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Long-term results of orbicularis oris muscle reconstruction in primary cleft lip repair using the "basket-weave method"

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ABSTRACT

The basket-weave method is an orbicularis oris muscle reconstruction method used in primary unilateral cleft lip repair. We compared the long-term results of the basket-weave method with those of a conventional method. For primary unilateral cleft lip repair, we compared the long-term results of 7 cases in which the orbicularis oris muscle was reconstructed by use of the basket-weave method, and of 7 cases in which the reconstruction was performed by use of the conventional method. The average postoperative follow-up period was 12 years and 7 months for the basket-weave method, and 11 years and 9 months for the conventional method. Using photographs of the front and elevation angle views, we evaluated the results as good if the philtrum ridge was formed on the fissure side and was almost symmetrical in height; as fair if the philtrum ridge was lower than the normal side; and as poor if the philtrum ridge had disappeared. For the basket-weave method, the results were good in 6 cases (85.7%), fair in 1 case (14.3%), and poor in 0 cases. For the conventional method, the results were good in 2 cases (28.6%), fair in 4 cases (57.1%), and poor in 1 case (14.3%). A significant difference was found between the 2 groups (Mann-Whitney U test, P = 0.0417). The philtrum ridge shape could be reconstructed by use of the basket-weave method, which gave better results in the long-term than did the conventional method for orbicularis oris muscle reconstruction in primary unilateral cleft lip repair.

Keywords: cleft lip, basket-weave method, orbicularis oris muscle reconstruction, primary unilateral cleft lip repair, long-term results

BACKGROUND

The basket-weave method is a method of orbicularis oris muscle reconstruction in which the orbicularis oris muscles are crossed and pulled across the philtrum ridge to emphasize the ridge of the philtrum in primary unilateral cleft lip repair; it was first reported by Seagle and Furlow in 2004.[1] In 2007, we compared the basket-weave method with conventional methods (overlap method and end-to-end suture method) and reported that a good philtrum ridge shape

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was obtained in the short term.[2] In the current study, we compared the long-term results obtained using the basket-weave method with those obtained using the conventional method (end-to-end suture method) in primary unilateral cleft lip repair.

PATIENTS AND METHODS

For primary unilateral cleft lip repair, 7 cases (3 complete cases, 4 incomplete cases) in which orbicularis oris muscle reconstruction was performed by use of the basket-weave method, and 7 cases (3 complete cases, 4 incomplete cases) in which it was performed by use of a conventional method (end-to-end suture method) were compared. The average postoperative follow-up period was 12 years and 7 months (range, 8 years and 7 months– 16 years and 3 months) for the basket-weave method, and 11 years and 9 months (range, 5 years– 17 years and 2 months) for the conventional method. The average operation time was 93 minutes (range, 76 min– 129 min) for the basket-weave method, and 87 minutes (range, 63 min– 110 min) for the conventional method. No significant differences in the average postoperative follow-up period or the average operation time were found between the 2 groups.

Surgical procedures

All the surgeries were performed by the same surgeon. The Millard + small triangular flap method was used for the skin incision. Cases in which revision reconstruction of the orbicularis oris muscle were performed after primary repair were not included. The methods used for orbicularis oris muscle reconstruction were the basket-weave method and the conventional method. In the basket-weave procedure, we divided the muscle of the white lip into 2 parts only, which is different from the original basket-weave method (Fig. 1).[2] In the conventional procedure, we performed end-to-end suturing and sutured the muscle with a slight valgus so as to raise the philtrum ridge (Fig. 2).

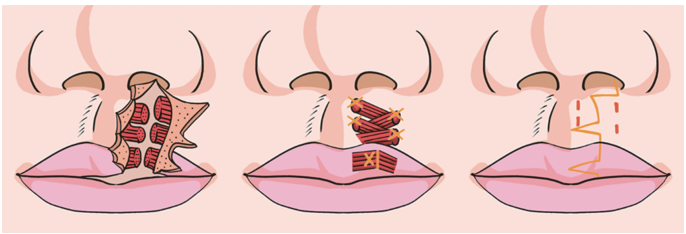

Fig. 1 Our surgical method[2]
The orbicularis oris muscle was divided into 3 parts (left). The uppermost part was fixed to the base of the nasal column, and the other 2 parts were alternately fixed subcutaneously (center). Completion of reconstruction (right).

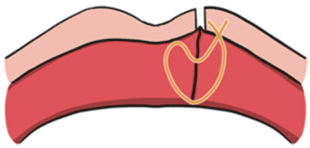

Fig. 2 Conventional method
End-to-end suturing was performed, and the muscle was sutured with a slight valgus so as to raise the philtrum ridge.

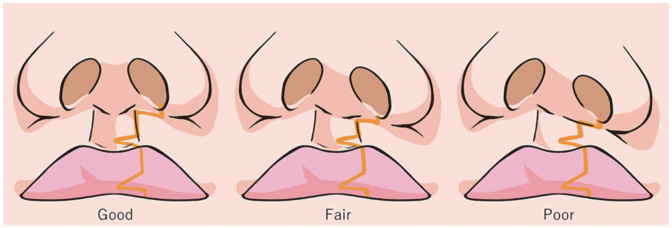

Fig. 3 Evaluation method[2]
Height of the reconstructed philtrum ridge compared with the normal side:
Good: almost symmetrical (left)
Fair: lower than the normal side (center)
Poor: disappearance of the philtrum ridge (right)

Evaluation

Using photographs of the front and elevation angle views, the results were evaluated as follows: philtrum ridge formed on the fissure side and almost symmetrical in height, good; philtrum ridge lower than the normal side, fair; and philtrum ridge disappeared, poor (Fig. 3).[2] The evaluation was performed by 3 specialists in plastic and reconstructive surgery in addition to the operating surgeon and the first author. The method of orbicularis oris muscle reconstruction was not described in the evaluation photograph, and the basket-weave method cases and the conventional method cases were presented at random. If the evaluations were divided, the one with the higher number of evaluations was selected.

Statistical analyses

Good, fair, and poor evaluations were converted to 2, 1, and 0, respectively. Since these are ordinal variables, the Mann-Whitney U test, which is a nonparametric test, was used for the statistical analysis.

Statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (R Foundation for Statistical Computing, Vienna, Austria).[3] More precisely, it is a modified version of R Commander, which is designed to add statistical functions, and is frequently used in biostatistics.

RESULTS

For the basket-weave method, the results were good in 6 cases (85.7%), fair in 1 case (14.3%), and poor in 0 cases (Tables 1, 3). For the conventional method, the results were good in 2

Table 1 Surgeries performed using the basket-weave method

No	Type of cleft	Time of judgement after primary repair	Result
1	Complete cleft lip and palate	8 years and 7 months	Good
2	Incomplete cleft lip	15 years and 3 months	Fair
3	Complete cleft lip	11 years and 6 months	Good
4	Incomplete cleft lip	13 years and 8 months	Good
5	Complete cleft lip and palate	16 years and 3 months	Good
6	Incomplete cleft lip	13 years and 10 months	Good
7	Incomplete cleft lip and palate	9 years and 3 months	Good

Table 2 Surgeries performed using the conventional method

No	Type of cleft	Time of judgement after primary repair	Result
1	Incomplete cleft lip	17 years and 2 months	Poor
2	Incomplete cleft lip	7 years and 8 months	Fair
3	Complete cleft lip and palate	8 years and 9 months	Fair
4	Incomplete cleft lip	5 years	Fair
5	Complete cleft lip and palate	10 years and 1 month	Fair
6	Incomplete cleft lip	17 years and 2 months	Good
7	Complete cleft lip	16 years and 7 months	Good

Table 3 Results of evaluation

Methods	Good	Fair	Poor
Basket-weave method	6 (85.7%)	1 (14.3%)	0 (0%)
Conventional method	2 (28.6%)	4 (57.1%)	1 (14.3%)

A significant difference was found between the 2 groups (Mann-Whitney U test, P = 0.0417).

cases (28.6%), fair in 4 cases (57.1%), and poor in 1 case (14.3%) (Tables 2, 3). A significant difference was found between the 2 groups (Mann-Whitney U test, P = 0.0417; Table 3).

Cases

We here present representative cases of orbicularis oris muscle reconstruction performed by use of the basket-weave method (cases 1, 2) and the conventional method (cases 3, 4).

Case 1. A girl with a left complete cleft lip and palate. She underwent primary surgery with the Millard + small triangular flap method at the age of 3 months. At 16 years and 3 months after the primary operation, her left philtrum showed almost the same shape as the normal side and was evaluated as good (Fig. 4, Table 1; no. 5).

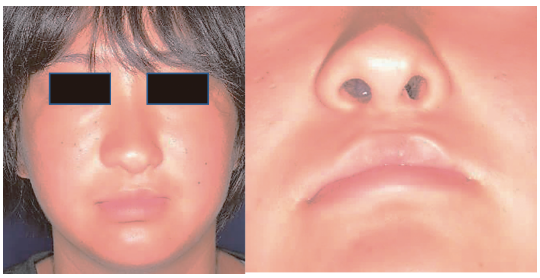

Fig. 4 Case 1, a girl with a left complete cleft lip and palate (Table 1, no. 5)
At the age of 3 months, she underwent primary surgery with the Millard + small triangular flap method and orbicularis oris muscle reconstruction performed by use of the basket-weave method. At 16 years and 3 months after the primary operation, the left philtrum ridge had almost the same shape as the normal side and was evaluated as good.
Left, front view; right, elevation angle.

Case 2. A girl with a left incomplete cleft lip. She underwent primary surgery with the Millard + small triangular flap method at the age of 3 months. At 13 years and 8 months after the primary operation, her left philtrum showed almost the same shape as the normal side and was evaluated as good (Fig. 5, Table 1; no. 4).

Fig. 5 Case 2, a girl with a left incomplete cleft lip (Table 1, no. 4)
At the age of 3 months, she underwent primary surgery with the Millard + small triangular flap method and orbicularis oris muscle reconstruction performed by use of the basket-weave method. At 13 years and 8 months after the primary operation, the left philtrum ridge had almost the same shape as the normal side and was evaluated as good.
Left, front view; right, elevation angle.

Case 3. A girl with a left complete cleft lip and palate. She underwent primary surgery with the Millard + small triangular flap method at the age of 3 months. At 10 years and 1 month after the primary operation, her left philtrum ridge was slightly lower than the normal side and was evaluated as fair (Fig. 6, Table 2; no. 5).

Fig. 6 Case 3, a girl with a left complete cleft lip and palate (Table 2, no. 5)
At the age of 3 months, she underwent primary surgery with the Millard + small triangular flap method and orbicularis oris muscle reconstruction performed by use of the conventional method. At 10 years and 1 month after the primary operation, her left philtrum ridge was slightly lower than the normal side and was evaluated as fair.
Left, front view; right, elevation angle.

Case 4. A boy with a left incomplete cleft lip. He underwent primary surgery with the Millard + small triangular flap method at the age of 3 months. At 17 years and 2 months after the primary operation, his left philtrum ridge disappeared and was evaluated as poor (Fig. 7, Table 2; no. 1).

Fig. 7 Case 4, a boy with a left incomplete cleft lip (Table 2, no. 1)
At the age of 3 months, he underwent primary surgery with the Millard + small triangular flap method and orbicularis oris muscle reconstruction performed by use of the conventional method. At 17 years and 2 months after the primary operation, his left philtrum ridge had disappeared and was evaluated as poor.
Left, front view; right, elevation angle.

DISCUSSION

The philtrum has a structure peculiar to the lips, and the orbicularis oris muscle is greatly involved in the expression of its shape. The orbicularis oris muscle is anatomically divided into the superficial and deep layers. The depressor anguli oris muscle that forms the superficial layer stops on the skin from the point beyond the median to the outside of the philtrum on the opposite side, and forms the philtrum by sandwiching it from the left and right. The deep layer continuously forms slings in the upper lip.[4,5]

Various methods have been reported for the orbicularis oris muscle reconstruction method in primary cleft lip repair. In particular, many methods (overlap method, and so forth) of forming a thick muscle layer and forming a philtrum ridge have been reported,[6-8] but few reports have been published on the long-term course. Tani[9] reported on orbicularis oris muscle reconstruction using the Skoog method, and the percentage of philtrum ridges not formed after 5 years or longer was 50%. In the method of filling a large number of muscles just below the philtrum ridge by means of the conventional method of our cases, philtrum ridge formation deficiency (evaluated as fair) and disappearance (evaluated as poor) were 71.4%, and the philtrum ridge was reconstructed in the long term. The philtrum ridge often disappeared. Hata[10] reported that the split edge of the orbicularis oris muscle divided by the basket-weave method did not respond to electrical stimulation and was a non-contracting site. From these results, it was inferred that the height of the philtrum ridge becomes lower after surgery.

The basket-weave method was first reported by Seagle and Furlow in 2004. In this method, the characteristics of the superficial layer of the orbicularis oris muscle are roughly reproduced in that the orbicularis oris muscles are crossed and pulled across the philtrum to emphasize the ridge. This concept is similar to that use in the methods of Randall et al[11] and Hata[10]: by suturing and fixing the muscle bundle to the contralateral skin, the effect of emphasizing the philtrum ridge is obtained.

Because the amount of orbicularis oris muscle in the normal side fissure is small, we divide the white lip into 2 parts only, which differs from the original method. We adopted this technique as a result of our experience that the muscle can be easily cut by pulling it with a suture thread on the muscle divided into 3 parts, and that by keeping it in 2 parts, the muscle can be more reliably sutured and fixed to the contralateral dermis (Fig. 1).[2]

Ours is the first report presenting the long-term course of the philtrum ridge shape reconstructed by use of the basket-weave method after primary unilateral cleft lip repair. In many of

our cases, the basket-weave method maintained the shape of the philtrum ridge even over a long period of time, and in no cases did the philtrum ridge disappear. The conventional method of filling the muscle just below the philtrum depends on the muscle volume, and it is presumed that it is easily affected by postoperative muscular atrophy. Since the basket-weave method is a philtrum reconstruction method that does not depend on muscle volume, we believe that this is the reason the disappearance of the philtrum ridge was prevented even in the long term.

Regarding the risk of complications in the basket-weave method compared with that of the conventional method, it is possible that excess tension resulting from suturing the muscle bundle to the contralateral dermis may overemphasize the philtrum ridge, but we have never experienced such results.

Of course, the basket-weave method does not provide sufficient long-term results in all cases, but it is an effective orbicularis oris muscle reconstruction method that can be used even during primary cleft lip repair. In the future, we would like to verify the functional effects of this reconstruction method.

CONCLUSION

The philtrum ridge shape could be reconstructed by use of the basket-weave method in orbicularis oris muscle reconstruction for primary unilateral cleft lip repair. Moreover, the long-term results were better than that those of conventional method.

ACKNOWLEDGMENTS

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval and informed consent

The clinical research ethics board of University of Tsukuba Hospital approved the study (no. R03-273). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed consent for inclusion in this study was obtained from all the patients.

Clinical trial registration information

Name of trial database registered: UMIN-CTR. Registration number and date registered: R000053887, March 3, 2022.

Additional contributions

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