

EVALUATION OF PTERYGOMAXILLARY DISJUNCTION WITH INTERPOSITIONAL Y-SHAPE PLATE AS AN INNOVATIVE MINIMALLY INVASIVE TECHNIQUE IN PATIENTS WITH TEMPOROMANDIBULAR JOINT INTERNAL DERANGEMENT (CLINICAL TRIAL)

Sherif A. Sadakah¹* *BDS*, Ahmed M. Shaaban² *PhD*, Mohamed Shokry³ *PhD*

ABSTRACT

INTRODUCTION: Surgical intervention in temporomandibular joint (TMJ) internal derangement is a controversial issue in cases not responding to conservative methods. the purpose of this study: was to evaluate the efficiency of pterygoid disjunction with interposition y-shape titanium plate in the treatment of anterior disc displacement without reduction through clinical and MRI evaluation.

MATERIALS AND METHODS: 10 patients (8 females and 2 males) with twelve joints suffering from anterior displacement were included.

RESULTS: There was significantly increased in the mean values of maximum mouth opening, lateral excursion to the right and left and protrusion in the postoperative follow up periods as compared to preoperative values. the improvement of jaw movement increased one and three months postoperatively. three months postoperatively, MRI showed improvement of disc position in all the operated joints. ten joints with moderate improved to slight while 2 improved to moderate displacement.

CONCLUSION: Pterygomaxillary disjunction is a minimally invasive extracapsular transoral technique that preserves TMJ integrity

KEYWORDS: temporomandibular joint anterior disc displacement without reduction, pterygomaxillary disjunction.

RUNNING TITLE: 980 nm Diode Laser for Pink Esthetics.

1. Demonstrator of Oral and Maxillofacial surgery, Oral and Maxillofacial Surgery Department, Faculty of Dentistry, El Salam University, Tanta, Egypt.

2. Professor, Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt.

3. Associate Professor, Oral and Maxillofacial Surgery Department,, Faculty of Dentistry, Alexandria University, Alexandria, Egypt.

* *Corresponding Author:*

E-mail: sadakah_1994@outlook.com

INTRODUCTION

Temporomandibular joint disorders (TMD) include a group of conditions characterized by pain in the TMJ or its adjacent tissues, functional limitations of the mandible, or clicking in the TMJ throughout movement. (1, 2) The most frequent TMJ disorder is the internal derangement due to abnormal connection between the condyle of the mandible, articular eminence and disc. (3) Disc displacement has an vital role in the development of inflammatory and degenerative joint alterations. (4, 5) In internal derangement, the articular disc is displaced in an anterior position producing elongation of its posterior insertion and then, joint loading on the bilaminar zone

(retro discal pad), leading to inflammation and restricted condylar mobility.

Typically, this aberrant association is accompanied by muscular discomfort, TMJ pain, mouth opening restriction, and odd noises.

Literature has highlighted the necessity to treat the mechanical problem resulting from disc displacement to avoid the development of ID to disc perforation and condyle osteoarthritis.(6) disc displacement is managed by different therapeutic modalities.it begins with conservative methods like medical treatment, physiotherapy, thermotherapy and bite appliance therapy. Surgical intervention is a controversial issue in cases not responding to conservative method. (7, 8)

Some writers suggest that internal derangement of the TMJ is caused by hyperactivity or hypoactivity of the lateral pterygoid muscle, inadequate coordination between its two heads, or a disruption in the muscle's normal involvement in the regulation or stability of the TMJ.(9)

The purpose of this work was to assess the efficiency of the use of pterygoid disjunction and the use of interposition Y-shape titanium plate in the treatment of cases with temporomandibular dysfunction anterior disc displacement without reduction through both clinical and MRI evaluation

MATERIALS AND METHODS

The present work was carried out as a clinical trial study. Cases were chosen from the Outpatient Clinic, Faculty of Dentistry, Alexandria University, and were operated in the Oral and Maxillofacial Surgery Department. The sample size was 10 patients complaining from anterior disc displacement without reduction. After ethical approval, the patients signed an informed consent prior to surgery. They were selected to fulfill some criteria:

Inclusion criteria:

- 1) Both genders
- 2) Patients aged from 18 to 36 years.
- 3) Patients without relevant disease.
- 4) Patients' refractory to conservative treatment > 6 months.
- 5) Patients are diagnosed, with unilateral/bilateral anterior disc displacement with no reduction, clinically and by MRI recently.
- 6) No previous TMJ surgery.
- 7) No previous maxillofacial trauma.

Exclusion criteria:

- 1- Patients with systemic joint disease (rheumatoid, osteoarthritis, gout).
- 2-Medically compromised patients contraindicating operation.
- 3- Patients to whom general anesthesia is contraindicated.
- 4- Patient with neuromuscular disorders.
- 5- Patients with any gross pathology of ear.
- 6- Patient with psycho-neurogenic disorders.

I. Preoperative assessment:

History includes personal history, full personal data were obtained from each patient in details including name, age, gender, occupation, address. Past medical and dental history. Chief complains by recording all details about the complains particularly its onset and previous trials at treatment.

Extraoral Joint examination by palpation for detection of the tenderness with maximal mouth opening, an audible click and crepitus over the joint region during

movements of the mandible may be present. Auscultation by using stethoscope and clicking sound are heard and recorded during jaw movements.

Intraoral examination to detect loss of teeth, premature contact of teeth, cuspal interference on excursions of the jaw, mis-directed and abnormally erupted teeth, improperly restored teeth with resultant occlusal and periodontal problems, all contribute to occlusal disharmony. Facets and grinding of occlusal surface of anterior and posterior teeth are indicators for the nervous tension of patients (bruxism and/or clenching) play an important role in TMJ arthralgia.

II. Assessment of Jaw movement:

Clinical evaluation of restriction in the range of jaw movement is separated into three sections: maximal mouth opening, lateral shift to both sides. The maximum protrusion

1-Maximum opening of the mouth was evaluated by calculating by the distance among the incisal edge of upper and lower incisors in millimeters (mm) by digital caliper at maximum pain free mouth opening (fig1) evaluated as follows:

- A value above 40 mm earns a score of zero.
- A measurement between 30 and 39 mm is worth 1 point.
- Openings smaller than 30 mm get a score of 5.



Figure 1: A photograph showing preoperative interincisal opening using digital caliper.

2- Maximum lateral excursion to right and left was evaluated by calculating the distance among the incisal edge of upper and lower incisors in millimeters (mm) by digital caliper at maximum pain free mouth opening as the mouth deviated. it was evaluated as follows:

- Score 0 if the measurement is 7 mm or more.
- Scores1 point if the range of motion is between 4 and 6 mm

-Scores 5 points if the range is less than 4 mm.

3- Protrusion was evaluated by calculating the distance, in millimeters (mm), between the incisal edges of the upper and lower incisors when the jaw is maximally protruded. It was evaluated as follows:

- Score 0 if the measurement is 7 mm or more.

-Score 1 if the range of motion is between 4 and 6 mm

-Score 5 : if the range is less than 4 mm.

These subsections of the item of limitation of jaw movements were added together to obtain a total:

- if the sum is 0 (no limitation of movement)
- if the sum is 1 - 4 (slight limitation of movement)
- if the sum > than 4 (severe limitation of movement).

III. Radiographic Examination:

MRI T2 proton-density assessment :

MRI temporomandibular joint internal derangement preoperative and postoperative assessment was based on MRI finding including, disc displacement and disc non-recapture.

The normal disc position in the sagittal plane was described as The posterior band of the disc is placed at the 12 o'clock or superior position with respect to the condyle as defined by Molinari et al(10) and Katzberg et al(11) When the anterior disc displacement remained in an aberrant position relative to the condyle, any forward movement of the disc was considered anterior disc displacement, It was categorized as anterior disc displacement with no reduction.

As described by Kurita et al(12), the degree of anterior disc displacement without reduction in the closed mouth position was classified as follows:

Slight: The posterior band of the disc was in contact with the condyle.

Moderate: The posterior band of the disc is positioned along the posterior slope of the articular eminence and does not contact the condyle.

Severe: The posterior band of the disc was positioned beneath or more anterior to the articular eminence.

MRI was performed for every patient preoperatively (fig 2) and 3 months postoperatively.



Figure 2: A photograph showing preoperative MRI of case No 6 with anterior disc displacement without reduction in open mouth position.

IV. Surgical procedure:

a) Preoperative patient preparation

All laboratory investigations necessary to obtain clearance for operation from the anesthesia specialist were done for all patients. All patients were instructed about at least 8 hours of fasting prior to the surgery. Cases were given anxiolytics, liniment application, local wet heat, and anti-inflammatory agents. Prophylactic antibiotic treatment were given preoperatively in the form of Cefotaxime* 1 gm/12 intravenously in order to avoid infection postoperatively.

b) Operative procedures

All cases were treated under general anesthesia by nasotracheal intubation. The surgical field was then washed with a povidone-iodine surgical scrub solution, and the patient was draped with sterile cloths that exposed just the operative region. Infiltration anesthesia with 2% lidocaine 1:80,000 epinephrine was done at the site of operation to achieve homeostasis. Ipsilateral maxillary vestibular incision just behind the zygomatic buttress on the buccal sulcus was performed then, mucoperiosteal elevator was used for tissue reflection.

At the root of the pterygoid plate, a stop cut was performed using a straight osteotome to prevent the fracture from extending to the cranial base. After separating the pterygoid plates from the maxilla using a curved pterygoid osteotome, the ball of the index finger was put on the palatal face of the pterygoid hamulus to confirm the accuracy of the disjunction. The pterygoid plate was shattered, elevated, and retracted. Y-shape titanium plate 4 mm diameter (manufactured by Leibinger Germany). was fixed by 4 mm length screws to the lateral maxillary surface with its vertical limb and the other two limbs were turned to fit into the retro maxillary space preventing the reattachment of the fractured pterygoid plate. (Fig 3) After debridement of the wound, it was closed using 3(0) vicryl interrupted sutures

V. Postoperative phase

a) Early postoperative care

All patients were instructed to apply ice pack extra-orally starting immediately postoperatively for 24 hours.

b) Postoperative medication

Intravenous cefotaxime 1 gm/12 hours for the first day followed by Amoxicillin+ clavulanate 1 gm twice daily for the next 5 days. Metronidazole tablets 500mg every eight hours for 5 days. chemo-trypsin ampoules as anti-edematous once daily for 5 days. Diclofenac potassium tablets 50mg every 8 hours for 5 days. Muscle relaxant one tablet 5 mg every 12 hours for one week.

-All patients were instructed to rinse their mouth using chlorhexidine as antiseptic mouth wash.

-Instruction of soft, fully liquid, high protein, diet rich in calories was given for all cases with avoidance of hot spicy food and liquids for one week postoperatively.

c) postoperative splints:

-Patients were also instructed to wear fabricated hard splints as long as they can to have joint space increased to facilitate reduction of the displaced disc.

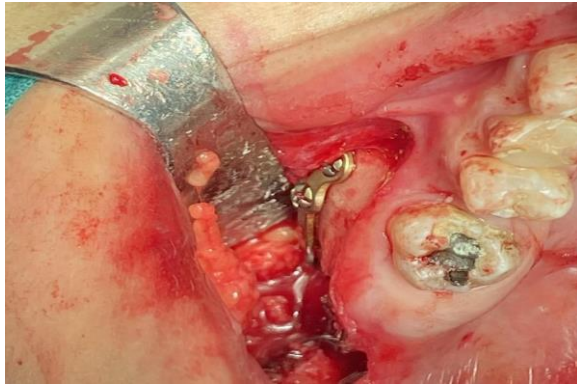


Figure 3: A photograph showing Y-shaped titanium plate (adapted to fit into the retro maxillary space).

VI. Postoperative assessment:

A. Clinical evaluation:

A thorough follow-up was done after, one week, 2 weeks, one month and 3 months for the assessment of the following clinical parameters:

1.Wound healing:

The sutured wounds were examined after one and two weeks for signs and symptoms of infection like redness, pus discharge, hotness, swelling, and pain in addition to observing for signs of wound healing disruption, such as wound dehiscence and hardware exposure, the patient must be monitored for wound dehiscence and hardware exposure.

2.Assessment of Jaw movement

Clinical assessment of the restriction of the jaw's range of motion is separated into three sections: maximal mouth opening, lateral shift to both sides. The greatest projection.

3- MRI T2 proton-density assessment:

Evaluation by MRI was done after 3 months to assure disc position

VII. Statistical analysis

For data analysis, the Statistical Package for the Social Sciences (SPSS) version 26 for Windows (IBM Corp., Armonk, New York, United States) was used.

Numerical data were tested for distribution utilizing the Shapiro-Wilk test for normality. Normally distributed continuous numerical variables were summarized as mean \pm standard deviation (SD), and

comparisons between repeated measurements were carried out using repeated measures analysis of variance (ANOVA) (if significant, a post-hoc Bonferroni test was done). For data that did not follow the normal distribution, median and interquartile range were computed and comparisons between repeated measurements were carried out using Friedman's test (if significant, a post-hoc Dunn-Bonferroni test was done).

For categorical data, the variables were summarized as frequencies (count and percentage). Cochran's Q test (followed by McNemar's test) or Marginal homogeneity test was used to examine repeated assessments of categorical variables. A p-value < 0.05 was adopted to interpret the tests of significance

RESULTS

3.1. Demographic data

A total of ten patients complaining from TMJID disc displacement without reduction as proved by MRI were involved in this work. Table (1) demonstrates the characteristics of the studied cases with 12 TMJID without reduction. As shown in this table, 8 patients were females and 2 were males, their age ranged between 18-35 years with a mean value of 28 ± 5.5 . Out of the studied patients, 6 females showed unilateral disc displacement with no reduction and 2 females showed bilateral disc displacement with no reduction. The remaining 2 cases were males with unilateral disc displacement without reduction.

3.2.Clinical assessment

1-Primary Wound healing was achieved for all cases by the end of the second week (Fig4).



Figure 4: A photograph showing wound healing two weeks postoperatively.

2--Assessment of limitation in the range of jaw movement (table 1):

1-Maximum mouth opening (fig 5): there was significantly progressive increased in the maximum mouth opening in the different postoperative follow up periods as compared to the preoperative period. However, the measurement of the maximum mouth opening after the third month increased insignificantly as compared to the one-month postoperative period.



Figure 5: A photograph showing interincisal opening one month postop.

2 - lateral excursion to right side: Statistically, there was significantly progressive increased in the maximum lateral excursion to the right in the different postoperative follow up periods as compared to the preoperative period. However, insignificant increase was observed in the mean values of maximum lateral excursion to the right in the second week compared to one week postoperatively ($p>0.05$) and in the third month compared to one month postoperatively. ($p>0.05$)

3 - lateral excursion to left side there was significantly progressive increased in the maximum lateral excursion to the right in the different postoperative follow up periods as compared to the preoperative period. However, insignificant increase was observed in the mean values of maximum lateral excursion to the right in the second week compared to one week postoperatively ($p>0.05$) and in the third month compared to one month postoperatively. ($p>0.05$)

4 - protrusion there was significantly progressive increased in protrusion in the different postoperative follow up periods as compared to the preoperative period. However, insignificant increase was observed in protrusion in the third month than one month postoperatively ($p>0.05$).

Table 1: Mean values of maximum mouth opening, lateral excursion to right and left sides & protrusion in the studied patients (n = 10 with 12 TMJID without reduction).

| | Mean(SD) | Min-Max | F | P-Value |
|---|------------|-------------|--------|---------|
| 1- Interincisal opening (mm.) | | | | |
| Baseline | 14.3 ± 5.7 | 4.0 - 20.0 | 77.113 | <0.001* |
| 1W PO | 21.8 ± 4.7 | 11.0 - 28.0 | | |
| 2W PO | 25.2 ± 4.8 | 15.0 - 32.0 | | |
| 1M PO | 30.8 ± 2.7 | 25.0 - 33.0 | | |
| 3M PO | 32.7 ± 2.4 | 28.0 - 36.0 | | |
| 2 - Lateral excursion to the right | | | | |
| Baseline | 14.3 ± 5.7 | 4.0 - 20.0 | 49.9'2 | <0.001* |
| 1W PO | 21.8 ± 4.7 | 11.0 - 28.0 | | |
| 2W PO | 25.2 ± 4.8 | 15.0 - 32.0 | | |
| 1M PO | 30.8 ± 2.7 | 25.0 - 33.0 | | |
| 3M PO | 32.7 ± 2.4 | 28.0 - 36.0 | | |
| 3 - Lateral excursion to the left | | | | |
| Baseline | 2.5 ± 1.1 | 1.0 - 4.0 | 75.68 | <0.001* |
| 1W PO | 4.3 ± 1.3 | 3.0 - 6.0 | | |
| 2W PO | 5.0 ± 1.3 | 3.0 - 6.0 | | |
| 1M PO | 6.5 ± 0.9 | 5.0 - 8.0 | | |
| 3M PO | 7.0 ± 1.0 | 5.0 - 8.0 | | |
| 4 - Protrusion | | | | |
| Baseline | 2.3 ± 1.1 | 1.0 - 4.0 | 74.714 | <0.001* |
| 1W PO | 4.0 ± 1.0 | 3.0 - 5.0 | | |
| 2W PO | 5.3 ± 1.4 | 3.0 - 7.0 | | |
| 1M PO | 6.3 ± 1.3 | 5.0 - 8.0 | | |
| 3M PO | 6.8 ± 1.1 | 5.0 - 8.0 | | |

F: Statistic of repeated-measures one way analysis of variance (ANOVA);
 Max: maximum; Min: minimum; PO: postoperative; SD: standard deviation; W: week; M: month; * significant at $p<0.05$.

Table 2: Degree of limitation of jaw movement in the studied patients (n = 10 with 12 TMJID without reduction):

| Degree of jaw movement limitation | Normal | Slightly limited | Severely limited | χ^2 | P |
|-----------------------------------|----------|------------------|------------------|----------|---------|
| Baseline | 0 (0.0%) | 0 (0.0%) | 12 (100.0%) | 37.250 | <0.001* |
| 1W PO | 0 (0.0%) | 0 (0.0%) | 12 (100.0%) | | |
| 2W PO | 0 (0.0%) | 2 (16.7%) | 10 (83.3%) | | |
| 1M PO | 0 (0.0%) | 10 (83.3%) | 2 (16.7%) | | |
| 3M PO | 0 (0.0%) | 11 (91.7%) | 1 (8.3%) | | |

χ^2 : Statistic of Cochran's Q test; a: p-value of Cochran's Q test; PO: postoperative; W: week; M: month; * significant at $p<0.05$.

Table (2) shows that, improvement of jaw movement started after the second week with significant increase one and three months postoperatively as compared to

the preoperative assessment and one and two weeks postoperatively .No significant increase in jaw movement was observed between one month and three months postoperatively.

3.3 MRI T2 proton-density assessment:

Table (3) demonstrates the, MRI proved anterior disc displacement with no reduction in all examined joints, 8 of them (66.7%) showed moderate disc displacement, and the other four (33.3%) showed severe disc displacement. Three months postoperatively, MRI showed improvement of disc position in all joints. The 8 operated joints with moderate anterior disc displacement improved to slight anterior disc displacement while in the other four operated joints with severe anterior disc displacement, 2 of them improved to moderate displacement and the other two improved to slight displacement. Statistically significant improvement was encountered in MRI findings of the studied joints with TMJID without reduction 3 months postoperatively than preoperative findings. (p<0.001, Fig6).



Figure 6: A photograph showing postoperative MRI of case No 6 with mild disc displacement in open mouth position.

Table 3: Disc position assessment Comparison between preoperative and postoperative magnetic resonance imaging (MRI) findings in the studied cases (n = 10 with 12 TMJID without reduction).

| MRI | Slight | Moderate | Severe | MH | P |
|---------------|---------------|--------------|--------------|-------|---------|
| Preoperative | 0 (0.0%) | 8 (66.7%) | 4 (33.3%) | 3.300 | <0.001* |
| Postoperative | 10 (83.3%) | 2 (16.7%) | 0 (0.0%) | | |

MH: statistic of Margin al homogeneity test; PO: postoperative; W: week; M: month; * significant at p<0.05.

DISCUSSION

Prevalence of TMD is quite common and the incidence is reported as 28%–69%. TMJ ID are therapeutic challenge in the oral and maxillofacial clinic. In order to avoid the advancement of ID to disc perforation and

condyle osteoarthritis, the literature has underlined the necessity to treat the mechanical issue resulting from disc displacement.(6) The purpose of this work was to assess the efficiency of pterygomaxillary disjunction with interpositional Y-shape titanium plate in the treatment of cases with temporomandibular dysfunction internal .

Concerning gender, the study showed that 8 patients were females, two of them had bilateral anterior disc displacement with no reduction (ADDWOR). The remaining patients and 2 males had unilateral ADDWOR .

The occurrence of anterior disc displacement with no reduction in females more than males has been previously reported by several authors who reported that it is four times higher in females than males(13, 14) .

They attributed the higher incidence of ADDWOR in females to the fact that structure of TMJ is weaker in female patients than males.(15)

Additionally, it has been reported that female patients seek treatment more than males. (16, 17)

The mean age of the studied patients was (28 ±5.5) .This is comparable with the study of Mizuhashi etal 2022 (18) where the mean age was 47 years in patients with ADDOWR and in agreement with Manfredini et al (2006)who reported that prevalence of symptoms is mostly pronounced between the age of 20-40 years.(19)

Patients were evaluated preoperatively and postoperatively. In the current work , the mean values of MMO was (14.3± 5.7). Reference wise, limitation of mouth opening was reported to be more related to ADDWOR than ADDWR.

The study revealed that 100% of the examined joints preoperatively had severe limitation in movements. It has been reported that prolonged limitation in joint movements leading to Reduced synovial fluid turnover, which permits the buildup of inflammatory chemicals that might cause injury if present for an extended time of reduced mobility.(20)

Several surgical methods have been advocated, tried, and discontinued While researchers continue to hunt for a rational, minimally invasive treatment for TMJ dysfunction caused by internal derangement.(21)

None of the examined surgical techniques are free of problems. Except for condylotomy and modified sub sigmoid vertical ramus osteotomy, all surgical methods invade the joint space. Invasion of the joint space can result in hemarthrosis and/or infection, followed by fibrosis and mouth opening restriction. With condylotomy, it is recommended to use intermaxillary fixation followed by trainer elastics. For all surgical procedures, physiotherapy and splints are required as postoperative care.

In the present study, with the proposed technique; pterygomaxillary disjunction with interposition of titanium plate, Indirect decompression of the joint occurs. Since the pterygoid plates are shattered, however, the spasm in these muscles is likely eased. The anterior and upward pull on the condyle is lessened, which relieves discomfort by reducing pressure on the retrodiscal lamina. Since the joint space is under less pressure, the minimally displaced disc has a greater chance of returning to its natural position.

To the best of researchers' knowledge this is the first study that evaluated the outcome of pterygoid maxillary dysjunction with interposition of titanium plate to prevent re-attachment. The objective for this surgical technique as preservation of the articular tissue to permit normalization and regeneration of synovium, and a restoration of the articular relations to permit the joint structures to adapt and function through an adequate range of motion. (21)

In the present study , 100% of the joints showed severely limited jaw movement preoperatively and improved significantly postoperatively starting from 1 month to be slightly impaired in 91.7% of the joints .

In a study performed by Mani et al (2005)(21) where pterygoid dysjunction was performed by fracturing, prying up and pushing backwards of the pterygoid plate, 90% of the patients showed complete relief of pain, for a further 7%,the pain was reduced. For 76% of patients, clicking disappeared and crepitus disappeared in 77%. For 93% of patients, mouth opening became normal and was improved for the remaining patients. Comparable with the present study, Kanan (2010) (22) following the same technique like Mani et al,(2005) reported that, following pterygoid dysjunction Immediate postoperatively, all patients exhibited restricted mouth opening, which improved between 14 to 21 days..

Similar to the current study, Sharma (2011)(23) using the same technique of Mani et al (2005) (21) and Kanan (2010) (22) reported that 30 cases were assessed at 1, 3, 6, 12 months. Position of the disc was evaluated after 1 year. Normal range of mandibular movement was found in 7 cases. In 13 cases smooth movement without TMJ sounds was achieved

Reference wise, MRI is currently the gold standard for the diagnosis of TMD. MRI is important to diagnose the internal derangement because it directly visualizes the articular disk in both the open- and closed-mouth positions. The accuracy of MRI is reported to be 95% in the assessment of disk position or form and 93% in the assessment of osseous changes.(18)

It is noteworthy that the purpose of treatment is to enable a patient to return to a regular diet, with some restrictions, and to achieve an acceptable functional range of motion. The success of the technique is not

dependent on obtaining a specific mouth opening in each case. The indices of surgical outcomes should instead be based on the patient's response to therapy in terms of whether the patient perceives a total eradication, major reduction, or minimal decrease of his or her symptoms, or no change or worsening of the illness.

CONCLUSION

The technique of pterygomaxillary disjunction with interpositional Y-shape titanium plate in the therapy of cases with temporomandibular dysfunction internal derangement proved to be a minimally invasive technique with no invasion of the TMJ.. It permitted restoration of the articular relations to allow TMJ structures to adapt and function through an adequate range of movement

DECLARATION

Registration

This randomized controlled clinical trial was registered at a clinical trial. Gov under the number NCT05561465 with the study name: effectiveness of Rotation-advancement and Straight-line surgical approaches in repairing unilateral cleft lip defect. This clinical trial was approved by the ethics committee in the Faculty of Dentistry, Alexandria University. Under the serial number IRB NO: 00010556 – IORG 0008839

Competing interests

The authors declare they have no conflict of interest.

Funding

No funding is subjected to the research reported in this manuscript.

Acknowledgements

We thank the patients for their cooperation, patience, and support.

REFERENCES

1. Stohler CS. Muscle-related temporomandibular disorders. *Journal of orofacial pain.* 1999;13(4).
2. Detamore MS, Athanasiou KA. Motivation, characterization, and strategy for tissue engineering the temporomandibular joint disc. *Tissue engineering.* 2003;9(6):1065-87.
3. Emshoff R. Clinical factors affecting the outcome of arthrocentesis and hydraulic distension of the temporomandibular joint. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology.* 2005;100(4):409-14.
4. Paegle D, Holmlund A, Hjerpe A. Expression of proteoglycan mRNA in patients with painful clicking and chronic closed lock of the temporomandibular joint. *International journal of oral and maxillofacial surgery.* 2005;34(6):656-8.

5. Dimitroulis G. The prevalence of osteoarthritis in cases of advanced internal derangement of the temporomandibular joint: a clinical, surgical and histological study. *International journal of oral and maxillofacial surgery*. 2005;34(4):345-9.
6. González-García R. Arthroscopic myotomy of the lateral pterygoid muscle with coblation for the treatment of temporomandibular joint anterior disc displacement without reduction. *Journal of Oral and Maxillofacial Surgery*. 2009;67(12):2699-701.
7. McCain JP, Sanders B, Koslin MG, Quinn JD, Peters PB, Indresano AT. Temporomandibular joint arthroscopy: a 6-year multicenter retrospective study of 4,831 joints. *Journal of oral and maxillofacial surgery*. 1992;50(9):926-30.
8. Holmlund AB, Axelsson S, Gynther GW. A comparison of discectomy and arthroscopic lysis and lavage for the treatment of chronic closed lock of the temporomandibular joint: a randomized outcome study. *Journal of oral and maxillofacial surgery*. 2001;59(9):972-7.
9. Al-Moraissi E. Arthroscopy versus arthrocentesis in the management of internal derangement of the temporomandibular joint: a systematic review and meta-analysis. *International journal of oral and maxillofacial surgery*. 2015;44(1):104-12.
10. Molinari F, Manicone PF, Raffaelli L, Raffaelli R, Pirronti T, Bonomo L, editors. *Temporomandibular joint soft-tissue pathology, I: Disc abnormalities*. *Seminars in Ultrasound, CT and MRI*; 2007: Elsevier.
11. Katzberg R, Westesson P, Tallents R. Anderson. R., Kurita, K, Manzione, JV and Totterman, S.: *Temporomandibular Joint: MR Assessment of Rotational and Sideways Disk Displacement*. *Radiology*. 1998;169:714-48.
12. Kurita H, Kurashina K, Ohtsuka A. Efficacy of a mandibular manipulation technique in reducing the permanently displaced temporomandibular joint disc. *Journal of oral and maxillofacial surgery*. 1999;57(7):784-7.
13. Rani S, Pawah S, Gola S, Bakshi M. Analysis of Helkimo index for temporomandibular disorder diagnosis in the dental students of Faridabad city: A cross-sectional study. *The Journal of the Indian Prosthodontic Society*. 2017;17(1):48.
14. Cunha SCd, Nogueira RVB, Duarte ÂP, Vasconcelos BCdE, Almeida RdAC. Análise dos índices de Helkimo e craniomandibular para diagnóstico de desordens temporomandibulares em pacientes com artrite reumatoide. *Revista Brasileira de Otorrinolaringologia*. 2007;73:19-26.
15. Matsuka Y, Yatani H, Yamashita A. Epidemiological investigation of temporomandibular disorders in Japanese adult populations-Analysis of the adaptive population. *J Jpn Soc TMJ*. 1994;6:13-24.
16. Zarb GA, Carlsson GE, Rugh JD. Clinical management. In: Zarb GA, Carlsson GE, Sessle BJ, Mohl ND (eds). *Temporomandibular joint and masticatory muscle disorders*. Copenhagen: Munksgaard; 1994. p529-48.
17. McNamara DC. The role of masticatory muscles biofeedback in temporomandibular joint and muscle dysfunction. PhD Thesis. Department of Oral & Maxillofacial Surgery, University of Western Australia. Perth. 1990. .
18. Mizuhashi F, Ogura I, Sugawara Y, Oohashi M, Mizuhashi R, Saegusa H. Analysis of related factors to internal derangement in temporomandibular joint dysfunction patients using magnetic resonance imaging. *Journal of Oral and Maxillofacial Radiology*. 2021;9(2):35.
19. Manfredini D, Chiappe G, Bosco M. Research diagnostic criteria for temporomandibular disorders (RDC/TMD) axis I diagnoses in an Italian patient population. *Journal of oral rehabilitation*. 2006;33(8):551-8.
20. Israel HA, Syrop SB. The important role of motion in the rehabilitation of patients with mandibular hypomobility: a review of the literature. *CRANIO®*. 1997;15(1):74-83.
21. Mani V, George A, Keshava PY, Puthanveedu RK. Pterygoid plate disjunction: minimally invasive treatment for internal derangement of the temporomandibular joint. *Asian Journal of Oral and Maxillofacial Surgery*. 2005;17(4):247-55.
22. Kannan SV. Pterygoid dysjunction: new minimally invasive technique for the treatment of painful temporomandibular joint dysfunction. *Journal of Craniofacial Surgery*. 2010;21(4):1264-9.
23. Sharma R. Pterygoid disjunction for internal derangement of temporomandibular joint. *Journal of maxillofacial and oral surgery*. 2011;10(2):142-7.