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Clinical Paper
TMJ Disorders

Endoscopically assisted fixation of the custom-made total temporomandibular joint prosthesis in TMJ Yang's system through a modified preauricular approach

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Abstract. This article describes the experience with the endoscopically assisted fixation of the customized total temporomandibular joint (TMJ) prosthesis in TMJ Yang's system only through a modified preauricular approach. Twenty patients (23 joints) treated with the custom-made total TMJ prosthesis were retrospectively recruited. An endoscopically assisted technique was used through a modified preauricular approach to fix the mandibular component for all these patients. These reconstructions were evaluated by surgical records, clinical examinations, and radiographic observations. All patients had successful fixation of the prosthesis. No patient had permanent weakness of the facial nerve and malocclusion or any other severe complications. The mean operative time was 111 min per joint (range, 85–133 min). The average surgical bleeding was 195 ml per side. The mean follow-up period was 16.2 months (range, 5–32 months). The mean scores were 8.3 for surgical satisfaction and 9.2 for scar healing evaluation. All patients experienced positive clinical outcomes, with a mean 75.2% reduction in pain and 53.7% increase in mouth opening with significant differences ($P < 0.05$). The endoscopically assisted TMJ reconstruction with the customized prosthesis in TMJ Yang's system through the modified preauricular approach could produce good aesthetic and functional results.

Key words: temporomandibular joint; customized prosthesis; endoscope; minimally invasive surgery.

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Total temporomandibular joint (TMJ) prosthesis is an effective method to treat TMJ lesions, including the intermediate or end stage TMJ osteoarthritis, severe idiopathic condylar resorption (ICR), TMJ ankylosis, comminuted condylar fractures, and some TMJ tumours[1–3]. Two types of total TMJ prosthesis have been commercially and widely used in Europe and America for more than 30 years: the Zimmer Biomet (Biomet microfixation, Jacksonville, FL, USA)[4] and the custom-made TMJ Concepts (Ventura, CA, USA)[2,3] prostheses. Following the clinical application of these prostheses, the surgical techniques have been modified based on different purposes and indications[5,6]. Currently, the common surgical approach for the implantation of the total TMJ prosthesis comprises the preauricular and submandibular incisions, of which the latter incision may lead to an unfavourable scar in some cases after surgery[2–6].

Recently, more endoscopic procedures are being advocated in the craniomaxillofacial region, such as the treatment of craniomaxillofacial trauma, orthognathic deformities, obstructive salivary gland diseases, maxillary sinus disorders, trigeminal nerve injury, and TMJ disorders[7,8]. The endoscope, which has been described as an 'extra set of eyes' and a basis for minimally invasive surgery, may be a better solution for this problem[7]. Based on the extensive experiences with the use of the endoscope in the TMJ field[9–12], the authors developed the idea of an endoscopy-assisted TMJ reconstruction with the prosthesis only through a modified preauricular approach.

The purpose of the present study was to introduce the experience regarding the use of the endoscope in the replacement of total TMJ prosthesis in TMJ Yang's system (TMJ Yang, Shanghai, China)[13,14] and to assess the outcomes obtained from patients implanted with TMJ prosthesis by the endoscopic procedure.

Materials and methods

Patients

This was a retrospective clinical study. Consecutive patients, treated with the custom-made total TMJ prosthesis in TMJ Yang's system[14] by the endoscopically assisted method conducted at Department of Oral Surgery, Shanghai Ninth People's Hospital from November 2016 to May 2018, were included.

This study was approved by the Shanghai Ninth People's Hospital Human Research Ethics Committee. Moreover, the principles outlined in the Declaration of Helsinki were also followed in the study. All patients were informed about the surgical purpose, protocol, recovery period, and possible complications. An informed consent was obtained from all participants.

Surgical procedure

The modified preauricular approach

As described in previous reports, the main approaches were performed as follows[11,14–16]:

1 A modified 'L'-shaped incision about 5 cm long, entirely along the curvature of the anterior border of the auricle or partially behind the tragus, extending to the temporal region anteriosuperiorly within the hairline, was used to expose the superficial musculoaponeurotic system (SMAS) in the operative field.
2 The SMAS was incised along and just ahead of the superficial temporal vessels to get access to the superficial temporal deep fascia and the parotidomasseteric fascia.
3 Both fascial layers were incised along and in front of the middle temporal vessels to expose the zygomatic arch and partial parotid gland with a blunt dissection in order to protect the facial nerve.
4 With lifting the SMAS flap and partial temporalis fascia anteriorly and well preservation of the facial nerve within the lifted flaps of soft tissue, the TMJ can be clearly visualized directly (Fig. 1A).
5 The condyle and the lesion were then resected with the help of templates

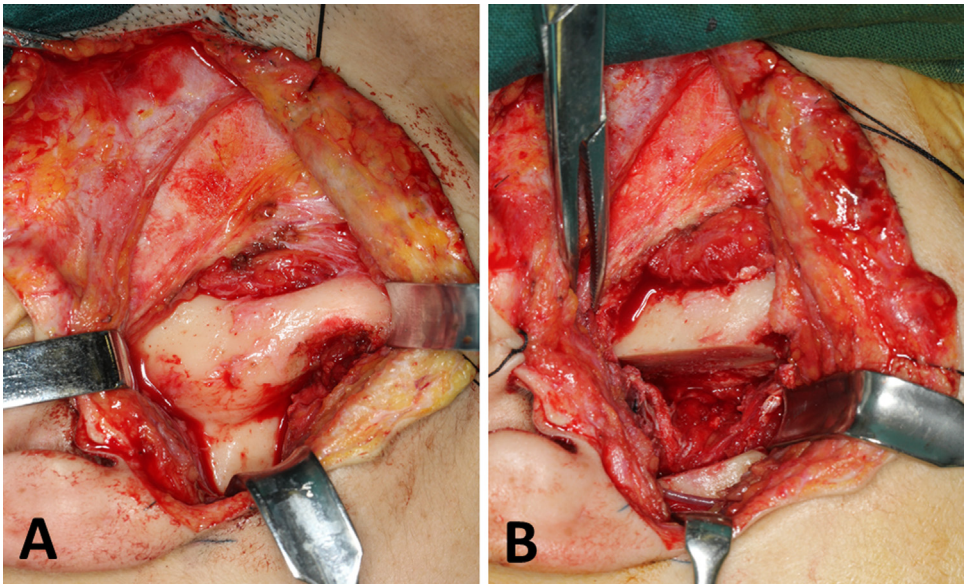

Fig. 1. The modified preauricular approach. (A) Exposure of the joint and bony fusion after dissection. (B) Intraoperative view after resection of the joint and lesion with the template guidance.

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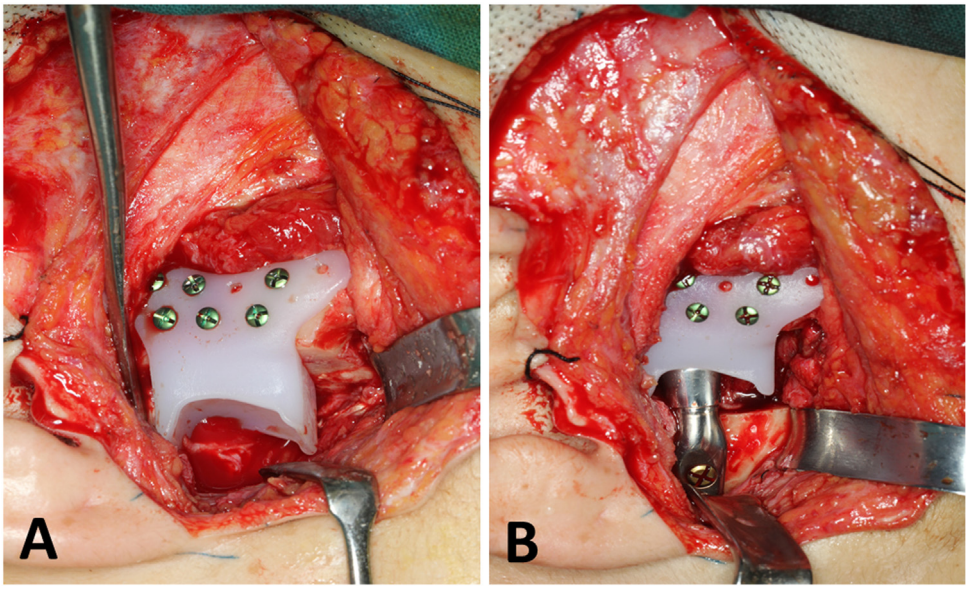

Fig. 2. The fixation of the total temporomandibular joint prosthesis. (A) Fixation of the fossa component. (B) Fixation of the mandibular component with the upper two Ti-screws first.

according to the type of joint diseases (Fig. 1B), but non-involved normal structures, such as the disc, were preserved to obliterate the space in the medial side of the prosthesis as much as possible.

Endoscopically assisted fixation of total TMJ prosthesis

The customized total TMJ prosthesis in TMJ Yang's system was used to repair the defect as a new 'joint'. The detailed procedure steps for the use of the endoscope which is a 30° instrument of 10 cm length and 4 mm diameter (Stryker, San Jose, CA, USA), were as follows[11,14]:

1 The fossa component was fixed with titanium screws firstly (Stryker Fixation System, Kalamazoo, MI, USA) based on the matching situation with the bony anatomy and the guidance of templates (Fig. 2A).
2 The mandibular component was preliminarily fixed by titanium screws in two upper holes, which were drilled using the template as a guide during the joint resection procedure, through the modified preauricular incision. The occlusion was then checked and should be stable as in the preoperative relationship (Fig. 2B).
3 A small incision about 3–5 mm long, located at the middle point of the mandibular component on the parotideomasseteric region, was made to insert the trocar of the transbuccal retractor.
4 Adjusting the trocar with the transbuccal retractor to match the hole in the prosthesis, a long drill of about 10 cm was passed through the trocar to make a bicortical hole (as carefully as possible) in the ramus with sufficient irrigation (Fig. 3A). Then, a titanium screw was driven in to fix the mandibular component through the trocar (Fig. 3B).
5 The remaining holes were fixed in the same way as detailed above until the total number of screws was at least five (Fig. 3C).
6 A piece of the fat graft harvested from the buccal fat pad was placed around the condylar head, and the wound was closed in layers with an 18-gauge drain after double-checking the occlusion (Fig. 3D).

Outcome evaluations of the endoscopic assistance

The operative time and the bleeding volume were traced from the charts. The maxillofacial general check-ups included (i) infection, (ii) dental malocclusion, (iii) wound healing, (iv) facial nerve damage, and gland swelling, which were evaluated postoperatively. The displacement, breakage, or loosening of the prosthesis components were checked using postoperative computed tomography (CT) or orthopantomogram.

The outcome indices related to (i) pain in the preauricular region, (ii) the satisfaction with the surgical outcomes, and (iii) the satisfaction with the scar healing, were obtained using a 10-length visual analog scale (VAS). The measurements of the maximal interincisal opening (MIO) were assessed directly in millimetres (mm). All quantitative measurements were performed by two oral and maxillofacial surgeons. In the case of a disagreement, a consensus was reached by discussion[2–4,14].

Statistical analysis

Data were analysed using the Statistical Package for Social Sciences software, version 17.0 (SPSS, Chicago, IL, USA). The assessment indices of pain and MIO before and after surgery were compared using the paired *t*-test of one-way analysis of variance. A *P*-value of less than 0.05 was considered statistically significant (* is $P \leq 0.05$).

Results

Twenty consecutive patients (23 joints) were included in this study. There were 15 females and five males. Their mean age was 49.4 years (range, 26–66 years). The mean previous surgical number was 0.3 (range, 0–2 times). The left side was affected in 10 patients, the right side in seven patients, and bilateral sides in three patients. Twelve patients were finally diagnosed as end stage TMJ osteoarthrosis, while the remaining six patients had ICR (two patients), ankylosis (two patients), and synovial chondroma (two patients), based on the final histopathology. The mean follow-up period was 16.2 months (range, 5 to 32 months).

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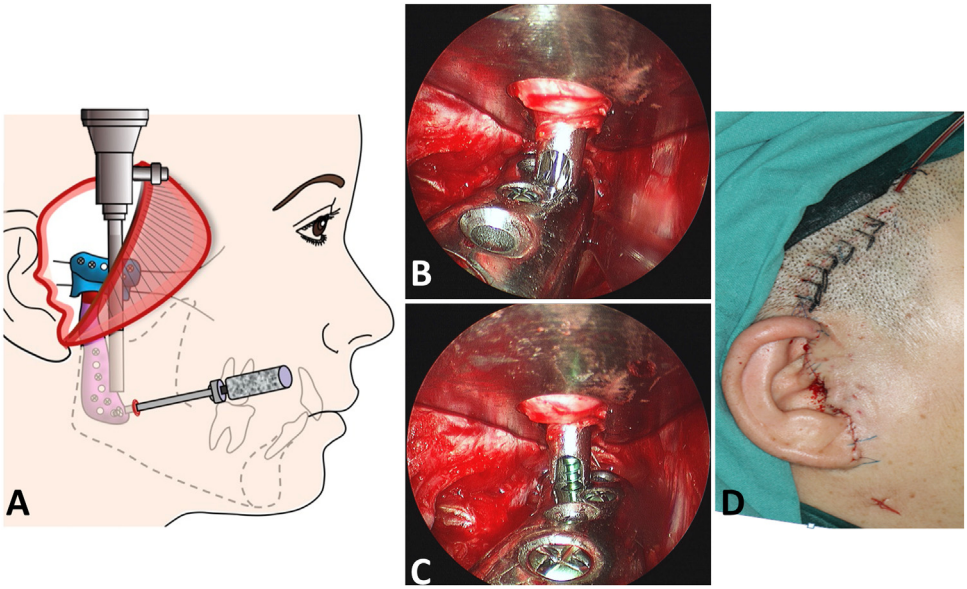

Fig. 3. The operation of endoscopically assisted fixation of total temporomandibular joint prosthesis. (A) Schematic view for the whole procedure. (B) Endoscopic view of the preparation of the hole. (C). Endoscopic view of the implant of the bi-cortical Ti-screw. (C) Intraoperative view after suturing.

The mean operative time was 111 min per joint (range, 85–133 min). The average surgical bleeding volume for one side was 195 mL (range, 140–400 mL). There were no severe complications, such as wound infection, permanent facial nerve damage, serious swelling and haematocele in gland field, in any patients after surgery. All patients had a stable occlusion the same as preoperatively. The surgical wounds of all patients healed well. There was no displacement, breakage, or loosening of the prosthesis components in postoperative CT or orthopantomogram during the study period (Fig. 4).

The mean scores were 8.3 (range, 6–10) for surgical outcome satisfaction and 9.2 (range, 8–10) for scar healing satisfaction (including the preauricular and cheek incision). There was a mean of 75.2% reduction from 5.7 ± 2.7 to 1.4 ± 1.56 in pain level, 53.7% improvement from 22.8 ± 10.6 to 35.1 ± 5.4 mm in MIO with significant differences ($P < 0.05$) (Fig. 5).

Discussion

During the past decades, craniomaxillofacial surgeons have been exploring new applications of the endoscopically assisted surgical procedures, which could decrease the occurrence of complications, increase the success rates, and promote earlier postoperative function recovery[7,8]. In the current study, the authors investigated the total TMJ prosthesis replacement in combination with the endoscope for this purpose. With the assistance of the endoscope, the whole procedure could be operated within 2 h with less than 200 mL of surgical bleeding per side. Patients showed high satisfaction with surgical outcomes (no complications, 75.2% reduction in pain, and 53.7% increase in mouth opening) and inconspicuous scars (the modified preauricular incision and no submandibular incision) after surgery. Accordingly, the implantation of the total TMJ prosthesis has become more minimally invasive.

The endoscopic technique has been widely applied to the diagnosis and treatment of TMJ diseases[8–10,12,17], in particular for TMJ disc repositioning and intracapsular lesion removal, such as synovial chondromatosis. However, only a few maxillofacial surgeons had tried to use the endoscope to assist in TMJ replacement rather than following the conventionally open surgical approaches, which included the preauricular and submandibular incisions to fix the fossa and mandibular components separately[11,18]. Qiu et al.[11] described the endoscopically assisted reconstruction of the condyle with a costochondral graft through a modified preauricular approach for more than 122 patients. The outcomes of good aesthetic and functional results resulting from reducing the operative time and tissue damage have been showed during 5-year follow-ups. Later, Belli et al.[18] reported a case treated with a modified approach for the TMJ replacement with a stock Biomet prosthesis under an intraoral endoscopic assistance. After 2 years of follow-up, quality of life improved significantly because of the suspension of the chronic opioid therapy, no masticatory complications, 40 mm of mouth opening compared with 15 mm preoperatively, and no scar appeared in the submandibular region. Compared with the approach in the current study, there was still an additional incision in the oral cavity to insert the endoscope into the ramus area, and the major problem was the high risk of cross-infection because the oral cavity was interconnected with the prosthesis and TMJ region. The technique of the endoscopic application for the implantation of the total TMJ prosthesis in this study was just through the modified preauricular incision and only a 3- to 5-mm-long incision on the parotideomasseteric region for transbuccal retractor; thus it seems to have prime results due to no submandibular incision and no risk of cross-infection between the intraoral and preauricualr incisions. Therefore, this approach may be a better option compared with its open or other endoscopic counterparts.

Similarly to other endoscopic techniques, the endoscopically assisted reconstruction of total TMJ prosthesis requires a detailed understanding of the use of an endoscope and strict indications for the inclusion of patients[8,11]. Firstly, the endoscopic assistance could just apply to the customized total TMJ prosthesis, because it is necessary for a stock TMJ prosthesis, such as Zimmer Biomet, to carry out

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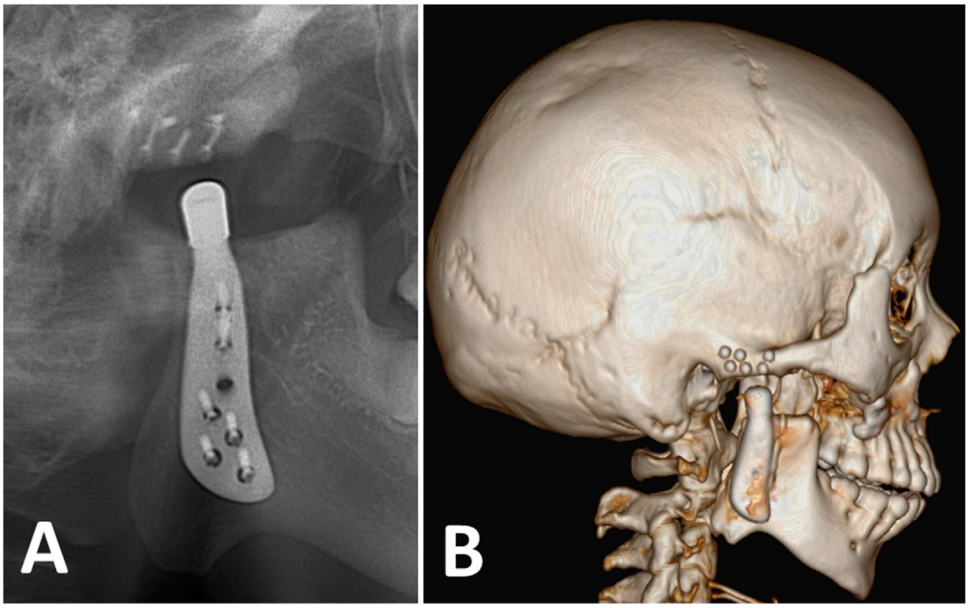

Fig. 4. Postoperative radiographic examination. (A) Orthopantomogram. (B) Three-dimensional computed tomography image.

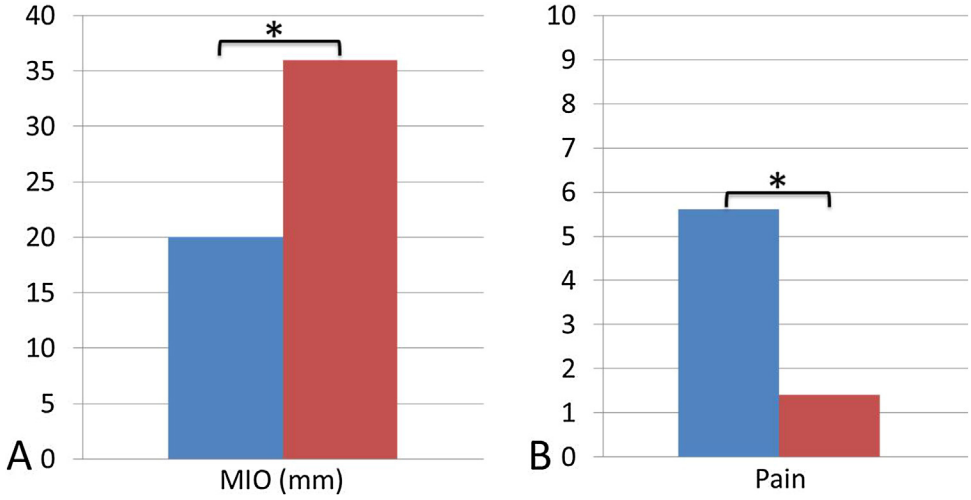

Fig. 5. The pre- and postoperative outcomes of pain level and maximal interincisal opening (MIO).

trimming and osteotomy of the bone on the ramus surface from the submandibular approach to match the prosthesis for more stability and accuracy[5,6]. Secondly, several special instruments, including a 30° endoscope (10 cm in length), a transbuccal retractor, and a drill (10 cm in length), have been prepared as completely as possible[11]. Meanwhile, it is very important to implant the upper two Ti-screws with a stable occlusion relationship prior to the use of the endoscope. The position of the prosthesis would be more similar with the location during design and more stable during fixation of the remaining Ti-screws by endoscope[14]. In addition, it would be preferable if two maxillofacial surgeons who have extensive experience in the use of the endoscope in TMJ were to perform this technique. The more experience the surgeons have, the better the outcome of this technique[11]. However, this technique still needs a higher level of skills and training in order to have enough experience to perform such delicate procedures.

In conclusion, the endoscopically assisted technique offers many advantages including fewer incisions and avoiding the esthetically unaccepted mandibular incision, minor tissue damage, and direct visualization of a magnified and illuminated operative field for the surgeon. With its wide range of indications, the endoscopically assisted fixation of total TMJ prosthesis could lead to improved aesthetic and functional outcomes, with greater surgeon and patient satisfaction.

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Competing interests

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

Ethical approval

This study was approved by the Shanghai Ninth People's Hospital Human Research Ethics Committee no. Hu Jiuyuan Lunshen [2015]18. All patients were informed about the surgical purpose, surgical protocol, recovery period, and possible complications. An informed consent was obtained from all participants.

Patient consent

Patient consent for publication, including any individual details, images or videos, was obtained with our institutional consent forms.

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