



Contents lists available at ScienceDirect

Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology

journal homepage: www.elsevier.com/locate/jomsmp



Original Research

Unilateral temporomandibular joint discectomy without interposal material in patients with disc perforation or fragmentation: A prospective study

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ARTICLE INFO

Article history:

Received 2 August 2021
Received in revised form
17 November 2021
Accepted 1 December 2021
Available online xxx

Keywords:

Temporomandibular joint
TMJ discectomy
TMJ meniscectomy
TMJ surgery
Prospective study

ABSTRACT

Objective: Temporomandibular joint (TMJ) discectomy is one of the most popular surgical techniques for patients with an unsalvageable disc. Previous studies have demonstrated predictable results of discectomy with optimal results in pain reduction and maximum mouth opening (MMO) improvement. However, those studies had most of the times wide-ranging inclusion criteria. This study was therefore conducted to assess the role of unilateral TMJ discectomy in a well defined diagnosis.

Methods: A 6-year prospective study was designed including patients treated with unilateral TMJ discectomy without interposal material, preserving condyle and temporal fibrocartilage, for two specific intra-articular diagnosis: disc perforation and disc fragmentation.

Results: A total of 19 patients were enrolled, with a mean age of 51.05 ± 13.71 (mean \pm SD) years. Preoperative pain was 7.63 ± 1.89 (mean \pm SD), MMO was 25.95 ± 10.27 mm (mean \pm SD) and muscle tenderness (MT) was 2.53 ± 0.77 (mean \pm SD). The most common diagnosis was disc perforation. After an average of 37.9 months of follow-up time (range from 10 to 71 months), a statistically significant improvement of pain ($P < 0.0001$), MMO ($P < 0.0001$) and MT ($P = 0.00011$) was observed. Postoperatively, 16 of 18 patients (89 %) showed a reduction in pain and improvement in MMO, fulfilling the criteria for a successful outcome of TMJ surgery. No second surgery was necessary.

Conclusion: Unilateral TMJ discectomy without interposal material in patients with disc perforation or fragmentation seems to be an adequate technique. However, we encourage rigorous long-term studies and new preclinical trials to pursuit a disc substitute, as relevant preclinical trials have demonstrated significant degenerative changes after TMJ discectomy.

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1. Introduction

Temporomandibular disorders (TMD) are the most prevalent orofacial pain source of nondental origin. Those disorders can be due to a heterogeneous group of pathologies affecting the temporomandibular joint (TMJ), the jaw muscles, or both. TMD symptoms prevalence has been reported between 10–33% of the population [1–4]. The most common signs and symptoms include pain, joint sounds, limitation of mandibular movement, facial deformities, condyle dislocation and recurrent headaches. These symptoms can negatively affect patients' quality of life. Surgical treatments for

TMD are reserved for specific cases, however with the popularization of mini-invasive surgical techniques such as TMJ arthroscopy, more patients have been eligible for these less invasive techniques, amplifying the scope of TMJ surgery. In diagnostics such as ankylosis, tumors and growth abnormalities, TMJ open surgery is strongly recommended [5]; however, those diagnosis are relatively uncommon. TMJ internal derangement involving disc position/integrity and osteoarthritis are more frequent, but the surgical indication is also more relative [5].

From all the open surgery techniques, TMJ discectomy without interposal material is probably one of the most popular procedures [6]. Recently, Ângelo et al. [7] showed that bilateral discectomy, preserving condyle and temporal fibrocartilage can induce severe imaging and histopathologic TMJ changes in black Merino sheep. Besides, the degenerative changes in the condyle, functional masticatory changes were not observed [8]. In a different preclinical

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<https://doi.org/10.1016/j.ajoms.2021.12.005>

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Table 1
Criteria for classification of success rate.

Good	No pain or only mild pain level (0–2 on a 0–10 VAS scale) and MMO ≥ 35 mm
Acceptable	No pain or only mild pain level (0–2 on a 0–10 VAS scale) and MMO ≥ 30 mm and ≤ 35 mm
Failure	Pain constantly or moderate (2–10 on a 0–10 VAS scale) and/or MMO ≤ 30 mm

study, disc and fibrocartilage removal resulted in traumatic TMJ ankylosis [9]. It remains poorly understood the role of the condyle and temporal fibrocartilage in the joint, but it appears to be crucial, balancing the disc function. In humans, short-term studies on TMJ discectomy were associated with successful results [10–13]. Michael Miloro et al. [14] in a retrospective study described discectomy without replacement as an effective procedure improving the maximum mouth opening (MMO). In long-term evaluations, discectomy was effective relieving the pain and led to greater improvement in MMO (>35 mm) [15,16]. Despite the good clinical outcome, some studies have observed degenerative changes in imaging analysis, showing bone changes and remodeling of the mandibular condyle due to mechanical stress [10,16,17]. Ellis et al. [18] pointed that a lower improvement in MMO (<10%) was associated with higher risk of poor outcome and the possible need of a TMJ total joint replacement. Together, clinical and preclinical results showed TMJ discectomy can be considered a suboptimal technique, and an effective disc substitute, acting as a cushion between the condyle and temporal fossa could, in theory, improve these results. Despite extensive research in the field of tissue engineering, currently no appropriate disc substitute has demonstrated safety and efficacy. In fact, the last guidelines do not recommend disc replacement because nonvalid option showed superiority over discectomy alone [19]. While there is no effective disc substitute, discectomy is often used when the disc is partial or total damaged and cannot be salvageable and/or when other techniques fail to relieve the symptoms. Some previous studies have heterogenous inclusion criteria, retrospective data and non-randomization disclosing difficulty to draw clear conclusions about this technique. We designed a rigorous prospective study for patients with: 1) unilateral TMJ disc perforation or 2) unilateral TMJ disc fragmentation. Those patients were proposed to unilateral TMJ discectomy preserving condyle and temporal fibrocartilage.

2. Material and methods

The variables measured throughout the study were 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. For MT, the authors used a 0–3 classification as defined in TMD/RDC [20,21]. This study is in form with the STROCSS guidelines [22]. The study was registered in ClinicalTrials.Gov with the number: NCT04857294. The success rate of the surgery was graded as good, acceptable and failure in accordingly with Table 1 as described by Eriksson, Westesson [17].

2.1. Study design

A 6-years prospective study was conducted in Portugal in a private institution from the 1st of January of 2015 to the 1st of October of 2021. The study was approved by the ethics review board. All enrolled patients gave their informed consent in writing, following current legislation. Patient data was scrubbed of any personal identifying parameters and given a random ID number. All surgeries were performed by the same surgeon (D.A.) with the same assistant surgeon (D.S.). The inclusion criteria were: 1) Age > 18 years old; 2) Unilateral TMJ pain >7 (0–10 VAS) and/or MMO < 30 mm (Fig. 1); 3) Magnetic Resonance Imaging (MRI) presenting unilateral disc perforation or disc fragmentation and confirmation of the definitive diagnosis during the surgery (Fig. 2); 4) Clinical and imaging examination with criteria for unilateral TMJ discectomy; 5) Dimitroulis classification in categories 3 and 4. Exclusion criteria: 1) Previous TMJ surgical intervention; 2) Concomitant contralateral surgery; 3) Age < 18 years old; 4) Degenerative changes of the condyle with or without osteophytes confirmed by MRI and intraoperatively. Patients’ VAS score, MMO and MT were registered preoperative and postoperative in the following timeline: T0 (preoperative – 2 weeks); and T1 (postoperative maximum follow-up) (Fig. 1).

2.2. Surgical protocol

Preoperative treatment included the use of a splint for more than 6 months and/or medication (NSAIDS and/or myorelaxant) for more than 1 month without symptomatic resolution. Dur-

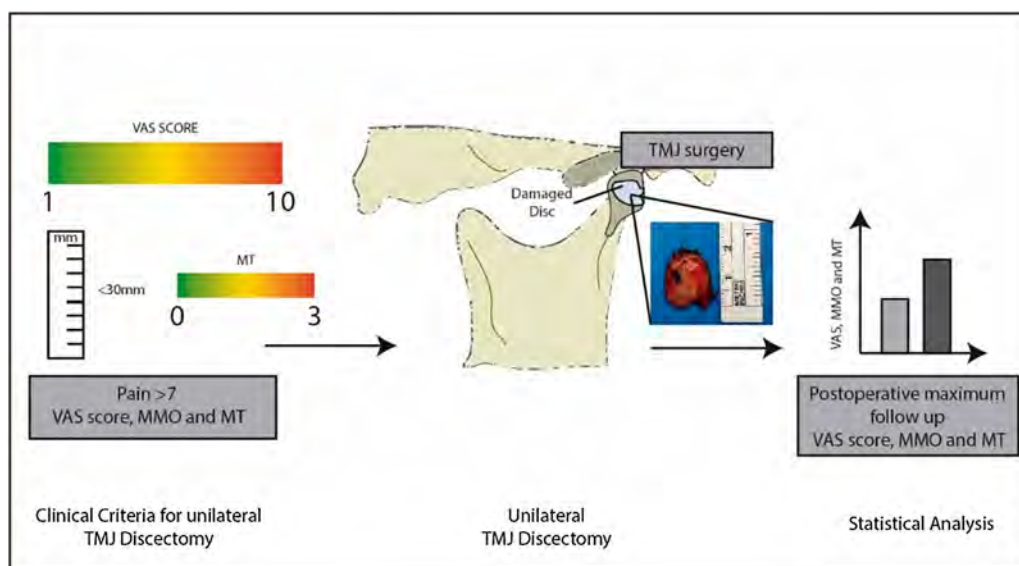


Fig. 1. Illustrative scheme of the study. MMO- Maximum Mouth Opening; MT- Muscle Tenderness; TMJ- Temporomandibular Joint; VAS- Visual Analogue Scale.



Fig. 2. Disc perforation (A) and fragmentation (B) imaging diagnosis. Images acquired through magnetic resonance.

Table 2
Patient characteristics.

Patient	Sex	Age	Diagnosis	VAS	MMO	MT	Side	Dimitroulis classification	Incision	Follow-up time (months)	
1	AT	F	48	Disc Perforation	9	9	3	R	4	Preauricular	51
2	AF	F	59	Disc Perforation	9	27	1	L	4	Preauricular	50
3	AL	F	66	Disc Perforation	7	24	3	L	4	RHITNI	32
4	AA	F	34	Disc Perforation	7	21	3	L	4	RHITNI	24
5	IL	F	55	Disc Perforation	8	34	3	L	4	RHITNI	39
6	JS	F	30	Disc Perforation	4	17	3	R	3	RHITNI	40
7	LFD	M	63	Disc Perforation	10	53	3	L	4	RHITNI	10
8	MM	F	69	Disc Perforation	4	19	3	R	4	RHITNI	31
9	MF	F	54	Disc Perforation	10	11	2	L	4	Preauricular	56
10	MC	F	66	Disc Fragmentation	8	31	3	R	3	RHITNI	43
11	MS	F	70	Disc Perforation	8	32	3	R	3	RHITNI	42
12	MV	F	56	Disc Fragmentation	8	21	1	R	4	Preauricular	49
13	MBC	F	60	Disc Perforation	4	33	3	R	3	RHITNI	38
14	NM	F	52	Disc Perforation	9	24	1	R	4	Preauricular	71
15	SC	F	34	Disc Perforation	8	21	3	L	3	RHITNI	41
16	SR	F	31	Disc Fragmentation	8	32	3	R	3	RHITNI	26
17	SP	F	31	Disc Perforation	10	35	3	R	4	RHITNI	15
18	SVC	F	42	Disc Perforation	7	16	2	R	4	RHITNI	23
19	VS	F	50	Disc Perforation	7	33	2	L	4	RHITNI	36
M			51.1		7.6	25.9	2.5		3.7		37.9
±SD			±13.7		±1.9	±10.3	±0.8		±0.5		14.7

F-Female; M-Male; MMO- Maximum Mouth Opening; MT- Muscle Tenderness; VAS- Visual Analogue Scale.

ing operation, all patients underwent general anesthesia with nasotracheal intubation, managed in most cases with intravenous anesthesia protocol, usually with remifentanil infusion. Intraoperative steroids, usually dexamethasone, were administered primarily to minimize postoperative swelling. A classic preauricular incision or a root of helix inter tragus notch incision (RHITNI) was used [23]. RHITNI is a modification of the classical endaural incision, marked from the inferior border of the root of the helix into the crux, performing a V shape following the inferior border of the tragus, to finish in the ear notch. This incision allows complete anatomic control during surgery, adequate surgical exposure, low risks in damaging nerve structures, reduced need for vessels ligation, and more satisfactory cosmetic results when compared to the classic preauricular or endaural approaches [23]. The discectomy was performed preserving condyle and temporal fibrocartilage. No bandage or special care was performed after the surgery. No hair washing restrictions were recommended.

2.3. Postoperative protocol

All patients were hospitalized for 24 h. Patients were instructed to maintain a soft, light-chew diet for 3–5 weeks. Jaw motion

rehabilitation program started 5 days after surgery with 9 sessions. Patients were seen on follow-up at 1-week, 15-days, 30-days, 90-days and then in 1-year intervals.

2.4. Statistical analysis

Data were analyzed using SPSS (v26) and GraphPad Prism (v9) software. The variables were expressed as the mean (± standard deviation (SD)). The normality of data was verified for all tests. Student's paired *t*-test was used for variables with normal distribution and Signed Ranks Test for variables without normal distribution. *P* < 0.05 was considered statistically significant.

3. Results

A total of 19 patients (between 30 and 70 years old), were included in this study (Table 2). Patients had a mean age of 51.05 ± 13.71 (mean ± SD) years, 18 of whom were female gender (95%). Of the 19 patients, 11 were operated on the right TMJ and 8 on the left TMJ. All patients were classified as 3 or 4 in the Dimitroulis classification, corresponding to moderate or severe stages, respec-

Table 3
Statistical test results for VAS, MMO and MT and comparison between preoperative and postoperative results.

	Mean Pre-Op ± SD	Mean Post-Op ± SD	Statistical significance
VAS (0–10)	7.63 ± 1.89	0.53 ± 1.22	p = 0.000004****
MMO (mm)	25.95 ± 10.27	40.74 ± 5.40	p = 0.000003****
MT (0–3)	2.53 ± 0.77	0.74 ± 0.81	p = 0.0001****

p < 0.005; * p < 0.0001 when compared to preoperative preoperative results.

Table 4
Success rate of TMJ discectomy.

Success rate	
Good	16 (89 %)
Acceptable	1 (6 %)
Failure	1 (6 %)

tively [24]. The mean preoperative pain was 7.63 ± 1.89 (mean \pm SD), MMO was 25.95 ± 10.27 mm (mean \pm SD) and MT was 2.53 ± 0.77 (mean \pm SD). The most common diagnosis was disc perforation. The mean follow-up time was 37.9 months (Table 2). There were no surgical or wound healing complications. The authors did not have to reoperate any joint after TMJ discectomy, however 2 patients reported contralateral pain (both with acute dislocated disc with reduction) and were treated with TMJ arthrocentesis [25]. A comparison between preoperative and postoperative outcomes was performed. A normal distribution was found in the MMO data, contrary to the MT and VAS outcomes. After an average of 37.9 months of follow-up time, a statistically significant improvement of pain, MMO and MT was observed (Table 3). The proportion of the patients that showed a good and acceptable outcome was eighty and nine percent (89 %) and six percent (6 %), respectively. Six percent (6 %) was classified as failure (Table 4).

4. Discussion

This centenary technique, firstly described by Lanz in 1909 [26], still be controversial. Until now, most of the studies are limited in short follow-up time. The patient behaviors after TMJ discectomy can contribute to different results across time [27] and combined with preclinical trials results, can provide a distrustful mood of TMJ surgeons with a difficult decision regarding disc removal. The present prospective study with 19 patients, investigated the effect of unilateral TMJ discectomy preserving condyle and temporal fibrocartilage, on pain, MMO and MT strictly in patients with unilateral disc perforation or fragmentation. In the last years, different reports have studied the role of TMJ discectomy [12,14,17,28,29]. However, in most cases the inclusion criteria for these studies comprised dislocated disc with reduction or dislocated without reduction [12,14,17,28,29]. Some studies have demonstrated dislocated disc with reduction or dislocated without reduction, have good results with mini-invasive techniques, such as TMJ arthrocentesis [30–33] and TMJ arthroscopy [33–37], in agreement with the authors clinical practice. However, when the disc is damaged, TMJ discectomy seems to be an accepted approach. A recent study observed significative histopathological changes in the TMJ discs in cases of disc fragmentation or perforation. Those changes were mainly: (1) pre-fibrous sclerosis with myxoid degeneration; (2) collagen deposits; (3) increase in fibro-hyaline and fibrous tissues; (4) loss of elasticity; (5) scattered calcifications, and (6) synovial inflammation This article reinforces the importance of performing discectomy in disc fragmentation and perforation cases, as these alterations seems to be irreversible [38].

In our study, the median age of patients was 51 years, superior to other studies (mean \sim 32–37 years) [12,14,28], yet our age range was 30–70 years. In our experience, we did not observe signs of per-

foration or fragmentation in patients under 30 years. Most studies assigned a Wilkes stage classification to all patients and predominantly included Wilkes III, IV, and V stage disease [12,14]. However, Wilkes classification is mostly based on 2 TMD sub-types (internal derangement and osteoarthritis), not covering all the possible sub-classifications known these days [39]. In our study, we used the Dimitroulis classification, a more recent classification that include more TMD sub-classifications. The mean Dimitroulis score was \sim 4 corresponding to “severe TMJ changes” with indication for TMJ discectomy as the mainstay treatment [24]. The authors believe Dimitroulis category 4 could be comparable to Wilkes stage IV.

Our study showed a statistically significant reduction in pain, measured with VAS score (Table 3). In the last years, different studies reported also reduction in pain postdiscectomy [12,14,17,28,29]. Eriksson, Westesson [17] described that 50 of 52 patients operated had no/reduced pain (0-19/100). Likewise, Takaku et al. [29] in 35 operated joints observed the absence of pain in 32 joints, and 3 joints presented mild pain. Nyberg et al. [28] in a 5-years retrospective study verified only a reduction in pain on chewing, while pain at rest was not significantly changed. Bjørnland, Larheim [12] observed no pain in 20 of 29 patients (69 %) after 3-years, and similar observations were made 10 years post-operatively.

Discectomy also had a positive effect on MMO (Table 3). MMO changed from a mean preoperative MMO of 25.95 mm (range 9–53 mm) to a postoperative of 40.74 mm (range 36–55 mm). Our results are similar to Miloro et al. [14] and Bjørnland, Larheim [12]

We verified a significant improvement in MT postdiscectomy (Table 3). However, no data has been reported in the literature regarding this parameter after TMJ discectomy. High levels of MT in the masseter and temporalis muscles are correlated with TMD dysfunction [40] and the evaluation of this parameter can be an important complement to determine the success of the surgery.

In this study, the global success rate of discectomy was 89 % (Table 4). This value is accordingly with other authors that obtained favourable results in 82–87 % of the patients [14,17,28].

Accordingly, to Bjørnland, Larheim [12], 3-years successful results after TMJ discectomy is a reliable predictor for a 10-year results, which can support the continuation of our results. Complications of TMJ surgery are uncommon but can have serious implications. In our study, we did not find surgical complications in the operated joint and the authors did not have to reoperate any patient. However, 2 patients reported contralateral pain during the follow-up period. Those patients were easily managed with TMJ arthrocentesis. In 2004, Nyberg et al. [28], in a retrospective study, observed in 15 patients submitted to unilateral TMJ discectomy an 87 % success rate in 5 years follow-up and no contralateral changes. On the contrary, Eriksson, Westesson [17] despite reporting a good outcome in 85 % of the 64 patients submitted to bilateral and unilateral TMJ discectomy, they reported a 5% reoperation rate, and in 8%, they operated the contralateral side. In the imaging analysis, they also observed that more than 90 % of the patients had condyle osteophytes/flattening or sclerosis without association with patients' symptoms. We did not evaluate imaging changes in this study. In a preclinical trial conducted in black Merino sheep, the authors observed significant imaging and histologic changes after bilateral TMJ discectomy. Those results were obtained in pre-

vious healthy joints with preserved fibrocartilage. The authors did not find any functional changes, neither in mastication or mastication [7,8]. Discussion can be made, rather bilateral discectomy can have worst outcome, compared to unilateral surgery. Also, the fibrocartilage condition, specially after discectomy, can probably be important to maintain the joint integrity. All these points remain poorly understood, and unfortunately this work is of little value to clarify these concerns.

From a clinical perspective, TMJ tissue engineering remains a great opportunity for investigators to join efforts to find an effective and safe TMJ disc substitute. That difficult path must be meticulous to avoid precipitated decisions that could compromise patient's health. In fact, failures from the past, as the example of Proplast-Teflon interpositional material [41–44] have demonstrated, we need to be careful in decisions regarding TMJ disc substitution. It is expected that in the coming years, with the evolution of tissue engineering, the disc replacement may be a reality. However, in this moment, in the presence of a damaged disc, discectomy without interpositional material seems to be superior to any interpositional material in the joint [45]. Some promising preclinical studies have demonstrated the possible role of a new interpositional material to protect the condyle and fossa from degenerative changes after TMJ discectomy [46].

The results of this study should be a reminder for TMJ surgeons to make an effort to record patient data in the long-term and share those results to ensure a close understanding of the effect of surgical interventions. Future long-term research, that analyze joint sound, imaging, or specific questionnaires can give more robust data regarding this topic. We strongly recommend other surgeons to study more variables to increase knowledge. Moreover, it seems important in future studies to ensure an independent element to record the outcomes. A more significant sample size will also reinforce the results obtained in this article.

With this prospective study the authors conclude, currently, unilateral TMJ discectomy without interpositional material, preserving the condyle and fossa fibrocartilage in patients with unilateral disc perforation or fragmentation seems to be an optimal technique.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Patient consent

All the enrolled participants gave their informed, clarified, and free term of consent in writing and per current legislation

Declaration of Competing Interest

The authors have no conflict of interest to declare.

Acknowledgement

This work is supported by Centro2020 through the Project reference: BIODISCU (CENTRO-01-0247-FEDER-039969).

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