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Extended total temporomandibular joint replacements: a classification system

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Abstract

Prosthetic total temporomandibular joint (TMJ) replacement (TJR) is well established in the United Kingdom, with clear guidelines for indications and nationally published outcomes. CAD/CAM technology has made it possible to push the boundaries of custom-made TJR to include extended versions (eTJR), which may replace segmental mandibular defects or defects in the skull base with extended components for the ramus and fossa, respectively. Such prostheses are uncommon, and published reports are restricted to isolated cases and series of cases. We know of no previous attempts to classify such prostheses, and here we suggest a bipartite classification system for use in communications between surgeons and manufacturers based on a review of 19 prostheses provided by one manufacturer (TMJ Concepts, Ventura, CA).

Keywords: temporomandibular joint; total joint replacement

Introduction

Total temporomandibular joint (TMJ) replacement (TJR) prostheses are well established in the UK, clear indications and guidelines have been created, and nationally pooled outcome data have been published.[1–3] TJR prostheses are provided by two American companies: TMJ Concepts (Ventura, CA) and Zimmer Biomet (Jacksonville, FL). In recent years there has been a shift to the use of custom-made TJR prostheses, particularly where the anatomy of the TMJ seems to be pathologically distorted, which renders the use of a stock prosthesis inadvisable.[2]

There are standard TJR prostheses that replace only the articulating components of the TMJ, and also more complex, extended ones (eTJR) that replace not only the articulating components of the TMJ but also associated mandibular segmental defects and defects in the skull base, if needed.[4] While the use of eTJR prostheses has become more common, a satisfactory design classification system has yet to be developed. In this paper we review a series of cases managed with eTJR prostheses to begin the development of a useful design classification system.

Methods

TMJ Concepts (Ventura CA) provided anonymised photographic records of custom-made eTJR with their associated stereolithographic models for us to review, and examination

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Table 1
Proposed classification system for devices for extended total joint replacement of the temporomandibular joint.

	Classification	Description
Fossa Components	F0	Standard fossa component (contained within fossa)
	F1	Extending anteriorly to but not beyond the articular eminence
	F2	Extending beyond the articular eminence anteriorly (zygomatic arch defect)
	F3	Temporal bone defect not including auditory apparatus +/− arch defect
	F4	Temporal bone defect involving auditory apparatus +/− arch defect
	F5	Temporal defect extending to jugular foramen
Condyle/mandible components	M0	Standard condyle-ramus component (proximal to angle of mandible)
	M1	Extended proximal to ipsilateral mental nerve foramen/region
	M2	Extended proximal to contralateral mental nerve foramen/region
	M3	Extensive extending beyond contralateral mental nerve foramen/region
	M4	Total alloplastic mandible (including both condyles)

of these enabled common features to be identified from which an initial design classification was developed.

A proposed classification system for eTJR must be: unambiguous and easy to use; exhaustive and mutually exclusive so that each possibility exists in only one class; clinically relevant and appropriate; flexible enough to accommodate any advances or changes in technology; and transcend language barriers so that it can be used internationally.

From these principles, we thought that a two-component design classification system could be developed based on the required extent of the design of the fossa (F) and mandibular (M) components of the eTJR prosthesis.

Results

Nineteen patients who had had eTJR of the TMJ were reviewed to find common unifying themes on which to develop the classification system. The mandibular component (M) of the classification had to describe the extent of the segmental mandibular defect, so it seemed reasonable to model this on an existing and validated classification of mandibulectomy defects. The most current of these was derived by Brown et al,[5] and has been validated and widely used since its introduction in 2016. All the prostheses in the study involved mandibular defects that included removal of the condyle, which rendered the "c" suffix used in the Brown classification[5] redundant.

The "M" component for the mandibular component of this prosthesis is based on the Brown classification, but instead of using the canine tooth to delineate an end-point, the mental nerve foramen was substituted as it seemed to be a more reliable landmark when the mandibular anatomy was distorted (as in hemifacial microsomia) (Table 1). A four-tier classification system of the eTJR was selected with a baseline "M0" to describe the standard ramus component with no mandibular extension. An "M2" describes a mandibular component that extends proximally to the contralateral mental nerve foramen (Fig. 1), while an "M3" describes a mandibular component that extends beyond this point (Fig. 2).

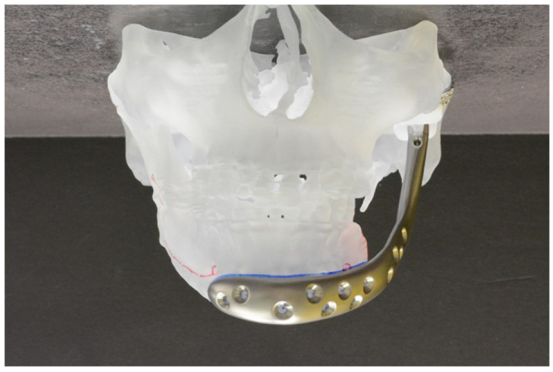

Fig. 1. Mandibular component extended up to the foramen of the contralateral mental nerve with regular design of the fossa (M2F0).

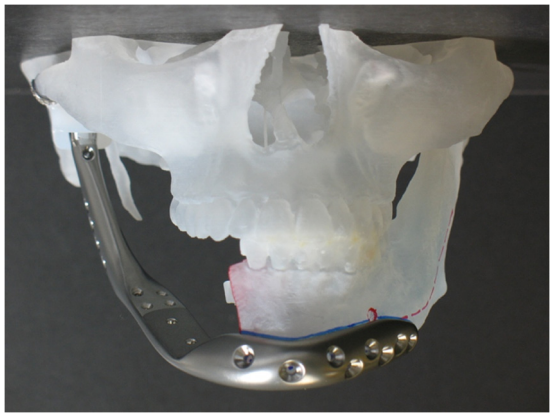

Fig. 2. Ramus component extended to beyond the foramen of the contralateral mental nerve with standard component of the fossa (M3F0).

The fossa component (F) of the eTJR classification was used to delineate the different levels of resection of the fossa and skull base. As with the mandibular eTJR component, a baseline "F0" describes the standard TJR fossa component (Fig. 1). Extension may be required as the result of isolated defects of the arch with an intact skull base and normal temporal bone (Fig. 3). They may also be needed for large defects of the temporal bone that involve varying degrees of bony loss that result from either congenital deformity (such as

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