Author Commentary—
Unilateral, Alloplastic TMJR,
Biomechanically What Happens to the Contralateral TMJ?—A Prospective Cohort Study

Sabine S. Linsen, DDS, MSc,* and Louis G. Mercuri, DDS, MS†,‡,§

In orthopedic surgery, total joint replacement is a surgical procedure in which parts of a diseased joint are removed and replaced with an alloplastic prosthesis. The most common alloplastic joint replacements are performed in the hip and the knee, but the temporomandibular joint (TMJ) can also be replaced by implanting a total alloplastic temporomandibular joint replacement device (TMJR).

TMJR is considered a biomechanical salvage surgical procedure for the management of end-stage TMJ pathology to restore mandibular function and form, reduce joint pain and increase in the patient’s quality of life. Therefore, it should only be considered after conservative therapy options have been exhausted.

The indications for TMJR include end-stage low (eg, osteoarthritis) and high inflammatory (eg, rheumatoid) arthritic disease, fibrous and bony ankylosis, failed prior autogenous and alloplastic TMJ reconstruction, and loss of posterior mandibular vertical dimension as the result of neoplasia, trauma, developmental or congenital disease. (The Use of Alloplastic Prostheses for Temporomandibular Joint Reconstruction. Mercuri LG. The use of alloplastic prostheses for temporomandibular joint reconstruction. J Oral Maxillofac Surg. 2000 Jan;58(1):70-5.)

There are presently 2 categories of TMJR devices available: stock and custom. The surgeon must make the stock device components fit, while custom devices are made to fit the bony configuration of each case. Brown et al describe the indications for each type of TMJR. (Brown ZL, Sarrami S, Perez DE. Will they fit? Determinants of the adaptability of stock TMJ prostheses where custom TMJ prostheses were utilized. Int J Oral Maxillofac Surg. 2021 Feb;50(2):220-226.)

The materials used in TMJR embodiments are the same as those that have been used successfully in orthopedic surgery for decades. Cobalt-chrome-molybdenum and titanium alloys are utilized to make the condyle/ramal component, while ultrahigh molecular weight polyethylene (UHMWPE) is utilized as the fossa bearing surface.

TMJR requires preauricular and retromandibular surgical approaches to implant the fossa and ramal components, respectively. Coronoidectomy is required in cases of ankylosis, coronoid hyperplasia or possible coronoid impingement on the posterior body of the zygoma in combined TMJR and orthognathic surgery cases.

The peculiarity of the natural TMJ is that it is a bilateral diarthrotic synovial joint separated by a disc. Its articular surfaces are incongruent and capable of a wide variety of movements guided by the articulating surfaces, masticatory muscles and ligaments. Further, since the bilateral natural joints are connected by the mandible, the movement of 1 joint influences the movement of the contralateral joint. However, after
TMJR, mandibular function is limited by the design of the articulation, as well as the lack of influences of the lateral pterygoid and temporalis muscles on mandibular lateral and vertical movements that are lost when the diseased condyle is removed and when a coronoidectomy is required.

The TMJR embodiment and the resection surgery result in a single compartment joint with the reconstructed condyle exhibiting loss of its translation function resulting in an almost purely rotational pattern with little to no lateral or protrusive excursions. To decrease the mechanical limitations of mandibular movement after TMJR, the fossa is designed thicker to reposition the mandibular center of rotation more inferiorly in order to achieve pseudo-translational condylar movement. This theoretically prevents a large deflection of the mandible towards the TMJR side, while protecting the contralateral nonreconstructed TMJ in unilateral cases.

Nevertheless, it can be assumed that in unilateral TMJR the altered biomechanics of the TMJR will affect the contralateral natural TMJ. Disturbances in any component of the stomatognathic system typically have a reciprocal effect on other system elements. This can lead to adaptive changes, but can also result in pathological changes if, as in the case of the TMJ, functional loading exceeds adaptability. This raised the question as to whether a healthy contralateral TMJ might be overloaded by the altered biomechanics of a TMJR, so that the healthy TMJ will require future replacement, or whether it adapts to the loading.

The aim of this study was to obtain reliable long-term information about the health of the contralateral untreated TMJ in unilateral TMJR. Therefore, objectively measurable parameters—mandibular kinematics, muscle activity, maximum voluntary clenching force (MVC), pressure pain threshold (PPT)—were recorded as well as the patients' subjective impressions about their oral health related quality-of-life.

Muscle force, measured by means of sEMG and the MVC, are indicators of the functional state of the masticatory system. The freedom from TMJ-related pain and muscle (PPT) are in turn basic conditions for undisturbed mandibular kinematics (jaw tracking) and for a high MVC. However, since the subjective perception of the patient also has a major influence on the clinical findings, the patients' oral health-related quality-of-life was investigated (VAS, OHIP).

The results of this study indicated that the clinical condition of the contralateral untreated TMJ improved over the observation period with regard to both the study's objectively measurable parameters and the subjective patient reports. With regard to the kinematic data, the maximum incisal opening improved significantly during the observation period (4.3 \pm 2.5 years), while laterotrusion and protrusion and the condylar movement of the untreated contralateral TMJ decreased slightly. Contralateral MVC increased significantly, while the sEMG activity increased only slightly. The patient-reported pain threshold values remained constant, so that no painful overloading of the contralateral TMJ and the muscles can be assumed. In this study 2 of 39 patients, (5.1%) required a contralateral TMJR, due to pain, decreased function, and arthrosis, after 5 and 7 years, respectively.

The take home points related to this study are that bilateral TMJR does not appear to be required when the contralateral TMJ is healthy. This is highlighted in a clinical study where only patients with TMJ disease on the unoperated TMJ side in a unilateral TMJR eventually required bilateral TMJR. (Perez DE, Woldford LM, Schneiderman E, Movahed R, Bourland C, Gutierrez EP. Does Unilateral Temporomandibular Total Joint Reconstruction Result in Contralateral Joint Pain and Dysfunction? J Oral Maxillofac Surg. 2016 Aug;74 (8):1539-47.) Furthermore, the contralateral untreated TMJ seems to adapt to the TMJR’s biomechanics and appears to benefit functionally after contralateral TMJR, so that an overload of that joint cannot be assumed.