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Patient experience and satisfaction with different temporomandibular joint treatments

Ana Lúcia Pereira Rodrigues

Orientado por:

Prof. Doutor David Faustino Ângelo

Co-Orientado por:

Dr. Miguel Amaral Nunes

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RESUMO

Introdução: A disfunção da articulação temporomandibular (ATM), dependendo do subtipo, pode ser tratada de forma conservadora, ou através de procedimentos cirúrgicos minimamente invasivos (artroscopia, artrocentese) ou, em alguns casos, cirurgia aberta com ou sem materiais aloplásticos. Atualmente, a literatura apresenta múltiplos estudos com *outcomes* de diferentes tratamentos, contudo, poucos avaliam o nível de satisfação do doente.

Métodos: Este estudo retrospectivo incluiu doentes submetidos a diferentes tipos de tratamentos da ATM (injeções de toxina botulínica, artrocentese, artroscopia, cirurgia aberta sem material aloplástico) entre 2017 e 2021. Todos os doentes foram tratados pelo mesmo médico. Um questionário de satisfação com 11 perguntas foi aplicado via chamada telefónica aos doentes.

Resultados: Foram incluídos neste estudo 120 doentes (idade média 41.20 ± 17.78), 109 (90%) mulheres e 11 homens (10%). A satisfação global de todos os doentes, independentemente do tratamento, foi 8.24 ± 2.23 (média \pm DP) e 97 doentes (80.8%) voltariam a submeter-se ao mesmo procedimento. A artrocentese e a artroscopia foram os tratamentos que apresentaram maiores níveis de satisfação global (9.09 ± 0.971 e 9.03 ± 1.13 , $p = 0.021$) seguidos da cirurgia aberta (8.38 ± 1.84 , $p = 0.021$). O tratamento com toxina botulínica foi o que apresentou níveis de satisfação mais baixos (7.05 ± 2.90 , $p = 0.021$). Existiram duas correlações estatisticamente significativas: (1) satisfação global e expectativas dos doentes ($r = 0.803$; $p < 0.0001$); (2) presença de depressão e necessidade de tratamentos adicionais da ATM ($r = 0.186$; $p\text{-value} = 0.043$).

Conclusões: Dentro das suas limitações, o nosso estudo sugere que os quatro tratamentos estudados são bem aceites pelos doentes, associados a altos níveis de satisfação global. As expectativas dos doentes devem ser abordadas *ad initium* e a presença dum diagnóstico de depressão com disfunção temporomandibular concomitante, deve acautelar o médico e o doente para a necessidade de tratamentos adicionais.

Palavras-chave: Articulação Temporomandibular; Tratamentos minimamente invasivos da articulação temporomandibular; Cirurgia da articulação temporomandibular; Satisfação dos doentes.

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ABSTRACT

Background: Temporomandibular joint (TMJ) disorders, depending on its subtype, may be treated in a conservative way, or through minimal invasive surgical procedures (arthroscopy, arthrocentesis) or, in some cases, open surgery with or without alloplastic materials. Currently, the available literature presents multiple studies with outcomes of different treatments however, few evaluate the level of patient-reported satisfaction.

Methods: This retrospective study included patients submitted to different types of treatments of the TMJ (botulinum toxin injections, arthrocentesis, arthroscopy, and open surgery without alloplastic material) between 2017 and 2021. All patients were treated by the same doctor. A satisfaction questionnaire with 11 questions was applied via phone call to all patients.

Results: 120 patients (mean age of 41.20 ± 17.78) were enrolled in this study, being 109 (90%) women and 11 men (10%). The overall satisfaction of all patients, regardless the treatment, was 8.24 ± 2.23 (mean \pm SD) and 97 patients (80.8%) would undergo the same procedure again. Arthrocentesis and arthroscopy were the treatments with higher overall satisfaction (9.09 ± 0.971 e 9.03 ± 1.13 , $p = 0.021$) followed by open surgery (8.38 ± 1.84 , $p = 0.021$). Botulinum toxin injections was the treatment with lower levels of satisfaction (7.05 ± 2.90 , $p = 0.021$). There were two statistically significant correlations: (1) overall satisfaction and patient expectations ($r = 0.803$; $p < 0.0001^{***}$); (2) the presence of depression and the need for further TMJ treatment ($r = 0.186$; $p\text{-value} = 0.043^*$).

Conclusions: Within its limitations, our study suggests that all four treatments included are well accepted by the patients, associated with high levels of overall satisfaction. Patient expectations should be addressed *ad initium* and the presence of a diagnosis of depression with concomitant TMJ disorder must warn the doctor and patient for the need of additional treatment.

Keywords: Temporomandibular joint; Minimally invasive temporomandibular joint treatments; Temporomandibular joint surgery; Patient satisfaction.

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INTRODUCTION

Temporomandibular joint

The temporomandibular joint (TMJ) is a synovial joint, between the mandibular condyle and the glenoid fossa in the temporal bone, responsible for important facial movements such as chewing, swallowing, verbal and emotional expression (Ahmad & Schiffman, 2016). The TMJ is surrounded by a fibrous capsule, stabilized by three major ligaments (lateral ligament, sphenomandibular and stylomandibular ligaments) and mainly mobilized by four muscles (masseter, temporalis, lateral pterygoid, and medial pterygoid). The joint upper and lower compartment are separated by the fibrocartilaginous articular disc, allowing a smooth gliding of the bony structures. The main functions of the articular disc are lubrication of the TMJ, absorb/distribute the masticatory forces and stabilize the movement of this joint.

TMJ is the most used joint in the human body, accounting about 2000 movements per day, and is essential to maintain the basic orofacial functions of daily life. It allows mandible movements in three dimensions: movements of elevation, depression, protrusion, and retraction. The maximum mouth opening normally varies between 35-60 mm and if less than 35 mm it is normally associated with daily life limitations. Maximal lateral and protrusive excursions should be superior to 5 mm.

Temporomandibular Joint Disorders and Classifications

Temporomandibular disorders (TMD) are a class of musculoskeletal and/or intra-articular problems associated with morphological and functional deformities (Murphy, MacBarb, Wong, & Athanasiou, 2013). The etiologies of TMD are multifactorial: trauma, tooth loss, parafunctions, infection, autoimmunity (Tanaka, Detamore, & Mercuri, 2008). Moreover, it is influenced by several mechanical, structural, systemic, and psychosocial determinants (F. Liu & Steinkeler, 2013).

TMD is the most common cause of orofacial pain of nondental origin (Soni, 2019). It is believed to affect between 5 to 12-15% of adults in the population (Ahmad & Schiffman, 2016; Li & Leung, 2021; F. Liu & Steinkeler, 2013), yet TMD related symptoms may be present in up to 50% of adults (Li & Leung, 2021). Symptoms and signs of TMD are diverse and can include pain in the TMJ or its surrounding tissues, masticatory muscles tension, functional limitations of jaw movements, or various sounds (clicking, crepitations). The signs and symptoms reported by the patient and evaluated by the surgeon have high importance to perform a correct differential diagnosis and adjust the treatment options.

According to the American Academy of Orofacial Pain, TMD are classified into two major groups: myogenous TMD, which are more related to masticatory muscle disorders; and arthrogenous TMD, mainly regarding the TMJ itself (Buescher, 2007). Similarly, the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)¹ categorizes TMD into three diagnostic sections: group I is masticatory muscle pain; group II is TMJ disc displacement (reducing or nonreducing, with or without limited jaw opening); and group III includes other TMD such as arthralgia, arthritis, and arthrosis (Dworkin & LeResche, 1992). It is generally believed that muscular disorders and internal derangement may precede degenerative diseases of the TMJ, although it does not always manifest in episodes of pain (Li & Leung, 2021). In addition, pain caused by a TMJ articular disorder may conversely lead to myofascial pain (Herb, Cho, & Stiles, 2006).

The TMJ internal derangement is one of the most common forms of TMD (Paesani, Westesson, Hatala, Tallents, & Kurita, 1992). The most usual condition occurs when the articular disc is displaced between the condylar head and glenoid fossa (Ahmad & Schiffman, 2016). Wilkes, provided a five-stage classification using clinical and radiographic findings ranging from a slight forward displacement to a nonreducing anterior disc displacement (Wilkes, 1989). As previously mentioned, individuals with disc displacement may be asymptomatic or present a variety of clinical findings, such as pain, pain upon palpation or mouth opening, clicking, limited mouth opening, crepitus or jaw locking (Schiffman et al., 2014).

¹ *(Developed by Dworkin and LeResche in 1992)*

Treatment Options for Temporomandibular Joint Disorders

The aim of treatment in TMD is the reduction of pain, restore function, and improve the patient's quality of life (Essam Ahmed Al-Moraissi et al., 2021; F. Liu & Steinkeler, 2013). Articular disc displacement, with or without reduction, and osteoarthritis are the most frequent types of TMD of articular origin (Ahmad & Schiffman, 2016; Young, 2015). Treatment strategies for these disarrangements involve a sequential approach (Essam Ahmed Al-Moraissi, Wolford, Ellis, & Neff, 2020). In a first attempt, the literature highlights the role of conservative approaches, such as patient education and counseling, physiotherapy, heat applications, oral anti-inflammatory drugs, occlusal splints, low-level laser therapy, and botulinum toxin (BTX) injections. Secondly, less invasive treatments should be attempted, meaning intraarticular injection (IAI) of different drugs (hyaluronic acid, platelet-rich plasma), minimally invasive techniques such as arthrocentesis or arthroscopy (alone or in combination with IAI). Finally, in more advanced situations, open joint surgeries may be considered (Essam Ahmed Al-Moraissi et al., 2020). Approaching myogenous TMD has similar step-by-step management and it is important to refer that intra-articular pathologic conditions such as internal derangement and osteoarthritis could also benefit from the interventions used to treat myofascial pain (Li & Leung, 2021).

BTX injections

Almost half of the cases diagnosed with TMD have a component of temporomandibular myofascial pain (Poveda-Roda, Bagan, Sanchis, & Carbonell, 2012) frequently induced by stress-related parafunctional habits (clenching and grinding) (Al Hayek, Al-Thunayan, AlGhaihab, AlReshaid, & Omair, 2019; Alkhudhairi et al., 2018). Bruxism consists of conscious or unconscious masticatory muscle activity such as clenching or grinding. Within the causes of myofascial pain in the masticatory muscles, bruxism has an important role, since it predisposes to musculature strain, spasm, pain, and functional limitation (F. Liu & Steinkeler, 2013). Nevertheless, it is important to highlight that other

studies have reported that sleep bruxism is not sufficient on its own to explain myofascial TMD (Raphael et al., 2012) and that probably somatization is a stronger predictor of an RDC/TMD diagnosis of myofascial pain than sleep bruxism (Ohlmann et al., 2020). Within the available conservative approaches, BTX injections have demonstrated its therapeutic effects in the treatment of myofascial pain (Schwartz & Freund, 2002; Song, Schwartz, & Blitzer, 2007). BTX has two effects on the neuromuscular junction: inhibition of acetylcholine which leads to muscle paralysis and to decrease the inflammatory pain by blocking substance P and glutamate release (Aoki, 2005). BTX is administered by injection into the masticatory muscles, and it has been reported as an effective treatment option to reduce pain in cases of bruxism by decreasing local inflammation modulators and the contraction force in the muscles (Sipahi Calis, Colakoglu, & Gunbay, 2019). Other TMD related with orofacial musculature, including masseteric hypertrophy, recurrent dislocation of the TMJ, muscle tenderness, oromandibular dystonias, myofascial pain with secondary TMJ involvement, trismus, hypermobility, and headaches, may also respond to treatment with BTX injections (Schwartz & Freund, 2002).

The safety and efficacy of BTX injections to treat TMD are extensively investigated, however the available literature is relatively inconsistent towards its exact effectiveness. Some studies report that BTX injections into the masticatory muscles are a considerable treatment method to address TMD pain, reducing its intensity (Sipahi Calis et al., 2019). Additionally, it is a brief procedure, with low pain levels and a good risk-to-benefit ratio (Sipahi Calis et al., 2019; Sunil Dutt, Ramnani, Thakur, & Pandit, 2015). A retrospective study confirmed an improvement in pain relief and better quality of life after BTX injections in a group of patients presenting myalgia of the masticatory muscles and 32 % of them had the concomitant diagnosis of disc displacement with reduction (Villa, Raoul, Machuron, Ferri, & Nicot, 2019). Nevertheless, the authors suggested the need for additional studies with larger samples to extrapolate these results. One randomized controlled trial (RCT) also concluded that BTX injections appear to be effective for patients with chronic facial pain (Chaurand, Pacheco-Ruíz, Orozco-Saldívar, & López-Valdés, 2017). A retrospective cohort study showed that the concomitant use of BTX in patients who underwent TMJ arthroscopy

had a benefit in pain reduction, supporting the use of BTX to manage refractory myofascial pain (Thomas & Aronovich, 2017).

In contradiction, a systematic review and meta-analysis concluded that BTX is slightly more effective than placebo in pain reduction for painful TMD patients. However, the low certainty evidence “limits the applicability of these findings and precludes practice recommendations” (Machado et al., 2020). Three other systematic reviews demonstrated contradictory results towards the effectiveness of BTX injections (Awan et al., 2019; Chen, Chiu, Chen, & Chuang, 2015; Thambar, Kulkarni, Armstrong, & Nikolarakos, 2020). A possible explanation for the lack of consistency of these results may be associated with the transient effect already demonstrated. BTX effect is reversible: it takes 1 to 14 days to have effect, reaches a maximum at 4 weeks, and starts to decrease after 12 weeks (Sunil Dutt et al., 2015). One other study suggests that BTX effect can last up to six months (Thambar et al., 2020). Finally, another systematic review and meta-analysis aiming to understand the treatment approach of different treatments for myogenous TMD, found that regarding pain reduction, manual therapy, counseling therapy, occlusal appliances, and BTX have a superior effect, in the short and intermediate term. With regard to maximum mouth opening capacity, manual therapy, local anesthesia, hypnosis, counseling therapy, and BTX were superior to the other treatments (Essam Ahmed Al-Moraissi et al., 2021). The findings in this study also suggested the need for further evaluation of complementary outcome variables such as patient satisfaction or global improvement, emotional status, among others.

Despite showing benefits in the literature, BTX injections still lack a clear consensus on their effectiveness among experts in the field.

Minimal invasive techniques

Today, with the conscience of the advantage, safety and effectiveness of minimally invasive techniques, TMJ arthrocentesis and arthroscopy are among the most widely used techniques for intra-articular disorders. Many studies concluded that both, TMJ

arthrocentesis and arthroscopic surgery provide a similar reduction in pain and increase the maximal mouth opening however, arthroscopy has shown superior efficacy compared to arthrocentesis in the improvement of mouth opening and reduction of pain (E. A. Al-Moraissi, 2015). Laskin performed a review in which the effectiveness of internal derangements treated either arthroscopically or by arthrocentesis was evaluated and the results of the comparisons provided strong evidence that “the two procedures are comparable in effectiveness” (Laskin, 2018). Nevertheless, since arthrocentesis is technically easier to perform and less invasive compared to arthroscopy, it could be the initial treatment in most instances (Laskin, 2018), depending on the personal preferences of the patient, surgeon experience, symptoms, and severity of the disease.

Additionally, as previously mentioned, both arthrocentesis and arthroscopy may be used alone or in combination with IAI. The most commonly used drugs include hyaluronic acid (HA), platelet-rich plasma (PRP), corticosteroids (CS) such as dexamethasone, prednisolone, and betamethasone, morphine, or tramadol. HA is produced by chondrocytes and synoviocytes and is physiologically found in the synovial fluid contributing to its elasticity, viscosity, joint lubrication and mechanical impacts. It is used as viscosupplementation since it is a viscous and a high/low molecular weight polysaccharide that allows subsequent protection, stabilization, and nutrition of the joint cartilage (Ferreira et al., 2018; Goiato, da Silva, de Medeiros, Túrcio, & dos Santos, 2016). PRP is a biological therapy obtained from the centrifugation of the patient’s blood which then contains a high concentration of his platelets. This concentrate has shown great potential as a therapeutic tool given its abundance of growth factors (GF) demonstrating anti-inflammatory and analgesic effects (Bousnaki, Bakopoulou, & Koidis, 2018).

Two recent systematic reviews indicated a combination of arthrocentesis with IAI has better results than arthrocentesis alone. The first review concluded that both arthrocentesis + HA and arthrocentesis + PRP had significantly better outcomes in pain relief compared to the arthrocentesis alone group. PRP showed the highest probability of being the best treatment to improve mouth opening (Y. Liu et al., 2020). Liapaki and colleagues

also verified that arthrocentesis + PRP resulted in MMO improvement compared to arthrocentesis + HA (Liapaki et al., 2021).

Another recent systematic review that intended to evaluate the effect of HA in treating TMDs with an articular origin, such as disc displacement with reduction and OA, could not perform a meta-analysis given the discrepancy between study methodologies/protocols and the fact that some of the studies compared HA alone and others compared HA + arthrocentesis. However, the authors believe that some conclusions can be drawn, even though they should be interpreted with caution given the significant limitations in the studies' protocols. To be known, HA treatment used alone appears to be effective in stimulating pain improvement compared to placebo or other therapies. And the use of HA combined with arthrocentesis does not appear to be superior to arthrocentesis used alone (Ferreira et al., 2018). Bousnaki et al., 2018 in a systematic review compared the effectiveness of PRP *versus* IAI of HA or saline after arthrocentesis/arthroscopy, in a population diagnosed with TMJ OA or anterior disc displacement with or without reduction. This review provided slight evidence for the potential benefits of intra-articular injections of PRP in patients with TMJ OA (Bousnaki et al., 2018).

A final note must be made regarding the use of corticosteroid injections in the TMJ and its possible risk-to-benefit ratio. One randomized control trial study, that compared IAI of HA, tenoxicam (an NSAID), and betamethasone to assess the relief of TMJ complaints, such as jaw pain, limited or painful jaw movement and clicking within the joint, demonstrated that HA was significantly superior comparing to the remaining treatments. However, the authors alert for the possible risks of CS use but since it is a less expensive treatment it could be considered an option for some patients (Gencer, Özkiriş, Okur, Korkmaz, & Saydam, 2014). In fact, the use of corticosteroids may lead to destructive changes in cartilage (Chandler & Wright, 1958). According to a 2015 systematic review, that compared different CS used as IAI, at higher doses and longer culture duration, CS in general were associated with cartilage damage and chondrocyte toxicity (Wernecke, Braun, & Dragoo, 2015). The use of CS as IAI must be very well pondered.

Open surgery

With the popularization of minimally invasive surgical techniques, such as TMJ arthroscopy and arthrocentesis, fewer patients have been eligible for open joint surgeries. Patients in our study that undergone an open surgery presented severe TMJ pathology, and were submitted to one of the following surgeries: TMJ discectomy (18 joints), TMJ discopexy (11 joints), TMJ condyle shaving (7 joints), or TMJ condylectomy (7 joints).

Ankylosis, tumors, and growth abnormalities are rare disorders but have a clear indication to undergo open surgery (Dimitroulis, 2005). However, articular disc displacement, are much more frequent condition that may lead to pain and/or degeneration of the articular surface without clear indication to TMJ treatment. The debate remains to clarify about the more adequate treatment, especially because disc displacement with reduction is seen as a normal variant in a third of the population without symptoms or risk of progression to OA (Peroz, Seidel, Griethe, & Lemke, 2011). The literature supports the concept that a disc that is structurally intact, with a healthy appearance should be salvaged while a damaged or diseased disc beyond repair is a good candidate for TMJ discectomy (Dimitroulis, 2005; Renapurkar, 2018). In fact, in patients with indication for TMJ discectomy, this treatment seems to be a valid treatment to improve pain (Ângelo, Sanz, & Cardoso, 2021; Miloro, McKnight, Han, & Markiewicz, 2017) MMO and MT (Ângelo et al., 2021). A recent 2021 survey conducted by Werkman and colleagues to analyze current practice trends among TMJ surgeons, revealed that 89% of surgeons preferred discectomy over discopexy for the management of anterior disc displacement with reduction but most (72%) did not considered that discectomy was beneficial over arthroscopy in the treatment of anterior disc displacement without reduction and simultaneous degenerative bone changes (Werkman, Mercuri, Troost, & Aronovich, 2021).

Study Objectives

In this study, the authors main objective was to evaluate the satisfaction of patients

with TMD, submitted to the following TMJ treatments: arthrocentesis, arthroscopy, open joint surgery, or botulinum toxin (BTX) injections from April 2017 to April 2021. The second aim was to assess which factors could possibly contribute to patient dissatisfaction.

MATERIALS AND METHODS

Study Design

A retrospective study was conducted in Instituto Português da Face (IPF) in Lisbon, Portugal including patients treated for TMD disorders from April of 2017 to April of 2021. The study was approved by the ethics committee of *Instituto Português da Face*.. All enrolled patients gave their informed consent in writing, following current legislation.

The inclusion criteria were: 1) Age > 14 years old; 2) One of the following TMD treatments: injection of botulinum toxin; arthrocentesis; arthroscopy; open surgery. Exclusion criteria: 1) Previous TMJ surgical intervention; 2) Impaired cognitive capacity; 3) Age < 14 years old; 4) Pregnant or breastfeeding women.

Prior to treatment, all patients were examined by the same doctor (David Ângelo, Ph.D., MD.). TMJ pain, with a Visual Analog Scale (VAS, 0-10, with 0 being no pain and 10 having maximum insupportable pain), MMO (mm) using a certified ruler between the incisor's teeth and muscle tenderness (MT) through palpation in masseter and temporalis muscle was accessed. For MT, the authors used a 0-3 classification as defined in TMD/RDC (Schiffman et al., 2014). All patients were instructed to follow a soft diet for 3 days after surgery and 5 physiotherapy and 3 speech therapy exercise sessions started 3-5 days after the intervention.

Design and application of patient satisfaction questionnaire

The patients enrolled in the study were contacted via phone call and all the answers were given directly at the moment of the call. The survey consisted of 11 questions: 6 using a 10-point Likert scale (0 = very dissatisfied and 10 = very satisfied) and 5 yes or no questions. Three of the questions had the possibility to explain the given answer and thus allow an open response.

The questionnaire was developed and written in Portuguese. The questions were written in the most neutral form to avoid response bias, specifically wording bias. We have also included binary response questions (yes or no) with those that offer a range of options, to force the patient to think about the answer. Open-ended questions were also included since it gives the patient the possibility to be honest and reflect on possible dissatisfaction factors as it should be actively investigated by the researcher.

The survey focused on evaluating satisfaction on the following parameters: 1) facial pain; 2) ability to open mouth, 3) chewing ability and comfort; 4) post-intervention recuperation; 5) global satisfaction; and 6) fulfilment of the expectations. The patients were also asked if they would undergo the same treatment again and if they would recommend it to friends. The presence of anxiety and/or depression and the level of education was also assessed, since it may have an impact on the patient perception of post-intervention outcome (Chow, Mayer, Darzi, & Athanasiou, 2009; Kahlenberg et al., 2018; Rauck et al., 2020). Lastly, the authors asked the patients about the need for further TMJ treatment.

It is important to understand discrepancies between patients' and clinicians' rating of outcome after specific therapies (Posnick & Wallace, 2008). This provides a patient-centered approach in the evaluation of outcomes since the success and, therefore, choice of treatment must also be defined in the context of the patient's opinion of its success (Rustemeyer et al., 2010). At the same time, we hope to add more information that may contribute to the current treatment recommendations of TMD.

Table 1. *Post-intervention satisfaction questionnaire used in our study is shown.*

Questions	
Question 1	Regarding the effect of the treatment in terms of facial pain, evaluate on a scale from 0 to 10, your satisfaction with the treatment, 0 being very dissatisfied and 10 very satisfied. (0-10)
Question 2	Regarding the effect of the treatment in terms of ability to open your mouth, evaluate on a scale from 0 to 10, your satisfaction with the treatment, 0 being very dissatisfied and 10 very satisfied. (0-10)
Question 3	Regarding the effect of the treatment in terms of chewing ability and comfort, evaluate on a scale from 0 to 10, your satisfaction with the treatment, 0 being very dissatisfied and 10 very satisfied. (0-10)
Question 4	Overall how satisfied are you with treatment results? 0 being very dissatisfied and 10 very satisfied. (0-10)

Question 5

Regarding your post-op/post-intervention recuperation (in terms of time and/or side effects that still bother you until today) how satisfied are you? 0 being very dissatisfied and 10 very satisfied. (0-10)

Question 6

Do you feel like your expectations have been met? 0 being they clearly weren't met and 10 it corresponded exactly to your expectations. (0-10). Could you please explain why?

Question 7

If you had to make the decision again, would you undergo this same treatment? (Yes, Maybe, No)
If you said no, could you please explain why?

Question 8

Would you recommend this same treatment to friends, in case they needed it? (Yes, Maybe, No)
If you said no, could you please explain why?

Question 9

Do you have or have ever had a diagnosis of anxiety? (Yes, No)

Question 10

Do you have or have ever had a diagnosis of depression? (Yes, No)

Question 11

Since your intervention, did you need any other
TMJ treatment? (Yes, No). If so, what treatment?

Table 2. *Post-intervention satisfaction questionnaire used in our study is shown. Original version, written in portuguese.*

Questões	
Questão 1	Em relação ao efeito do tratamento realizado para a dor na face, avalie numa escala de 0 a 10 a sua satisfação com esse tratamento, sendo 0 muito insatisfeito e 10 extremamente satisfeito. (0-10)
Questão 2	Em relação ao efeito do tratamento realizado na capacidade de abrir a boca, avalie numa escala de 0 a 10 a sua satisfação com esse tratamento, sendo 0 muito insatisfeito e 10 extremamente satisfeito. (0-10)
Questão 3	Em relação ao efeito do tratamento realizado na eficácia e conforto da sua mastigação, avalie numa escala de 0 a 10 a sua satisfação com esse tratamento, sendo 0 muito insatisfeito e 10 extremamente satisfeito. (0-10)
Questão 4	Em geral, quão satisfeito está com o resultado do tratamento? Sendo 0 muito insatisfeito e 10 extremamente satisfeito. (0-10)

Questão 5

Em relação à recuperação no pós-operatório (em termos de tempo e/ou sequelas que lhe causem incômodo no dia a dia) quão satisfeito está? Sendo 0 muito insatisfeito e 10 extremamente satisfeito. (0-10)

Questão 6

Sente que as suas expectativas foram cumpridas? Sendo 0 claramente não foram cumpridas e 10 correspondeu claramente às expectativas. (0-10) Pode, por favor, explicar porquê?

Questão 7

Numa situação hipotética que ainda não tinha realizado este tratamento, voltaria a tomar a mesma decisão e realizá-lo? (Sim, Talvez, Não). Se respondeu não, será que pode explicar porquê?

Questão 8

Recomendaria este tratamento a um amigo, caso o mesmo precisasse? (Sim, Talvez, Não). Se respondeu não, será que pode explicar porquê?

Questão 9

Teve ou tem algum diagnóstico de ansiedade? (Sim, Não)

Questão 10

Teve ou tem algum diagnóstico de depressão?
(Sim, Não)

Questão 11

Desde a sua intervenção, teve necessidade de algum outro tratamento da ATM? Se sim, que tratamento?

Statistical analysis

The variables were expressed as the mean (\pm standard deviation (SD)). The normality analysis was performed with the Shapiro-Wilk test. Normality assumption was not fulfilled. For comparison between groups, the Kruskal-Wallis test was performed. Correlations between the study variables were performed with Spearman's rank correlation coefficient. $P < 0.05$ was considered statistically significant. These data analyses were obtained using SPSS (v26) and GraphPad Prism (v9).

RESULTS

1.1) Demographics and diagnosis

158 patients were assessed for study eligibility. 30 could not be reached with the contact details provided, 6 refused to participate and 2 were already deceased. Thus, 120 patients (108 female and 12 male) were included in the present study. Mean age was 41.20 ± 17.78 (ranging from 14 to 89 years old). Regarding education, 12 patients (10%) had completed primary and/or middle school; 35 patients (29.2%) had completed secondary school and 73 patients (60.8%) had a college degree (bachelor's, master's, and/or doctorate degrees).

Table 3. Study Variables

Variables	n (%), or mean \pm SD	
Number of patients	120	
Sex	Female	108 (90%)
	Male	12 (10%)
Age Mean (years)	41.20 ± 17.78	
	<18	6 (5.0%)
	18-30	29 (24.2%)
	30-45	41 (34.2%)
	45-65	27 (22.5%)
	>65	17 (14.2%)

Table 4. Summary table of sociodemographic characteristics of the study population.

Education	Low Level	12 (10.0%)
	Medium Level	35 (29.2%)
	High Level	73 (60.8%)

Among 120 persons, 188 joints were treated. The most frequent diagnosis was disc dislocation with reduction, DDwR, (81 joints, 43.1%), followed by disc dislocation without reduction, DDwoR, (31 joints, 16.5%). TMJ synovitis was observed in 19 joints (15,4%). 7 joints (3.7%) had a diagnosis of DDwR and osteoarthritis (OA) and 1 joint (0.5%) had DDwR plus osteophytes. 19 joints (10.1%) were diagnosed with DDwoR and OA; 16 joints (8.5%) had DDwoR and perforated disc; 3 joints (1.6%) had 4 concomitant diagnoses: DDwoR, OA, osteophytes and condylar resorption, and lastly, 1 joint (0.5%) was diagnosed with DDwoR, OA and osteophytes.

The mean preoperative pain was 4.9 ± 3.2 (mean \pm SD), MMO was 32.2 ± 10.1 mm (mean \pm SD), and MT was 2.5 ± 0.8 (mean \pm SD).

Table 5. TMJ Diagnostic

Number of Joints	188
Preoperative Diagnosis	
	DDwR 81 (43.1%)
	DDwR + OA 7 (3.7%)
	DDwR + osteophytes 1 (0.5%)
	DDwoR 31 (16.5%)
	DDwoR + OA 19 (10.1%)
	DDwoR + Perforated Disc 16 (8.5%)
	DDwoR + OA + Osteophytes 1 (0.5%)
	DDwoR + OA + Osteophytes + Condylar Resorption 3 (1.6%)
	Synovitis 29 (15.4%)
Preoperative VAS (0-10)	4.9 ± 3.2 (mean \pm SD)
Preoperative MMO	32.2 ± 10.1 mm (mean \pm SD)
Preoperative MT (0-3)	2.5 ± 0.8 (mean \pm SD)

Considering the treatments: 22 patients undergone BTX injections, 25 TMJ arthrocentesis, 46 patients had an arthroscopy performed and 27 were submitted to open surgery (Table 6).

Table 6. Treatments performed

Treatment performed	n (%)
BTX injections	22 (18.3%)
Arthrocentesis	25 (20.8%)
Arthroscopy	46 (38.3%)
Open surgery	27 (22.5%)
Total of patients:	120 (100%)

Almost two-thirds of the group (63,3 %) reported a clinical history of anxiety (46 patients) or depression (30 patients) (Table 7).

Table 7. Psychiatric disorders Diagnostics

Other Diagnostics	n (%)
Anxiety	46 (38.3%)
Depression	30 (25.0%)

1.2) Global satisfaction assessment

The mean subjective overall satisfaction of all four treatments included in this study was 8.24 ± 2.23 . 97 patients (80.8%) reported that they would repeat the procedure performed (Table 8). Furthermore, 106 patients (88.3%) would recommend the treatment (Table 8). The mean subjective improvement on ability to open mouth, pain, and chewing ability evaluation was 8.52 ± 1.97 , 8.38 ± 2.06 , and 8.41 ± 1.97 , respectively. Patients also rated their satisfaction regarding expectations in 8.20 ± 2.43 . The mean satisfaction with postoperative recovery was 8.24 ± 1.95 .

Table 8. Overall satisfaction

Outcome	n (%), or mean \pm SD	
Overall satisfaction	8.24 \pm 2.23	
Satisfaction with pain reduction	8.38 \pm 2.06	
Satisfaction with the ability to open mouth	8.52 \pm 1.97	
Satisfaction with chewing ability	8.41 \pm 1.97	
Satisfaction with postoperative recovery	8.24 \pm 1.95	
Satisfaction of postoperative expectations	8.20 \pm 2.43	
Satisfaction with the treatment choice	Yes	97 (80.8%)
	Maybe	12 (10.0%)
	No	11 (9.2%)
Treatment recommendation	Yes	106 (88.3%)
	Maybe	7 (5.8%)
	No	7 (5.8%)

In the study patients, 98 (82%) required no other TMJ intervention and the remaining 21 patients (18%) needed further TMJ treatment: either BTX injections, 4 people; arthrocentesis, 13 people; and open surgery, 4 people; with a total of 21 patients, 18%.

Further TMJ treatment

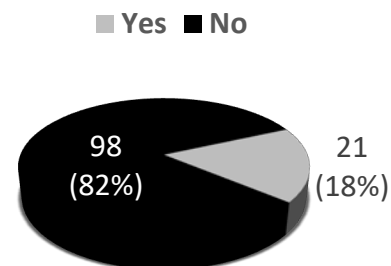


Figure 1. Analysis of the need for further TMJ treatment.

1.3) Satisfaction assessment within each treatment

The degree of satisfaction with each surgical intervention was analyzed. The overall satisfaction was higher with arthrocentesis, 9.09 ± 0.971 , followed by arthroscopy, 9.03 ± 1.13 , and open surgery, 8.38 ± 1.84 (Table 9). The treatment that provided less overall satisfaction to patients was the BTX injections, 7.05 ± 2.90 . (Table 9, p-value = 0.021).

Regarding the analysis of other satisfaction parameters, no statistically significant differences were found. Therefore, BTX injections were the treatment that presented fewer satisfaction values across all parameters evaluated. The minimal invasive technique, TMJ arthrocentesis had higher satisfaction levels across all parameters, compared to the remaining treatments, except in the chewing ability where arthroscopy proved to be slightly superior (8.84 ± 1.34 versus 8.83 ± 1.83). It must also be noticed that open surgery appeared to have higher satisfaction levels, compared to arthroscopy, in two aspects: satisfaction in pain reduction (8.78 ± 1.58 versus 8.66 ± 1.72) and satisfaction with the fulfillment of expectations (8.56 ± 1.74 versus 7.94 ± 2.82).

Table 9. Degree of satisfaction in each treatment. $P < 0.05^*$

Outcome	Botulin Toxin (BTX) (n=22)	Arthrocentesis (n=22)	Arthroscopy (n=34)	Open surgery (n=32)	P- value
	mean \pm SD	mean \pm SD	mean \pm SD	mean \pm SD	
Overall satisfaction	7.05 ± 2.90	9.09 ± 0.971	9.03 ± 1.13	8.38 ± 1.84	0.021*
Satisfaction in pain reduction	7.34 ± 2.82	8.91 ± 1.35	8.66 ± 1.72	8.78 ± 1.58	0.189
Satisfaction in the ability to	8.05 ± 2.09	8.83 ± 1.72	8.81 ± 1.96	8.31 ± 1.84	0.203

open your mouth					
Satisfaction in chewing ability	7.74 ± 2.51	8.83 ± 1.83	8.84 ± 1.34	8.22 ± 1.91	0.158
Satisfaction in postoperative recovery	8.05 ± 2.15	8.48 ± 1.76	8.31 ± 2.09	8.25 ± 1.44	0.772
Satisfaction of postoperative expectations	7.45 ± 3.39	8.74 ± 1.57	7.94 ± 2.82	8.56 ± 1.74	0.851

1.4) Correlation between treatment and study variables

To assess possible dissatisfaction factors, the authors used the Spearman's rank correlation coefficient. It was shown that the overall satisfaction and the fulfillment of expectations were strongly correlated ($r = 0.803$) and it is statistically significant (p -value <0.0001). This value is extremely relevant because the individual's satisfaction rating is extremely dependent on the degree of expectations that the patient has. The presence of a depression diagnostic and the need for further TMJ treatment were also positively correlated ($r = 0.186$, $p=0.043$). No other statistically significant correlations were found.

Table 10. Correlations between the study variables: Spearman's rank correlation coefficient (r) and P -values. $P<0.05^*$; $P<0.005^{***}$

Correlation between:	r	P-value
Overall satisfaction and Age	-0.100	0.280
Overall satisfaction and expectations	0.803	$<0.0001^{***}$
Overall satisfaction and Sex	0.105	0.257
Overall satisfaction and Education	-0.174	0.059

Overall satisfaction and Anxiety Diagnostic	0.016	0.860
Overall satisfaction and Depression Diagnostic	0.027	0.774
Further TMJ surgery and Anxiety Diagnostic	-0.044	0.637
Further TMJ surgery and Depression Diagnostic	0.186	0.043*

DISCUSSION

Currently, in the literature, there are not many studies that evaluate the patient perception of outcome and satisfaction after four TMJ treatments. Understanding and comparing the patients' insight allows the surgeon to critically evaluate the methodologies applied and can be an important tool to understand the patient insight of different treatments.

According to the literature, it is reported that 80% of patients with signs and symptoms of TMD have some form of internal derangement of the TMJ (Paesani et al., 1992). In this study the 120 patients included had a preoperative diagnosis of an articular TMD, mainly disc displacement with or without reduction, 47 of them with other additional diagnoses. Moreover, during the survey, some patients have reported other concomitant diagnoses: 2 had fibromyalgia, 2 had trigeminal neuralgia and 16 patients had symptoms resembling bruxism-related pain. The treatment with BTX injections is a highly reviewed subject and studies seem to indicate that it has therapeutical value. However, it still remains unclear who and what TMD benefits the most from this treatment. The literature presents multiple evidence supporting the use of BTX injections alone or in combination with other treatments to address TMD, claiming its improvement in pain and quality of life (Thomas & Aronovich, 2017; Villa et al., 2019). The lack of a validated protocol regarding the type of BTX, length of the follow-up period, outcomes studied, makes it difficult to interpret the existing results in the literature. Within our study group, BTX injections had a lower level of overall satisfaction (7.05 ± 2.90 , p-value = 0.021*) compared to the remaining treatments in the study. Moreover, this group of patients had the highest standard deviations across all parameters evaluated, which is in agreement with the answers collected, with some patients reporting full satisfaction and a complete improvement in quality of life and others reporting some positive change but not as much as they expected. This is an important premise demonstrating that BTX has efficacy but perhaps not all patients respond the same way to it. Another reason that may explain the BTX results, is due to the transient effect and cost. Six subjects in our study said BTX injections were too expensive for the result to last

less than a year. The cost has been referred as a disadvantage in other studies (Thambar et al., 2020; Yurttutan, Tütüncüler Sancak, & Tüzüner, 2019). Finally, one must notice that within this group of patients, there was a bigger need for some patients to engage more in the physiotherapy sessions and to acquire some muscular relaxation techniques to use in their day-to day life. This need for bigger patient compliance and potential risk to not fully follow the recommendations, could help explain the level of satisfaction achieved. We believe the results obtained were very satisfactory, especially considering the low risk of the BTX treatment. Moreover, it must be taken into account, the fact that some patients reported a sustained and significant gain in quality of life with a technique performed in an outpatient basis. Therefore, BTX seems a viable option that surgeons should consider.

In this work, all the studied treatments achieved a high level of overall patient satisfaction. However, TMJ arthrocentesis was the one with better results, 9.09 ± 0.971 (p-value= 0.021*). It is important to specify that all TMJ arthrocentesis were performed under local anaesthesia. This treatment is described as a simple, less invasive, less expensive, and highly effective procedure with a minimum number of complications and significant clinical benefits (E. A. Al-Moraissi, 2015; Laskin, 2018; Soni, 2019). According to Al-Moraissi and colleagues, there may be a current paradigm shift in the treatment of arthrogenous TMDs, supporting the initiation of minimally invasive procedures, particularly in combination with IAI of PRP, HA or CS sooner in the treatment course, since they seem more effective than conservative treatments for pain reduction and MMO improvement. Nevertheless, the success rate of this treatment varies significantly within the available literature. The review performed by Soni in 2019, evaluated seven studies, with the success rate of arthrocentesis ranging from 70% to 95%, and it was recognized that arthrocentesis could reestablish normal mouth opening and reduce pain and functional disorder (Soni, 2019).

With very little difference to arthrocentesis, the overall satisfaction obtained with TMJ arthroscopy was 9.03 ± 1.13 . According to Laskin, the effectiveness of both arthrocentesis and arthroscopy is comparable (Laskin, 2018). However, arthrocentesis is less invasive, cheaper, with less postoperative morbidity and possible complications (Laskin, 2018). Additionally, unlike arthrocentesis, arthroscopy is performed under general

anaesthesia, which may lead to a greater potential for complications and also contribute for a longer recovery period. Nevertheless, the arthroscopy group of patients still presented with high levels of satisfaction regarding postoperative recovery. On the other side, arthroscopy allows the surgeon to see the joint during the procedure, thus having a diagnostic and therapeutic role (Sidebottom & Murakami, 2017) that cannot be equaled to arthrocentesis. Moreover, arthroscopy has shown to be superior to arthrocentesis in terms of improvement of mouth opening (Essam Ahmed Al-Moraissi et al., 2020). In this work though, patients who undergone arthrocentesis and arthroscopy had equal satisfaction levels regarding the ability to open the mouth and to chew.

Open surgery is used only in more advanced TMD (Li & Leung, 2021) as a last attempt to prevent the need for a replacement joint. Al-Moraissi and colleagues concluded that there are not enough data available to draw meaningful conclusions as to the efficacy of open surgery versus minimally invasive procedures (Essam Ahmed Al-Moraissi et al., 2020). Open surgery should be the last resource to treat progressive stages of arthrogenous disease when conservative approaches fail. Even though our study participants still reported high levels of satisfaction (8.38 ± 1.84), three of them also described side effects that had implications in their quality of life, to be known: changes in facial sensitivity, tinnitus, and maxillary deviation. The bigger risk of complications in combination with the fact that it is a more invasive treatment with a longer post-operative recovery may explain the lower levels of satisfaction achieved. In fact, patient satisfaction regarding postoperative recovery was the lowest (8.25 ± 1.44) compared to arthrocentesis and arthroscopy, however without statistical significant differences.

Temporomandibular disorders have been related to emotional distress, disturbed sleep and impaired oral health-related quality of life (Jie Lei, Yap, Zhang, & Fu, 2021). Depression, anxiety, and stress usually coexist in patients with TMD and they appear to be interconnected (J. Lei, Liu, Yap, & Fu, 2015). Patients in our study also reported the exacerbation of the symptoms in periods of greater stress and anxiety, which is in accordance with the review of (Li & Leung, 2021), who referred symptoms may be exacerbated during times of stressful events in TMD patients. This is an important fact since

some studies suggest that parafunctional oral habits could be a risk factor for myofascial pain and disc derangement (Michelotti, Cioffi, Festa, Scala, & Farella, 2010). This is in accordance with our work, in which 46 patients (38.3%) had anxiety and 30 patients (25.0%) had depression in the present or recent past. There was also a statistically significant correlation between the need for further TMJ intervention (either BTX injections, 4 people; arthrocentesis, 13 people; and open surgery, 4 people; with a total of 21 patients, 18%) and the presence of a depression diagnostic ($r = 0.186$; $p\text{-value} = 0.043^*$). It is well established that depression and pain intensity have complex interactions (Goesling, Clauw, & Hassett, 2013). Living with chronic pain causes emotional distress as it becomes more difficult to manage it due to psychological deterioration and somatization (Li & Leung, 2021) which may aggravate a depression or precipitate one. On the other hand, a depression diagnostic can cause cognitive changes regarding the perception of pain. Severe depression and higher levels of somatization are associated with TMD of arthrogenous and myogenous origins (A. U. J. Yap, Tan, Prosthodont, Chua, & Tan, 2002). On the contrary, no statistically significant correlation was identified between the need for further TMJ surgery and anxiety diagnose which corroborates the work of Reiter and colleagues, who suggested a less significant role of anxiety in TMDs (Reiter, Emodi-Perlman, Goldsmith, Friedman-Rubin, & Winocur, 2015).

In this study, other association was found with the correlation between overall satisfaction and the fulfillment of patients' expectations ($r = 0.803$, $p\text{-value} = <0.0001^{***}$). It is clear when the outcome of treatment fails to meet patients' expectations, they will express more dissatisfaction with the outcome (Graham, 2016). Therefore, and as pointed out by our patients during the survey, surgeons must explain, prior to treatment, what would be a reasonable outcome, how long it might take to achieve it, how long will it last and possible risks and complications. The fulfillment of these premises will allow the patient not to feel disappointed in relation to his expectations.

Study limitations

- 1) The postoperative period was very different between patients. Study answers may have recall bias since the greater the time gap between the procedure and the questionnaire, the greater the risk of patients overlooking aspects that bothered them at the time of the treatment. On the other side, if the questionnaire is applied too close after the treatment date, there is the possibility that maximum satisfaction was not yet achieved.
- 1) The questionnaire was not validated;
- 2) The patients were not anonymous;
- 3) All patients were treated in one single institution;
- 4) All patients were treated by the same surgeon;
- 6) The authors only assessed the presence of an anxiety or depression diagnosis in the present or recent past but did not take into account how many years mean “recent past”.

RCTs should be done to compare these four different treatments and further studies are needed to compare the patients’ perception of outcome with the surgeon’s measurements of the outcome.

CONCLUSIONS

TMD is a very common musculoskeletal condition, often with a multi-factorial etiology and the exact causes of the symptoms may be difficult to isolate. To accurately treat these conditions, the patient must first be properly examined and then correctly diagnosed. The causes of the symptoms, and whether their origin is myogenous and/or articular, should be well understood before initiating any treatments.

This study suggests that all four treatments present high levels of patient overall satisfaction. Minimally invasive techniques, such as TMJ arthrocentesis and arthroscopy, were the techniques with the highest levels of satisfaction, with very little complications to the patients, proving these techniques are very well tolerated by the patients. These facts support the possibility of these techniques being started earlier, rather than using long-term conservative treatment without the desired efficacy. Despite, open surgery presents a longer recovery time with more associated risks, but when indicated, patients have still shown a high degree of satisfaction and it demonstrates to be a safe and effective technique in more severe cases of the disease. The more discrepant results regarding BTX injections highlights the need for detailed patient selection and awareness to their symptomatology and that this treatment alone should be reserved for muscular TMD patients and should be used in conjunction with other therapy when the patient has intra-articular and muscular TMD.

Our study also emphasized the complex interactions that exist between TMD and the presence of anxiety and/or depression. In fact, we found that patients with a diagnosis of depression would more likely need further TMJ reintervention which should warn the surgeon prior to treatment. Additionally, we also found a statistically significant correlation between overall satisfaction and the fulfillment of patients' expectations, highlighting the need to explain what is a reasonable and achievable outcome.

The authors suggest that in the future, rigorous studies defining standardized protocols according to diagnosis for the different types of treatment will allow for more in-depth conclusions.

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