Anatomical Considerations of the Thai Fibula Used as a Fibula Osteocutaneous Free Flap in Mandibular Reconstruction and Dental Implant Placement

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Objective: *Although the fibula osteocutaneous free flap has many proven advantages in restoring mandibular defects, the dimension of available fibula is one of its limitations. The present study aimed to investigate the suitability of dimensions and the quality of harvested fibulae for mandibular reconstruction and dental implant placement in Thais.*
Material and Method: *One hundred fourteen fibulae of 57 adult Thai cadavers were dissected. Total fibular length and the length of harvested fibula were measured. Dimensions of the fibula cross sections available for dental implant placement were recorded. Additionally, the cortical bone thickness and densities of cortical and spongy bones of 60 fibulae were assayed using cone beam computed tomography scan images.*
Results: *Mean total fibular length and mean length of harvested fibulae were 34.2 ± 2.3 cm and 18.2 ± 2.3 cm, respectively. A dental implant length of 7 to 10 mm could be placed in the fibula. The mean cortical bone thickness was 2.2 ± 0.6 mm. The mean densities of the cortical and spongy bones were 614.4 ± 148.8 HU and -600.6 ± 228.7 HU, respectively.*
Conclusion: *The present study suggests that, in Thais, a harvested fibula of 16 to 20 cm in length is sufficient to provide bone for reconstructing defected mandible and the dental implant placement is 7 to 10 mm in length. The mean cortical and spongy bone densities of fibula are less than that of the mandible in previous reports. The result supports the clinical experience using the fibula as donor site for the mandibular reconstruction and dental implant placement.*

Keywords: *Fibula, Mandibular reconstruction, Fibula osteocutaneous free flap, Dental implant*

J Med Assoc Thai 2012; 95 (4): 561-8
Full text. e-Journal: *http://www.jmat.mat.or.th*

The mandible is a major skeletal component of the human facial appearance and plays an important role in orofacial function and aesthetics, being a platform for the dentition[1,2]. The mandibular resection resulting from treatment of malignant tumors, aggressive odontogenic tumors, or trauma can cause extensive composite defects including bone, oral lining mucosa, muscles, and teeth, with a significant decrease in the patient quality of life[3]. Previously, limitations of nonvascularized bone grafts and alloplastic materials mitigated satisfactory functional reconstruction[4]. Currently, composite fibular vascularized flaps can provide sufficient amounts of bone and adequate soft tissue for functional reconstruction of a continuity defect of the mandible[5,6].

The fibula osteocutaneous free flap has been used extensively as a donor site for mandibular reconstruction since Taylor et al[7] first used the fibula to reconstruct two tibial defects. In 1989, Hidalgo was the first to use a vascularized fibular flap for functional reconstruction with 100% of osseous survival in 13 patients[8]. To date, the fibula osteocutaneous free flap is considered to be the bony flap of choice for the mandibular reconstruction because of an available length of a bicortical segment of bone, a long vascular pedicle, large-diameter blood vessels, good bone quality, the ability to contour the bone with multiple osteotomies, and the ability to incorporate osseointegrated dental implants[9-11].

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According to Choi et al[12] approximately 25 to 28 cm of fibula in Caucasians can be harvested while preserving 6 to 8 cm of bone both proximally and distally to maintain the integrity of the knee and ankle joints. Furthermore, the donor site has low morbidity and the anatomic locations allow a two-team approach. However, one of its disadvantages is the limited volume of the fibula for the mandibular reconstruction and the placement of dental implants.

For preoperative planning of the dental implant placement in mandible, precise evaluation of bone dimensions and morphology is important[13]. For example, the size of the selected implant depends on the height and width of available bone. However, up to now, few studies have addressed the anatomical considerations of the fibula for the mandibular reconstruction and the dental implant placement[3,12]. Particularly, there is no published data regarding the fibular harvesting volume and its application for dental implants in Thais. The present study aimed to investigate the available dimensions and the quality of bone harvested from the fibula for the mandibular reconstruction and dental implant placement in a Thai population sample.

Material and Method

The experimental protocols of the present investigation were approved by the Ethics Committee of the Siriraj Institutional Review Board (SIRB) Protocol No. 184/2554 (Exempt), Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.

Subjects

One hundred fourteen fibulae dissected from 57 adult formalin-embalmed Thai cadavers were investigated in the present study. These subjects had been partially dissected in the gross anatomy laboratory by medical students at the Department of Anatomy of the Faculty of Medicine Siriraj Hospital, Mahidol University.

Dimension of the fibula for the mandibular reconstruction

A total length of the fibula was measured from the fibular head to the lateral malleous. Since the lengths of 8 cm from the proximal end and 8 cm from the distal end of the fibula were left to protect the peroneal nerve, the knee and ankle joints, respectively[12], the length of the harvested fibula was the total length of the bone minus 16 cm (Fig. 1).

Dimension and quality of the fibula for the dental implant placement

Generally, a dental implant has an outer diameter of 3.75 mm and a length of 7.0, 8.5, 10.0, 13.0, 15.0, or 20.0 mm. Therefore, a minimum width of 6 mm and a minimum height of 8 mm were chosen to allow for 1 mm of surrounding bone.

To assay the dimensions of the fibula available for the dental implant placement, the height measurements were taken in the cross-sections at the upper, middle, and lower parts of the total fibula. By placing the posterior surface of the fibula to face the inferior border of the mandible, two distances were measured: the L1 (the height from the posterior and the anterior surfaces of the fibula), and the L2 (the height from the posterior surface to the point at the width of 6 mm) (Fig. 2)[12].

L1 and L2 were measured using vernier calipers (Mitutoyo®, Japan) capable of measuring to

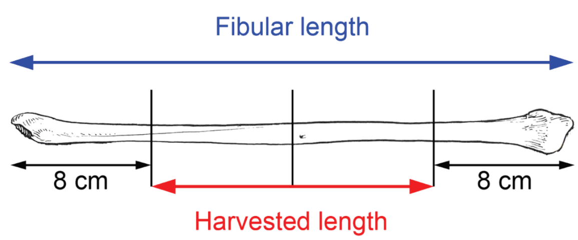

Fig. 1 Posterior surface of a fibula showing the measurements of the total fibular length and the length of harvested fibula

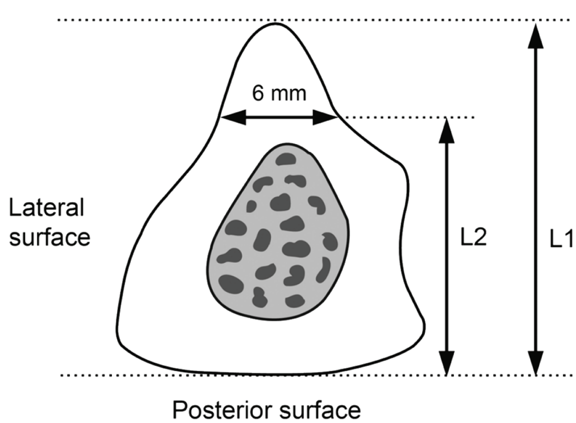

Fig. 2 Orientation and measurements of a cross-section of the fibula. L1: height from the posterior to the anterior surfaces. L2: height from the posterior surface to the point at the width of 6 mm (Adapted from Choi et al 2001)

the nearest 0.01 mm, while the total length of the fibula was measured using a measuring tape. To test the reproducibility of measurements, after the first measurement 20% of the fibula were randomly selected and re-measured. The differences between each measurement on the two occasions were determined by the paired t-test. No significant variation of measurements was found in the present study.

Additionally, the quality of the fibulae for dental implant placement was investigated. Sixty fibulae were selected from both sides of 15 males and 15 females in a criterion of no different mean age. Then, they were examined using cone-beam computed tomography (cone-beam CT) (CB MercuRay, Hitachi Medico Technology Corporation, Chiba-ken, Japan), operated at 120 kV and 15 mA with panoramic mode (FOV = 150 mm, voxel size of 0.029 mm). Then, the cross-sectional reconstructions were created by reformatting the axial cone-beam CT scans. The cortical bone thickness (mm) and the densities (Hounsfield Unit; HU) of the cortical and spongy bones of the upper, middle, and lower fibulae were measured using Infinitt software (Infinitt Healthcare, Seoul, Korea). The thickness and density of the cortical bone were measured at the midpoints of the anterior, medial, posterior, and lateral surfaces (areas 1-4) (Fig. 3). The density of the spongy bone was also measured at the center of the spongy bone (area 5) (Fig. 3).

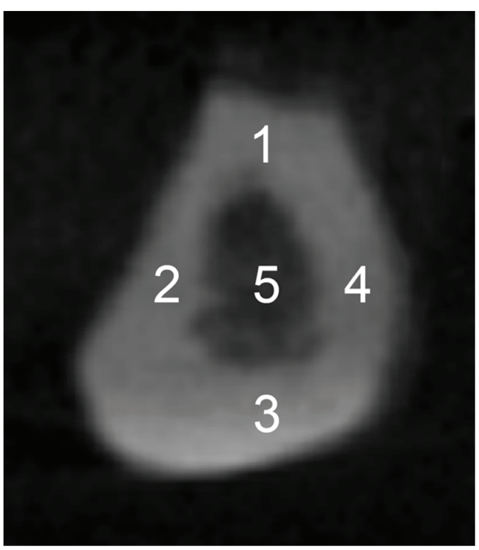

Fig. 3 Cone beam computed tomography images of a fibula showing the five measurement areas of the cortical bone thickness and density (areas 1-4), and the spongy bone density (area 5)

Statistical analysis

All measurements and frequencies of the data were tabulated and separated according to sex and side. Statistical Package for the Social Science (version 11.5) software (SPSS; Chicago, IL, USA) was used for data analysis. The mean, standard deviation (SD), and range of each measurement were assessed. The values of all measurements were compared between sides and sexes using the pair t-test and unpaired t-test, respectively. One-way ANOVA and the Scheffe's test were used for comparing three parts of the fibula. The Chi-square test was used to test for differences of frequency of data between sexes. Significant differences were determined at p-values of less than 0.05.

Results

Of 57 subjects, 29 were male and 28 were female. Subjects' ages ranged from 49 years to 96 years with a mean of 71.2 $\pm$ 10.2 years. No significant age difference was found between sexes ($p = 0.944$).

Dimension of the fibula for the mandibular reconstruction

The mean total fibular length was 34.2 $\pm$ 2.3 cm (range, 27.3-40.0 cm) and the mean length of harvested fibula was 18.2 $\pm$ 2.3 cm (range, 11.3-24.0 cm) (Table 1). Both the total length and length of harvested fibula were longer in males (35.6 $\pm$ 1.7 cm, 19.6 $\pm$ 1.7 cm) than in females (32.7 $\pm$ 1.8 cm, 16.7 $\pm$ 1.8 cm, respectively) (Table 1) ($p < 0.05$).

There was no difference in all measurements between sides (data not shown).

Dimension of the fibula for the dental implant placement

The cross-sectional shape of the fibula was triangular at the upper fibula, trapezoidal at the mid-fibula (Fig. 2, 3), and elliptical at the lower fibula. Mean heights of the fibular cross-sections, L1 and L2 were 13.9 $\pm$ 1.6 mm and 9.8 $\pm$ 1.9 mm, respectively (Table 1). The heights of the fibular cross-sections at L1 and L2 in male (14.2 $\pm$ 1.7 mm and 10.3 $\pm$ 1.9 mm, respectively) were longer than L1 and L2 in female (13.6 $\pm$ 1.4 mm and 9.2 $\pm$ 1.8 mm, respectively) (Table 1) ($p < 0.05$). In addition, L1 and L2 of the mid-fibula (14.6 $\pm$ 1.4 mm, 10.8 $\pm$ 1.8 mm) were longer than those of the upper fibula (13.6 $\pm$ 1.7 mm and 9.4 $\pm$ 2.0 mm, respectively) and lower fibula (13.6 $\pm$ 1.5 mm and 9.1 $\pm$ 1.6 mm, respectively) (Table 2) ($p < 0.05$).

The frequencies of the bone height sufficient for the implant lengths of 7, 8.5, 10, and 13 mm were

Table 1. The dimensions and qualities of the fibula and their comparisons between sexes

Measurement	Total			Male			Female		
	n	Mean ± SD	Range	n	Mean ± SD	Range	n	Mean ± SD	Range
Total length of fibula (cm)	114	34.2 ± 2.3	27.3-40.0	58	35.6 ± 1.7[a]	32.0-40.0	58	32.7 ± 1.8[a]	27.3-36.5
Length of harvested fibula (total length of fibula -16) (cm)	114	18.2 ± 2.3	11.3-24.0	58	19.6 ± 1.7[b]	16.3-24.0	58	16.7 ± 1.8[b]	11.3-20.5
L1 (mm)	341	13.9 ± 1.6	9.4-18.2	174	14.2 ± 1.7[c]	10.0-18.2	167	13.6 ± 1.4[c]	9.4-16.9
L2 (mm)	341	9.8 ± 1.9	5.2-14.8	174	10.3 ± 1.9[d]	6.3-14.6	167	9.2 ± 1.8[d]	5.2-14.8
Cortical bone thickness (mm)	180	2.2 ± 0.6	0.8-3.7	90	2.6 ± 0.5[e]	1.4-3.7	90	1.9 ± 0.6[e]	0.8-3.4
Cortical bone density (HU)	180	614.4 ± 148.8	266.5-962.0	90	611.6 ± 150.8	266.5-905.8	90	617.3 ± 147.5	353.8-962.0
Spongy bone density (HU)	180	(-600.6) ± 228.7	(-995.0)-(-107.0)	90	(-546.5) ± 237.4[f]	(-960.0)-(-107.0)	90	(-654.7) ± 207.3[f]	(-995.0)-(-139.0)

L1: Height from the posterior to the anterior surfaces of the fibular cross-section
L2: Height from the posterior surface to the point at the width of 6 mm of the fibular cross-section
[a-f] Significant differences between sexes which are indicated with the same alphabet ($p < 0.05$)

shown in Table 3. The present study showed the available fibular bone height could support implant lengths of 7, 8.5 and 10 mm in 28.2%, 24.9%, and 26.4% of the Thai bone samples, respectively (Table 3). Of total samples, 72.5% had a height less than 11 mm. Chi's square test indicated the significant difference of frequency of the available fibular bone height to support the dental implant between sexes ($p < 0.05$).

Quality of the fibula for the dental implant placement

Using CT scan images, the thickness and the density of the cortical and spongy bones were shown in Table 1. Mean cortical bone thickness was 2.2 ± 0.6 mm. Mean densities of the cortical and spongy bones were 614.4 ± 148.8 and -600.6 ± 228.7 HU, respectively. In comparison between sexes, the mean cortical bone thickness of male (2.6 ± 0.5 mm) was greater than that of female (1.9 ± 0.6 mm) ($p < 0.05$). The mean spongy bone density of male [(-546.5) ± 237.4 HU] was higher than that of female [(-654.7) ± 207.3 HU] ($p < 0.05$), but there was no significant difference between sex upon the cortical bone density (Table 1).

The cortical bone thickness as well as the cortical and spongy bone densities of the fibular cross-sections was measured at three different parts of the fibula as shown in Table 4. The cortical bone thickness of the mid-fibula (2.6 ± 0.6 mm) was greater than those of the upper fibula (2.0 ± 0.6 mm) and lower fibula (2.1 ± 0.6 mm). The cortical bone density of the lower fibula (747.9 ± 96.7 HU) was higher than those of the upper fibula (638.2 ± 91.3 HU) and mid-fibula (457.2 ± 74.9 HU) ($p < 0.05$). The spongy bone density of the lower fibula (-523.2 ± 221.7 HU) was higher than that of the mid-fibula (-672.9 ± 197.6 HU) ($p < 0.05$).

Discussion

The mandible is important for function and aesthetics. The loss of its continuity due to trauma or tumor resection causes considerable impairment of vital functions such as chewing, swallowing, speaking, and breathing[(14)]. Therefore, the mandibular reconstruction with a fibula osteocutaneous free flap and dental implantation is an elegant solution to restore the anatomic arch, oral function, and facial aesthetics[(15)].

The present study demonstrated adequate dimensions and density of the fibula for the mandibular reconstruction and the dental implant placement. The mean total fibular length of 34.2 ± 2.3 cm (range, 27.3-40.0 cm) was found in Thai specimens investigated in the present study, of which is shorter than the length of 35.8 ± 2.7 cm reported in a previous

Table 2. Height of the fibular cross-sections (mm) compared among three parts of the fibula

Parts of fibula	n	L1		L2	
		Mean $\pm$ SD	Range	Mean $\pm$ SD	Range
Upper fibula	114	13.6 ± 1.7^{a}	9.4-17.5	9.4 ± 2.0^{c}	5.2-14.8
Mid-fibula	114	$14.6 \pm 1.4^{a,b}$	11.3-18.2	$10.8 \pm 1.8^{c,d}$	6.0-14.6
Lower fibula	114	13.6 ± 1.5^{b}	10.1-17.8	9.1 ± 1.6^{d}	5.5-13.5
Total	342	13.9 ± 1.6	9.4-18.2	9.8 ± 1.9	5.2-14.8

L1: Height from the posterior to the anterior surfaces of the fibular cross-section
L2: Height from the posterior surface to the point at the width of 6 mm of the fibular cross-section
$^{a-d}$ Significant differences among three parts of the fibula which are indicated with the same alphabet ($p < 0.05$)

Table 3. Frequency of sufficient fibular bone height available (%) for placing the dental implant at the lengths of 7, 8.5, 10, and 13 mm

Implant length (mm)	Bone height (mm)	Frequency (%)		
		Total	Male	Female
	<8.00	66 (19.4%)	19 (5.6%)	47 (13.8%)
7	8.00-9.49	96 (28.2%)	47 (13.8%)	49 (14.4%)
8.5	9.50-10.99	85 (24.9%)	43 (12.6%)	42 (12.3%)
10	11.00-13.99	90 (26.4%)	62 (18.2%)	28 (8.2%)
13	14.00-15.99	4 (1.2%)	3 (0.9%)	1 (0.3%)
	Total	341 (100%)	174 (51.0%)	167 (49.0%)

Frequency of bone height versus sex; $X^2 = 25.644$, $p < 0.05$

Table 4. Cortical bone thickness (mm) and bone density (HU) of the fibular cross-sections compared among three parts of the fibula

Parts of fibula	Cortical bone thickness (mm)			Cortical bone density (HU)			Spongy bone density (HU)		
	n	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range
Upper fibula	60	2.0 ± 0.6^{a}	0.9-3.4	60	638.2 ± 91.3^{c}	472.8-788.0	60	$(-605.8) \pm 243.1$	(-995.0)-(-137.0)
Mid-fibula	60	$2.6 \pm 0.6^{a,b}$	0.8-3.7	60	457.2 ± 74.9^{c}	266.5-685.0	60	$(-672.9) \pm 197.6^{d}$	(-971.5)-(-268.5)
Lower fibula	60	2.1 ± 0.6^{b}	0.8-3.0	60	747.9 ± 96.7^{c}	506.8-962.0	60	$(-523.2) \pm 221.7^{d}$	(-901.0)-(-107.0)
Total	180	2.2 ± 0.6	0.8-3.7	180	614.4 ± 148.8	266.5-920.0	180	$(-600.6) \pm 228.7$	(-995.0)-(-107.0)

$^{a-d}$ Significant difference among three parts of the fibula which are indicated with the same alphabet ($p < 0.05$)

study[16]. In consideration of sex, the total length of 35.6 $\pm$ 1.7 cm and 32.7 $\pm$ 1.8 cm were found in Thai males and females, respectively, of which is similar to the lengths of 35.4 $\pm$ 1.8 cm and 31.33 $\pm$ 1.5 cm found in Korean males and females, respectively[12]. Significantly, the total length of the fibula in males was greater than that in females. This is probably because, on average, men are taller than women.

To maintain the integrity of the knee and ankle joints, 8 cm both proximally and distally of the fibula should be preserved. The length of harvested fibula in Thais ranged 11.3-24.0 cm found in the present study is wider range than 15-20 cm in the study of Koreans[12], but the obtained mean length of 18.2 $\pm$ 2.3 cm is shorter than 22.2 $\pm$ 2.5 cm reported in Germans[17]. The explanation of the difference of total length and the harvested length of the fibula between the present study and the previous studies might be the ethnical difference in height. Choi et al[12] suggested a range of 15-20 cm of the harvested fibula could provide sufficient bone to allow the reconstruction of the mandibular defects in Koreans.

In comparison between sexes, the values of the harvested fibula, L1, L2, cortical bone thickness and spongy bone density in Thai males were higher than those in Thai females. This present result contradicts the study in Germans, which showed that sex did not have a significant influence either on bone dimension or bone density[18].

The height of the fibula should approximate to the height of the alveolar process. As evidenced, the mean height of the alveolar process of the mandibular central incisor was reported as 12.07 $\pm$ 1.27 mm in a sample of Thais[19]. The mean height of the fibula in Thais found in the present study was 13.9 $\pm$ 1.6 mm (range: 9.4-18.2 mm) while the range of the height of the fibula was 11-15 mm in Koreans[12] and 25-30 mm in Caucasians[20]. Although this 11-15 mm height in Koreans is acceptable for reconstruction of the atrophic mandible, it is not entirely adequate for the partially edentulous mandible. To solve such deficiencies, fixing the fibula 1 cm above the lower border of the mandible or shaping the fibula into two folded bones (double barrel technique) could be performed[18,21]. The detail of the double barrel technique has been described in the report of Bahr et al[21].

In the present study, the heights (L1 and L2) and bone density of the fibular cross-section were compared among the different parts of the fibula: upper fibula, mid-fibula, and lower fibula to explore the appropriate parts of the fibula for the dental implant placement. The results showed that L1 and L2 of the mid-fibula were longer than those of the upper and lower parts. The highest value of the cortical bone thickness was in the mid-fibula, whereas those of the cortical and spongy bone density were in the lower fibula. This result is relatively parallel to the study in Germans that found that the highest values of cortical thickness and density were in the central and distal parts[18].

The bone that is capable of supporting a dental implant should have a height at least 1 mm more than the implant length. The present study showed that in Thais, 72.5% had a height of less than 11 mm. Therefore, the harvested bone height can support the implant lengths of 7, 8.5, and 10 mm. This is different from a study of Caucasians where all subjects had a height of more than 15 mm[17] and 95% of subjects reported in another study had a height of more than 10 mm[18]. Thus, according to the present result, the fibula could provide sufficient bone to allow the placement of a 7 to 10 mm dental implant length in Thais, whereas it was reported that an 8 to 12 mm dental implant length could be placed in Koreans[12]. Notably, the frequencies of the bone support for the dental implants were different between Thai males and females. The result indicates the tendency to place the longer dental implant in males than in females.

In comparison with previous studies, the mean cortical thickness of fibula in Thais (2.2 $\pm$ 0.6 mm) was between 1.8 $\pm$ 0.7 mm[18] reported in Germans and 3.8 $\pm$ 0.95 mm reported in Koreans[22]. The cortical bone density of the fibula in Thais was 614.4 $\pm$ 148.8 HU while the cortical bone density of the alveolar process of the mandible was 800 to 1580 HU and that of basal bone of the mandible was 1320 to 1560 HU in Koreans[23]. The mean spongy bone density of fibula of Thais [(-600.6) $\pm$ 228.7 HU] is less than that of the mandible in Koreans (325-530 HU)[23]. The lower densities of the cortical and the spongy bone of fibula than those of the alveolar process of the mandible should be aware for the implant placement in the patients because the bone quality is one of factors contributing to the failure of dental implants[24].

Conclusion

A length of 16 to 20 cm of the fibula could be harvested from Thais. This possibly provides sufficient bone to allow the reconstruction of mandibular defects and the placement of 7 to 10 mm dental implant length. Mean cortical bone thickness was 2.2 $\pm$ 0.6 mm. The mean cortical and spongy bone densities of the fibula; however, are less than those of the mandible reported in previous studies. The result could be useful as a reference and supportive information for the surgical determination for the mandibular reconstruction and dental implant placement, especially in Thais.

Acknowledgment

This study was supported with a grant from the Dental Research Fund, Faculty of Dentistry, Chulalongkorn University, Bangkok 10330, Thailand. Special thanks are expressed to the Department of Anatomy, Faculty of Medicine Siriraj Hospital, Mahidol University for the provision of samples, Miss Paipan Phitayanon, an instructor for her statistical advice, Dr. Kevin Tompkins, Chulalongkorn University and Dr. Vipavadee Chaisuksunt, Chiang Mai University for their critical review of the present manuscript, and Mrs. Natchaya Amornmettajit for her technical assistance.

Potential conflicts of interest

None.

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ข้อควรพิจารณาทางกายวิภาคของกระดูกน่องคนไทยสำหรับใช้เป็นแผ่นเนื้อเยื่อปะปลูกชนิดอิสระฟีบูลาออสทิโอคิวทาเนียสในการบูรณะขากรรไกรล่างและการปักรากเทียม

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วัตถุประสงค์: *แม้ว่าแผ่นเนื้อเยื่อปะปลูกชนิดอิสระออสทีโอคิวทาเนียสฟีบูลา มีข้อได้เปรียบหลายประการในการบูรณะความวิการของขากรรไกรล่าง แต่มีข้อจำกัดเรื่องขนาดของกระดูกน่องที่จะเก็บมาใช้ การศึกษานี้มีจุดมุ่งหมายเพื่อศึกษาความเหมาะสมของมิติและคุณภาพของกระดูกน่องที่สามารถเก็บมาใช้สำหรับการบูรณะขากรรไกรล่างและการปักรากเทียมในคนไทย*

วัสดุและวิธีการ: *ทำการศึกษาโดยชำแหละกระดูกน่องจำนวน 114 ชิ้นจากศพดองของผู้ใหญ่คนไทย 57 ศพ ทำการวัดความยาวของกระดูกน่อง และความยาวของกระดูกน่องที่เก็บมาใช้ได้ วัดมิติของภาคตัดขวางของกระดูกน่องที่เหมาะสำหรับการปักรากเทียม อีกทั้งศึกษาความหนาของกระดูกเนื้อแน่น และความหนาแน่นบริเวณกระดูกเนื้อแน่นและบริเวณกระดูกเนื้อโปร่งของกระดูกน่อง 60 ชิ้นจากภาพถ่ายรังสีส่วนตัดอาศัยคอมพิวเตอร์ชนิดโคนบีมของกระดูก*

ผลการศึกษา: *ค่าเฉลี่ยของความยาวของกระดูกน่อง และความยาวของกระดูกน่องที่เก็บมาใช้ได้เท่ากับ 34.2 $\pm$ 2.3 ซม. และ 18.2 $\pm$ 2.3 ซม. ตามลำดับ กระดูกน่องสามารถรองรับรากเทียมที่ยาว 7-10 มม. ความหนาเฉลี่ยของกระดูกเนื้อแน่นมีค่าเท่ากับ 2.2 $\pm$ 0.6 มม. ส่วนความหนาแน่นเฉลี่ยบริเวณกระดูกเนื้อแน่น และบริเวณกระดูกเนื้อโปร่งของกระดูกน่องเท่ากับ 614.4 $\pm$ 148.8 HU และ -600.6 $\pm$ 228.7 HU ตามลำดับ*

สรุป: *การศึกษานี้แสดงให้เห็นว่า ความยาวของกระดูกน่องในคนไทยที่เก็บมาใช้ได้เท่ากับ 16-20 ซม. ซึ่งเพียงพอที่จะบูรณะความวิการของขากรรไกรล่าง และสามารถรองรับรากเทียมซึ่งยาว 7-10 มม. ความหนาแน่นเฉลี่ยของกระดูกเนื้อแน่น และกระดูกเนื้อโปร่งของกระดูกน่องมีค่าน้อยกว่าความหนาแน่นของกระดูกขากรรไกรล่างที่เคยรายงานในการศึกษาก่อนหน้านี้ ผลจากการศึกษาครั้งนี้สนับสนุนผลทางคลินิกในการใช้กระดูกน่องสำหรับการบูรณะขากรรไกรล่าง และการปักรากเทียม*