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Treatment of compound tibia fracture with microvascular latissimus dorsi flap and the Ilizarov technique: A cross-sectional study of long-term outcomes[☆]

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KEYWORDS

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Latissimus dorsi;
Muscle flap;
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Ilizarov;
Distraction osteogenesis

Summary *Background:* Extensive compound tibial fractures present reconstructive challenges. The present study aimed to assess the outcomes of microvascular latissimus dorsi (LD) flap combined with the Ilizarov technique for extensive compound tibial fractures with bone loss and bone healing complications.

Methods: Patient records were reviewed retrospectively. The Lower Extremity Functional Scale (LEFS), the Disabilities of the Arm, Hand and Shoulder (DASH), and the 15D health-related quality of life (HRQoL) instrument were applied.

Results: Between 1989 and 2014, 16 patients underwent reconstruction with a microvascular LD flap and bone transport (11/16) or late bone lengthening (5/16). The mean clinical follow-up time was 6.6 (standard deviation (SD): 6.5) years. Three patients had minor complications requiring reoperation. Partial necrosis of one flap required late flap reconstruction in one case. Late bone grafting was used to enhance union in eight of 16 cases. The mean new bone gain was 3.8 cm (SD: 2.5).

Overall, 11 patients completed the questionnaires in a mean of 22.3 years (SD: 2.4) after surgery. The main findings revealed a relatively good function of the reconstructed limb and good shoulder function. The mean HRQoL was comparable to that of an age-standardized sample of the general population.

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Conclusion: Segmental tibia transport and lengthening to correct limb length discrepancy do not compromise the microvascular muscle flap. Combined microvascular LD flap reconstruction and the Ilizarov technique can be used in treating acute compound tibial defects, pseudoarthrosis, and osteitis, all associated with significant amputation risk. Fair long-term functional outcomes and HRQoL are achieved when these combined techniques are used.

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Introduction

Compound tibia fracture with significant zone of injury or sequelae of bone healing complications can be managed with complex methods including the Ilizarov technique of distraction osteogenesis,^{1,2} the Masquelet technique,³ or vascular bone transfers, such as the iliac crest and fibula.⁴ In cases of extensive soft-tissue loss, local or pedicled muscle flaps or free flaps may be indicated.⁵ Tibia lengthening by distraction osteogenesis may also be used to correct posttraumatic limb length discrepancy.^{6,7}

In 1989, Gavril Ilizarov introduced his technique of distraction osteogenesis.^{8,9} In this technique, the bone is stabilized with an external fixator and corticotomy is performed outside the fracture site, thereby enabling formation of new bone through distraction. Free muscle flap transfer combined with the Ilizarov technique to reconstruct lower-extremity compound defects has been previously described.^{1,10}

There are several reports concerning assessment of the long-term outcomes of these combined techniques; however, only a few have focused on the long-term outcomes assessed by patient-reported outcome measures. In the present study, the microvascular LD flap and distraction osteogenesis was used in limb salvage of acute tibial defects with large zones of injury due to combined absolute bone defect and soft-tissue loss. This technique has also proven reliable in treating prolonged sequelae of complications including osteomyelitis and pseudoarthrosis with impaired bone blood circulation. An additional indication for external tibia distraction has been correction of late traumatic limb length discrepancy after microvascular flap reconstruction.

The present study aimed to assess the reliability of this combined method and to report the long-term outcomes of all patients with traumatic acute or chronic compound tibia defect treated with microvascular LD flap reconstruction and the Ilizarov distraction osteogenesis (either bone transport or lengthening) in the authors' institution between 1989 and 2014.

Patients and methods

The study was approved by the Ethics Committee of the Helsinki University Hospital. Patients were identified from the hospital records, and their patient records were retrospectively reviewed. Patients with femoral reconstruction, intramedullary distraction osteogenesis, fracture

stabilization with external fixation only, and soft-tissue reconstruction other than LD were excluded. The results were reported following the STROBE¹¹ guidelines for cross-sectional studies.

Outcome measures

Shoulder function was examined by the main section of the Finnish version¹² of the Disabilities of the Arm, Shoulder and Hand¹³ (DASH) questionnaire. It comprises 30 questions (physical activities, 23 questions; symptoms, seven questions). The DASH rewards a total score between 0 and 100 points.¹³

The function of the reconstructed limb was assessed by the Finnish version¹⁴ of the Lower Extremity Functional Scale¹⁵ (LEFS). It contains 20 function-related questions. The total score ranges between 0 and 80, with higher scores representing better functional ability.

HRQoL was measured by the 15D¹⁶ questionnaire. It is a comprehensive, 15-dimensional HRQoL instrument that compares positively with other analogous, generic HRQoL instruments.^{16–19} Incorporating population-based preference weights into the dimensions yields a single index score that ranges from 0 (equivalent to being dead) to 1 (best possible HRQoL). A difference ≥ 0.015 in the 15D score is estimated to be clinically important.²⁰ The authors hypothesized that the patients enjoy a HRQoL comparable to that of an age-standardized general population.

The level of physical activity was assessed by the frequency intensity time (FIT) index.²¹ The index is obtained by multiplying the scores of each question together, yielding a score between 0 and 100 (the higher the score, the greater the physical activity).

Finally, a questionnaire designed for the study charted comorbidities and the use of analgesics. A written informed consent was obtained from the patients participating in the cross-sectional assessment with patient-reported outcome measures.

Statistical analysis

Results are obtained as means with SD, medians, or ranges. HRQoL results of the patients were compared with those of an age-standardized sample of the general Finnish population ($n = 2413$) obtained from the Health 2011 Survey.²² The statistical significance of the differences between patients and the general population was compared using the independent samples *t*-test. A significance level was set at

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