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## Functional long-term results after the harvest of vascularised iliac bone grafts bicortically with the anterior superior iliac spine included

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Accepted 7 April 2012

Available online 5 June 2012

### Abstract

The aim of this study was to evaluate the postoperative morbidity at the donor site and the long-term outcome after the harvest of bicortical iliac bone grafts, including the iliac crest and the anterior superior iliac spine (ASIS), by using a confirmed score. We retrospectively examined 54 consecutive patients who had had vascularised iliac bone grafts harvested to reconstruct different parts of the mandible. We used the Harris Hip Score to evaluate objectively the long-term postoperative morbidity at the donor site. Of 54 patients, 20 were female (37%) and 34 male (63%), with a mean age of 49 years (range 12–81). The causes of the bony defects were malignancy ( $n=37$ , 69%), benign tumours ( $n=7$ , 13%), osteomyelitis ( $n=9$ , 17%), and atrophy of the alveolar ridge ( $n=1$ , 2%). All transplants healed adequately. A total of 38/52 patients (73%) had a score of more than 80 points, which defines clinical success. Vascularised iliac bone grafts offer excellent bony dimensions with optimal shape to be used for reconstruction of different parts of the mandible. They can be harvested bicortically, including the iliac crest and the ASIS, with acceptable morbidity at the donor site. The Harris Hip Score is an appropriate tool for the evaluation of long-term impairment at the donor site after the harvest of vascularised iliac bone grafts, and it could be used to compare the results of different studies.

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**Keywords:** Donor site morbidity; Iliac bone grafts; Harris Hip Score

### Introduction

Bony defects in the maxillofacial region can be caused by various diseases and conditions. Depending on the site, dimension, and type of defect different reconstructive procedures are required.<sup>1,2</sup> Agreement exists that vascularised bone grafts should be used in the reconstruction of long bony defects in the load-bearing parts of the mandible,

particularly if the recipient bed is poorly vascularised or has been irradiated.<sup>1–3</sup> At present two important donor regions, the fibula and the iliac bone, have major roles in mandibular reconstruction.<sup>4,5</sup>

The iliac bone can optimally be used to reconstruct more than half of the mandible, as it offers sufficient bone with a similar shape.<sup>6</sup> It provides adequate volume of bone for insertion of dental implants to rehabilitate patients both functionally and aesthetically.<sup>7</sup> Its gentle curve parallels that of the mandible, and the type of vascularisation permits contouring osteotomies from the lateral side to obtain the desired shape. The corticocancellous nature of the graft is beneficial, as it facilitates fixation of a graft with miniplates as well as having

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Table 1  
Sizes of defects in 54 patients.

Diagnosis	Size of defect (cm <sup>2</sup> )				Total (n = 54)
	<4 (n=2)	4–8 (n=2)	8–12 (n=20)	>12 (n=30)	
Malignant	1	1	13	22	37
Benign	1	0	2	4	7
Osteomyelitis	0	1	4	4	9
Atrophic mandible	0	0	1	0	1

excellent graft-host healing potential.<sup>8,9</sup> Many concerns still exist about using such flaps since the introduction of vascularised iliac bone grafts by Taylor et al.,<sup>10,11</sup> because of the difficult anatomy and potential postoperative morbidity at the donor site.<sup>12–15</sup> Several methods have been suggested to reduce this morbidity, which can lead to some limitations in the use of the iliac bone flap.<sup>16–19</sup>

The aim of this study was to evaluate the morbidity at the donor site using a standard score, the Harris Hip Score,<sup>20</sup> which incorporates multiple elements of clinical importance to evaluate objectively the function of the hip using a points system. Harris described this method for postoperative assessment of traumatic arthritis of the hip in 1969. Subsequently it has been used as a way to assess hip-related treatments.<sup>21</sup> To our knowledge there are no publications about morbidity at the iliac donor site that have been quantitatively assessed according to a recognised score.

## Patients and methods

We retrospectively examined data about 54 patients who were treated consecutively in the Department of Maxillofacial Surgery of the RWTH Aachen University Hospital. A trauma surgeon and a maxillofacial surgeon performed the examination. Subjects had their mandibles reconstructed with vascularised iliac bone grafts. Two experienced surgeons did all the operations according to the same protocol. After the cut surface of the iliac bone had been covered with a little bone wax, the donor site was closed first by reposition of the preperitoneal fat by connection of the stump of the transversus and iliacus muscles to avoid development of a hernia. Then the oblique muscle was adapted to the gluteus muscle group with absorbable 0 sutures. After insertion of two Redon drains (12–14 Ch) the remaining wound was closed in layers. Personal and clinical characteristics, including age, sex, diagnosis, date of operation, and site and size of the mandibular defect according to the classification by Jewer et al., were recorded.<sup>13</sup>

Fifty-four patients were available for physical examination using the Harris Hip Score one year postoperatively. The score assesses pain, function regarding gait and activities, absence of deformity and range of movement in the hip (flexion, abduction, adduction, external rotation, and internal rotation), with point values exactly defined for the findings in each of these categories. A score of more than 90 points is considered as excellent, while values between 80 and 90

points are estimated as good, and values between 70 and 80 are fair. We therefore defined clinical success as a score of more than 80 points. Scores of less than 70 points were rated as moderate. Postoperative wound healing at the donor site was evaluated separately taking into account the rates of wound infection and wound dehiscence. The development of donor site-related complications such as hernia, haematoma, fractures, failure of the flap, necrosis of the bone graft, and extrusion or fracture of the plate at the recipient site were also documented. Finally, we recorded mean (SD) length of the cut iliac segment.

## Statistics

Statistical analyses were aided by the use of the Statistical Package for the Social Sciences (SPSS version 19.00 for Windows XP, SPSS, Chicago IL, USA). We used Fisher's exact test, and probabilities of less than 0.05 were accepted as significant. We compared age, diagnosis, size of mandibular defect, functional disturbances, extrusion and fracture of the plate, and failure of the flap.

## Results

All 54 patients had had bicortical vascularised iliac bone grafts, including iliac crest and ASIS. Of these patients 20 were female (37%) and 34 were male (63%), mean (SD) age 49 (16) years (range 12–81) at operation.

The patients were divided into 4 diagnostic groups (Table 1). Vascular iliac bone grafts were used to reconstruct different parts of the mandible including chin, body, ramus, or a combination of these sites. The Jewer classification was used to illustrate the different mandibular defects (Fig. 1).

In 48 patients the iliac bone graft was harvested from the right side and in 6 patients from the left, with the harvested side being dependent on the required curvature and the ideal position of the vascular pedicle. To fix the transplant into the original mandible, miniplates were used in 39 patients and reconstruction plates in the remaining 15. There were no significant differences in the incidence of wound dehiscence and type of osteosynthesis ( $p=0.22$ ). The mean length of defect was more than 6 cm, and in malignant tumours more than 9 cm, which showed a significant difference ( $p=0.05$ ) (Table 1). The healing of the wound at the donor site was uncomplicated in all patients. During the immediate postoperative course, 4 patients developed wound

No. of cases	Reconstruction class	Location
3	C	
14	L	
1	H	
9	LC	
21	HC	
1	LCL	
4	HCL	
1	HH	

Fig. 1. Basis of the HCL method for classifying mandible defects.

dehiscences of less than 2 cm long. Two patients developed wound infections. However, in none of these 6 cases was revision necessary, as medical treatment successfully resolved them. There were no fractures of the iliac ala and no patient developed a hernia.

A total of 38/52 patients had a Harris Hip Score of more than 80 points (73%), implying clinical success, while only 14/52 (27%) scored less than 80 (Table 2). Thirty-five of 52

Table 2  
Harris Hip Score in 54 patients.

Score	No. (%) of patients
54	1 (2)
55	3 (6)
59	1 (2)
64	3 (6)
76	2 (4)
77	2 (4)
78	1 (2)
79	1 (2)
80	8 (15)
81	2 (4)
83	4 (7)
84	24 (44)
Missing values	2 (4)
Total	54 (100)

patients (65%) reported no pain or ignored their pain, whereas 3/52 (6%) had moderate, 11/52 (21%) had occasional, and 4/52 (8%) had mild pain with limitation of ordinary activity or work. They all needed medication stronger than aspirin for analgesia. No patient was totally disabled with pain at rest. Fifty patients (96%) had no difficulties when walking.

### Discussion

Although the causes of loss of the jaw bone may change with time, the large continuity defects of the mandible still remain a challenge for reconstructive surgeons, particularly if the reconstruction has to be undertaken in poorly-vascularised recipient sites. The success and reliability of free bone grafts are curtailed by metabolic dependence on the recipient's facial bed.<sup>22</sup> The challenge will be even greater if excellent functional and aesthetic recoveries are expected. Any reconstruction that carries the expectation of good functional and aesthetic outcomes requires appropriate dimensions of the bone graft, ease of harvesting, and low postoperative complications.

Iliac bone grafts can be used alone or in combination with other soft tissue grafts to reconstruct combined defects. This flap undoubtedly offers favourable shape, quality, and quantity of bone to replace different missing parts of the mandible.

There are many reports about donor site morbidity.<sup>1,5,12–15</sup> Several authors have reported pain on walking, weakness of the abdominal wall, frank herniation, and disturbances of gait.<sup>13,14</sup> A few other approaches have been suggested to reduce impairments at the donor site such as taking only the inner cortex, which will reduce the amount of bone available and its implantability.<sup>14</sup> Others have suggested leaving the iliac crest and harvesting the underlying bone.<sup>23</sup> However, this manoeuvre can jeopardise the nutrient vessels, which usually run close to the iliac crest. Other investigators have suggested leaving the ASIS for better muscular reattachment and stability,<sup>16</sup> which may also make the iliac region more prone to fracture. This segment can also be used optimally for reconstruction of the mandibular angle. We know of no comparable studies with standard ratings of postoperative complications. In most studies complications are not reported, but general comments are made without discussion of complications.

We have been using vascularised iliac bone grafts for reconstruction of different bony parts by harvesting the iliac region bicortically with crest and spine included. We have seen none of the complications made in general comments. Abdominal weakness and hernia can be avoided by reducing the amount of soft tissue removed, and by closure of the donor site with meticulous attention to the specific anatomy.

Long-term postoperative examination has shown that recovery of hip function was adequate in almost three-quarters of patients, and in 87% of cases the final functional outcome was at least fair.

Donor site morbidity is variably reported and rarely measured by comparable scores. Rogers et al. used different scores to compare the long-term morbidity of two important flaps.<sup>24</sup> This rating method seems to give a more accurate and comparable assessment of the patients' hip pain and functional capacity,<sup>20</sup> and also correlates with health-related quality of life (QoL).<sup>25</sup> A limitation of the points values is that the scores are arbitrarily defined, which makes them qualitative in nature. We agree with Colen et al. who, in a review, stated that major donor site morbidity is uncommon and that most problems at donor sites are preventable.<sup>12</sup>

Our study has shown that good outcomes with low donor site morbidity are achievable and the Harris Hip Score can be used to compare the results of different studies. However, additional evaluations of the immediate postoperative course and the aesthetic outcome should be considered.

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