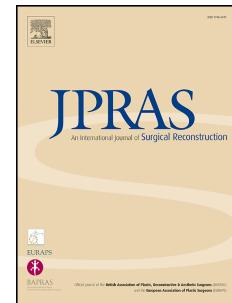


# Accepted Manuscript

Bidirectional/Double fascia grafting for simple and semi-dynamic reconstruction of lower lip deformity in facial paralysis

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5

6 Conflict of Interest

7 None.

8

9 Financial disclosure

10 None of the authors has a financial interest in any of the products, devices, or drugs  
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## 1                             Summary

2         Background: For the total aesthetic reconstruction of facial paralysis, treatment of lower lip  
 3         deformity as “a neglected target in facial reanimation” is important. Although various  
 4         dynamic reconstruction approaches have been reported for lower lip deformity, these have not  
 5         been popularly performed due to aggressive surgical invasiveness, long recovery time for  
 6         reinnervation and unstable outcomes. To reconstruct the lower lip deformity more simply but  
 7         semi-dynamically, we modified bidirectional/double fascia grafting methods that have been  
 8         established as simple and minimally-invasive treatments for pediatric congenital lower lip  
 9         paralysis.

10         Methods: Between 2009 and 2011, nine patients were treated using this procedure alone or  
 11         with combinations of other procedures of facial reanimation like one-stage free muscle  
 12         transfer. For outcome assessment, patients were evaluated using a lower lip paralysis grading  
 13         system, including the objective aesthetics and functional results of the lower lip at rest (score  
 14         range, 0 to 1), during smiling (score range, 0 to 4) and mouth opening (score range, 0 to 2).

15         Results: The mean total scores improved from 1.43 (poor) preoperatively to 5.71  
 16         (excellent) postoperatively. In all evaluation items, the postoperative scores improved  
 17         significantly compared to the preoperative scores ( $p<0.01$ ) with no severe complications.

18         Conclusions: The procedure is simply applied to various types of extensive facial paralysis,  
 19         as well as congenital lower lip paralysis in combination with other static and dynamic  
 20         reconstruction methods for facial paralysis, and it is suggested that this approach significantly  
 21         and semi-dynamically improves the aesthetic function of the lower lip at rest, during smiling  
 22         and during mouth opening.

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1 Key words  
2 Facial paralysis; Bidirectional/double fascia grafting; Semi-dynamic reconstruction; Lower lip  
3 deformity

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1                           Text

2      Introduction

3                 The main goal of reconstructive surgery for facial paralysis is restoration of the  
4 expression of smile and the function of eye closure. Patients with reversible facial paralysis  
5 are treated with facial nerve reconstruction by nerve transplantation,<sup>1</sup> and patients with  
6 irreversible and long-standing facial paralysis are treated with neurovascular free muscle  
7 transfer<sup>2,3,4</sup> or temporalis myoplasty.<sup>5</sup>

8                 When total aesthetic facial balance is considered, reconstructive treatment of lower lip  
9 deformity in facial paralysis, termed “a neglected target in facial reanimation” by Terzis et  
10 al.,<sup>6</sup> is also necessary. In lower lip deformity associated with paralysis of the marginal  
11 mandibular branch, the corner of the mouth ptosis on the paralyzed side at rest, the vermillion  
12 is everted, and the whole lip is pulled toward the healthy side, appearing deviated. These  
13 deformities appear markedly in the elderly, but are not noticeable in children and young  
14 patients because tension of the skin is maintained.

15                 However, during smiling, the lower lip on the paralyzed side is pulled inward and in an  
16 upper direction, lifting the corner of the mouth, and opening the mouth, revealing the  
17 deformity even in children and young subjects, even more markedly than at rest.<sup>7</sup> Moreover,  
18 in extensive facial paralysis, even though favorable dynamic reconstruction is performed to  
19 improve smiling and lifting of the corner of the mouth, lower lip deformity becomes  
20 noticeable during smiling and lifting the corner of the mouth. Therefore, treatment of lower  
21 lip deformity is an important issue.

22                 Although various dynamic reconstruction approaches have been reported for lower lip  
23 deformity, these have not been popularly or positively performed because of their  
24 disadvantages, such as aggressive surgical invasiveness, required muscle and nerve grafting,

1 long recovery time for reinnervation and unstable outcomes.  
2 To reconstruct the lower lip deformity more simply but semi-dynamically, we modified two  
3 fascia grafting methods (the bidirectional fascia graft reported by Udagawa et al.<sup>7</sup> and the  
4 double fascia graft reported by Yamamoto et al.<sup>8</sup>) that have been established as simple and  
5 relatively minimally-invasive treatments for pediatric congenital lower lip  
6 paralysis-associated lower lip deformity, and investigated their application to adult patients.  
7 We treated adult patients of congenital lower lip paralysis with this procedure alone, and more  
8 extensive facial paralysis with this procedure in combination with facial reanimation by  
9 neurovascular free muscle transfer<sup>4</sup> or surgical rehabilitation with reconstruction of the  
10 facial-hypoglossal network system<sup>1</sup> to investigate this procedure as a simple and  
11 semi-dynamic reconstruction method that improves the aesthetics and function of the lower  
12 lip during smiling, lifting the corner of the mouth, and opening the mouth, in addition to  
13 acquisition of lower lip symmetry at rest, which has previously been considered difficult.

14

## 15 Patients and Methods

16 Between 2009 and 2011, nine patients underwent semi-dynamic reconstruction of lower  
17 lip deformity associated with lower lip paralysis at our department using this procedure and  
18 were able to be followed for 6 months or longer. The etiology of paralysis, postoperative  
19 complications, and the aesthetics and function of the lower lip were investigated  
20 retrospectively from their medical records. The present study was approved by the  
21 Institutional Review Board and complied with Helsinki Declaration.

22

## 23 Surgical procedures of bidirectional/double fascia grafting

24 Surgery was performed under general anesthesia with basically nasotracheal intubation.

1      Firstly, 2 fascia strips (7 mm width × 12 cm length) were excised from the lateral thigh for  
2 transplantation.

3

4      Fascia graft in the horizontal direction

5      The deviation of the center of the lower lip toward the healthy side was marked.  
6      Incisions (1 cm in length) were made at 3 sites: the marked center of the lower lip, the middle  
7      point between the corner of the mouth on the paralyzed side and the marked center of the  
8      lower lip, and the labial mucosal side of the corner of the mouth on the paralyzed side (Figure  
9      1A). The anterior surface of the orbicularis oris muscle on the caudal side of the lower lip was  
10     dissected from each incision and a subcutaneous pocket was prepared by joining the  
11     dissections. The subcutaneous pocket was expanded about 1.5 cm from the center of the lower  
12     lip toward the healthy side.

13     At the corner of the mouth on the paralyzed side, the subcutaneous pocket was expanded  
14     closed to the zygomatic and orbicularis oris muscle attachment sites, i.e., the muscle  
15     condensation site at the corner of the mouth (modiolus). When neurovascular free muscle  
16     transfer was applied for facial reanimation and elevation of the corner of the mouth, the  
17     subcutaneous pocket was expanded to the muscle graft stump-fixed site near the corner of the  
18     mouth (Figure 1B).

19     Femoral fascia strips were subsequently grafted to the horizontal lower lip subcutaneous  
20     pocket anterior to the orbicularis oris muscle, after preparation as described above (Figure  
21     1B).

22     The medial stump of the fascia graft was fixed with 4-0 nylon at 2 sites in the region at  
23     which the depressor labii inferioris muscle on the healthy side crossed the orbicularis oris  
24     muscle, which became approachable after slightly expanding the subcutaneous pocket from

1 the center toward the healthy side. The lateral stump of the fascia graft was fixed with 4-0  
2 nylon at 2 sites in the modiolus of the corner of the mouth, represented by the zygomatic and  
3 orbicularis oris muscle attachment sites, or a region near the corner of the mouth on the  
4 paralyzed side to which the free muscle graft stump had been sutured. The fascia graft length  
5 and tension in the horizontal direction were determined to arrange the marked center of the  
6 lower lip to the facial midline and obtain symmetry of the lower lip morphology under  
7 general anesthesia. Loading of excess tension in consideration of postoperative retrogression  
8 was avoided on fixation.

9 After fixation of both stumps of the horizontal fascia graft, the graft was also fixed with  
10 4-0 nylon at 2 sites at the middle point between the corner of the mouth on the paralyzed side  
11 and the center of the lower lip.

12 To ensure transplantation of the fascia graft without twisting the subcutaneous pocket, a  
13 silicone drain with the same width as that of the fascia graft was passed through the  
14 subcutaneous pocket as a guide beforehand. After fixing the stump of the fascia graft to the  
15 stump of this silicone drain by sutures at 2 sites, the silicone drain was slowly pulled out,  
16 which ensured simple and reliable fascia transplantation into the subcutaneous pocket.

17  
18 Fascia graft in the vertical direction on the caudal side

19 A subcutaneous pocket for the fascia graft in the vertical direction on the caudal side was  
20 then prepared. The pocket was prepared on the posterior surface of the orbicularis oris muscle  
21 from the incision at the middle point between the corner of the mouth on the paralyzed side  
22 and center of the lower lip toward the inferior border of the mandible on the paralyzed side.  
23 The direction of lower lip movement on the healthy side was carefully observed before  
24 surgery, and the direction of the subcutaneous pocket was set symmetrically to it. A 1.5 cm

1 skin incision was made along the direction of the subcutaneous pocket at the inferior border  
2 of the mandible, through which the mandibular periosteum was approached. The  
3 subcutaneous pocket was prepared from the middle point between the corner of the mouth on  
4 the paralyzed side and the center of the lower lip toward the periosteum of the inferior border  
5 of the mandible.

6 Both stumps of the vertical fascia graft were inserted from the labial incision at the  
7 middle point between the corner of the mouth on the paralyzed side and center of the lower  
8 lip and passed through the subcutaneous pocket to cross and overlap the horizontal fascia  
9 graft transplanted earlier, and pulled out of the incision at the inferior border of the mandible.  
10 After confirming that the vertical fascia graft crossed the horizontal fascia graft, forming a  
11 loop, both stumps of the vertical fascia graft were firmly held with Pean forceps and pulled  
12 downward to confirm that the lower lip on the paralyzed side was pulled downward obliquely  
13 (Figure 1C and 1D).

14 When the vertical fascia graft was fixed to the mandibular periosteum, the fascia tension  
15 was set to acquire symmetry of the lower lip morphology during mouth closure as well as  
16 during passive mouth opening (Figure 1E). Fixation at an excessively corrected position was  
17 avoided. The vertical fascia graft length capable of acquiring this appropriate tension was  
18 decided, and the graft was fixed at this length to the mandibular periosteum with 4-0 nylon at  
19 3 sites (Figure 1B and 1E).

20 In patients in which the loop region of the vertical fascia graft crossing the horizontal  
21 fascia graft was thick and noticeable, the lip and subcutaneous tissue of the loop region were  
22 partially resected at the middle point between the corner of the mouth on the paralyzed side  
23 and the center of the lower lip.

24

1      Outcome evaluations

2      For pre- and postoperative outcome evaluations, a lower lip paralysis grading system  
3      (Table 1) that was developed to evaluate the aesthetics and function of the lower lip at rest and  
4      during smiling and mouth opening was used. In this system, 3-step scoring was used for the  
5      function at rest (0 for total paralysis and 1.0 for normal), 5-step scoring for the function  
6      during smiling (0 for total paralysis and 4.0 for normal), 3-step scoring for the function during  
7      mouth opening (0 for total paralysis and 2.0 for normal), and 5-step grading for the total score  
8      (with grade ranging from poor to excellent). High scores were attributed to deformities that  
9      became obvious during smiling and mouth opening as weighted evaluation. The lower lip  
10     aesthetics during smiling was considered particularly important because it is the most  
11     important reconstruction target for facial expression.

12     To investigate the efficacy of this procedure, photographs and videos obtained before and  
13     after surgery (including the final records 6 months or more after surgery) were assessed by 3  
14     evaluators, who were independent of the research group, using the grading system. The  
15     differences for each item were analyzed using the Wilcoxon signed-rank test. A p-value < 0.05  
16     was considered significant. ~~The inter rater reliability of the lower lip paralysis grading system~~  
17     ~~was evaluated and validated using Cronbach's alpha ( $\alpha$ ). An  $\alpha$  value > 0.8 was considered~~  
18     ~~sufficiently high to validate the reliability between evaluators.~~ Because the grading system  
19     was not established with a rigorous validation process, there were limitations to the objective  
20     outcome evaluation of this study.

21

22     Results

23     All 9 patients (mean age: 37.2 years (18-75 years), 2 males and 7 females) were included in  
24     the analysis (Table 2). The etiology of lower lip paralysis were congenital in 4 patients (lower

1 lip paralysis alone), one patient had fresh paralysis after resection of a parotid gland tumor, 3  
2 patients had long-standing paralysis after resection of an acoustic tumor, and one patient had  
3 Bell's palsy. The 4 patients with congenital lower lip paralysis were treated with this  
4 procedure alone (Figure 2). In the 3 patients with long-standing paralysis after acoustic tumor  
5 resection, facial reanimation was initially performed by one-stage free latissimus dorsi muscle  
6 transfer using dual innervation method,<sup>4</sup> and the procedure was then applied as the second  
7 step more than one year after the first surgery when elevation of the corner of the mouth was  
8 observed on the paralyzed side (Figure 3). The remaining 2 patients were treated with  
9 combinations of the procedure with nerve grafting and surgical rehabilitation with  
10 reconstruction of the facial-hypoglossal network system.<sup>1</sup> One patient was treated 2 years  
11 after nerve grafting to reanimate the smile and the other was treated at the same time with  
12 nerve grafting for surgical rehabilitation of the facial-hypoglossal network system in response  
13 to the patient's request for static symmetry in the early postoperative stage.

14 The mean duration of postoperative follow-up was 1.8 years (Table 2).

15

16 No severe postoperative complications developed in any of the patients, and the surgical  
17 scars in the lips, inferior border of the mandible, and femoral fascia donor site were  
18 inconspicuous. Transient hypesthesia of the lower lip was noted after surgery in 4 patients but  
19 improved within 2 months in all patients. Four patients complained of thickening of the lower  
20 lip on the paralyzed side, but it gradually improved 6 months after surgery or later.

21 On evaluation of the aesthetics and function of the lower lip using the lower lip paralysis  
22 grading system (Table 1), the mean total scores before and after surgery were  $1.43 \pm 1.56$   
23 (grade poor) and  $5.71 \pm 0.85$  (grade excellent), respectively. Based upon each evaluation item,  
24 the mean scores at rest before and after surgery were  $0.52 \pm 0.37$  and  $0.81 \pm 0.25$ , respectively,

1 the mean scores during smiling before and after surgery were  $0.67 \pm 1.1$  and  $3.2 \pm 0.68$ ,  
2 respectively, and the mean scores during mouth opening before and after surgery were  $0.24 \pm$   
3  $0.44$  and  $1.71 \pm 0.46$ , respectively. In all evaluation items, the postoperative scores improved  
4 significantly compared to the preoperative scores ( $p < 0.01$ ). (Table 3) Cronbach's alpha ( $\alpha$ )  
5 was 0.84, which validated the lower lip palsy grading system.

6

## 7 Discussion

8 The main goal of reconstructive treatment for facial paralysis is dynamic reconstruction of  
9 the smile and lifting of the corner of the mouth, and favorable surgical outcomes have  
10 recently been achieved by applying neurovascular free muscle transfer<sup>2-5</sup> and surgical  
11 rehabilitation with reconstruction of the facial-hypoglossal network system.<sup>1, 9</sup> Thus, methods  
12 to reconstruct a more aesthetic, symmetric smile and lip deformity are needed, as the  
13 importance of treatment of lower lip deformity,<sup>6</sup> which was previously regarded as a  
14 secondary target of facial paralysis treatment, has increased.

15 Transfer of muscles, such as the digastric muscle,<sup>6, 10, 11</sup> marginal mandibular branch-  
16 hypoglossal nerve transfer,<sup>6</sup> and neurovascular free muscle transfer<sup>12-15</sup> have previously been  
17 reported as dynamic reconstruction methods for lower lip deformity. However, these methods  
18 must be selected very carefully because muscles innervated by nerves other than the facial  
19 nerve require rehabilitation after surgery to acquire movement corresponding to facial  
20 expression, in addition to the high degree of surgical invasiveness and difficulty of the  
21 procedures.

22 On the other hand, lower lip muscle resection<sup>16</sup> and selective resection of the marginal  
23 mandibular branch<sup>17</sup> to reduce lower lip movement on the healthy side, with the goal of  
24 improving lower lip deformity at rest and during smiling, have been reported because many of

1 the surgical procedures used to reconstruct the aesthetic function of the lower lip on the  
2 paralyzed side are complex. These methods are simple, but adjustment of the amounts of  
3 muscle and nerve resection can be difficult, as well as prediction of the treatment effect. These  
4 methods should be selected more carefully because normal muscles and nerves on the healthy  
5 side are resected, which may cause lower lip deformity on the healthy side as an irreversible  
6 complication.

7 The effect of botulinum toxin injection as a method to reduce the lower lip function on  
8 the healthy side is temporary but reversible, and the procedure is simple.<sup>18-21</sup> Among the  
9 disadvantages, the treatment effect is temporary, persisting for only about 6 months, and thus,  
10 periodic injection is necessary. Accordingly, the cost for long-term treatment is high. However,  
11 this is a favorable indication for patients in which facial paralysis is localized to the lower lip.  
12 Furthermore, these methods to reduce lower lip movement on the healthy side should be  
13 carefully selected for patients with extensive facial paralysis and the complication of  
14 orbicularis oris muscle paralysis, because disturbance of mouth closing and lip biting may  
15 occur due to relaxation of the entire lower lip.<sup>16-22</sup>

16 The surgical options for lower lip reconstruction for facial paralysis are described in Table  
17  
18 4.

19 We applied and modified the bidirectional/double fascia grafting method<sup>7,8</sup> to establish a  
20 more effective semi-dynamic reconstruction of lower lip deformity for adult patients. As this  
21 procedure is a semi-dynamic reanimation procedure for the paralyzed lower lip, the patients  
22 need to be able to smile or have their smile reconstructed before this procedure. Thus,  
23 application of this procedure is limited to incomplete patients who are able to smile with  
24 lower lip deformity.

26

1       The modified points are as follows: The medial stump of the horizontal fascia graft was  
2       fixed to the depressor labii inferioris muscle and orbicularis oris muscle on the healthy side.  
3       The lateral stump was fixed to the muscle condensation site at the corner of the mouth  
4       (modiolus), represented by the zygomatic and orbicularis oris muscle attachment sites, on the  
5       paralyzed side (for patients with lower lip paralysis alone). When neurovascular free muscle  
6       transfer was applied, the lateral stump was fixed to a site near the corner of the mouth at  
7       which the medial stump of the muscle graft had been fixed (when dynamic reconstruction of  
8       smile and lifting of the corner of the mouth was applied) (Figure 1B). Both stumps of the  
9       horizontal fascia graft were fixed to the sites that move with facial expression, through which  
10      the lower lip on the paralyzed side was able to move in conjunction with expression to some  
11      extent, although it is impossible to move the lower lip alone.

12      The role of the caudal vertical fascia graft is to maintain an almost constant distance  
13      between the inferior border of the mandible and lower lip on the paralyzed side, which  
14      inhibits that the deformity of the lower lip is pulled in the upper inward direction during the  
15      simultaneous movement of the lower lip, particularly during mouth opening, and the lower lip  
16      on the paralyzed side appears as if it moves in the lower outward direction. Although the  
17      correct amount of tension of both fascia grafts is the key to success during surgery, the tension  
18      is re-adjusted under local anesthesia after surgery if patient wants to correct a minor lower lip  
19      deformity.

20      To our knowledge, although various dynamic reconstruction methods for the lower lip  
21      have been reported, there has been a few report describing treatment of lower lip deformity  
22      during mouth opening.<sup>7,8</sup>

23      The addition of appropriate tension and continuity between the orbicularis oris muscle and  
24      depressor labii inferioris muscle on the healthy side and the modiolus at the corner of the

1 mouth on the paralyzed side exhibits an illusion of depressor effect on the lower lip on the  
2 paralyzed side during smiling, in particular with large movement of the entire region around  
3 the lips in full denture smile, and the lower lip on the paralyzed side appears as though it  
4 moves in the lower outward direction. With regard to this point, this procedure may be  
5 applied as a semi-dynamic reconstruction method combining dynamic reconstruction of the  
6 lower lip, in addition to static reconstruction.

7 The indications of this procedure are: 1) congenital lower lip paralysis and traumatic and  
8 iatrogenic paralysis of the marginal mandibular branch alone retaining the function of smile  
9 and lifting the corner of the mouth comparable to that on the healthy side, and 2) patients with  
10 smile and lifting of the corner of the mouth favorably reconstructed by neurovascular free  
11 muscle transfer or surgical rehabilitation with reconstruction of the facial-hypoglossal  
12 network. For extensive facial paralysis not limited to lower lip paralysis, the semi-dynamic  
13 reconstruction effect of this procedure for lower lip deformity is ineffective and limited to the  
14 acquisition of symmetry at rest, when dynamic reconstruction of smile and lifting of the  
15 corner of the mouth is insufficient.

16

## 17 Conclusions

18 The procedure was simply applied to various types of extensive facial paralysis, as well as  
19 congenital lower lip paralysis in combination with other static and dynamic reconstruction  
20 methods for facial paralysis, and it was suggested that this approach significantly and  
21 semi-dynamically improved the aesthetic function of the lower lip at rest, during smiling and  
22 during mouth opening.

23

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1  
2 Conflicts of Interest: None declared

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4 Ethical Approval: Not required

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2

1   Figure legends

2

3   Figure 1. Surgical procedures of bidirectional/double fascia grafting.

4   (A) Preoperative design. The center of the lower lip deviated from the facial midline toward  
5   the healthy side. A T-shape subcutaneous pocket was prepared extending the dissection to  
6   the depressor labii inferioris muscle on the healthy side (D) and the modiolus at the corner of  
7   the mouth on the paralyzed side (A) in the horizontal direction, and to the mandibular  
8   periosteum (P) in the vertical direction on the caudal side.

9

10   (B) Fascia grafts were applied in the 2 directions. The vertical fascia graft crossed and  
11   overlap the horizontal fascia graft, forming a loop. ×: fixed sites.

12

13   (C) The fascia grafts were passed through the subcutaneous pocket. The horizontal fascia  
14   graft was fixed at a site to shift the center of the lower lip to the facial center line. The stump  
15   of the vertical fascia graft was pulled out of the inferior border of the mandible.

16

17   (D) When the stump of the vertical fascia graft outside the inferior border of the mandible  
18   was pulled, the lower lip on the paralyzed side was pulled. The vertical fascia graft was fixed  
19   to the periosteum at the mouth opening position at which the lower lip became symmetric.

20

21   (E) Lower lip symmetry was confirmed at the mouth opening position immediately after  
22   surgery.

23

24   Figure 2. An 18-year-old woman with congenital left lower lip paralysis.

1 The patient had suffered from congenital lower lip asymmetry during smiling and mouth  
2 opening.

3 (A,B) Before surgery, lower lip asymmetry was not noticeable at rest, but during smiling (A)  
4 and mouth opening (B), the paralyzed left side of the lower lip was pulled in the upper inward  
5 direction, showing the deformity, and the preoperative grade was ‘Fair’.

6 (C,D) As of 2 years and 6 months after surgery, lower lip asymmetry was not noticeable at  
7 rest, during smiling (C) or mouth opening (D), and the postoperative grade was ‘Excellent’.

8

9 Figure 3. An 18-year-old woman with complete facial paralysis following left cerebellar  
10 tumor resection.

11 Complete left facial paralysis developed after left cerebellar tumor resection at 8 years of  
12 age, and the patient was referred to our hospital for facial reanimation.

13 (A,B) Before surgery, the lower lip asymmetry was not noticeable at rest, but the paralyzed  
14 left lower lip was pulled upward during smiling (A) and mouth opening (B), showing the  
15 lower lip deformity, and the preoperative grade was ‘Poor’.

16 (C,D) The procedure was applied one year after one-stage free latissimus dorsi muscle flap  
17 transfer, when sufficient muscle contraction was achieved. As of one year and one month after  
18 surgery with this procedure, the lower lip asymmetry was not noticeable at rest, during  
19 smiling (C) or mouth opening (D), and the postoperative grade was ‘Excellent’.

20

Table 1. Lower lip paralysis grading system

At rest		Smile / Full smile		Mouth opening		Total	
Score	Description	Score	Description	Score	Description	Score	Grade
0	Severe asymmetry	0	Severe asymmetry with smile	0	Severe asymmetry	0-1.0	Poor
0.5	Moderate asymmetry	1.0	Severe asymmetry with full smile	1.0	Moderate asymmetry	1.1-2.5	Fair
1.0	Normal	2.0	Mild asymmetry with smile	2.0	Normal	2.6-4.0	Moderate
		3.0	Mild asymmetry with full smile			4.1-5.5	Good
		4.0	Normal smile with full smile			5.6-7.0	Excellent

Table 2. Patient summary

Age (years)	Sex		Etiology of paralysis				Follow-up (years)
	Male	Female	Developmental	Tumor	Bell's palsy		
37.2 ± 24.1	2	7	4	4	1	1.8 ± 0.9	

mean ± standard deviation

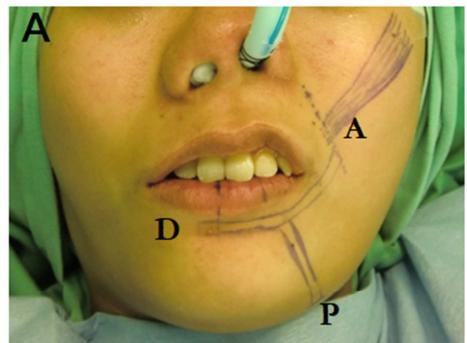
Table 3. Results of aesthetics and function of the lower lip as evaluated by the lower lip paralysis grading system

	At rest	Smile	Mouth opening	Total
Pre operation	$0.52 \pm 0.37$	$0.67 \pm 1.1$	$0.24 \pm 0.44$	$1.43 \pm 1.56$
(n = 9)				
Post operation	$0.81 \pm 0.25^{**}$	$3.2 \pm 0.68^{**}$	$1.71 \pm 0.46^{**}$	$5.71 \pm 0.85^{**}$
(n = 9)				

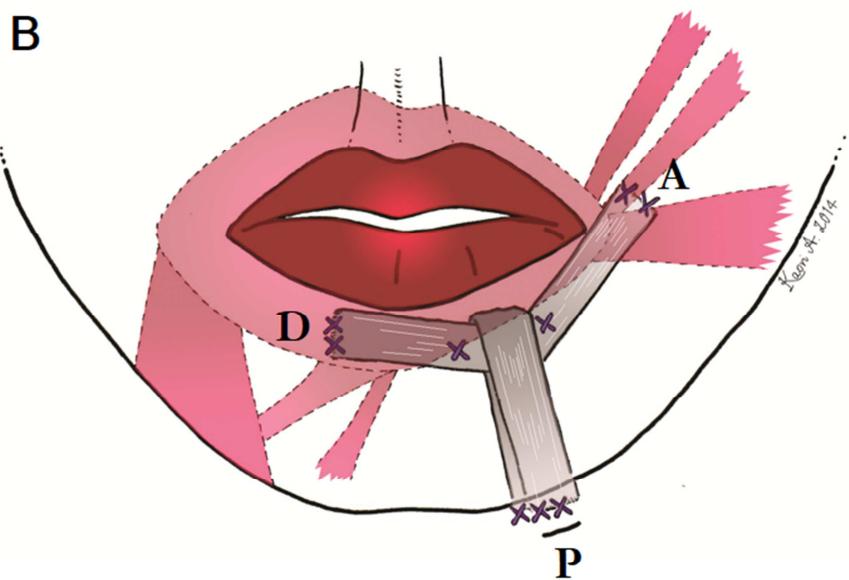
mean  $\pm$  standard deviation; \*\*, p < 0.01

Table 4. Surgical Options for Lower Lip Reconstruction for Facial Paralysis.

	<b>Method of Reconstruction</b>		
	<b>Dynamic Reconstruction</b>	<b>Semi-dynamic Reconstruction</b>	<b>Static Reconstruction</b>
<b>Surgical Procedure</b>	Digastric muscle transfer  Marginal mandibular branch-hypoglossal nerve transfer  Neurovascular free muscle transfer	Bidirectional/Double fascia graft	Lower lip muscle resection  Selective resection of the marginal mandibular branch  Depressor myectomy by botulinum toxin injection
<b>Category of Treatment</b>	Intervention on paralyzed side	Intervention on both sides	Intervention on paralyzed side



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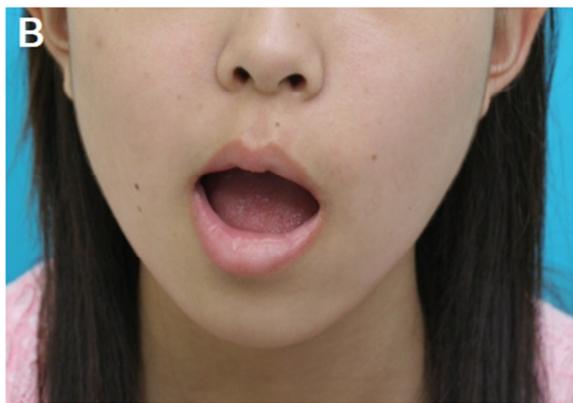
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