ORIGINAL RESEARCH

Temporomandibular joint syndrome treatment with peripheral nerve stimulation

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Abstract

Introduction: Temporomandibular joint syndrome is defined by a triad of intense joint pain together with restriction of mouth opening and jaw clicking. The objective of this study is to evaluate the efficacy and safety of peripheral nerve stimulation for the treatment of this pathology.

Material and Methods: A retrospective study was conducted. All patients met selection criteria that include prior resistance to medical or surgical treatment and completion of a series of pre-surgical tests. An octopolar electrode was implanted in the affected preauricular region. The results were measured using the Analog Pain Scale, a short questionnaire on pain, improvement of restriction in mouth opening and reduction of analgesic medication.

Results: A total of 10 patients with 14 performed procedures were included. The mean reduction in pain measured by VAS was 86.2% at one month and 79% at one year after surgery. All patients experienced a drastic improvement in pain and its impact according to the Brief Pain Inventory, the mean improvement being 90% at 4 weeks and 82% at one year. There was an improvement in the mean oral opening of 10.14 mm (minimum of 4 and maximum of 13 mm). One case was excluded due to the complication demanding the system removal.

Conclusions: Patients with temporomandibular joint syndrome who do not respond to conventional treatments are ideal candidates for peripheral nerve stimulation, showing improvement in pain, oral restriction, and quality of life with a low percentage of serious complications.

Keywords: temporo-mandibular joint; peripheral electrical stimulation; auriculo-temporal nerve; orofacial pain syndrome

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Introduction

Temporomandibular joint syndrome (TMJS), or Costen syndrome, is a fairly common functional disorder. The overall prevalence of TMJS was approximately 31% in adults/elderly and 11% in children[1], amounting to the second most common cause of musculoskeletal pain. About 33% of the population has at least one TMJS symptom and 3.6 to 7.0% of the population has TMJS with sufficient severity that they desire treatment[2]. One study found average ratings of pain intensity due to TMJS of 4.3 on a 10-point scale, like the averages reported for chest pain and back pain. Studies consistently find that TMJS has a pronounced impact on quality of life.

TMJS may present with a variety of signs and symptoms and is a diagnosis of exclusion, therefore, all other possible diagnoses must be ruled out[3].

This clinical diagnosis is based mainly on neuropathic pain attributed to the atrio-temporal nerve or mandibular branch of the trigeminal nerve, joint clicking upon mouth opening or chewing, and an anterior meniscus dislocation on magnetic resonance imaging (MRI)[4].

Anamnestic details are of utmost importance, and require a complete historical identification of predisposing, initiating, and perpetuating factors[5]. De Leeuw in 2010, proposed the importance of the physical examination in the diagnosis, which consists of palpation of the temporomandibular joint (TMJ), musculature, active recognition of movement and analysis of joint noise when performed by trained professionals[6]. Psychosomatic, social, and emotional factors may prompt the symptoms of TMJS[7].

Although the optimal treatment remains unclear, determining how to manage TMJS patients would yield significant clinical and economic benefit[8]. Most symptoms improve without treatment, but some patients will require semi-invasive therapies and or potentially invasive therapies such as peripheral nerve stimulation[9]. Candidates for neurostimulation are minimal, though neurostimulation may be underutilized[10].

These patients may fail to attain relief with conventional medical and semi-invasive therapies and require a more invasive treatment. We present a study on peripheral nerve stimulation for the treatment of TMJS.

Material and Methods

Patient Selection

A retrospective analysis of a series of patients with temporomandibular pain treated by the authors between January 2018 and January 2021 was performed.

The inclusion criteria in this series were:

1. Severe pain compatible with temporomandibular joint dysfunction.
2. Neuropathic characteristics and negatively affecting the quality of life of the patients
3. Limitation in mouth opening
4. Resistance to other aggressive treatments performed by the Pain Unit or by Maxillofacial Surgery Unit
5. Positive response to a pre-atrial blockade of the affected joint.
6. Follow-up of at least one year.

The exclusion criteria were:

1. Medical and psychological disorders that prevent adequate intervention or monitoring of patients.

All patients presented with temporomandibular joint pain characterized by intense pain in the masticatory muscles, temporomandibular joint, or both. Pain was present at any time of day, even without jaw activity. Patients also had clicks or cracks when moving the jaw. In more than half of the patients, there was mandibular deviation with opening.

One patient was excluded from the analysis due to unpleasant stimulation of the eye on the stimulated side and allodynia. Her treatment was discontinued, therefore not followed afterwards.

Pre-surgical test

A pre-atrial blockade of the affected joint was performed with 5 ml of 2% lidocaine. This test confirms the existence of a peripheral neuropathy with the possibility of responding to neurostimulation[11,12]. Immediate pain relief and increased mouth opening were considered positive.

Procedure

The electrodes were implanted subcutaneously over the preauricular area of the affected joint. A preauricular incision was made up to the superficial fascia with insertion of the electrode subcutaneously under fluoroscopy control. The final location of the electrode was chosen according to the superposition of the electrical paresthesia on the area of pain. Subsequently, the electrode was tunneled towards the pectoral level, connecting it to a generator in a subfascial pocket. An impedance check was performed, and the battery was left off. The stimulation parameters were established by tailoring conventional procedures of the spinal stimulation systems to the patient (***Figures 1 and 2***).

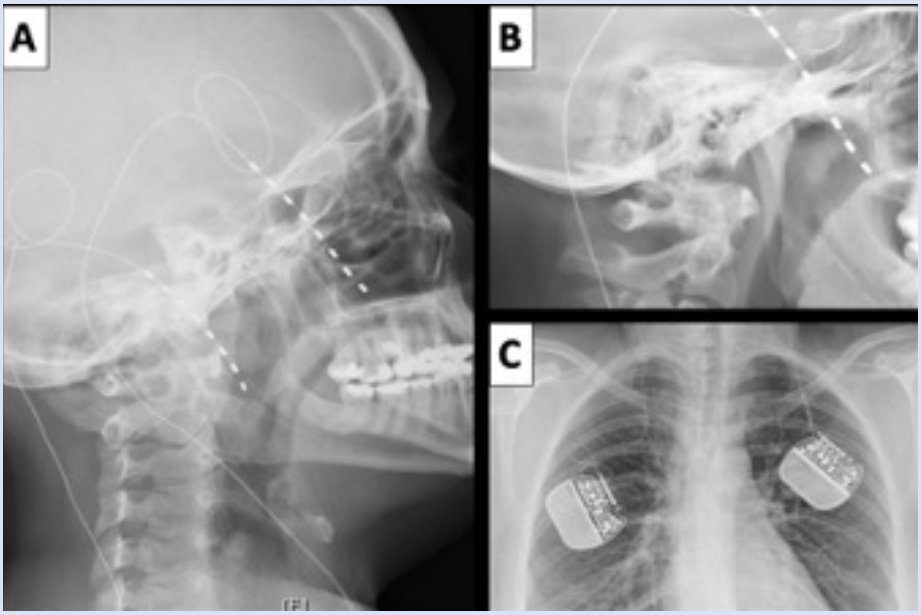

Figure 1. Radiological image showing: **A and B.** the location of the electrodes: at the level of the temporomandibular joint; **C.** the placement of the generators at the subfascial pectoral level

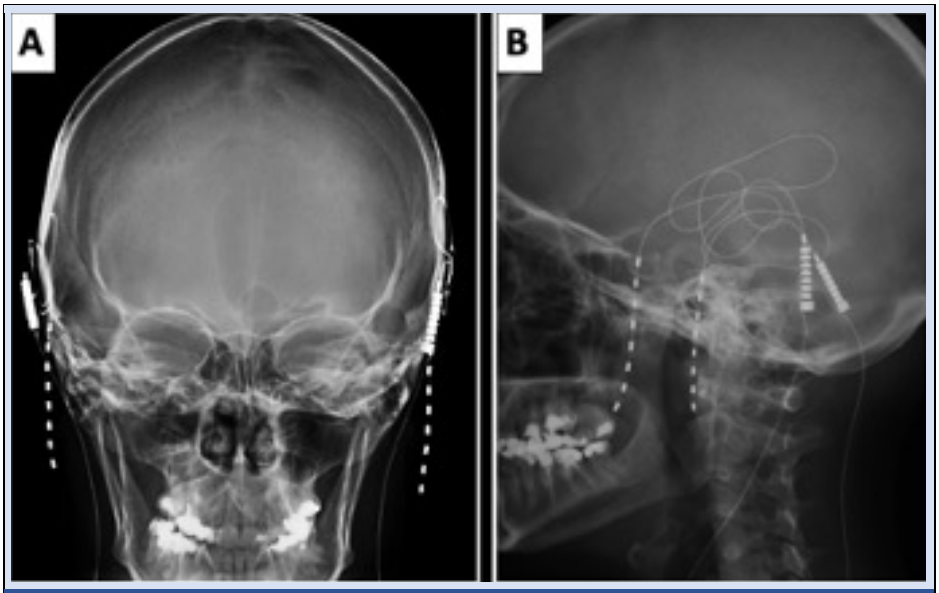

Figure 2. Postoperative radiological image in: **A.** anteroposterior; and **B.** lateral; positions to verify electrode placement.

Outcomes assessment

Outcomes were quantified using the visual analog scale of pain (VAS) and by investigating improvement in mandibular restriction at 1 month, 3 months, 6 months, 9 months, and 1 year following peripheral neurostimulation. Pain intensity, reduction in drugs used for TMJS, the functional status of the patient, and complications were monitored.

The brief questionnaire for the assessment of pain – Brief Pain Inventory (BPI) is a multidimensional pain assessment questionnaire that provides information, not only on the intensity of pain, but also its interference in the daily activities. It was developed by Daut in 1983[13] and was validated in its Spanish version by Badía et al. in 2002[14]. It consists of two dimensions: "pain intensity," with 4 items, and “interference in daily activities," with 7 items. Each item is scored using a numerical scale from 0 (absence of pain / absence of interference in daily life) to 10 (worst pain imaginable / maximum impact on daily life). Based on the results obtained, a summary score is obtained. for each of the two dimensions.

Statistical analysis

Numerical data were presented as median values with ranges (minimum and maximum values), and the absolute values of changes in VAS and BPI values between different assessments were presented as percentage difference.

Results

Demographics

This study involved 10 female patients with a mean age of 41.21 years (range: 31-58 years) who underwent a total of 14 surgeries (8 right, 6 left). One patient was excluded due to the intolerable complication.

They had pain for an average of 7.79 years (range: 2-14 years). TMJS pain was unilateral right in 3 patients (30%) and bilateral in 7 (70%). All had limitation in mouth opening, with an average opening of 19.36 mm (range: 13-25 mm, standard measurement is between 40-60 mm). The number of previous treatments was an average of 6.21 (range: 4-8). These treatments included arthroscopies of the TMJ, injection of botulinum toxin, ozone, and intra-articular injections of lidocaine. No patient presented a significant improvement in pain or mouth opening following the previous treatments. All patients were taking a mean of 4.43 analgesic drugs (range: 3-6 drugs), including at least two opiates.

Treatment Outcomes

All patients attained reduction of pain between 85% and 100% within the first 6 hours of treatment according to the postoperative VAS, performed to adjust postoperative analgesia. The patients had a mean follow-up of 14.36 months (range: 12-28 months).

The initial pre-surgery average VAS was 9.86, including 10 in 12 interventions and 9 in the other 2 surgeries. At the first month after surgery, the mean VAS was 1.36 (range: 0-4). The mean reduction in VAS was 86.2%, and a total of 7 surgeries produced a 100% reduction with a VAS of 0. At 3 months post-surgery, the mean VAS was 2.07 points (0-5 points). The average reduction was 79%, with only in 4 surgeries maintaining a 100% reduction in VAS. At 6 months post-surgery, the mean VAS was 1.79 points (0-4 points). The average reduction was 81.84%. The 100% reduction was maintained in 4 surgeries. At 9 months following surgery, the mean VAS was 2.29 points (0-4 points). The mean reduction was 76.77%. Only 2 surgeries maintained the 100% reduction in VAS. At 1 year post-surgery, the mean VAS was 2.07 points (0-5 points). The average reduction was 79%. A 100% reduction in VAS was maintained in 3 surgeries. ***Figure 3*** demonstrates evolution in VAS over time.

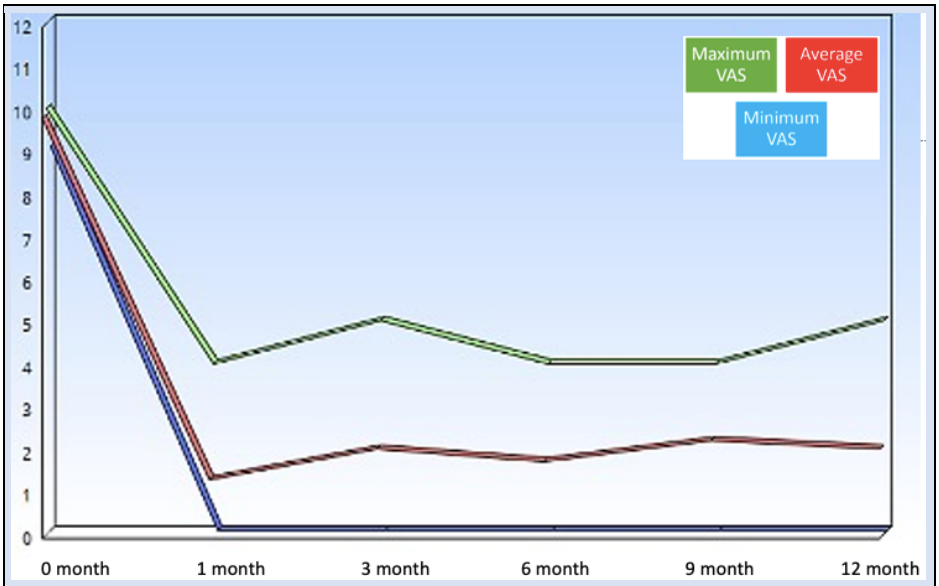

Figure 3. Temporal evolution of the average VAS, maximum VAS, and minimum VAS, demonstrating a clear improvement in pain

All patients experienced a drastic improvement in pain assessment according to the BPI, with a mean improvement of 90% at 1 month, 79.9% at 3 months, 86.6% at 6 months, and 82% at 1 year. Mean mouth opening at 12 months was 29.50 mm (range: 25-38 mm). The mean improvement was 10.14 mm per surgery (range: 4-13 mm). These data are reflected in ***Figure 4***.

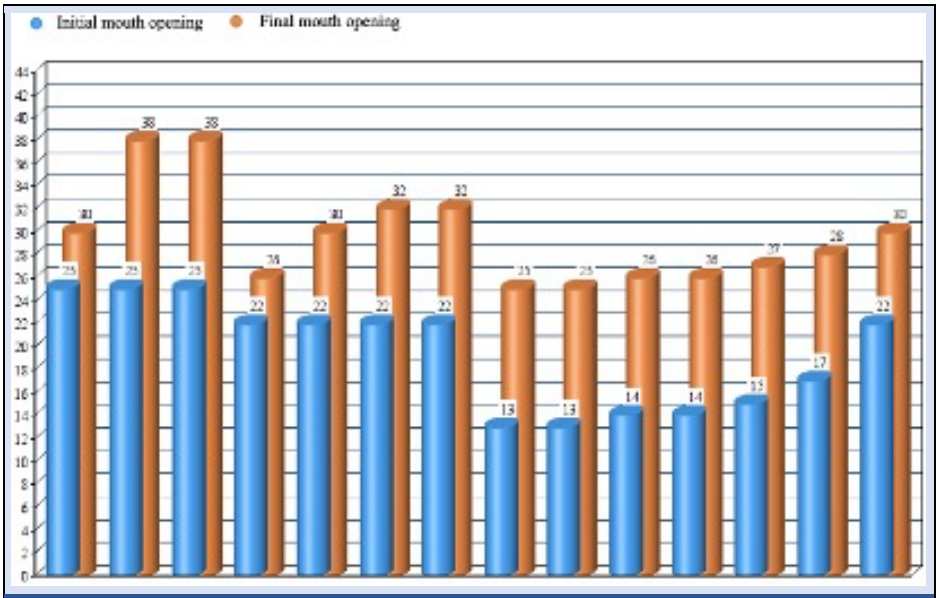

Figure 4. Graph showing the comparison between the initial and final mouth opening for each surgery.

Reduction in the use of analgesic drugs at 12 months was 83.97%% with a mean of 0.72 drugs (range: 0-2). A 100% reduction in analgesic medication was achieved for 7 surgeries. The rest of the surgeries achieved a decrease in analgesic medication that allowed patients to open their mouths, yawn, and chew without pain. All patients normalized their physical activity and sleep.

Complications

There were 2 complications, in one, the patient experienced unpleasant stimulation of the eye and allodynia on the stimulated side, leading to the exclusion from this study analysis, as the stimulation was discontinued within days after implantation. In other patient, breakage of the electrode occurred in at the level of the trajectory 3 months after surgery. It was reimplanted, with no further complications afterwards.

Discussion

Temporomandibular joint dysfunction was first described in 1943 by the Belgian otolaryngologist Dr. James Costen. Drawing on 11 cases, he was the first to suggest that changes in dental conditions were responsible for various otological symptoms. He found cases with symptoms in the region of the TMJ, such as pain of musculoskeletal origin, crackles, otological symptoms such as tinnitus, difficulty opening the mouth, as well as significant unilateral headache[15].

The etiology is multifactorial. All the factors involved can be modulatory or triggers. The most important factors are excessive tension of the jaw muscles causing limited movement of the joint; poor alignment between the upper and lower teeth, resulting in imbalanced movement of the jaw joint; abnormal position or displacement of the jaw joint or cartilage disc within the joint; and jaw pathologies. Possible jaw pathologies include condylar alterations, congenital defects, acromegaly, trauma or dislocation, inflammation or infection of the joint, and bone tumors[16]. A loss of teeth, poorly adapted prostheses, parafunctional habits such as bruxism or nail biting, postural alteration of the jaw and neck, and psychological conditions cause an increase in local muscle activity, leading to spasms and fatigue of the TMJ region[10,16]. Common risk factors are female sex, young adulthood (30-50 years), bruxism, use of very tight dentures, and the presence of other pathologies such as fibromyalgia, stress and arthritis[17].

TMJS presents with very intense pain in TMJ or jaw; extension to one side of the scalp, nape or neck; worsened by chewing, yawning, or talking too much; temporo-mandibular stiffness; difficulty opening the mouth or chewing; popping and cracking joints sensation of closing or brief hooking of the jaw when trying to open or close it; and sensation of muffled hearing, tinnitus, or vertigo. Additionally, diagnosis of TMJS is challenging because its nonspecific and variable symptoms, multidisciplinary workup required, and lack of knowledge among medical professionals.

Conservative medical treatment should always be the first option. This includes administration of a soft diet, avoidance chewing gum, excitants and tobacco, use of dental protector to relax the jaw muscles, and physical therapy. Analgesics, anxiolytics, muscle relaxants or antidepressants are also used[18]. Some patients will be candidates for semi-invasive therapies, such as occlusal adjustment, orthodontics, electrotherapy, botulinum toxin, laser therapy, drug treatment, acupuncture, cryotherapy, and heat therapy[19].

Surgical procedures are considered the last resort. In recent years, the peripheral nerve stimulator has become a very useful surgical resource given its medium and long-term efficacy and low rate of serious complications. Furthermore, unlike other invasive treatments, it is a reversible treatment as it is based simply on stimulation of nerves contributing to paresthesia, rather than destruction of lesions[20]. It was first described in 1967 by Wall and Sweet[21], who found that peripheral neurostimulation produced hypoesthesia and analgesia distal to the stimulated point. They established that the main indication for this procedure is the presence of neuropathic pain[22].

Peripheral nerve stimulation using electrodes is commonly accepted in other pathologies such as headache, facial neuralgia, chronic low back pain, pelvic and perineal pain[23], migraine[24], cluster headache, trigeminal neuralgia[25], postherpetic neuralgia, and post-surgery groin pain[26]. The literature supports its use for neuropathic pain with an efficacy of at least 50% improvement compared to baseline. Few centers perform peripheral nerve stimulation for TMJS. A study of 6 cases found high improvement in pain with few complications limited to rupture of the electrode and unpleasant stimulation of the facial nerve with retraction of the mouth corner[27]. Our study corroborates these findings. However, both series are too small to determine factors associated with efficacy and clarify why some patients, but not others, respond. It is possible that the duration of the disease, which produces nerve involvement in the long term, may modulate the efficacy of peripheral nerve stimulation for TMJS, as with trigeminal neuralgia[28].

Conclusions

Pain secondary to TMJS is a complex and multidisciplinary problem leading to a significant deterioration in the quality of life. Patients who fail to attain relief with conservative and semi-invasive treatments may benefit from peripheral neurostimulation, with a high degree of pain relief and low complication rate. Future studies with larger cohorts will be necessary to validate the findings in this study.

Disclosures

Conflict of Interest: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (name of institute/committee) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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