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Reconstruction of anterior iliac crest bone graft donor sites: presentation of a surgical technique

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Abstract This study is a prospective evaluation of the reconstruction of anterior iliac crest bone graft donor sites using a technique developed by the authors. We present the technique and the initial results obtained with its use in 15 patients followed up for a period ranging from 6 to 16 months. Reconstruction of the iliac crest is performed using a rib, which is removed by an anterior approach to the spine. The rib is divided into two segments, which are fitted into the

defect created in the iliac crest after removal of the bone graft. Clinical evaluation of the patients found a good cosmetic appearance of the reconstruction site, and the rib segments used showed good radiologic integration. Partial resorption of the segments was observed in two patients, with no effects on the cosmetic result.

Key words Bone graft · Iliac reconstruction · Rib · Spinal fusion · Surgical treatment

Introduction

The need to use a cortico-cancellous bone graft in reconstructive surgery of the anterior portion of the spine often requires the removal of large segments of the anterior iliac crest, which is a recognized bone graft donor site. Several reconstructive techniques of this bone graft donor area have been developed using material ranging from homologous bone grafts to biomaterials [1, 3, 5].

We have developed a technique for the reconstruction of the defect created in the iliac crest during removal of the bone graft using one of the patient's own ribs, which is removed by an anterior approach to the spine [2] (thoracolumbotomy, thoracotomy) (Fig. 3).

The objective of the present report is to describe the technique we have developed for reconstruction of the iliac crest graft donor site and the clinical and radiologic results of its application.

Materials and methods

Reconstruction of the iliac bone graft donor site with rib segments was performed on 15 patients submitted to spinal arthrodesis (14 fractures and one compression of the vertebral canal due to a pathologic fracture). Ten patients were men and five were women, ranging in age from 19 to 65 years (mean age 36 years).

The patients were evaluated over a period ranging from 6 to 16 months (mean 10 months). Only one patient reported mild pain, which he felt only on palpation of the reconstruction site, but which did not interfere with his activities or require the use of medication. The remaining patients reported no pain.

All patients were satisfied with the cosmetic appearance of the reconstruction, showing no skin depression at the site of graft removal, which is a characteristic feature of this region after removal of the bone graft if no replacement is inserted.

Radiologic evaluation showed integration of the rib segments in 13 patients (Fig. 1) and resorption of the upper part of the rib segment in two, with a tapered appearance but with continuity with the iliac bone in these latter cases (Fig. 2). Despite this radiologic aspect, these patients presented no clinical problems and their cosmetic result was good.

Surgical technique

The anterior iliac crest reconstruction technique uses one of the patient's own ribs, which is removed during an anterior surgical ap-

Fig. 1 Illustration of the use of a rib for the reconstruction of iliac crest bone defects

proach to the spine, so that it can be performed on patients submitted to thoracotomy or thoracolumbotomy (Fig. 3).

The removed rib is divided into two segments, which are fitted into the site of removal of the iliac crest graft. The first segment (the larger of the two) is placed in the spongy portion of the iliac crest in order to restore the height of the bone defect, and the second is fitted into the upper margins of the bone defect perpendicular to the first. Restoration of the surface of the iliac crest is facilitated by the shape and contour of the rib, whose curvature and torsion are similar to those of the iliac surface. The two rib segments are simply fitted under pressure into the iliac bone, with no need for any type of additional fixation (Fig. 4).

Discussion

Utilization of a cortico-spongy bone graft from the iliac crest has been a good option for the reconstruction of the anterior portion of the spine because of its ability to support weight and its rapid integration with adjacent bone tissue [4]. A bone graft from the fibula is an alternative option for this procedure, which we have been indicating for situations in which a long bone graft is needed, making the use of iliac crest bone impracticable [2]. Non-biological alternatives have recently become available for restoration of the anterior portion of the spine, such as prostheses replacing vertebral bodies and metal boxes or cages with greater mechanical resistance to application of force [4], which avoid the removal of large amounts of bone from the donor site, whose disadvantages have been mentioned earlier. The use of these materials is still quite limited in our country, although we recognize their advantages.

When performing surgery for reconstruction of the anterior portion of the spine (anterior arthrodesis), we started to think about the fact that we were removing the patient's rib during the procedure of anterior access to the spine without utilizing it, while we were leaving a large bone defect in the iliac crest after removal of the bone graft. We therefore decided to use the rib removed during the surgical approach for the reconstruction of the iliac defect, and we were surprised at how easy it was to fit and fix the rib fragment into the iliac crest, and by the advantages of its curvature and torsion for the reconstruction of the more external and superficial portion of the iliac crest.

The execution of this reconstructive technique has presented no problems and the clinical and radiologic results observed have been highly satisfactory, especially from a cosmetic viewpoint, with no skin depression occurring at the site of bone graft removal in any of the patients.

The execution of this reconstructive technique alone does not prevent some of the complications of the iliac crest graft. It should also be pointed out that, in addition to executing an appropriate surgical technique for bone graft removal, other precautions are very important, such as avoiding surgical incisions over a bone prominence in order to avoid painful scars, and subperiosteal exposure of the iliac crest to protect the femoral cutaneous nerve and to prevent excessive bleeding [2].

We believe that reconstruction of the iliac crest graft donor area with rib segments using the technique described has clinical advantages, and is a less costly procedure than reconstruction with bioactive materials such as ceramics and hydroxyapatite [1]. The long-term results will define the fate of the technique, which can definitely be improved further and expanded by the use of homologous rib grafts.

Fig. 2 A–B Photograph illustrating the surgical steps for reconstruction. **A** Aspect of the iliac crest after surgical exposure; **B** aspect of the iliac crest after bone graft removal; **C, D** placement of

the first rib segment; **E** placement of the second rib segment; **F** final aspect of the reconstruction

Fig. 3 Radiologic aspect 12 months after reconstruction in a 38-year-old female patient

Fig. 4A–F Radiograph of the iliac crest during the immediate postoperative period (**A**) and 9 months after reconstruction (**B**) in a 35-year-old man. Observe the segmental resorption of the rib used in the reconstruction

Conclusion

The developed technique for anterior iliac crest reconstruction presented good clinical and radiologic results, is easy to execute and does not require special resources or implants.

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