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# Guidelines in the management of orofacial pain/ TMD

## An evidence-based approach

Pain and dysfunction related to the jaw joint and jaw muscles are conditions dentists face regularly in their dental practice. It is essential that the individual patient is examined from both a dental and a psychosocial perspective since co-morbidities between temporomandibular disorders (TMD) and other conditions, such as widespread pain, systemic inflammatory disorders, and depression as well as impaired general health is common.

The Swedish government initiated a scrutiny review of the scientific literature in dentistry for the purpose of developing national guidelines in dentistry. One policy area was orofacial pain and TMD. The review included systematic reviews, randomized clinical trials, clinical trials, and observational studies of high quality published between 1965 and 2014. The scrutiny review is unique since it also included health economic analyses and the directive to arrive at a statement for every possible condition that may be encountered in the dental clinic, even when the scientific evidence was insufficient for an evidence-based statement.

Counseling and a behavioral approach, which aim to change maladaptive behaviors, are considered first-line interventions. Evidence of effect and analysis of cost effectiveness support the use of occlusal appliances and jaw exercises, which for limited periods, may be combined with non-steroidal anti-inflammatory drugs.

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### Clinical relevance box

Dentist should provide patients with:

- Temporomandibular disorders (unspecified): behavior-directed treatment (priority 4), instruction in jaw exercises (priority 4), treatment with a stabilization appliance (priority 4) or pharmacological treatment with NSAIDs (priority 5).
- Symptomatic disc displacement with reduction: treatment with a stabilization appliance (priority 5) or coordination exercise (priority 6).
- Symptomatic disc displacement without reduction: instruction in stretching exercises of the jaw (priority 4), treatment with a stabilization appliance (priority 6), or instruction in coordination exercise (priority 6).
- Arthralgia of the TMJ: pharmacological treatment with NSAIDs (priority 4), treatment with a stabilization appliance (priority 4), or instruction in jaw exercises (priority 5).
- Myalgia: treatment with a stabilization appliance (priority 4) or instruction in jaw stretching exercises (priority 5); optional: treatment with soft appliances (priority 6) or partially covering frontal appliances (priority 7).
- Traumatizing occlusal contacts: selective occlusal adjustment (priority 5).
- Bruxism and tooth wear with risk for progression: treatment with a stabilization appliance (priority 5 – 6).

Dentists should not provide patients with:

- Temporomandibular disorders (unspecified): treatment with low-level laser (priority 8) or TENS (priority 9).
- Myalgia: treatment with occlusal adjustment (priority 9), or intramuscular injections of botulinum toxin (priority 10) or diazepam (priority 10)
- Acute arthralgia: occlusal adjustment (not to do).
- Symptomatic disc displacement without reduction: treatment with TENS (priority 9).
- Bruxism: treatment with TENS (priority 10).
- Dysocclusion (phantom bite): occlusal adjustment (not to do).

In 2008, the Swedish government tasked The Ministry of Health and Welfare in Sweden to develop national guidelines for dental care and indicators of good dental health care for adults. The aim was to highlight effective measures with the best possible evidence. One of the seven chosen policy areas was orofacial pain and temporomandibular disorders (TMD). TMD refers to musculoskeletal conditions in the jaw, face, and temple regions, including symptoms such as pain, temporomandibular joint (TMJ) sounds, impaired jaw opening, and associated headaches. The estimated prevalence of treatment need of these conditions is in the range 5–15 % (higher in women than in men), while available statistics indicate that only 0.5–1.5 % receive treatment within the Swedish dental health care system, although TMD affects patients' quality of life negatively. It should be emphasized that it is considered essential that the individual patient is examined from both a dental and a psychosocial perspective since co-morbidities between TMD and other conditions, such as widespread pain, systemic inflammatory disorders, and depression as well as impaired general health are common.

### Method (Table 1)

A National Board Librarian conducted a literature search between 1965 and 2008 in these databases (Table 1): Medline/PubMed, the Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, Health Technology Assessment Database, and Cochrane Central Register of Controlled Trials. Twelve specialists (10 in TMD and 2 in maxillofacial surgery) reviewed the results of the search; all had a PhD degree. The reviewers systematically assessed the publications in a pair-wise audit system using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) (1). The treatment methods were grouped as follows: behavior treatment, jaw exercises, sensory stimulation, pharmacological therapy, occlusal appliances, occlusal correction, and temporomandibular joint surgery. Evaluation of treatment effect was based on patient-important outcomes that included these IMMPACT (Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials) domains: pain intensity, physical functioning, emotional functioning, and global rating of improvement (2).

Each treatment outcome was assigned a scientifically based statement supported by its evidence (high, moderate, low) or based on experts' shared opinion. The cost-benefit of each treatment was evaluated separately by health economists (i.e., low, moderate, or high cost per archived effect of treatment). A panel of experts judged the severity of each condition on a 10-graded scale (1–2 very high; 3–4 high; 5–6 moderate; or 7–10 low impact on oral health). Another panel, comprising dentists and dental hygienists, ranked all treatments for each condition from 1 (very high priority) to 10 (very low priority) or classified the treatment as «not to do» or «further research needed» based upon data from the systematic review, including effect of treatment, strength of evidence, and a health economic assessment. A treatment could not be assigned a higher priority than the condition's severity rank. The final report included 107 statements based on

218 studies. This article is a condensed summary of those parts of the national guidelines we considered important to highlight. A new literature search, of publications between 2008 and 2014, has been done, and another 63 studies have been added.

The aim of the scrutiny review was to establish guidelines in the treatment of orofacial pain and TMD for general practitioners and specialists. The guidelines are unique since they are evidence based and integrate current and best available scientific quality with health economical assessment for common TMD conditions. The intention of the Ministry of Health and Welfare was to establish guidelines for all TMD conditions, even for those where scientific support is sparse.

**Table 1.** Search strings of publications from 1965 to 2008\*. Filters: Humans; Systematic Reviews, Meta-analysis, randomized controlled trial, clinical trials, controlled clinical trial, reviews; English; Danish; Norwegian; Swedish.

| Term        | Search string  |
|-------------|--|
| 1 MeSH      | Craniomandibular Disorders OR Burning Mouth Syndrome OR Bruxism OR Dental Occlusion, Traumatic OR Open Bite OR Tooth Abrasion OR Tooth Attrition OR Tooth Erosion OR Facial Pain OR Facial Neuralgia OR Glossopharyngeal Nerve Diseases OR Hypoglossal Nerve Diseases OR Facial Nerve Diseases OR Trigeminal Nerve Diseases OR Mandibular Fractures OR Muscular Dystrophy, Duchenne Myotonic Dystrophy |
| 2 MeSH      | Counseling OR Psychotherapy OR Therapeutics OR Orthodontic Appliances OR Occlusal Adjustment OR Surgery, Oral  |
| 3 Free text | "drug therapy" OR surgery OR rehabilitation  |
| 4           | 1 AND (2 OR 3).  |

\* a supplementary search was done for publications 2008 to 2012 in an update using the same data bases, filters and search terms. An additional search was done for the period 2012 to 2014 using the MeSH term craniomandibular disorders with limits humans, age 19+, randomized clinical trial, and systematic review.

### Results

#### Behavior-directed treatment (Table 2)

The aim of behavior treatment is to guide the patient in how maladaptive behavior can be modified and changed. The objective is usually to increase the person's engagement in positive or socially reinforcing activities. Behavior-directed therapies are structured approaches that carefully measure a person's actions; then, the caregiver and the patient together agree on measures the patient can do to improve the patient's condition and situation. A number of therapies aiming at changing adverse behaviors have been studied (3–12). These include biofeedback, biofeedback-based training, cognitive behavioral therapy (CBT), habit-reversal, self-treatment at home after instruction, progressive relaxation, and self-hypnosis. All methods showed moderate to high effect in reducing pain related to myalgia. Their treatment effect was similar to other treatment modalities such as a bite-splints and superior to no or minimal treatment. Behavior-directed treatment showed minimal ef-

fect on maximal jaw opening capacity. Four of seven CBT studies reported significant improvement in various measures of mental health such as depression and improved the patient's ability to cope with their problems. The other three studies found no difference in this respect. A Cochrane report (13) and a systematic review (14) found weak evidence of the effectiveness of behavior-directed interventions in chronic oro-facial conditions and TMD. Behavior-oriented treatment is considered a basic intervention in the management of TMD.

**Table 2. Behavior-directed treatment. Severity of condition (Severity): high impact (3) on oral health and jaw function; Cost-effect (Cost): low (L), moderate (M), high (H); Priority rank (Priority) = high (1) – low (10).**

| Behavior treatment | Condition/diagnosis              | Severity | Cost | Priority |
|--------------------|----------------------------------|----------|------|----------|
| Behavior-directed  | Temporomandibular disorder (TMD) | 3        | M    | 4        |

Expected effect of behavior-directed treatments in patients with TMD:

- \* Moderate on pain (moderate evidence)
- \* Low to moderate on mental health and depression (low evidence)
- \* None to low on improved maximal jaw opening capacity (low evidence)

### Activation of motor function/ jaw exercises (Table 3)

The aim of posture exercise and coordination training is to increase patients' body awareness and reduce loads that negatively affect joints and muscles. The aim of passive stretching is to improve mobility – the length of the muscle and the range of movement of the TMJ; stretching may also help patients overcome feelings of fear to move the jaw. Seven randomized and controlled trials (RCT) involving 304 patients with primarily myofascial pain and subjected to posture exercise were identified. The studies examined the effect of posture training, activation against resistance, or both compared to counseling (15–19) or splint therapy (20, 21). The analyses of the effect of stretching were based on two systematic reviews (22, 23) that had reviewed three RCTs involving 62 patients with TMD; the RCTs examined the effect of passive stretching compared to advice or jaw opening-closing exercises (16), splint therapy (20), or massage (24). Another five RCTs included patients with disc displacement (25–27) and patients with myofascial pain who had not responded to treatment (28). Treatment was passive stretching supplemented by NSAID compared to splint therapy with NSAID or only advice (26,29), stretching supplemented by NSAIDs compared to no treatment (25), and stretching as adjunctive treatment to splint therapy compared to splint therapy only (27, 28). The expert recommendation regarding symptomatic disc displacement with reduction was to exercise jaw opening and closing movements that not provoke clicking sounds. Passive stretching was considered more

effective than posture and co-ordination exercise and was thus given a higher priority. For luxation of the TMJ, a manual maneuver to reposition the condyle into the fossa is recommended.

**Table 3. Activation of motor function/ Jaw exercises. Severity of condition (Severity): very high impact (1), high impact (3), moderate impact (5) on oral health and jaw function; Cost/effect (Cost): low (L), moderate (M), high (H); Priority rank: high (1) – low (10).**

| Jaw exercise         | Condition/diagnosis                             | Severity | Cost | Priority |
|----------------------|---|----------|------|----------|
| Posture              | TMD   | 3        | L    | 6        |
|                      | Myalgia   | 3        | *    | 7        |
| Stretching           | TMD   | 3        | L    | 4        |
|                      | Symptomatic disc displacement without reduction | 3        | L    | 4        |
|                      | Myalgia   | 3        | *    | 5        |
|                      | Arthralgia                                      | 3        | L    | 5        |
| Coordination         | Impaired jaw opening capacity                   | 3        | L    | 5        |
|                      | Symptomatic disc displacement with reduction    | 5        | M    | 6        |
| Jaw exercise         | Arthritis associated with systemic inflammation | 1        | L-M  | 6        |
|                      | Myalgia associated with widespread pain         | 1        | L-M  | 6        |
| Manual repositioning | TMJ luxation                                    | 1        | L    | 2        |

\* stretching is considered more cost effective than posture exercise

Passive stretching has:

- \* As an adjunctive treatment, moderate effect on pain reduction (moderate evidence)
- \* Moderate effect on global improvement (low evidence)
- \* Moderate effect on maximal jaw opening capacity (moderate evidence)

### Sensory stimulation (Table 4)

Sensory stimulation treatment (e.g., transcutaneous electrical nerve stimulation [TENS] and acupuncture) aims to activate the afferent nervous system and thereby modulate endogenous pain control systems to promote pain relief. Acupuncture causes the release of endogenous opioids, serotonin, and noradrenaline in the CNS and stimulates blood perfusion in tissues. Favorable patient expectations have also proved to be significantly important. Low-level lasers are proposed to induce an anti-inflammatory effect by influencing cell activity. TENS stimulates the nerves electrically via electrodes on the skin. Increased activity in the thick

nerve fibers (A-beta fibers) that mediate touch and vibration inhibits activity in thin nerve fibers (C fibers) which mediate nociceptive signals.

Acupuncture demonstrated superior pain relief in TMD and myalgia analgesic compared with no treatment and equal efficacy to other therapies (30–32). Compared with placebo, results are contradictory (33). From a health-economic perspective, acupuncture was estimated to be more expensive and so received a higher priority score compared to occlusal appliance or jaw exercise. None of the studies reported any adverse events or side effects from acupuncture treatment.

Low-level laser was compared with placebo treatment (laser with no or minimal stimulation) or TENS (34–40) and was not effective in reducing pain. A recent systematic review found no evidence to support low-level laser in the treatment of TMD (41).

Two studies evaluated TENS, one in patients with TMD (36), and one in symptomatic disc displacement without reduction (42). None of the studies found significant improvement of symptoms with TENS compared to control treatment.

**Table 4. Sensory stimulation** Severity of condition (Severity): high impact (3) on oral health and jaw function; Cost-effect (Cost): low (L), moderate (M), high (H); Priority rank (Priority) = high (1) – low (10).

| Sensory stimulation | Condition                                       | Severity | Cost | Priority |
|---------------------|---|----------|------|----------|
| Acupuncture         | TMD   | 3        | M    | 6        |
|                     | Myalgia   | 3        | M-H  | 6        |
| Low-level laser     | TMD   | 3        | M    | 8        |
| TENS                | TMD   | 3        | H    | 9        |
|                     | Symptomatic disc displacement without reduction | 3        | H    | 9        |

Acupuncture has:

\* Moderate effect on TMD and myalgia (moderate evidence)

Low-level laser has:

\* Low effect on pain reduction and on maximal jaw opening capacity (low evidence)

TENS has:

\* Low effect on TMD pain and on maximal jaw opening capacity (expert statement)

### Pharmacological therapy (Table 5)

For TMD pain, few well-designed studies with a relevant follow-up time were found. Thus, due to current limitations in knowledge of pharmacologic effects on TMD pain, the pharmacologic effect on similar pain conditions such as backache or tension-type headache was included in the review.

**Table 5. Pharmacological therapy.** Severity of condition (Severity): very high impact (1), high impact (3) on oral health and jaw function; Cost/effect (Cost): low (L), moderate (M), high (H), not assessed (na); Priority rank: high (1) – low (10).

| Pharmacological therapy                    | Condition   | Severity | Cost | Priority |
|--|---|----------|------|----------|
| Paracetamol                                | TMD   | 3        | L    | 6        |
| NSAID                                      | Arthritis associated with systemic inflammation   | 1        | L    | 4        |
|  | Arthralgia  | 3        | L    | 4        |
|  | Headache associated with TMD                      | 3        | L    | 5        |
|  | TMD   | 3        | L    | 5        |
| Topical NSAID or salicylate cream          | Myalgia   | 3        | M    | 8        |
| Glucocorticoid, intra-articular injections | Arthritis associated with systemic inflammation   | 1        | L    | 3        |
|  | Arthralgia  | 3        | L    | 5        |
| Opioids                                    | TMD (unspecified)                                 | 3        | L    | 8        |
| Diazepam                                   | Myalgia   | 3        | L    | 10       |
| Botox                                      | Myalgia   | 3        | M-H  | 10       |
| Tricyclic antidepressants                  | Myalgia associated with widespread pain           | 1        | na   | 4        |
| Anti-epileptics                            | Idiopathic orofacial pain and atypical odontalgia | 1        | L    | 4        |
| Topical capsaicin or lidocaine cream       | Idiopathic orofacial pain and atypical odontalgia | 1        | L    | 6        |

#### Paracetamol

Paracetamol seems to act on both the peripheral and central nervous systems. When combined with a weak opioid such as tramadol and NSAIDs, it is more effective than when used alone. The few adverse events that were reported were of the same magnitude as those reported for placebo. A low-to-moderate effect regarding pain relief with paracetamol in mild-to-moderate musculoskeletal pain conditions was reported (3, 43).

#### Nonsteroidal anti-inflammatory drug (NSAID)

NSAID blocks prostaglandin synthesis and is therefore effective in relieving acute inflammatory pain. In a randomized and controlled study in patients with TMD, 80 percent reported pain reduction after 3 months of treatment with NSAIDs, which was the same as that obtained after 3 months of treatment with occlusal appliance (44). Moderate pain relief with NSAIDs for light-to-moderate musculoskeletal pain was reported (3, 43).

### *Glucocorticoid administered intra-articularly*

Two randomized controlled trials (45, 46) and two controlled clinical studies (47, 48) found that intra-articular injections of glucocorticoid reduce pain and provide global improvement. No side effects or adverse effects were reported. Pain reduction was moderate and maximal jaw opening capacity had low-to-moderate improvement.

### *Opioids*

In mild-to-moderate musculoskeletal pain conditions, about 40 percent pain reduction was obtained using weak opioids with an effect equivalent to that of NSAIDs (3). Opioids, however, have troublesome side effects, including a risk of dependency. Most common side effects were constipation, fatigue, dizziness, nausea, and vomiting. In TMD pain, opioid treatment is expected to have a low-to-moderate effect on pain reduction and risk of side effects.

### *Diazepam*

The evidence for using diazepam in chronic pain was low and inconclusive based on a systematic review and a randomized clinical trial (3, 49). In myalgia, treatment with diazepam was found to have a very low effect on pain. Diazepam was also associated with side effects; long-term treatment should be avoided due to the risk of drug dependency.

### *Botulinum toxin (Botox®)*

The literature search identified one systematic review (50) and 5 RCTs (51–55). In myalgia, injections with botulinum toxin have low effect on pain.

### *Tricyclic antidepressants*

Three systematic reviews assessed the effect of antidepressants in fibromyalgia (3, 56, 57) and one systematic review the effect in TMD pain (58). Evidence for moderate pain relief with tricyclic antidepressants in fibromyalgia was reported (3, 56). Antidepressants were found to be better than placebo in TMD pain. Pain relief in myalgia compared with widespread pain was judged to be moderate and equivalent to the general effects found for the drug. Side effects are often reported, and the most common ones are dry mouth and dizziness.

### *Anti-epileptics*

There is evidence for moderate pain relief with the use of anti-epileptic drugs in neuropathic pain conditions such as trigeminal neuralgia and postherpetic neuralgia (3, 43, 59). One systematic review assessed the effect of anti-epileptics in different orofacial pain/TMD conditions (59). The consensus was that anti-epileptic drugs have moderate effect on neuropathic pain in the orofacial region and are comparable to the effect found for other neuropathic pain conditions. Reported side effects that may occur are fatigue and balance disorders.

### *Topical capsaicin and lidocaine*

In neuropathic pain, topical treatment with capsaicin or topical application of 5 percent lidocaine cream can provide pain relief (3). The scientific evidence for treatment with capsaicin or lidocaine in idiopathic facial pain and atypical odontalgia is limited. Side effects are common but mostly local. Topical application of capsaicin or lidocaine may provide low-to-moderate short-term pain relief in patients with idiopathic orofacial pain conditions.

- \* Paracetamol has low-to-moderate and NSAID moderate pain relieving effect in TMD pain (expert statement)
- \* Glucocorticoid administered intra-articularly has moderate pain relieving effect on TMJ arthritis associated with systemic inflammation (expert statement)
- \* Antiepileptic drugs have moderate pain relieving effect on idiopathic pain and atypical odontalgia (low evidence)
- \* Tricyclic antidepressants have moderate effect in myalgia associated with widespread pain (low evidence)
- \* The positive effects of any drug should be weighed against possible adverse effects and the risk of dependency

## **Occlusal appliances (Table 6)**

### *Stabilization appliances (splints)*

Occlusal appliance therapy is one of the most commonly used treatments for TMD, with stabilization appliances being the type most often recommended. Stabilization appliance therapy is also the treatment modality with the best evidence, both from randomized controlled studies and systematic reviews with meta-analyses. The treatment is reversible and aims to induce relaxation of the jaw muscles, unload the TMJ, and protect the teeth from wear due to bruxism.

Six systematic reviews (3, 60–64), including a Cochrane review, and a number of RCTs, have evaluated the effect of stabilization appliance therapy in TMD. Recently, a systematic review with a meta-analysis was published that evaluated the effect of stabilization appliance therapy compared to minimal or no treatment and used pain, depression, and quality of life as outcome measures (65).

The studies showed that stabilization appliances have a low-to-moderate effect on pain, a moderate-to-high effect on global improvement, a moderate effect on palpation pain and muscle fatigue, and a low effect on chewing capacity in patients with TMD pain, but that the effect exceeds that of no or minimal treatment. The effect is similar to other active treatments (palatal plate, acupuncture, biofeedback/stress management, jaw exercise, relaxation, and other types of appliances).

For treatment of bruxism, one systematic review (66) and five RCTs (67–71) were identified in which the effect of stabilization appliances was compared to palatal plate, no treatment, and repositioning splints. A majority of the studies showed a reduction in EMG activity for all types of appliances (67, 71), but no effect on bruxism activity or sleeping quality. The expert's opinion was that occlusal appliances can reduce tooth wear.

**Table 6. Occlusal appliances. Severity of condition (Severity): very high impact (1), high impact (3), moderate impact (5) on oral health and jaw function; Cost-effect (Cost): low (L), moderate (M), high (H), not assessed (na); Priority rank: high (1) – low (10).**

| Occlusal appliances         | Condition/diagnosis                             | Severity | Cost | Priority |
|-----------------------------|---|----------|------|----------|
| Stabilization splint/       | TMD   | 3        | L    | 4        |
| Bite splint                 | Arthritis associated with systemic inflammation | 1        | na   | 4        |
|                             | Myalgia   | 3        | L    | 4        |
|                             | Arthralgia                                      | 3        | L    | 4        |
|                             | Headache associated with TMD                    | 3        | L-M  | 5        |
|                             | Symptomatic disc displacement with reduction    | 5        | L    | 5        |
|                             | Symptomatic arthrosis                           | 5        | L    | 5        |
|                             | Tooth wear with risk for progression            | 3        | M    | 5        |
|                             | Bruxism and orofacial parafunction              | 5        | M    | 6        |
|                             | Symptomatic disc displacement without reduction | 3        | L-M  | 6        |
|                             | Myalgia associated with widespread pain         | 1        | M    | 8        |
|                             | Dysocclusion/phantom bite                       | 5        | na   | 8        |
| Frontal partial bite splint | Myalgia   | 3        | M    | 7        |
| Soft splint                 | Myalgia   | 3        | M    | 6        |
| Repositioning splint        | Symptomatic disc displacement with reduction    | 5        | M    | 6        |

In patients with headache attributed to TMD results from 7 RCTs (72–78) show that headache frequency and intensity were reduced after treatment with stabilizations appliances, but that the effect was similar to other interventions (information and other types of appliances).

Regarding TMJ arthritis associated with inflammatory disorders, symptomatic TMJ arthrosis, tooth wear with risk for progression, myalgia associated with widespread pain, and dysocclusion, recommendations are based on judgments by the panel of experts.

The literature suggests that stabilization appliance therapy is indicated for patients with symptomatic TMJ arthrosis and systemic arthritis, except during acute relapses of TMJ inflammation. The clinical experience is that the patients perceive the treatment as positive; thus, stabilization appliance therapy could reduce their anxiety and improve their quality of life.

Stabilization appliance therapy was judged to have a moderate effect on pain in patients with headache attributed to TMD (moderate evidence).

Stabilization appliances are also indicated to protect teeth from wear. However, a long-term follow-up study showed that progression of wear is slow and that the impact of stabilization appliances on the wear is unknown (79).

In patients with myalgia associated with widespread pain, pain reduction was reported to be similar to that of the placebo splint (80).

For dysocclusion (i.e., patient's opinion of an unfitting occlusion that cannot be observed clinically – «phantom bite»), the clinical experience is that reversible treatment should be prioritized, thus, stabilization appliance therapy is an alternative for evaluating subjective treatment effects.

- \* Stabilization appliances have moderate to high effect on TMD pain reduction and global improvement, and low effect on jaw movement capacity (moderate evidence)
- \* Stabilization appliances have moderate effect on the ability to influence parafunctions, to protect teeth from wear, and to prevent bruxism and other orofacial parafunctions

#### *Partial-coverage occlusal appliances (frontal)*

As the name implies, partial-coverage occlusal appliances in the frontal region cover only the frontal teeth, either the incisors only (NTI-tss) or the incisors and canines (Relax®). One systematic review and three RCTs (61, 81–83) showed that the effect of partial-coverage appliances does not differ from that of the stabilization appliance, but was better than information only. However, the systematic review concluded that the stabilization appliance should be regarded as the criterion standard, due to the lower risk of side effects, such as occlusal changes and risk of inhalation (61). Thus, partial-coverage frontal appliances are only indicated for short-term use and require regular follow-ups.

- \* Partial-coverage frontal appliances have moderate effect on TMD myalgia (low evidence)
- \* The risk of unwanted side effects is greater for partial-coverage appliances in the frontal region during long-term treatment and thus requires careful monitoring

#### *Soft appliances*

Results from five RCTs (76, 84–87) showed that soft appliances have a moderate effect on global improvement and palpation pain. The effect was better than no or minimal treatment and equal to that of the stabilization appliance. It is more difficult to maintain adequate oral hygiene with the soft appliance, and their durability is shorter. Thus, they are recommended for short-term use.

#### *Repositioning appliances*

Repositioning appliances aim to reduce symptoms related to disc displacement with reduction. They are constructed with the mandible in a protruded position and the disc in «normal» position;

- \* Soft appliances have moderate effect on TMD myalgia (low evidence)
- \* The durability of soft appliances is shorter than of the stabilization appliance, and it is more difficult to maintain adequate oral hygiene

this may thus unload the posterior TMJ disc attachment to relieve pain. One systematic review with a meta-analysis (62) and six RCTs (88–93) showed that the repositioning appliance had a moderate effect on TMJ palpation pain and a better effect on TMJ pain and clicking than no treatment or treatment with a stabilization appliance. However, when treatment was stopped, the clicking returned. One study showed a decline in treatment effect after 1 year, whereas another reported a positive effect in 90 % of the patients after 3 years. The clinical experience is that occlusal changes sometimes occur after treatment with repositioning appliances so they require careful follow-ups.

- \* Repositioning appliances have a high effect on TMJ pain and clicking (moderate evidence) and a moderate effect on TMJ palpation pain (low evidence) in patients with disc displacement with reduction
- \* Clicking often returns after treatment is completed, so the success rate decreases over time. Long-term use of a repositioning appliance is accompanied by a risk for occlusal changes (expert group judgment).

### Occlusal correction/adjustment (Table 7)

Occlusal adjustment includes both building-up of teeth and selective grinding in order to improve occlusal stability and, hence, to reduce adverse loading of the TMJ and teeth. The aim is to increase chewing comfort, improve jaw function, and reduce pain. There is inconclusive evidence for occlusal adjustment in the treatment of TMDs and other orofacial pain disorders and the recommendations are thus based on expert statements.

Remodeling as a consequence of TMJ destruction caused by inflammation or degenerative disease may lead to occlusal changes causing unfavorable TMJ loading during chewing and biting. Recent studies have reported an association between subjective experience and objective findings of instable occlusion and TMJ arthralgia (94, 95). Thus, occlusal adjustment may be indicated in those cases when chronic or recurrent TMJ arthralgia can be considered caused by repetitive trauma to the TMJ due to unstable occlusion.

Treatment that aims to reduce loading of teeth due to traumatic occlusion in order to increase chewing comfort and jaw function was highly effective and could improve quality of life.

Occlusal adjustment is highly effective to improve disturbed jaw function (chewing and biting) due to unstable occlusion in patients with chronic TMJ arthritis or degenerative changes

Occlusal adjustment may reduce symptoms related to unstable occlusion in patients with chronic TMJ arthralgia caused by repetitive trauma

**Table 7. Occlusal correction/adjustment. Severity of condition (Severity): very high impact (1), high impact (3), moderate impact (5) on oral health and jaw function; Cost/effect (Cost): low (L), moderate (M), high (H), not assessed (na); Priority rank: high (1) – low (10), Research (only in clinical controlled trials), Not to do (not accepted as treatment modality)**

| Occlusal correction | Condition/diagnosis   | Severity | Cost | Priority  |
|---------------------|---|----------|------|-----------|
| Occlusal correction | Malocclusion related to chronic TMJ arthritis associated with systemic inflammation | 1        | L    | 4         |
|                     | Chronic arthralgia  | 3        | L    | 5         |
|                     | Traumatizing occlusion  | 5        | L    | 5         |
|                     | Myalgia   | 3        | na   | 9         |
|                     | Myalgia associated with widespread pain   | 1        | na   | Research  |
|                     | Acute arthralgia  | 3        | na   | Not to do |
|                     | Acute arthritis associated with systemic inflammation                               | 1        | na   | Not to do |
|                     | Dysocclusion/phantom bite   | 5        | na   | Not to do |

### Jaw myalgia

A Cochrane review (96) reported no difference in treatment effect of occlusal adjustment in patients with myalgia compared to placebo, no treatment, or information only. There is evidence that patients with jaw myalgia associated with widespread pain have reduced pain thresholds in general, which may lead to low tolerance to loading. Knowledge is lacking whether unstable occlusion may have a negative impact in these patients. Reversible treatments are therefore recommended to improve jaw function and quality of life.

- \* Occlusal adjustment has no to low effect on pain reduction in patients with myalgia.

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### Acute TMJ disorders and dysocclusion

During acute TMJ arthralgia and TMJ arthritis associated with systemic inflammation, the condyle may have changed its position due to edema, which may cause a feeling of changed occlusion. When the inflammation resolves, the condyle regains its normal position. Irreversible treatments are therefore contraindicated in these conditions.

In patients with dysocclusion (phantom bite) (97–98), in which occlusal changes cannot be recorded objectively, irreversible treatments are contraindicated.

## TMJ surgery (Table 8)

A majority of patients with symptomatic disc displacement with reduction and disc displacement without reduction has been found to respond favorably to conservative treatment modalities. Surgical TMJ approaches should only be considered in patient's

\* Occlusal adjustment in patients with acute TMJ arthralgia, TMJ arthritis associated with systemic inflammation, and dysocclusion may be harmful and are therefore contraindicated.

refractory to conservative treatment for at least 6 months and with severe disability related to the conditions in the TMJ. Thus, the diagnoses were termed disabling symptomatic disc displacement with or without reduction who had not responded to reversible treatment. One systematic review assessed arthroscopy in patients with disc displacement without reduction (99). Arthro-

**Table 8. TMJ Surgery Severity of condition (Severity): very high impact (1), high impact (3), on oral health and jaw function; Priority rank: high (1) – low (10).**

| TMJ Surgery    | Condition   | Severity | Priority |
|----------------|---|----------|----------|
| Arthroscopy    | Disabling symptomatic disc displacement with reduction    | 1        | 7        |
|                | Disabling symptomatic disc displacement without reduction | 3        | 3        |
| Discectomy     | Disabling symptomatic disc displacement with reduction    | 1        | 3        |
|                | Disabling symptomatic disc displacement without reduction | 3        | 4        |
| Arthrocentesis | Disabling symptomatic disc displacement with reduction    | 3        | 7        |
|                | Disabling symptomatic disc displacement without reduction | 3        | 4        |

scopy and discectomy were found to have similar pain relief and improvement in jaw function. Arthroscopy is a less invasive procedure than discectomy and thus suggested to be first line surgical treatment for disabling symptomatic disc displacement without reduction. From the health-economical perspective, arthroscopy required less operation time and fewer days of sick leave (100). Discectomy was assessed in patients with disc displacement with reduction in five studies (101–105) and outcomes were high effect on pain relief, reduced clicking and catching of the TMJ, and improved jaw function. Side effects were nerve injury in one case and an increase of crepitus in the majority of the patients. Two RCT studies assessed arthrocentesis and found similar pain relief and improved jaw function in comparison with arthroscopy in disc displacement without reduction (106, 107).

## Future perspectives

Presence of TMD affects an individual's quality of life and may even contribute to development of widespread pain disorders. There are still many research questions left to be answered regarding causal factors for these conditions. A recently developed and validated examination protocol and diagnostic algorithms may help to homogenize the conditions. Further efforts to analyze treatment outcomes, cost effectiveness, and patient values, not only in specialist settings but also in general practice, should be essential contributions to current knowledge. The scrutiny of the literature related to TMD treatment exposed many knowledge gaps that remain to be closed in future studies.

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