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## Implant Dental Rehabilitation of Fibula-Free Flap Reconstructed Jaws

Emanuele Zavattero, MD, PhD,\* Guglielmo Ramieri, MD, DDS,\* Giovanni Agnò, DDS,† Massimo Fasolis, MD,\* Paolo Garzino-Demo, MD,\* and Claudia Borbon, MD\*

**Background:** The possibility of placing dental fixtures in the reconstructed regions allows us to overcome the problems related to dental rehabilitation with removable prosthesis. The aim of this study was to assess the clinic-radiological outcome in a series of patients who underwent fibula flap jaws reconstruction and rehabilitation with implant-supported prosthesis with a minimum follow-up of 24 months.

**Material and Methods:** The study included 10 patients who underwent reconstruction with fibula free flap between 2010 and 2018. Albrektsson criteria were used to define the implant survival. The follow-up evaluation was performed according to a standardized protocol including clinical examination, radiological evaluation (panoramic radiograph) and patient interview.

**Results:** A total of 45 implants were positioned.

The time between mandibular reconstruction and implant placement ranged from 13 months to 39 months.

The prosthesis used was fixed in 6 cases and supported overdenture in 4 cases.

No implant failure was observed.

Regarding implant survival no infections were observed in these series. Nine patients out of 10 had no pain and signs of mobility. Seven patients out of 10 had absence of peri-implant radiolucency at the panoramic radiograph.

One patient presented with an overgrowth of granulomatous soft tissue around the implant abutments that caused pain.

**Conclusions:** Implant placed in vascularized bone grafts are a safe and reliable opportunity to rehabilitate patients following mandibular resection. The results of this series demonstrate a high survival rate for implants placed in reconstructed mandibles with an improvement of the quality of life.

**Key Words:** Dental rehabilitation, fibula free flap, implants, jaw reconstruction

Maxillo-mandibular defects due to tumor resection, infection or trauma have both functional and aesthetic consequences and accurate reconstruction is still a challenge for the maxillofacial surgeons. A successful mandibular reconstruction includes a healed wound, restoration of facial contours, facilitation of speech, swallowing and breathing.

The vascularized free fibula flap is often the first choice for jaws defects restoration, because of the shape and quality of bone suitable for three-dimensional reconstruction.<sup>1–3</sup>

Dental restoration following reconstruction should be the goal for every patient.

The feasibility of placing dental fixtures in the reconstructed bone allow us to overcome the difficulty related to dental rehabilitation with removable prosthesis.

Although the efficacy and long-term safety of osseointegrated implants has been described in the general population, their outcomes in the reconstructed patients remain not completely clear.<sup>4</sup>

The purpose of this retrospective case-series was to assess the clinic-radiological results of patients who underwent jaws

From the \*Maxillofacial Unit, Surgical Science Department, City of Health and Science University Hospital; and †Division of Oral Surgery, San Luigi Gonzaga Hospital, University of Torino, Italy.

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Address correspondence and reprint requests to Claudia Borbon, MD, Maxillofacial Unit, Surgical Science Department, Città della Salute e della Scienza University Hospital, University of Torino, Torino, Italy; E-mail: cla.borbon@gmail.com

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reconstruction with fibula flap and rehabilitation with implant-retained prosthesis with a minimum follow-up of 24 months.

## MATERIALS AND METHODS

The charts of patients who underwent reconstruction with fibula flap between 2010 and 2018 at the Division of Maxillofacial Surgery, City of Health and Science Hospital, Torino, Italy, were analyzed. Data concerning demographics, diagnosis, surgical features, treatment modalities, dentition, implant use and rehabilitation were obtained through a retrospective review.

The time of analysis was from the reconstruction date to the date of last follow-up.

We adopted the Albrektsson criteria were adopted to define the implant survival: absence of persistent pain, absence of mobility, absence of infection and absence of continuous peri-implant radiolucency.<sup>5</sup>

Implant failure was defined as implant removal.

Standardized protocol was used during the follow-up examination. Clinical examination, radiological evaluation (panoramic radiograph) and patient interview were performed by a dentist and maxillofacial surgeons.

Radiographic findings was obtained with panoramic radiograph taken pre-operatively, immediately after implant surgery, at the time of prosthetic rehabilitation and annually thereafter.

The questionnaire submitted to patients regards the problems concerning: nutrition, satisfaction about dental prosthesis, quality of life, and aesthetic perception.

This study was conducted according to the Declaration of Helsinki. The study do not required IRB approval because it in a retrospective case-series.

## RESULTS

Ten patients treated for malignant and benign tumors were reconstructed using fibula free flap and 45 implants were placed.

The age of the patients at the time of surgery ranged from 31 to 75 years, the mean age was 56-year.

Information concerning the patients' characteristics and the indications for reconstructions are reported in Supplementary Digital Content, Table 1, <http://links.lww.com/SCS/B665>.

Five patients underwent resection and reconstruction for malignant tumors, 5 patients for benign tumors of fibrous dysplasia and one patient for bone resorption. Seven patients out of 10 underwent surgery for mandibular reconstruction and 3 patients underwent maxilla reconstruction.

All patients were reconstructed using fibula free flap; single segment in 6 patients, double segments in 3 patients, and 3 segments in 1 patient.

In 3 cases distraction was used after primary reconstruction to implement the bone volume.

Two patients received radiotherapy in the head and neck area before the implant placement, with irradiation doses ranging from 50 to 65 Gy.

In all cases the microvascular reconstruction was carried out at the same time of the resection (primary reconstruction).

A total of 45 implants were placed. The inclusion criteria for the patients selected as implants candidates were as follows: favorable prognosis after tumor resection based on grading and staging, good residual tongue and salivary function, absence of systemic disease that could compromise osseointegration, sufficient bone quantity and bone quality, absence of untreatable soft tissue abnormalities, good oral hygiene and favorable relationship between the mandible and the maxilla.

The time elapsed between bone reconstruction and implant placement ranged from 13 months to 39 months. Corrective pre-implant

surgery was required in 4 cases: thinning of the skin or muscle islands in 2 cases and creation of the buccal sulcus in 2 cases.

The prosthesis used was fixed in 6 cases and supported over-denture in 4 cases.

The minimum follow-up period was 24 months.

No implant failure was observed.

Regarding implant survival no infections were observed in these series. Nine patients out of 9 had no pain and signs of mobility. Seven patients out of 10 had absence of peri-implant radiolucency at the panoramic radiograph (Supplementary Digital Content, Table 2, <http://links.lww.com/SCS/B666>).

One patient presented with an overgrowth of granulomatous soft tissue around the implant abutments that caused pain. In this case, the tissue was surgically removed.

Function and aesthetic outcomes are reported in Supplementary Digital Content, Table 3, <http://links.lww.com/SCS/B667>.

## DISCUSSION

The primary aim of oral cancer is to resect the tumors with safe margins and to reconstruct the surgical defect. However, improving the functional and morphological outcomes is still a challenge for the maxillofacial surgeons.<sup>6</sup>

Traditional prostheses generally do not give the same results in terms of prosthetic retention of osseointegrated implants.

In the literature, there are many papers of implant rehabilitation after reconstruction of the jaws which are mostly case series.

Anyway, comprehensive analyses of the complete surgical process in a single center is mandatory in order to assess the accuracy of the treatment plan and in order to improve the efficacy.<sup>7-9</sup>

In this paper, we retrospectively evaluated our experience with implant rehabilitation in 10 patients who underwent fibula reconstruction for upper or lower jaw defect between 2010 and 2018.

The number of patients who complete the whole rehabilitation procedure is almost always low, due to the poor-related prognosis and due to the complexity of the defect.

Many variables should be taken in to account assess outcomes of osseointegrated implants in oncology patients, for example the need for adjuvant radiotherapy.<sup>10,11</sup>

The high quality of the cortical bone makes the fibula flap a good choice for implant-supported prosthetic rehabilitation as has already been demonstrated by many papers in the literature.

The most complex cases to rehabilitate are the partial resections in which a residual dentition on the other side is still present.

In these patients, despite successful reconstruction, a relevant bone gap at the graft-to-residual stump level may be present.<sup>10-18</sup>

Recently, the availability of Computer-assisted surgery has improved the quality of prosthetically guided outcomes of the microvascular reconstruction.<sup>5,21</sup>

Most studies published in the literature on implant-related outcomes report only survival rates.

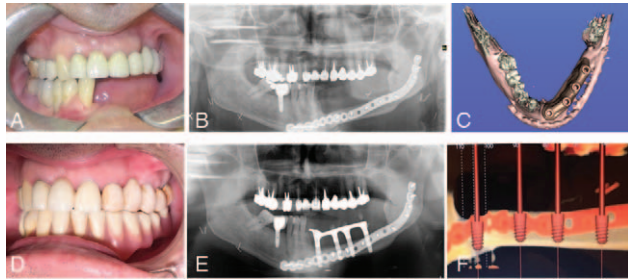
Survival rates have been reported to be 88% to 100% in reconstructed patients as shown in Supplementary Digital Content, Table 2, <http://links.lww.com/SCS/B666>.

Our data show a high survival rate, similar to Ferrari et al even if the primary bias is the small sample.<sup>10</sup>

One of the main parameters to consider that affects the success or failure of osseointegration is the timing of implant placement.

This issue is widely discussed and there is no scientific evidence for the optimal implant placement time until now. Usually, dental implants are placed after a delay of 6 months after radiotherapy, but it is still unknown whether longer delays are beneficial. In our Division, we perform implant insertion at least 12 to 24 months after the end of radiation treatment.

Our implant survival rate in irradiated patients was similar than in patients who underwent surgery alone.<sup>17,18</sup>



**FIGURE 1.** A. Pre-operative view after tumor resection and reconstruction using fibula free flap; B. Pre-operative orthopantomograph showing fibula reconstruction; C. Surgical template; D. Overdenture prosthesis; E. Post-operative radiographic view; F. Superimposition between planning and post-operative result.

Panoramic radiography is commonly used as a follow-up investigation in patients undergoing bone reconstructions.

It provides a wide observation of the maxillo-mandibular complex in a single film. Limitations of panoramic radiography are mainly related to the high distortion, two-dimensional view and the demand of previous training and knowledge to the magnification factor to avoid mistakes when measuring bone dimensions.

These limits make difficult to estimate the real implants success for patients reconstructed with fibula free flap.

As in other papers also in this report peri-implant bone was quantified based on panoramic radiographs.<sup>19,20</sup>

The most relevant problem in these patients is the large amount of soft tissue inflammation around the implants. We found hyperplastic overgrowth or mucositis in 2 patients.

This overgrown tissue is probably due to the absence of firmly attached and keratinized mucosa around the implants and because the prosthetic structure causes major difficulties in managing peri-implant hygiene.<sup>22,23</sup>

No correlation between implants design and gingival hyperplasia is evident in our experience, due to the small sample size in relation to the different types of implants positioned.

In this series good functional and morphological results were obtained, in terms of speech, deglutition and facial appearance as reported in Supplementary Digital Content, Table 3, <http://links.lww.com/SCS/B667>.

Figure 1 shows implant rehabilitation after mandibular reconstruction with fibula flap.

Implant placed in vascularized bone grafts are a safe and reliable opportunity to rehabilitate patients following mandibular resection.<sup>24,25</sup> The results of this series, according to other,<sup>7,22,23</sup> demonstrate a high survival rate for implants placed in reconstructed mandibles and an important improvement of the quality of life.

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