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The pedicled masseter muscle transfer for smile reconstruction in facial paralysis: Repositioning the origin and insertion

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Summary *Background:* The pedicled masseter muscle transfer (PMMT) is introduced as a new reconstructive option for dynamic smile restoration in patients with facial paralysis. The masseter muscle is detached from both its origin and insertion and transferred to a new position to imitate the function of the native zygomaticus major muscle.
Methods: Part one of this study consisted of cadaveric dissections of 4 heads (eight sides) in order to determine whether the masseter muscle could be (a) pedicled solely by its dominant neurovascular bundle and (b) repositioned directly over the native zygomaticus major. The second part of the study consisted of clinical assessments in three patients in order to confirm the applicability of this muscle transfer. Commissure excursion and vector of contraction following PMMT were compared to the non-paralyzed side.
Results: In all eight sides, the masseter muscles were successfully isolated on their pedicle and transposed on top of and in-line with the ipsilateral zygomaticus major. The mean length of the masseter and its angle from Frankfurt's horizontal line after transposition compared favorably to the native zygomaticus major muscle. In the clinical cases, the mean commissure movements of the paralyzed and normal sides were 7 mm and 12 mm respectively. The mean angles of commissural movement for the paralyzed and normal sides were 62° and 59° respectively.
Conclusions: The PMMT can be used as a dynamic reconstruction for patients with permanent facial paralysis. As we gain experience with the PMMT, it may be possible to use it as a first-line option for patients not eligible for free micro-neurovascular reconstruction.

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Introduction

The irreversibly paralyzed lower face continues to be a reconstructive challenge. The ideal reconstruction should enable a natural, dynamic, and spontaneous smile utilizing a reconstructive technique that is simple, consistent, and reliable. Rubin described the most common natural smile as the "Mona Lisa" or zygomaticus major smile in which the oral commissure is moved superiorly and posteriorly following the contraction vector of the zygomaticus major muscle.[1]

In order to reproduce the zygomatic major smile, dynamic reconstructions have supplanted static, non-functioning suspension techniques when patient and anatomic factors make this feasible. In particular, functioning microneurovascular muscle transfers such as the innervated gracilis free tissue transfer, have become the method of choice over local muscle flaps in contemporary reconstruction.[2,3] The most significant advantage of this option is the ability to simulate a functioning smile. A major disadvantage of this technique is its complexity, need for microsurgical expertise and resource, and the possibility of requiring multiple stages. Although the technique is well described, the results may be variable across centers. Furthermore, many patients may not be candidates for free tissue transfers.

The masseter muscle has been used as a local muscle flap to reanimate the face since the early 1900s.[4–8] Its proximity to the oral commissure, size and power, synchronous action with the facial muscles of smile, and easy accessibility made it an attractive alternative to static sling procedures.[9] Traditionally, the anterior half to two-thirds of the muscle was released from its insertion on the inferior border of the mandible. The released muscle was then re-attached to the oral commissure, lower lip, or the surrounding orbicularis oris.[4–14] Several modifications have more recently been introduced in an attempt to improve the dynamic smile.[15–18]

Although the masseter muscle offers considerable potential, its use for dynamic smile restoration has not gained wide acceptance. The fundamental limitation with the conventional masseter dynamic suspension is the incorrect vector of contraction when compared to the vector of the zygomaticus major muscle. The zygomaticus major muscle originates from the body (malar eminence) of the zygoma running obliquely to insert into the modiolus of the oral commissure. In contrast, the masseter muscle originates from the inferior edge of the zygomatic arch. This limitation created by the fixed origin of the masseter muscle generates a pull of the oral commissure in a horizontal direction rather than an elevation.

We introduce the pedicled masseter muscle transfer (PMMT) as a new surgical technique for dynamic smile restoration for irreversible facial paralysis. The technique detaches both the origin and insertion of the masseter muscle in order to transfer the masseter into a similar position as the native zygomaticus major muscle thereby achieving an optimal vector of contraction.

The purpose of this study is to introduce a new technique for dynamic smile restoration using the PMMT that may provide a contraction vector similar to the native zygomaticus major muscle. The study consisted of two parts:

Part I: To perform an anatomic dissection using fresh cadaver heads in order to ascertain whether (a) the masseter muscle can be pedicled solely by its dominant neurovascular bundle and (b) the fully detached masseter muscle can be transferred and positioned over the zygomaticus major muscle in order to reproduce its vector of pull.

Part II: Report the clinical application of this new muscle flap in three patients with detailed evaluation of commissure position and elevation.

Materials/patients and methods

Ethics approval for this study was obtained through our institution's research ethics board.

Part I: cadaver study

An anatomic study was performed on four cadaveric heads. A modified rhytidectomy incision was used to expose both the zygomaticus major and masseter muscles. The anatomy of the masseter nerve with its accompanying vascular pedicle has been previously described.[10,19] The pedicle predictably enters the muscle on its deep surface through the coronoid notch of the mandible.[19]

The zygomaticus major muscle was identified and its dominant fiber direction was marked to represent its vector of contraction. A line was then drawn from the external auditory meatus to the inferior orbital rim to define Frankfurt's horizontal plane. In addition, a line perpendicular to Frankfurt's plane was then drawn starting from the edge of the lateral orbital rim and running inferiorly to cross the belly of the zygomaticus major. These two lines were used to measure the angle of the zygomaticus major and masseter muscles *in situ* (Figure 1). Lengths of both muscles were measured. Dissection and mobilization of the masseter muscle was performed while maintaining the integrity of the neurovascular bundle. The freed origin and insertion of the masseter muscle were then moved to the new position to overlay the native zygomaticus major muscle. The angle of its new position was measured and compared to the angle of the zygomaticus major muscle.

Part II: clinical study

In order to confirm the viability and applicability of the new muscle flap, three consecutive patients underwent PMMT for dynamic smile reconstruction for irreversible facial paralysis, between February 2009 and February 2011. All operations were performed by the authors (JY and DM) at London Health Sciences Centre, London, Canada. None of the patients was a candidate for a free tissue transfer. Postoperative measurements documenting oral commissure position during repose and function were recorded.

Results

Part I: cadaver study

All masseter muscles were successfully dissected on 8 separate sides in 4 cadaver heads. All zygomaticus major muscles were identified. Two cadavers were female.