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ORIGINAL ARTICLE

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Acetabular roof reconstruction with pedicled iliac graft

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Abstract Reconstruction of the acetabular roof in patients with hip dysplasia shows disappointing mid-term results due to insufficient incorporation and collapse of the bone graft. We have developed a new reconstructive method using a pedicled iliac graft. We simulated surgical reconstruction of the acetabular roof in ten cadaver specimens. The purpose was to evaluate whether the deep circumflex artery was long enough to allow transfer of the graft without requiring micro-vascular anastomosis. In all cadavers, the length of the pedicle was sufficient to reach any desired position of the acetabular roof. The use of such a pedicled structural graft may provide good primary stability and allow local bony remodelling and incorporation under load.

Résumé Dans la dysplasie de la hanche, la reconstruction du toit acetabulaire donne des résultats décevants à moyen terme à cause de la mauvaise intégration et de l'effondrement de la greffe osseuse. Nous avons développé une nouvelle méthode de reconstruction qui utilise un greffe iliaque pédiculée. Nous avons simulé cette reconstruction chirurgicale du toit acetabulaire sur dix cadavres. Le but était d'évaluer si l'artère circonflexe profonde était assez longue pour le transfert de la greffe sans anastomose micro-vasculaire. Sur tous les cadavres la longueur du pédicule était suffisante pour permettre le placement désiré du toit acetabulaire. L'usage de telle greffe structurelle pédiculée peut fournir une bonne stabilité initiale aussi bien qu'une bonne possibilité de remodelage osseux avec une incorporation sous la contrainte de charge.

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Introduction

Appropriate positioning of the acetabular component during total hip replacement in patients with hip dysplasia is often difficult [6, 21, 24]. The placement in the true acetabulum is preferable for mechanical reasons. Where there is inadequate bone stock at the level of the true acetabulum, some authors advise cotyloplasty (controlled medialisation) while others advise placing the cup superiorly where the bone stock may be better, but not laterally [7, 8, 9, 28, 33].

In many patients with hip dysplasia and deficient bone stock, some kind of reconstruction is necessary. However, revision rates after using these reconstruction techniques are high – between 30% and 50% after between 4 and 8 years [12, 13, 18, 22, 36, 37]. The results are even less favourable if the cup is less than 50% contained within the original acetabulum. Although special designs of augmented acetabular components are available, most surgeons prefer to use biological reconstructive techniques [3, 14, 15, 17, 27, 29, 30, 35]. Numerous bone-grafting techniques have been reported, and autologous grafts have been found to be superior to homologous grafts. However, the amount of available autologous graft is limited, and homologous grafts often are used, particularly in revision procedures [2, 6, 10, 20, 21, 24, 26].

When large structural grafts are used for such reconstruction they give good early results but have a high mid-term failure rate due to collapse of the graft under load. Large structural corticocancellous grafts incorporate slowly and incompletely [5, 12, 13, 18, 22, 31, 36, 37].

We have therefore developed a new method for reconstruction of the superolateral acetabular rim using a vascularised iliac graft based on the deep circumflex artery and vein (Fig. 1). The purpose of this study is to describe the operative technique and to assess whether the deep circumflex pedicle is long enough to allow transfer of such a graft without the need for micro-vascular anastomosis.

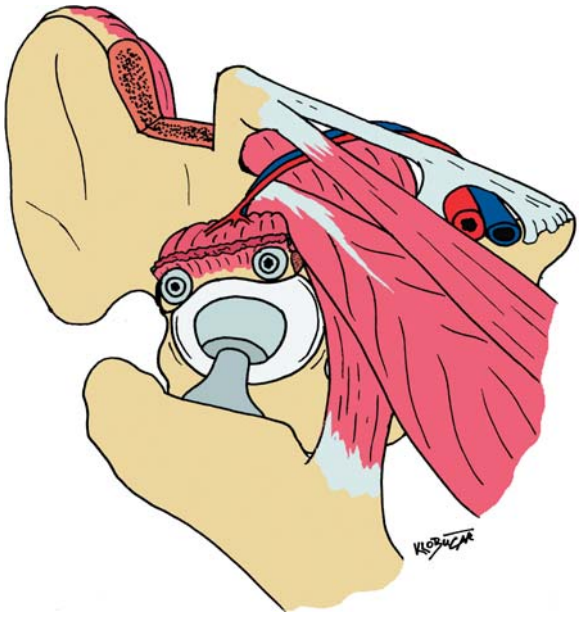

Fig. 1 Vascularised iliac graft based on deep circumflex pedicle

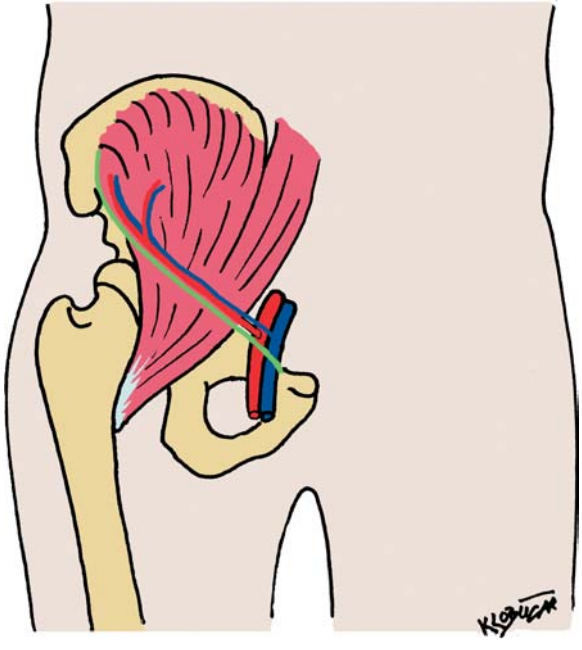

Fig. 2 Incision is placed along the upper border of the inguinal ligament and iliac crest

Material and methods

An experimental study was undertaken on ten cadaver specimens simulating the operative procedure of acetabular roof reconstruction in patients with hip dysplasia. A standard Bauer lateral approach with the patient in the supine position was used to expose the hip. Meticulous exposure of the acetabular rim wae performed, and the bone stock was evaluated.

An additional incision was used along the upper border of the inguinal ligament and iliac crest (Fig. 2). The external oblique

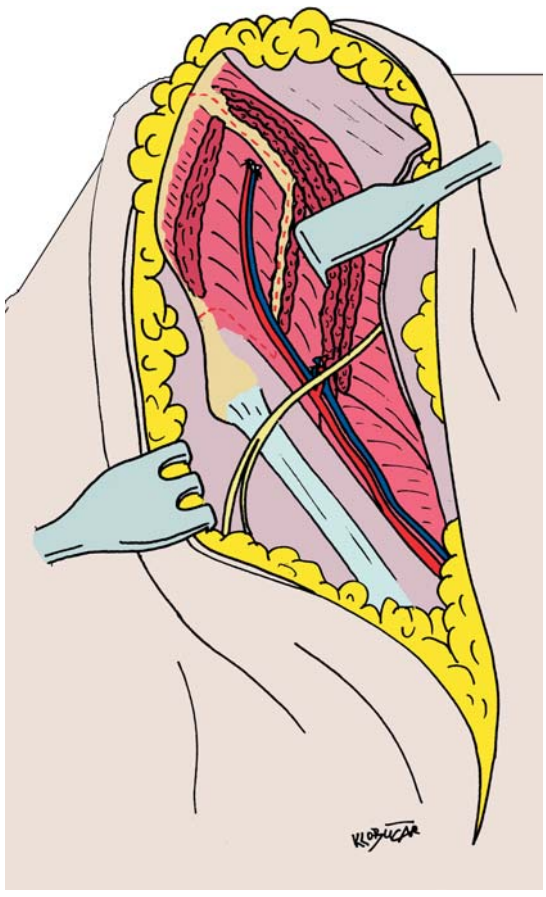

Fig. 3 Exposure of deep circumflex pedicle. Iliac muscle is divided at least 1 cm below the course of pedicle

aponeurosis was split 1 cm above and parallel to the inguinal ligament, from the mid-point of the ligament to the anterior superior iliac spine. The spermatic cord, or round ligament, was retracted and the posterior wall of the inguinal canal exposed. The external iliac artery was easily identified, and the deep circumflex iliac artery and vein exposed. About 1 cm medial to the anterior superior iliac spine, the lateral femoral cutaneous nerve was identified and protected. The ascending branch of the deep circumflex iliac artery was identified and ligated. After dissection and protection of the vascular pedicle of the deep circumflex artery and vein, the incision was extended laterally. The three layers of abdominal muscles were detached from the iliac crest. The iliacus muscle was divided at least 1 cm below the course of the deep circumflex iliac bundle to allow exposure of the inner surface of the ilium (Fig. 3). The anterior superior iliac spine remained intact to allow a satisfactory cosmetic outcome. Subperiosteal stripping of the gluteus medius muscle was performed if a full thickness iliac crest graft was required or, alternatively, only the inner table was used if a graft of lesser thickness was required. A tunnel was easily prepared beneath the inguinal ligament and the sartorius muscle, and the graft was passed under them to the desired position at the acetabular rim (Fig. 4). Rarely, if a very large graft was required and could not be passed under the inguinal ligament and sartorius muscle, their proximal origin was released and later repaired.

The original acetabulum was reamed down to the inner table. The graft was contoured to the recipient area of the pelvis and secured with two lag screws with washers. The inferior portion of the graft may be trimmed with a reamer to create a smooth transition between the original acetabulum and the grafted roof (Fig. 5). The screws were tightened further before the cup was inserted. A

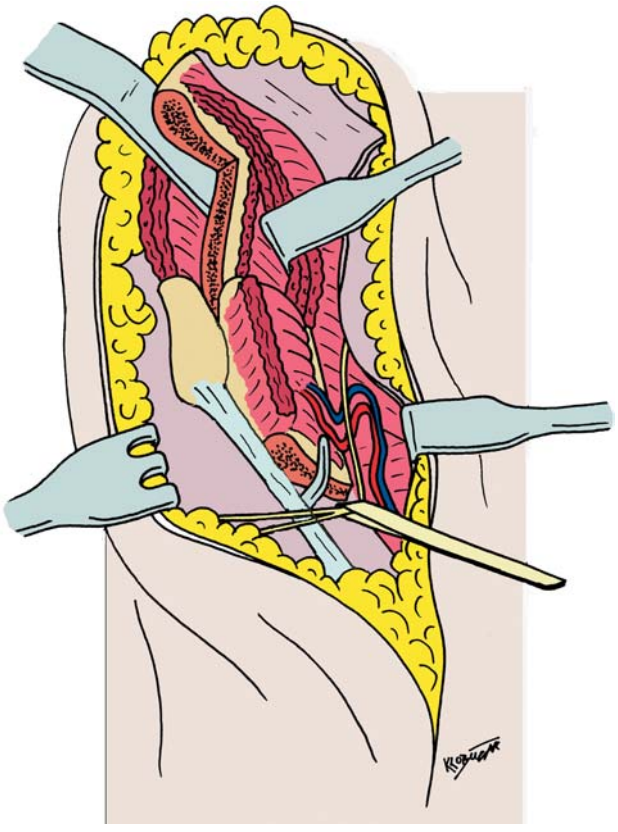

Fig. 4 The tunnelling of the graft underneath the inguinal ligament and the sartorius muscle

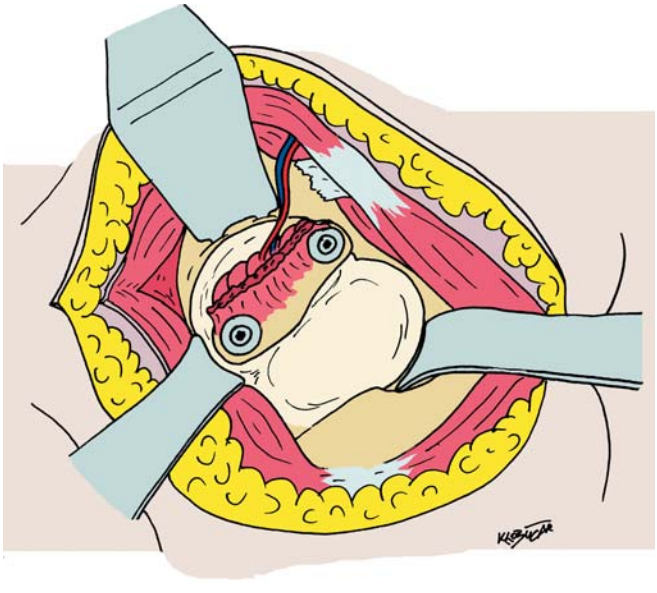

Fig. 5 The graft is placed and secured with two lag screws with washers

meticulous closure of the donor site was undertaken. The iliacus muscle was sutured to the transversalis muscle and fascia (Fig. 6). The internal and external oblique muscles were sutured to the gluteus medius and tensor fascia lata muscles (Fig. 7). The inguinal canal and ligament also were also repaired.

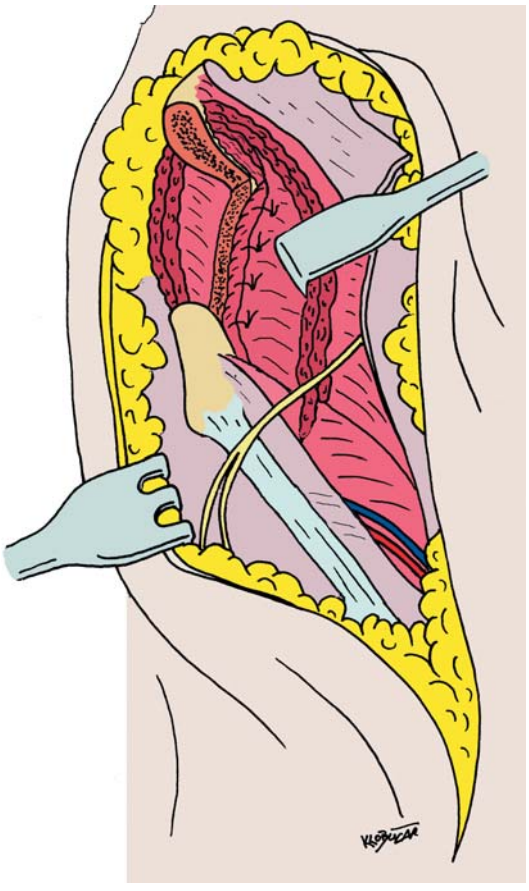

Fig. 6 The iliac muscle is sutured to transversalis muscle and fascia

Results

An experimental study on ten cadaver specimens was performed simulating the operative procedure of a total hip replacement in patients with congenital hip dysplasia. In all cadavers, the vascular pedicle was of sufficient length to allow the grafts to be placed in the desired position at the superolateral acetabular rim without tension (Fig. 8). Thus, local vascularlised bone transfer may be achieved without requiring micro-vascular anastomosis.

Discussion

Patients with dysplastic hips present for total hip arthroplasty at a relatively young age and often have deficient acetabular bone stock. The most commonly used standard procedures for hip replacement have given disappointing results, with revision rates of between 30% and 50% after between 4 and 8 years, due to the collapse of the autologous or homologous bone grafts [2, 6, 7, 12, 13, 18]. Vascularised bone grafts have been shown to have a much better biological potential, as they contain viable bone cells and a blood supply and do not require re-vascularization from the host bone. Vascularised bone

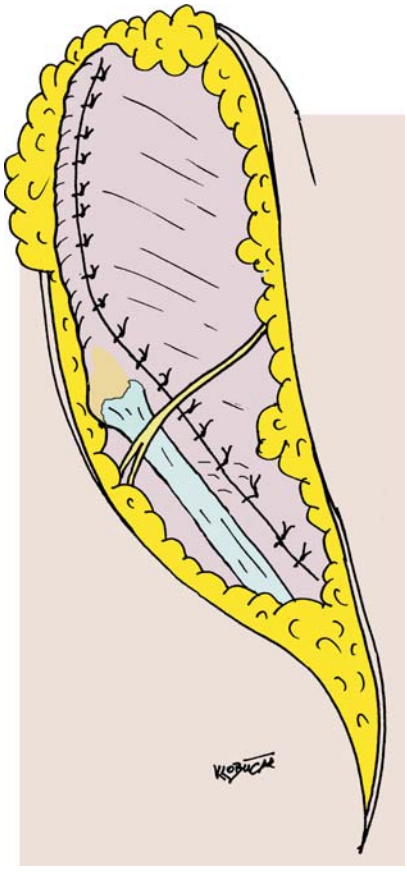

Fig. 7 Internal and external oblique muscle are sutured to the gluteus medius and tensor fasciae late muscle

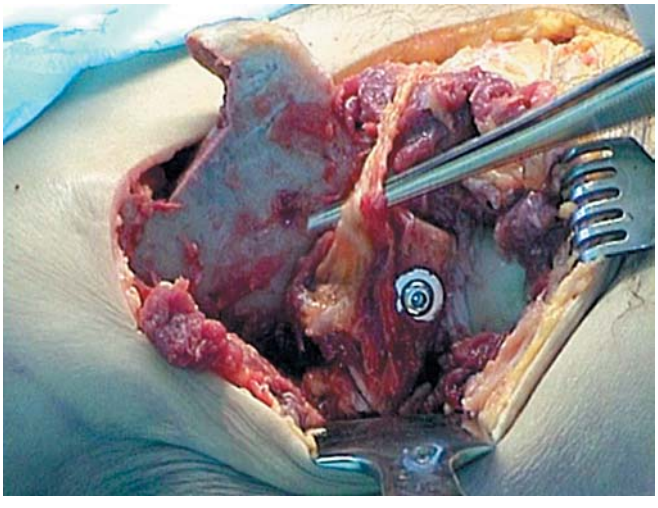

Fig. 8 Vascular pedicle in all cadaver specimens was long enough to allow the placement of the graft without any tension

grafts have been compared with non-vascularised grafts in numerous experimental and clinical studies. They show more rapid incorporation and better adaptation to the new mechanical loading with graft hypertophy, and a higher survival and consolidation rate under adverse conditions such as in the presence of infection or when the recipient bed is poorly vascularised. Such bone grafts have been used in many sites and show excellent potential for remodelling [1, 11]. The most common complications of such procedures relate to the mirco-vascular anastomosis that maybe required. The incidence of these complications maybe as high as between 40% and 60% and, even in expert hands, is not below 10% [11]. Therefore, ideally, a bone graft should be transferred from a nearby site so that it need not be detached from its vascular pedicle and the complications associated with a micro-vascular anastomosis avoided. Such pedicled bone grafts have been successfully used since the beginning of the twentieth century but, to our knowledge, they have not been used to augment total hip replacement [4, 11, 16, 19, 23, 25]. Although there are other possible donor sites available for the reconstruction of the acetabular roof, vascularised iliac bone graft based on the deep circumflex iliac artery is ideal due to the long length of the pedicle and the fact that the vessels are of adequate diameter to allow the procedure [32, 34].

The use of such a pedicled bulk structural graft provides both good primary stability and good potential for bone remodelling and incorporation under load. However only mid- and long-term clinical studies will show the outcome after this reconstruction procedure.

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