

# Stair Ascent and Descent in Assessing Donor-Site Morbidity Following Osteocutaneous Free Fibula Transfer: A Preliminary Study

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**Purpose:** The aim of this study was to investigate gait kinematic parameters during stair ascent and descent after fibula free flap removal for facial reconstruction.

**Materials and Methods:** Eight patients who underwent facial reconstruction with fibula free flap removal ascended and descended 3 standard steps. Their movements were recorded by a motion analyzer; gait kinematic parameters were obtained and compared with those calculated in 8 control subjects.

**Results:** Stride time, percentage of swing, and support phases did not differ among healthy and operated limbs and control subjects (Kruskal-Wallis,  $P > .05$ ). No significant differences were found for hip and knee movements, pelvis rotation and tilt, and body center of mass displacements. During stair descent, the patients had significantly larger pelvis inclinations than the control subjects ( $P < .05$ ).

**Conclusions:** No functional limitations during stair performance were found. The only significant difference could indicate a minor control of the pelvis and should be used to define specific rehabilitative interventions.

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Removal of the fibula free flap (FFF) is one of the methods used for reconstructing mandibular, maxillary, and segmental long bone defects.<sup>1-7</sup> The flap is very versatile, as it can be harvested with only bone tissue or in association with muscular and skin

components. Since the first description of FFF removal for long bone reconstruction,<sup>1</sup> it has been successfully used for composite bone and soft tissue defects of the oral cavity.<sup>6,7</sup> This flap combines several advantages: a bone segment of good length can be

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harvested with a vascular pedicle of adequate length and diameter, the surgical approach is easy, and the fibula can be shaped as necessary with osteotomies, with a resulting 3-dimensional reconstruction well mimicking the original anatomy.<sup>2,3,6</sup>

Additionally, the resulting bone thickness is adequate to position osteointegrated implants for subsequent dental prosthetic rehabilitation, and the donor and recipient sites are at sufficient distance to permit the concomitant work of 2 teams, thus reducing surgical time.<sup>2,3,8,9</sup>

Nonetheless, possible donor-site functional morbidity should be attentively considered, together with the advantages of facial bone reconstruction. Indeed, various lower limb muscles insert on the fibula, and their detachment or partial withdrawal during FFF harvest can cause leg and foot dysfunction.

Over the past 20 years, several investigations have reported data on donor-site functional morbidity after FFF removal. Knee and ankle stability,<sup>10</sup> the tibiotalar angle, and ankle joint deformity and range of motion (RoM) have been studied.<sup>11</sup> Moreover, gait kinematic characteristics (stride length, cadence, speed, single and double support time, ankle angle) have been investigated under various experimental conditions, even including additional cognitive and visual demands to better assess daily tasks.<sup>4,10-14</sup>

In general, no significant differences have been observed when the donor side was compared with the contralateral side,<sup>13</sup> the preintervention radiographic images,<sup>11</sup> a healthy control group,<sup>10,12</sup> and after normalization with anthropometric values.<sup>4</sup> Additionally, no differences in mediolateral compartment strength,<sup>10</sup> the force of the peroneus longus and extensor hallucis longus muscles,<sup>15</sup> the moment of force and power in dorsal and plantar flexion,<sup>16</sup> and the power output in knee and ankle flexion-extension<sup>13</sup> have been found.

In particular, following the directions of the British Medical Research Council,<sup>17</sup> no decrease in performance was found by therapists in the lower limb muscles.<sup>13</sup> Among others, Agarwal et al<sup>11</sup> examined walking on heels and on a slope (20°), together with hopping performance, but no studies have evaluated the morbidity of the donor site in a typical action of daily life: stair ascent and descent.

Most previous studies in which donor-site morbidity was considered low or absent were made using questionnaires or clinical subjective evaluations.<sup>12,18-22</sup> Whenever possible, clinical data should be supported by quantitative instrumental evaluations, allowing an objective assessment of the cost/benefit ratio.

Thus, the aim of the present preliminary study was to investigate gait kinematic parameters and the displacement of the body center of mass (CoM) during the ascent and descent of 3 standard steps. A pilot

group of patients who had defects of the oral cavity reconstructed by using FFF removal was compared with a control group matched for age and anthropometric characteristics.

The determination of quantitative measurements during the various walking phases could permit better evaluation of motor performance, providing some insight into the possible adaptation or osteo-arthromuscle limits of subjects who undergo FFF harvesting. In particular, evidence-based indications could be suggested to physicians and physiotherapists to improve the rehabilitation program.

## Materials and Methods

### SURGICAL APPROACH

The surgical approach used in the present group of patients was devised by our surgical team and previously published.<sup>6,7</sup> In brief, presurgical lower limb angiography and ultrasound or angiography of the recipient vessels was performed in all patients. An osteoseptocutaneous FFF was harvested in each patient, taking care to include only minimal muscle cuffs around the fibula, thus maintaining periosteal circulation.

Two fibular osteotomies, one proximal and one distal, were made; for both epiphyses, about 6 cm of bone was preserved to retain knee and ankle joint stability and to conserve the common peroneal nerve. Additionally, the nerve for the flexor hallucis longus muscle was disjoined from flap pedicle vessels and preserved.

Subsequently, to preserve hallucis function, the flexor hallucis longus muscle was sutured to the tibialis posterior muscle and to the remaining interosseous membrane with proper tension. When only bone tissue or a little skin paddle were harvested, the skin wound was primarily closed.

In all patients, the donor site was treated with a semi-rigid compressive medication for 2 weeks. One or 2 weeks after surgery, all patients started rehabilitation with a physiotherapist, following a general program without specific indications for the fibular deficit.

### PATIENTS

Between 2005 and 2011, 22 patients underwent reconstruction of the mandibular or maxillary region with FFF in the Department of Maxillofacial Surgery at the Policlinico Hospital of Milan and Galeazzi Institute of Milan.

Eight of these patients (36% of the initial group) agreed to participate in this study (Table 1). At the time of data collection, all participants walked independently and without walking aids. The remaining patients were excluded because of refusal to

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