Journal of Plastic, Reconstructive & Aesthetic Surgery (2014) 67, 986–991

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

The effect of flexor hallucis longus harvest on hallux function: A retrospective cross-sectional cohort study

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Received 29 May 2013; accepted 8 March 2014

KEYWORDS
Free fibula flap;
Donor site morbidity;
Flexor hallucis longus;
Hallux function;
Microsurgery

Summary *Background and aim:* Our aim was to evaluate the long-term morbidity of the hallux function after harvesting a free fibula flap. Special attention was given to the differences between patients who underwent the dissection of an osteo-cutaneous flap (without inclusion of the flexor hallucis longus (FHL) muscle) and patients who were treated with an osteo-myo-cutaneous (with inclusion of the FHL muscle).
Methods: During the period 1995–2009, 167 patients underwent an autologous mandible reconstruction using a free fibula flap. By the time of our investigation, 64 patients were deceased, 29 patients were lost to follow-up, 14 patients did not meet the inclusion criteria and 28 patients were unable or unwilling to come to the hospital. Thus, 32 patients were examined in this study. Combined flexion strength of the hallux flexors and range of motion (ROM) of the metatarsophalangeal (MTP) and interphalangeal (IP) joints were measured.
Results: Hallux flexion strength tests showed a significant decrease in strength in the operated leg versus control, 28 ± 16.6 versus 37 ± 19.2 N/s ($p = 0.003$). The ROM for the MTP was significantly lower for the donor leg than for the control leg: $26 \pm 12^\circ$ versus $30 \pm 10^\circ$ ($p = 0.024$) for plantar flexion and $30 \pm 13^\circ$ versus $37 \pm 11^\circ$ ($p < 0.001$) for dorsal flexion. In addition, the ROM for plantar flexion in the IP joint was significantly lower in the donor group. No significant differences were found when comparing reduction of flexion strength or reduction of ROM in the osteo-cutaneous versus osteo-myo-cutaneous harvest.
Conclusions: The main conclusion to be drawn from our results is that free fibula flap donor site morbidity in terms of hallux function is independent of the inclusion or exclusion of the FHL muscle in the flap.

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http://dx.doi.org/10.1016/j.bjps.2014.03.005

Level of evidence III: Retrospective cohort or comparative study; case—control study; or systematic review of these studies.

Introduction

Since its first description by Ueba and Fujikawa in 1973,[1] the free fibula osteo-fascio-cutaneous flap has become very popular as a source for vascularized bone and skin. Originally developed for extremity reconstruction, the fibula flap is now widely used in various other clinical applications including reconstruction of the mandible.[2,3]

The fibula is the strongest and the longest bone available for vascularized transfer.[4] Up to 30 cm of bone can be harvested, and a large skin island, measuring up to 30 × 15 cm, can be included. To add bulk, the flexor hallucis longus (FHL) muscle and part of the posterior tibial and soleus muscles can be included in the flap. The vascularized fibula can take multiple osteotomies without losing its vascularity and provides an adequate base for osteo-integrated implants.[5] The donor site in the lower leg facilitates a two-team approach in most cases and thus operating time can be reduced.

In addition to the advantages mentioned above, the fibula flap appears to have relatively low donor site morbidity. Most reported donor site complications are described as mild or temporary and include the following: pain, sensory disturbances, the feeling of ankle instability, an inability to run, muscle weakness and flexion contracture of the great toe.[6,7]

There are several studies describing the donor leg morbidity after removal of osseous and osteo-cutaneous fibula flaps, but the effect of FHL harvest on remaining function is unknown. Therefore, the aim of this study was to assess functional characteristics of the donor site after dissection of a free fibula flap with or without inclusion of the FHL muscle.

After harvesting of the osteo-myo-cutaneous fibula flap, reduced flexion strength of the hallux is expected. Flexion contracture of the hallux and/or reduced range of motion (ROM) are expected to occur more often after harvesting of the osteo-cutaneous fibula flap, due to devascularization of the FHL muscle, thus creating fibrosis or even ischaemic contracture.

Patients and methods

This is a retrospective cohort study in patients who underwent an autologous mandible reconstruction using a free osteo-cutaneous (without FHL) or a free osteo-myo-cutaneous fibula flap (with FHL).

Between 1995 and 2009, at the Department of Plastic and Reconstructive Surgery of the VU University Medical Centre in Amsterdam, both methods were used. Incentives for inclusion of the FHL muscle in the flap were easier dissection of the free flap, enhanced flow and protection of bone[8] and vascular pedicle.

Patients who underwent an autologous mandible reconstruction using a free osteo-cutaneous (without inclusion of the FHL muscle) or a free osteo-myo-cutaneous fibula flap (with inclusion of the FHL muscle) between 1995 and 2009 were included.

Exclusion criteria were as follows: an affliction of the contralateral leg (earlier operations, earlier trauma of the leg), diabetic neuropathy or neurological disorders of the extremities.

Minimum follow-up time was 12 months. Informed consent was obtained from all participating subjects. All flap harvests and reconstructions were performed under the direction of a single surgeon (H. A. H. Winters, MD, PhD).

Surgical technique

The differences in surgical technique between the two groups are limited. When the FHL muscle was left in situ, a small muscle cuff consisting of FHL and posterior tibial muscle was left around the vascular pedicle and raised with the flap. Innervation of the FHL was left intact. When the FHL was included in the flap, only the motor nerve was transected because no vascular branches run from the posterior tibial vessels to the FHL. Distally, the FHL was transected at the level of the distal fibular osteotomy. Proximally, the FHL rarely reaches beyond the level of the proximal osteotomy, necessitating no further dissection.

Functional assessments

All included patients were evaluated by a single treatment-blinded observer. Combined flexion strength of the hallux flexors and the ROM of the metatarsophalangeal (MTP) and interphalangeal (IP) joints were measured. The combined flexion strength of the hallux flexors was measured using MicroFET2® (Salt Lake City, UT 84104). The MicroFET2® handheld dynamometer is a portable 'force evaluating and testing' system. This system makes it possible to receive objective and quantitative data of muscular strength.[9,10] Although instrumented muscular strength tests are generally reliable and valid, there is no specific information on methodological quality to measure the power of the hallux flexors. The measurement was standardized by fixing the ankle at a 90° angle and isolating hallux flexion by strapping the foot to our custom MicroFET system (Figure 1). The strength of the hallux flexors was calculated as the average of three attempts (after 0 min, 1 min and 2 min). Bilateral leg testing allowed comparison between the donor leg and the un-operated (control) leg for each subject.

The ROM of both the MTP joint and IP joint (flexion, extension) was measured using a goniometer with a resolution of 1° (Figure 2). The average of three measurements was recorded and compared with three measurements of the ROM of the contralateral, unaffected leg.