

FILLING OF SEGMENTAL BONE DEFECTS IN REVISION KNEE ARTHROPLASTY USING MORSELLIZED BONE GRAFTS CONTAINED WITHIN A METAL MESH

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For revision knee surgery with uncontained tibial bone defects, the authors report the containment of compacted morsellized allograft using metal-wire mesh, followed by implantation of a cemented total knee prosthesis.

This method is comparable to the “impaction grafting technique” described for revision hip surgery and could be an alternative to metal wedges, augmented components, custom-made implants, polymethylmethacrylate or structural bone grafts to solve some problems of cavitory and segmental bone defects in revision total knee arthroplasty.

Keywords : bone defects ; bone grafting ; revision total knee arthroplasty.

Mots-clés : reprise de prothèse totale de genou ; greffe osseuse ; défauts osseux.

INTRODUCTION

The problem of bone defects during revision knee arthroplasty can be solved using polymethylmethacrylate, custom-made implants, metal augmentation wedges in modular total knee systems, or bone grafts.

For uncontained segmental tibial bone defects, we report the containment of tightly compacted morsellized allograft using flexible metal wire meshes in the place of cortical defects, before reimplantation of a cemented total knee prosthesis.

CASE REPORT

A 43-year-old woman with rheumatoid arthritis had undergone bilateral total knee replacement, using Freeman prostheses, in 1982.

A revision procedure was performed on the right knee in May 1996 owing to mechanical loosening with severe tibial bone resorption (fig. 1). After removing the implant, the cement, the fibrous tissue interface and the affected soft bone, we were left with an important uncontained tibial defect with absence of the peripheral cortex of the medial plateau.

This uncontained defect was obliterated using a flexible stainless steel mesh (X-change Revision Mesh, Howmedica, Rutherford, NJ, USA), fixed to the proximal tibia with cerclage wiring. Adequate physical constraint was thus obtained and morsellized graft from two fresh frozen femoral heads was tightly packed into the defect. The cerclage wiring also avoided the risk of splitting and crushing the flimsy proximal tibia at the time of vigorous graft impaction.

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Fig. 1. — Pre-operative xray situation with important tibial bone loss.

Finally, a cemented prosthesis was implanted (AGC-Dual, Biomet, Warsaw, USA), with a 37-mm. cemented tibial stem, a 126-mm femoral stem, and with 5-mm. distal and posterior femoral metal augmentations to compensate for bone defects in the medial femoral condyle (fig. 2).

Based on the comparison of the immediate post-operative xrays (fig. 3a, 4a) with the postoperative films up to the 5-year follow-up (fig. 3b, 4b), our findings suggest graft incorporation and remodeling. The clearly delineated graft-host junction is no longer discernable, the impacted allograft has become identical in radiodensity to the host bone, and a delineated trabecular pattern is visible around the stem, without evidence of graft resorption, implant migration, or radiolucencies at the graft-cement interface.

There were no problems with the soft tissue coverage of the mesh and, at the last follow-up, the patient had a pain-free knee, with a range of motion of 0 to 100°.

DISCUSSION

It has been reported that the use of polymethylmethacrylate, alone or with screws, is a good option to fill bone defects smaller than 5 mm. For larger defects, it poses problems of inadequate cement pressurization, poor trabecular penetration,



Fig. 2. — Surgical reconstruction using a cemented stemmed knee prosthesis, with morsellized compacted allograft contained by a metal-wire mesh on the tibial side.

excessive heat generation, the risk of cement mantle fractures due to its lamination, and an unacceptable amount of strain at the interface under loading (13, 20).

Augmented tibial components, metal wedges and custom-made implants have the disadvantages of high cost, the need to increase the bone deficiency to accommodate the implant, its imprecise fit to the host bone at the time of surgery, and delay in obtaining a custom-made prosthesis (13, 20).



Fig. 3. — Cement demarcation and change in the graft radiodensity compared to that of the host bone from initial anteroposterior xrays (left) to 5-year follow-up (right).

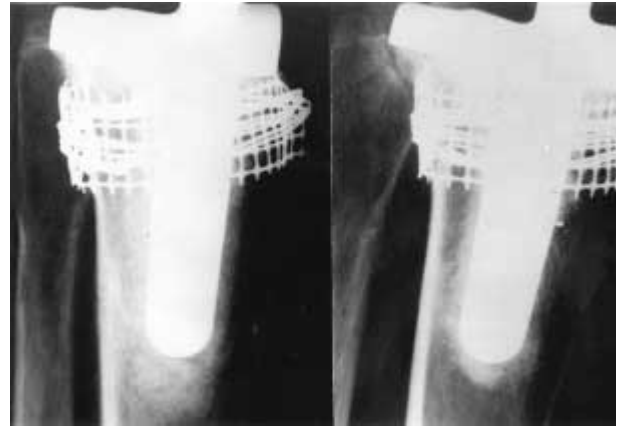


Fig. 4. — Delineated trabecular pattern around the stem and through the graft-host junction from initial lateral xrays (left) to 5-year follow-up (right).

The main benefits of using a graft reconstruction are the adaptability to a wide variety of defect configurations (11, 20) and the fact that the bone deficiency, instead of being increased, may be decreased with gradual graft incorporation to the host bone (3, 4, 7, 8, 9, 10, 15, 20). The potential for long-term success is thus increased and subsequent revisions may be facilitated (1, 2, 11).

Despite the fact that the incorporation potential for autograft is superior to that of allograft (13), allograft (structural or morsellized) is more commonly used owing to the limited availability of autograft without creating considerable donor site morbidity.

Structural bulk allografts have been used for both cavitory and segmental bone defects in revision knee surgery (2, 3, 9, 13, 15, 20). They have the disadvantages that it is difficult to achieve a proper fit in close contact with the host bone (10), they are liable to disintegrate (5, 8) and, although they remain intact, they have frequently not been revascularized and new bone has been laid down only on the periphery of a dead allograft (9). They must be used in combination with long-stemmed components to reduce stress and avoid graft collapse (2, 9, 11); this may in turn make a problem as long extensions may lead to increased bone resorption due to the stress shielding effect of the stem (18).

Morsellized allograft had been used classically to fill cavitory bone defects prior to the implantation of an uncemented prosthesis in total knee arthroplasty (19). Following the experience in revision hip surgery (4, 12, 14, 16), compacted morsellized allograft has also been used recently in combination with cemented stemmed knee prostheses for larger contained cavitory tibial defects (1, 10, 17).

For uncontained segmental bone defects, morsellized allograft and cemented implants have also been used: fixing a flexible metal wire mesh in the place of cortical defects transforms an uncontained defect into a contained one in which it is possible to tightly pack morsellized allograft followed by the implantation of a cemented prosthesis. Good clinical results have been reported with this reconstructive method in revision hip (4, 14) and elbow arthroplasty (6). Histological evidence of graft incorporation has been shown, with regenerated cortical bone, fully mineralized, normal vascular channels and filled osteocyte lacunae under this type of mesh (7, 8).

However, as far as we know, the use of cemented knee prostheses into compacted morsellized allograft contained with a metal wire mesh for segmentary defects in revision knee surgery had not been previously reported. According to the criteria used by the majority of authors (1, 2, 4, 10, 11, 14, 17, 19, 20) our findings with this technique at five

years follow-up suggest graft consolidation, incorporation and remodeling, with a stable implant.

The metal mesh and the cerclage wires were made of stainless steel, while the AGC-Dual prosthesis was made of cobalt-chromium-molybdenum-nickel alloy, and a theoretical cause for concern over the long-term could be the potential problems related to the presence of these two different alloys.

Despite the limitations of a case report and the mid-term follow-up, this result is encouraging, suggesting that this method could be a valid alternative for uncontained segmental tibial defects during revision total knee arthroplasty, avoiding the disadvantages of other reconstructive options and with the advantages of morsellized bone grafting.

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SAMENVATTING

M. A. SUÁREZ-SUÁREZ, A. MURCIA, A. MAESTRO. Segmentale defectvulling bij revisie van knieprotheses met aangestampte beenfragmentjes in een metalen netwerk. Technische nota in een geval.

Het probleem van de ondersteuning van stevig aangestampte losse botentjes in segmentale botdefecten van de tibia zonder corticale wand bij de revisie van een knieprothese werd door de auteurs opgelost door het aanbrengen van een metalen netwerk rond de greffen verstevigd met cerclage, naar analogie met de impactie

greffe techniek gebruikelijk bij heuprevisie. Zij stellen deze methode voor als een alternatief voor metalen wiggen, maat protheses, cementopvulling en volledige segment botgreffen. Bondige literatuur discussie.

RÉSUMÉ

M. A. SUÁREZ-SUÁREZ, A. MURCIA, A. MAESTRO. Comblement de pertes de substance osseuse segmentaires dans la reprise d'arthroplastie du genou au moyen d'allogreffes fragmentées à l'intérieur d'un filet métallique.

Les auteurs présentent une technique applicable aux reprises de prothèse du genou avec pertes de substance osseuse ouvertes : cette technique comporte le comblement par des fragments d'allogreffe tassés à l'intérieur d'un filet métallique, avant réimplantation d'une prothèse cimentée. Cette méthode est comparable à la méthode de greffes tassées décrites dans la reprise d'arthroplasties de hanche ; elle pourrait représenter une alternative aux coins métalliques, aux implants sur mesure, au comblement par ciment ou par greffes osseuses massives, pour faire face à certains problèmes de perte de substance osseuse cavitaire ou segmentaire dans les reprises d'arthroplastie du genou.