Modification of the Orthodromic Temporalis Tendon Transfer Technique for Reanimation of the Paralyzed Face

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Abstract

Objective. To report a modification of the temporalis tendon transfer technique used in facial paralysis where dynamic adjacent muscle transfer is determined to be the best treatment option.

Study design. Case series with chart review.

Setting. Tertiary care teaching hospital.


Results. Patient satisfaction was high, with a mean score of 7.0 (possible score of 10). Four patients were graded by the observer as excellent to superb. The other 6 patients were rated as having fair to good postoperative results. Movement was identified in every patient and ranged from 2.1 to 9.3 mm, with mean movement of the oral commissure of 5.12 mm. One patient developed a seroma at the site of harvest of the fascia that was drained without further complication.

Conclusions. This facial reanimation procedure is a novel modification of the temporalis tendon transfer technique in which the coronoid process is transferred in conjunction with the tendon. This technique is minimally invasive and may result in less variability of the postoperative aesthetic result. The procedure allows orthodromic action of the temporalis muscle, is relatively easy to perform, and eliminates the facial asymmetry typically produced by transfer of the origin of the temporalis muscle.

Keywords
facial paralysis, reanimation, temporalis

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Reanimating the paralyzed face is a unique problem that has challenged surgeons for centuries. Despite the existence of numerous procedures to help restore symmetry, there is, to date, no gold standard procedure. This is partly due to the complex nature of facial mimetic motion. Indeed, there are 23 paired muscles of facial expression and the orbicularis oris that are innervated by the facial nerve. Furthermore, each case of facial paralysis is unique in its cause and its consequences on the affected individual.

There are abundant options available to reanimate the paralyzed face. The surgeon must be familiar with numerous techniques and be able to tailor a treatment plan that addresses each individual patient’s condition. When possible, dynamic reanimation is preferred to static suspension. Therefore, primary nerve repair, nerve grafting, and nerve substitutions are generally considered first-line treatment options. There is general consensus that nerve grafting becomes less effective as time passes after denervation. Most surgeons maintain a 2-year time limit during which they will consider nerve-grafting procedures. After that, too many motor end plates have atrophied to warrant reinervation surgery. In cases in which nerve grafting is not possible, muscle substitution becomes the best option.

Recently, there has been a resurgence of interest in the transfer of the temporalis tendon to reanimate the corner of the

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Orthodromically transferring the tendon, and not the muscular origin, allows the muscle to contract in the muscle’s natural vector. The procedure is significantly less invasive than the more recently reported alternative of free tissue transfer. Furthermore, this is a single-stage procedure that can provide nearly immediate results. As with all muscle replacement surgeries, however, the surgeon must be diligent to carefully judge the proper amount of tightening when insetting the muscle and fascial sling to the perioral musculature. There is considerable tension placed on the sutures to support the weighty skin and soft-tissue envelope. Accounting for the relaxation and “cheese-wiring” effect of the sutures with time must be considered during surgery to create a desirable postoperative result in the months to come. Inadequate suspension of the soft tissues of the face can result in a droopy face late in the recovery process.

Here we describe a novel modification of the transfer of the temporalis tendon for reanimation of the paralyzed face. Our modification involves transection of the coronoid process from the mandible with the temporalis tendon still attached. The fascial sling, created from harvested fascia lata, is secured through a hole drilled in the coronoid without removing the coronoid bone from the temporalis tendon. We intend to show that function and aesthetic form are consistent with current standards and that less intraoperative overcorrection may be needed due to the enhanced physical stability of repair.

**Methods**

Institutional review board approval was obtained from Northwestern University. The first 10 consecutive patients who underwent transfer of the temporalis tendon with attached coronoid process were retrospectively evaluated for subjective and objective results. All patients included in this study had either surgical disruption of the facial nerve without possibility of nerve grafting or long-standing facial paralysis (>2 years).

The technique described is a further modification of previously described temporalis tendon transfer techniques. Under general anesthesia, the affected side of the face and 1 thigh are prepared. Fascia lata is harvested from a leg chosen by the patient. A short incision in the upper thigh is made paralleling a line drawn between the anterior superior iliac spine and the lateral tibial condyle. The harvested portion of fascia lata is generally about 8 cm × 1 cm (Figure 1A). The wound is ultimately closed in layers and is not typically drained.

Then a 3- to 4-cm incision is created in the nasolabial fold of the paralyzed side. Marking the incision location in the preoperative area while the patient is seated in the upright position would make it more anatomically correct and easier to perform the surgery.

**Figure 1.** (A) Fascial lata graft harvested from the upper thigh. (B) A 3- to 4-mm hole is drilled into the center of the coronoid process. (C) The fascia lata graft is passed through the hole in the coronoid, creating a sliding fascial pulley. (D) Precise tension is applied to expose the first premolar as soft tissues are resuspended.
can aid is proper camouflage in the nasolabial fold. Finger dissection is carried out through the subcutaneous tissue into the buccal space. There, the buccal fat pad and Stenson’s duct are identified and retracted. Manual palpation will identify the coronoid process. The soft tissue surrounding the temporalis muscle and coronoid process is freed without disturbing the tendon attachment. Using a long right-angle clamp, the level of the coronoid notch is determined. Electric diathermy is used to mark the site of osteotomy and clear soft tissue off of the bone. A Stryker (Kalamazoo, MI) reciprocating saw is used to cut the coronoid process (and attached temporalis tendon) free from the mandible. At this point, the coronoid-tendon complex is secured with an Allis clamp. Then a Stryker 2.1-mm Taper Side Cutting Carbide Bur is used to drill a 3- to 4-mm hole in the center of the coronoid process (Figure 1B). A trimmed (8 cm × 1 cm) fascia lata graft is then passed through the 3- to 4-mm hole (Figure 1C). The ability of the fascia lata graft to slide freely through the drilled hole in the coronoid aids in fine-tuning the smile in the next step.

Next, the fascia lata extension graft from the coronoid is sutured to the deep mimetic musculature of the perioral area. One end is first sewn to the modiolus of the oral commissure. A 3-0 braided polyester mattress stitch is used to permanently secure the graft to the facial musculature. Then the fascial graft is pulled through the coronoid in a pulley-like action to elevate and resuspend the oral commissure and overlying soft tissues. Generally, we pull tight enough just to expose the first premolar (Figure 1D). The other end of the fascia is then secured similarly near the midline of the upper lip, as described by Sherris. Preoperative photographs as well as visual inspection guide the final position and tension of the repair.

Some patients in the series also received additional concurrent surgeries, including a browlift, upper eyelid loading, and an inferior lid tarsal strip. These adjunctive procedures were offered based on individual patient need. Postoperatively, the patient was asked to maintain a soft diet for 2 weeks to prevent aggressive mastication and tearing of the buried sutures. All skin sutures were removed 7 days following surgery.

The subjective outcomes were measured by patient self-assessment and by 3 independent objective physician observers. Patients were asked to retrospectively complete the validated FaCE scale questionnaire. The FaCE Scale Instrument evaluates mimetic function on a 1 to 5 scale via 15 questions. The Wilcoxon signed-rank test was used to evaluate the significance of the patients’ assessments of their improvement. To assess the improvement in facial symmetry both at rest and with smile, the observers rated preoperative and postoperative photographs according the grading scale devised by May. This scale is specifically designed to aid in measuring analysis tool (Fairfield, NJ). Each photograph was calibrated based on the patient’s interpupillary distance, a constant throughout adulthood. Natural smile patterns involve the elevation of the lateral oral commissure toward the lateral canthus. Therefore, the distance from the lateral canthus to the ipsilateral oral commissure was measured both at rest and with smile (Figure 2). The amount of volitional movement of the oral commissure by contraction of the temporalis muscle was thus measured.

**Results**

The ages of the 10 patients ranged from 25 to 77 years, with a mean of 56.5 years. Six were male and 4 were female. The amount of movement produced from voluntary contraction of the temporalis muscle ranged from 2.1 mm to 9.3 mm, with a mean of 5.1 mm.

Patient satisfaction was very high, with a mean score of 7 (of 10). Scores ranged from 4 to 10. Using the FaCE questionnaire, patients reported significant improvement in the movement at the corner of their mouth. The overall median score improved from 1 to 3. This change was significant, \( P = .017 \).

All 10 patients had photographs that met inclusion criteria. Mean objective observer assessments for improved symmetry at rest and smiling were 2.23 and 2.63, respectively. The scores ranged from 1 to 4 (1 = best, 6 = no change; Figures 2 and 3).

Complications from the procedure were limited. One patient developed a seroma at the site of fascia lata harvest. This was drained in the office and ultimately healed without further complication. There were no infections or extrusions.

**Discussion**

Our study introduces a novel modification of the temporalis tendon transfer technique for reanimation of the paralyzed face. It shows that a less invasive procedure can provide excellent results that are evident immediately and persist long term. Nevertheless, we still consider nerve anastomosis and nerve-grafting procedures to be first-line treatment in paralyzed patients in whom these types of reinnervation are possible. Hypoglossal-facial nerve anastomosis has the potential to produce excellent results. However, the results are variable and significantly delayed as they rely on regrowth of nerve fibers that may take as long as up to 1 year. Because of the minimal invasive nature of this modified technique, we feel it is appropriate as an adjunct and are beginning to perform it concurrently in patients undergoing facial hypoglossal nerve grafting.

Patients who have facial paralysis due to intracranial pathology may also have dysfunction of the ipsilateral trigeminal nerve. Before a surgeon performs a temporalis tendon transfer to create volitional movement, he or she must first confirm that the temporalis muscle is functional. Determining functionality of the temporalis muscle is accomplished by palpating and observing the body of the temporalis muscle in the temporal fossa while asking the patient to bite down.

Despite the excellent results offered by free tissue transfer techniques, interest has grown in the more minimally invasive techniques such as transfer of the temporalis tendon. Free tissue transfer techniques often require multiple stages and,
again, require many months until the results are seen. The traditional single-staged procedure of reanimating the corner of the mouth using the temporalis muscle origin can provide excellent and more timely outcomes but results in a soft-tissue donor site deficiency in the temple and a muscular bulge over the zygomatic arch. In an effort to mitigate the drawbacks of these procedures, McLaughlin first described the transfer of the temporalis tendon to the corner of the mouth by transecting the coronoid process through an intraoral approach. Breidahl et al modified this technique by using an external approach. Although numerous modifications have subsequently been described, Croxon et al were the first to describe approaching the temporalis tendon transfer through a nasolabial fold incision as we have done. Our modification

Figure 2. With the interpupillary distance calibrated on each photograph, the amount of volitional movement of the oral commissure was measured using the analysis measuring tool of the Canfield Mirror Software (Fairfield, NJ).
also uses only a 3-cm incision in the nasolabial fold. All of the facial work can be performed through this one small incision. Because it is hidden in the nasolabial fold, patient satisfaction was high, and no scar revisions were necessary.

The amount of movement achieved with this technique is consistent with what has been previously published using different types of temporalis tendon transfers.3 In the present study, volitional movement was measured using only 1 method: distance from the stable lateral canthus to the mobile oral commissure. We feel this is an appropriate way of quantifying movement, as most smile patterns involve the movement of the corner of the mouth toward the lateral canthus.

Temporalis transfer has been previously described with and without the use of a fascial graft to bridge the gap between the temporalis tendon and the perioral musculature.3-5 In our modification, the fascia lata graft is vital to success for multiple reasons. It bridges the gap between the coronoid process and the perioral musculature. The coronoid and temporalis tendon will not reach the desired perioral insertion sites without secondary incisions and extensive mobilization of the muscle. By passing the fascia lata through a hole drilled in the coronoid process, it acts like a pulley. This facilitates adjustment and management of proper tension at the orbicularis suspension site. We feel that less overcorrection is needed than that described by other authors.4,5 In each case, we overcorrected only enough to see the first premolar. In addition, the use of fascia lata allows for distinctly separate points of insertion to the oral musculature, creating a broad attachment with more realistic mimetic movement. One branch is inserted into the orbicularis muscle near the ipsilateral philtral line as proposed by Sherris,5 and the other at the modiolus.

Transfer of the temporalis tendon to create mimetic motion of the oral commissure has significant advantages over its free tissue transfer alternatives. First, the procedure is much less invasive and performed in 1 stage. Free tissue transfer, most often gracilis, has proven itself to be an effective method of restoring the smile.1,12 Undoubtedly, this procedure is still evolving, and single-stage procedures offer advantages over multiple-stage procedures. Still, free tissue transfers as a group overall suffer from some limitations. Free gracilis transfer with cross facial nerve grafting can be a multistaged procedure and take up to a year to see results.1,12 The results we present are evident as early as the first postoperative day. Some patients may require physical therapy to aid in consciously coordinating individual muscle contraction,3 but all of our patients achieved evidence of volitional movement without special assistance.

Although the results of this study are excellent as determined by the patients and the independent observers, significant study limitations exist. There existed significant variability in the amount of volitional movement that each patient could produce at the corner of his or her mouth. The patients who had the least volitional mimetic movement after the surgery were the only 3 patients who had received prior local radiation therapy for treatment of a parotid malignancy. We suspect that this may be due to restricted mobility of the coronoid process and attached temporalis tendon due to changes in the tissue quality as the result of radiation. Future studies may determine that patients who have received prior local radiation therapy will, in general, exhibit less smile movement than their nonirradiated counterparts. Further investigation is necessary to fully evaluate this scenario.

Also of note is the fact that most of our patients reported improved mastication and speech intelligibility. Perhaps the replacement of the paralyzed buccinator muscle with a taught musculofascial sling with a more medial vector aids in both of
these processes. Further study is needed to determine the significance of these observations.

**Conclusion**
The modified orthodromic temporalis tendon transfer was a safe and effective technique for the reanimation of the paralyzed face. There was high patient satisfaction, and volitional movement was seen in all patients. Improvement in symmetry was clearly reported by the independent observers. This technique is a less invasive alternative to the traditional transfer of the origin of the temporalis muscle or a free tissue transfer.

**Author Contributions**
Douglas M. Sidle, corresponding author, principal investigator, article preparation; Andrew J. Fishman, co-investigator, article preparation.

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