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Technical Note

# Total temporomandibular joint replacement without a submandibular incision

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**Abstract –** Temporomandibular joint replacement is a well-accepted and successful treatment option for advanced pathology of the temporomandibular joint. There are however a number of complications associated with the procedure such as post-operative infection, facial nerve damage and scarring. Total joint replacement has traditionally involved the use of both a pre-auricular and submandibular incision. We present an approach that uses only a pre-auricular incision without the need for a submandibular incision. This approach is less invasive and has the potential to decrease risk of damage to the marginal mandibular branch of facial nerve and scarring of the neck.

## Introduction

The temporomandibular joint (TMJ) is a ginglymoarthroidal joint that facilitates speech and mastication and is formed by the articulation of the mandibular condyle to the base of skull. A fibrocartilage disc divides the joint into two separate cavities with the condyle and fossa being lined with fibrocartilage as opposed to hyaline cartilage. Due to the complex anatomy of the TMJ and the continual stress it undergoes, it is prone to both local and systemic pathologies. A variety of management strategies have been developed for TMJ pathology such as occlusal splint therapy, the use of Botulinum toxin as well as surgical management.

For certain TMJ pathologies, or where more conservative treatments have failed, the only viable treatment modality is total joint replacement (TJR). Indications for TJR include joint ankylosis, degenerative joint disease (osteoarthritis), inflammatory joint disease (rheumatoid, ankylosing spondylitis, psoriatic), condylar loss (traumatic or post-operative including neoplasia resection), previous prosthetic reconstruction or costochondral graft, congenital deformity, or multiple previous procedures. There are several complications of TJR including haemorrhage, malocclusion, post-operative infection, dislocation, and temporary and permanent facial nerve paralysis.

Alloplastic TMJ prostheses have been in use since 1963 [1], and several new systems have been developed since, such as Kent/Vitek, TMJ concepts, Biomet Lorenz and Christensen. The procedure of TJR is classically carried out using two incisions; a pre-auricular incision in addition to a submandibular or retromandibular incision. The submandibular or retromandibular incision is made to facilitate access to the ascending ramus for adaptation and fixation of the mandibular component of the prosthesis.

Temporary facial nerve paralysis has been reported as a complication of TJR with reports of temporal, zygomatic, buccal and marginal mandibular branch involvement [2,3]. During a submandibular approach the marginal mandibular branch is frequently encountered and retracted superiorly. This puts the marginal mandibular branch at risk of permanent or temporary paralysis resulting in denervation of the depressor anguli oris muscle [3]. Furthermore, the submandibular incision results in an additional scar on the patients neck and associated increased post-operative morbidity.

We present a modified technique for TJR with a custom joint that utilises the pre-auricular incision without the need for a submandibular incision. This technique is less invasive, aims to decrease the risk of damage to the marginal mandibular branch of the facial nerve and avoids an additional neck scar.

## Innovation report

### Planning

Custom joints require precise 3-Dimensional planning to ensure optimal adaptation of both the fossa and condyle component of the prosthesis. This maximises functionality of the joint and minimises the need for intra-operative modification of the bone fitting surfaces and the prosthesis. For this described technique, the condyle component must be

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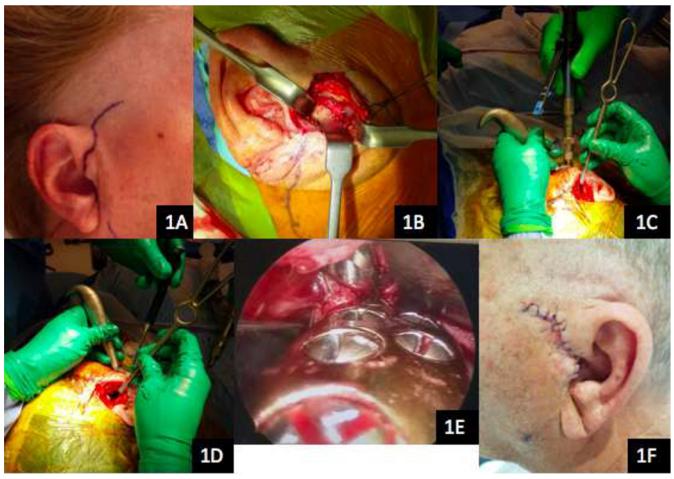


**Fig. 1.** Total joint replacement via pre-auricular approach with no submandibular incision. (a) The pre-auricular incision with anterior extension is marked out prior to preparation and draping and infiltration of local anaesthetic. (b) Dissection through to TMJ as per normal pre-auricular approach. (c) A transbuccal approach is established with a trochar and holes drilled using a drill guide. (d) Fixation of the plate with screws placed through the transbuccal cannula. (e) Visualisation of the prosthesis being fixated with the use of an angled 4 mm endoscope placed through the pre-auricular incision. (f) Closure of the pre-auricular and transbuccal incisions.

of a size that does not extend too far inferiorly down the ramus to allow adequate visualisation and fixation of the prosthesis. Therefore, we suggest the use of a custom joint with careful planning between the surgeon and joint engineer to ensure the joint is of a size that facilitates this approach and has the biomechanical properties to provide long-term function and stability.

### Surgical approach

General anaesthesia and nasal endotracheal intubation is performed as per normal protocol with strict preparation and draping and aseptic technique throughout the procedure. The pre-auricular incision with anterior extension (Fig. 1a) is marked out as previously described [3], prior to infiltration of local anaesthetic with adrenaline. Dissection to the TMJ capsule is then carefully carried out (Fig. 1b), with the superficial temporal artery being ligated when encountered. Once the fossa, condyle and condylar neck are exposed, a periosteal elevator is used to dissect subperiosteally down the ascending ramus to an adequate amount to allow complete adaptation of the prosthesis to the ramus. A piezotome is used to remove the required amount of the condyle as well as the articular disc. The size of the excised condyle can be checked with the 3-D model to ensure an adequate amount of the condyle has been removed as per the pre-operative planning. The fossa component of the prosthesis is then secured in place by screws and the fit and adaption of the condyle component is then checked after the patient has been placed in

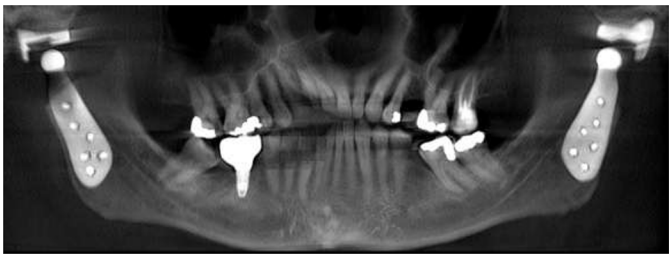

**Fig. 2.** Post-operative scan of bilateral custom TMJ replacement.

intra-operative intermaxillary fixation (IMF). A small 5–10 mm buccal stab incision is then made. We recommend this incision be made between the buccal and marginal mandibular branches of the facial nerve in order to minimise stretch and traction injury of the upper branches. The transbuccal trochar is then inserted through the cheek and replaced with the drill guide through which the screw holes are drilled with the prosthesis in position (Fig. 1c). Fixation of the prosthesis is then carried out with application of screws through the transbuccal cannula (Fig. 1d), with the use of an angled 4 mm endoscope (Fig. 1e). The most inferior screw should be placed first. Adaptation of the prosthesis is then checked prior to release of the IMF and occlusion and joint function is checked. Abdominal fat graft can then be placed within the joint depending on operator protocol. Closure of the pre-auricular and transbuccal stab incision is then performed (Fig. 1f). This approach facilitates the use of both custom and stock joints with adequate exposure for adaptation and fixation. The post-operative scans demonstrate a bilateral custom OrthoTiN TMJ system (Whippany, NJ, USA) through the single pre-auricular incision (Fig. 2).

## Discussion

TJR is an effective treatment modality for end stage joint disease, however has significant potential complications. The technique we have described aims to decrease the morbidity associated with TJR by avoiding the need for a second submandibular incision whilst still maintaining excellent clinical outcomes.

Facial nerve paralysis is a significant complication of TJR surgery whether transient or permanent. Damage to isolated branches of the facial nerve such as the marginal mandibular branch can occur during the submandibular or retromandibular approach [4]. Sidebottom and Gruber reported 7% of patients having immediate but temporary marginal mandibular palsy in TJR surgery [2], whilst McKenzie and Louis found that 44% of patients had dysfunction of the temporal or marginal mandibular branches [5]. Avoiding a submandibular incision decreases the risk of transection of the marginal mandibular branch when dissecting through to the mandible, and decreases the amount of stretching of the nerve that is required to retract the nerve superiorly. It is speculated that a significant amount of nerve injuries following TJR are from neuropraxia caused from retraction of tissues stretching or compressing the facial

nerve [6]. The nerve may also be severed during the surgical approach or with electrocautery and the risk of this occurring with a single incision approach is eliminated.

Post-operative infection is a risk of all surgical procedures, and in the case of TJR can lead to the need for removal of the prosthesis. The most common source of infective organisms in infected TJR is from endogenous flora with skin having a very high concentration of organisms [7]. Therefore, by decreasing the number of skin incisions, it is possible that this decreases the risk of post-operative infection in TJR. The size of the pre-auricular incision however needs to be adequate to ensure the tissues are not over-stretched leading to ischaemia and increased risk of post-operative infection [7]. For this reason, we advise using the full length of the pre-auricular incision, and minimising stretch of the tissues with the transbuccal retractor during fixation of the prosthesis. Further, it has been recommended that the parotid capsule remain intact during TJR surgery to avoid salivary contamination of the surgical field [8]. Breach of the parotid capsule may occur during a retro-mandibular or trans-parotid approach, and likely also to a small degree during our transbuccal approach. Therefore, we believe there is no increased risk of infection from salivary contamination in this approach versus an open approach. Further, the transbuccal approach is commonly used for treatment of mandible fractures and does not increase the risk of infection [9].

Variations of the incision to access the ramus have been reported, with some leaving more noticeable scars such as a ramus incision between the buccal and marginal mandibular branches of the facial nerve compared to a retromandibular incision [10]. The resulting scar from a submandibular approach to condyle fractures was shown in one study that 78% of patients had a visible scar [11]. Various other strategies such as trans-oral endoscopically-assisted fracture repair have also been developed to minimise the use of extraoral incisions in an attempt to minimise nerve damage and facial scarring [12]. Although a submandibular incision generally results in minimal or aesthetically acceptable scarring, we believe eliminating the need for an additional incision beneficial to the patient and eliminates a neck scar altogether. This is particularly beneficial in younger patients with minimal neck creases and patients prone to hypertrophic or keloid scarring. Further, avoiding a submandibular incision eliminates the potential risk or amount of bleeding that occurs with a sub-mandibular approach. Although some surgeon's preference is ligation of the external carotid artery in the event of excessive bleeding from the pre-auricular incision, it has been suggested as ineffective due to anastomoses. Further, ligation of the external carotid prevents the ability to embolise the vessel which has increased in popularity since interventional radiology has become more accessible [13].

Malocclusion is a post-operative complication of TJR and orthognathic surgery. Condylar sag has been described as a cause of malocclusion following orthognathic surgery [14]. Maintaining adequate attachment of the medial pterygoid during intraoral vertical ramus osteotomy has been described as an important factor in avoiding condylar sag and resulting malocclusion [15]. Therefore, we speculate that by avoiding a submandibular incision, we are able to maintain full integrity of the pterygomasseteric sling which may help avoid condylar sag and post-operative malocclusion. This may be particularly important when the surgeon performs a coronoidectomy as part of the TJR procedure. We believe that the use of an endoscope further adds precision to this technique by allowing better visualisation of the prosthesis to the ramus and ensure optimal adaptation. The insertion of an abdominal fat graft by harvesting through a small 2–3 cm peri-umbilical incision reduces the chance of heterotrophic bone formation in the future.

The limitations of this technique must also be acknowledged. These include when greater access and visualisation of the ramus are required, such as when a previous rib graft has been used as a replacement, and when there is significant ramus loss. Further, cases that require large mandibular advancement or counter clockwise rotation would not be possible, as in this technique we are not releasing the pterygomasseteric sling.

At the time of writing, we have so far carried out 36 TJR using the described technique, without the need for utilising a submandibular incision in any case since this method was developed. More cases carried out in this described manner, and analysis of the length of procedure, rate of nerve damage, occlusion, occurrence of post-operative infection, joint function and overall reduction in pain will shed light on the effectiveness of this approach compared to the traditional technique.

## Conclusion

In conclusion, we believe this technique allows for TJR to occur through a single incision with reduced invasiveness, improved perception by patients, decreased post-operative pain and less trismus allowing for a shorter rehabilitation post-operatively.

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