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IDEAS AND INNOVATIONS

Peripheral Nerve

Zygomatic Muscle Neurotization with Nerve Grafts and End-to-Side Neurorrhaphies: A New Technique for Facial Palsy

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Summary: Moebius syndrome is a rare congenital facial palsy that can generate serious emotional repercussions, mainly due to the inability to smile. Currently, no treatment is available; however, surgery can restore muscle function. This case report introduces a new technique for the treatment of Moebius syndrome with zygomatic muscle neurotization using nerve grafts and end-to-side neurorrhaphies, in a 3-year-old girl diagnosed with bilateral Moebius syndrome who was unable to smile on the left side. After 4 years, the patient presented with full smile restoration on the left side, with right and left independent movements and complete symmetry. *(Plast Reconstr Surg Glob Open 2022;10:e4288; doi: 10.1097/GOX.0000000000004288; Published online 5 July 2022.)*

INTRODUCTION

Moebius syndrome (MS), first described by Von Graefe in 1880[1] and Moebius in 1888,[2] is a rare congenital facial palsy characterized by unilateral or bilateral nonprogressive congenital facial paralysis with impairment of ocular abduction.[3,4] The etiology of MS has not yet been completely elucidated; however, two explanations have been proposed: a primary genetic cause[5,6] and a primary ischemic cause.[7,8]

Often, MS can generate serious emotional repercussions[9] because patients have great difficulty in social integration, mainly due to facial differences such as the inability to smile[10] and the absence of facial expression, which is due to facial paralysis. To date, there is no treatment available; however, surgery can be a relevant alternative to reduce these alterations through the restoration of muscle function by specific techniques.[11–17] Although current methods can result in the ability to smile[18] and improve the patient's quality of life, they involve muscle transfer and therefore can result in unsightly volume increases.

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METHODS

A 3-year-old girl diagnosed with bilateral MS without any smile on the left side and incomplete lid occlusion on the right side (Fig. 1) was submitted to left zygomatic muscle neurotization. (**See Video 1 [online],** in which we can see a girl without any smile on the left side and incomplete lid occlusion on the right side.) For this, two sural nerve grafts were connected with end-to-side neurorrhaphies[19] in the contralateral buccal branch of the right facial nerve.

The surgery was performed in June 2014 at the Clinics Hospital of Botucatu Medical School of São Paulo State University, by a plastic surgery team.

The procedure was performed under general anesthesia and nasotracheal intubation. A vertical right preauricular incision, similar to that employed in face lifting, was used. Cutaneous detachment was performed using Viterbo's blunt dissectors,[20] approximately 3 cm long medially. Next, the right buccal branch was carefully isolated. (**See figure 1, Supplemental Digital Content 1,** which shows the isolated right buccal branch. **http://links.lww.com/PRSGO/C15**.) An electric stimulator was used to confirm nerve identification. A 4-mm wide rubber tape was passed through the buccal branch. A sural nerve graft was divided into two 8-cm segments, and the distal portions of these nerves were sutured laterally to the right buccal branch with 8.0 Mononylon embracing neurorrhaphies,[21] crossing the face (Figs. 2, 3). (**See figure 2,**

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Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

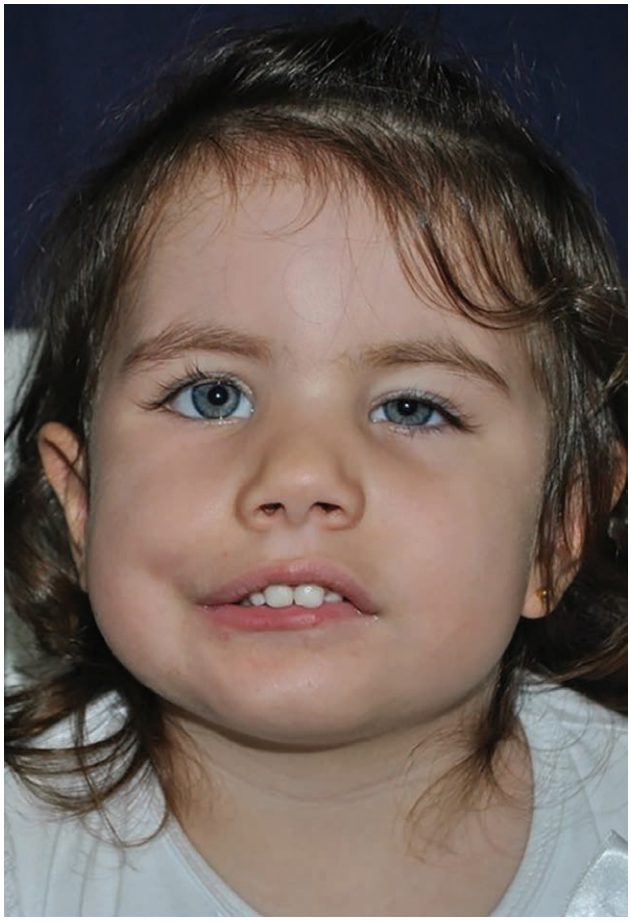

Fig. 1. A Preoperative photograph of a 3-year-old girl diagnosed with bilateral MS, without any smile on the left side and incomplete lid occlusion on the right side.

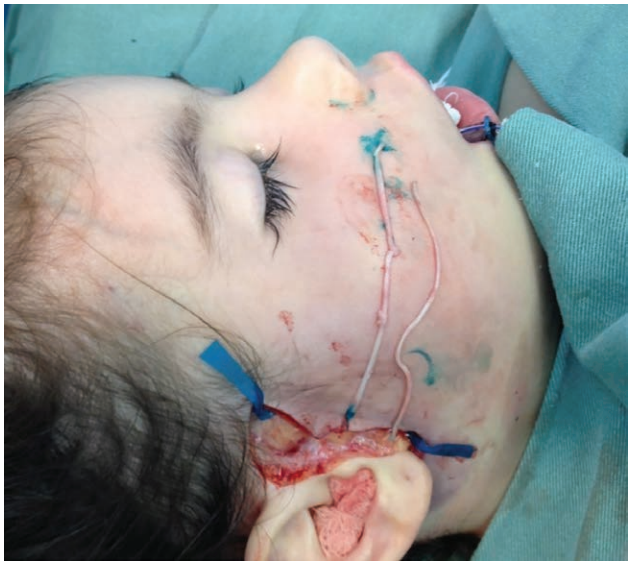

Fig. 2. The sural nerve grafts crossing the face to reach the left zygomatic muscle.

Takeaways

Question: Can we save the original zygomatic muscle with nerve grafts and end-to-side neurorrhaphies to restore the ability to smile?

Findings: Four years after surgery, the patient presented full smile restoration on the left side with right and left independent movements and complete symmetry.

Meaning: This new technique, different from others, saves the original zygomatic muscle and therefore does not add any bulk. It should be used in any other kind of recent facial palsy. More than a new technique, it is a new concept that could be used in any denervated muscle in the body, such as upper and lower limbs.

Supplemental Digital Content 2, which shows schematic representation of the embracing neurorrhaphy. **http://links.lww.com/PRSGO/C16**.)

A 2-cm intraoral mucosa incision was made 1 cm from the left upper lip and labial commissure. A 2-cm mucosa detachment allowed visualization of the major and minor zygomatic muscles. These muscles presented a light pink color, indicating a very atrophied muscle.

A 5-mm incision was made around the right nasal wing. A cylindrical and straight surgical instrument with blunt tip 2.5 mm in diameter, with a hole, was introduced into the right preauricular dissected region and was exteriorized in the right nasal wing opening. The endings of the two nerve grafts were attached to this instrument, which, when pulled, brought the grafts with it. The same maneuver was repeated, causing the nerves to emerge in the intraoral aperture.

The nerve grafts had 3-mm fascicles dissected and separated. Four microincisions were made in the lateral aspect of the dissected fascicles with microsurgical scissors.

Subsequently, a 5-mm incision on the medial face of the major zygomatic muscle was made, and a Halsted forceps was introduced until it was externalized on the lateral face of the muscle. The forceps grasped the nerve grafts and were then pulled out, leaving them inside the muscle. An 8-0 Mononylon suture fixed the nerve grafts to the muscle to prevent displacement. The mucosal incision was closed with 4-0 cat gut separated sutures, and the preauricular incision was closed with 4-0 Monocryl simple intradermal sutures. A simple dressing with gauze and micropores was applied. In postsurgical care, we recommended that the patient try to avoid sleeping on the right side for 30 days.

The patient was followed up at 1.5 years postoperatively, 3 years postoperatively, and 4 years postoperatively (Fig. 4). Written consent has been obtained from relevant persons (such as the parent or legal guardian) to publish the information, including photographs and videos.

RESULTS

The patient showed uneventful evolution. In 1.5 years postoperative, she presented with a full and spontaneous smile on the left side but no complete symmetry. (**See Video 2 [online],** which displays the girl 1.5 years postoperative, in which she presented full and spontaneous

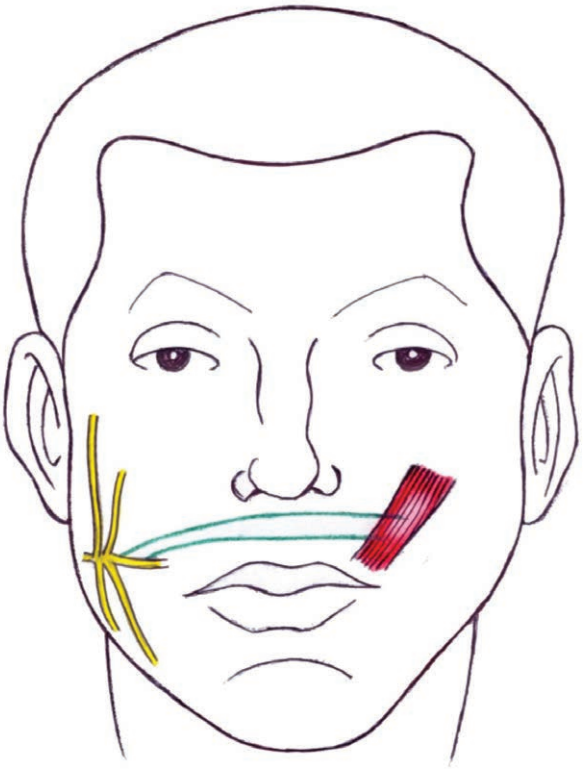

Fig. 3. Illustration of the placement of nerve grafts.

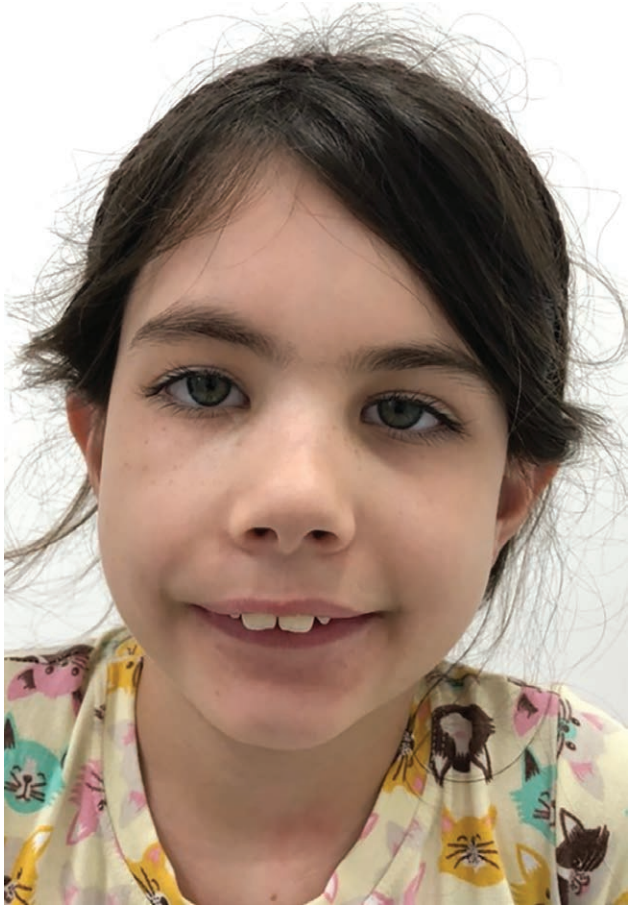

Fig. 4. Four years postoperative. The patient presented an improved symmetry and spontaneity, but more importantly, an independent right and left smile.

smile on the left side but no complete symmetry, and 3 years postoperative in which she presented complete symmetry.) In the 3-year postoperative visit, the patient had complete symmetry. Spontaneity was observed in both postoperative evaluations. In the 4-year postoperative visit, she presented an even more improved symmetry and spontaneity, but more importantly, an independent right and left smile (Fig. 4). (**See Video 3 [online],** which displays the girl 4 years postoperative in which she presented an even more improved symmetry and spontaneity, with an independent right and left smile.)

DISCUSSION

The current surgical options for MB treatment are focused on temporal flaps and free muscle flaps but not the original zygomatic muscles, which may cause suboptimal aesthetic and functional results.[22] The possibility of using the original muscles (such as the major zygomatic, as presented in this case report), with normal smile restoration considering symmetry, spontaneity, and facial volume, opens new perspectives for smile surgery.

Many clinicians believe that in the conditions of congenital facial palsy, especially in MS, the nerves and muscles are defective or absent. However, we believe that in many cases, the nerves are absent, but the muscles are not; however, they atrophy in time as a consequence. Following this line of thought, we believe that neurotization[23] may be employed in young children under the age of 3 years, where the muscles, when present, are likely not yet definitively atrophied.

End-to-side neurorrhaphy with stitches have potential to harm the donor nerve in cases where the diameter is small (<1.5 mm). Embracing end-to-side neurorrhaphy[21] prevents any possible damage to the donor nerve and produces a favorable pressure of the receptor against the donor, which is positive in terms of favoring the lateral sprouting of axons. In this case, the nerve graft fascicle extremities were dissected to maximize terminal sprouting. Although this was not proven yet, we believe this could be helpful.

Zygomatic muscle neurotization compared with treatment with free flaps or temporal flaps showed superior outcomes in terms of using the original muscle, which means that there was no bulk and no concerns about flap, tendon, or fascia lata graft insertion, allowing perfect symmetry. Also, there was no vascular anastomosis, which is time-consuming and presents risks related to thrombosis. In addition to this advantage, the patient eventually showed a spontaneous smile.

Another important point is the progressive evolution made in terms of smile quality observed in spontaneity and even independent smile movement in the left and right sides due to brain plasticity. Another relevant point is

that this technique is time-dependent: in other words, the earlier the surgery, the greater the chance to avoid atrophy in zygomatic muscles and, therefore, preserve their ability to be subjected to muscle neurotization.[24]

Although the present case involves a 3-year-old child, we believe that an early age of 2 years or even 1 year could be more advantageous for this procedure, allowing for the obtaining of muscles that have not yet atrophied. Further, the buccal branch nerve and zygomatic muscles present a feasible dimension, making it possible to be handled using a microscope.

Electrical stimulation prevents muscle atrophy, and we strongly recommend that it be started as soon as facial muscle palsy is detected. This may allow muscle under better conditions in terms of being submitted to neurotization. Immediately after reinnervation, electric stimulation should be continued because, beyond the mentioned muscle advantages, it creates an increase in the nerve regeneration velocity.[25]

Comparing the 1.5 with the 3- and 4-year follow-up, it is clear that the muscle function showed an evolution after the surgery. Muscle reinnervation takes time.

In summary, this case report presents a new approach for treating congenital facial paralysis with functional and aesthetic improvements of great relevance. The original muscle was restored without any excessive bulkiness. Based on these findings, this early rescue, being the first in the world, starts a new era in the early treatment of congenital facial paralysis, in addition to opening new horizons for the surgical correction of other types of congenital paralysis. Thus, zygomatic muscle neurotization should be considered during smile restoration in young children.

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PATIENT CONSENT

Parents or guardians provided written consent for the use of the patients' image.

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