Int. J. Oral Maxillofac. Surg. 2014; 43: 1096–1103
http://dx.doi.org/10.1016/j.ijom.2014.05.010, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
TMJ Disorders

Neurosensory assessment in patients with total reconstruction of the temporomandibular joint

S. F. Kothari[1], L. Baad-Hansen[1], K. Andersen[2,3], P. Svensson[1,4]
[1]Section of Clinical Oral Physiology, Department of Dentistry, Aarhus University, Denmark; [2]Section of Oral and Maxillofacial Surgery, Aarhus University Hospital, Denmark; [3]Section of Oral Pathology and Maxillofacial Surgery, Department of Dentistry, Aarhus University, Denmark; [4]Center for Functionally Integrative Neuroscience (CFIN), MindLab, Aarhus University Hospital, Denmark

S.F. Kothari, L. Baad-Hansen, K. Andersen, P. Svensson: Neurosensory assessment in patients with total reconstruction of the temporomandibular joint. Int. J. Oral Maxillofac. Surg. 2014; 43: 1096–1103.

Abstract. Somatosensory sensitivity and postoperative endogenous pain modulation have not been investigated in temporomandibular joint (TMJ) prosthesis patients. The objectives of this study were to assess somatosensory function at the TMJ and examine possible differences in conditioned pain modulation (CPM) between patients with total TMJ prostheses ($n = 7$) and a reference group of healthy controls ($n = 20$). Somatosensory abnormalities were assessed using quantitative sensory testing (QST), which encompasses thermal and mechanical testing procedures. CPM was tested by comparing pressure pain thresholds (PPT) before (baseline), during, and after the application of painful and non-painful cold stimuli. PPTs were measured at the TMJ and thenar eminence (control). The effect of CPM on PPT values was tested with analysis of variance. Three patients exhibited mixed somatosensory loss (i.e., decreased thermal and mechanical detection) with mixed hyperalgesia (i.e., increased sensitivity to thermal and mechanical pain) and two patients exhibited mixed loss with only mechanical hyperalgesia. There was a significant decrease in pressure pain sensitivity at both sites during painful cold application in healthy controls ($P < 0.001$) but not in patients ($P = 0.476$). In conclusion, QST measures demonstrated somatosensory abnormalities in patients with total TMJ prostheses. Noxious conditioning cold stimuli evoked CPM-like effects in healthy subjects but not in patients with TMJ reconstruction.

Key words: total temporomandibular joint prostheses; somatosensory function; quantitative sensory testing; conditioned pain modulation.

Accepted for publication 9 May 2014
Available online 12 June 2014

The temporomandibular joint (TMJ) is among the most complicated articulations in the body. Total alloplastic TMJ replacement is a biomechanical solution for the treatment of end-stage disease.[1] However, replacement of the TMJ apparatus is only considered when all other treatment modalities including conservative, non-surgical, and surgical therapies have been used.[2] Indications for total TMJ reconstruction are ankylosed or resorbed joints with severe anatomical abnormalities, severe inflammatory arthritic disease, previously failed alloplastic reconstruction, and failed autogenous grafts in multiply operated patients. Irrespective of the specific indication, the main aim of TMJ reconstruction is to restore the form and

0901-5027/0901096 + 08

function of the joint, with the relief of pain as a secondary benefit.[3,4]

Although studies on TMJ reconstruction have indicated improvements in subjective and objective parameters after replacement, many postoperative complications have been identified.[5,6] These complications include pain, infection, heterotopic bone deposition, nerve damage, haematoma formation, salivary fistula, and malocclusion.[3,7] Many studies have reported a reduction in pain after joint reconstruction,[1,4] but unfortunately, complete elimination of pain has not been mentioned in the literature. Therefore, considering that pain is one of the most common complications, this study was performed to provide a better understanding of the pain mechanism involved in these patients.

The assessment of positive and negative somatosensory signs and symptoms in relation to pain complaints is one of the first steps towards a better understanding of pain mechanisms.[8,9] The standardized quantitative sensory testing (QST) battery introduced by the German Research Network on Neuropathic Pain (DFNS), consisting of 13 parameters, can assess somatosensory function through sensory loss (small and large nerve fibre function) and sensory gain (hyperalgesia, allodynia, and hyperesthesia).[8,9] The QST battery tests different sub-modalities of nerve fibres involved in the transduction of sensory information from the periphery to the spinal cord, such as Aβ-fibres, Aδ-fibres, and C-fibres. It can also be used to quantitate changes in somatosensory neural function.[10] In addition, defective endogenous pain inhibitory systems are proposed to play an important role in the development of persistent pain.[11]

Conditioned pain modulation (CPM) paradigms can assess the function of endogenous pain inhibitory pathways in humans.[12] CPM can also be used to predict ongoing pain, as well as the risk of future chronic pain, including chronic postoperative pain.[13] CPM testing generally involves the use of two simultaneous stimuli (conditioning and test stimulus) to estimate the resultant pain inhibition of the test stimulus. To date, no studies have assessed postoperative somatosensory sensitivity and pain modulatory effects in TMJ prosthesis patients.

The aims of the present study were (1) to assess the somatosensory function at and around the TMJ in patients with total TMJ prostheses, and (2) to examine the possible differences in conditioned pain modulation between the patients with total TMJ prostheses and healthy controls.

Materials and methods

Subjects

This case-series study included seven consecutive patients (five women, two men) who had undergone a total joint reconstruction with a Biomet Total TMJ Replacement System at the study institution. Patients who had undergone a TMJ reconstruction at another hospital were excluded.

Out of seven patients, five had bilateral prostheses and two had a unilateral prosthesis. Indications for TMJ reconstruction were ankylosis in six patients and resection of the mandibular ramus because of a keratocystic odontogenic tumour in one patient. The average age of the patients at the time of surgery was 46 years (range 26–59 years). The prostheses were placed in an average 6 years (range 4–9 years) before the follow-up examination. Twenty healthy controls (11 women, nine men) with no signs of a temporomandibular disorder (TMD) or musculoskeletal or rheumatologic disease were recruited; their average age was 32 years (range 21–47 years). All patients and healthy controls gave their written informed consent prior to study participation, in accordance with the Declaration of Helsinki. The study was approved by the local ethics committee in Denmark.

Clinical procedures

The TMJ implant used in this study was the Biomet Total TMJ Replacement System.[2] This implant system is a two-component stock system consisting of mandibular condyle and glenoid fossa components. The components were attached to the bone with titanium screws.

The surgical procedure used involved a submandibular incision and a pre-auricular incision. An osteotomy was performed at the neck of condyle and then the condyle was removed. Another osteotomy was performed at the articular eminence and a perfect fit of the fossa prosthesis dummy was obtained. The fossa prosthesis was fixed with screws. Intermaxillary fixation using arch bars was then performed. For the resection of the lateral part of the ramus, the dummy of the condylar prosthesis served as a guide. The mandibular prosthesis was then fixed with screws with the condylar head in the fossa prosthesis on the remaining ramus. The intermaxillary fixation was removed and the extra-oral approaches were sutured. The patients were readmitted for follow-up controls after 1 week, 1 month, 3 months, and 12 months.

In the present study, the subjective assessment of pain, neurosensory assessment using QST, and endogenous pain modulation (CPM) were assessed in all of the patients and healthy controls during a follow-up examination, at an average 6 years after placement of the prostheses. The neurosensory assessment and surgical procedures were not performed by the same surgeon.

Subjective assessment of pain

Characteristic pain intensity (CPI) is a self-report measure derived from the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) history questionnaire.[14] It appraises current pain, average pain, and worst pain in the jaw during the last 6 months. The resulting CPI score ranges from 0 to 100, with 100 being the most pain.

Quantitative sensory testing (QST)

A standardized battery of QST was performed according to the protocol of the DFNS.[8] The QST battery consists of seven tests measuring 13 parameters that cover relevant nerve function. For a detailed description of the protocol, see Rolke et al.[8] In summary, the protocol investigates the following sensory functions: (1) thermal thresholds: cold detection (CDT), warm detection (WDT), cold pain (CPT), heat pain (HPT), and thermal sensory limen (TSL); (2) mechanical thresholds: mechanical detection (MDT), vibration detection (VDT), mechanical pain (MPT), and pressure pain (PPT); (3) stimulus–response functions: mechanical pain sensitivity (MPS), dynamic mechanical allodynia (DMA), wind-up ratio (pain summation to repetitive pinprick) (WUR), and paradoxical heat sensations (PHS) during the thermal limen procedure.

QST was performed on the skin overlying the TMJ on both sides in all patients and healthy controls. In patients, the most painful side was defined as the test site and the non-painful or less painful side was defined as the control site.

Thermal detection and pain thresholds and the number of paradoxical heat sensations

As a measure of Aδ-fibre function, thresholds for cold detection (CDT) and cold pain (CPT) were assessed. C-fibre function was tested by assessing thresholds for warmth detection (WDT). Heat pain thresholds (HPT) determined with contact thermal stimulators are considered to