**Original Article**

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

Dr. Ruthika Shivajirao Patil¹, Dr. Dayanithi B.S², Dr. Abhimanyu Singh³, Dr. Sumaiyya Patel⁴, Dr Dhananjay Rathod⁵, Dr. Ummy Salma⁶, Dr. Rahul VC Tiwari⁷

¹BDS, MDS, Prosthodontics, The Dental Specialists, Banjara Hills Road No.11, Hyderabad, Telengana, India; ²Senior Resident, Dept of Oral & Maxillofacial Surgery, Meenakshi Medical College & Research Institute, Meenakshi Academy of Higher Education Research, TamilNadu, India; ³P.G student, Department of Pediatric and Preventive Dentistry, Saraswati Dental College, Lucknow, India; ⁴MDS, Assistant professor, Dept of Oral and Maxillofacial Surgery, Shri Yashwant Roa Chawan Dental College and Hospital, Ahmednagar, Maharashtra, India; ⁵Reader, Department of Orthodontics, Vananchal Dental College and Hospital, Garhwa, Jharkhand, India; ⁶Postgraduate, Department of Pediatric and Preventive Dentistry, Bangalore Institute of Dental Sciences, Bangalore, Karnataka, India; ⁷OMFS, AOMSI Fellow in OGS, Dept of OMFS & Dentistry, Jubilee Mission Medical College Hospital & Research Institute, Thrissur, Kerala, India

**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 surgery, Shri Yashwant Roa Chawan Dental College and Hospital, Ahmednagar, Maharashtra, India; two to TBMI and maxillofacial surgery; and six to behavioural therapy. 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

Received: 22 November 2017  Accepted: 26 December 2017

**Corresponding author:** Dr. Ruthika Shivajirao Patil, BDS, MDS, Prosthodontics, The Dental Specialists, Banjara Hills Road No.11, Hyderabad, Telengana, India


**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.
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

<table>
<thead>
<tr>
<th>Authors, year, reference</th>
<th>Study design, diagnosis, and no. of patients</th>
<th>Intervention (I) and control (C) groups</th>
<th>Outcome measures</th>
<th>Results</th>
<th>Quality score</th>
<th>Authors’ (A) conclusions</th>
<th>Reviewers’ (R) comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanmataram A 1998 (25)</td>
<td>SR and Meta-analysis of 6 RCTs Disc displacement with reduction 212 patients</td>
<td>11: Occlusal appliance 12: repositioning splint</td>
<td>Pain reduction TMD click</td>
<td>12 better than 11 for pain reduction and TMD click.</td>
<td>AMSTAR 2  LRD II-V</td>
<td>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 &lt; 0.001). B: Methodological weaknesses of primary studies such as heterogeneous patient material, outcome measures not clearly defined, and three of the studies were not RCTs.</td>
<td></td>
</tr>
<tr>
<td>Al-Ani MZ 2003 (19)</td>
<td>Qualitative SR of 12 RCTs Myofacial pain 696 patients</td>
<td>11: Occlusal appliance 12: Other treatment (biofeedback, jaw exercises, acupuncture) C1: No treatment C2: Placebo</td>
<td>Jaw motion</td>
<td>II no better than C1 II somewhat better than C2 II no better than C3</td>
<td>AMSTAR 6  LRD II</td>
<td>A: There is insufficient evidence either for or against the use of stabilization splint therapy over other active interventions for the treatment of temporomandibular myofacial pain. However, it appears that stabilization splint therapy may be beneficial for reducing pain severity at rest and on palpation and depression when compared to no treatment. B: 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.</td>
<td></td>
</tr>
<tr>
<td>Ferrell E 2004 (20)</td>
<td>Qualitative SR of 20 RCTs TMD 1138 patients</td>
<td>11: Occlusal appliance 12: Occlusal adjustment C1: Other treatment (biofeedback, jaw exercises, acupuncture) C2: No treatment C3: Placebo</td>
<td>Pain reduction Global improvement Clinical examination Depression scale</td>
<td>Contradictory results for I1 compared with C1-C3 I2 no better than C1 or C2</td>
<td>AMSTAR 7  LRD II</td>
<td>A: Occlusal splints yielded equivocal results. Even for the most studied area, stabilization splints for myofacial pain, the results do not jointly definite conclusions about the efficacy of splint therapy. Though clinical effectiveness to relieve pain also seems moderate when compared with treatment methods in general. None of the occlusal adjustment studies provided evidence supporting the use of this treatment method. B: Included studies small, often not blinded, heterogeneity concerning outcome measures and control treatment.</td>
<td></td>
</tr>
<tr>
<td>van’t Spider A 2007 (28)</td>
<td>Qualitative SR of 33 studies 2 studies related to Intervention because of bruxism 1 RCT and 1 case series 27 patients</td>
<td>11: Occlusal appliance C1: No treatment</td>
<td>Attention</td>
<td>I1 reduces attention compared with C1.</td>
<td>AMSTAR 6  LRD II-V</td>
<td>A: One study was prospective and reported less attention in young children wearing bite plates compared with subjects who did not wear devices. In a case series of patients with severe bruxism, occlusal splints were worn to slow down the rate of tooth wear. B: Small studies, methodological weaknesses in primary studies. The results seem to confirm clinical experience.</td>
<td></td>
</tr>
<tr>
<td>Turp IC 2004 (21)</td>
<td>Qualitative SR of 9 RCTs Myofacial pain 452 patients</td>
<td>11: Introral appliance C1: Other treatment including placebo C2: No treatment</td>
<td>Pain reduction Clinical examination Depression scale</td>
<td>I1 better than C2 I1 no better than C1</td>
<td>AMSTAR 6  LRD II</td>
<td>A: Based on the currently best available evidence, it appears that most patients with maxillofacial muscle pain are helped by incorporation of a stabilization splint. A stabilization splint does not appear to yield a better clinical outcome than a soft splint, a non-retaining palatal splint, physical therapy, or acupuncture. B: Well-conducted SR. Limitations: small patient studies, outcome measures vary between studies, no long-term results.</td>
<td></td>
</tr>
<tr>
<td>Friction J 2006 (22)</td>
<td>Qualitative SR of 39 RCTs TMD patients*</td>
<td>11: Stabilization splint C1: Palcbo C2: Other treatment</td>
<td>Pain reduction</td>
<td>No difference between I1 and I2. I1 and I2 have similar effects I1, I2, and I4 have similar effects</td>
<td>AMSTAR 4  LRD II</td>
<td>A: Stabilization splints can reduce TMD pain compared to placebo splints. Stabilization splints are effective in reducing pain compared to physical therapy, acupuncture and behavioral therapy in the short term. The long-term effects of behavioral therapy may be better than splints in reducing symptoms in more severe patients with psychosomatic problems. B: The article is an overview and separate articles are under publishing with details regarding methods and results.</td>
<td></td>
</tr>
<tr>
<td>SRU 2006 (23)</td>
<td>Qualitative SR of 3 SRs and 3 RCTs TMD 2299 patients</td>
<td>11: Stabilization splint C1: Palcbo C2: Other treatments C3: No treatment</td>
<td>Pain reduction Clinical examination Depression scale</td>
<td>I1 better than C3 I1 and C2 have similar effect Results of I1 compared with C1 are contradictory I2 and C4 have similar effect</td>
<td>AMSTAR 6  LRD II-I</td>
<td>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. B: Reviewers and authors are identical persons</td>
<td></td>
</tr>
<tr>
<td>Authors, year, reference</td>
<td>Study design, diagnosis, and no. of patients</td>
<td>Intervention (I) and control (C) groups</td>
<td>Outcome measures</td>
<td>Results</td>
<td>Quality score</td>
<td>Authors' (A) conclusions</td>
<td>Reviewers' (R) comments</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------------------</td>
<td>----------------------------------------</td>
<td>-----------------</td>
<td>---------</td>
<td>---------------</td>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Stapelmann H 2008 (24)</td>
<td>Qualitative SR of 5 RCTs TMD Bruxism Tension-type headache (TTH) Migraine 190 patients</td>
<td>I1: NTI splint C1: Hat occlusal splint C2: Bite-stripping tray</td>
<td>EMG activity Polysomnographic evaluation Pain intensity Jaw opening Comfort Analytic consumption</td>
<td>Reducing EMG activity: I more effective than C1 Improvement in pain reduction: results for I1 compared with C1 more effective than C2 Five reports of complications or side-effects reported for I1 No difference</td>
<td>AMSTAR 7 LRD II</td>
<td>A: NTI-max 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 I2 was not more effective than C1, only limited indication is surrounding. R: Well-conducted SR; limitations are small studies. Methodological weaknesses in primary studies such as heterogeneous concerning outcomes measures and diagnostic criteria.</td>
<td></td>
</tr>
<tr>
<td>Koh I 2009 (26)</td>
<td>SR and meta-analysis of 6 RCTs TMD 392 patients</td>
<td>I1: Occlusal adjustment C1: Placebo, no treatment or reassurance</td>
<td>Global symptoms Relief of headache</td>
<td>No difference between I1 and C1</td>
<td>AMSTAR 10 LRD II</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Menendez CR 2009 (27)</td>
<td>SR and meta-analysis of 5 RCTs TMD 63 patients</td>
<td>I1: Occlusal splint I2: Other appliances I3: Other therapies C1: No treatment</td>
<td>Sleep variables e.g. EMG activity, arousal index Report of bruxism by partner Tooth wear</td>
<td>No difference between I1 and I2 in the meta-analysis of arousal index. No difference between I1 and C1 for tooth wear factors No difference between I1 and I3 for TMD pain</td>
<td>AMSTAR 9 LRD II</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Ernst E 1999 (29)</td>
<td>Qualitative SR of 6 RCTs TMD 205 patients</td>
<td>I1: Acupuncture C1: Occlusal appliance C2: No treatment</td>
<td>Pain intensity Daily activity Global improvement Clinical examination</td>
<td>I1 better than C2 No difference between I1 and C1</td>
<td>AMSTAR 5 LRD II</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Jorde R 2003 (30)</td>
<td>Qualitative SR of 7 RCTs TMD 379 patients</td>
<td>I1: Biofeedback I2: Acupuncture I3: TENS C1: No treatment C2: Other treatment</td>
<td>Self-reported symptoms Pain intensity Clinical examination</td>
<td>No evidence of an effect for any treatment mode</td>
<td>AMSTAR 3 LRD II</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Roedel P 1998 (31)</td>
<td>Qualitative SR of 3 RCTs (7 RCTs on TMD) Acute toothache TMD patients*</td>
<td>I1: Acupuncture C1: Other treatment</td>
<td>Pain intensity</td>
<td>No difference between I1 and C1</td>
<td>AMSTAR 4 LRD II-IV</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>SBU 2006 (23)</td>
<td>Qualitative SR of 5 SBs and 1 RCT TMD 379 patients</td>
<td>I1: Acupuncture C1: Placebo C2: Other treatment C3: No treatment</td>
<td>Pain intensity Daily activities Global improvement Clinical examination</td>
<td>I1 better than C3 I1 and C2 have similar effect I1 and C1 have contradictory results</td>
<td>AMSTAR 6 LRD II-IV</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>SBU 2006 (23)</td>
<td>Qualitative SR of a RCT TMD 279 patients</td>
<td>I1: Jaw exercises I2: Pulled radio frequency therapy I3: Laser I4: Pulsed electromagnetic fields I5: Postural correction C1: Minimal information C2: Placebo C3: No treatment</td>
<td>Pain intensity Daily activities Clinical examination</td>
<td>I1 better than C1 I1-4 no different from C2 I3 better than C3</td>
<td>AMSTAR 6 LRD II-IV</td>
<td>A: The evidence to draw any conclusions regarding physical treatment for TMD is insufficient because the studies are heterogeneous regarding diagnosis and treatment methods. R: Some of the studies showed a difference compared with controls. Lack of evidence did not support the results of more studies, but there is lack of evidence. Reviewers and authors are identical persons</td>
<td></td>
</tr>
</tbody>
</table>

---

141
<table>
<thead>
<tr>
<th>Authors, year, reference</th>
<th>Study design, diagnosis, and no. of patients</th>
<th>Intervention (I) and control (C) groups</th>
<th>Outcome measures</th>
<th>Results</th>
<th>Quality score</th>
<th>Authors’ (A) conclusions</th>
<th>Reviewers’ (R) comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frick M 2006 (32)</td>
<td>Qualitative SR of 6 RCTs TMD 225 patients</td>
<td>1: Acupuncture, acupuncture 2: Sham acupuncture 3: No treatment</td>
<td>Pain intensity</td>
<td>I1 and C2 have similar effects No difference between I1 and C1</td>
<td>AMSTAR 7</td>
<td>A: The analysis studies on acupuncture in the treatment of TMD confirm acupuncture to be as effective as conservative treatment. R: Short follow-up 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.</td>
<td></td>
</tr>
<tr>
<td>McNeely M 2006 (33)</td>
<td>Qualitative SR of 12 RCTs TMD 480 patients</td>
<td>1: Exercise and manual therapy 2: Acupuncture 3: Electrophysical modalities (PRFE, TENS, biofeedback, laser) 4: Other therapies 5: Placebo</td>
<td>Pain reduction, jaw mobility</td>
<td>No synthesis of results</td>
<td>AMSTAR 7</td>
<td>A: The results support the 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 the use of acupuncture in TMD treatment. There is no evidence to support the 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.</td>
<td></td>
</tr>
<tr>
<td>Mediciotti MS 2006 (34)</td>
<td>Qualitative SR of 24 RCTs and 6 uncontrolled studies TMD 1071 patients</td>
<td>1: Exercise 2: Manual therapy 3: Electrotherapy (ultrasound, TENS, laser, PRFE) 4: Relaxation training and education 5: Occlusal splint 6: Placebo 7: Waiting-list</td>
<td>Pain intensity, Global improvement, Clinical examination, law mobility, Pressure pain threshold</td>
<td>No synthesis of results</td>
<td>AMSTAR 5</td>
<td>A: Active exercise and manual mobilization 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 populations and to differences in diagnosis and outcomes measures, it is not possible to draw any clear conclusions from this SR.</td>
<td></td>
</tr>
<tr>
<td>Sommer C 2002 (35)</td>
<td>Qualitative SR of 27 RCTs TMD, trigeminal neuralgia, atypical facial pain 931 patients</td>
<td>1: Carbamazepine, baclofen, lamotrigine 2: Conus paraps 3: Diuretics 4: Antidepressants 5: Placebo</td>
<td>Pain reduction &gt;50%</td>
<td>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</td>
<td>AMSTAR 4</td>
<td>A: Apart from studies on trigeminal neuralgia, there is little evidence for pharmacotherapy in orofacial 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.</td>
<td></td>
</tr>
<tr>
<td>List T 2003 (36)</td>
<td>Qualitative SR of 11 RCTs TMD, atypical facial pain, burning mouth syndrome 368 patients</td>
<td>1: Analgesics 2: Antidepressants 3: Benzodiazepines 4: Miscellaneous (corticosteroids, sodium hyaluronate, sumatriptan, corticosteroids) 5: Placebo</td>
<td>Pain reduction, Global improvement, Depression scale</td>
<td>TM and atypical facial pain: few studies found better effect of I1-14 compared with C1 Burning mouth: I2 = C1</td>
<td>AMSTAR 7</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>SSU 2006 (23)</td>
<td>Qualitative SR of 1 SR and 11 RCTs TMD, atypical facial pain, burning mouth syndrome 968 patients</td>
<td>1: Analgesics 2: Antidepressants 3: Benzodiazepines 4: Miscellaneous (corticosteroids, sodium hyaluronate, sumatriptan, capsaicin, botulinum toxin) 5: Placebo</td>
<td>Pain reduction</td>
<td>TMD and atypical facial pain: few studies found better effect of I1-14 compared with C1 For burning mouth, I = C1</td>
<td>AMSTAR 6</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
| Authors, year, reference | Study design, diagnosis, and no. of patients | Intervention (I) and control (C) groups | Outcome measures | Results | Quality score | Authors' (A) conclusions

R esearchers' (R) comments |
---|---|---|---|---|---|---|
Shi ZC 2009 (37) | SR and meta-analysis of 7 RCTs. TMD, rheumatoid arthritis; 364 patients | I: Hyaluronan
II: Hyaluronan + Arthroscopy/lavage
C1: Placebo
C2: Glycoprotein/Collagen
C3: Arthroscopy/lavage | Symptoms
(e.g. pain, clinical examination, adverse events) | Long-term effects favour II compared to C1. II had the same long-term effects on symptoms and clinical signs compared to C2. Comparing II to C3, results were inconsistent. | AMSTAR 11
LIR II | A: There is insufficient consistent evidence to support or refute the use of hyaluronate for treating patients with TMD. B: Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study. |
Al-Mahmoud MA 2009 (38) | SR and meta-analysis of RCTs. No studies included. Muscles: hypertrophy 0 patients | I: Botulinum toxin
C1: Placebo | Self-reported facial appearance
Pain and discomfort | 167 references were retrieved, but none matched the inclusion criteria. | AMSTAR 7
LIR II | A: No randomized trial on the efficacy of intra-muscular injections of botulinum toxin with bilateral design manner hypertrophy was identified. B: No trend of the effect can be drawn because all studies were excluded. |
Carreno-Romero 2009 (39) | Qualitative SR of 1 SR, 1 RCT and 1 case-control study. TMD patients. Muscles: hypertrophy 0 patients | I: Amitriptyline
C1: Placebo | Pain | III better than C1 | AMSTAR 4
LIR 1-III | A: The use of tricyclic antidepressants for the treatment of TMD is recommended. B: Synthesis of results from primary studies is missing, and therefore, because of limitations in the SR, it is difficult to draw any conclusions. |
Ihle 2007 (40) | Qualitative SR of 1 RCT and 10 case series. TMD. Muscles: hypertrophy 0 patients | I: Botulinum toxin
C1: Placebo | Pain reduction
Jaw opening
Functional improvement
Aesthetic result | III better than C1 for reducing pain based on one RCT. No synthesis of results. | AMSTAR 3
LIR IV | A: Botulinum toxin appears relative safe and effective in treating chronic facial pain associated with mandibular hyperactivity. B: 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. |
---|---|---|---|---|---|---|
Resen JT 2003 (41) | SR and meta-analysis of 30 studies (5 RCTs and 27 uncontrolled studies). Disc displacement with reduction, Disc displacement without reduction: 1653 patients | I: Arthroscopy
II: Arthroscopy + Disc repair/repositioning
III: Discoscopy | Pain reduction
Global improvement
Jaw mobility | Disc displacement with reduction: 12 and 13 comparable results
Disc displacement without reduction: Similar results for 11, 12, and 11 | AMSTAR 4
LIR 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 arthroscopy and arthroscopy for patients with disc displacement with reduction. B: Methodological weaknesses of primary studies such as heterogeneous patient material, outcome measures not clearly defined, and majority of the studies were not RCTs. |
Krommen T 1999 (42) | Qualitative SR of 24 studies (6 RCTs and 6 case-controlled and 12 uncontrolled studies). Disc displacement without reduction: 4516 patients | I: Arthroscopy
II: Arthroscopy + Disc repair/repositioning
III: Discoscopy | Pain intensity
Jaw function
Jaw mobility | No synthesis of results presented | AMSTAR 2
LIR IV | A: No distinguishing effects on jaw mobility, jaw function, or pain intensity was seen between arthroscopic surgery, arthroscopy, and physical therapy in patients with prominent temporomandibular joint disc displacement. B: Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study. A majority of the studies are LIR level IV, and therefore, it is not possible to draw any clear conclusions from this SR. |
Al-Babtain 2007 (44) | Qualitative SR of 3 case-control studies. 280 patients | I: Bilateral sagittal split and/or Le Fort I osteotomy
II: No treatment | Self-report of symptoms
Clinical examination | Contradictory results in signs and symptoms | AMSTAR 8
LIR 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. B: Well-designed SR, Methodological weaknesses of primary studies such as diagnostic criteria of TMD and outcome measures in the study. |
<table>
<thead>
<tr>
<th>Authors, year, and reference</th>
<th>Study design, diagnosis, and no. of patients</th>
<th>Intervention (I) and control (C) groups</th>
<th>Outcome measures</th>
<th>Results</th>
<th>Quality score</th>
<th>Authors’ (A) conclusions</th>
<th>Reviewers’ (R) comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Bely FA 2007 (43)</td>
<td>Qualitative</td>
<td>I1: Acupuncture</td>
<td>Pain intensity</td>
<td>Overall success varied between 60%-100%, No comparison between I1 and C1</td>
<td>AMSTAR 2 LRD II-IV</td>
<td>A: The majority of the reviewed publications were prospective case series with flawed methodology and, despite the impression that biofeedback may be beneficial for patients with TMD closed lock, there have been no good prospective randomized clinical trials 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 medication. The majority of the studies are LRD level IV, and therefore, it is not possible to draw any clear conclusions from this SR.</td>
<td></td>
</tr>
<tr>
<td>Corder AB 1999 (45)</td>
<td>SR and meta-analysis of 13 RCTs and uncontrolled studies</td>
<td>I1: Electromyographic Biofeedback</td>
<td>Pain reduction</td>
<td>Pain reduction and clinical signs I1 better than C1 and C2</td>
<td>AMSTAR 4 LRD II-IV</td>
<td>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. 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.</td>
<td></td>
</tr>
<tr>
<td>Corder AB 2005 (46)</td>
<td>SR of 6 RCTs</td>
<td>I1: Biofeedback training</td>
<td>Global reduction</td>
<td>II was superior to C1 in one of two RCTs</td>
<td>AMSTAR 3 LRD II-III</td>
<td>A: Biofeedback training with adjunctive CBT was reported to be an effective treatment for TMD: both biofeedback training as the sole intervention and biofeedback-assisted relaxation training are probably effective treatments. R: Small studies, no long-term follow-up, Methodological limitations in SR.</td>
<td></td>
</tr>
<tr>
<td>SIU (23)</td>
<td>Qualitative</td>
<td>I1: CBT</td>
<td>Pain intensity</td>
<td>II was better than C1 and C3</td>
<td>AMSTAR 6 LRD I-II</td>
<td>A: Behavioural treatment such as biofeedback and CBT have better effect than no treatment. R: Reviewers and authors are identical persons</td>
<td></td>
</tr>
<tr>
<td>McSecely M 2006 (33)</td>
<td>SR of 4 RCTs</td>
<td>I1: CBT</td>
<td>Pain reduction</td>
<td>Pain reduction II better than C2, 12 similar effect to C1, 12 and E1 similar effect</td>
<td>AMSTAR 7 LRD II</td>
<td>A: Programs involving relaxation techniques and biofeedback, electromyographic training, and proproceptive 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.</td>
<td></td>
</tr>
<tr>
<td>Trupp J 2007 (47)</td>
<td>Qualitative</td>
<td>I1: Simple treatment</td>
<td>PMT Intensity</td>
<td>Disc displacement with reduction without treatment</td>
<td>AMSTAR 4 LRD II</td>
<td>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, inter disciplinary 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</td>
<td></td>
</tr>
</tbody>
</table>
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 NTL, 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 glycochorticoid 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.

REFERENCES
4. van ‘tSpijker A, Kreulen CM, Creugers NH. Attrition, occlusion, (dys)function, and intervention: a systematic
10. Medlicott MS, Harris SR. A systematic review of the effec-
tiveness of exercise, manual therapy, electrotherapy, relaxa-
16. Ihde SK, Konstantinovic VS. The therapeutic use of botu-
17. Reston JT, Turkelson CM. Meta-analysis of surgical treat-
18. Kropmans TJ, Dijkstra PU, Stegenga B, de Bont LG. Ther-
19. Al-Belasy FA, Dolwick MF. Arthrocentesis for the treat-