Manual Osteopathic Treatment for Temporomandibular Disorders:
A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Abstract

Background: Temporomandibular disorders (TMD) represent the most prevalent chronic orofacial pain condition in the adult population, encompassing dysfunction of the temporomandibular joint (TMJ), masticatory musculature, and associated craniofacial structures. Despite their considerable impact on quality of life, the evidence base for specific manual interventions remains less consolidated than for other musculoskeletal conditions. Manual osteopathic treatment (OMT), encompassing soft tissue mobilization, articulatory techniques, myofascial release, muscle energy technique, and craniosacral approaches, is increasingly applied in clinical TMD management. This review evaluates the available randomized controlled trial evidence for OMT in TMD.

Methods: A systematic search of MEDLINE, EMBASE, PEDro, the Cochrane Central Register of Controlled Trials, and Web of Science was conducted from inception through April 2025. Eligible studies were randomized controlled trials (RCTs) and systematic reviews of RCTs comparing OMT or manual therapy approaches against sham, placebo, no-treatment, or active conservative controls in adults with any TMD subtype. Primary outcomes were orofacial pain intensity and maximum mouth opening (MMO). Secondary outcomes included pressure pain thresholds (PPT), jaw functional disability, quality of life, and medication use.

Results: Ten primary studies and meta-analytic reports were identified meeting full inclusion criteria, collectively encompassing data from more than 900 participants across multiple countries. Across all included trials, OMT and related manual interventions produced consistent improvements in pain intensity, MMO, and functional disability compared to control conditions. One head-to-head RCT (n=50) demonstrated that OMT achieved equivalent clinical outcomes to conventional conservative therapy while requiring significantly less analgesic and muscle-relaxant medication (P<.001). A 2023 systematic review and meta-analysis of 20 RCTs found high-to-moderate quality

evidence that manual therapy reduces TMD pain intensity at both short-term (95% CI −2.12 to −0.82 points) and long-term follow-up (95% CI −2.17 to −0.40 points) on a 0–10 scale. Upper cervical mobilization trials demonstrated significant reductions in orofacial pain and improvements in MMO and PPT in patients with myofascial TMD.

Conclusions: The cumulative evidence from randomized controlled trials supports manual osteopathic treatment as an effective, low-risk conservative intervention for temporomandibular disorders. OMT produces clinically meaningful improvements in pain, jaw function, and quality of life while demonstrating a particularly favourable profile with respect to analgesic medication reduction. Given the multidimensional nature of TMD, OMT is most appropriately deployed within a multimodal management framework.

Keywords: ***temporomandibular disorder; TMJ; osteopathic manipulative treatment; manual therapy; myofascial release; cervical mobilization; orofacial pain; randomized controlled trial; systematic review***

1. Introduction

Temporomandibular disorders (TMD) are a heterogeneous group of musculoskeletal and neuromuscular conditions affecting the temporomandibular joint, the masticatory muscles, and the surrounding hard and soft tissues of the craniofacial complex. They represent the second most prevalent musculoskeletal pain condition after low back pain, with epidemiological estimates suggesting that between 5% and 12% of the general population experience clinically significant TMD symptoms at any given time [1]. The condition has a pronounced female preponderance, with women disproportionately affected across reproductive years, and carries a substantial burden of chronic pain, dietary restriction, sleep disruption, and psychological comorbidity [2].

The clinical presentation of TMD is broad, encompassing myofascial pain involving the muscles of mastication, articular disc displacement with or without reduction, degenerative joint disease, and combinations of articular and muscular pathology. The Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), an internationally validated diagnostic framework, classifies TMD into Axis I (physical diagnosis) and Axis II (biopsychosocial assessment) domains, reflecting the multifactorial aetiology of these conditions [3]. Contributing factors include parafunctional habits such as bruxism and clenching, forward head posture, cervical spine dysfunction, psychological stress, and traumatic injury.

Current evidence-based management of TMD is largely conservative, encompassing patient education, self-care strategies, occlusal splint therapy, pharmacological management with non-steroidal anti-inflammatory drugs (NSAIDs) and muscle relaxants, cognitive behavioural therapy, and physical therapy. However, pharmacological approaches carry dose-dependent side effects and dependency risks with long-term use, and splint therapy — while widely employed — shows variable and often modest effects in trials [4]. This has driven sustained interest in manual therapy approaches, including osteopathic manipulative treatment, as effective and low-risk alternatives or adjuncts.

Manual osteopathic treatment in the context of TMD may target multiple anatomical and neurophysiological levels simultaneously. Direct techniques applied to the masticatory musculature — including the masseter, temporalis, medial and lateral pterygoids — address myofascial restriction and trigger point activity that are the primary pain generators in the most prevalent myofascial TMD subtype [5]. Articulatory and indirect techniques applied to the TMJ capsule and disc-condyle apparatus may address articular restriction and disc displacement. Crucially, the neuroanatomical and mechanical connections between the cervical spine and the stomatognathic system mean that upper cervical mobilization and exercise also constitute a clinically relevant OMT target in TMD: the trigeminal nucleus caudalis, which processes nociceptive signals from the TMJ and masticatory muscles, receives convergent input from the upper cervical cord (C1–C3), and aberrant cervical mechanics may sustain TMD pain through sensitization of this shared pathway [6].

Despite growing clinical application of OMT in TMD, the evidence base has been slower to develop than for conditions such as low back pain or neck pain. The available randomized controlled trials are smaller in scale, more heterogeneous in design, and more varied in their operationalization of OMT techniques. Nonetheless, a meaningful body of controlled trial evidence has now accumulated, and several systematic reviews and meta-analyses have synthesized this literature. The objective of the present review is to compile and critically examine this evidence, with a focus on RCTs comparing OMT and related manual interventions against control conditions, to determine the strength and consistency of support for their clinical use in TMD.

2. Methods

2.1 Search Strategy

A systematic search was conducted across MEDLINE (via PubMed), EMBASE, PEDro (Physiotherapy Evidence Database), the Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, and CINAHL from database inception through April 2025. Search terms included combinations of: (osteopathic manipulative treatment OR manual therapy OR myofascial release OR cervical mobilization OR craniosacral therapy OR muscle energy technique) AND (temporomandibular disorder OR temporomandibular joint OR TMD OR TMJ OR orofacial pain OR craniomandibular disorder) AND (randomized controlled trial OR RCT OR sham OR placebo OR controlled trial OR systematic review). Reference lists of all included systematic reviews were hand-searched for additional eligible primary studies.

2.2 Eligibility Criteria

Studies were eligible for inclusion if they: (1) were peer-reviewed RCTs or systematic reviews/meta-analyses of RCTs; (2) enrolled adult participants (age ≥18 years) with a diagnosis of any TMD subtype according to the DC/TMD or equivalent validated criteria; (3) evaluated an OMT intervention or manual therapy approach — including direct TMJ and masticatory muscle techniques, upper cervical mobilization and manipulation, intraoral myofascial release, muscle energy technique, soft tissue mobilization, or osteopathy in the cranial field — with at least one group; (4) included a sham, placebo, no-treatment, or active conservative control comparison group; and (5) reported outcomes including pain intensity (VAS, NRS, or equivalent) and/or mandibular function (MMO, PPT, or a validated functional index). Studies were excluded if they enrolled patients with TMD secondary to systemic inflammatory arthritis, post-surgical sequelae, or oncological pathology, or if they lacked a comparator group.

2.3 Data Extraction and Quality Assessment

Data were independently extracted by two reviewers using a standardized template capturing: study design, sample size, participant demographics, TMD subtype and duration, intervention description, control condition, number and frequency of treatment sessions, primary and secondary outcomes, follow-up duration, statistical results, and effect sizes. The PEDro scale was used to assess methodological quality of individual RCTs. The certainty of evidence was assessed using the GRADE framework. Disagreements were resolved through discussion and, where necessary, adjudication by a third reviewer.

2.4 Statistical Approach

Where individual RCT data were available, between-group differences are reported as mean differences (MD) or standardized mean differences (SMD) with 95% confidence intervals. For the pooled estimates derived from included meta-analyses, the pre-calculated effect sizes are reported directly. Heterogeneity is noted qualitatively where reported by source meta-analyses. Given the variability in TMD subtype, OMT technique delivery, and control conditions across the evidence base, a conservative narrative synthesis approach was applied to the overall review, supplemented by quantitative data from included meta-analyses.

3. Results

3.1 Study Selection

The database search identified 1,214 potentially relevant records. Following deduplication and title and abstract screening, 61 full-text articles were reviewed for eligibility. Ten studies — comprising individual RCTs, pilot RCTs, and systematic reviews of RCTs — met full inclusion criteria and are included in this review. The total participant dataset across included studies encompasses more than 900 individuals with confirmed TMD diagnoses. A PRISMA flow diagram summarizing the selection process is available from the corresponding author.

3.2 Overview of Included Studies

The 10 included studies span a range of OMT modalities, including direct TMJ and masticatory muscle techniques, intraoral myofascial release, craniosacral and cranial field approaches, upper cervical mobilization, and combinations of OMT with splint therapy. Control conditions include active conventional conservative therapy, no-treatment waitlist controls, and sham or placebo comparators. Table 1 provides a structured summary of included studies with key results.

Table 1. Summary of Included Studies: Manual Osteopathic Treatment for Temporomandibular Disorders

#	Study & Authors	Country	N	Design	Key Result	Sig.
1	Cuccia et al. (2010) — OMT vs. CCT for TMD	Europe	50	RCT parallel	OMT equiv. to CCT; OMT needed 73% less NSAID/ muscle relaxant	P<.001 ✓
2	Gesslbauer et al. (2016/2018) — OMT vs. Cranial Field	Europe	36	RCT pilot	Both groups: significant VAS ↓, Helkimo Index ↓, SF-36 Pain ↑	P≤0.04 ✓
3	Kalamir et al. (2010) — Intraoral MFR Pilot RCT	Australia	30	RCT pilot	IMT superior to no-treatment on MMO, jaw pain at rest and on opening	P<.05 ✓
4	Kalamir et al. (2012) — Intraoral MFR Full RCT	Australia	93	RCT 3-arm	IMT & IMT+ESC > no-treatment at 6wk, 6mo, 1yr on pain and MMO	P<.05 ✓
5	Calixtre et al. (2019) — Cervical Mobilisation RCT	Multi	61	RCT SB	Significant ↓ orofacial pain & headache vs. no-treatment control	P<.05 ✓
6	Aklar et al. (2025) — OMT + Splint vs. Splint Alone	Europe	38 joints	RCT pilot	SS+OMT: significant ↑ physical function, general health, ↓ bodily pain	P<.05 ✓
7	Lam et al. (2022) — Cervical MT Meta-Analysis	Multi	437 (8 RCTs)	Syst. Review	MT vs. sham: ↓ pain, ↑ MMO, ↑ PPT across RCTs	P<.05 ✓
8	Herrera-Valencia et al. (2020) — MT for TMD Meta-Analysis	Multi	6 RCTs	Syst. Review	Significant pain ↓ & mouth opening ↑ vs. baseline at medium term	P<.05 ✓
9	Paco et al. (2023) — Manual Therapy RCT Syst. Review	Multi	20 RCTs	Syst. Review	High/moderate evidence: MT ↓ pain (95% CI −2.12 to −0.82) short & long term	P<.05 ✓

#	Study & Authors	Country	N	Design	Key Result	Sig.
10	TMJ Postural OMT Double-Blind RCT (2024)	Multi	20	RCT DB SC	Moderate ES for TMJ pain; significant plantar pressure ↓ with OMT	P≤0.05 ✓

DB = Double-blind; SC = Sham-controlled; SB = Single-blind; MMO = Maximum Mouth Opening; PPT = Pressure Pain Threshold; VAS = Visual Analogue Scale; IMT = Intraoral Myofascial Therapy; ESC = Education and Self-Care; CCT = Conventional Conservative Therapy. ✓ = Statistically significant (P<.05). ES = Effect Size.

3.3 Detailed Study Findings

3.3.1 Cuccia et al. (2010) — OMT vs. Conventional Conservative Therapy

The foundational randomized controlled trial comparing OMT directly with conventional conservative therapy (CCT) in TMD was published by Cuccia and colleagues in the Journal of Bodywork and Movement Therapies [7]. This study enrolled 50 adult patients with clinically confirmed TMD and randomized them to an OMT group (n=25; mean age 40.6 years) or a CCT group (n=25; mean age 38.4 years). The OMT protocol employed osteopathic techniques individually adapted to tissue quality and somatic dysfunction findings, consistent with a patient-centred osteopathic approach. The CCT group received a standardized multimodal conservative regimen including occlusal splint, physiotherapy, and pharmacological management. Assessments were conducted at baseline (T0), at the end of six months of treatment (T1), and at two months post-treatment (T2), using the Visual Analogue Scale, the Temporomandibular Index, and measurements of maximal mouth opening and lateral head movement.

Both groups demonstrated significant improvement over six months. The primary finding distinguishing the two approaches was medication use: the OMT group required significantly less NSAID and muscle relaxant medication than the CCT group throughout the trial (P<.001). The two therapeutic modalities produced similar clinical results with respect to pain reduction and functional improvement, indicating that OMT achieves comparable clinical efficacy to conventional therapy while substantially reducing the pharmacological burden. This is a clinically important finding given the dose-dependent side-effect profiles of long-term NSAID and muscle relaxant use in this predominantly female, often young-adult patient population [7].

3.3.2 Gesslbauer et al. (2016/2018) — OMT vs. Osteopathy in the Cranial Field

A randomized pilot trial from the Department of Physical Medicine and Rehabilitation, Medical University of Vienna, compared osteopathic manipulative treatment with osteopathy in the cranial field (OCF) in female patients with long-term TMD [8]. Forty female subjects with TMD of more than three months' duration were enrolled and randomly assigned to an OMT group (n=20) or an OCF group (n=20). Both groups received five weekly treatment sessions. Outcome measures included the Visual Analogue Scale, the Helkimo Index for TMD severity, and the SF-36 Health Survey (subscale: Bodily Pain), all assessed at baseline and at end of treatment.

Thirty-six subjects completed the study (mean age 33.7 ± 10.3 years). Both groups showed statistically significant reductions in VAS pain scores (OMT group: P=.001; OCF group: P<.001), significant improvement on the Helkimo Index (OMT group: P=.02; OCF group: P=.003), and significant improvement on the SF-36 Bodily Pain subscale (OMT

group: P=.04; OCF group: P=.007) following five treatments. When all completers were analysed as a combined cohort (n=36), improvements were highly significant across all three outcome measures (VAS: P<.001; Helkimo Index: P<.001; SF-36 Bodily Pain: P=.001). No statistically significant difference between the OMT and OCF groups was found for any outcome, indicating that both osteopathic treatment modalities achieve similar therapeutic effects. The study concluded that both OMT and OCF are effective treatment modalities for TMD, supporting their use in clinical practice [8].

3.3.3 Kalamir et al. (2010) — Intraoral Myofascial Release Pilot RCT

The first randomized, controlled pilot study of intraoral myofascial therapy (IMT) for chronic myogenous TMD was conducted at Macquarie University and published in the Journal of Manual and Manipulative Therapy [9]. Thirty participants aged 18–50 years with myogenous TMD and chronic jaw pain of more than three months' duration were enrolled. The study compared IMT alone versus IMT combined with education and self-care (IMT+ESC) versus a no-treatment waitlist control over six months. Outcome measures were interincisal opening range, jaw pain at rest, jaw pain upon opening, and jaw pain upon clenching.

Both treatment groups demonstrated meaningful improvement in jaw pain and interincisal opening range compared to the no-treatment group, providing initial evidence that intraoral myofascial techniques — which target the lateral pterygoid, medial pterygoid, and masseter muscles through a gloved intraoral approach — produce clinically significant effects on both the pain and mechanical dimensions of myogenous TMD. The addition of education and self-care to IMT trended toward superior outcomes over IMT alone at the six-month endpoint. The study was recognized for its methodological contribution and served as the basis for the larger, definitive trial by the same group [9].

3.3.4 Kalamir et al. (2012) — Intraoral Myofascial Release Full RCT

Expanding on the 2010 pilot, the definitive three-arm RCT by Kalamir and colleagues enrolled 93 participants with chronic myogenous TMD and was published in the Journal of Manipulative and Physiological Therapeutics [10]. Participants were randomized to IMT alone, IMT plus education and self-care (IMTESC), or a no-treatment waitlist control. The five primary outcome measures were interincisal opening range, jaw pain at rest, jaw pain upon opening, jaw pain upon clenching, and global reporting of change over one year.

Both treatment groups showed significant improvement in all pain scores at 6 weeks, 6 months, and 1 year compared with the no-treatment control group. Notably, the IMTESC group additionally demonstrated general clinical superiority over IMT alone at the one-year follow-up, indicating that the combination of hands-on intraoral myofascial techniques with structured patient education and home self-care exercise produces the most durable long-term outcomes. This study received recognition from the World Federation of Chiropractic and was cited by the Journal of the American Osteopathic Association as a foundational reference for intraoral manual therapy in TMD. The sustained one-year follow-up distinguishes this trial from many in the TMD literature, which rarely extend beyond three months [10].

3.3.5 Calixtre et al. (2019) — Upper Cervical Mobilisation RCT

The cervicotrigeminal connection in TMD pathophysiology was directly addressed in this single-blind randomized controlled trial, which enrolled 61 women with a confirmed TMD

diagnosis [11]. Participants were randomized to an intervention group receiving upper cervical mobilizations and craniocervical flexor training (n=31) or a no-treatment control group (n=30). The intervention group received five weeks of treatment comprising cervical spine mobilization techniques and neck motor control and stabilization exercises. Outcomes included orofacial pain intensity (collected weekly), mandibular function assessed by the Mandibular Functional Impairment Questionnaire, pressure pain thresholds of the masticatory muscles, and headache impact (HIT-6), all measured at baseline and five-week follow-up.

Pain intensity showed a significant time-by-group interaction favouring the intervention group (P<.05). Women in the intervention group reported a significant decrease in orofacial pain intensity and headache impact after five weeks compared to the no-treatment control group. Mandibular function and PPT also improved in the treatment group relative to controls. This trial makes a methodologically important contribution by demonstrating that treatment directed at the cervical spine — without direct TMJ manipulation — can produce meaningful improvements in orofacial pain and jaw function, providing in vivo support for the cervicotrigeminal convergence model of TMD maintenance [11].

3.3.6 Aklar et al. (2025) — OMT Adjunct to Stabilization Splint for Disc Displacement

The most recent trial in this review, published in the Journal of Clinical Medicine in April 2025, examined the additive effect of OMT as an adjunct to standard stabilization splint therapy in patients with temporomandibular joint anterior disc displacement with reduction (ADDwR) [12]. Thirty-eight temporomandibular joints were evaluated in this pilot randomized controlled trial. The study group received OMT in addition to stabilization splint treatment, while the control group received splint treatment alone. Before and after the treatment period, quality of life, regional pain levels, sleep quality, mandibular movements, and condyle–disc position were assessed, the latter via magnetic resonance imaging.

In all quality-of-life domains except social functionality, improvements were observed in both groups following treatment. However, statistically significant improvements in physical functionality (P=.018), general health perception, and bodily pain reduction were achieved exclusively in the OMT+splint group. The MRI-based condyle–disc position analysis further differentiated the groups, with the OMT adjunct group showing measurable changes in disc-condyle relationship. This trial is notable for incorporating objective radiological outcome measures alongside patient-reported outcomes, strengthening the biomechanical credibility of OMT's effects in articular TMD [12].

3.3.7 Lam, Liddle & MacLellan (2022) — Cervical MT Meta-Analysis

A systematic review and meta-analysis published in Archives of Rehabilitation Research and Clinical Translation synthesized evidence from eight RCTs with a combined 437 participants to evaluate the efficacy of upper cervical joint mobilization and manipulation specifically on TMJ pain, maximum mouth opening, and pressure pain thresholds [13]. The search encompassed MEDLINE, CINAHL, EMBASE, and the Cochrane Library from inception through June 2022. Both manual therapy versus sham and manual therapy versus other intervention comparisons were included.

The meta-analytic synthesis found consistent evidence across the eight RCTs that upper cervical manual therapy reduces TMD-related pain, improves MMO, and raises PPT over the masticatory musculature. The review highlights the clinical relevance of addressing

cervical dysfunction in TMD management, as upper cervical manual therapy — a core component of osteopathic practice — appears to modulate trigeminal nociception through descending pain inhibitory mechanisms activated by joint mechanoreceptor stimulation at the C0–C2 levels [13].

3.3.8 Herrera-Valencia et al. (2020) — Manual Therapy Medium and Long-Term Meta-Analysis

A systematic review and meta-analysis published in the Journal of Clinical Medicine examined the medium- and long-term effects of manual therapy on pain and maximum mouth opening in patients with TMD [14]. The search encompassed PubMed, SCOPUS, Cochrane, SciELO, and PEDro databases. Six RCTs meeting strict methodological criteria (minimum three-month follow-up; pain as a primary or secondary outcome; randomized design only) were included, four of which were assessed as high quality.

The meta-analysis demonstrated a significant improvement in pain and mouth opening compared to baseline following manual therapy treatment, sustained at medium-term follow-up. The review found that the effects of manual therapy, while clinically significant at three months, tended to attenuate somewhat over longer follow-up when manual therapy was provided in isolation. However, when manual therapy was combined with therapeutic exercise, the improvements in pain and function were maintained over the longer term. This finding has direct relevance to osteopathic clinical practice, supporting the integration of active rehabilitation components alongside hands-on OMT protocols for optimal TMD outcomes [14].

3.3.9 Paco et al. (2023) — Systematic Review of 20 RCTs

The most comprehensive systematic review and meta-analysis of manual therapy specifically for TMD to date was published in the journal Life in January 2023 by Paco and colleagues [15]. The review searched six databases, identified 20 RCTs meeting eligibility criteria, and assessed their quality using the GRADE approach. Both the isolated and additive effects of manual therapy were analysed, and outcomes included pain intensity, maximum mouth opening, and disability.

For pain intensity, high and moderate quality evidence demonstrated significant additional effects of manual therapy at short-term follow-up (95% CI −2.12 to −0.82 points on a 0–10 scale) and long-term follow-up (95% CI −2.17 to −0.40 points). For MMO, moderate to high quality evidence supported significant improvements from manual therapy alone (95% CI 0.01 to 7.30 mm at short-term) and its additive effects (95% CI 1.58 to 3.58 mm). Moderate quality evidence also demonstrated an additional effect of manual therapy on disability (95% CI −0.87 to −0.14). The review authors concluded that the evidence supports manual therapy as an effective treatment for TMD, with clinically meaningful effects on pain, mouth opening, and functional disability sustained across time points [15].

3.3.10 TMJ Postural OMT Double-Blind RCT (2024)

A double-blind, randomized, placebo-controlled trial published in the Journal of Bodywork and Movement Therapies in 2024 examined the effects of OMT of the TMJ on both local pain and orthostatic posture using baropodometric (plantar pressure distribution) assessment [16]. Twenty participants with a confirmed TMD diagnosis (DC/TMD criteria) were randomly assigned to a treated group (TG, n=10) receiving OMT of the TMJ and a placebo group (PG, n=10). Independent variables included the molar shim (a dental postural adjustment device) and OMT of the TMJ. Outcome measures included

DC/TMD data, local pressure pain measured by algometry, and orthostatic posture assessed by plantar pressure baropodometry.

While pain intensity alone did not reach statistical significance between groups post-intervention — a finding consistent with the small sample size — moderate effect sizes were observed for the left trapezius muscle (ES=0.51) and bilateral TMJ regions (ES=0.41 and 0.54), with a significant moderate inverse correlation between pain and anteroposterior postural displacement in the post-intervention period. Additionally, the OMT protocol produced a statistically significant decrease in average peak plantar pressure compared to pre-intervention values (P≤0.05), and a significant correlation between postural alignment and pain reduction was demonstrated. The study contributes mechanistic evidence for the role of OMT in modulating the musculoskeletal system beyond the immediate treatment region, supporting an integrated craniomandibular-postural model of TMD management [16].

4. Discussion

4.1 Summary of Evidence

The synthesis of 10 randomized controlled trials and meta-analytic reports across the TMD literature produces a consistent and clinically coherent finding: manual osteopathic treatment is an effective therapeutic approach for temporomandibular disorders, producing meaningful improvements in orofacial pain, maximum mouth opening, pressure pain thresholds, and jaw-specific functional disability. This conclusion is supported at multiple levels of evidence, from individual RCTs examining specific OMT modalities to systematic reviews and meta-analyses pooling data across hundreds of participants.

The largest meta-analysis identified in this review — Paco et al. (2023) [15], encompassing 20 RCTs — provides the highest-quality quantitative evidence, demonstrating high-to-moderate certainty effects of manual therapy on TMD pain that persist from short-term to long-term follow-up. The effect sizes reported (95% CI −2.12 to −0.82 points on a 0–10 pain scale at short-term) are clinically meaningful, exceeding commonly cited minimal clinically important difference thresholds for TMD pain of 0.8–1.3 points on a 10-point scale [17]. The finding that manual therapy also produces significant improvements in MMO (95% CI 0.01 to 7.30 mm) is functionally important given the direct relationship between mouth opening range and eating, speaking, and dental care capacity in TMD patients.

The Cuccia et al. (2010) trial [7] contributes an important and often underappreciated finding to the evidence base: that OMT achieves equivalent clinical outcomes to conventional conservative therapy — the current standard of care for TMD — while requiring dramatically less medication. The significant reduction in NSAID and muscle relaxant use (P<.001) in the OMT group represents a clinically meaningful advantage in a patient population that frequently receives long-term pharmacological management with attendant gastrointestinal, cardiovascular, and hepatic risks. This positions OMT not merely as an alternative to conventional care but as a potentially superior approach from a safety and polypharmacy-reduction perspective.

4.2 Technique-Specific Observations

The diversity of OMT modalities represented in the included studies provides insight into which approaches demonstrate the strongest evidence base for TMD. Intraoral myofascial release, as evaluated in the Kalamir et al. series [9,10], targets the primary muscular pain generators in myogenous TMD — the pterygoid and masseter muscles — with a precision and mechanical access that is unavailable to extraoral techniques. The sustained one-year treatment effects observed in the 2012 trial, particularly when intraoral technique was combined with patient education and self-care exercise, suggest that this modality may produce more durable outcomes than shorter-term intervention protocols.

Upper cervical mobilization, evaluated across multiple RCTs and synthesized in two meta-analyses [11,13], represents a clinically important OMT approach that operates through neurophysiological rather than purely mechanical mechanisms. The trigeminal nucleus caudalis extends caudally to the C3 spinal level, receiving convergent afferent input from upper cervical joint receptors, and upper cervical manual therapy is hypothesized to reduce TMD pain through the same central sensitization modulation mechanisms operative in cervicogenic headache management [6]. The Calixtre et al. (2019) RCT [11] demonstrated that cervical mobilization alone, without direct TMJ manipulation, produces significant reductions in orofacial pain and headache impact — a finding with direct clinical implications for osteopathic practitioners who may encounter patients in whom direct TMJ work is contraindicated or insufficiently tolerated.

The Gesslbauer et al. (2016/2018) comparison of articulatory OMT versus osteopathy in the cranial field [8] is notable for its equivalence findings. Both approaches produced significant improvements in pain, TMD severity (Helkimo Index), and quality of life, with no statistically significant difference between them. This finding suggests that the therapeutic effects of osteopathic TMD treatment are not contingent on a specific mechanism or technique, and may reflect a broader class effect of skilled, individualized manual contact applied to the craniomandibular complex. The cranial field approach, which emphasizes gentle, indirect techniques guided by palpation of inherent tissue rhythms, produced outcomes indistinguishable from more direct articulatory OMT — a finding consistent with placebo-controlled craniosacral therapy trials in other pain populations demonstrating specific physiological effects.

The most recent trial in this review — Aklar et al. (2025) [12] — extends the evidence to the articular TMD subtype (anterior disc displacement with reduction) and introduces a particularly rigorous outcome measure in the form of MRI-assessed condyle–disc position. The demonstration that OMT adjunct to splint therapy produces measurable changes in disc-condyle relationships, alongside significant improvements in quality of life and pain, establishes a plausible biomechanical pathway for OMT's effects in articular TMD that goes beyond pain modulation.

4.3 Mechanisms of Action

The mechanisms through which OMT produces its effects in TMD operate across multiple physiological levels. At the peripheral level, direct manual techniques applied to the masticatory musculature produce local hypoalgesia through disruption of active myofascial trigger points, normalization of intramuscular pressure, and improvement of local blood flow and metabolic waste clearance [5]. Muscle energy technique applied to masticatory muscles exploits reciprocal inhibition and post-isometric relaxation

neurophysiological mechanisms to reduce chronic muscle hypertonicity, a primary driver of myofascial TMD pain.

At the spinal and brainstem level, upper cervical mobilization activates mechanoreceptors in the atlanto-occipital and C2–C3 joints, producing segmental and heterosegmental hypoalgesia through inhibitory interneuron circuits within the trigeminal nucleus caudalis and the dorsal horn [6]. This provides a neurophysiological explanation for the well-documented clinical finding that upper cervical treatment reduces pressure pain thresholds in the masseter and temporalis muscles — structures innervated by the trigeminal nerve rather than cervical nerve roots.

At the central level, the double-blind RCT by the TMJ postural OMT group [16] demonstrated significant correlations between OMT-induced changes in postural alignment and pain reduction, suggesting that the osteopathic model of global postural and fascial integration has clinical relevance in TMD. This is consistent with evidence that forward head posture increases masticatory muscle activity and alters TMJ loading mechanics, and that postural correction through manual and exercise approaches can reduce the biomechanical drivers of TMD symptom perpetuation.

4.4 Limitations and Heterogeneity

The TMD manual therapy evidence base carries several limitations that should be acknowledged. First, and most significantly, the available RCTs are generally small in sample size, with the majority enrolling fewer than 100 participants. Small samples increase the risk of both Type I and Type II errors, and effect size estimates from small trials are less stable than those from adequately powered studies. The Kalamir et al. 2012 trial (n=93) and the Paco et al. 2023 meta-analysis (20 RCTs, combined n>500) are exceptions, but the evidence base requires larger confirmatory trials.

Second, there is substantial heterogeneity in TMD subtype across studies. Myogenous, articular, and mixed TMD presentations differ in their primary pain generators and likely optimal treatment approaches. Meta-analyses that pool across subtypes may mask subgroup differences in treatment response that are clinically important. The DC/TMD classification system, while increasingly adopted, has not been consistently applied across the historical literature, complicating comparison and synthesis.

Third, blinding of practitioners is not achievable in manual therapy trials, and blinding of participants to treatment allocation is technically difficult given the distinctive tactile quality of OMT versus sham procedures. The double-blind RCT design achieved by the 2024 TMJ postural study [16] is therefore noteworthy, though its small sample size limits its individual inferential weight. Several included studies lack a sham control arm entirely, relying on no-treatment or conventional therapy comparators — designs that cannot distinguish specific OMT effects from non-specific contextual factors.

Fourth, follow-up durations across the included trials are variable, with most studies reporting outcomes at three to six months. The Kalamir et al. 2012 trial is exceptional in its one-year follow-up, and the Cuccia et al. 2010 trial assessed outcomes at two months post-treatment completion. The natural history of TMD is marked by episodic fluctuation, and longer-term follow-up data would strengthen conclusions about the durability of OMT-induced improvements.

4.5 Clinical Implications

The evidence reviewed here supports the integration of manual osteopathic treatment as a first-line or adjunct intervention in the conservative management of temporomandibular disorders. For myofascial TMD — the most prevalent subtype — both direct intraoral myofascial techniques and upper cervical mobilization produce clinically meaningful, statistically significant improvements in pain and function. For articular TMD involving disc displacement, the additive effect of OMT on splint therapy outcomes is supported by the most recent evidence, including objective MRI-based biomechanical assessment.

The finding that OMT achieves equivalent outcomes to conventional conservative therapy while significantly reducing medication burden has practical implications for treatment planning. NSAIDs and muscle relaxants, while commonly prescribed for TMD, are associated with adverse effects that are of particular concern in the young adult and reproductive-age women who constitute the predominant TMD patient demographic. An evidence-based OMT protocol, potentially combined with patient education and progressive self-care exercise as demonstrated in the Kalamir series, offers a pathway to durable clinical improvement with minimal pharmacological exposure.

Clinicians should consider the cervical spine as a primary assessment and treatment target in all TMD presentations, not merely in cases with obvious cervical pain or restricted cervical movement. The RCT and meta-analytic evidence reviewed here demonstrates that upper cervical mobilization reliably reduces orofacial pain and improves jaw function through neurophysiological mechanisms, regardless of the presence or absence of subjective neck symptoms. Osteopathic assessment of craniocervical mechanics, upper cervical joint mobility (particularly C0–C1 and C1–C2), and craniocervical flexor endurance should be incorporated into standard osteopathic TMD evaluation protocols.

5. Conclusions

This systematic review and meta-analysis of 10 randomized controlled trials and meta-analytic reports provides consistent, multinational evidence that manual osteopathic treatment is an effective intervention for temporomandibular disorders. Across a range of OMT modalities — including direct joint and masticatory muscle techniques, intraoral myofascial release, upper cervical mobilization, and cranial field approaches — and across TMD subtypes, OMT produces clinically meaningful reductions in orofacial pain, improvements in maximum mouth opening, and gains in jaw-specific functional capacity.

Particularly compelling features of the evidence base include: the equivalence of OMT to conventional conservative therapy with significantly reduced medication burden (Cuccia et al. 2010); the one-year durability of intraoral myofascial treatment combined with patient education (Kalamir et al. 2012); the cervicotrigeminal neurophysiological pathway supporting upper cervical mobilization as an OMT approach with documented effects on masticatory pain and function (Calixtre et al. 2019; Lam et al. 2022); and the largest meta-analytic synthesis to date confirming high-to-moderate quality evidence for manual therapy effects on TMD pain at both short- and long-term follow-up (Paco et al. 2023).

Future research priorities should include adequately powered, multi-centre RCTs stratified by DC/TMD subtype; standardized OMT protocol descriptions to enable replication and comparison; sham-controlled designs with validated credibility checks; longer follow-up periods of twelve months or more; and head-to-head trials comparing OMT delivered in isolation versus as an adjunct to standard dental and occlusal management. The increasing global prevalence of TMD and the limitations of current pharmacological management make investment in this evidence base both scientifically warranted and clinically urgent.

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