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Research Paper
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Feasibility of the vascularized fibula bone graft for reconstruction of the mandible: a cadaveric study

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Abstract. The aim of this study was to assess the feasibility of the unilateral single-barrel vascularized fibula bone graft (VFBG) for the restoration of mandibular defects. Eighty-one dry mandibles and fibulas were used. Each mandible was marked to measure the total mandible length (TML) and maximum defect length (MDL) for each type of defect (HCH, H, L, C, HC, LC, LCL, HCL; Boyd's classification and angle to angle). The fibula length (FL) was measured. The maximum vascularized fibula length (MVFL) was calculated as FL – 12 (cm). The feasibility of the unilateral single-barrel VFBG to reconstruct the mandible for each type of defect was determined from the MVFL:MDL ratio. Descriptive statistics, the Student's *t*-test, and Pearson's correlation coefficient were used for the statistical analysis; significance was set at $P < 0.05$. Average TML, FL, and MVFL were 30.82 ± 1.96 cm, 31.75 ± 2.23 cm, and 19.75 ± 2.23 cm, respectively. The average MVFL:MDL ratios of HCH, LCL, and HCL were all <1. There was a significant positive correlation between TML and FL ($r = 0.48$, $P < 0.01$). The unilateral single-barrel VFBG alone is not feasible for the reconstruction of a near-total or total mandibular defect.

Key words: vascularized fibula bone graft; mandibular defect; cadaveric study.

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Microvascular bone grafts are commonly used in oral and maxillofacial reconstruction to reduce the risk of bone graft resorption, and have the potential to restore defects with a long span and to simultaneously restore bone and soft tissue defects.[1–3] The vascularized fibula bone graft (VFBG) is the most common vascularized bone graft used in oral and maxillofacial surgery. There are several advantages to the VFBG, such as (1) bicortical structures that can support primary stability of dental implants; (2) large diameter and long vascular pedicles that promote successful anastomosis; (3) thin and pliable skin paddle with or without a muscular cuff that can be used to restore intraoral and/or extraoral soft tissue defects; (4) low incidence of donor site morbidity; (5) a two-team approach saves operation time.[1,4,5]

Mandibular defects can be restored with a unilateral VFBG using either a single-barrel or double-barrel technique. The single-barrel technique is the most commonly used. The fibula has been reported to have sufficient length (20–26 cm in adults) and volume to allow it to be used to restore a total or subtotal mandibular defect if the single-barrel technique is used.[3,6–8] However, it is not clear whether the VFBG alone can restore a near-total or total mandibular defect or not. Moreover, the relationship between the fibula length and mandibular defect remains unclear. The aim of this study was to assess the feasibility of the unilateral single-barrel VFBG to reconstruct the mandible and to determine the relationship between total mandible length (TML) and fibula length (FL).

Materials and methods

The dry mandibles and fibulas of 81 cadavers were included in the study. The cadavers were obtained from the Department of Anatomy of Khon Kaen University in Thailand. Inclusion criteria were the following: (1) the bone had to be derived from cadavers aged >18 years; (2) the mandible had to contain at least one incisor (31 or 41) and present a canine or first premolar on each side; (3) the bone had to be unbroken. Details of the sex and age of the cadavers were collected from the medical records. The measurements of mandibles and fibulas were performed by a single person using a standard Vernier caliper. The distance from A to D on each side of the mandible was measured and calculated for each type of maximum defect length (MDL) using Boyd's classification of mandibular defects.[9] The angle to angle mandibular defect type (Ag–Ag) was introduced by the authors and also measured apart from Boyd's classification. The MDLs of LCL and HCL defect types represent near-total mandibular defects, while the MDL of HCH represents a total mandibular defect. Details of the marking and measurement of the dry mandibles are shown in Fig. 1.

The fibula length was measured from the highest point of the fibula head laterally to the highest point of lateral malleolus, by a single person. The individual average fibula length was calculated from both sides of the fibula. The maximum vascularized fibula length (MVFL) was calculated by subtracting 12 cm from the measurement (Fig. 2).

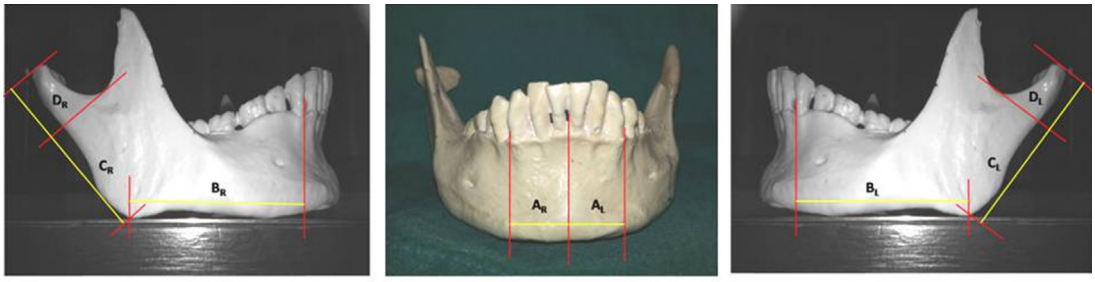
The ratio of the MVFL to each type of MDL was calculated and used to determine the feasibility of using the unilateral single-barrel fibula graft to reconstruct the mandible, with a ratio >1 indicating a feasible result. The number of samples for which the MVFL was greater than or equal to each type of MDL was determined. Descriptive statistics were used for age, sex, fibula length, MVFL, and MDL. The comparison of TML and MVFL between males and females was analyzed by Student's *t*-test. The relationship between TML and fibula length was performed using Pearson's correlation coefficient. Significance was set at $P < 0.05$.

Results

Of a total of 81 cadavers, 58 were male and 23 were female. The average (±standard deviation) age was 63.35 ± 16.66 years (range 25–92 years), 62.03 ± 16.82 years for males and 66.05 ± 16.11 years for females. The average TML, fibula length, MVFL, and other parameters are shown in Table 1. Fibula length ranged from 26.50 cm to 36.90 cm, with an average length of 31.75 cm.

Table 2 shows average MVFL:MDL ratios for each defect type, as well as the range and the number of samples in which the ratio was >1. For the L and C defect types, the ratios were all >1, while for LCL, HCL, and HCH, the ratios were all <1.

Males had significantly higher mean TML and MVFL values compared to



Defect type	Measurement of MDL
HCH (TML)	$D_R + C_R + B_R + A_R + A_L + B_L + C_L + D_L$
Angle to angle	$B_R + A_R + A_L + B_L$
H_R	$D_R + C_R + B_R + A_R$
H_L	$A_L + B_L + C_L + D_L$
C	$A_R + A_L$
L_R	$C_R + B_R + A_R$
L_L	$A_L + B_L + C_L$

Defect type	Measurement of MDL
HC_R	$D_R + C_R + B_R + A_R + A_L$
HC_L	$A_R + A_L + B_L + C_L + D_L$
LC_R	$C_R + B_R + A_R + A_L$
LC_L	$A_R + A_L + B_L + C_L$
LCL	$C_R + B_R + A_R + A_L + B_L + C_L$
HLC_R	$D_R + C_R + B_R + A_R + A_L$
HLC_L	$A_R + A_L + B_L + C_L + D_L$

Note: Subscript characters: R = right side; L = left side
MDL = Maximum defect length

Fig. 1. Measurement of the maximum defect length (MDL) in each mandibular defect type.