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Mandibular reconstruction using the deep circumflex iliac artery free flap: effect of the length of bone harvested on donor site morbidity

Q. Liu, Z. Shao *, Z. Shang

Department of Oral and Maxillofacial and Head and Neck Oncology, School and Hospital of Stomatology, Wuhan University, #237 Luoyu Road, Wuhan, 430079, China

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Abstract

The aim of this study was to assess the amounts of pain and morbidity that are associated with the length of the harvested anterior iliac bone graft (cm), and their effect on the contour of the donor site and activities of daily life. A total of 62 patients who had mandibular reconstruction using an iliac bone graft were enrolled in this study at the Wuhan University Hospital. The same surgical standards were used throughout. We divided the patients into two groups depending to the length of the graft (<9 cm or 9 cm or more). The amount and duration of the pain, the time necessary to walk normally, abnormalities of sensation, contour of the donor site, length of the scar, and the patients' satisfaction with the donor site were evaluated, and outcomes in the two groups compared. The worst pain after operation ($p = 0.001$) the length of the scar ($p = 0.001$), and the time needed before the patients were able to walk ($p = 0.001$) differed significantly between the two groups. There was no significant difference between the two groups regarding other complications. The anterior iliac crest might still be considered to be an ideal donor site for large mandibular defects.

Keywords: Iliac bone graft; Morbidity; Harvest site pain; Complication

Introduction

Mandibular reconstruction remains challenging for head and neck surgeons. Currently, segmental mandibular defects are usually the result of resection of a tumour, bony necrosis after radiation, or post-traumatic bony damage. Microvascular myo-osseous grafts using the iliac crest,[1] fibula,[2] or rib[3] are preferred for reconstruction of the mandibular defect.

The iliac crest free flap based on the deep circumflex iliac artery (DCIA) was first introduced by Taylor et al in 1979,[4] and it enables the reconstruction of the mandible to its correct width and height thanks to its abundant volume and high quality bone.[5] The DCIA flap is usually recommended when the mandibular defect is under 9 cm long.[6] However, its use is discouraged for the reconstruction of defects longer than 14 cm because of the potential risk of inguinal hernia, abnormal gait, and pelvic instability.[7,8] Other donor site complications include infection, pain, defect in the contour, haematoma, and bleeding.[9,10]

In the present study we have compared the incidence of complications after the harvesting of different lengths of the iliac crest. Our aim was to confirm the safe length of iliac

* Corresponding authors.
E-mail address: shaozhe@whu.edu.cn (Z. Shao).

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crest that can be harvested both for survival of the bone graft and minimal donor site complications.

Patients and methods

Patients

The records of 62 patients who were treated by mandibulectomy and mandibular reconstruction with a DCIA flap at Wuhan University of School and Hospital of Stomatology between January 2014 and January 2017 were retrospectively reviewed. No patient had a donor site injury, disease, or other operation. Patients were divided into two groups according to the harvested length of the iliac crest (<9 cm and 9 cm or more).

Surgical technique

All patients underwent regular preoperative examinations, including physical and radiographic evaluation. Mandibulectomy was simulated with Surgicase CMF (Materialise). Next, we superimposed the 3-dimensional computed tomographic (CT) image of the iliac crest on to the mandibular defect to choose the best region of the iliac crest. The surgical templates were designed to facilitate intraoperative harvesting, shaping, and positioning of the iliac crest. A standardised procedure was used for harvesting the iliac crest grafts.

The incision was made a finger's breadth above the iliac crest and then parallel to the inguinal ligament, followed by blunt dissection to the subcutaneous tissues, musculofascial attachments, and periosteum. Once the vessels of the DCIA and vein had been identified, the external and internal oblique muscles were divided along the course of the DCIA. A full-thickness osteotomy of the iliac crest was then made and the bone graft shaped under the guide of the cutting templates from the preoperative virtual design. All the bone grafts were harvested starting from the anterior superior iliac spine (ASIS). The lateral cutaneous thigh nerve was carefully preserved during the operation. In the donor site, sharp edges were smoothed using a bone file and bleeding was avoided using medical bone wax. The cut edges of the internal oblique, transverse abdominis, and iliac muscles were carefully sutured together. The external oblique muscle was then sutured to the gluteus muscle. A suction drain was placed in the area of the donor site and the incision was meticulously closed in layers. Postoperatively patients were asked to fasten an abdominal bandage around the waist to avoid an inguinal hernia and to wear bitewing guides for two months to keep normal occlusal contacts.

Collection and analysis of data

Duration of follow-up was 6–12 months postoperatively. All patients were interviewed and examined by an independent investigator at the same hospital. We used the Harris Hip Score to evaluate postoperative recovery in the iliac region. We measured the length of the iliac bone graft starting from the ASIS and based on the preoperative and postoperative iliac CT. A postoperative maxillofacial CT scan was then obtained for each patient. The preoperative and postoperative CT data were compared in the Surgicase CMF to evaluate changes of the position of the gonion and condyle after the operation. A CT of the ilium was also done to examine the growth of the iliac crest and eventual defects and contour deformities after operation.

We then focused on collecting the data and analysing the pain, sensation, gait, shape, and patients' satisfaction with the iliac donor site. The level and duration of the pain in the donor site were evaluated postoperatively, and the amount of pain measured using a visual analogue scale (VAS) on which 0 signified no pain, and 10 the worst pain imaginable. According to the judging criteria, the pain in the donor site was scored 0 before operation. Patients were asked how soon they were able to walk, whether or not they experienced problems, and how long the problems with walking lasted. They were asked to describe whether or not they experienced numbness, loss of sensation in the thigh and donor site area, and how long it lasted. A VAS was then used to establish patients' satisfaction with the appearance of the scar and contour of the donor site (0 not satisfied, and 10 very satisfied).

The appearance and length of the scar in the donor site were evaluated by clinical examination and recorded, and the examiners wrote down any disturbance with gait. The contour of the donor site was examined by the doctor and recorded as normal, subtle defect, or clear defect. Other postoperative complications at the donor site were also recorded.

Table 1
Measurements of postoperative pain on a visual analogue scale (0–10), and duration of pain (weeks).

Variable	Incision <9 cm	Incision 9 cm or more	p value
Severity of pain:			
Mean (range)	4.64 (2-8)	6.71 (3-10)	0.00
Duration of pain:			
Mean (range)	11.53 (4-24)	9.28 (6-24)	0.223

Statistical analysis

Data were analyed using IBM SPSS Statistics for Windows (version 22, IBM Corp). Probabilities of less than 0.05 were accepted as significant.

Results

A total of 62 patients who were treated by harvesting of an anterior iliac graft were enrolled for this clinical follow-up investigation. According to the length of the anterior iliac graft, patients were divided into two groups, depending on the length of incision the first group (less than 9 cm) consisted of 35 patients, 18 female and 17 male, mean (SD) age 38

Table 2
Postoperative recovery.

Variable	Incision <9 cm	Incision 9 cm or more	p value
Time to walking (weeks)	4.72	6.64	0.002
Time to normal activities (months)	7.14	7.40	0.738

Table 3
Abnormality of sensation (data are number of patients except where otherwise stated).

Variable	Incision < 9 cm	Incision 9 cm or more	p value
Abnormal sensation:			
Lateral thigh	24	19	
Anterior thigh	6	6	
Normal sensation	5	5	
Mean (SD) duration of abnormality (months)	12.44 (3.96)	10.41 (2.47)	0.075

Table 4
Length of scar (cm) and patients' satisfaction (visual analogue scale).

Variable	Incision < 9 cm	Incision 9 cm or more	p value
Mean (range) length of scar	18.14 (18-20)	19.18 (17-25)	0.00
Mean (SD) patients' satisfaction	5.29 (1.43)	5.96 (2.87)	0.12

(9.47) years. The second group (9 cm or more) consisted of 27 patients, 11 female and 16 male, mean (SD) age 34 (8.36) years. According to the Harris scores of the two groups, there was no significant difference between them (p = 0.23).

Pain

The severity and duration of pain in the two groups is shown in Table 1, and the difference was not significant.

Disturbance of gait

The period of time necessary for the patient to achieve sufficient walking ability for normal living (walking, climbing stairs and doing daily work) is shown in Table 2, and the difference between the groups was not significant.

Abnormalities of sensation

In total, seven patients had no sensory anomalies, and the results are shown in Table 3.

Appearance of the scar and patients' satisfaction

The lengths of the mature scars are shown in Table 4, and no patient reported any discomfort from the scar. Patients' satisfaction was evaluated by VAS and the mean (range) score was 5.29 (2–9) in the <9 cm group, and 5.96 (3–8) in the 9 cm or more group. The difference was not significant (Table 4).

Table 5
Abnormality of donor site (data are number of patients).

Variable	Incision < 9 cm	Incision 9 cm or more
Normal	10	2
Slightly abnormal	19	12
Very abnormal	6	13

Table 6
Complications (data are number of patients).

Variable	Incision < 9 cm	Incision 9 cm or more
Wound dehiscence	1	0
Iliac effusion	1	2

There were no other complications.

Defects at the donor site and complications

Defects at the donor site are shown in Table 5 and complications in Table 6.

Discussion

The mandible is a multifunctional bone and reconstruction of segmental mandibular defects remains a challenge for oral and maxillofacial surgeons. At our hospital we prefer to use the iliac crest to correct mandibular defects of under 14 cm because it gives minimal donor site morbidity. According to the 50 years' research of Tessier et al,[11] about 20 000 complications of autogenous bone grafts have been reported. However, it is difficult to have complete statistics and a definitive evaluation because clinicians and research workers usually use different criteria.[12] In addition, the different operations and techniques may result in different surgical complications.[13] Harvest of an iliac crest graft breaks the hip anatomy and biomechanics, and reduces the efficiency of the hip musculature, leading to postoperative gait disturbances (antalgic gait or limp).

The pain after harvest of an iliac bone graft has been reported as a major donor site complication.[14–16] We found that the degree of pain did correlate with the length of the iliac bone graft. The longer the bone graft, the more significant was the difference in VAS for worst postoperative pain compared with the shorter group. The worst pain was recorded in those patients who had experienced excessive muscular and subperiosteal dissection, and medial retraction seems to increase the amount of postoperative pain and the risk of damage to the lateral cutaneous nerve of the thigh.[14,15,18] Because this retrospective study was limited, the accurate duration of the pain could not be assessed.

The disturbance of sensation was a chronic donor site complication. The lateral cutaneous branches of the ilio-

hypogastric and subcostal nerves and the lateral femoral cutaneous nerves exert important influence in disorders of sensation.[14–17] During harvesting of the iliac bone graft, surgeons should pay attention to the iliohypogastric and subcostal nerves when separating the muscle that are wrapped around the iliac bone. Additionally, wrapping the nerve in the muscle and avoiding putting the nerves above the bone when suturing the donor site could reduce the pressure on the nerves.

The scar at the donor site is still considered a postoperative complication. The donor site scars in our study were much longer than those described elsewhere,[9,12–14] and the length of the scar differed significantly between our two groups. The contour defect at the donor site was chronic, and most patients in our study found that the appearance differed from that on the other side. Because the donor site was not exposed, few patients were not satisfied with it.

We found no wound infection, fracture of the iliac bone, instability of the pelvis, haematoma or hernia. Because there were only mandibular defects in our cases, with little soft tissue damage and only a small amount of internal oblique muscle had been harvested along the iliac crest to protect the DCIA/DCIV, the mesh to prevent incisional hernia was not used. The abnormal contour and uneventful growth were found on the patients' radiographic examination.

The mean age of the patients was less than 40 years old, and there were no age differences between the groups, so we found no relations between age and donor site complications, though some published research has found a relation between age and the occurrence of donor site fractures.[19] The Harris score was used to evaluate the overall function of the iliac donor site after operation, and found that there was no significant difference between the two groups, which indicated that it was feasible to intercept the long iliac valve.

Our results suggest that there were no major complications and no evidence of disturbance of growth, only minor self-limiting ones in the donor site area. We still think that the anterior iliac crest is a good donor site for harvesting large bone grafts, particularly when a careful surgical technique is used that avoids excessive reflection of soft tissue.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

The protocol for this retrospective study was approved by the Institutional Review Board of Hospital of Stomatology of Wuhan University, China. Patients' permission was obtained.

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