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Article

# Evaluation of arthroscopic disc repositioning: a prospective study

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**Aim:** To evaluate clinical outcomes and success rates of our arthroscopic disc repositioning and suturing technique in patients with internal derangements of the temporomandibular joint (TMJ). **Materials and methods:** This was a prospective study in selected patients who met certain criteria. At baseline, we collected the information on their age, gender, disease duration, and the operated TMJ. Preoperative and postoperative variables included joint pain, joint clicking, maximal inter-incisal opening, mandibular protrusion, and lateral movements. Postoperative assessments were also performed, including magnetic resonance imaging (MRI) scans, assessment of numbness, scar, diet, and quality of life. All patients were assessed preoperatively and at 1, 3, 6, 12 months after the arthroscopic surgery. An independent t-test was used to assess the quantitative data and chi-square test was applied to the binary data. **Results:** The study was completed in 224 joints from 179 patients. Their mean age was 21.35 ± 8.71 years. Joint pain and quality of life improved significantly at 1 month of the follow-up, and almost vanished at 3 months of the follow-up. Frequency of joint clicking was significantly lower at 1 month of the follow-up, but increased significantly at 3 months of the follow-up. Numbness was significantly reduced at 12 months after surgery. Dietary and scar improvements were obvious at 3 months after surgery. Jaw movements were significantly improved at 12 months after the surgery. The success rate of the disc position evaluated by MRI decreased slightly from 99.6% to 97.8% at 1 month and 12 months of the follow-up. **Conclusion:** Our arthroscopic disc repositioning technique is an effective surgical method not only to improve the joint functioning, but also to correct the disc displacement for a relatively long time. It can be regarded as an appealing technique for the treatment of TMJ internal derangements.

**Key words:** temporomandibular joint, disc reposition, arthroscopy, prospective study, clinical outcomes, magnetic resonance imaging, pain, joint clicking, mandibular protrusion, numbness, scar, diet, quality of life

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**Conflicts of Interest**

The authors declare that they have no conflict of interest.

Internal derangements of the temporomandibular joint (TMJ) are described as disturbances in the biomechanical functioning of the TMJ due to a damage to the intra-articular tissues [1]. It is most frequently caused by anterior displacement of the articular disc, presenting as pain, joint sounds, and locking or restricted mouth opening [2].

To correct the mechanical interference in the TMJ, improve range of motion and reduce pain, disc repositioning is commonly performed, which was first described by W.L. McCarty and W.B. Farrar in 1979 [3]. The technique of TMJ arthroscopy was first introduced in Japan in 1975, but was only used as a diagnostic tool [4]. With the development of equipment and surgical skills, TMJ arthroscopy has been established as a diagnostic tool, as well as a surgical intervention [5–7]. Nowadays, arthroscopy has becoming more and more popular owing to its

minimally invasive character, early mobilization of the jaw, shorter recovering time and fewer postoperative complications for patients [8–9].

Standard TMJ arthroscopies include lysis and lavage of the superior joint space, whereas more advanced procedures involve tissue coagulation, debridement, disc repositioning and disentomb [1, 10]. Since 2001, we have been developing a new technique of arthroscopic disc repositioning and suturing, with specially designed appropriate equipment and dedicated sutures [11]. In our previous study we have also reported a significant improvement in the disc position detected by magnetic resonance imaging (MRI) in 95.42% of 764 joints [12]. However, our last report evaluated the immediate success rate only but did not provide detailed information regarding symptoms.

The aim of the present study was to prospectively evaluate the clinical outcome and success rate of our disc repositioning and suturing procedure. The investigators hypothesized that this procedure would improve clinical symptoms significantly and achieve a high success rate.

## Materials and methods

### Study design and subjects

A prospective study was designed and conducted in the Department of Oral Surgery, the Ninth People's Hospital, Shanghai Jiao Tong University. The study has done in accordance with the guidelines of Helsinki Declaration and approved by the local Ethics Committee.

To be included in the study, participants had to meet the following inclusion criteria: 1) undergoing arthroscopic disc repositioning by one senior surgeon (C. Yang) between 2014.4~2015.4; 2) internal derangements of TMJ ranging from II to V Wilkes stages; 3) unilateral or bilateral TMJ involvement; 4) using coblation to perform anterior release; 5) failed conservative, non-surgical treatment. No sex and age restrictions were applied to patients' selection.

Exclusion criteria were as follows: 1) severe malocclusion, bruxism, or psychiatric disease; 2) history of TMJ infection, injuries to the jaws, or congenital, developmental and systematic disorders; 3) advanced arthrofibrosis, ankylosing osteoarthritis and any prior surgery; 3) discontinued surgery due to a large perforation observed intraoperatively.

### Registered clinical variables

At entry, we collected the information on patient age and gender, disease duration, operated joint (left/right/bilateral), and the date of operation.

The following preoperative variables were registered: Wilkes classification, joint pain, joint clicking, maximal inter-incisal opening, mandibular protrusion, and lateral movements.

Postoperative assessments included: MRI scans, assessment of joint pain, joint clicking, numbness, scar, diet, quality of life, and jaw movements (maximal inter-incisal opening, protrusion and lateral).

All patients were assessed preoperatively and at 1, 3, 6, 12 months after the arthroscopy surgery.

### Assessment methods

*MRI scans*. The location of the disc was examined in the sagittal MRI scans at three different levels (medial/central/lateral) to evaluate the efficacy of disc repositioning. The criteria were as follows: 1) reposition in 3 sagittal parts was excellent; 2) reposition in 2 parts was good; 3) none or only 1 reposition was poor. Excellent and good evaluations were regarded as successful reposition (if the disc displacement was seen in only 1 or 2 levels, only replacement of all levels was a success).

*Joint pain*. They were scored subjectively by patients with a 10 grade visual analogue scale (VAS) (where 0 means no pain, 10 means maximum pain).

*Joint clicking and numbness*. They were both assessed as none or present.

*Scar*. The appearance of the surgical incision was evaluated subjectively with a 10 grade VAS (0 means very unaesthetic, 10 means very aesthetic).

*Diet*. It was one of the indicators of the jaw function, and was also evaluated by patients themselves with a 10 grade VAS (0 means normal, 10 means that the patient could only take fluids).

*Quality of life*. Quality of life was a measure of the impact of the surgery on the patient's ability to enjoy normal daily life activities, ranging from 1 to 4 (1 means a very serious impact on life, 4 means no impact on life).

### Surgical technique

The arthroscopic procedures were performed by one and the same surgeon under local anesthesia. The Coblation probe (Arthro Care System2000; Arthro Care, Sunnyvale, CA) was used to release the anterior attachment of the disc and a portion of the lateral pterygoid muscle before disc repositioning. This allowed for easy and effective disc reduction. Then the disc was reduced with a blunt probe and horizontal mattress suturing was performed twice at the posterior margin of the disc with suturing instruments (Shanghai Shen Ding Industrial Co, Ltd Manufacturing, Shanghai, China). The disc was fixed with 2 sutures from the medial part to the lateral part. Overcorrection of the disc was usually achieved to avoid a relapse of disc displacement [11].

### Data analysis

Statistical analysis was performed with a standard statistical software packages (SPSS, version 17.0, Chicago). A *p* value of less than 0.05 was accepted as statistically significant. Independent t-test was used to assess the quantitative data and chi-square test was performed to evaluate the binary data.

## Results

Two hundred and six (206) eligible patients were recruited into this study. Five patients were excluded for discontinued surgery and 22 patients were lost from the follow-up. Thus, the study was finally completed in 224 joints from 179 patients (26 males and 153 females). The number of unilateral joints was 134, that of bilateral joints, 45. The mean age was 21.35 ± 8.71 years (range, 11 to 61 years).

The joint pain decreased significantly (p = 0.001) at 1 month follow-up and almost vanished at 3 months of the follow-up (Table 1). There were no significant differences among 3, 6, and 12 months of the follow-up.

As seen from Table 2, 46% of patients had joint clicking before surgery, and its frequency was significantly reduced (p < 0.001) at 1 month of the follow-up. However, there was a significant increase (p = 0.022) of the joint clicking at 3 months of the follow-up (Figure 1). Although the occurrence of clicking was decreased after surgery, no significant differences were found between its preoperative rates and 3, 6, and 12 months of the follow-up. The presence of numbness was significantly reduced 12 months after the surgery (p < 0.001).

Dietary improvement was obvious at 3 months after the surgery (p < 0.001). The aesthetics of the scar was acceptable at 1 month of the follow-up, and significantly improved 3 months later (p < 0.001). Quality of life of the patients at 1 month after the surgery was significantly higher compared to baseline (p < 0.001), and we could safely claim that there was no notable influence on the patients' quality of life (Table 3).

Table 4 demonstrates that maximal inter-incisal opening (p = 0.002), forward and lateral movements

**Table 1.** Joint pain assessment

| | Preoperatively | 1 month of the follow-up | 3 months of the follow-up | 6 months of the follow-up | 12 months of the follow-up |
|---|---|---|---|---|---|
| Pain (Mean ± SD) | 2.09 ± 2.06 * | 1.41 ± 1.87 * | 0.99 ± 1.47 | 0.83 ± 1.24 | 0.75 ± 1.2 |

*The difference is statistically significant

**Table 2.** Joint clicking and numbness assessment

| | Preoperatively | | 1 month of the follow-up | | 3 months of the follow-up | | 6 months of the follow-up | | 12 months of the follow-up | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Clicking | 54% | 46% * | 80.8% | 19.2% * | 69.4% | 30.6% | 67.3% | 32.7% | 61.6% | 38.9% |
| Numbness | 100% | 0% | 89.3% | 10.7% | 91.7% | 8.3% | 95% | 5% | 97.2% | 2.8% |

*The difference is statistically significant

**Table 3.** Evaluation of diet, scar and quality of life

| | Preoperatively | 1 month of the follow-up | 3 months of the follow-up | 6 months of the follow-up | 12 months of the follow-up |
|---|---|---|---|---|---|
| Diet | 3.48 ± 1.77 | 3.62 ± 1.88 * | 2.72 ± 1.79 | 2.71 ± 2.02 | 2.5 ± 1.6 |
| Scar | | 9.1 ± 1.36 | 9.68 ± 0.92 * | 9.67 ± 0.77 | 9.91 ± 0.27 |
| Quality of life | 2.6 ± 0.8 * | 3.48 ± 0.62 | 3.61 ± 0.49 | 3.58 ± 0.55 | 3.67 ± 0.57 |

*The difference is statistically significant

**Table 4.** Jaw movements evaluation

| | Preoperatively | 1 month of the follow-up | 3 months of the follow-up | 6 months of the follow-up | 12 months of the follow-up |
|---|---|---|---|---|---|
| Maximal inter-incisal opening | 31.28 ± 7.83 | 29.13 ± 5.95 | 33.43 ± 6.59 | 35.04 ± 6.38 | 36.04 ± 6.37 |
| Forward | 4.34 ± 1.93 | 2.65 ± 1.6 | 3.79 ± 1.99 | 4.84 ± 2.11 | 5.87 ± 1.9 |
| Left lateral | 4.32 ± 2.62 | 3.23 ± 2.18 | 3.94 ± 2.59 | 4.5 ± 2.25 | 5.54 ± 2.62 |
| Right lateral | 4.37 ± 3.76 | 3.16 ± 2.23 | 3.82 ± 2.56 | 4.53 ± 2.63 | 5.84 ± 2.57 |

($p < 0.001$) were significantly restricted at 1 month of the follow-up. However, they improved significantly 3 months later, compared with their values at 1 month of the follow-up ($p < 0.001$, $p = 0.002$, $p = 0.016$, $p = 0.024$, respectively). At 12 months, jaw movements were significantly increased compared to preoperative movements ($p = 0.002$, $p < 0.001$, $p < 0.001$, $p < 0.001$, respectively).

MRI evaluations of the disc position and success rates are summarized in Table 5. There were only 5 patients with relapse of disc displacement at 12 months after the surgery (Figure 2). The success rate had a slight decrease from 99.6% to 97.8% at 1 month and 12 months of the follow-up.

## Discussion

The aim of the present study was to evaluate clinical outcome and success rates of our arthroscopic disc repositioning technique. Our hypothesis was that such a procedure would improve clinical symptoms significantly and may help to achieve a higher success rate. The results obtained confirmed our hypothesis.

Minimally invasive arthroscopic surgery has many benefits as regards to healing time, pain scores and health costs. In this study significant improvements in VAS scores for pain, scar and diet, jaw movements and quality of life were observed at 1 or 3 months after the surgery, supporting the statement that TMJ localized symptoms are best treated by the surgical procedure, and arthroscopy is minimally invasive [13–14].

Most interestingly, the changes in joint clicking significantly decreased at 1 month of the follow-up, but became non-significant 3 months later, compared to the preoperative status. We believe that restricted mouth opening and repositioned disc are the main reasons for the reduction of joint clicking 1 month after the surgery. But why was there joint clicking several months later, although the disc had been repositioned? There might be four factors accounting for this phenomenon: a short disc length, overcorrected disc position, condyle-disc separation and osteophytes. To prevent any relapse of disc displacement, we generally perform overcorrection of the disc. That is to say, instead of putting the disc in its normal anatomic position (11 o'clock to 12 o'clock), we seek to place it at 12 o'clock to 1 o'clock position. Sometimes the disc length is relatively small and it may not cover the anterior slope of the condyle. When the patient could

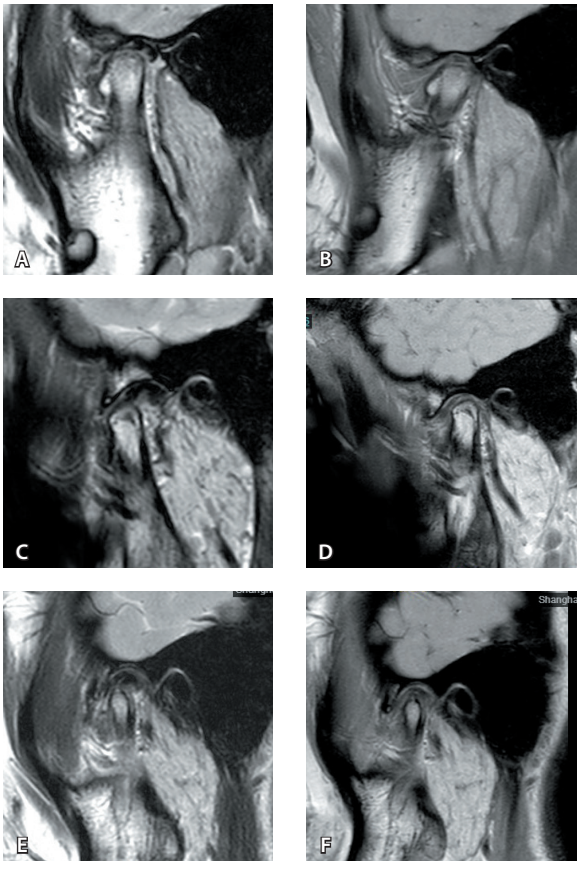


**Fig. 1.** Causes of joint clicking after the surgery. **A**, **B** short disc length and overcorrection of the disc; **C**, **D** condyle-disc separation; **E**, **F** osteophyte of the condyle (**A**, **C**, **E** show closed mouth position; **B**, **D**, **F** show open mouth position)

**Table 5.** Magnetic resonance imaging assessment of disc position and success rate

| | 1 month of the follow-up | 3 months of the follow-up | 6 months of the follow-up | 12 months of the follow-up |
|---|---|---|---|---|
| Excellent | 213 | 210 | 207 | 207 |
| Good | 10 | 13 | 14 | 12 |
| Poor | 1 | 1 | 3 | 5 |
| Success rate | 99.6 | 99.6 | 98.7 | 97.8 |

open mouth widely several months after the surgery, the condyle might move in the anterior direction to the disc at its maximal opened position, leading to joint clicking, as shown in Figure 1A and 1B. Figure 1C and 1D show another case, where the disc is long enough and is in its anatomic position, but the disc does not move along with the condyle (condyle-disc separation), resulting in clicking when disc re-locates back to its normal position. Moreover, when there is an osteophyte, joint clicking might also occur during jaw movements (Figure 1E, 1F).

Many publications have reported good results of lysis and lavage [2, 10, 15]. Retrospective reports show the success rate from 65% to 90% [16–18]. However, internal derangements of the TMJ involves not only inflammatory changes, but also mechanical dysfunction. Lavage only treats the inflammation and does no good to the mechanical aspects. It may only temporarily relieve pains. Besides, with time, discs tended to become shorter and distort more seriously, leading to sever osteoarthritis and condyle resorption, especially during the pubertal growth spurt [19–21]. Therefore, the goal of internal derangements treatment should be both symptom alleviation and restoring normal functional anatomy.

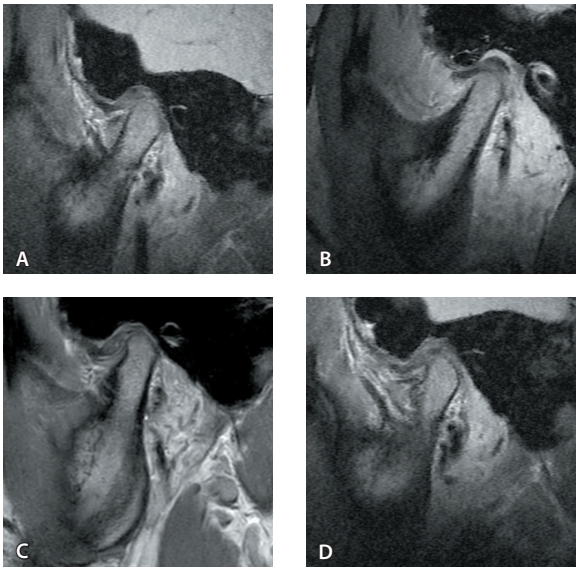


**Fig. 2.** Relapse of disc displacement, showing the importance of overcorrection: **A** preoperatively, **B** 1 month after surgery, **C** 6 months after surgery, **D** 12 months after surgery

Open surgery for disc repositioning via several techniques can yield acceptable results, and possibly reduce or even prevent posterior condyle degeneration [22–25]. However, current clinical practices call for minimally invasive alternatives to open surgery. Our disc repositioning technique by arthroscopy proves a high success rate 1 year after the surgery, confirmed by MRI, as well as significant improvement of clinical symptoms. Arthroscopic disc repositioning is the treatment of choice, with similar or better success and less morbidity than open surgery. To apply arthroscopy only for lysis and lavage would be an extremely limited approach.

Although our present study only involves patients who underwent arthroscopic disc repositioning and lacks a control group of those who underwent open surgery, it is still safe to conclude that arthroscopic surgery is a minimally invasive and effective procedure. The comparison of arthroscopic surgery and open surgery will be investigated in our further study. Moreover, the factors influencing the success rate need to be further gone into. Last but not least, a longer follow-up period is required to confirm the validity of its effectiveness.

## Conclusion

The ultimate goal of TMJ internal derangements should be to improve the biomechanical functioning in terms of clinical symptoms and disc position. Our arthroscopic disc repositioning technique is an effective surgical method that not only improves the joint function, but also helps to correct the disc displacement for a relatively long time. It is an appealing technique for the treatment of TMJ internal derangements.

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