Canadian Agency for Drugs and Technologies in Health

RAPID RESPONSE REPORT:
SUMMARY WITH CRITICAL APPRAISAL

TITLE: **Neuromuscular Occlusion for Diagnosis and Treatment of Temporomanibular Joint Disorders: A Review of the Clinical Evidence**

DATE: 11 January 2013

CONTEXT AND POLICY ISSUES

Temporomandibular disorder (TMD) is defined as a group of clinical problems that involve the masticatory muscles, the temporomandibular joint (TMJ), and the associated structures.[1] Symptoms of TMD include pain in the TMJ and masticatory muscles, TMJ sound, and difficulty chewing.[2]

Clinical TMD diagnosis can be established using a clinical exam called the Research Diagnostic Criteria for TMD (RDC/TMD).[3] The examination protocol includes the range of jaw motion, TMJ sounds, and muscle and joint palpation for tenderness. Clinical diagnostic data can be classified according to the RDC/TMD protocol in three mutually exclusive groups:

- Group I: muscle diagnosis or myogenous TMD – myofacial pain with or without limited range of motion
- Group II: disk displacement – with or without reduction (return of the TMJ disk to its rest place in the joint), with or without limited mouth opening,
- Group III: arthrogenous TMD that can be caused by arthralgia, osteoarthritis, or osteoarthrosis.

A fourth group can be defined as psychogenous TMD when the disorder cannot be related to any of the above groups.

Theories about the etiology of TMD are based on the structures related to the anatomy and function of the TMJ; these are dental, skeletal, and the neuromuscular or functional theories. The neuromuscular occlusion (NMO) concept considers the components responsible for the positioning and function of jaw; these are the teeth, muscles and joints.[4] The International College of Cranio-Mandibular Orthopedics (ICCMO) fosters the NMO concept, and it has issued a position paper that clarifies the basis of neuromuscular occlusion.[4] In this paper it was stated that *"TMD most commonly have a physical/physiological basis with dental malocclusion as a major etiologic agent." (page 237)*[4]

Correction of this malocclusion, for this concept, starts by the identification of mandibular rest position. This rest position is obtained by relaxing the masticatory muscles using a technique called transcutaneous electrical neural stimulation (TENS). The NMO concept considers this mandibular position as a reference for selecting the neuromuscular occlusal position. The mandibular position is recorded using the surface electromyograms (EMG), computerized mandibular scans, electrosonography, and kinesiography. Finally, the dental occlusion is altered or adjusted according to this new mandibular position.

There are concerns that this procedure is ineffective and not based on solid evidence. The current review has the objective to evaluate the diagnostic and therapeutic values of methods based on the neuromuscular concept in the management of TMD patients.

RESEARCH QUESTIONS

1. What is the clinical evidence on the use of the neuromuscular occlusion (NMO) concept for diagnosis of temporomandibular joint (TMJ) disorders?

2. What is the clinical evidence of the effectiveness of occlusal adjustments, based on the neuromuscular occlusion concept, in treating TMJ disorders

KEY FINDINGS

The available evidence does not support the use of electromyography as a diagnostic test for temporomandibular disorder. The use of electrical stimulation for the treatment of TMD is not supported by the current evidence. No conclusions can be made on the efficacy of occlusal splint based on the neuromuscular occlusion concept.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2012, Issue 11), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to health technology assessments, systematic reviews, meta-analyses, randomized controlled trials and non-randomized studies. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2007 and December 4th, 2012.

Selection Criteria and Methods

One reviewer screened citations and selected studies. The first level of screening was based on the titles and abstracts of the identified citations. Full texts of any relevant titles/abstracts were retrieved, and the final article selection was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Adult patients with temporomandibular joint disorders with one or a combination of pain, discomfort and dysfunction
Intervention	Question 1: The identification of the mandibular rest position (or planning for occlusal adjustment) using one or a combination of transcutaneous electrical neural stimulation (TENS), surface electromyograms (EMG), computerized mandibular scans (CMS), and electrosonography (ESG) Question 2: Occlusal modification (splints or any occlusal surface alteration) to reach an occlusion based on mandibular rest position identified and recorded using TENS, EMG, CMS, or ESG
Comparator	Question 1: The identification of rest position using the traditional techniques (repeated jaw movements, swallowing, and patient distraction). Recording the rest position using the wax plates or impression materials used for occlusal recording Question 2: No treatment or placebo, behavioural therapy, physical therapy, pharmacological treatment, electro-physical treatment, surgical interventions, or occlusal modification based on mandibular rest position identified and recorded using conventional methods
Outcomes	Question 1: Diagnostic accuracy as measured by the psychometric values of the diagnostic test Question 2: Patient satisfaction, quality of life, relief of TMD symptoms, and masticatory functions
Study Designs	Health technology assessment, systematic review, meta-analysis, randomized controlled trials, and non-randomized studies.

Exclusion Criteria

Studies were excluded if they did not meet the selection criteria. Duplicate reports of the same outcomes from the same trials were also excluded. With regard to study population, studies were excluded if they were conducted on healthy volunteers, edentulous or asymptomatic patients; patients whose TMD was associated with osteoarthritis, rheumatoid arthritis, multiple sclerosis; bruxism patients with no clinical TMD diagnosis. Studies were also excluded if they had randomized controlled design that did not directly compare treatment based on the neuromuscular occlusion concept with any other therapeutic modality. Finally, studies were excluded if the evaluation of TMD was not related directly on the masticatory complex (e.g., evaluation of the muscles of the neck and body posture).

Critical Appraisal of Individual Studies

Critical appraisal of the included studies was based on study design.

The methodological quality of the included systematic review was evaluated using the "assessment of multiple systematic reviews" (AMSTAR).[11] AMSTAR is an 11-item checklist that has been developed to ensure reliability and construct validity of systematic reviews. The Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool[12] was used to evaluate the

included diagnostic studies. The QUADAS tool is a 14-item questionnaire that is used to evaluate bias, data variability, and quality of reporting in diagnostic studies. The methodological quality of the included randomized controlled trial was evaluated using the SIGN50 checklist for the controlled studies.[13] The non-randomized controlled trial included in this review were evaluated using the SIGN50 checklist for the cohort studies.[14]

For the included studies a numeric score was not calculated. Instead, the strengths and limitations of the study were described narratively.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 596 potential citations were identified by the search in bibliographic database, with 581 citations being excluded during the title and abstract screening based on irrelevance to the questions of interest. The full text documents of the remaining 15 articles were retrieved. Six additional articles were identified by the grey literature search. Of the 21 articles, 6 did not meet the inclusion criteria and were excluded,[5-10] leaving 15 articles that reported from 14 unique trials to be included in this review.[1,15-27] A PRISMA diagram demonstrating the study selection process is presented in APPENDIX 1.

Summary of Study Characteristics

Fifteen articles that addressed at least one of the review questions were included in this report. The accuracy and validity of the electromyography or kinesiography in the diagnosis of TMD was evaluated in one systematic review[15] and eleven case-control studies.[1,16-25] The efficacy of TMD therapies based on NMO concept was evaluated in one case-control study,[28] one placebo-controlled study,[26] and one randomized controlled study.[27] Details regarding primary studies characteristics are tabulated in APPENDIX 2.

Diagnostic Studies

The systematic review by Al-Saleh et al.[15] evaluated the accuracy of EMG in the diagnosis of TMDs in comparison with other diagnostic tools. The review included two studies in which EMG diagnostic values were compared with the clinical and physical evaluation of patients. Results were presented in terms of the psychometric values of EMG.

Two studies reported estimates of EMG reproducibility, its correlation with clinical outcomes, and comparisons of EMG values between TMD patients and controls.[1,20] Felicio et al.[1] evaluated the accuracy of EMG in diagnosing TMD by comparing EMG values and TMD severity scores between TMD patients and asymptomatic students. The study included 60 participants who were classified as myogenic TMD patients or controls according to RDC/TMD criteria. Discriminant power of the EMG test was evaluated relative to two clinical questionnaires developed by the authors of the same study, the ProTMD multi- part II and the orofacial myofunctional evaluation with scores. Santana-Mora et al.[20] assessed the differences in EMG activity during clenching in women with chronic unilateral TMD as compared to control subjects. A total of 75 women were included in the study based on the diagnosis of chronic pain; however, the method of TMD diagnosis was not reported. The comparisons of EMG values were made based on the baseline classification of participants, TMD patients or asymptomatic individuals.

Manfredini et al.[16] evaluated the diagnostic accuracy of EMG and kinesiography for TMD patients. This was a case-control study that included 72 participants equally distributed into TMD group and control. Diagnosis of TMD was confirmed using RDC/TMD criteria. The results were reported in terms of the difference between groups in terms of EMG and kinesiography values, and in terms of sensitivity and specificity of both methods.

The comparison of EMG indices between TMD patients and controls was used as an estimate of the discriminate value of EMG in eight studies.[17-19,21-25] The diagnosis of TMD was confirmed using RDC/TMD in all these studies except two studies; one by Ferrario et al.,[24] in which a non-standardized clinical exam was used instead, and the other one by Ardizone et al.[19] in which the diagnostic method was not reported. In four studies, patients had to have a clear TMD classification; one study included one group of myogenous TMD,[21] another study included one group of arthrogenous TMD,[17] and two studies included three groups of TMD: myogenous, arthrogenous and psychogenous.[23,25] The remaining four studies did not report the TMD classification.[18,19,22,24]

Efficacy Studies

Silva et al.[28] evaluated the efficacy of occlusal splints prepared using the EMG values as a reference of the ideal occlusion. The study included 15 TMD patients and 15 controls who did not need any occlusal treatment; all participants were diagnosed using the RDC/TMD criteria. Results were reported in terms of the difference between groups in mouth opening, pain during maximum mouth opening and EMG values.

Monaco et al.[26] conducted a placebo-controlled trial to assess the effect of a single 60 minute transcutaneous electrical nervous stimulation (TENS) on EMG and kinesiographic activity in EMD patients. The trial included 60 women with unilateral arthrogenous TMD as confirmed by the RDC/TMD. Participants were divided into three groups, TENS group, placebo group, and a control group; the difference between the placebo and control groups was that in the placebo participant had a sham TENS treatment, while in the control group participant did not have any kind of treatment. The evaluation was based on EMG and kinesiographic indices without any clinical outcomes.

A randomized-controlled trial was conducted to determine the effect of contingent electrical stimulation on jaw muscle activity during sleep.[27] In this trial, eleven patients were randomly allocated to receive placebo treatment or nocturnal treatment with electrical stimulation. The stimulation was produced by EMG apparatus that gave an electrical stimulation each time it detected EMG activity related to tooth-clenching or grinding. Both patients and investigators were kept blinded to the allocated treatment. Evaluation was based on the number of EMG events/hour, and RDC/TMD criteria and self-reported evaluations of pain, mouth opening and depression.

Summary of Critical Appraisal

The strength and limitations of included studies are summarized in APPENDIX 3.

Diagnostic Studies

In systematic review by Al-Saleh et al.[15] two reviewers conducted study selection and data extraction in duplicate, and they evaluated the quality of the included studies according to the

QUADAS critical appraisal tool for diagnostic studies. In general, the conduct of the review was methodologically sound; however, the article did not explicitly state that the grey literature was included in the search.

Generally in diagnostic studies, the use of a standardized, well established and widely accepted reference test is essential. This reference test gives the true classification of the tested participants as having the disease or not; this classification is necessary to estimate the specificity and sensitivity of the new (index) test. The Research Diagnostic Criteria for TMD (RDC/TMD) is an acceptable reference test which was used in seven studies;[16-18,21-23,25] this test allow for the diagnosis of TMD and its classification into myogenous, arthrogenous and psychogenous groups. However, the severity of TMD was not reported in any of the studies that used this diagnostic test. Two studies used reference tests that allowed the evaluation of TMD severity;[1,19] in the study conducted by Felicio et al.[1] it was reported that they used a self-judgment of severity questionnaire called "ProTMD multi- part II" and another test called "Orofacial Myofunctional Evaluation with Score", both tests were reported as being validated in previous trials. Ardizone et al.[19] used a reference test called "Helkimo" test that classified TMD patients as minor, moderate and serious TMD patients. The Helkimo test was also reported as validated.[19]

On the other hand, two studies failed to use, or at least report, an acceptable reference test.[20,24] In one study a non-standardized clinical diagnosis was used as the reference test.[24] In the other study, the diagnostic method was not reported at all; instead, the visual analogue scale of pain was used as the reference test.[20]

The use of continuous measures for the reference and/ or index tests allows the estimation of the correlation between the two tests. However, the presence of strong correlation between the two tests is not sufficient to validate the index (new) test; the test should also be able to discriminative between patients and non-patients. When a continuous measure is to be used as a diagnostic test it should have an established threshold value that have the power to discriminate between patients and healthy subjects, this value is called minimally clinically significant value. Three of the included studies used four continuous measures as reference tests;[19,20,24] none of which had an established minimally clinically significant value. Therefore, the correlations seen between the reference tests and TMG indices cannot be considered as diagnostic accuracy values based on these studies.

The reproducibility of the diagnostic test should be evaluated by measuring the correlation or the difference between the results of the same test conducted on the same patients within a reasonable interval of time. The reproducibility of EMG test was evaluated in two studies only.[1,20] In both studies, the reproducibility was evaluated in a subgroup of participants only.

The eleven diagnostic studies included in this review were based on the comparison between the results of EMG indices between TMD patients groups and healthy control groups. The statistical tests of difference should be sufficiently powered to give the confidence that the detected differences are due to real effects of the test and not due to the play of chance. One study conducted by Manfredini et al. included a sample size according to power calculation.[16] The remaining ten diagnostic studies included a convenient sample size without any power estimation.

Interpretation of the index test results should be conducted without knowledge (blinded) of the participant disease status, TMD patient or control. Awareness of the reference test classification

of participants might introduce a bias due to preconceived ideas. Blinding was used on two studies, on by Manfredini et al.[16] and the other by Tartaglia et al.[23]. All remaining diagnostic studies did not precisely report that investigators, or at least interpretation of results, were blinded.

Efficacy Studies

The study by Silva et al.[28] had a case-control design in which the intervention was not controlled with any reference treatment. On the other hand, Monaco et al. controlled their TENS intervention with a placebo intervention in a non-randomized design.[26] Both studies included a convenient sample size not based on power calculation, and neither study reported if investigators or patients were blinded to the disease status or the intervention.

Jadidi et al.[27] conducted a randomized-controlled trial in which acceptable methods of randomization, allocation concealment and blinding were adopted. The trial was limited by the fact that it recruited a convenient sample size rather than being based on power calculation.

Summary of Findings

A summary of study findings and authors' conclusions are provided in APPENDIX 4.

Diagnostic Studies

Accuracy values of the electromyography

The diagnostic accuracy values of EMG were reported in two studies; both studies reported a wide range and inconsistent accuracy values.[15,16] In the systematic review by Al-Saleh et al. the sensitivity and the negative predictive value of EMG ranged from low (0.15) to moderate (0.69).[15] On the other hand, the same studies included in the systematic review reported moderate (0.67) to high (0.98) specificity and positive predictive values. The case-control study by Manfredini et al. reported low sensitivity and specificity of EMG (0.28 to 0.52) when evaluated at muscular rest position.[16] The same evaluation during maximum teeth clenching provided a wide range of sensitivity and specificity depending on the masticatory muscle tested, values ranged from 0.77 to 0.92.[16]

Reproducibility of the electromyography

Reproducibility of the EMG tests was evaluated in two case-control studies; both studies showed good signs of EMG reproducibility.[1,20] Felicio et al. reported the P-value of the difference between the results of EMG tests and retests when conducted in the same session (for TMD patients) and after 3 months (for the healthy controls).[1] The study showed no difference between the results of EMG test and retest. Santana-Mora et al. reported an intra-class correlation coefficient of 0.886 between the test and retest of EMG.

Correlation of electromyography indices with clinical endpoints

Two case-control studies estimated the correlation of EMG indices with the clinical signs and symptoms of TMD, such as pain and function.[1,20] Felicio et al. used two clinical evaluation protocols developed by the authors of the same study, the "Orofacial Myofunctional Evaluation with Scores" protocol and the "ProTMDmulti" questionnaire. The correlation coefficients

between EMG indices and these two evaluation protocols ranged from very weak (0.02) to moderate (0.43). Santana-Mora et al. estimated a correlation coefficient between the EMG-activity of two masticatory muscles (masseter and temporal muscles) with pain scores as measured by a visual analogue scale.[20] The study reported that the correlations were not statistically significant between the pain scores and the tested muscles activity.

Difference in electromyography between TMD patients and healthy individuals

The difference in EMG indices between TMD cases and controls was evaluated in eleven studies.[1,16-25] Two masticatory muscles were frequently used in the analyses, the masseter and the anterior temporal muscles. EMG indices included the percentage overlapping coefficient (POC - which is an index of the symmetric distribution of muscular activity), torque coefficient (which is the rotation produced due to the difference in muscular forces), individual muscular activity, and the standardised muscular activity. Evaluation was conducted either when the muscles were at rest or during their contraction.

- *POC temporalis and masseter muscles*

Six studies reported the muscular symmetry analysis for both the temporalis and masseter muscles.[1,17,18,22-24] POC temporalis was statistically significantly different between TMD patients and control the group in four studies,[1,17,23,24] the two other studies did not show a significant difference.[18,22] Concerning the POC for masseter muscle, three studies failed to show statistically significant difference between TMD patients and the control group.[17,18,23]

- *Torque coefficient*

Four studies reported estimations of the torque coefficient;[1,17,23,24] three of which reported statistically significant difference between TMD group and the control group.[1,17,24]

- *Standardized muscle activity index*

Five studies calculated a standardized index for the masticatory muscles activity and reported the difference between TMD patients and the control group.[1,17,23-25] Three of these studies reported a statistically significant difference between the compared groups.[1,23,24] One study reported significant differences when the control group was compared to arthrogenous or myogenous TMD groups; however, the same study failed to show this difference between the control group compared to a mixed TMG group.[25] The last study demonstrated that the difference between groups was not statistically significant.[17]

- *Temporal and masseter muscles ENG activity*

The individual muscle activity was reported in four studies.[16,18,20,21] Two studies evaluated the muscular activity at rest; one study reported a statistically significant difference between TMD patients and controls,[18] the other study failed to show a significant difference.[16] When the activity was evaluated during muscular contraction, two studies showed that the difference between groups was not significant,[18,21] one study reported statistically significant difference,[16] while the forth study reported inconsistent differences between groups depending on the side of TMD, right or left.[20]

Kinesiography

One case-control study by Manfredini et al.[16] evaluated the kinesiography in the diagnosis of TMD; results were reported in terms of diagnostic accuracy estimates and differences between TMD patients and controls in kiensiographic indices. The study reported a wide range of

sensitivity and specificity (0.39 to 0.69) depending on the used index. With regard to differences between groups, the study reported a statistically significant difference in maximum right deflection index; however, this difference was not seen for the maximum mouth opening, maximum left deflection, or freeway space.[16]

Efficacy Studies

Silva et al. reported that the use of occlusal splints adjusted based on EMG recordings produced a statistically significant reduction of pain in TMD as compared to pain scores before treatment.[28] However, these results are not conclusive because the tested treatment was not controlled with any reference therapy.

Monaco et al. reported that the use of TENS produced a statistically significant difference between the treatment group and the control groups in terms of the masseter and temporalis muscle EMG activity.[26] The kinesiographic evaluation showed that TENS treatment was associated a statistically significant difference between groups in terms of the vertical evaluation; however, these differences were not provided for the anterior/posterior index or the ratio of vertical/ anterior-posterior indices.

In the randomized-controlled trial by Jadidi et al., the use of contingent electrical stimulation for the treatment of TMD patients was not statistically different from placebo in terms of sleep hours during the night, maximum pain-free jaw-opening, number of painful muscles, depression scores, sleep/tiredness/snoring questionnaire score, TMD pain scores, muscle tension scores, or EMG indices.[28]

Limitations

The current review included 12 studies were that assessed the diagnostic values of EMG and kinesiogrphy methods. In these studies, different reference tests were used including the RDC/TMD, Orofacial Myofunctional Evaluation with Scores" protocol, the "ProTMDmulti" questionnaire, and "Helkimo" test. The current review is limited by the fact that the diagnostic validity of these tests in TMD patients could not be verified within the scope of this review. Furthermore, none of the included studies provided a threshold value for the EMG or kinesiogrphy methods that can be used as a cut-off to differentiate between TMD patients and healthy individuals.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

This report had the objective of evaluating the diagnostic and therapeutic methods based on the neuromuscular concept of occlusion for the management of TMD patients. The diagnostic values of the electromyography and kinesiography were reviewed. The efficacy of TMD treatment based on the electrical stimulation of muscular muscles and the used of occlusal splints prepared using the EMG values were also reviewed. A total of fifteen studies were retrieved.

With respect to the diagnostic values of the electromyography in TMD patients, the data was obtained mainly from eleven case-control studies and one systematic review. It was shown that electromyography produced a wide range and inconsistent values of specificity and sensitivity that prevent its adoption as a diagnostic test for TMD. These EMG indices were not consistently

different between TMD patients and the healthy controls. Furthermore, the EMG indices correlated poorly with the clinical signs and symptoms of TMD such as pain and function.

With regards to the clinical efficacy of TMD treatment based on the electrical stimulation of muscular muscles, data was limited to one randomized-controlled trial and two non-randomized trial. Results from the randomized-controlled trial showed that the use of contingent electrical stimulation was not different from the use of placebo in changing the clinical outcome or the electromyographic evaluation. The non-randomized trial reported contradictory results between the electromyographic and kinesiographic evaluations. Further development of these methods by establishing discriminative values that correlate with the clinical signs and symptoms of TMD may enhance their acceptance in clinical practice. The use of occlusal splints prepared with EMG values reduced TMD pain; however, this result should be interpreted in light of the fact that it was obtained from uncontrolled trial, and the magnitude of pain reduction was not reported.

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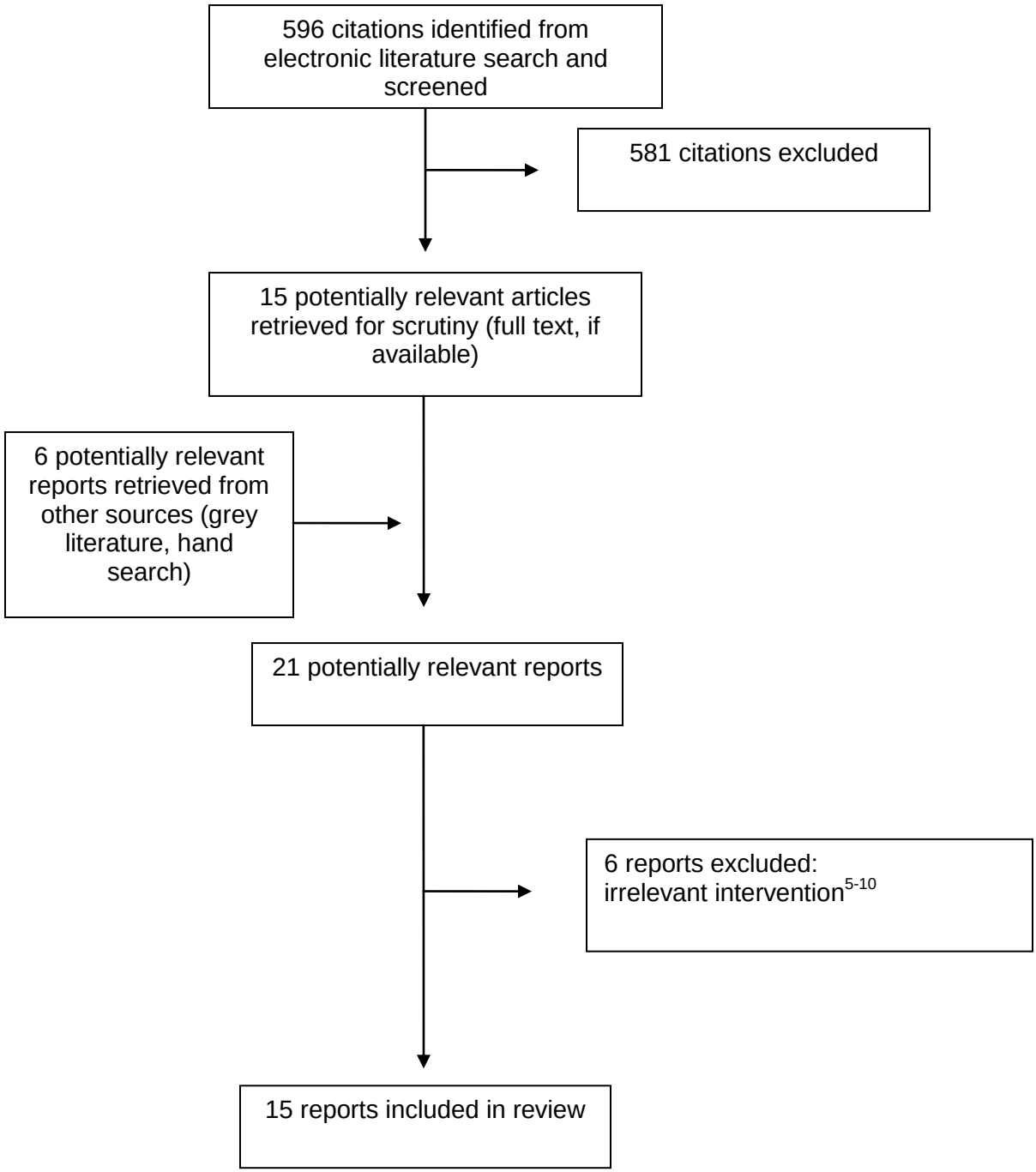
APPENDIX 1: Selection of Included Studies



APPENDIX 2. Characteristics of the Included Studies

Table 2. Characteristics of the Included Systematic Review on the Diagnostic Accuracy Trials

Review Objectives	Types of Studies and Types of Participants	Interventions and Comparators	Outcomes
Al-Saleh et al. 2012[15] – Canada			
To evaluate the accuracy of EMG in diagnosing TMDs when compared with other diagnostic tools.	• **Type of Studies** ○ Clinical trials, cohort studies, case-control studies, cross-sectional studies. ▪ Two studies • **Types of Participants** ○ Patients with TMD regardless of age and sex, and who had received TMD diagnosis on the basis of a reference standard method.	• **Intervention:** ○ Use of EMG as a diagnostic tool for TMD. • **Comparator:** ○ TMD diagnosis based on the clinical evaluation of patient's chief complaint, history, and physical examination, supplemented by imaging and laboratory analysis	• **Primary outcomes:** ○ Sensitivity, specificity, positive and negative predictive values, and the likelihood ratios.

EMG= electromyography ; TMD= temporomandibulardisorders

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Felicio et al. 2012[1] – Brazil (Diagnostic Study No. 1/11 – Case-control design)			
To compare TMD patients with healthy controls in terms of EMG of masticatory muscles, orofacial myofunction assessment, and TMD severity score. Case-Control study	• **Patient Group:** ○ Consecutive patients with orofacial pain in a dental school. ○ Presenting TMD, muscle diagnosis plus disk displacement with reduction (according to RDC/TMD) ○ N= 42 women, mean age 30 years • **Control Group:** ○ Students and healthy volunteers. ○ No TMD (according to RDC/TMD) ○ N= 18 women, mean age 26 years	**Intervention (the tested diagnostic method):** • Surface electromyography ○ The masseter and anterior temporal muscles of both sides were examined. ○ Evaluation was done during the maximum voluntary teeth clenching ○ Computer-based analysis system was used. ○ Four indices were collected: ▪ POC masseter ▪ POC anterior temporal ▪ Torque coefficient[a] ▪ Total standardized activity **Comparators (the reference test):** • Self-judgment of severity – measured by the "*ProTMDmulti-part II*"[b] questionnaire. • Orofacial myofunctional evaluation – measured by the *"Orofacial Myofunctional Evaluation with Scores - OMES"*[c] protocol in terms of appearance/ posture, mobility, and performance during function.	• EMG test reproducibility – measured by the test-retest exams. Evaluation was based on the p-value of the paired test sample • Spearman correlations between EMG indices, scores of the OMES categories, and ProTMDmulti total score • Comparison of the EMG indices between the control and TMG groups.

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction**;**

[a] Torque coefficient evaluates the potential lateral displacing components given by unbalanced contractile activities of contralateral masseter and temporal muscles, the Torque Coefficient (unit %) was assessed. Torque coefficient ranges between 0% (absence of lateral displacing force) and 100% (maximum lateral displacing force).
[b] the *ProTMDmulti-part II*" evaluated the severity as indicated on a printed 11 point numerical scale where zero corresponded to the complete absence of the symptom, and 10 corresponded to the highest possible severity. The severity score was the sum of the scores attributed to each sign and symptom in the four questioned situations (range 0–40). The total severity score varies between zero (absence) and 360 (the highest possible severity). Validity of this questionnaire was not assessed in this review.
[c] The validity of the Orofacial Myofunctional Evaluation with Scores protocol was not evaluated in this review.

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Manfredini et al. 2011[16] – Italy (Diagnostic Study No. 2/11 – Case-control design)			
to assess the diagnostic accuracy of a commercially available surface electromyography and kinesiography Case-Control study	• **Patient Group:** (N= 36 patients) o Consecutive patients seeking TMD treatment in a dental school. o Presenting TMD with or without limited mouth opening (according to RDC/TMD) o 24 women and 12 men; mean age 34 years • **Control Group:** (N= 36 subjects) o Recruited from the university staff and their friends. o No TMD (according to RDC/TMD) o Subjects who did not enter in contact in the past with the investigators or the instruments.	**Interventions (the tested diagnostic methods):** • Surface electromyography o The masseter and anterior temporal muscles of both sides were examined. o Evaluation was done at rest and during the maximum voluntary teeth clenching. • Kinesiography o Recorded the location of the mandible relative to a sensor array suspended on the bridge on the bridge of the nose. o three indices were collected: ▪ maximum mouth opening, ▪ maximum lateral deviation from mid-sagital plane during jaw opening ▪ vertical free-way space **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects	• Difference between TMD patients and control in terms of EMG values. Evaluation was based on the p-value of the t-test for independent sample • Diagnostic accuracy was based on the receiver operating characteristics curve (ROC). o True positive rate (sensitivity) o False-positive rate (1- specificity)
Tartaglia et al. 2011[17] –Italy (Diagnostic Study No. 3/11 – Case-control design)			
To assess the normalized EMG characteristics of masticatory muscles of a group of young adult patients with long lasting TMD. Case-Control Study	• **Patient Group:** (N= 30 patients) o Consecutive patients with craniofacial pain consulting in a private clinic. o Presenting arthrogenous TMD (Axis I, groups II and III, according to RDC/TMD) o 15 women and 15 men, mean age 23 years • **Control Group**: (N= 20 subjects) o Students in a dental school. o No TMD (according to RDC/TMD) o 10 women and 10 men, mean age 23 years	**Intervention (the tested diagnostic method):** • Surface electromyography o The masseter and anterior temporal muscles of both sides were examined. o Evaluation was done during the maximum voluntary teeth clenching o Computer-based analysis system was used. o Four indices were collected: ▪ POC masseter ▪ POC anterior temporal ▪ Torque coefficient[a] ▪ Total standardized activity **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects.	• Comparison of the EMG indices between the control and the TMD groups.

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**;**
RDC/TMD= Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction
[a] Torque coefficient evaluates the potential lateral displacing components given by unbalanced contractile activities of contralateral masseter and temporal muscles, the Torque Coefficient (unit %) was assessed. Torque coefficient ranges between 0% (absence of lateral displacing force) and 100% (maximum lateral displacing force).

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Rodrigues-Bigaton et al. 2010[18] – Brazil (Diagnostic Study No. 4/11 – Case-control design)			
Compare the symmetry of the activity and masticatory muscles in individuals with TMD and asymptomatic. Case-Control Study	• **Patient Group:** ○ Presenting TMD (according to RDC/TMD), pain and fatigue in the masticatory muscles ○ 31 women • **Control Group:** ○ Volunteers with no TMD (according to RDC/TMD) ○ 19 women • mean age 24 years (both groups)	**Intervention (the tested diagnostic method):** • Surface electromyography ○ The masseter and anterior temporal muscles of both sides were examined. ○ Evaluation was done at rest and during isometric contraction (the maximum voluntary teeth clenching). ○ Computer-based analysis system was used. ○ Two indices were collected: ▪ Masticatory muscles activity index ▪ Masticatory muscles asymmetry index **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects.	• Comparison of the EMG indices between the control and the TMD groups.
Ardizone et al. 2010[19] – Spain (Diagnostic Study No. 5/11 – Case-control design)			
Detect the possible existence of TMG pattern in TMD patients as compared with asymptomatic individuals. Case-Control Study	• **Patient Group:** ○ Previously diagnosed with TMD (method not reported) ○ 95 women, age range from 20 to 50 years • **Control Group:** ○ 31 women ○ No signs or symptoms of TMD	**Intervention:** • Surface electromyography ○ The masseter and anterior temporal muscles of both sides were examined. ○ Evaluation was done at rest and maximum effort contraction (the maximum voluntary teeth clenching). ○ Muscle relaxation using transcutaneous electrical nervous stimulation (TENS) was used between each recording ○ Computer-based analysis system was used. ○ Indices collected: ▪ Masticatory muscles activity at rest/ maximum clenching ▪ Masticatory muscles activity during the peak activity in the masticatory cycles **Comparators:** • "Helkimo" test, participants were classified in four groups: ○ Group 0: control group ○ Group I: minor TMD affliction – n=33 ○ Group II: moderate TMD affliction – n=29 ○ Group III: serious TMD affliction – n=33	• Comparison of the EMG indices between the four groups.

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Santana-Mora et al. 2009[20] – Spain (Diagnostic Study No. 6/11 – Case-control design)			
Assesse the differences in EMG activity during clenching in women with chronic unilateral TMD as compared to control subjects. Case-Control Study	• **Patient Group** ○ Random selection from a TMD clinic in an academic facility ○ Previously diagnosed with TMD (method not reported) ○ Diagnosed as chronic pain Axes I, ○ 50 women, 25 patients had right and 25 patients had left TMD ○ Mean age 20 years • **Control Group:** ○ 25 female dental students, mean age 20 years ○ Pain-free subjects	**Intervention:** • Surface electromyography ○ The masseter and anterior temporal muscles of both sides were examined. ○ Evaluation was done during the maximum voluntary teeth clenching. ○ Computer-based analysis system was used. ○ Indices collected: ▪ Masticatory muscles activity at maximum clenching ▪ Masticatory muscles asymmetry index **Comparators:** • Not reported explicitly in the article. Comparisons were made based on the presence or absence of pain in the masticatory apparatus at baseline. Pain was measured using visual analogue scale.	Clinical • Pearson correlation coefficient between EMG activity and the visual analogue pain score. • Intraclass coefficient correlation was calculated to estimate the intra- and inter-sessional reproducibility. • Comparison of the EMG indices between the control and the right and left TMD groups.
Caria et al. 2009[21] – Brazil (Diagnostic Study No. 7/11 – Case-control design)			
Look for signals of muscle fatigue in TMD patients during short period of mastication. Case-Control Study	• **Patient Group:** (N= 10 patients) ○ Volunteer TMD patients ○ Presenting myogenic TMD (according to RDC/TMD) ○ 10 women, mean age 25 years • **Control Group**: (N= 10 subjects) ○ Volunteers ○ No TMD (according to RDC/TMD) ○ 10 women, mean age 24 years	**Intervention (the tested diagnostic method):** • Surface electromyography ○ The masseter and anterior temporal muscles of both sides were examined. ○ Evaluation was done during the maximum voluntary muscle contraction (on an elastic cord) ○ Computer-based analysis system was used. ○ Two indices were collected: ▪ Median frequency values of power spectrum of muscle activity ▪ Amplitude of EMG signals for the muscle activity **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects.	• Comparison of the EMG indices between the control and the TMD groups

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Ries et al. 2008[22] – Brazil (Diagnostic Study No. 8/11 – Case-control design)			
Analyze the symmetry of the electromyography of the temporalis, masseter and sternocleidomastoid muscles in TMD patients and asymptomatic controls Case-Control Study	• **Patient Group:** (N= 20 patients) o Volunteer TMD patients o Presenting TMD (according to RDC/TMD) o 20 women • **Control Group**: (N= 10 subjects) o Volunteers o No TMD (according to RDC/TMD) o 20 women	**Intervention (the tested diagnostic method):** • Surface electromyography o The masseter, anterior temporal and sternocleidomastoid muscles of both sides were examined. o Evaluation was done at maximal intercuspal position (maximum clenching), mandibular rest position, and a non-habitual chewing cycle o Computer-based analysis system was used. o Two indices were collected: ▪ POC masseter ▪ POC anterior temporal ▪ POC sternocleidomastoid muscles **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects.	• Comparison of the EMG indices between the control and the TMD groups.
Tartaglia et al. 2008[23] –Italy (Diagnostic Study No. 9/11 – Case-control design)			
Examine if EMG indices differ between patients in the different RDC/TMG groups and control individuals. Case-control study	• **Patient Group:** (N= 103 patients) o Patients with craniofacial pain consulting in a private clinic. o According to RDC/TMD criteria, patients were presenting: ▪ Myogenous TMD (n= 25) ▪ Arthrogenous TMD (n= 61) ▪ Psycogenous TMD (n=17) o 90 women and 13 men, mean age 42 years • **Control Group**: (N= 32 subjects) o 25 women and 7 men from the same dental clinic, who had EMG test for other reasons than TMD o No TMD (according to EMG values)	**Intervention:** • Surface electromyography o The masseter and anterior temporal muscles of both sides were examined. o Evaluation was done during the maximum voluntary teeth clenching o Computer-based analysis system was used. o Four indices were collected: ▪ POC masseter ▪ POC anterior temporal ▪ Torque coefficient[a] ▪ Standardized activity **Comparators (the reference test):** • Research Diagnostic Criteria for TMD – it was used to classify TMD patients in subgroups, but it was not used for the diagnosis of controls	• Comparison of the EMG indices between the control and the TMD groups.

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

[a] Torque coefficient evaluates the potential lateral displacing components given by unbalanced contractile activities of contralateral masseter and temporal muscles, the Torque Coefficient (unit %) was assessed. Torque coefficient ranges between 0% (absence of lateral displacing force) and 100% (maximum lateral displacing force).

Table 3. Characteristics of the Included Diagnostic Accuracy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Ferrario et al. 2007[24] – Italy (Diagnostic Study No. 10/11 – Case-control design)			
Assess the EMG characteristics of TMD patients and neck pain patients. Case-Control Study	• **Patient Group:** (N= 38 patients) o Patients with orofacial or neck pain consulting in a private clinic. o According to physical examination, patients were classified: ▪ TMD – 17 women and 7 men, mean age 35 years ▪ Neck pain – 11 women and 3 men, mean age 48 years • **Control Group**: (N= 95 subjects) o No TMD (no signs or symptoms) o 28 women and 67 men, mean age 20.	**Intervention:** • Surface electromyography o The masseter and anterior temporal muscles of both sides were examined. o Evaluation was done during the maximum voluntary teeth clenching o Computer-based analysis system was used. o Four indices were collected: ▪ POC masseter ▪ POC anterior temporal ▪ Torque coefficient[a] ▪ Standardized activity **Comparators (the reference test):** The physical examination	• Comparison of the EMG indices between the control and the TMD and neck pain groups.
Tosato et al. 2007[25] – Brazil (Diagnostic Study No. 11/11 – Case-control design)			
Assess the masticatory muscles behaviour in individuals with myogenic, arthrogenic and mixed TMD. Case-Control Study	• **Patient Group:** (N= 28 patients) o Volunteers o According to RDC/TMD criteria, patients were presenting: ▪ Myogenous TMD (n= 9, mean age 28 years) ▪ Arthrogenous TMD (n= 6, mean age 29 years) ▪ Mixed TMD (n=13, mean age 30 years) • **Control Group**: (N= 12 subjects) o No TMD (According to RDC/TMD criteria) o Mean age 28 years	**Intervention:** • Surface electromyography o The standardized activity was collected (root mean square) **Comparators:** • Research Diagnostic Criteria for TMD – participants were classified as TMD patients or no TMD subjects.	• Comparison of the EMG indices between the control and the TMD group

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

[a] Torque coefficient evaluates the potential lateral displacing components given by unbalanced contractile activities of contralateral masseter and temporal muscles, the Torque Coefficient (unit %) was assessed. Torque coefficient ranges between 0% (absence of lateral displacing force) and 100% (maximum lateral displacing force).

Table 4. Characteristics of the Included Clinical Efficacy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Silva et al. 2012[28] – Brazil (Efficacy study No. 1/3 – Case-Control design)			
Evaluate the effectiveness of an occlusal splint based on electromyographic index Non-randomized trial (Case-control design)	• **Patient Group:** (N= 15 patients) ○ Consecutive patients at an academic facility ○ According to RDC/TMD criteria, patients were presenting TMD with disk displacement ○ 11 women and 4 men, mean age 26 years • **Control Group**: (N= 15 subjects) ○ No TMD (According to RDC/TMD criteria)	**Intervention:** • Occlusal splint prepared according to the "Functional Anatomy Research Centre – FARC" protocol ○ The splint was prepared with 2mm thickness, ○ It was built on a semi-adjustable articulator so that only two bilateral points in the posterior teeth touch the splint without previous static or dynamic anterior contact ○ The surface of the splint is adjusted based on the EMG registration to obtain a balanced muscular activity. ○ Conventional clinical control of dental occlusion was performed using articulating paper ○ The splint was used for 5 weeks **Comparators:** • Non	• Mouth opening • Pain score during maximum opening (measuring method was not reported) • Evaluation was based on EMG indices at maximal intercuspation ○ POC masseter ○ POC temporalis ○ Torque coefficient[a] ○ Activity index
Monaco et al. 2012[26] – Italy (Efficacy Study No. 2/3 – Placebo-controlled trial)			
Assess the effect of a single 60 minute transcutaneous electrical nervous stimulation (TENS) on EMG and kinesiographic activity in EMD patients Placebo-controlled trial	• 60 women • unilateral arthrogenous TMD (according to RDC/TMD criteria) • Median age 26 years	**Intervention group (N= 20)** • Transcutaneous electrical nervous stimulation (TENS) ○ Single session of 60 minutes **Comparators:** • Placebo group (N=20) ○ Sham TENS treatment • Control group (N=20) ○ No treatment	• EMG indices at maximal intercuspation ○ Muscle activity (right and left masseter, temporalis, anterior digastric, and sternocleidomastoid) • Kinesiographic values ○ Vertical movement ○ Anterior-posterior movements ○ Ratio of vertical/ anterior-posterior movements

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

[a] Torque coefficient evaluates the potential lateral displacing components given by unbalanced contractile activities of contralateral masseter and temporal muscles, the Torque Coefficient (unit %) was assessed. Torque coefficient ranges between 0% (absence of lateral displacing force) and 100% (maximum lateral displacing force).

Table 4. Characteristics of the Included Clinical Efficacy Trials

Study Objectives and Design	Inclusion Criteria, Sample Size, and Patient Characteristics	Intervention, Comparator, and Study Conduct	Clinical Outcomes
Jadidi et al. 2012[27] – Denmark (Efficacy study No. 3/3 – Randomized-controlled trial)			
Determine the effect of contingent electrical stimulation on jaw muscle activity during sleep. Randomized-controlled trial	• 11 patients (women and 2 men) • Mean age 37 years • Patients were referred to an academic facility • Patients included if they had: ○ Myogenic TMD (according to RDC/TMD criteria) ○ History of nocturnal teeth grinding ○ Frequent report of stiffness, fatigue, or discomfort in the jaw muscles upon awakening	**Intervention:** • Contingent electrical stimulation (CES) ○ It is a portable EMG apparatus which is placed around the forehead and kept on during sleep ○ The machine delivers an electrical stimulation each time it detects EMG activity associated with tooth-clenching or tooth-grinding throughout the full sleep period. **Comparators:** • Placebo ○ The same machine; however, the software delivered the electrical stimulation for the first 20 minutes only **Study Conduct:** Both patients and investigators were blinded to the allocated treatment.	**RDC/TMD criteria:** • Number of painful muscles on palpation • Maximum pain-free jaw opening • Depression score (measured by the SCL-90 questionnaire) **Self-reported outcomes:** • levels of muscle pain and tension • Sleep/Tiredness/Snoring questionnaire **Surrogate outcome:** • Number of EMG events/hour (the trial primary outcome)

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

APPENDIX 3. Critical Appraisal of the Included Guidelines

Strengths	Limitations
Al-Saleh et al. 2012[15] – Canada (Diagnostic accuracy – Systematic review)	
• The review was based on a priori design • Study selection and data extraction were done by two reviewers • The scientific quality of the included studies was evaluated using the QUADAS critical appraisal tool for diagnostic studies. The results of the evaluation was reflected on the studies' conclusions	• Although the literature search was systematic using several databases, the grey literature was not included in the search.
Felicio et al. 2012[1] – Brazil (Diagnostic accuracy – Case-control study)	
• The TMD patients were consulting for orofacial pain, and they were recruited from an academic facility. This spectrum of patients is representative to the patients who will receive the EMG test. • The reference test allowed the classification of TMD patients according to their disease severity	• The TMD patient group and the control group were imbalanced in term of their number. • The study included a convenient sample size without any power estimation. • The control group was composed mainly of students from the dental facility. The awareness of the control group of the instrument and the investigation might introduce a bias due to preconceived ideas. • The study used two reference tests; the "ProTMDmulti-part II" questionnaire and the "Orofacial Myofunctional Evaluation with Scores" protocol. These two tests were created and validated by the authors of the trial, and they were not evaluated independently in this review. The Research Diagnostic Criteria for TMD is a reliable and validated tool was used in this trial to confirm the diagnosis of TMD, and would be more appropriate if the same tool was used to control the EMG indices. • The retest exam was given for a subgroup of participants only. Same session retest was provided mainly for TMD patients, while the 3-month retest was given for the control group only. • It was not clear in the article if the three diagnostic tests were conducted and interpreted with knowledge of the results of the Research Diagnostic Criteria for TMD.
Manfredini et al. 2011[16] – Italy (Diagnostic accuracy – Case-control study)	
• Sample size was calculated a priori to detect a achieve 80% statistical power to deference of 2.5µV between TMD patients and asymptomatic subjects. • The examiners were blinded to the participant's status, being TMD patient or control. • The recruited patients are representative to the patients who will receive the EMG test.	• Although the study used The Research Diagnostic Criteria for TMD for diagnosis of TMD, the severity of TMD was not evaluated. Therefore, correlations were only made with the presence/absence of TMD, but not with its severity. • Test reproducibility (test-retest) was not evaluated

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Strengths	Limitations
Tartaglia et al. 2011[17] –Italy (Diagnostic accuracy – Case-control study)	
• The TMD patients were consulting for craniofacial pain. This spectrum of patients is representative to the patients who will receive the EMG test. • All included participants received the reference test (The Research Diagnostic Criteria for TMD) and the EMG tests.	• The TMD patient group and the control group were imbalanced in term of their number. • The study included a convenient sample size without any power estimation. • The control group was composed mainly of students from the dental facility. The awareness of the control group of the instrument and the investigation might introduce a bias due to preconceived ideas. • The severity of TMD was not evaluated. Correlations were only made with the presence/absence of TMD, but not with its severity. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control
Rodrigues-Bigaton et al. 2010[18] – Brazil (Diagnostic accuracy – Case-control study)	
All included participants received the reference test (The Research Diagnostic Criteria for TMD) and the EMG tests.	• The article did not report details on the setting from which the study population was recruited; therefore, the generalizability of patients' characteristics could not be evaluated. • The study included a convenient sample size without any power estimation. • Results of the Research Diagnostic Criteria for TMD evaluation were not detailed. Classification of the TMD (myogenic/ arthrogenic) was not reported. • The severity of TMD was not evaluated. Correlations were only made with the presence/absence of TMD, but not with its severity. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control
Ardizone et al. 2010[19] – Spain (Diagnostic accuracy – Case-control study)	
• The article reported a detailed description of the EMG protocol. • The reference test allowed the classification of TMD patients according to their disease severity	• The method of TMD diagnosis was not reported. • The study included a convenient sample size without any power estimation. • The TMD patient group and the control group were imbalanced in term of their number. • The validity of the reference test "Helkimo" test was not evaluated independently in this review. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Strengths	Limitations
Santana-Mora et al. 2009[20] – Spain (Diagnostic accuracy – Case-control study)	
• The TMD patients were recruited from a TMD clinic in an academic facility. This spectrum of patients is representative to the patients who will receive the EMG test. • The article reported a detailed description of the EMG protocol. • The reference test (visual analogue scale of pain) allowed the classification of TMD patients according to their disease severity. • Investigator was blinded to the participant's status, TMD patient or control	• The method of TMD diagnosis was not reported. • The study included a convenient sample size without any power estimation. • Test reliability (test-retest) was evaluated for a subgroup of patients.
Caria et al. 2009[21] – Brazil (Diagnostic accuracy – Case-control study)	
• All included participants received the reference test (The Research Diagnostic Criteria for TMD) and the EMG tests. • The article reported a detailed description of the EMG protocol.	• The article did not report details on the setting from which the study population was recruited; therefore, the generalizability of patients' characteristics could not be evaluated. • The study included a convenient sample size without any power estimation. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control. • Results of the Research Diagnostic Criteria for TMD evaluation were not detailed. Classification of the TMD (myogenic/ arthrogenic) was not reported. • The severity of TMD was not evaluated. • Correlations were only made with the presence/absence of TMD, but not with its severity.
Ries et al. 2008[22] – Brazil (Diagnostic accuracy – Case-control study)	
• All included participants received the reference test (The Research Diagnostic Criteria for TMD) and the EMG tests. • The article reported a detailed description of the EMG protocol.	• The article did not report details on the setting from which the study population was recruited; therefore, the generalizability of patients' characteristics could not be evaluated. • The study included a convenient sample size without any power estimation. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control. • Results of the Research Diagnostic Criteria for TMD evaluation were not detailed. Classification of the TMD (myogenic/ arthrogenic) was not reported. • The severity of TMD was not evaluated. • Correlations were only made with the presence/absence of TMD, but not with its severity.

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Strengths	Limitations
Tartaglia et al. 2008[23] –Italy (Diagnostic accuracy – Case-control study)	
• The TMD patients were consulting for craniofacial pain. This spectrum of patients is representative to the patients who will receive the EMG test. • Investigator was blinded to the participant's status, TMD patient or control • The article reported a detailed description of the EMG protocol.	• Test reproducibility (test-retest) was not evaluated. • The study included a convenient sample size without any power estimation. • Individuals in the control group were classified as controls based on EMG tests conducted for other reasons than TMD. No other reference tests were used to confirm the absence of TMD in these patients.
Ferrario et al. 2007[24] – Italy (Diagnostic accuracy – Case-control study)	
• The TMD patients were consulting for craniofacial pain. This spectrum of patients is representative to the patients who will receive the EMG test. • The article reported a detailed description of the EMG protocol.	• It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control. • The study included a convenient sample size without any power estimation. • The investigators used physical examination for to differentiate between groups; however, the article did not report how this exam was standardized and interpreted, • The severity of TMD was not evaluated. • Correlations were only made with the presence/absence of TMD, but not with its severity
Tosato et al. 2007[25] – Brazil (Diagnostic accuracy – Case-control study)	
• All included participants received the reference test (The Research Diagnostic Criteria for TMD) and the EMG tests.	• The article did not report details on the setting from which the study population was recruited; therefore, the generalizability of patients' characteristics could not be evaluated. • The study included a convenient sample size without any power estimation. • Test reproducibility (test-retest) was not evaluated • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control • The severity of TMD was not evaluated. • Correlations were only made with the presence/absence of TMD, but not with its severity.
Silva et al. 2012[28] – Brazil (Efficacy study / Case-Control design)	
• The treatment and control groups had their TMD status confirmed by the Research Diagnostic Criteria for TMD and baseline EMG tests.	• The control group was composed of asymptomatic individuals who did not need any treatment. • The intervention (occlusal splint) was not controlled with any kind of reference treatment • It was not clear in the article if the EMG testing was conducted and interpreted with knowledge of the participant's status, TMD patient or control

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

Strengths	Limitations
Monaco et al. 2012[26] – Italy (Efficacy Study – Placebo-controlled trial)	
• The trial was conducted according to a priori prepared protocol.	• The trial used a convenient sample size not based on power calculation. • The article did not report if interpretations of the EMG and kinesiography results were blinded or not • The trial used surrogate outcomes without any evaluation of clinical endpoints. Furthermore, the surrogate measures used did not have known values that represent clinically meaningful effects.
Jadidi et al. 2012[27] – Denmark (Efficacy study – Randomized-controlled trial)	
• Randomization was produced in blocks using computer generated random number combinations • Allocation was concealed using opaque sealed envelops with sequential ID numbers • Both patients and investigators were blinded to the allocated treatment	• The trial used a convenient sample size not based on power calculation.

EMG= electromyography**; RDC/TMD=** Research Diagnostic Criteria for TMD;**TMD=** temporomandibular dysfunction

APPENDIX 4. Main Study Findings and Authors' Conclusions

Table 5. Findings of the Diagnostic Accuracy Trials

Study Findings				Authors' Conclusions / Reviewer's Comments
Al-Saleh et al. 2012[15] – Canada (Diagnostic Accuracy – Systematic Review)				
Estimates of the psychometric values of the EMG in TMD diagnosis				**Authors' conclusions:** The available evidence does not support the use of EMG for TMD screening or diagnosis.
	Range in values (from the 1st study)	**Average values (from the 2nd study)**	**Interpretation**	**Reviewer's comments**
Sensitivity	0.15 to 0.4	0.69	Percentage of patients correctly identified as having TMD	poor sensitivity
Specificity	0.95 to 0.98	0.67	Proportion of participants without TMD for whom test results are negative	results from the included studies are not consistent
Positive Predictive Value	0.75 to 0.94	0.67	Probability of having TMD in a patient whose test result is positive	These values are too broad to indicate the likelihood that a participant actually has TMD or not based on the EMG values
Negative Predictive Value	0.53 to 0.63	0.68	Probability of not having TMD in a patient whose test result is negative	
Positive Likelihood Ratio	3 to 16.4	2.06	Minimal to large increase in the likelihood of having TMD when the EMG value is high	These estimates are not affected by the prevalence of TMD. The results of these estimates were not conclusive in the included studies
Negative Likelihood Ratio	0.61 to 0.9	0.47	Minimal decrease of the likelihood of having TMD when the EMG value is low	

EMG= electromyography**; TMD=** temporomandibular dysfunction**;**

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th>Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="2">Felicio et al. 2012[1] – Brazil (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td>
EMG test reproducibility
<table>
<tr><th>EMG Index</th><th>POC temporal</th><th>POC Masseter</th><th>Torque coefficient</th><th>Standardized activity</th></tr>
<tr><td>p-value (retest same session, n= 25)</td><td>0.65</td><td>0.74</td><td>0.21</td><td>0.34</td></tr>
<tr><td>P-value (retest after 3 months, n= 13)</td><td>0.40</td><td>0.84</td><td>0.54</td><td>0.50</td></tr>
</table>
Spearman correlations between EMG indices, OMES scores, and ProTMDmulti
<table>
<tr><th>EMG Index</th><th>POC temporal</th><th>POC Masseter</th><th>Torque coefficient</th><th>Standardized activity</th></tr>
<tr><td>Appearance/ posture</td><td>0.3</td><td>0.3</td><td>-0.3</td><td>0.34</td></tr>
<tr><td>mobility</td><td>-0.02</td><td>-0.02</td><td>-0.03</td><td>0.02</td></tr>
<tr><td>Functions</td><td>0.25</td><td>0.25</td><td>-0.3</td><td>0.18</td></tr>
<tr><td>ProTMDmulti</td><td>-0.42</td><td>-0.27</td><td>-0.43</td><td>-0.17</td></tr>
</table>
Difference in EMG values between EMD patients the controls during maximum clenching
<table>
<tr><th>EMG Index</th><th>POC temporal</th><th>POC Masseter</th><th>Torque coefficient</th><th>Standardized activity</th></tr>
<tr><td>Difference between groups</td><td colspan="3">Statistically significant</td><td>Statistically not significant</td></tr>
</table>
EMG= electromyography; OMES= Orofacial Myofunctional Evaluation with Scores Protocol; TMD= temporomandibular dysfunction;
</td><td>
Authors' Conclusions:
The EMG, OMES, and ProTMD protocols allowed discriminating TMD and health women.

Reviewer's comments:

Reproducibility of EMG showed that the test-retest results were not statistically significantly different. The retest exam was given on the same session for TMD patients, while the 3-month retest was given for the control group only.
The EMG indices showed correlations with the OMES and ProTMDmulti that ranged from 0.02 to 0.43. These correlations are considered very weak to moderate.[29]
The statistical significance of the difference in EMG indices between TMD patients and the control group are meaningless because the EMG showed weak correlation with the clinical diagnostic tools. Therefore, EMG lacks normative values which can be used to discriminate TMD patients and asymptomatic subjects.

</td></tr>
</table>

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th>Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="2">Manfredini et al. 2011[16] – Italy (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td>
EMG and Kinesiography tests – comparison between TMD and control group and the diagnostic values
<table>
<tr><th></th><th>Difference between groups</th><th>Sensitivity</th><th>Specificity</th></tr>
<tr><td colspan="4">EMG Tests</td></tr>
<tr><td>At rest: RT, LT and RM</td><td>Statistically not significant</td><td rowspan="2">28% to 48%</td><td rowspan="2">43.5% to 52.2%</td></tr>
<tr><td>At rest test: LM</td><td>Statistically significant</td></tr>
<tr><td>During Clenching: RT, LT, RM, LM</td><td>Statistically significant</td><td>77.8% to 91.7%</td><td>76.7% to 86.7%</td></tr>
<tr><td colspan="4">Kinesiographic recording</td></tr>
<tr><td>Maximum opening</td><td>Statistically not significant</td><td rowspan="4">47.8% to 62.9</td><td rowspan="4">38.9% to 69.4%</td></tr>
<tr><td>Maximum right deflection</td><td>Statistically significant</td></tr>
<tr><td>Maximum left deflection</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>Freeway space</td></tr>
</table>
</td><td>Authors conclusions:
• Resting EMG values, symmetry of muscle activity at rest and during clenching, kinesiography parameters show high rates of false-positive findings in TMD-free subjects.
• EMG during clenching showed a significantly higher activation in TMD suggesting that patterns of muscle activation governing the pain-motor function relationship are not dependent on the absolute magnitude of activity.
• EMG and kinesiography should not be used for the diagnosis or monitoring the course of TMD because of the potential risk of over-diagnosis and overtreatment.</td></tr>
<tr><td colspan="2">Tartaglia et al. 2011[17] –Italy (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td>
Difference in EMG values between TMD patients the controls
<table>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscle</th><th>Difference between groups</th></tr>
<tr><td rowspan="2">Symmetry (POC) analysis</td><td rowspan="3">Maximum clenching</td><td>Temporal</td><td>Statistically significant</td></tr>
<tr><td>Masseter</td><td>Statistically not significant</td></tr>
<tr><td>Torque Coefficient</td><td>-</td><td>Statistically significant</td></tr>
<tr><td>Standardized activity</td><td>-</td><td>Statistically not significant</td></tr>
</table>
</td><td>Authors conclusions:
Young adults with long lasting TMD have an increased and more asymmetric standardized activity of their temporalis anterior muscle, and reduced mean power frequencies, relative to health controls.

Reviewer's comments:
The EMG indices did not show consistent differences between TMD patients and controls</td></tr>
</table>

EMG= electromyography**; LT=** left anterior temporal**; LM=** left masseter; **POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; RT=** right anterior temporal**; ; RM=** right masseter; **TMD=** temporomandibular dysfunction

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th colspan="4">Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="5">Rodrigues-Bigaton et al. 2010[18] – Brazil (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">Difference in EMG values between EMD patients the controls
<table>
<tr><th>EMG index</th><th>Muscle Status</th><th>Masticatory muscle</th><th>Difference between groups</th></tr>
<tr><td rowspan="4">Activity Index</td><td rowspan="2">Rest</td><td>Masseter</td><td rowspan="2">Statistically significant</td></tr>
<tr><td>Temporalis</td></tr>
<tr><td rowspan="2">Isometric contraction</td><td>Masseter</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>Temporalis</td></tr>
<tr><td rowspan="2">Asymmetry Index</td><td>Rest</td><td rowspan="2">All muscles</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>Isometric contraction</td></tr>
</table></td><td rowspan="2">Authors' conclusions:
• TMD patients and controls showed predominance of the temporal muscle at rest.
• No difference was found between groups for the symmetry of the temporal and masseter muscles.

Reviewer's comments:
• The difference between groups in terms of the EMG indices is an important factor for the evaluation of EMG as a diagnostic test for TMD. The discrimination power of EMG was not consistent, and it was only recorded by the activity index at rest.</td></tr>
<tr><td colspan="5">Ardizone et al. 2010[19] – Spain (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">• Multiple comparisons analysis showed that the differences between the dysfunction groups were not significant in any of the EMG tests.
• Baseline tests showed that there were differences between the control group and the greatest dysfunction group only.
• These differences faded out at the rest test (after TENS).
• Tests during masticatory activity showed that the control group was statistically significantly different from the greatest dysfunction group only.</td><td>Authors' conclusions:
• Classification using electromyography matches that established by the Helkimo test.

Reviewers' comments:
• The EMG tests were able to discriminate the control group from the most severe TMD patients; however, the discriminative power was not consistent in all tests.</td></tr>
</table>

EMG= electromyography;; **TENS=** transcutaneous electrical neural stimulation **; TMD=** temporomandibular dysfunction**;**

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th>Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="2">Santana-Mora et al. 2009[20] – Spain (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td>
Correlation between EMG-activity and the visual analogue pain score:
Pearson's correlations were not statistically significant between the pain scores and the muscle activity of the two masticatory muscles tested (masseter and temporal muscles)

Reproducibility:
Intra-class coefficient was 0.886

Difference in EMG values between EMD patients the controls at maximum teeth clenching
<table>
<tr><th></th><th>Controls versus right TMD patients</th><th>Controls versus left TMD patients</th></tr>
<tr><td>Right temporalis</td><td rowspan="4">Statistically significant</td><td>Statistically not significant</td></tr>
<tr><td>Right masseter</td><td rowspan="2">Statistically significant</td></tr>
<tr><td>Left temporalis</td></tr>
<tr><td>Left masseter</td><td>Statistically not significant</td></tr>
</table>
</td><td rowspan="2">
Authors' conclusions:
• EMG activity in unilateral TMD-pain patients was lower on the pain side than on the pain-free side.
• The asymmetry index may be useful measure in discriminating patients with right versus left-side TMD.

Reviewer's comments
• Pain is one of the most important manifestations of TMD; however, EMG indices were not correlated with the clinical scores of pain.
• Reproducibility of EMG showed a good correlation coefficient; however, this coefficient was tested in 13% of the included participants.
• The discrimination power of EMG was not consistent.
</td></tr>
<tr><td colspan="2">Caria et al. 2009[21] – Brazil (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td>
Difference in EMG values between TMD patients the controls
<table>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscle</th><th>Difference between Groups</th></tr>
<tr><td>EMG amplitude</td><td rowspan="2">maximum voluntary muscle contraction (on an elastic cord)</td><td>Temporalis (left and right)</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>EMG median frequency</td><td>Masseter (left and right)</td></tr>
</table>
</td><td>
Authors' conclusions:
• There are no differences in the EMG amplitude and median frequency between TMD patients and clinically normal volunteers.
</td></tr>
</table>

EMG= electromyography **; TMD=** temporomandibular dysfunction**;**

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th colspan="4">Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="5">Ries et al. 2008[22] – Brazil (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">Difference in muscle symmetry between TMD patients the control</td><td rowspan="4">Authors Conclusions:
• Individuals with TMD present higher asymmetry of jaw and neck muscles that cervical posture should be included in the clinical evaluation of TMD.</td></tr>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscle</th><th>Difference between Groups</th></tr>
<tr><td rowspan="3">Symmetry (POC) analysis</td><td rowspan="3">multiple comparisons at rest, maximum clenching and during the chewing cycle</td><td>Temporal</td><td>Statistically not significant</td></tr>
<tr><td>Masseter</td><td rowspan="2">Statistically significant</td></tr>
<tr><td>sternocleidomastoid</td></tr>
<tr><td colspan="5">Tartaglia et al. 2008[23] –Italy (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">Difference in EMG values between control group and the three TMD groups (myogenous, arthrogenous and psycogenous)</td><td rowspan="5">Authors Conclusions:
• EMG of masticatory muscles allowed the assessment of the functional and dysfunctional characteristics of TMD patients
• The analyses permitted the discrimination among the different RDC/TMD subgroups

Reviewer's comments:
The EMG indices did not show consistent differences between TMD patients and controls</td></tr>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscle</th><th>Difference between groups</th></tr>
<tr><td>Symmetry (POC) analysis</td><td rowspan="3">Maximum clenching</td><td>Temporal</td><td>Statistically significant</td></tr>
<tr><td>Torque Coefficient</td><td>Masseter
-</td><td>Statistically not significant</td></tr>
<tr><td>Standardized activity</td><td>-</td><td>Statistically significant</td></tr>
<tr><td colspan="5">Ferrario et al. 2007[24] – Italy (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">Difference in EMG values between control group, TMD and neck pain groups</td><td rowspan="5">Authors Conclusions:
• EMG test allowed the differentiation between patients with TMD and patients with neck pain</td></tr>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscle</th><th>Difference between groups</th></tr>
<tr><td>Symmetry (POC) analysis</td><td rowspan="3">Maximum clenching</td><td>Temporal
Masseter</td><td rowspan="3">Statistically significant*</td></tr>
<tr><td>Torque Coefficient</td><td>-</td></tr>
<tr><td>Standardized activity</td><td>-</td></tr>
</table>

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; TMD=** temporomandibular dysfunction**;**

* Generalized linear model was used to compare the three groups and to adjust for the age difference between groups

Table 5. Findings of the Diagnostic Accuracy Trials

<table>
<tr><th colspan="4">Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="5">Tosato et al. 2007[25] – Brazil (Diagnostic Accuracy – Case-Control Study)</td></tr>
<tr><td colspan="4">Difference in EMG values between control group and TMD groups</td><td rowspan="4">Authors Conclusions:
• Alteration on the muscle contraction pattern of TMD individuals compared to that of asymptomatic patients.</td></tr>
<tr><th>EMG index</th><th>Muscle Status</th><th>Compared groups</th><th>Difference between groups</th></tr>
<tr><td rowspan="3">Standardized activity</td><td rowspan="3">Isotonic contraction</td><td>Control vs. mixed TMD</td><td>Statistically not significant</td></tr>
<tr><td>Control vs. arthrogenic TMD</td><td rowspan="2">Statistically significant</td></tr>
<tr><td>Control vs. myogenic TMD</td></tr>
</table>

EMG= electromyography**; TMD=** temporomandibular dysfunction**;**

Table 6. Findings of the Efficacy Trials

<table>
<tr><th>Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="2">Silva et al. 2012[28] – Brazil (Efficacy study – Case-Control design)</td></tr>
<tr><td>
Mouth opening :
TMD group : at baseline 50.8mm – at the end of treatment 53.1mm; p-value of the difference = 0.03
Control group : not recorded

Pain score :
TMD group : Statistically significant reduction of pain score (the magnitude was not reported)

Difference in EMG values between TMD patients the controls during maximum clenching at the end of the treatment period
<table>
<tr><th>EMG Index</th><th>POC temporal</th><th>POC Masseter</th><th>Torque coefficient</th><th>Standardized activity</th></tr>
<tr><td>Difference between groups</td><td colspan="4">Statistically significant</td></tr>
</table>
</td><td>
Authors Conclusions:
• the use of occlusal splints adjusted based on EMG recordings promoted balance of the EMG activities during its use, and it relieved symptoms

Reviewer's comments:
• the study did not appropriately controlled the intervention; the use of healthy individuals as control for an intervention does not allow the evaluation of the clinical efficacy of an intervention.
</td></tr>
<tr><td colspan="2">Monaco et al. 2012[26] – Italy (Efficacy Study – Placebo-controlled trial)</td></tr>
<tr><td>
Difference in EMG values between TENS, placebo and control groups
<table>
<tr><th>EMG index</th><th>Muscle Status</th><th>Tested Muscles</th><th>Difference between groups</th></tr>
<tr><td rowspan="4">Muscle activity</td><td rowspan="4">Maximum intercuspation</td><td>Masseter</td><td rowspan="2">Statistically significant</td></tr>
<tr><td>Temporalis</td></tr>
<tr><td>Anterior digastric</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>sternocleidomastoid</td></tr>
</table>
Difference in Kinesiographic values between TENS, placebo and control groups
<table>
<tr><th>Kinesiographic value</th><th>Difference between groups</th></tr>
<tr><td>Vertical</td><td>Statistically significant</td></tr>
<tr><td>Anterior/posterior</td><td rowspan="2">Statistically not significant</td></tr>
<tr><td>Ratio of vertical/ antrerior posterio</td></tr>
</table>
</td><td>
Authors Conclusions:
• the application of single session of 60 minutes of TENS could reduce the EMG activity of masticatory muscles, and increase the interocclusal distance.

Reviewer's Comments
• the results of both EMG and kinesiogrpahy tests were not consistently significantly different between groups
• The surrogate outcomes did not have known clinically meaningful values to help the interpretation of differences
</td></tr>
</table>

EMG= electromyography**; POC=** percentage overlapping coefficient – an index of the symmetric distribution of muscular activity; it ranges between 0% (no symmetry) and 100% (perfect symmetry)**; TENS=** transcutaneous electrical neural stimulation**; TMD=** temporomandibular dysfunction**;**

Table 6. Findings of the Efficacy Trials

<table>
<tr><th>Study Findings</th><th>Authors' Conclusions / Reviewer's Comments</th></tr>
<tr><td colspan="2">Jadidi et al. 2012[27] – Denmark (Efficacy study – Randomized-controlled trial)</td></tr>
<tr><td>Statistically not significant differences between the contingent electrical stimulation group and placebo were reported for the following outcomes:
• Sleep hours during the nights
• Maximum pain-free jaw-opening
• Number of painful muscles
• Depression scores
• Sleep/Tiredness/Snoring questionnaire score
• TMD pain scores
• Muscle tension scores

Difference in EMG values between groups
<table>
<tr><th></th><th>CES treatment group</th><th>Placebo group</th></tr>
<tr><td>Difference from baseline – at the end of treatment</td><td>Statistically significant</td><td>Statistically not significant</td></tr>
<tr><td>Difference between groups – at the end of treatment</td><td colspan="2">Statistically not significant</td></tr>
</table>
</td><td>Authors conclusions:
• The contingent electrical stimulation had a significant inhibitory effect on jaw muscle EMG activity during sleep, but with no effect on self-reported pain

Reviewer's comments:
• The trial showed significant difference in EMG activity associated with the use of contingent electrical stimulation relative to the baseline values only. These differences did not persist when the contingent electrical stimulation was compared with the control group, and this was true for the EMG values and the clinical outcomes.</td></tr>
</table>

EMG= electromyography**; TMD=** temporomandibular dysfunction**;**