Bilateral Harvesting of a Fibula Free Flap: Assessment of Morbidity

Silvano Ferrari, MD, Giuseppe Perlangeli, MD,* Patrizia Mammi, MD,† Andrea Varazzani, MD,* Bernardo Bianchi, MD,* Stefano Fusetti, MD, DMD,‡ Bruno Carlo Brevi, MD,§ and Andrea Ferri, MD**

Purpose: To investigate morbidity related to harversting of bilateral fibula free flap for head and neck reconstruction using subjective and functional tests.

Methods: Patients were retrospectively evaluated using point evaluation system (PES) and balance evaluation systems test (BESTest) questionnaires to assess morbidity related to surgery.

Results: Five patients were enrolled in the study. Mean PES scores was 22.2 over 24. Mean overall function assessed with BESTest was 77.6%, and the results were poorest for section I. Sections V and VI had scores of 88% and 83%, respectively, indicating that the sensory balance and gait stability of the patients were compromised only minimally.

Conclusion: Bilateral harvesting of the fibula free flap is not associated with an increase in long-term morbidity and does not lead to significant functional impairments. Therefore, this procedure should be considered safe, and can be performed without concern regarding morbidity, when bone reconstruction with a fibula free flap is indicated.

Key Words: Assessment of morbidity, bilateral fibula free flap, fibula free flap

(*J Craniofac Surg* 2018;29: 2131–2134)

Fibula free flap is commonly used to reconstruct mandibular defects[1] because it has several advantages, including bone length, the possibility of osteocutaneous harvesting, long and large vascular pedicles, and relatively low morbidity.[2–4] This low morbidity has been explored by several previous studies in the last decade.[5–9] In these studies, the fibula free flaps were shown to be safe and reliable, and harvesting was associated with only low-level impairment in patients, which is typically limited to finger elevation or a low level of chronic pain which have no impact on daily life activities.[10,11]

Conversely, as far as we know, only one study has explored the morbidity associated with bilateral harvesting of both fibulas as free flaps.[12] Bilateral fibula transplant is a rare procedure that is typically associated with second free flap harvesting in cases of salvage surgery after free flap failure, recurrence, or secondary inflammatory disease, such as osteoradionecrosis.[13,14]

In these cases, the second fibula represents an ideal solution for reconstruction, when we cannot use bone tissue engineering or bone substitutes.[15,16]

Incomplete understanding of the morbidity associated with bilateral fibula harvesting could be a safety concern. In this study, using subjective and objective tests, we explored the morbidity of bilateral fibula free flap harvesting in a series of 5 patients.

METHODS

Patients who underwent bilateral fibula free flap harvesting from January 1, 2005 to December 31, 2015 at the Maxillo-Facial Surgery Division, Head and Neck Department, University Hospital of Parma, were retrospectively evaluated.

Due to the retrospective study design, institutional review board approval was not mandated by our institution. The study was designed in accordance with the Declaration of Helsinki.

Patients were evaluated subjectively based on the point evaluation system (PES) of Jeng-Yee-Lin[17] (Appendix 1). The PES consisted of 6 sections, each composed of items designed to assess different aspects of a patient's experience (pain, paresthesia, walking ability, restriction in activities, gait alteration, and cosmesis). For each section, the PES provides a score ranging from 0 (*poor outcome*, *several limitations*) to 4 (*normal performance of daily life activities*, *optimal results*), combined into an overall score ranging from 0 (*poorest outcome*) to 24 (*highest quality of life*).

A functional evaluation was performed using the balance evaluation systems test (BESTest)[18] under the supervision of an expert physiatrist (see Supplemental Digital Content, Appendix 2, http://links.lww.com/SCS/A348). This test targets 6 different balance control systems: "Biomechanical Constraints," "Stability Limits/Vertically," "Anticipatory Postural Adjustments," "Postural Responses," "Sensory Orientation," and "Stability in Gait." Scores in each section are converted into a percentage that represents the residual function of the patient. The total possible score across the 36 items ranges from 0 to 108 and this score indexes the overall function of the patient.

RESULTS

The study population consisted of 5 patients (3 females and 2 males) aged from 22 to 64 years (mean: 46 years). Patient data are provided in Table 1. The first fibula free flap was harvested for mandibular

From the *Maxillo-Facial Surgery Division, Head and Neck Department; †Rehabilitation Department, University Hospital of Parma, Parma; ‡Maxillofacial Surgery Unit, Department of Neuroscience, University of Padova Medical School, Padova; and §Maxillo-Facial Surgery Division, Head and Neck Department, University Hospital of Pisa, Pisa, Italy.

Received November 16, 2017.

Accepted for publication April 16, 2018.

Address correspondence and reprint requests to Andrea Varazzani, MD, Maxillo-Facial Surgery Division, Head and Neck Department, via Gramsci 14, 43100 Parma, Italy; E-mail: andrea2787@libero.it

The authors report no conflicts of interest.

Supplemental digital contents are available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.jcraniofacialsurgery.com).

ISSN: 1049-2275

DOI: 10.1097/SCS.0000000000004674

TABLE 1. Patient Data

No	Age	Sex	Age 1st Fibula	Age 2nd Fibula	Months Between 1st and 2nd Fibula	Indication of 2nd Fibula
1	52	F	43	44	6	Osteoradionecrosis
2	22	M	17	21	48	Secondary reconstruction
3	29	M	25	27	14	Osteoradionecrosis
4	64	F	60	62	21	Necrosis of primary fibula
5	62	F	60	60	2	Necrosis of primary fibula

malignancy resection in 4 cases, and for benign mandibular dysplasia in the remaining case. The second fibula free flap was harvested after the first fibula failed as a delayed secondary reconstruction procedure (n = 2), for the treatment of postadjuvant radiation therapy osteoradionecrosis (n = 2), and for delayed reconstruction and substitution of the first flap after patient growth (n = 1). The time between harvesting of the first and second fibula flap ranged from 2 months to 4 years (mean: 18.2 months).

All flaps were harvested and transplanted as osteocutaneous flaps without muscular components with no major or minor complications. In all cases, a distal and proximal bone segment of 5 to 6 cm in length was left in place to improve joint stability. Skin paddle sizes ranged from 2×10 to 5×15 cm, and this parameter was not related to differences in results.

In the panel, Figure 1A-G and H-I show patients 3 and 4, respectively (osteoradionecrosis and necrosis of the first fibula).

The follow-up period ranged between 2 and 9 years (mean: 3.4 years). The PES results are provided in Table 2. Total scores ranged from 21 to 24 (mean: 22.2), corresponding to very low perceived morbidity. No patient reported pain, paresthesia, or gait changes, and only 1 patient had a score of 3 regarding the cosmetic appearance of the leg. Walking ability was scored as 4 by 3 patients and as 3 by the other 2 patients (mean: 3.6). The domain that was most affected was restrictions in activities (mean score: 2.8), with 3 patients giving a score of 2.

FIGURE 1. (A) Preoperative picture of patient 3 treated for osteonecrosis of a fibula free flap transplanted 14 months earlier after mandibular squamous cell carcinoma resection and reconstruction performed in another hospital. (B) Preoperative computer tomography showing previous fibula flap harvesting from the left leg. (C) Preoperative ortopantomography of the patient. (D) Intraoperative picture showing mandibular defect. (E) Reconstruction with second osteocutaneous fibula free flap: the skin paddle has been de-hepitelized and used to provide cheek contour improvement. (F) Postoperative ortopantomography showing reconstruction with second fibula flap. (G) Postoperative results. (H) Preoperative picture of patient 4 treated for necrosis of a fibula free flap performed in another Hospital for reconstruction after oral cavity squamous cell carcinoma resection. (I) Postoperative results after second fibula free flap reconstruction.

The BESTest results are shown in Tables 3 and 4. The mean overall function score was 77.6%, and the results were poorest for section I. This was most obvious when the patient was asked to stand up over his fingers and push the examiner's hands. Sections V and VI had scores of 88% and 83%, respectively, indicating that the sensory balance and gait stability of the patients were compromised only minimally. Furthermore, we observed a correlation between better results and a younger age of patients, while worse results were expected in older patients.[19]

DISCUSSION

It is important to explore the impact of harvesting a bilateral fibula free flap on patient function and quality of life. Unfortunately, examining this issue remains challenging, since few patients undergo the procedure. Furthermore, to the best of our knowledge, few studies have explored this topic[20]; only 1 such study has been published previously. Prospective studies are challenging to perform in the case of rare events; thus, we referred to the retrospective design of Lin et al for this report. With such a design, it is not possible to compare pre- and postoperative patient function, which would be a better way to assess morbidity. On the contrary, a retrospective case-to-case comparison with a control group of healthy individuals is also not ideal, since this introduces too many biases related to control group selection and individual attitudes, particularly when characteristics such as balance and strength are considered, since these variables are based on personal experience, training, and sports practice.[21] For these reasons, we evaluated a series of patients using a subjective test based on quality of life and a functional test that assesses functional impairment via a validated scale.

The PES results were encouraging, with an overall mean score of 22.4 on a scale ranging from 0 to 24. Thus, the patients who underwent harvesting of a double fibula free flap did not perceive any major limitation in their quality of life, particularly in terms of pain, balance, and gait stability. Concerning the relatively lower score for restrictions in daily activities, it is important to note that younger patients had a higher score in this domain (4), while the older patients noted a score of 2, suggesting that age may have biased our results.[22] Older age may confer a limitation on daily activities, particularly in oncologic patients.[23]

The BESTest is considered to be among the most reliable functional tests, since it is the most comprehensive, including aspects from several different popular tests and thereby allowing for complete analysis of postural and balance issues in several rehabilitative fields.[24] The major disadvantage of the BESTest is the time required for completion (30 minutes), but considering the small cohort of patients that we included, this was not an issue in the present study. The BESTest results were encouraging in our patients; the mean overall score for residual function was 77.6%. However, the age of the patients could have affected the score in certain domains, especially strength, which could explain the

TABLE 2. Results of Point Evaluation System

No	Pain	Paresthesias/Numbness	Walking Ability	Restriction in Activities	Gait Alteration	Cosmetic Appearance/Wound Problem	Total
1	4	4	3	2	4	4	21
2	4	4	4	4	4	4	24
3	4	4	4	4	4	3	23
4	4	4	3	2	4	4	21
5	4	4	4	2	4	4	22

TABLE 3. BESTest Results

No	Section I x/15	Section II x/21	Section III x/18	Section IV x/18	Section V x/15	Section VI x/21	Total	Total, %
1	8	18	11	13	14	15	79	73.10
2	14	17	17	18	13	20	99	91.60
3	9	16	18	16	14	20	93	86.11
4	9	12	14	12	13	14	74	68.51
5	9	15	12	8	12	18	74	68.51

TABLE 4. BESTest Results: Percentage Conversion and Related Morbidity Assessment

No	Section I x%/100%	Section II x%/100%	Section III x%/100%	Section IV x%/100%	Section V x%/100%	Section VI x%/100%	Total, %
1	53.3	85.71	61.11	72.2	93.3	71.42	73.10
2	93.3	80.95	94.4	100	86.6	95.2	91.60
3	60	76.19	100	88.88	93.33	95.23	86.11
4	60	57	77.77	66.66	86.66	66.66	68.51
5	60	71	66.66	44	80	85.71	68.51
Mean in %	65.32	74.17	80	74.35	88	83	77.60
Morbidity	34.68	25.83	20	25.65	12	17	22.40

variation seen between the scores of the 2 younger patients versus the other 3 patients in this series. These data should be evaluated with consideration of the small cohort of patients; however, the outcomes were satisfactory considering that the most impaired domains were those related to "fine" functions (section I: Biomechanical Constraints), while "daily" functions (sections V and VI: Sensory Orientation and Stability in Gait) were less impaired, with scores of 88% and 83%, respectively. These data should be considered along with the optimal results of the subjective PES, which together support the conclusion that the final outcomes of these patients were more than acceptable.

Additional studies, featuring a multicentric design, would be useful to confirm our results.

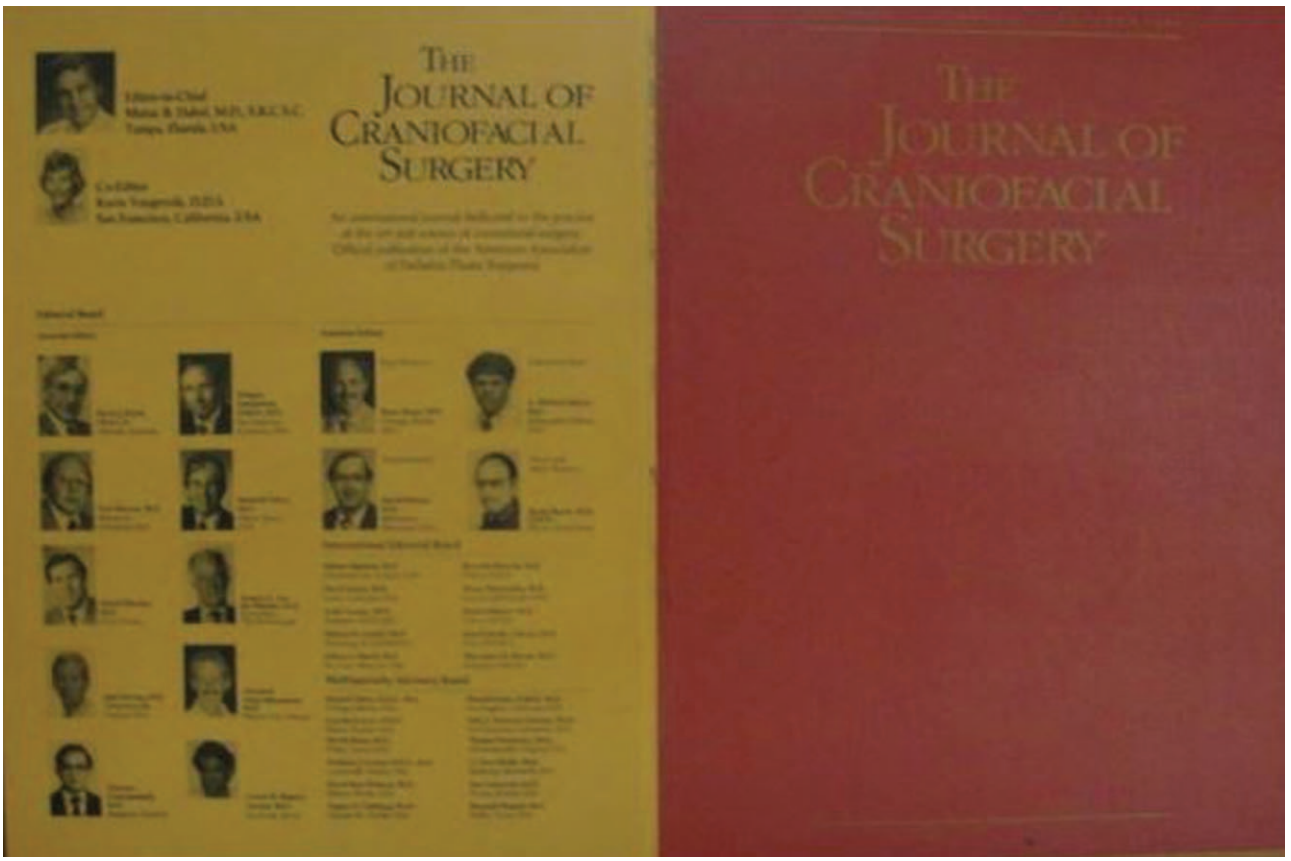
CONCLUSION

The results obtained in this study for the PES and BESTest confirm that bilateral harvesting of the fibula free flap is not associated with an increase in long-term morbidity and does not lead to significant functional impairments. Therefore, this procedure should be considered safe and can be performed without concern regarding morbidity, when bone reconstruction with a fibula free flap is indicated.

REFERENCES

1. Wei FC, Seah CS, Tsai YC, et al. Fibula osteoseptocutaneous flap for reconstruction of composite mandibular defects. *Plast Reconstr Surg* 1994;93:294–304
2. Peled M, El-Naaj IA, Lipin Y. The use of free fibular flap for functional mandibular reconstruction. *J Oral Maxillofac Surg* 2005;63: 220–224
3. Ferrari S, Bianchi B, Savi A, et al. Fibula free flap with endosseous implants for reconstructing a resected mandible in bisphosphonate osteonecrosis. *J Oral Maxillofac Surg* 2008;66:999–1003
4. Marchetti C, Bianchi A, Mazzoni S, et al. Oromandibular reconstruction using a fibula osteocutaneous free flap: four different "preplating" techniques. *Plast Reconstr Surg* 2006;118:643–651
5. Baj A, Lovecchio N, Bolzoni A, et al. Stair ascent and descent in assessing donor-site morbidity following osteocutaneous free fibula transfer: A preliminary study. *Journal of Oral Maxillofacial Surgery* 2015;73:184–193
6. Feuvrier D, Sagawa Y, Beliard S, et al. Long-term donor-site morbidity after vascularized free fibula flap har-vesting: clinical and gait analysis. *J Plast Reconstr Aesthet Surg* 2015;69:262–269
7. Farhadi J, Valderrabano V, Kunz C, et al. Free fibula donor-site morbidity: clinical and biomechanical analysis. *Ann Plast Surg* 2007;58:405–410
8. Chou SW, Liao HT, Yazar S, et al. Assessment of fibula osteoseptocutaneo us flap donor site morbidity using balance and gait test. *J Orthop Res* 2009;27:555–560
9. Hadouiri N, Decavel P, Feuvrier D, et al. Donor-site morbidity after vascularized free flap fibula: gait analysis during prolonged walk condition. *Int J Oral Maxillofac Surg* 2018;47:309–315
10. Bodde EW, de Visser E, Duysens JE, et al. Donor site morbidity after free vascularized autogenous fibular transfer: subjective and quantitative analyses. *Plast Reconstr Surg* 2003;111:2237–2242
11. Rendenbach C, Rashad A, Hansen L, et al. Functional donor site morbidity longer than one year after fibula free flap: a prospective biomechanical analysis. *Microsurgery* 2018;38:395–401

12. Lin JY, Djohan R, Dobryansky M, et al. Assessment of donor-site morbidity using balance and gait tests after bilateral fibula osteoseptocutaneous free flap transfer. *Ann Plast Surg* 2009;62:246–251
13. Andrades P, Bohannon IA, Baranano CF, et al. Indications and outcomes of double free flaps in head and neck reconstruction. *Microsurgery* 2009;29:171–177
14. Balasubramanian D, Thankappan K, Kuriakose MA, et al. Reconstructive indications of simultaneous double free flaps in the head and neck: a case series and literature review. *Microsurgery* 2012;32:423–430
15. Cicciù M. Real opportunity for the present and a forward step for the future of bone tissue engineering. *J Craniofac Surg* 2017;28:592–593
16. Cicciù M, Cervino G, Herford AS, et al. Facial bone reconstruction using both marine or non-marine bone substitutes: evaluation of current outcomes in a systematic literature review. *Mar Drugs* 2018:16pii: E27
17. Enneking WF, Dunham W, Gebhardt MC, et al. A system for the functional evaluation of reconstructive procedures after surgical treatment of tumors of the musculoskeletal system. *Clin Orthop Relat Res* 1991;286:241–246
18. Horak FB, Wrisley DM, Frank J. The balance evaluation systems tests (BESTest) to differentiate balance deficits. *Phys Ther* 2009;89:484–498
19. Prieto TE, Myklebust JB, Hoffmann RG, et al. Measures of postural steadiness: difference between healthy young and elderly adults. *IEEE Trans Biomed Eng* 1996;43:956–966
20. Ferrari S, Copelli C, Bianchi B, et al. Free flaps in elderly patients: outcomes and complications in head and neck reconstruction after oncological resection. *J Craniomaxillofac Surg* 2013;41: 167–171
21. Chiari L, Rocchi L, Cappello A. Stabilometric parameters are affected by anthropometry and foot placement. *Clin Biomech* 2002;17:666–677
22. Winter DA. Human balance and posture control during standing and walking. *Gait Posture* 1995;3:193–214
23. Alexander NB. Postural control in older adults. *J Am Geriatr Soc* 1994;42:93–108
24. Mancini M, Horak FB. The relevance of clinical balance assessment tools to differentiate balance deficits. *Eur J Phys Rehabil Med* 2010;46:239–248



Volume one, number one.