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Original Article

Diagnosis and treatment of temporomandibular disorders: Systematic review & Meta analysis

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ABSTRACT:

Introduction: In the present study we aim to conduct the systemic review and the meta analysis of the diagnosis and treatment of temporomandibular disorders. **Material and methods**: A Electronic searching of Pubmed, ScienceDirect and institute library databases to identify studies reporting the diagnosis and treatment of temporomandibular disorders. **Results**: Twenty one SAs were finalized. Ten SRs were related to occlusal appliances, occlusal adjustment or bruxism; eight to physical therapy; seven to pharmacologic treatment; four to TMJ and maxillofacial surgery; and six to behavioural therapy and multimodal treatment. The overall inter-reliability agreement of the two authors in assessing the quality of the SRs was 0.70 and free-marginal kappa 0.67. **Conclusion**: We can conclude that in alleviating TMD pain: occlusal appliances, acupuncture, behavioural therapy, jaw exercises, postural training, and some pharmacological treatments are effective. Evidence for the effect of electro- physical modalities and surgery is insufficient, and occlusal adjustment seems to have no effect.

Keywords: Systematic Review, Diagnosis, Treatment, Temporomandibular Disorders

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INTRODUCTION

Studies report that nearly 10–15% have temporomandibular disorders (TMD) pain and 5% a perceived need for treatment. Few studies show that persistent and recurrent pain has a potential impact on daily life – mainly in the areas of psychological discomfort, physical disability, and functional limitations – that leads to limitations in quality of life (1-5). Systematic reviews (SRs) are a cornerstone in evidence-based medicine. An SR may have a qualitative approach if data from the primary studies are presented descriptively or a quantitative approach if statistical analysis has combined data in a meta-analysis. Of the over 24 instruments that have been developed to assess SR quality, one recent instrument deserves mention: assessment of multiple systematic reviews (AMSTAR). This tool comprises 11 items and has good face and content validity for measuring methodological quality.

Hence in the present study we aim to conduct the systemic review and the meta analysis of the diagnosis and treatment of temporomandibular

disorders.

MATERIAL AND METHODS

A comprehensive search of the literature was undertaken. This included electronic searching of the Pubmed, ScienceDirect and institution library. Keywords used in the electronic searches were Systematic Review, Diagnosis, Treatment, Temporomandibular Disorders.

Full-text versions of all the remaining after duplicate removal, potentially eligible studies were retrieved, and three independent reviewers evaluated the articles for compliance with the selection criteria. The investigators independently evaluated the methodological quality of each identified SR using AMSTAR and level of research design (LRD) scoring. The following data were extracted: study design, diagnosis, number of patients, types of intervention, outcome measures, results, quality score, and author's conclusion.

RESULTS

A total of Twenty one studies were finalized for the meta analysis.(1-21) The most common diagnosis in the SRs was TMD, more specific TMD diagnoses such as disc displacements and myofascial pain were seen. Two SRs focused on bruxism. Although it is in the TMD domain, bruxism differs from other TMD diagnoses: although it may be accompanied by pain, bruxism is not related to pain in many cases. The number of patients were 1245. The pain reduction was the primary outcome others included jaw movement and tenderness ⁄ pain on palpation, and psychological status, daily activities, or quality of life. **Table 1**

The treatment was done by occlusal appliances, occlusal adjustment, non-occluding splints, stabilisation splints and anterior positioning and soft splints, various physical like acupuncture, jaw exercises, manual therapy and various forms of electrical therapy.

The pharmacological treatment was considered in few studies that included along with the placebo, NSAIDS, clonazepam or diazepam, antidepressants, and hyaluronate. Three SRs evaluated surgical treatment of the TMJ in patients with disc displacements and one SR orthognathic surgery in patients with TMD. In patients with disc displacements with reduction, one SR reported similar treatment effects for arthrocentesis, arthroscopy, and discectomy. In patients with disc displacement without reduction, one SR reported similar effect for arthrocentesis, arthroscopy, and physical therapy. The cognitive behavioural therapy (CBT) or relaxation (two SRs). **Table 1** The overall inter-reliability agreement of the two authors in assessing the quality of the SRs was 0.70 and free-marginal kappa 0.67. **Figure 1**

Figure 1: Percentage of same primary study cited in one or more of the different systematic reviews, for each treatment area

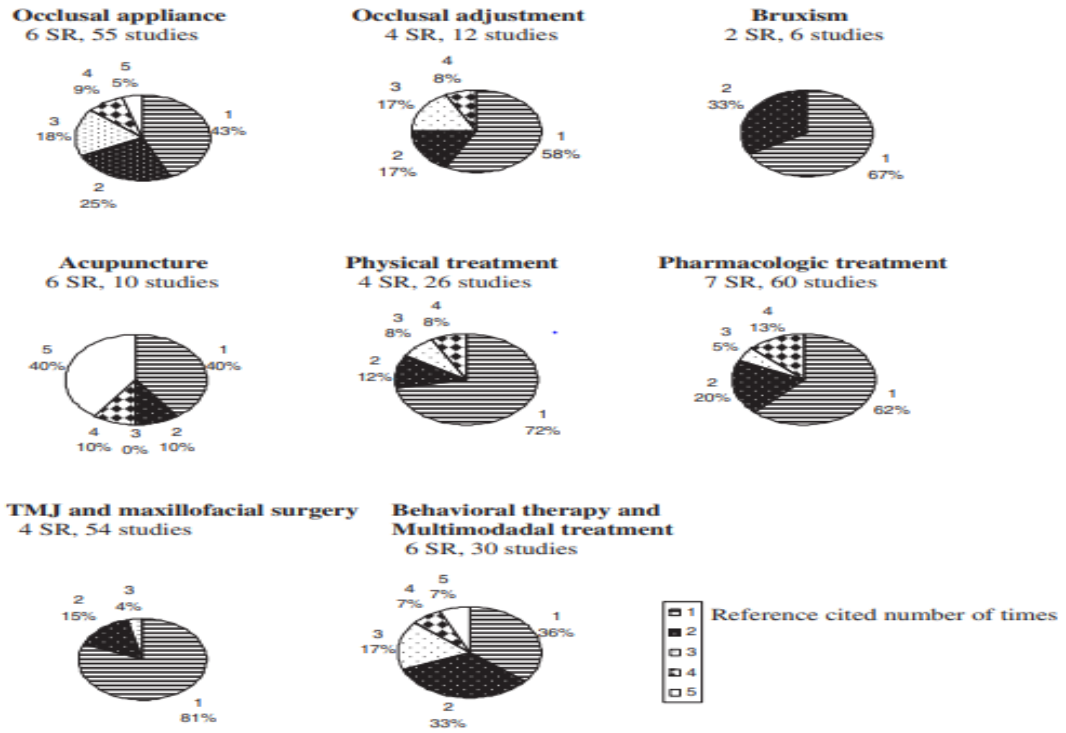

Table 1: Study characteristics and various interventions employed

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Santacatterina A 1998 (25)	SR and Meta-analysis of 6 RCTs Disc displacement with reduction 212 patients	I1: Occlusal appliance I2: repositioning splint	Pain reduction TMJ click	I2 better than I1 for pain reduction and TMJ click.	AMSTAR 2 LRD II-IV	A: A comparison between the two kinds of treatment has demonstrated that the repositioning splint is more effective both in the resolution of the articular click and in the resolution of the pain ($P < 0{\cdot}001$). R: Methodological weaknesses of primary studies such as heterogeneous patient material, outcome measures not clearly defined, and three of the studies were not RCTs.
Al-Ani MZ 2003 (19)	Qualitative SR of 12 RCTs Myofascial pain 496 patients	I1: Occlusal appliance C1: Other treatment (biofeedback, jaw exercises, acupuncture) C2: No treatment C3: Placebo	Pain reduction Jaw motion	I1 no better than C1 I1 somewhat better than C2 I1 no better than C3	AMSTAR 6 LRD II	A: There is insufficient evidence either for *or* against the use of stabilisation splint therapy over other active interventions for the treatment of temporomandibular myofascial pain. However, it appears that stabilisation splint therapy may be beneficial for reducing pain severity at rest and on palpation and depression when compared to no treatment. R: Included studies were small. Patient material was heterogeneous. Outcome measures varied between studies. Short-term follow-up. Exclusion, inclusion, and diagnostic criteria not clearly defined.
Forssell H 2004 (20)	Qualitative SR of 20 RCTs TMD 1138 patients	I1: Occlusal appliance I2: Occlusal adjustment C1: Other treatment (biofeedback, jaw exercises, acupuncture) C2: No treatment C3: Placebo	Pain reduction Global improvement Clinical examination Depression scale	Contradictory results for I1 compared with C1–C3 I2 no better than C1 or C2	AMSTAR 7 LRD II	A: Occlusal splints yielded equivocal results. Even for the most studied area, stabilisation splints for myofascial pain, the results do not justify definite conclusions about the efficacy of splint therapy. Their clinical effectiveness to relieve pain also seems modest when compared with treatment methods in general. None of the occlusal adjustment studies provided evidence supporting the use of this treatment method. R: Included studies small, often not blinded, heterogeneity concerning outcome measures and control treatment.
van't Spijker A 2007 (28)	Qualitative SR of 33 studies 2 studies related to Intervention because of bruxism. 1 RCT and 1 case series. 27 patients	I1: Occlusal appliance C1: no treatment	Attrition	I1 reduces attrition compared with C1.	AMSTAR 6 LRD II-IV	A: One study was prospective and reported less attrition in young children wearing bite plates compared with subjects who did not wear devices. In a case series of patients with severe attrition, occlusal splints were found to slow down the rate of tooth wear. R: Small studies, methodological weaknesses in primary studies. The results seem to confirm clinical experience.
Türp JC 2004 (21)	Qualitative SR of 9 RCTs Myofascial pain 482 patients	I1: Intra-oral appliance C1: Other treatment including placebo C2: No treatment	Pain reduction Clinical examination Depression scale	I1 better than C2 I1 no better than C1	AMSTAR 6 LRD II	A: Based on the currently best available evidence, it appears that most patients with masticatory muscle pain are helped by incorporation of a stabilisation splint. A stabilisation splint does not appear to yield a better clinical outcome than a soft splint, a non-occluding palatal splint, physical therapy, or acupuncture. R: Well-conducted SR. Limitations: small patient studies, outcome measures vary between studies, no long-term results.
Fricton J 2006 (22)	Qualitative SR of 39 RCTs TMD patients*	I1: Stabilisation splint I2: Anterior positioning and soft splints C1: Placebo C2: Other treatment	Pain reduction	No difference between I1 and I2. I1 and C2 have similar effects I2, I1, and C1 have similar effects	AMSTAR 4 LRD II	A: Stabilisation splints can reduce TMD pain compared to placebo splints. Stabilisation splints are equally effective in reducing pain compared to physical therapy, acupuncture and behavioural therapy in the short term. The long-term effects of behavioural therapy may be better than splints in reducing symptoms in more severe patients with psychosocial problems. R: The article is an overview and separate articles are under publishing with details regarding methods and results.
SBU 2006 (23)	Qualitative SR of 3 SRs and 3 RCTs TMD 2299 patients	I1: Stabilisation splint I2: Occlusal adjustment C1: Placebo C2: Other treatments C3: No treatment	Pain reduction Clinical examination Depression scale	I1 better than C3 I1 and C2 have similar effect Results of I1 compared with C1 are contradictory I2 and C1 have similar effect	AMSTAR 6 LRD I–II	A: Occlusal appliances gave better pain reduction than no treatment. Treatment with occlusal appliance had similar effect as other therapies whereas the effect compared with placebo was contradictory. No study found occlusal adjustment to be effective compared to a control. R: Reviewers and authors are identical persons

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Stapelman H 2008 (24)	Qualitative SR of 5 RCTs TMD Bruxism Tension-type headache (TTH) Migraine 190 patients	I1: NTI splint C1: Flat occlusal splint C2: Bleaching tray	EMG activity Polysomnographic evaluation Pain intensity Jaw opening Comfort Analgesic consumption	Reducing EMG activity: I1 more effective than C1 Improvement in pain reduction: results for I1 compared with C1 are contradictory Treating TTH and migraine: I1 more effective than C2 Five reports of complications or side-effects reported for I1	AMSTAR 7 LRD II	A: NTI-tss devices may be successfully used to manage bruxism and TMDs. To avoid potential unwanted effects, it should be chosen only if a patient will be compliant with follow-up. Two of five studies focused on treatment of TMD. Overall, small groups, median of 14 participants in each group. As adverse events were reported for I1, and I1 was not more effective than C1, only limited indication is warranted. R: Well-conducted SR. Limitations are small studies. Methodological weaknesses in primary studies such as heterogeneity concerning outcome measures and diagnostic criteria.
Koh H 2009 (26)	SR and meta-analysis of 6 RCTs TMD 392 patients	I1: Occlusal adjustment C1: Placebo, no treatment or reassurance	Global symptoms Relief of headache Quality of life	No difference between I1 and C1	AMSTAR 10 LRD II	A: There is an absence of evidence, from RCTs, that occlusal adjustment treats or prevents TMD. Occlusal adjustment cannot be recommended for management or prevention of TMD. R: Small studies, diagnostic criteria inaccurate. Outcome measures poorly defined.
Marcedo CR 2009 (27)	SR and meta-analysis of 5 RCTs Bruxism 63 patients	I1: Occlusal splint I2: Other appliances I3: Other therapies C1: No treatment	Sleep variables: e.g. EMG activity, arousal index Report of bruxism by partner Tooth wear	No difference between I1 and I2 in the meta-analysis of arousal index. No difference between I1 and C1 for tooth wear facets No difference between I1 and I3 for TMD pain	AMSTAR 9 LRD II	A: There is not sufficient evidence to state that the occlusal splint is effective for treating sleep bruxism. Indication of its use is questionable concerning sleep outcomes, but it may be that there are some benefits concerning tooth wear. R: Small studies, methodological weaknesses in primary studies

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Ernst E 1999 (29)	Qualitative SR of 6 RCTs TMD 205 patients	I1: Acupuncture C1: Occlusal appliance C2: No treatment	Pain Intensity Daily activity Global improvement Clinical examination	I1 better than C2 No difference between I1 and C1	AMSTAR 5 LRD II	A: Although all studies agree with the notion that acupuncture is effective for TMD, this hypothesis requires confirmation through more rigorous investigations. R: Short follow-up time in two studies. One study reports a 1-year follow-up. No reported side-effects. SR based on three studies with low quality.
Jedel E 2003 (30)	Qualitative SR of 7 RCTs TMD 379 patients	I1: Biofeedback I2: Acupuncture I3: TENS C1: No treatment C2: Other treatment	Self-reported symptoms Pain intensity Clinical examination	No evidence of an effect for any treatment mode	AMSTAR 3 LRD II	A: The studies were heterogeneous with low quality, and therefore it is not possible to draw any conclusions. R: Limitations in the SR methodology and therefore difficult to draw any conclusions
Rosted P 1998 (31)	Qualitative SR of 15 RCTs (7 RCTs on TMD) Acute toothache TMD patients*	I1: Acupuncture C1: Other treatment	Pain intensity	No difference between I1 and C1	AMSTRAR 4 LRD II-IV	A: Acupuncture and conventional treatment were found to have similar effect. The effect in treating TMD and facial pain seems real, and acupuncture could be an alternative to conventional treatment. R: Non-RCTs were included in the evaluation. Methodology and results not clearly described.
SBU 2006 (23)	Qualitative SR of 3 SRs and 1 RCT TMD 575 patients	I1: Acupuncture C1: Placebo acupuncture C2: Other treatment C3: No treatment	Pain intensity Daily activities Global improvement Clinical examination	I1 better than C3 I1 and C2 have similar effect I1 and C1 have contradictory results	AMSTAR 6 LRD I–II	A: Acupuncture was found to show better pain reduction than no treatment and similar effect compared to other treatments. Compared to placebo, the results are contradictory. R: Reviewers and authors are identical persons
SBU 2006 (23)	Qualitative SR of 6 RCTs TMD 279 patients	I1: Jaw exercises I2: Pulsed radio frequency therapy I3: Laser I4: Pulsed electromagnetic fields I5: Postural correction C1: Minimal information C2: Placebo C3: No treatment	Pain intensity Daily activities Clinical examination	I1 better than C1 I1–I4 no different from C2 I5 better than C3	AMSTAR 6 LRD I–II	A: The evidence to draw any conclusions regarding physical treatment for TMD is insufficient because the studies are heterogeneous regarding diagnosis and treatment method. R: Some of the studies showed a difference compared with controls. Because these findings were not supported by more studies, there is lack of evidence. Reviewers and authors are identical persons

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Fink M 2006 (32)	Qualitative SR of 6 RCTs TMD 223 patients	I1: Acupuncture C1: Sham acupuncture C2: Other treatment C3: No treatment	Pain intensity Global improvement Daily activities Clinical examination Pain thresholds	I1 and C2 have similar effects No difference between I1 and C1	AMSTAR 7 LRD II	A: The analysed studies on acupuncture in the treatment of TMD confirm acupuncture to be as effective as conservative treatment. R: Short follow-up time in three studies. One study reports a 1-year follow-up. No reported side-effects. SR based on three studies with low and one with high quality.
McNeely M 2006 (33)	Qualitative SR of 12 RCTs TMD 480 patients	I1: Exercise and manual therapy I2: Acupuncture I3: Electrophysical modalities (PRFE, TENS, biofeedback, laser) C1: Other therapies C2: Placebo	Pain reduction Jaw mobility	No synthesis of results	AMSTAR 7 LRD II	A: The results support use of active and passive oral exercises and exercises to improve posture as effective interventions to reduce symptoms associated with TMD. There is inadequate information to either support or refute use of acupuncture in TMD treatment. There is no evidence to support use of electrophysical modalities to reduce TMD pain. R: Methodological weaknesses of primary studies such as diagnostic criteria of TMD, outcome measures and chosen controls limit conclusions in the study.
Medlicott MS 2006 (34)	Qualitative SR of 24 RCTs and 6 uncontrolled studies TMD 1071 patients	I1: Exercise I2: Manual therapy I3: Electrotherapy (ultrasound, TENS, laser, PRFE) I4: Relaxation training and education C1: Occlusal splint C2: Placebo C3: Waiting-list	Pain intensity Global improvement Clinical examination Jaw mobility Pressure pain threshold	No synthesis of results	AMSTAR 5 LRD II-IV	A: Active exercise and manual mobilisation may be effective. Postural training may be used in combination with other interventions, as independent effects of postural training are unknown. Mid-laser therapy may be more effective than other electrotherapy modalities. Programmes involving relaxation techniques and biofeedback, electromyographic training, and proprioceptive re-education may be more effective than placebo treatment or occlusal splints. Combinations of active exercise, manual therapy, postural correction, and relaxation techniques may be effective. R: Because of the heterogeneous population and to differences in diagnosis and outcome measures, it not possible to draw any clear conclusions from this SR.

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Sommer C 2002 (35)	Qualitative SR of 27 RCTs TMD, trigeminal neuralgia, atypical facial pain 931 patients	I1: Carbamazepin, baclofen, lamotrigine I2: Clonazepam, Diazepam I3: Amitriptyline C1: Placebo	Pain reduction >50%	Trigeminal neuralgia: I1 significantly better than C1 TMD: moderate evidence that I2 and I3 are better than C1 Atypical facial pain: a moderate effect of I3 compared with C1	AMSTAR 4 LRD II	A: Apart from studies on trigeminal neuralgia, there is little evidence for pharmacotherapy in oro-facial pain. R: Some of the studies showed a difference compared with controls. Limitations in the primary studies were small groups, heterogeneous outcome measures, and no long-term follow-up.
List T 2003 (36)	Qualitative SR of 11 RCTs TMD, atypical facial pain, burning mouth syndrome 368 patients	I1: Analgesics I2: Antidepressants I3: Benzodiazepines I4: Miscellaneous (corticosteroids, sodium hyaluronate, sumatriptan, cocaine) C1: Placebo	Pain reduction Global improvement Depression scale	TMD and atypical facial pain: few studies found better effect of I1-I4 compared with C1 Burning mouth: I2 = C1	AMSTAR 7 LRD II	A: The common use of analgesics in TMD, AFP, and BMS is not supported by scientific evidence. R: The studies are too heterogeneous to draw any conclusions from.
SBU 2006 (23)	Qualitative SR of 1 SR and 13 RCTs TMD, atypical facial pain, burning mouth syndrome 968 patients	I1: Analgesics I2: Antidepressants I3: Benzodiazepines I4: Miscellaneous (corticosteroids, sodium hyaluronate, sumatriptan, capsaicin, botulinum toxin) C1: Placebo	Pain reduction	TMD and atypical facial pain: few studies found better effect of I1–I4 compared with C1 For burning mouth, I = C1	AMSTAR 6 LRD I–II	A: Studies on pharmacological treatment of TMD, atypical facial pain, and burning mouth syndrome report contradictory results. No conclusions can be drawn as the studies are heterogeneous regarding diagnosis and treatment method. R: Reviewers and authors are identical persons

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Shi ZC 2009 (37)	SR and meta-analysis of 7 RCTs TMD, rheumatoid arthritis 364 patients	I1: Hyaluronate I2: Hyaluronate + Arthroscopy/lavage C1: Placebo C2: Glycocorticoid C3: Arthroscopy/lavage	Symptoms (e.g. pain, Clinical examination Adverse events	Long-term effects favour I1 compared to C1 I1 had the same long-term effects on symptoms and clinical signs compared to C2 Comparing I1 to C3, results were inconsistent	AMSTAR 11 LRD II	A: There is insufficient consistent evidence to support or refute the use of hyaluronate for treating patients with TMD. R: Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study.
Al-Muharraqi MA 2009 (38)	SR and meta-analysis of RCTs No studies included Masseter hypertrophy 0 patients	I1: Botulinum toxin C1: Placebo	Self-reported facial appearance Pain and discomfort	167 references were retrieved, but none matched the inclusion criteria.	AMSTAR 7 LRD II	A: No randomised trial on the efficacy of intra-muscular injections of botulinum toxin with bilateral benign masseter hypertrophy was identified. R: No trend of the effect can be drawn because all studies were excluded.
Cascos-Romero J 2009 (39)	Qualitative SR of 1 SR, 1 RCT and 1 case–control study TMD patients*	I1: Antidepressants C1: Placebo	Pain	I1 better than C1	AMSTAR 4 LRD I–III	A: The use of tricyclic antidepressants for the treatment of TMD is recommended. R: Synthesis of results from primary studies are missing, and therefore, because of limitations in the SR, it is difficult to draw any conclusions.
Ihde S 2007 (40)	Qualitative SR of 1 RCT and 10 case series TMD Bruxism Masseter hypertrophy Oro-mandibular dystonia 402 patients	I1: Botulinum toxin C1 Placebo	Pain reduction Jaw opening Functional improvement Aesthetic result	I1 better than C1 for reducing pain based on one RCT. No synthesis of results.	AMSTAR 3 LRD II-IV	A: Botulinum toxin appears relative safe and effective in treating chronic facial pain associated with masticatory hyperactivity. R: Methodological limitations in the SR. Results only relate to one RCT study. Synthesis of results missing so a conclusion of the effect of Botulinum toxin is difficult to determine

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Reston JT 2003 (41)	SR and meta-analysis of 30 studies (3 RCTs and 27 uncontrolled studies) Disc displacement with reduction, Disc displacement without reduction 1463 patients	I1: Arthrocentesis I2: Arthroscopy I3: Disc repair/repositioning I4: Discectomy	Pain reduction Global improvement Jaw mobility	Disc displacement with reduction: I2 and I3 comparable results Disc displacement without reduction: Similar results for I1, I2, and I3	AMSTAR 4 LRD II–IV (most studies, level IV)	A: Surgical treatment appears to provide some benefit to patients refractory to non-surgical therapies. The most reliable evidence supports the effectiveness of arthrocentesis and arthroscopy for patients with disc displacement with reduction. R: Methodological weaknesses of primary studies such as heterogeneous patient material, outcome measures not clearly defined, and majority of the studies were not RCTs.
Kropmans TJ 1999 (42)	Qualitative SR of 24 studies (6 RCTs and 6 case–control and 12 uncontrolled studies) Disc displacement without reduction 4916 patients	I1: Arthroscopy I2: Arthrocentesis I3: Physical therapy (e.g. exercise, massage, TENS) C1: Placebo C2: No treatment	Pain intensity Jaw function Jaw mobility	No synthesis of results presented	AMSTAR 2 LRD II–IV	A: No distinguishing effects on jaw mobility, jaw function, or pain intensity was seen between arthroscopic surgery, arthrocentesis, and physical therapy in patients with permanent temporomandibular joint disc displacement. R: Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study. A majority of the studies are LRD level IV, and therefore, it not possible to draw any clear conclusions from this SR.
Abrahamsson C 2007 (44)	Qualitative SR of 3 case–control studies 280 patients	I1: Bilateral sagittal split and/or Le Fort I osteotomy C1: No treatment	Self-report of symptoms Clinical examination	Contradictory results in signs and symptoms	AMSTAR 8 LRD III	A: Because of few studies with unambiguous results and heterogeneity in study design, the scientific evidence was insufficient to evaluate the effects that orthognathic surgery had on TMD. R: Well-designed SR. Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study.

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Al-Belasy FA 2007 (43)	Qualitative SR of 19 Studies (2 RCTs and 6 case–control and 11 uncontrolled studies) Anchored disc phenomenon, Disc displacement with or without reduction, capsulitis/ synovitis. 571 patients	I1: Arthrocentesis C1: Not specified	Pain intensity Jaw mobility Clinical examination	Overall success varied between 60% -100%. No comparison between I1 and C1.	AMSTAR 2 LRD II-IV	A: The majority of the reviewed publications were prospective case series with flawed methodology and, despite the impression that arthrocentesis may be beneficial for patients with TMJ closed lock, there have been no good prospective randomised clinical trial confirm the efficacy of the procedure. R: The overall success rate was high from the primary studies. The results are difficult to interpret because of methodological weaknesses of primary studies such as diagnostic criteria of TMD, outcome measures, missing analysis between Intervention and control treatment in the studies. In addition, a majority of the studies patients received complementary pharmacologic or conservative treatment besides lavage. The majority of the studies are LRD level IV, and therefore, it not possible to draw any clear conclusions from this SR.

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
Crider AB 1999 (45)	SR and meta-analysis of 13 RCTs and un-controlled studies TMD patients*	I1: Electromyographic biofeedback C1: Active control C2: No treatment or placebo	Pain reduction Clinical signs of dysfunction Global assessment	Pain reduction and clinical signs: I1 better than C1 and C2	AMSTAR 4 LRD II-IV	A: Although limited in extent, the available data support the efficacy of EMG biofeedback treatments for TMD. R: Methodological weaknesses of primary studies such as heterogeneous patient material, outcome measures not clearly defined, and several studies were not RCTs.
Jedel E 2003 (30)	Qualitative SR of 7 RCTs TMD 379 patients	I1: Biofeedback I2: Acupuncture I3: TENS C1: No treatment C2: Other treatment	Self-reported symptoms Pain intensity Clinical examination	No evidence of an effect for any treatment mode	AMSTAR 3 LRD II	A: The studies were heterogeneous with low quality, and therefore, it is not possible to draw any conclusions. R: Limitations in the SR methodology and therefore difficult to draw any conclusions
Crider AB 2005 (46)	Qualitative SR of 6 RCTs TMD 449 patients	I1: Biofeedback training I2: Biofeedback training + CBT I3: Biofeedback-assisted relaxation training I4: Alternative treatment C1: Sham treatment C2: No treatment	Pain intensity Global improvement Limitation in jaw function Depression Clinical examination	I1 was superior to C1 in one of two RCTs I2 was significantly better than C2 and I4 I3 was better than C2 I3 was better than I4 in one of two RCTs	AMSTAR 3 LRD II–III	A: Biofeedback training with adjunctive CBT was reported to be an efficacious treatment for TMD; both biofeedback training as the sole intervention and biofeedback-assisted relaxation training are probably efficacious treatments. R: Small studies, no long-term follow-up. Methodological limitations in SR.
SBU (23)	Qualitative SR of 2 SRs and 6 RCTs TMD XX patients	I1: CBT I2: Biofeedback I3: Education I4: Education + home instruction C1: Brief information C2. No treatment C3: Conventional treatment	Pan intensity Daily activities Depression Sleep quality	I1 was better than C1 and C3 I2 was better than £2 I3 was similar to I4	AMSTAR 6 LRD I–II	A: Behavioural treatment such as biofeedback and CBT have better effect than no treatment. R: Reviewers and authors are identical persons

Authors, year, reference	Study design, diagnosis, and no. of patients	Intervention (I) and control (C) groups	Outcome measures	Results	Quality score	Authors' (A) conclusions Reviewers' (R) comments
McNeely M 2006 (33)	Qualitative SR of 4 RCTs TMD 207 patients	I1: CBT I2: Biofeedback I3: Relaxation C1: Occlusal splint C2: No treatment	Pain reduction Jaw mobility	Pain reduction: I1 better than C2 I2 similar effect to C1 I2 and I3 similar effect	AMSTAR 7 LRD II	A: Programmes involving relaxation techniques and biofeedback, electromyographic training, and proprioceptive re-education may be more effective than placebo treatment or occlusal splints. R: Studies had small numbers of participants and outcome measures were poorly defined, so it is difficult to draw any conclusions.
Türp J 2007 (47)	Qualitative SR of 11 RCTs TMD: Disc displacement without reduction, with pain TMD pain, without major psychological symptoms TMD pain, with major psychological symptoms 895 patients	I1: Simple treatment I2: Multimodal treatment	Pain intensity Graded Chronic Pain Scale Analgesic consumption Psychologic status Pain threshold	Disc displacement without reduction with pain: I1 = I2. TMD pain, without major psychological symptoms: I1 = I2 TMD pain, with major psychological symptoms: I2 better than I1.	AMSTAR 4 LRD II	A: Current research suggests that individuals without major psychological symptoms do not require more than simple therapy. In contrast, patients with major psychological involvement need multimodal, interdisciplinary therapeutic strategies. R: Methodological weaknesses of primary studies such as diagnostic criteria of TMD, poor description of how the treatment was conducted, and outcome measures in the study

DISCUSSION

From our study there were inconsistencies in several SRs concerning diagnosis. Temporomandibular disorders were inconsistently defined in the primary studies. Comparable results were reported for radiographic findings in TMD. The classification that has been found to provide acceptable reliability and validity and is commonly used in TMD research is the research diagnostic criteria for temporomandibular disorders (RDC ⁄ TMD). The future challenge is to convince researchers to use the diagnostic system with the best evidence – acceptable sensitivity and specificity. In future, the ability to synthesize the results of several primary studies would allow more accurate assessment of treatment efficacy and treatment effectiveness.

QUALITY ASSESSMENT

In this SR, AMSTAR scores ranged from 2 to 11. Synthesizing evidence from several SRs can also be a tool for validation of this kind of meta-research.

OCCLUSAL APPLIANCES, OCCLUSAL ADJUSTMENT, AND BRUXISM

Several of the SRs decided that management of TMD with a stabilisation splint worn at night is likely to lead to short-term improvement when compared with no treatment, but is inconclusive compared with placebo (non-occluding palatinal splint). The major concern with adverse events has been related to partial non-occluding splints such as the NTI, where the design of the splint may contribute to tooth pain and occlusal changes.

One SR evaluated the use of splints in bruxism, that was assessed as number of bruxism episodes per hour [electromyographic (EMG) activity] and episodes with grinding noises. The SR found no significant differences between occlusal splints, no treatment, and palatinal splints. Small sample size was one explanation for the lack of significance between outcomes that the authors of the SR emphasised (3). It should also be emphasised that some primary studies, particularly those that use polysomnographic registration, are technically very difficult to conduct on large patient samples. One SR examined tooth attrition related to bruxism, and based on two small studies, found that occlusal appliances retarded wear.

PHYSICAL THERAPY

Most SRs found evidence that acupuncture is better than no treatment and comparable to other forms of conservative treatment. Next to information, patient education, and occlusal appliance, jaw exercises are a common form of TMD treatment (62). One SR found active exercise and postural training to be effective in treatment of TMD pain but no evidence for the effectiveness of various electrical modalities.

PHARMACOLOGIC TREATMENT

Several SRs indicated that analgesics, antidepressants, diazepam, hyaluronate, and glycocorticoid may be effective in TMD pain. In several chronic pain conditions, drugs such as analgesics, opioids, antidepressants, and anti-epileptics have been found to be effective in relieving pain; these drugs would probably be effective in TMD pain. Important endpoints such as numbers needed to treat (NNT) and numbers needed to harm (NNH) were rare in these primary studies, despite being recommended for use in pharmacologic treatment studies because they are easy to understand and provide a clinically relevant measure of the success rate and rate of harm of an intervention (63).

TMJ AND MAXILLOFACIAL SURGERY

The SRs of surgical treatment of TMD determined that arthroscopic surgery, arthrocentesis, and physical therapy affected mandibular movement, reduction in pain intensity, and mandibular functioning to the same degree. Success rates were often high, independent of treatment mode.

BEHAVIORAL THERAPY AND MULTIMODAL TREATMENT

All SRs of behavioral therapy determined that this type of treatment was effective in treating TMD pain. The treatment modalities included education, biofeedback, relaxation training, stress management, and CBT.

One limitation of most of the SRs reviewed was that the considerable variation in methodology between the primary studies made definitive conclusions impossible.

CONCLUSION

There is some evidence that occlusal appliances, acupuncture, behavioural therapy, jaw exercises, postural training, and some pharmacological treatments can be effective in alleviating pain in patients with TMD. Evidence is insufficient for the effect of electro- physical modalities and surgery. Occlusal adjustment seems to have no effect according to the available evidence.

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