

**Title:** Outcome and Complications Following Free Fibula Reconstruction for Oncologic Defects of the Extremities

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**Background:** Following tumor resection, reconstructive surgeons are often left with large composite bone and soft tissue defects in a physiological poor host. In order to achieve limb salvage and provide the patient with a functional extremity, vascularized bone transfer, namely free fibula transfer, has become the work-horse for reconstruction. In the traumatic setting the use of these flaps has been reliable, however, due to the various host factors the use of vascularized bone transfer has associated with a high complication rate following oncological reconstruction.

**Purpose:** The aim of this study was to review our institution's experience with the use of free fibula reconstruction following an oncological resection in the extremities affecting 1) overall survivorship, 2) disease specific survival, both local recurrence and distant disease, 3) union of the fibula and 4) postoperative complications including limb salvage.

**Methods:** We retrospectively reviewed the records of 64 cases of free fibula transfer performed for limb salvage following an oncological resection from 1992 and 2013. Pertinent demographics as well as information regarding the surgical procedure and disease status at latest follow-up were reviewed. Disease free survival and overall survival were estimated using Kaplan Meier method. The cohort consisted of 35 males and 29 females; with a mean age at surgery of 21 years (5-60 yrs) and a mean follow-up of 7 yrs (range 1-17 yrs). 59% of the tumors were located in the lower extremity.

**Results:** The overall 2-, 5-, 10- and 15-year survival was 98%, 87%, 74% and 74%. In an analysis of risk factors for mortality, failure of limb salvage and tumor recurrence was associated with a worse overall survival (Table 1). In regards to disease specific survival, the overall 2-, 5-, and 10-year survival was 84%, 74%, 66% and 49%. No analyzed factor was associated with a worse disease specific survival.

In regards to union of the fibula graft, first time union was observed in 75% of cases at a mean time to union of 10 months (range 5-35 mo). 25% of patients required an additional autologous bone grafting procedure. The overall union rate was 98%, with only 1 patient requiring a revision of the fibula graft with a new free vascularized bone graft. Patients undergoing chemotherapy following the free-fibula graft were more likely (OR 3.3,  $P=0.09$ ) and patients with a spanning locking plate construct were less likely (OR 0.54,  $P=0.30$ ) to need an additional bone grafting procedure, however this was not significant.

The overall rate of limb salvage was 94%, with 4 patients requiring an amputation for local tumor recurrence ( $n=3$ ) and infection ( $n=1$ ). In addition to these amputations, postoperative complications occurred in 22 patients. These complications included infection ( $n=5$ ), nerve palsy ( $n=3$ ) and compartment syndrome ( $n=2$ ).

**Conclusion:** The free-fibula is considered the work horse vascularized bone graft for extremity reconstruction in limb-salvage surgery. In the oncological setting a repeat bone grafting procedure was common, and likely related to the patient undergoing chemotherapy, however following this procedure the fibula reliably heals. In addition to this we advocated to supplement the fibula fixation with a spanning locking plate, as the added stability may increase the first time union rates.

Table 1: Factors Associated with Development of Disease Recurrence and Overall Survival

| Patient Factors         | Disease Specific Survival<br>Hazard Ratio (95% CI) | P Value | Overall Survival<br>Hazard Ratio (95% CI) | P Value           |
|-------------------------|--|---------|---|-------------------|
| <b>Age</b>              |  |         |   |                   |
| ≤ 40 Years              | 0.71 (0.25-2.53)                                   | 0.57    | 0.68 (0.16-4.56)                          | 0.64              |
| > 40 Years              | 1.39 (0.39-3.89)                                   | 0.57    | 1.46 (0.21-5.92)                          | 0.64              |
| Male Gender             | 1.09 (0.43-2.86)                                   | 0.85    | 0.86 (0.23-3.10)                          | 0.81              |
| Upper Extremity Tumor   | 0.72 (0.24-1.88)                                   | 0.51    | 0.78 (0.16-2.83)                          | 0.72              |
| Lower Extremity Tumor   | 1.38 (0.53-4.05)                                   | 0.51    | 1.27 (0.35-5.90)                          | 0.72              |
| Failure of Limb Salvage | -  | -       | <b>6.58 (1.40-23.96)</b>                  | <b>0.02</b>       |
| Tumor Recurrence        | -  | -       | <b>26.40 (4.92-487.89)</b>                | <b>&lt;0.0001</b> |

Figure 1:

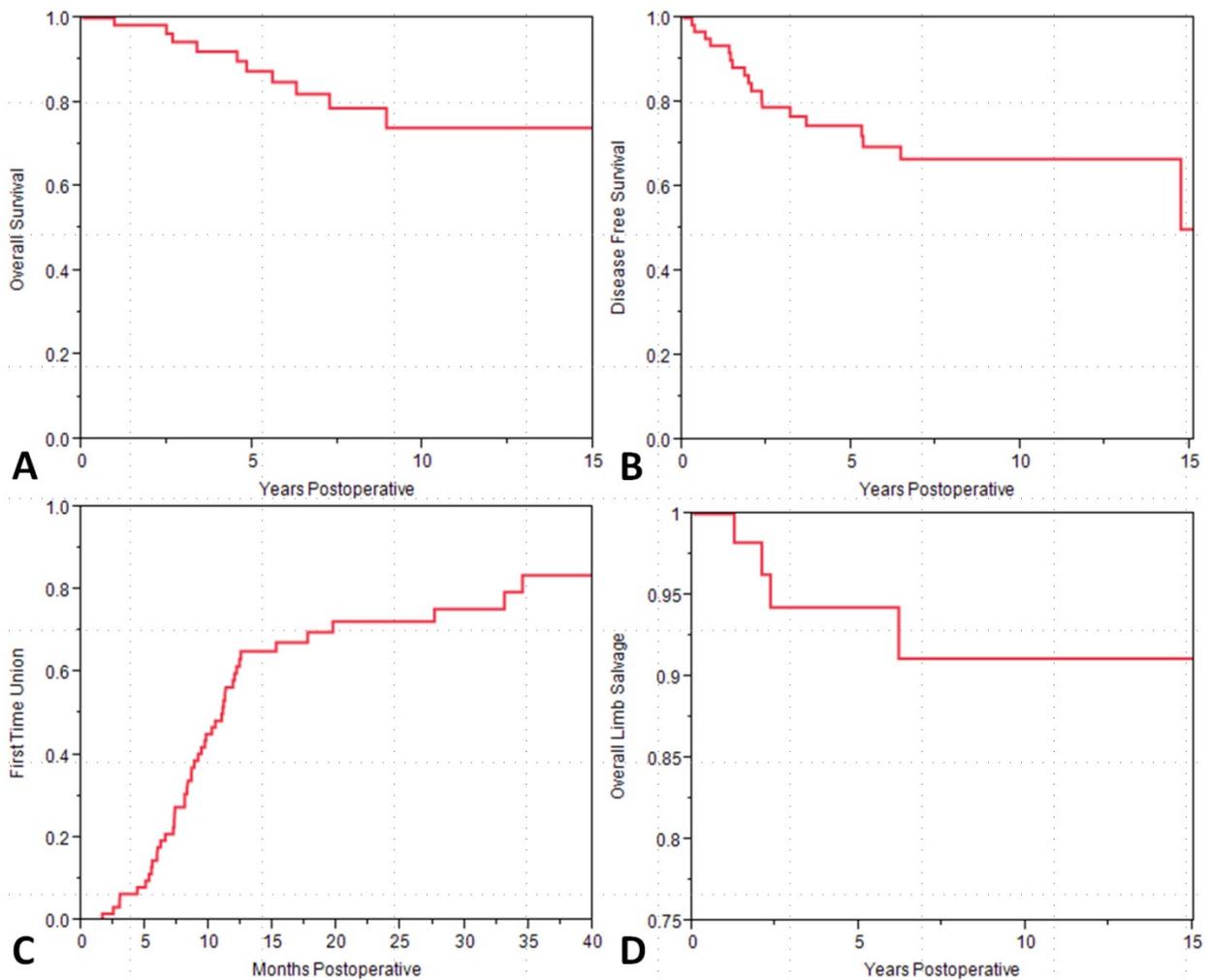


Figure 1: Kaplan-Meier survival curves for overall (A) and disease free (B) survival. First-time union was seen in 75% of patients, with an overall limb salvage rate of 94% following free-fibula grafting for extremity reconstruction in the setting of limb salvage.

Figure 1: Kaplan Meir Survival Curves for Disease Free- and Overall Survival

