Morbidity of Chin Bone Transplants Used for Reconstructing Alveolar Defects in Cleft Patients

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Objective: **The aim of this study was to evaluate the objective and subjective morbidity of symphyseal chin bone harvesting used for reconstruction of alveolar defects in young cleft patients.**

Design: **All patients who had undergone chin bone harvesting for alveolar cleft reconstruction in the period from 1992 through 2000 at the Department of Oral and Maxillofacial Surgery of the University Hospital Groningen, Groningen, The Netherlands, were invited to participate in this retrospective study.**

Patients' acceptance, perioperative and postoperative morbidity were evaluated. A survey of the medical records was performed. In addition, the patients completed a questionnaire for their appreciation of the procedure. They were also subjected to a clinical and radiographic examination.

Patients: **Thirty patients (21 males and 9 females; mean age 11.8 ± 3.6 years) participated in this study.**

Results: **Neither the medical records nor the experiences of the patients showed significant morbidity. The procedure was appreciated with 6.8 ± 3.5 (scale 0 to 10). Postoperative pain was scored as 1.2 ± 2.5 (scale 0 to 10). Three patients reported transient sensory disturbances at the donor site. Two patients showed a slight sensibility disorder in the symphyseal region. In three patients, an endodontic problem had developed in a lower incisor.**

Conclusion: **This study showed that chin bone harvesting for reconstructing alveolar cleft in young patients is a well-accepted procedure with low objective and subjective morbidity. Notwithstanding this low morbidity, the patients (and their parents) have to be informed about the risk of objective and subjective disturbances of the sensibility in the donor region and the risk of dental pulp necrosis.**

KEY WORDS: *alveolar defect, autogenous bone grafting, mandibular symphysis, morbidity*

Autogenous bone grafts are frequently used for reconstruction in maxillofacial surgery. For example, bone defects due to tumor surgery, trauma, severe bone resorption, or congenital malformations can be reconstructed with such grafts. Currently, autogenous bone is still considered the best material for free bone grafting procedures (Marx, 1993). The anterior iliac crest is still the first-choice donor site for alveolar cleft grafting (Sinder-Pederson et al., 1988), but similar results have been reported for chin bone grafts (Koole et al., 1989; Enemark et al., 2001).

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The mandibular symphysis is an attractive donor site because it is generally assumed to have an excellent risk-benefit ratio (Triplett et al., 1998). The symphyseal area is easily accessible and usually contains a sufficient quantity of bone for reconstructing an alveolar defect in cleft patients. However, the available volume of bone in the symphyseal region is restricted, because of the permanent dentition. When compared with iliac crest bone grafts, it has been postulated that chin bone grafts show a more rapid revascularization and less resorption because of their membranous origin (Koole, 1994). Other advantages include the restriction to one (intraoral) operation site and the avoidance of iliac crest graft-related morbidity that might occur, including seroma, hernia through the donor site, gait disturbance, instability of the sacro-iliac joints, adynamic ileus, and uretral injury (Kalk et al., 1996).

Since 1992, we have routinely reconstructed alveolar defects in cleft patients with symphyseal bone. A graft is taken from the anterior iliac crest only if it is assumed that the symphyseal

FIGURE 1 No bone was harvested from the lower border of the mandible to prevent the chin contour from changing.

FIGURE 2 After removal of the cortical plate, additional spongious bone can be harvested.

region offers an insufficient quantity of bone. This mostly concerns patients with bilateral clefts. The morbidity of symphyseal bone grafting in cleft patients has been reported by Hoppenreijs et al. (1992). They concluded that chin bone harvesting in children is a procedure with minimal postoperative morbidity. In their study, only objective morbidity was evaluated. Subjective postoperative problems were not investigated. Raghoebar et al. (2001) described minimal objective and subjective postoperative morbidity of symphyseal chin bone grafting as preimplantologic surgery in adults in cases of alveolar deficiency. They concluded that there was good acceptance of the chin bone harvesting procedure. In their study, the objective morbidity was low, but almost half of the patients reported a changed (decreased) sensibility in the donor area. The aim of this study was to evaluate both the objective and subjective morbidity of symphyseal bone harvesting in young cleft patients.

Materials and Methods

Patients

Seventy-five patients who had undergone chin bone harvesting for alveolar cleft reconstruction from 1992 through 2000 at the Department of Oral and Maxillofacial Surgery of the University Hospital Groningen, Groningen, The Netherlands, were invited to participate in this study. Thirty-one patients (41%) volunteered. Patients who declined to participate indicated that they were not interested in such a study or were not available due to lack of time. Because none of the patients who were unwilling to travel to the clinic for another visit indicated that they were (still) suffering from morbidity related to the grafting procedure, the assumption was made that attending the evaluation was independent of satisfaction and clinical state. Because of mental retardation, one patient could not be examined properly. This patient was excluded from the study. The studied group comprised 21 males and 9 females. The mean age was 11.8 $\pm$ 3.6 years. None of the patients had undergone previous surgery in the symphyseal region.

Surgical Procedure

In our department, an alveolar cleft is reconstructed when the root formation of the impacted cuspid has reached one half to two thirds of the expected total root length. At that time, most patients are between 11 and 12 years old. Two types of incisions for mandibular bone graft harvesting were used to elevate the muco-periostal flap: a crevicular incision with vertical releasing incisions in the canine region ($n = 22$) or a vestibular incision in the intercanine region ($n = 8$). A vestibular incision was chosen in cases of crowding of the lower incisors. After raising the muco-periostal flap, the mental nerve was localized bilaterally. A safety margin of 5 mm from both mental foramina was observed. To prevent vitality-loss of the lower incisors, a margin 5 mm caudal to the apices was also taken into account. To prevent the chin contour from changing, the lower border of the mandible was not used for bone harvesting (Fig. 1). In all patients, monocorticospongious bone was harvested using a reciprocal saw or a fissure burr under copious irrigation with saline. After removing the bone block with a chisel, additional bone was harvested with gauges and curettes (Fig. 2). The harvested bone was preserved in cold saline until it was transplanted to the cleft in the superior alveolar ridge. Sharp osseous edges and irregularities were reduced. Gelitta (Braun, Tüttlingen, Germany) was applied onto the donor site as a hemostatic dressing. The wound was closed with Vicryl (Johnson & Johnson, Gateway, U.K.). Elastic tape was applied to the skin of the chin to prevent postoperative swelling and hematoma formation (Fig. 3). This tape was removed 4 days after surgery. All patients received pre- and postoperative broad-spectrum antibiotics for 48 hours. Chlorhexidine mouth rinse (0.2%) was prescribed for 2 weeks. The patients were required to use a soft diet for 2 weeks.

Evaluation

An independent investigator (A.B.), who did not perform the surgery on these patients, examined all of them. A survey of the medical records was carried out; the patients had to

FIGURE 3 Elastic tape is placed on the chin to minimize postoperative swelling.

complete a questionnaire (Appendix) and were subjected to a clinical and radiographic examination.

The medical records were examined for the type of intraoral approach to the donor site, perioperative and postoperative complications, medication used, and medical history, all of which had been recorded according to a standard protocol.

The questionnaire contained multiple choice questions concerning perioperative and postoperative pain, as well as its severity and duration. Severity of pain was graded on a 10-cm visual analogue scale (VAS), with 0 representing no pain and 10 representing severe pain. Another 10-cm visual analogue scale was used to score the appreciation of the chin bone harvesting procedure (0 to 10; 0 = very annoying, 10 = not a problem at all). Furthermore, the questionnaire focused on sensory disturbances of skin and oral mucosa, contour changes of the chin, perception of the surgical intraoral scar, and the patient's perception and acceptance of the surgical procedure.

The clinical examination was restricted to the donor site, including the function of the mental and alveolar nerves. Tactile sensibility was tested by gently touching the skin with a cotton wisp. The patients were asked to count the number of touches with their eyes closed. Superficial sensibility was tested with both a sharp and a dull instrument. The patients were asked to discern the difference between sharp and dull with their eyes closed. Furthermore, the vitality of the anterior lower teeth was tested with a cotton wisp sprayed with ethyl chloride.

The radiological examination consisted of a panoramic x-ray and an intraoral radiograph. The lower teeth were examined radiologically for pulp canal obliteration and root resorption. The criteria for pulp necrosis included both loss of vitality and periapical radiolucency, because testing only the vitality of the tooth pulp by a thermal method revealed many false negative outcomes. The ingrowth of bone into the defect at the donor site was evaluated on the panoramic x-ray. Bone ingrowth was classified as successful if no residual defect was seen.

RESULTS

Medical Records

The patients had undergone the harvesting procedure at an age ranging from 7.9 to 29.6 years (mean 11.8 ± 3.6 years; median 11.7 years). Only one adult patient participated in this study. In all cases, a sufficient amount of bone could be harvested to reconstruct the alveolar cleft. With regard to definite dental rehabilitation, no additional grafting procedures were needed. On average, the late morbidity was assessed 4.9 ± 2.5 years after surgery (range, 1 to 8.9 years). With regard to the postoperative complications, wound dehiscence at the donor site was observed in one patient, which healed uneventfully after prescribing a 0.2% chlorhexidine mouth rinse. No other complications were noted.

Questionnaires

None of the patients reported persistent sensory changes. Two patients reported a slight contour change of their chin after the operation. This contour change did not bother them and could not be observed clinically or radiographically.

On a visual analogue scale, the pain experienced related to the cleft grafting procedure averaged 1.2 ± 2.5 (median, 0) for the entire population. Five patients had experienced postoperative pain after harvesting symphyseal bone. The five patients who complained about pain averaged 6.0 ± 2.7 (range, 3 to 8) on a visual analogue scale. In three patients, the pain disappeared within 2 months. The other two patients were pain-free within a year.

Three patients reported a transient sensory disturbance of the chin region. None of the disturbances persisted and all resolved within 1 month.

In twenty-five cases, it took less than 3 months for the patients to consider themselves to be completely recovered. Three patients needed 6 to 12 months to recover. One patient did not answer this question. The questionnaire showed that this patient had no complaints, discomfort, or pain at all. On a visual analogue scale, the harvesting of chin-bone was appreciated with a 6.8 ± 3.5 (range 0 to 10).

Three patients judged the procedure as more dramatic than they expected. Most complaints after surgery concerned the cleft region. Only six patients experienced more problems in the chin region. Eight cases reported no difference between the donor and grafting site.

Twenty-eight patients were satisfied with the surgical result. Two patients were not satisfied, of whom one patient had experienced temporary sensory deficit related to weather changes. Neither the questionnaire nor the clinical examination could give a clear explication for the other patient's dissatisfaction. The surgical scar bothered one patient.

Clinical Examination

Extraoral contour deformations could not be noticed with either visual inspection or palpation. Slight sensory distur-

FIGURE 4 Six months after harvesting the bone graft, the postoperative scar is hardly visible.

bances of the skin in the chin region were observed in two patients. One of these patients had a disturbed gnostic sensibility (tested with a dull instrument) of the chin, whereas the other patient had a vital sensibility disorder (tested with a sharp instrument) of the lower lip. Both patients were unaware of these sensibility disturbances. In all patients, the intraoral mucosa reacted normally to sensibility testing.

Three intraoral scars were clearly visible (Fig. 4). None of these patients had complained about the scar in the questionnaire. One patient with a moderate visible scar reported minor complaints due to irregularity of mucosal tissue. In this patient, a vestibular incision had been used.

Radiographic Examination

The donor site could not be visualized on the panoramic x-ray or on intraoral radiographs for any patient, because the harvesting procedure created proper bone ingrowth in the defect (Fig. 5). In one patient, an endodontic treatment of one lower incisor was performed. The reason for this treatment could not be traced. Neither root resorption nor periapical radiolucencies were observed. In one patient, all pulp canals in the left lower incisors were obliterated. This patient reported also postoperative transient sensibility disorders in the lower front teeth. In another patient, one left lower incisor was obliterated. The obliterated incisors all responded negatively to vitality testing.

Discussion

From this study, it appears that chin bone harvesting for reconstruction of an alveolar cleft is a well-accepted procedure with a low objective and subjective morbidity. According to the questionnaire, the patients' average judgment of the procedure was moderate: on a visual analogue scale (range, 0 to 10), the harvesting of chin bone was appreciated with a rating of 6.8 ± 3.5. Only a few patients experienced a postoperative course that was worse than they had expected.

All patients had undergone the procedure 1 year or more before the evaluation took place. It is important to keep in mind that this long-term interval may have influenced the outcome of the questionnaires. The average severity of postoperative pain observed in this study of young cleft patients was very low (1.2) when compared with the average postoperative pain reported in adults (4.7 ± 2.4) by Kalk et al. (1996) using similar instruments for evaluating morbidity of chin bone harvesting. A possible explanation for this remarkable difference is that in the study by Kalk et al. (1996), morbidity was studied in adult patients in whom the grafting procedure was performed using local anesthesia. The patients in the current study were hospitalized and received standardized adequate, professionally administered pain medication. Furthermore, the grafting procedure was needed in the young cleft patients to obtain continuity of their superior alveolar rim, whereas in the adults, this procedure was an obligatory part of a preimplantology procedure.

Endodontic problems occurred in three patients. Pulp necrosis or devitalization of teeth could be the result of the surgical procedure, because harvesting the symphyseal bone has the potential to damage both the incisive branches of the mandibular nerve and the vascular supply for the teeth. When evaluating this potential hazard of the grafting procedure, it is worthwhile to realize that thermal vitality testing is not a reliable test for pulp necrosis. Seltzer and co-workers (1963)

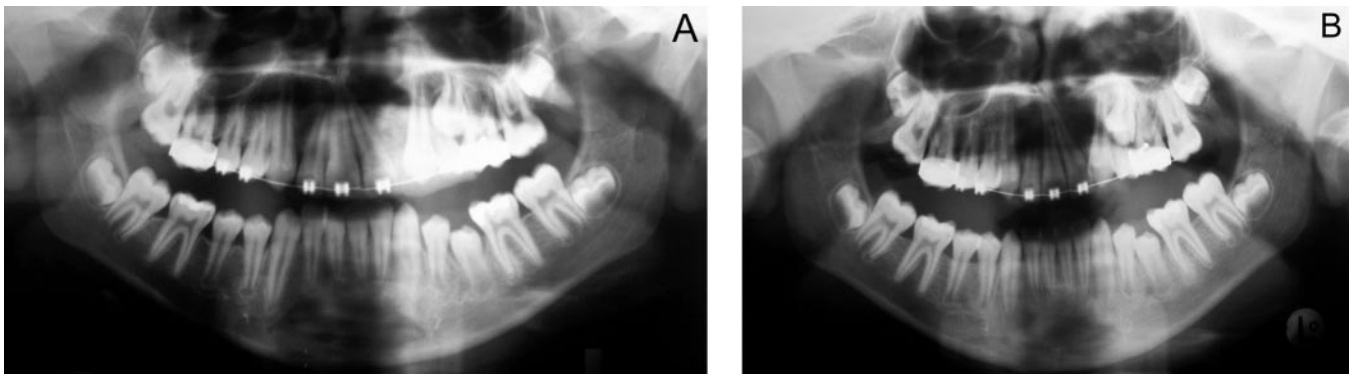

FIGURE 5 Panographic radiographs showing the pre-, early post-, and late postoperative situation. A: One day postoperative, the defect created by the harvesting procedure is clearly visible. B: Six months postoperative, the defect created by the harvesting procedure is filled with bone.

validated clinical thermal pulp-testing by postextraction histology findings, and reported that thermal vitality testing showed a false positive result in 22% of the cases, whereas the outcome was a false negative in 5% of the cases.

It has been posited in the literature that membranous bone grafts show early revascularization. Within 3 days, blood vessels penetrate membranous bone grafts more extensively than endochondral bone grafts. It has been postulated that this rapid vascularization prevents bone grafts from resorption (Zins et al., 1983; Kusiak et al., 1985). Because of its membranous origin, symphyseal bone is potentially a better grafting material for intraoral reconstruction than iliac crest bone. A second obvious advantage of harvesting symphyseal bone instead of iliac crest bone or bone from other donor sites is the convenient surgical access. The proximity of donor and recipient site reduces the time needed for anesthesia and surgical treatment. This advantage also applies to the other intraoral donor sites. The use of monocortical bone grafts is advocated, because a bicortical procedure may develop a hematoma at the mouth floor. In cases of insufficient amount of symphyseal monocortical bone, iliac crest bone should be harvested instead.

The results of this study show that chin bone harvesting for reconstructing alveolar clefts is a well-accepted procedure with a low objective and subjective morbidity. The patients (and their parents), however, must be informed about the risk of objective and subjective sensory disturbances in the donor region and the risk of dental pulp necrosis.

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Appendix

Questionnaire (translated from Dutch)

In the interest of this research, it is very important to answer the questions as accurately as possible. The questions deal exclusively with the functioning of your lower jaw in relation to bone removal from the chin region for reconstruction of the cleft in your upper jaw.

1. Did you experience any complaint related to removal of bone from your chin?
   - Yes
   - No

2A. Did you suffer from any postoperative pain at the site where the bone was removed? (This was at the chin.)
   - Yes
   - No

   If the answer to question 2A is YES, then answer question 2B.

   If the answer to question 2A is NO, then skip questions 2B and 3 and proceed to question 4.

2B. How much pain did you suffer at the site where bone was removed? (Mark with an X on the black line.)

   |———————————————————|

   0 (no pain at all) 10 (severe pain)

3. How long did you suffer from pain in the region where the bone was removed?
   - Less than one week
   - Less than one month
   - 1–2 months
   - 2–3 months
   - 3–6 months
   - 6–12 months
   - More than one year
   - I still suffer from pain

4. Do weather changes cause you to experience pain or sensory disturbances at the site where the chin bone was removed?
   - Yes
   - No

5A. Did the sensibility of your lower lip, chin, or lower incisors change after the operation?
   - Yes
   - No

   If the answer on question 5A is YES, then answer questions 5B and 5C.

   If the answer on question 5A is NO, then skip questions 5B and 5C and proceed to question 6.

5B. In what way did the sensibility change?
   - Decreased sensibility in this area
   - I do not feel anything in this area
   - The area is painful when I touch it

5C. How long did this change last?
   - Less than one month
   - More than one month. It lasted for. . . . . months

- This change of sensibility persists.

6. Did the shape of your chin change after the operation?
   - Yes
   - No
7. How much time did it take to recover completely from the operation?
   - Less than one month
   - 1–2 months
   - 2–3 months
   - 3–6 months
   - 6–12 months
   - More than one year
8. Was the procedure for removing bone from your chin unpleasant? (Mark with an X on the black line.)

   0 (very unpleasant) 10 (no problem at all)
9. Did the complaints and chin pain you experienced after the operation match your expectations?
   - It was as I expected
   - It was worse than I expected
   - It was less than I expected
10. Which jaw caused the most complaints after the surgical procedure?
    - The upper jaw
    - The lower jaw
    - Both jaws caused an equal number of complaints
11. Does the scar inside your mouth bother you?
    - Yes
    - No
12. Are you satisfied with the result of the operation with regard to your mouth?
    - Yes
    - No

Thank you for answering these questions.