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Facial symmetry after free fibula flap mandibular reconstruction: An observational study

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Abstract:

Mandibular reconstruction with a free fibula flap restores function, but objective outcome assessment remains limited. Therefore, it is of interest to evaluate the facial symmetry and patient satisfaction in five patients over 6 months. AI-assisted 3D anthropometry and FACE-Q showed satisfactory facial symmetry and high patient satisfaction. Digital anthropometry provided an objective and practical method for post-operative assessment. Thus, data shows the accessible AI-assisted 3D evaluation after mandibular reconstruction.

Key-words: Mandibular reconstruction, free fibula flap (FFF), digital anthropometry, facial symmetry, FACE-Q, quality of life

Background:

Segmental mandibular defects following benign tumour resection, malignancy, trauma and other causes can majorly affect facial contour, occlusion, mastication, speech and even social confidence, which ultimately take a toll on the psychological well-being of the patient [1]. Since its introduction by Dr. John Hidalgo, the free fibula flap for mandibular reconstruction has become a versatile and reliable option because of the availability of adequate vascularised bone length for the flap, the possibility of multiple osteotomies and its capability to support later implant-supported dental rehabilitation [2]. Though contemporary series and previous literature report high flap reliability, successful reconstruction should not be judged by flap survival alone - restoration of pre-surgery form and function with patient satisfaction after surgery should also be an objective, which is less frequently quantified [3]. Conventional clinical assessment of facial symmetry is often subjective and depends on surgeon perception; on the other hand, aesthetic discrepancy in the facial region affects the psychosocial status of the patients [4]. Digital anthropometry is a method for quantifying symmetry from standardized facial photographs and complementing it with freely available three-dimensional photography applications allow a better standardised result. Patient-reported outcome measures are equally important because a technically accurate reconstruction may still be associated with dissatisfaction, social avoidance, or functional limitations. FACE-Q Head and Neck Cancer were developed to capture appearance, function, quality of life and experience of care from the patient perspective [5]. Therefore, it is of interest to report to assess facial symmetry and aesthetic outcome after mandibular reconstruction with a free fibula flap and to correlate these findings with patient satisfaction and quality of life.

Materials and Methods:

This observational pilot study included five patients who underwent mandibular reconstruction with a free fibula flap

performed by a single experienced surgeon, treated in the Department of Oral and Maxillofacial Surgery.

Inclusion criteria:

Patients who underwent mandibular reconstruction using a free fibula flap, had available pre-operative and post-operative 3D facial photographs, completed 1-, 3- and 6-month follow-up and consented for FACE-Q Head and Neck Cancer scales assessment.

Exclusion criteria:

Patients with incomplete follow-up, poor-quality 3D photographs, recurrent disease during the study period, secondary revision surgery before 6 months, or inability to complete FACE-Q Head and Neck Cancer scales. Pre-operative and post-operative facial assessment was performed using standardized 3D facial photography. Post-operative 3D photographs were recorded at intervals of 1 month, 3 months and 6 months after surgery to evaluate changes in facial symmetry and aesthetic outcome over time. Digital anthropometric analysis was performed on the 3D facial images using facial landmarks to assess midline deviation, lower facial height proportion and gonial angle symmetry. A freely accessible AI-assisted smartphone 3D photography application with digital analysis tools was used as a practical tool for image-based landmark identification, facial symmetry evaluation and objective post-operative comparison. All AI-generated landmarks and measurements were verified manually to ensure clinical accuracy. Patient-reported outcomes were assessed at the same follow-up intervals using relevant FACE-Q Head and Neck Cancer scales, focusing on satisfaction with facial appearance and psychosocial well-being. Serial changes from baseline to 1, 3 and 6 months were recorded, while the 6-month values were used as the primary post-operative endpoint for summary analysis. Descriptive analysis was performed to explore trends between objective anthropometric measurements and patient-reported outcomes. Owing to the pilot nature of the study and

small sample size, inferential statistical testing was not performed.

Results:

Five patients who underwent free fibula flap mandibular reconstruction were evaluated using serial 3D facial photography and digital anthropometric analysis (**Figure 1**). Pre-operatively, all patients demonstrated variable degrees of lower facial asymmetry, with midline deviation ranging from 6.5 to 9.0 mm and gonial angle discrepancy ranging from 13° to 18° due to pathologic findings. Progressive improvement was observed at the 1-month, 3-month and 6-month post-operative intervals. At 6 months, the mean facial midline deviation was 2.4 ± 0.6 mm, with values ranging from 1.6 to 3.4 mm. Four patients showed midline deviation within the clinically acceptable 2- to 3-mm range. A single patient showed a slightly higher deviation of 3.4 mm, associated with mild residual gonial contour discrepancy; however, overall facial balance remained acceptable. At the 6-month interval, lower facial height ratios ranged between 0.94 and 1.08, suggesting preservation of vertical facial proportion. Gonial angle discrepancy ranged from 3° to 8°, with a mean

value of 5.6 ± 1.8°. FACE-Q Head and Neck Cancer scale scores ranged from 72 to 88, while psychosocial well-being scores ranged from 70 to 86. The patient with greater objective asymmetry reported comparatively lower FACE-Q scores, but these remained within an acceptable satisfaction range. Overall, serial assessment demonstrated gradual improvement from 1 month to 6 months, likely due to resolution of post-operative edema, soft-tissue settling and adaptation of the reconstructed mandibular contour. A summary of the 6-month post-operative findings is given in **Table 1**. These findings support the use of serial 3D photography, digital anthropometry and FACE-Q Head and Neck Cancer scale assessment as a realistic and reproducible framework for post-operative evaluation after free fibula flap mandibular reconstruction. An exploratory trend was observed whereby patients with greater residual facial asymmetry tended to report lower FACE-Q satisfaction scores; however, because of the limited sample size, no definitive statistical conclusions could be drawn. Serial digital anthropometric and FACE-Q findings for the five patients are presented in **Table 2**.

Table 1: Summary of 6-Month post-operative findings

Parameter	Mean ± SD	Range	Clinical Interpretation
Midline deviation	2.4 ± 0.6 mm	1.6–3.4 mm	Mild residual deviation; acceptable overall
Lower facial height ratio	1.00 ± 0.05	0.94–1.08	Vertical facial balance maintained
Gonial angle discrepancy	5.6 ± 1.8°	3–8°	Mild residual gonial asymmetry
FACE-Q satisfaction with face	81.2 ± 6.2	72–88	High patient satisfaction
FACE-Q psychosocial well-being	79.2 ± 6.2	70–86	Improved psychosocial outcome

Table 2: Serial Digital Anthropometric and FACE-Q findings in five free fibula flap reconstructed patients

Patient	Defect/Reconstruction Site	Time Point	Midline Deviation (mm)
P1	Lateral mandibular defect	Pre-operative	7.8
		1 month	2.4
		3 months	1.9
		6 months	1.6
P2	Segmental body defect	Pre-operative	6.5

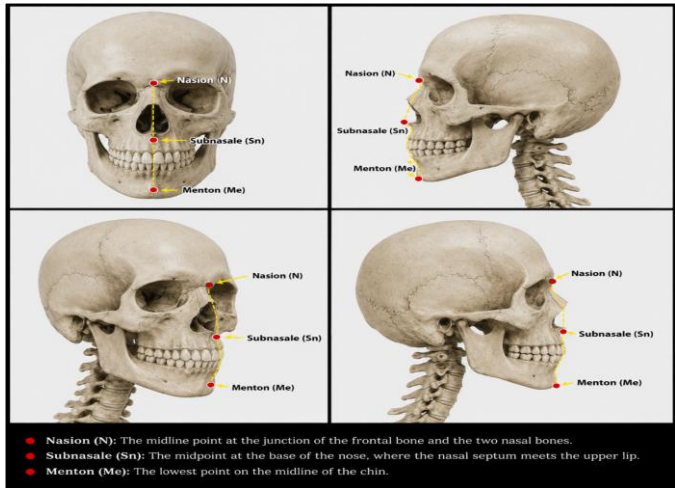


Figure 1: Facial anthropometric landmarks for digital facial analysis after mandibular reconstruction

Discussion:

The free fibula flap is widely regarded as the gold standard for mandibular reconstruction because it provides vascularized bone, permits multiple osteotomies and supports future implant rehabilitation. Although flap survival remains an important indicator of success, restoration of facial symmetry, mandibular contour and patient-reported quality of life has become equally important in evaluating reconstructive outcomes. In this pilot study, facial symmetry progressively improved during the 6-month follow-up. Mean midline deviation at 6 months was 2.4 ± 0.6 mm, lower facial height remained within acceptable limits and residual gonial angle asymmetry was minimal, indicating satisfactory restoration of facial balance. Similar improvements in post-operative facial appearance and quality of life have been reported following fibula flap reconstruction, although minor residual asymmetry may persist because of soft-tissue adaptation and post-operative remodeling [6, 7]. Patient-reported outcomes complement objective clinical assessment by reflecting satisfaction with appearance and psychosocial recovery. In the present study, FACE-Q scores demonstrated high levels of patient satisfaction despite mild residual asymmetry, suggesting that overall facial harmony may have greater influence on perceived outcomes than complete anatomical symmetry. These findings agree with previous

studies validating the FACE-Q Head and Neck Cancer module as a reliable measure of patient-centered outcomes following head and neck reconstruction [8]. An important strength of this study was the integration of digital anthropometry with patient-reported outcome assessment. Three-dimensional facial photography enables objective, reproducible measurement of facial landmarks while reducing observer bias, making it a valuable adjunct to conventional clinical evaluation [9]. Furthermore, recent developments in artificial intelligence have enabled automated landmark identification and symmetry analysis, improving measurement consistency and facilitating serial post-operative comparisons [10]. Integration of AI with virtual surgical planning and three-dimensional imaging may further optimize fibular segment positioning and improve prediction of post-operative facial contours, although further clinical validation is required before routine implementation [11, 12]. This study has several limitations, including the small sample size, single-center design and relatively short follow-up period. Potential confounding factors such as defect characteristics, soft-tissue loss, dental rehabilitation, osteotomy number and adjuvant therapy were not evaluated separately [13]. Larger prospective studies with standardized imaging protocols, blinded assessments and longer follow-up are required to validate these findings and establish the relationship between objective facial symmetry and patient-reported quality of life after free fibula flap mandibular reconstruction [14].

Conclusion:

Digital anthropometry combined with FACE-Q provided a practical and patient-centered evaluation of free fibula flap mandibular reconstruction. Most patients achieved satisfactory facial symmetry, mandibular contour and high post-operative satisfaction. Further large-scale studies are needed to validate AI-assisted assessment and its relationship with long-term quality of life.

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Ethics and consent: Written informed consent was obtained.

AI Assistance statement:

AI-assisted language editing and formatting support was used. The author reviewed and approved all scientific content and remains responsible for the manuscript.

Ethics statement:

The study involved non-invasive observational assessment of patients undergoing routine post-operative follow-up after mandibular reconstruction. No experimental intervention was performed and all data were collected as part of standard clinical care. Written informed consent was obtained from all participants for participation and publication. Patient anonymity was preserved throughout the study.

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