Harvesting of Cancellous Bone From the Proximal Tibia Under Local Anesthesia: Donor Site Morbidity and Patient Experience

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Purpose: The objective of this retrospective study was to evaluate postoperative morbidity, risk of complications, and patient discomfort after ambulatory tibial bone harvesting procedures under local anesthesia.

Patients and Methods: Between 2000 and 2005, bone was harvested from the head of the tibia for internal or external maxillary augmentation in 79 patients. A medial osteoplastic approach to the donor region was used. All patients’ records were reviewed. Forty-five of the 79 patients later came in for follow-up examination. A traumatologist examined the donor region both clinically and radiologically. Subjective disorders and experiences of the patients were documented using a standardized questionnaire.

Results: The patient records revealed that 80% did not report significant complaints or gait disturbances after bone harvesting, and only 5% reported postoperative complaints or gait disturbances lasting longer than 2 weeks. In 1 case, a nondisplaced fracture healed without further complications. Clinical and radiologic examinations of 45 patients revealed full regeneration of the donor region in all cases. Some 91% of the patients described the outpatient bone harvesting procedure under local anesthesia as “not distressing” and would undergo such an intervention again if required.

Conclusions: This study demonstrates that both complaints and risk of complications after outpatient bone harvesting from the proximal tibia under local anesthesia can be considered very low, especially as far as outpatient maxillary augmentation (eg, sinus floor elevation) is concerned.

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Autogenous bone grafts remain the gold standard among the various augmentation materials, especially for expansive augmentations.¹⁻⁵ Large-scale defect reconstructions often require grafts obtained extraorally. According to the literature, bone is most commonly harvested from the iliac crest region.⁶⁻⁷ This procedure is usually carried out under general anesthesia and requires hospitalization; other disadvantages include postoperative complaints and mobility problems.⁹⁻¹⁰ For these reasons, bone harvesting from the iliac crest is indicated only in situations with major and highly complex alveolar crest defects.
As another extraoral donor region for defect augmentation, the oral tibia was introduced to oral surgery by Catone et al., and various harvesting techniques have been developed. All previous studies have reported the ability to obtain sufficient spongyous bone material (up to 12 mL of spongiosa) with low postoperative morbidity. Thus, augmentations of the alveolar bone are increasingly carried out with the aid of grafts from the proximal tibia. This procedure marks a further development of the method, especially for implantologic dental interventions under outpatient conditions and local anesthesia. Earlier studies on harvesting bone from the tibia dealt mainly with examining morbidity in the donor region and evaluated exclusively bone harvesting under inpatient conditions involving sedation or general anesthesia. Subjective impressions together with patient acceptance of outpatient bone harvesting from the proximal tibia under only local anesthetic have not yet been sufficiently documented and evaluated.

On the one hand, it was the declared aim of this study to assess the complication rate and morbidity in the area of the donor region with the medial approach to the tibia of Jakse et al. On the other hand, the study also evaluated the specific experiences of and acceptance by the patients under outpatient conditions and local anesthesia.

**Patients and Methods**

**PATIENTS**

Over a 6-year period (2000 to 2005), bone was harvested from the proximal tibia in 79 consecutive cases at the Department of Oral Surgery and Radiology, Medical University of Graz. Exclusion criteria for this bone harvesting procedure were poor general health, disorders of bone tissue metabolism (eg, osteoporosis), and complaints involving the region of the donor site (eg, injuries or previous surgery). Bone was harvested unilaterally in 78 patients and bilaterally in 1 patient, with 6 months elapsing between the 2 harvests. The patient group was comprised of 41 females and 38 males, ranging in age from 32 to 74 years (average age, 53 years). In 73 cases, the harvested spongiosa was used exclusively as augmentation material for sinus floor elevations; 29 of these cases involved ambilateral sinus floor elevations. In 6 cases, the harvested bone graft was used to reconstruct external deformations in the alveolar crest.

A total of 45 patients (26 females and 19 males) agreed to participate in this retrospective study involving clinical and radiologic examinations.

**SURGICAL PROCEDURE**

Bone from the proximal tibia was always harvested in an outpatient procedure under local anesthesia (mepivacaine 2%) without sedation largely following a method described by Jakse et al in 2001. The bone was harvested from the medial tibia condyle, with the access lying roughly at the height of the tuberositas tibiae. After an incision corresponding to the direction of the skin tension line, a bony lid of 10 × 10 mm was prepared and extracted with a bone chisel (Fig 1). The bony lid was left jointed medially to the periostium or to the insertion of the adductors (pes anserinus). Spongiosa was then taken from the interior of the head of the tibia through the bony window with bone curettes. After bone harvesting, the bony lid could be repositioned free of the defect before being fixed with a single knot suture (osteoplastical bone harvesting technique from the tibia). In 6 of the 79 cases of bone harvesting, no bony lid was prepared, but for the harvesting of spongiosa, a cortical block graft of 10 × 15 mm was obtained to reconstruct the defect at the alveolar process (osteoclastic technique). In 12 cases, the spongiosa was harvested through the same soft tissue approach using a trepane drill (trepane technique). The wound was closed layer by layer, and the skin was sutured intracutaneously.

**POSTSURGICAL MANAGEMENT**

A skin pressure dressing was applied for the first 24 hours, and the patient left the clinic immediately after the operation. After the skin pressure dressing was removed, checks were done weekly up to complete recovery, with the healing process recorded in the patient’s record. The patient was prescribed the antibiotic clindamycine, 300 mg (oral, 3 times daily), from the day before the operation to the fourth postoperative day. For postoperative anti-inflammation and analgesia, diclofenac (50 mg, 3 times daily) was administered for the first 4 days. The leg that was operated on was preferably immobilized and elevated for the first 24 hours after the operation; average physiologic exercise of the operated leg was expressly allowed thereafter. After 1 week, running and cycling could be resumed. However, the patient was asked to refrain from any excessive strain, such as skiing or mountaineering, for 8 weeks.

**METHODS OF INVESTIGATION**

The study comprised the analysis of all 79 case records between 2000 and 2005 for evaluation of the healing process and complications. In addition, the 45 patients who agreed to participate in the follow-up examination scheme were examined clinically and radiologically in the area of the donor site.
by a traumatologist, with functionality and mobility assessed based on the Lysholm score. Simultaneously, the patients' subjective experiences were evaluated with standardized questionnaires. The questionnaires were chosen in collaboration with a psychologist.

The interviews and evaluation of results were performed by a staff member not involved in the treatment scheme. On the one hand, patients were asked what had originally compelled them to agree to undergo outpatient bone harvesting from the head of the tibia; on the other hand, they were...
queried as to intraoperative and postoperative pain and anxiety, postoperative complaints, gait disturbances, and the current condition in the area of the donor site.

Results

EVALUATION OF PATIENT RECORDS

In all 79 cases, the patient was discharged on the day of the intervention. There were no complications intraoperatively or immediately postoperatively that called for hospitalization.

Of the 79 patients, 63 (80%) reported no major complaints or gait restrictions in the donor region at any time after the operation (Table 1; Fig 2). Twelve (15%) reported pain and mobility restrictions in the area of the knee for up to 2 weeks after the operation; 4 (5%) noted pain and gait disturbances for more than 2 weeks. Seven patients (9%) reported temporary paresthesias in the donor region; in 7% of the patients, the paresthesias persisted for up to 6 months. In 2 cases, retrospective evaluation of patients’ records revealed major postoperative complications that were documented in the course of the follow-up examinations: 1 case of delayed wound healing at the donor site and 1 case of stress fracture at the head of the tibia without displacement. In the delayed wound healing case, complete healing followed surgical revision of the wound. In the fracture case, complete healing occurred without any further complications after a 4-week immobilization, and no surgical intervention was necessary.

EXAMINATION OF THE DONOR SITE REGION

Between 6 and 60 months after bone harvesting, 45 patients underwent a clinical and radiologic examination of the donor site region by a traumatologist. All patients had insignificant scars at the donor site. None

Table 1. DATA FROM PATIENTS’ RECORDS OF TIBIAL BONE HARVEST PROCEDURES (n = 79) PERFORMED BETWEEN 2000 AND 2005 AT THE DEPARTMENT OF ORAL SURGERY AND RADIOLOGY, MEDICAL UNIVERSITY OF GRAZ

<table>
<thead>
<tr>
<th>Patient Characteristic Category</th>
<th>Number (percentage) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38 (48.1%)</td>
</tr>
<tr>
<td>Male</td>
<td>41 (51.9%)</td>
</tr>
<tr>
<td>Donor site</td>
<td></td>
</tr>
<tr>
<td>Right tibia</td>
<td>77 (97.5%)</td>
</tr>
<tr>
<td>Left tibia</td>
<td>2 (2.5%)</td>
</tr>
<tr>
<td>Postoperative complaints and gait disturbances</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td>63 (79.7%)</td>
</tr>
<tr>
<td>≤2 weeks</td>
<td>12 (15.2%)</td>
</tr>
<tr>
<td>&gt;2 weeks</td>
<td>4 (5.1%)</td>
</tr>
<tr>
<td>Paresthesias</td>
<td></td>
</tr>
<tr>
<td>Temporary (not longer than 6 months)</td>
<td>7 (8.9%)</td>
</tr>
<tr>
<td>Major complications</td>
<td></td>
</tr>
<tr>
<td>Fracture</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Wound healing disorder</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>

of the patients complained of pain in the donor region. One patient reported sensitivity to changes in weather in the area around the scar. Another patient reported a slight nocturnal burning sensation at the donor site. At the time of the follow-up examination, 93% of the patients had achieved a Lysholm score of 100, the maximum number of points attainable, and the other 7% had achieved a score of 98. None of the patients exhibited mobility restrictions. X-ray images of the knee revealed complete osseous regeneration of the donor region in all cases. X-rays of the full leg showed no axial deviations.

EVALUATION OF THE PATIENT QUESTIONNAIRES

The 45 patients who took part in the follow-up examinations answered standardized questions on their subjective experience of outpatient bone harvesting from the head of the tibia under local anesthesia without sedation (Table 2). When asked why they first agreed to undergo the procedure, 93% of the patients stated that they agreed following a recommendation by their doctor. Of these, 57% explained that they had opted for this specific bone harvesting procedure because from their point of view, sinus floor elevation with the help of autogenous spongiosa would ensure a good outcome.

Forty-one patients (91%) said that the bone harvesting from the proximal tibia did not prove stressful. They did describe a scraping sensation during the procedure, but no real pain as such. Four patients (9%) reported that the intervention involved psychological and physical stress.

Retrospectively, 4 patients (9%) reported postoperative complaints and functional restrictions persisting for more than 2 weeks. Among these were the 2 patients with major complications in the healing process described earlier.

The records of the remaining patients revealed no objectifiable causes for delayed rehabilitation. All other patients questioned said that they experienced an uncomplicated postoperative healing process. Forty-one patients (91%) stated that they would again agree to this procedure if it proved to be necessary.

Discussion

Bone harvesting from the proximal tibia in oral surgery and, more specifically, in surgical implantology procedures for complex maxillary augmentation was originally introduced as an alternative to bone harvesting from the iliac crest. Both experimental and clinical studies have shown that spongiosa harvested from the head of the tibia can be compared, both quantitatively and qualitatively, with the spongiosa obtained from the iliac crest, and that it is also suitable for expansive maxillary augmentation.11,12,23,24 Our own experience has confirmed these reports. Clinically, the quality of the spongiosa graft from the head of the tibia corresponds mainly to spongiosa harvested from the pelvis in terms of harvesting and further processing, but spongiosa harvested from the pelvis seems to be slightly more dense. In terms of quantity, expansive ambilateral sinus floor elevations also can be done with spongiosa harvested exclusively from the tibia.

Essentially, pure spongiosa grafts have the highest osteogenous potency compared with other bone grafts.25 Patients place high value on the quality of

<p>| Table 2. DATA FROM THE FOLLOW-UP EXAMINATION OF 45 PATIENTS 6 TO 60 MONTHS AFTER BONE HARVESTING BASED ON CLINICAL AND RADIOLOGIC PARAMETERS AND ON EVALUATION OF THE PATIENTS’ QUESTIONNAIRES |
|-----------------------------------------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Category</th>
<th>Number (percentage) of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>19 (41.8%)</td>
</tr>
<tr>
<td>Donor site</td>
<td>Right</td>
<td>44 (97.8%)</td>
</tr>
<tr>
<td>Functional disorders (Lysholm score)</td>
<td>None (Lysholm 100)</td>
<td>42 (93.3%)</td>
</tr>
<tr>
<td>Subjective gait disturbances</td>
<td>None</td>
<td>45 (100%)</td>
</tr>
<tr>
<td>Sensitivities in the donor region</td>
<td>None</td>
<td>43 (95.6%)</td>
</tr>
<tr>
<td>Radiologic examination</td>
<td>Complete osseous regeneration</td>
<td>45 (100%)</td>
</tr>
<tr>
<td>Scars</td>
<td>Insignificant</td>
<td>45 (100%)</td>
</tr>
<tr>
<td>Subjective experience of bone harvesting procedure</td>
<td>Not stressful</td>
<td>41 (91.2%)</td>
</tr>
<tr>
<td>Patient would again agree to this procedure</td>
<td>Yes</td>
<td>41 (91.2%)</td>
</tr>
</tbody>
</table>

*Nocturnal burning (1 patient) and changes in weather (1 patient).

spongiose grafts. Almost 60% of the patients specifically opted for spongiose harvesting from the head of the tibia in the current retrospective questioning.

One decisive argument in favor of harvesting from the head of the tibia is the comparative lack of postoperative complaints and reduced risk of complications compared with harvesting from the iliac crest. The evaluation of 79 case histories from our patient population between 2000 and 2005 has confirmed the figures reported in the relevant literature. Immediately after the operation, 80% of the patients had no significant complaints or gait restrictions. Impairments in mobility and gait disturbances for up to 2 weeks were reported by 15% of the patients. Only 5% of the patients complained of pain in the donor region for more than 2 weeks.

The clinical follow-up examination performed by a traumatologist in 45 patients revealed persistent mobility restrictions around the area of the donor site. An investigation of the mobility in the area of the knee joint using the Lysholm score revealed the maximum number of points, 100, in 93% of the patients and a score of 98 in the remaining 7%. In comparison, when bone was harvested from the iliac crest, up to 50% of the patients showed gait disturbances after 2 weeks, and 5% reported complaints lasting for at least 8 weeks. Also, the subjective retrospective assessment by the patients confirmed the details reported in the literature, thus supporting our own experiences. In contrast to the iliac crest method, when bone was harvested from the proximal tibia, only 9% of the patients reported retrospectively suffering from gait disturbances persisting for more than 2 weeks. The remaining 91% of the patients did not retrospectively recall any major postoperative complaints.

In the literature, local sensitivity impairments around the donor site region are described as a possible, if rare, complication. In our patient group, 9% reported transitory hypoesthesia or anesthesia in the area and distal to the donor site. In 7%, this condition persisted for 6 months or less. In the context of our follow-up examination of 45 patients, no sensitivity impairments were mentioned. Two patients reported suffering from changes in the weather and recurrent burning in the area of the donor site. Moreover, evaluation of the patients’ subjective impressions revealed that the postoperative healing process can be considered uncomplicated.

Our retrospective examinations also confirmed that major complications are extremely rare and can actually be avoided altogether by applying appropriate surgical technique and postoperative care. One major complication was delayed wound healing, which could be linked mainly to lack of compliance; the patient had not appeared for her scheduled postoperative follow-up examinations. On the tenth postoperative day, the dressing was removed for the first time, revealing an inflamed dehiscence in the wound area. Subsequent intensive local wound treatment and systemic antibiotic therapy prompted a secondary healing process within 2 weeks without any further complications. Another patient was diagnosed with a nondisplaced fracture in the area of the medial condyle 6 weeks after bone harvesting. This was possibly due to excessive bone harvesting, with too-deep delving into the medial condyle. The patient complained of sudden and persistent pain, and an x-ray revealed the fracture. There was no displacement, and callus formation had set in. Subsequently, under conservative treatment, no further complications developed and complete healing occurred.

Altogether, fractures at the proximal tibia are extremely rare, with only 6 documented cases of fractures of the bone in the context of bone harvesting from the proximal tibia reported in the literature. An experimental examination by Alt et al investigated the mechanical stability of the head of the tibia after bone harvesting and revealed that even after expansive bone harvesting, the proximal tibia can still bear strain.

Bone harvesting from the proximal tibia has become especially interesting for implantology in combination with an outpatient procedure under local anesthesia without sedation. Bone harvesting from the tibia under intravenous sedation has been described as a well-tolerated procedure. The current study was the first to examine a patient population in which all surgical interventions were carried out under local anesthesia and without sedation or general anesthesia. The advantage of not applying sedation or a narcotic lies in the immediate postoperative mobilization and discharge of the patient. Most patients experienced bone harvesting from the proximal tibia as a nonstressful procedure. What they did describe was a scraping sensation during bone harvesting, but no pain. Only 4 patients reported experiencing psychological and physical stress during bone harvesting. Even under sedation, patients reported physical discomfort caused by the scraping and grating during bone harvesting. The low intraoperative stress is also mirrored in high patient tolerance: 91% of the patients questioned said that they would undergo such an operation a second time if this proved necessary.

Based on the results of this study, the harvesting of spongiose bone from the proximal tibia under local anesthesia without sedation or general anesthetic can be recommended. The complication rate is low, and patient tolerance is extremely high. Nonetheless, patients should be made aware of possible intraoperative discomfort as well as postoperative complaints.
and impairments that may occur and, last but not least, fracture as an unlikely complication.

References


