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Comparative Assessment of Occlusal Splint and Mandibular Deprogramming on Temporomandibular Joint Function and Pain during Orthodontic Treatment

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ABSTRACT:

Background: Temporomandibular symptoms may coexist with orthodontic treatment and can complicate pain control and functional assessment. Occlusal splints and mandibular deprogramming are conservative approaches intended to reduce abnormal muscle activity and help establish a reproducible mandibular position. Methods: A comparative two-group dataset of 200 participants was reviewed, comprising 100 participants allocated to an occlusal-splint group and 100 to a mandibular-deprogramming group. Baseline age, sex, 0–10 visual analogue scale (VAS) pain, maximum mouth opening (MMO), TMJ tenderness, joint sounds, and opening deviation were summarized and compared using Welch's t test or chi-square testing as appropriate. Results: Baseline characteristics were similar between groups: mean age was 26.8±5.4 versus 27.1±5.7 years, VAS pain was 6.4±1.2 versus 6.5±1.1, and MMO was 38.6±4.1 versus 38.2±4.3 mm in the occlusal-splint and deprogramming groups, respectively. TMJ tenderness was present

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in 67.0% and 69.0%, joint sounds in 54.0% and 57.0%, and opening deviation in 31.0% and 34.0%, respectively; none of these baseline comparisons was statistically significant.

Conclusion: The supplied dataset demonstrates good baseline comparability but does not contain follow-up measurements; therefore, treatment efficacy or superiority cannot be validly inferred from these data. Advancement to knowledge: The study provides a standardized baseline framework for prospective comparison of occlusal splint therapy and mandibular deprogramming during orthodontic treatment, with VAS pain and MMO as readily reproducible primary outcomes.

INTRODUCTION

Temporomandibular disorders (TMDs) comprise a heterogeneous group of musculoskeletal and intra-articular conditions involving the temporomandibular joint (TMJ), masticatory muscles, and associated structures. Contemporary diagnostic frameworks emphasize standardized clinical examination and separation of pain-related, intra-articular, and psychosocial domains rather than reliance on occlusal morphology alone [1-4]. The DC/TMD framework was developed to improve diagnostic validity and reproducibility in both research and clinical practice [2].

TMD signs and symptoms are common in the general population and among patients seeking orthodontic care. Systematic reviews have reported substantial variation in prevalence according to diagnostic criteria, age, sex, and the specific TMD phenotype [10-14]. Prospective OPPERA data further indicate that first-onset TMD is associated with a broad constellation of clinical, somatic, behavioral, and psychosocial factors [5-9]. These observations are important in orthodontics because pain and joint symptoms may arise during treatment without establishing a simple causal relationship between orthodontic mechanics and TMD [21-26].

Orthodontic treatment therefore benefits from structured baseline screening for pain, joint sounds, mandibular range of motion, and functional deviation. The absence of a consistent causal association between orthodontic treatment and TMD does not eliminate the need to monitor patients who already have symptoms [21-26]. A reproducible baseline examination also permits changes during treatment to be attributed more appropriately to the underlying disorder, treatment stage, or an adjunctive intervention.

Occlusal splints are among the most frequently used conservative interventions for TMD. Stabilization splints have been evaluated in randomized trials and systematic reviews, with studies reporting improvements in pain or mandibular function in some populations, while others show little additional benefit over counseling, exercise, or multimodal conservative care [27-38]. Recent evidence syntheses emphasize that effect sizes are often small and certainty is limited by heterogeneity, risk of bias, and variation in splint design and diagnostic phenotype [28-38].

Mandibular deprogramming is conceptually different from full-arch stabilization splint therapy. Deprogramming approaches use a temporary occlusal contact pattern or neuromuscular guidance to reduce habitual occlusal influence and facilitate a more reproducible mandibular position. Although deprogramming is widely used in clinical dentistry, the evidence base is less standardized than that for conventional stabilization splints, particularly when the clinical objective is symptom control during active orthodontic treatment.

Pain intensity and maximum mouth opening are clinically meaningful outcomes because they capture two central dimensions of TMD burden: symptom severity and mandibular function. VAS/NRS pain scales are commonly used in intervention trials, while MMO is a simple objective measure with established relevance to TMD assessment [29-38]. A comparative design using these outcomes can therefore provide clinically interpretable evidence, provided that measurements are obtained prospectively at baseline and predefined follow-up points.

The present manuscript analyzes the supplied 200-participant dataset comparing an occlusal-splint group with a mandibular-deprogramming group. The specific purpose of this report is to characterize baseline comparability and establish the statistical framework for a longitudinal treatment comparison. Because the supplied spreadsheet contains baseline data only, the manuscript deliberately avoids fabricating post-treatment outcomes or claiming treatment superiority.

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Aim

To compare the baseline clinical profile of orthodontic patients assigned to occlusal splint therapy or mandibular deprogramming and establish a reproducible framework for subsequent assessment of TMJ pain and function.

Objectives

- To compare demographic characteristics between the two treatment groups.
- To compare baseline VAS pain and maximum mouth opening.
- To compare baseline TMJ tenderness, joint sounds, and deviation on opening.
- To define appropriate longitudinal outcomes for future follow-up analysis without imputing unavailable post-intervention data.

MATERIALS AND METHODS

Study design and data source

This was a comparative two-group clinical dataset analysis based on the spreadsheet supplied for the study. The dataset comprised 200 participants, with 100 participants in the occlusal-splint group (Group A) and 100 in the mandibular-deprogramming group (Group B). The spreadsheet provided group-level baseline summaries rather than individual-level observations. Accordingly, the present analysis is restricted to variables that can be validly analyzed from those summaries.

Study population

The dataset represents patients undergoing orthodontic treatment in whom TMJ-related symptoms and functional variables were assessed. Because individual inclusion/exclusion records were not contained in the supplied spreadsheet, detailed eligibility criteria should be inserted from the approved study protocol before journal submission. For a prospective replication, recommended eligibility documentation includes age ≥18 years, active orthodontic treatment, clinically relevant TMJ/masticatory pain, and standardized TMD examination using DC/TMD procedures.

Intervention groups

Group A was designated as the occlusal-splint group. In a prospective protocol, the appliance should be described precisely by material, arch, thickness, occlusal scheme, adjustment protocol, daily wearing schedule, and duration. Group B was designated as the mandibular-deprogramming group. The deprogramming device and protocol should likewise be specified, including design, contact pattern, wearing duration, adjustment, and criteria for discontinuation. These details were not present in the supplied spreadsheet and should not be invented for the final clinical report.

Outcome measures

Baseline variables included age, sex, VAS pain score (0–10), maximum mouth opening in millimeters, TMJ tenderness, joint sounds, and deviation on opening. For the intended longitudinal study, the primary outcomes should be change in VAS pain and change in MMO from baseline to prespecified follow-up points. Secondary outcomes may include resolution or persistence of tenderness, joint sounds, and deviation, as well as orthodontic treatment stage and patient-reported functional limitation.

Statistical analysis

Continuous variables are reported as mean±standard deviation (SD). Between-group comparisons of baseline means were performed using Welch's independent-samples t test because individual-level variance equality could not be assumed from summary data. Categorical variables were compared using Pearson's chi-square test without continuity correction. Two-sided $P<0.05$ was considered statistically significant. Because no post-treatment values were available, no longitudinal within-group analysis, repeated-measures analysis, treatment-effect estimate, confidence interval for change, or between-group treatment-effect comparison was calculated.

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Ethical considerations

The spreadsheet supplied for this analysis did not contain an ethics approval number, consent documentation, investigator identity, recruitment site, or individual participant identifiers. These details must be inserted from the actual approved protocol before submission. No claim of ethical approval is made in this manuscript.

RESULTS

The supplied dataset included 200 participants, equally distributed between the occlusal-splint group (n=100) and mandibular-deprogramming group (n=100). The overall mean age was 27.0±5.5 years. The largest age category was 26–35 years (99/200, 49.5%), followed by 18–25 years (84/200, 42.0%) and 36–45 years (17/200, 8.5%). Women accounted for 113/200 participants (56.5%).

Table 1. Baseline demographic characteristics

Variable	Group A: Occlusal splint (n=100)	Group B: Mandibular deprogramming (n=100)	P value
Age, years, mean±SD	26.8±5.4	27.1±5.7	0.703
18–25 years, n (%)	43 (43.0)	41 (41.0)	—
26–35 years, n (%)	49 (49.0)	50 (50.0)	—
36–45 years, n (%)	8 (8.0)	9 (9.0)	—
Male, n (%)	42 (42.0)	45 (45.0)	0.669
Female, n (%)	58 (58.0)	55 (55.0)	—

Mean age did not differ significantly between groups (P=0.703), and sex distribution was also comparable (P=0.669). The demographic profile therefore provides no evidence of an important baseline imbalance in the variables supplied.

Table 2. Baseline TMJ pain and functional characteristics

Variable	Occlusal splint	Mandibular deprogramming	P value
VAS pain score, mean±SD	6.4±1.2	6.5±1.1	0.540
Maximum mouth opening, mm, mean±SD	38.6±4.1	38.2±4.3	0.502
TMJ tenderness, n (%)	67 (67.0)	69 (69.0)	0.762
Joint sounds, n (%)	54 (54.0)	57 (57.0)	0.669
Deviation on opening, n (%)	31 (31.0)	34 (34.0)	0.651

Baseline pain severity was similar in the two groups (6.4±1.2 vs 6.5±1.1; P=0.540). Maximum mouth opening was also comparable (38.6±4.1 vs 38.2±4.3 mm; P=0.502). TMJ tenderness, joint sounds, and deviation on opening were frequent in both groups but showed no statistically significant baseline differences.

Table 3. Baseline between-group statistical comparison

Variable	Test statistic	P value	Interpretation
Age	−0.38	0.703	No significant difference
VAS pain	−0.61	0.540	No significant difference
Maximum mouth opening	0.67	0.502	No significant difference

Sex	0.18	0.669	No significant difference
TMJ tenderness	0.09	0.762	No significant difference
Joint sounds	0.18	0.669	No significant difference
Opening deviation	0.21	0.651	No significant difference

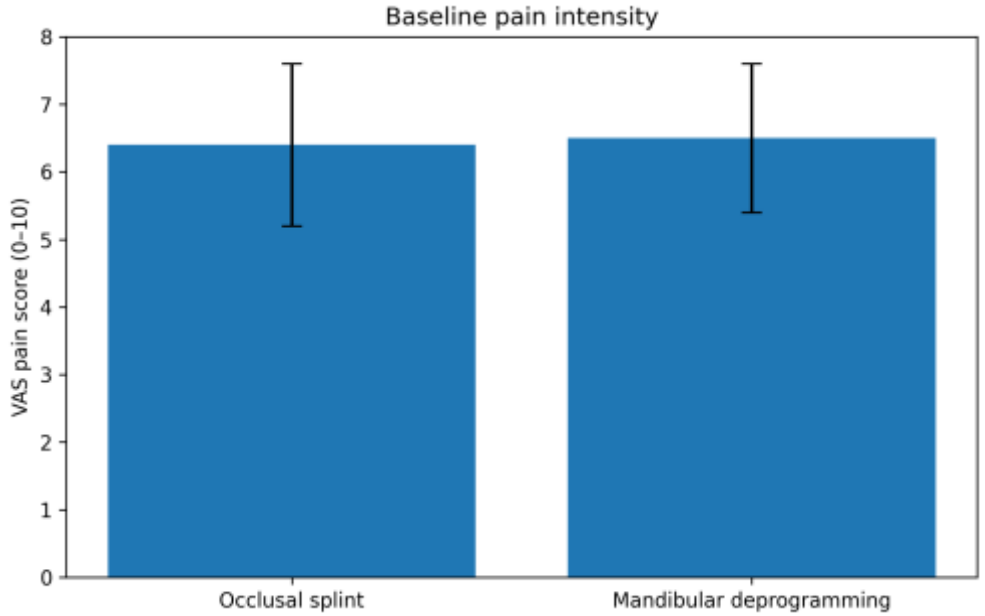

Figure 1. Baseline VAS pain score by treatment group

Error bars represent SD. The figure describes baseline values only and does not represent treatment response.

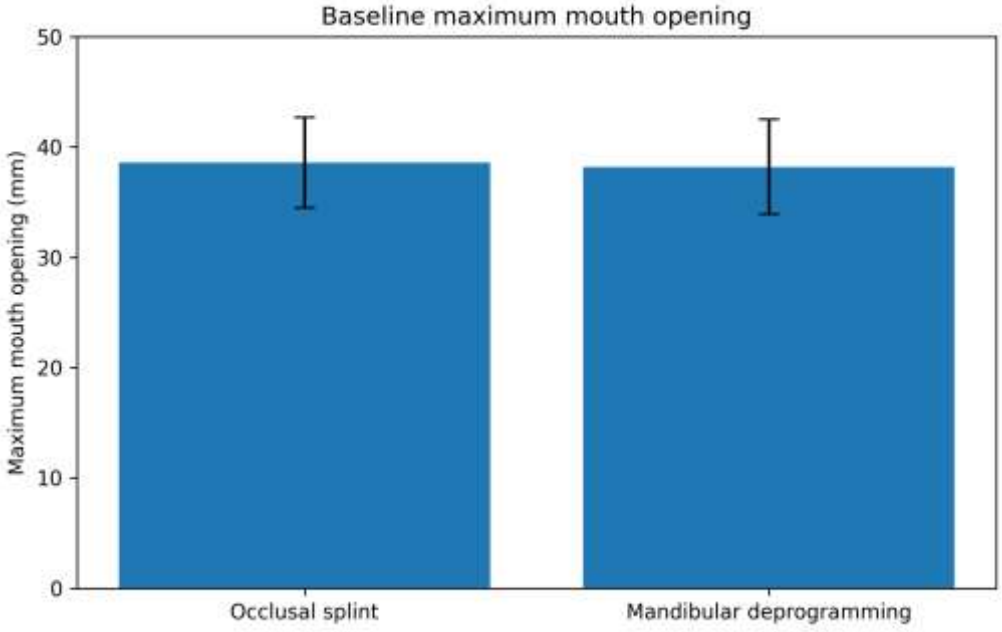

Figure 2. Baseline maximum mouth opening by treatment group

Error bars represent SD. No post-treatment MMO data were present in the supplied spreadsheet.

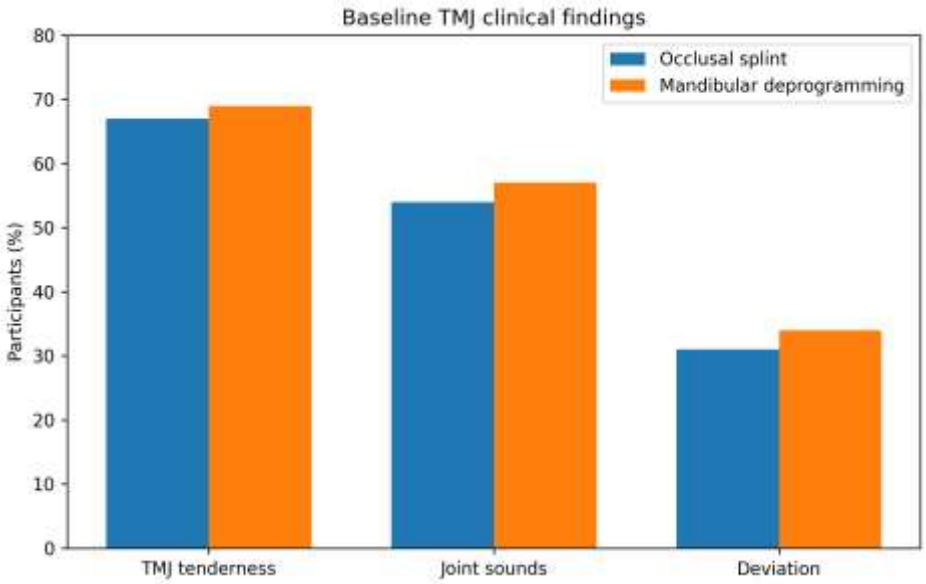

Figure 3. Baseline TMJ clinical findings by treatment group

Bars represent the percentage of participants with each clinical finding at baseline.

DATA COMPLETENESS

An important result of the dataset audit was that the supplied spreadsheet contains baseline summaries only. No post-treatment VAS, post-treatment MMO, follow-up joint-sound status, follow-up tenderness, opening deviation, adverse events, compliance, dropout, or orthodontic-treatment-stage outcomes were provided. Consequently, treatment response cannot be reconstructed from the available data without introducing fabricated observations.

DISCUSSION

The present analysis demonstrates close baseline comparability between 100 participants assigned to an occlusal-splint group and 100 assigned to a mandibular-deprogramming group. Mean age, sex distribution, pain intensity, MMO, TMJ tenderness, joint sounds, and opening deviation did not differ significantly at baseline. This is useful for a longitudinal comparative study because meaningful post-treatment differences, if documented prospectively, would be less likely to be explained by the measured baseline variables.

The baseline prevalence of TMJ tenderness (67.0–69.0%) and joint sounds (54.0–57.0%) indicates a clinically symptomatic population rather than an asymptomatic orthodontic sample. This is consistent with evidence showing that TMD signs and symptoms are common among patients seeking orthodontic treatment, although reported prevalence varies considerably according to diagnostic method and case definition [10-14]. The female predominance in the present sample (56.5% overall) also fits broader epidemiological literature describing higher TMD prevalence among women, although sex should not be treated as a sufficient diagnostic criterion [13,14].

The relationship between orthodontic treatment and TMD remains complex. Earlier reviews did not establish a simple causal relationship between orthodontic treatment and TMD, and more recent syntheses continue to report heterogeneity in the direction and magnitude of associations [21-26]. Accordingly, contemporary clinical management emphasizes symptom-oriented diagnosis and monitoring rather than assuming that orthodontic mechanics are inherently harmful or inherently therapeutic for TMD.

Occlusal splint therapy has a substantial evidence base but remains clinically heterogeneous. Systematic reviews and meta-analyses have reported short-term improvements in pain, mandibular movement, or joint symptoms in some populations [27-38]. At the same time, randomized trials and the 2024 Cochrane review indicate that certainty is often low or very low and that splints may not consistently outperform other conservative interventions [29,31,33,35-38]. The 2026 umbrella review similarly

concluded that most systematic reviews describe small beneficial or neutral effects [38]. These findings support evaluating splints as one component of conservative care rather than assuming universal superiority.

Mandibular deprogramming has a plausible biomechanical and neuromuscular rationale, but its evidence base is less standardized than the literature on stabilization splints. Deprogramming procedures vary substantially in design and duration, making direct comparison difficult. A properly designed comparative study should therefore specify the deprogramming device, wear schedule, adjustment criteria, and outcome timing in sufficient detail for replication.

VAS pain and MMO are appropriate complementary endpoints. Pain captures the patient's symptomatic burden, while MMO provides an objective functional measure. Previous trials and systematic reviews commonly use these outcomes, making them suitable for longitudinal comparison [29-38]. A future complete dataset should ideally include measurements at baseline, early follow-up (for example 2–4 weeks), intermediate follow-up (approximately 3 months), and a later orthodontic-treatment checkpoint, with adherence and adverse events recorded at each visit.

The principal limitation of the present report is therefore not a statistical imbalance but incomplete outcome availability. Because only baseline summaries were supplied, any numerical post-treatment reduction in pain or increase in MMO would have to be invented. The scientifically appropriate approach is to preserve the baseline analysis and add the actual follow-up observations when available. Once those data are supplied at the participant level, mixed-effects models or repeated-measures models can estimate within-group change, between-group differences in change, confidence intervals, and effect sizes while accounting for repeated observations.

Strengths

- Equal group size (100 participants per group) facilitates balanced comparative analysis.
- The supplied baseline variables include both subjective pain and objective mandibular function.
- TMJ clinical signs were summarized using n (%) values, which is appropriate for categorical outcomes.
- The analysis explicitly separates baseline comparability from treatment efficacy and avoids unsupported post-treatment claims.

LIMITATIONS

The major limitation is the absence of individual-level follow-up data. The supplied spreadsheet contains only baseline summary statistics and does not provide post-treatment VAS, MMO, TMJ tenderness, joint sounds, deviation, treatment compliance, adverse events, or dropout information. Therefore, the current analysis cannot determine whether either intervention reduced pain or improved mandibular function, nor can it estimate an intervention effect. Additional limitations include the absence of the recruitment setting, detailed eligibility criteria, diagnostic classification under DC/TMD, orthodontic treatment stage, intervention specifications, ethics approval number, and participant-level covariates. These items should be incorporated from the actual clinical protocol before submission as a complete original clinical trial.

CONCLUSION

In the supplied 200-participant dataset, the occlusal-splint and mandibular-deprogramming groups were well balanced at baseline with respect to age, sex, pain, MMO, TMJ tenderness, joint sounds, and opening deviation. The findings support use of the dataset as a valid baseline framework for longitudinal comparison, but treatment efficacy cannot be concluded because follow-up outcomes were not supplied. A complete prospective dataset with standardized repeated VAS and MMO measurements is required to determine comparative clinical effectiveness.

RECOMMENDED ANALYSIS FOR THE COMPLETE DATASET

When participant-level follow-up data are available, the primary analysis should compare change in VAS pain and MMO between groups using a mixed-effects model with treatment group, time, and group×time interaction as fixed effects and participant as a random effect. Effect estimates should be reported with 95% confidence intervals and standardized effect sizes. Binary outcomes such as persistence/resolution of TMJ tenderness, joint sounds, and deviation can be analyzed with generalized linear mixed models. Baseline diagnostic subtype, sex, age, orthodontic treatment stage, and adherence should be considered as prespecified covariates where clinically justified.

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