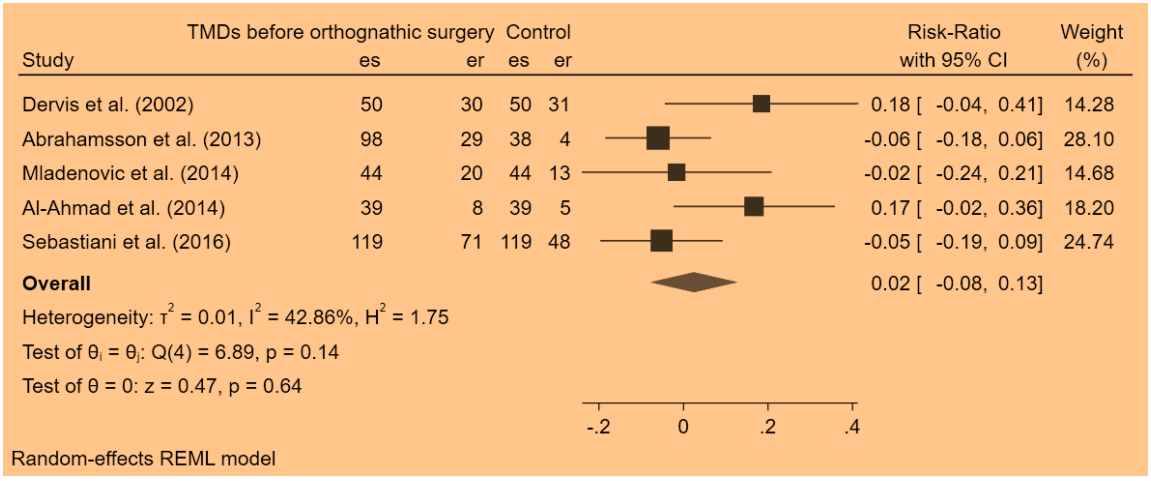

Figure 2. Forest plots showed TMDs before orthognathic surgery (Es: Effect Size; Er: Event Rate).

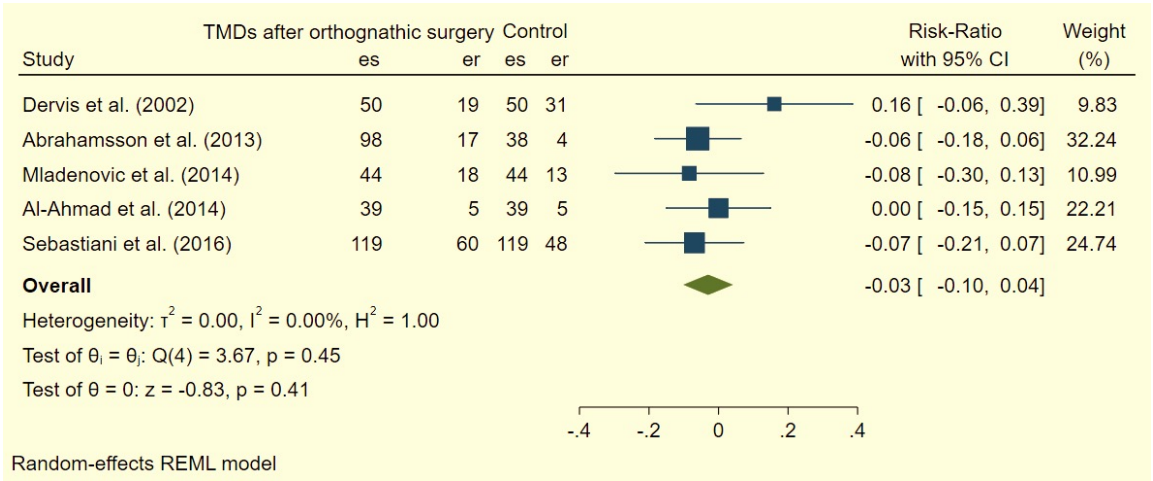

Figure 3. Forest plots showed TMDs after orthognathic surgery (Es: Effect Size; Er: Event Rate).

Table 2. Studies selected for systematic review and meta-analysis.

Study/Year	Design	Sample Size		Male		Female		Age		Follow-up Period	Dentofacial Deformities			Conclusions
		G1	G2	G1	G2	G1	G2	G1	G2		Class III	Class II	Class I	
Dervis et al. (2002) [14]	Prospective	50	50	21	29	22	28	29.3	29.8	1w 12m 24m		NA		Not Statistical differences between symptoms and the type of dentofacial deformity
Abrahamsson et al. (2013) [15]	Prospective	98	38	38	23	60	33	22.4	23.4	18mo-24mo	58	20	13	The positive effects of the treatment on the TMD pain
Mladenovic et al. (2014) [16]	Prospective	44	44	25	19	25	19	23.2	23.5	NR	44	-	-	TMD in class III dentofacial deformities had the same rate of prevalence.
Al-Ahmad et al. (2014) [17]	Prospective	39	39	12	17	21	18	23.8	23	21mo	24	6	7	TMDs following the treatment could negatively influence life quality.
Sebastiani et al. (2016) [18]	Retrospective	119	106	10	7	35	2	30.2	23	6–12mo	33	17	4	Statistical differences for pre-surgery and post-surgery outcomes were not clearly reported.

Table 3. Risk of bias.

Study/Year	Random Selection	Defined Inclusion/ Exclusion Criteria	Loss to Follow-Up	Validated Measurement	Statistical Analysis	The Estimated Potential Risk of Bias
Dervis et al. (2002) [14]	Yes	Yes	Yes	Yes	Yes	Low
Abrahamsson et al. (2013) [15]	No	Yes	Yes	Yes	Yes	Moderate
Mladenovic et al. (2014) [16]	No	Yes	Yes	Yes	Yes	Moderate
Al-Ahmad et al. (2014) [17]	No	Yes	Yes	Yes	Yes	Moderate
Sebastiani et al. (2016) [18]	No	Yes	Yes	Yes	Yes	Moderate

Discussion

In this systematic review meta-analysis, there were no differences in TMD pervasiveness in the patients with dentofacial deformity before the treatment. Some studies showed improvements in the TMDs symptoms. Particularly, pain declined following orthognathic surgery [15,19]. In addition, malocclusion caused TMDs in numerous patients so that aggravated malocclusion healed the TMDs. Unfortunately, that the conducted studies did not accept this simplistic justification. Therefore, to reply to a few of the above questions, it is necessary to investigate the multifactorial etiologies of TMDs. Therefore, analyses did not confirm the correlation between TMD and occlusal condition. However, there has been not a new approach to establishing a weak relationship between a specific occlusal interferer and TMDs [20-22].

Some studies reject this point that malocclusion alone can cause TMD [20,21,23], but certain forms of crossbites [24], as well as profound chomps [25], could play a part in declining a few TMJ symptoms [26,27]. Previous authors determined the prevalence of the symptoms of temporomandibular disorders in adolescents and children with and without crossbites [28]. Hence, TMD frequency could be compared in two groups at follow-up sessions. Another study demonstrated that patients with dentofacial deformities corrected by the orthodontic treatments related to orthognathic surgery exhibited a positive treatment impact on TMD pains [15]. Consequently, this systematic review and meta-analysis reported no differences in TMD pervasiveness in the patients suffering from dentofacial deformity after treatment. However, numerous investigations discussed condyle disc relationships and orthognathic surgery [29].

There is enough information about the alterations in the disc position following the mandibular osteotomy [30]. Such changes in the position could justify the reason for relieving aches within the TMJ following the corrective jaw surgery; however, other authors recommended it as one of the plausible sources of relapse [29]. Besides, some researchers utilized osteotomies or altered condylotomy and approved its contribution to reducing the pain within TMJ, particularly in the patients with the disc displacement. However, there has been no adequate data of if alterations in the disc position following the orthognathic surgery could contribute to the relief or preservation of TMD [31].

Previous authors assessed the effects of the orthognathic surgical treatments on the TMD, quality of life (QoL), and psychosocial well-being [32]. They discovered that psychological parameters and TMD strongly influenced the life quality of the patients compared to the objective treatment outcome measure. However, this has been exceptionally conceivable: before surgical operations, the patients have been disappointed with their appearances and had lower self-esteem, which induced TMD. Therefore, enhancement in the cosmetic appearances following the surgical operation and the consequent impact on the patients, in general confidence and psychological images, could diminish depression and stress that made a difference in the control of a number of the subjective aspects of TMD [12,33].

It is notable that the systematic review and meta-analysis previously conducted [2] dealt with this question "Do patients with malocclusion exhibit a greater prevalence of TMDs than the control group before and following the orthognathic surgery". The researchers showed that patients with the corrected malocclusion by orthognathic or orthodontics surgeries had a considerable rate of incidence of TMD in comparison with the controls. These results are consistent with the present study. It is exceptionally conceivable that patients are dissatisfied with their appearance before surgery and have lower self-esteem, in which these components induce TMDs. Advancement in cosmetic appearance after surgery and its subsequent impact on patients' overall confidence and psychological image may decrease stress and depression, making a difference in controlling some of the subjective aspects of TMDs.

Conclusion

Findings demonstrated that malocclusion by orthognathic and orthodontics surgeries had a considerable rate of TMD in comparison with the controls. Following the treatment, TMD frequency did not vary from the frequencies seen in the controls.

Authors' Contributions

SHM	0000-0002-8333-8511	Writing – Original Draft Preparation and Writing – Review and Editing.
SJ	0000-0003-3803-1235	Conceptualization, Methodology, Software, Investigation, Formal Analysis, Writing – Original Draft Preparation, Writing – Review and Editing and Supervision.
AA	0000-0001-7280-5500	Writing – Original Draft Preparation and Writing – Review and Editing.
NN	0000-0002-6365-6619	Writing – Original Draft Preparation and Writing – Review and Editing.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

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