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Femoral Head Autograft to the Iliac for Use in Future Revisions of Total Hip Arthroplasty: 15-Year Follow-Up

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Abstract

Introduction: The therapeutic success of total hip arthroplasty (THA) is unquestionable. However, in young patients, it is still a controversial topic, not because of the results obtained, but because of the presumed need for revision of the prosthetics components in the future. **Objectives**: The present work performs a retrospective study of patients who underwent THA surgery in the past, in which the femoral head was transferred to the iliac for use in future revisions of total hip arthroplasty (autograft), and describes the proposed technique. **Methods**: The research reviewed 27 patients operated on using the femoral head autograft technique for the ipsilateral iliac in total hip arthroplasty, performed from 1996 to 2005; the study considered medical records, X-rays and CT scan images, and photographs taken at the time of surgery. **Results**: To date, only two revisions of total hip arthroplasty have been performed, in which the patients have benefited from the technique of autografting of the femoral head. No case evolved with infection or any other type of complication. All inserted grafts are consolidated and integrated with the iliac. **Conclusion**: The autograft technique is cheap, simple and reproducible, making available large amounts of bone for use in future revisions of total hip arthroplasty in young patients.

Keywords

Total Hip Arthroplasty, Bone Graft, Revision of Total Hip Arthroplasty,

Femoral Head

1. Introduction

Many years after the concepts were eternalized by Sir John Charnley, total hip arthroplasty is today one of the most successful therapeutic procedures of all surgical areas [1] [2] [3]. The concept of replacing a natural joint with prosthetic components involves complex variables that continue to evolve [2]. There are dozens of materials to be used, types of fixations and tribological pairs that essentially try to mimic the natural joint [4] [5].

Although most of the procedures performed are for the treatment of primary or secondary osteoarthritis, total hip arthroplasty is an extremely versatile technique for resolving multiple orthopedic and traumatological diseases [2]. With the ageing of the population, there is a trend that this procedure becomes a more frequent surgery since the prevalence of osteoarthritis in the elderly is significant [5] [6]. The improvement of the prosthetic components employed in terms of durability, resistance and fixation will possibly make total hip arthroplasty a more long-lasting procedure, until a revision of the implants is necessary [3] [4] [5] [6].

Despite all the historical therapeutic success, total hip arthroplasty in younger patients makes surgical indication an even more controversial topic, not because of the results obtained, but because of the presumed need to review the components in the future [7] [8]. The revision of total hip arthroplasty is a highly complex procedure, since all surgical risks and complications present in the primary technique are increased, in addition to the fact that parts of the patients develop differently, and over time, acetabular and femoral bone failures may be of different magnitudes [6] [7] [8]. Although they often are insufficient to fill these bone cavities, autologous grafts have mechanical and biological properties considered to be ideal for restoring these tissue failures [8] [9] [10]. The most commonly used source bone is the posterior or anterior iliac, but grafts of the fibula, ribs, femoral condyles, tibial plateau, radius and ulna have also been described [8] [10] [11]. The need to use bone tissue provided space for allogeneic grafts, xenografts and even synthetics, where the basic objective is to fill bone gaps, osteointegrating to the patient himself [11]. It should also be noted the difficulties of obtaining bone grafts in tissue banks, since they are rarely available and difficult to access for most surgeons. This type of technique can be useful in cases where it is difficult to obtain trabecular metal, due to the high costs of the implants involved, or when a bone-preserving technique is desired. The present work carried out an unprecedented study, with no similar articles in the literature, a retrospective of patients undergoing total hip arthroplasty (THA) surgery in the past, in which the femoral head was transferred to the iliac for use in future revisions of total arthroplasty (autograft), and describes the proposed technique.

2. Methods

The study was submitted to and approved by the Research Ethics Committee of our institution. All cases were operated on at the Santa Casa Hospital Complex in Porto Alegre. It consists of a retrospective study of 27 patients operated on using the femoral head autograft technique for the ipsilateral iliac at the time of primary THA, performed between 1996 and 2005. Data and article began to be written in 2020, 15 years after the last case have been operated on. All patients were instructed and informed about the technique described to be performed and agreed with the autograft of the femoral head in the iliac to be used in a future revision of the arthroplasty.

The inclusion criteria for the research were healthy and young patients (<40 years old) with primary or secondary osteoarthritis in which total hip arthroplasty was performed with autograft from the femoral head to the iliac. No patient was previously operated on the hip.

No patient operated by the technique presented was excluded from this article. The 27 patients refer to the number of patients operated on in the specified time.

The surgeries were performed almost 20 years ago, a time when trabecular metal was not widely available and tribological pairs wear out more. Therefore, new options needed to be created.

Medical records, radiographs and computed tomography and photographs obtained at the time of surgery and postoperatively were reviewed and analyzed. The analyzes were performed by 03 orthopedists and traumatologists with experience in hip surgery. Data were collected at 1, 5, 10, and 15 years after surgery using the proposed technique to assess outcome.

The identity of the patients was kept confidential, serving only for the purpose of documentation or illustration of the technique presented in this work.

3. Description of the Technique

Patients are operated in the supine position in all cases, and two access points are used. The first access is the routinely used approach to total hip arthroplasty (anterolateral), and the other one is performed to include the femoral head graft in the iliac.

After total hip arthroplasty, the iliac wing is exposed with a curvilinear incision, from 3 cm of the upper anterior iliac spine, in a superior and posterior direction of approximately 8 cm. The iliac wing in its anterior and middle thirds is osteotomized using chisels, and the internal and external boards are separated to simulate the opening of a book. The femoral head, after cartilage stripping, is cut into 3 or 4 triangular wedges and implanted between the iliac boards under pressure (**Figure 1**). Suction drains are used for THA and the iliac in which the graft is placed. All drains are removed within 48 hours of the procedure. The patients are maintained with partial support for 3 weeks, being progressively released to full bearing according to the pain and are monitored by physiotherapists of our team.

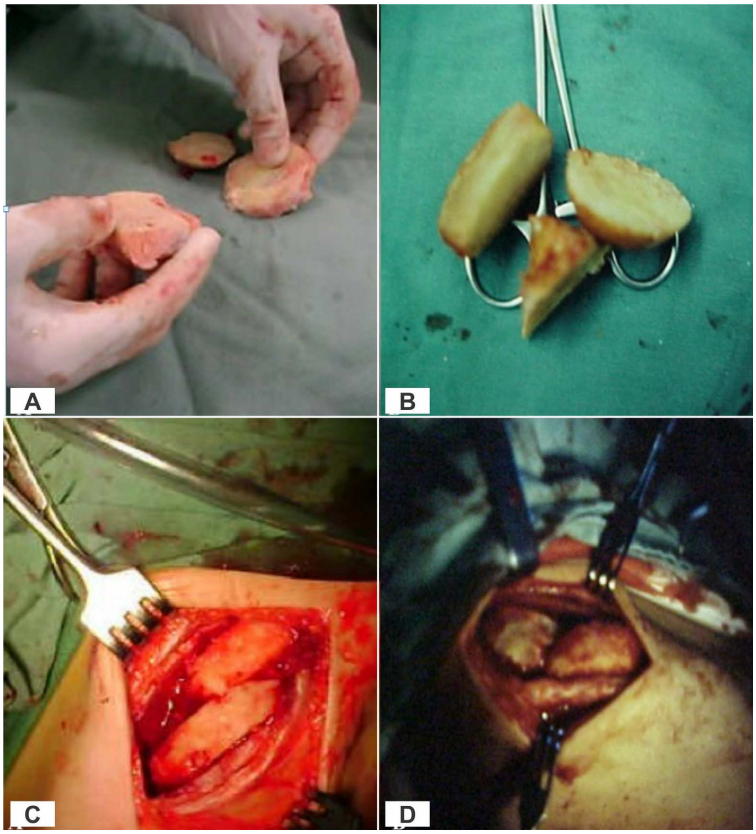

Figure 1. Surgical technique: femoral head (A) after the removal of the cartilage; (B) femoral head osteotomized in 3 to 4 triangular wedges; (C) and (D) two cases showing the insertion of bone wedges of the femoral head between the iliac boards in an "open book".

4. Results

Twenty-seven patients underwent a series of 30 total hip arthroplasty, being three individuals with bilateral THA at different times, when the respective femoral heads were inserted into the iliac wing homolateral to the surgery as an autograft. Eighteen patients were male and nine were female. Twenty arthroplasties were performed on the right side and ten on the left side. The youngest patient was 18 years old at the time of the procedure and the oldest 39 years old. The average age was 30.5 years (±4.6). As for the initial diagnosis, 2 patients had rheumatoid arthritis, 2 sequelae of hip dysplasia, 3 patients had ankylosing spondylitis, 8 avascular osteonecrosis of the femoral head, and 12 were classified as primary osteoarthritis.

The prostheses used were 5 cemented (Charnley), 6 hybridized with non-cemented spherical acetabulum and cemented femoral stem, and 19 were cementless prostheses with threaded acetabulum and non-cemented stem. A metallic femoral head and conventional polyethylene was the tribological pair of choice for all surgeries.

The same access routes were used to review the cases as previously used. Two patients evolved with meralgia paresthetica, with spontaneous improvement. The 27 patients were questioned about the anti-aesthetic effect of the iliac enlarge-

ment: 18 considered it acceptable and 9 were indifferent (Figures 2(A)-(D)). No case evolved with infection or any other type of complication. All grafts inserted in the iliac consolidated in an average time of 4.40 months (SD ± 1.34) (Figures 2(G)-(J)).

Nineteen patients were followed up with periodic annual clinical and radiological examinations for 15 years. During the follow-up, 2 patients died for reasons other than the procedure and in 6 patients, there was loss of follow-up after at least 7 years.

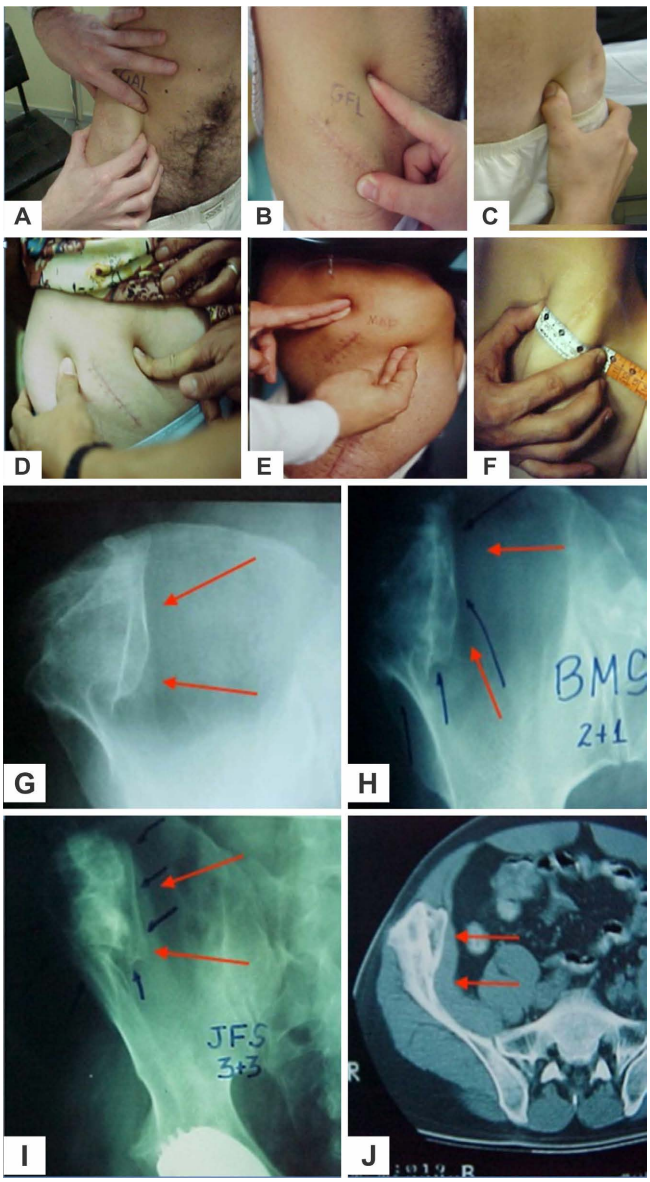

Figure 2. Clinical and radiographic appearance of patients who underwent THA and performed the proposed technique: (A) to (F) six clinical cases in which the femoral head graft is integrated into the iliac. There is an increase in bone volume at the surgical site; (G) a (I) radiographic images of the femoral heads inserted into the iliac (red and black arrows); (J) Axial computed tomography section of a case in which the autograft was inserted.

To date, only two cases performed with the technique of autografting have been reviewed. In the review of these total hip arthroplasty cases, both occurred due to aseptic failure of the acetabular component and the iliac already grafted from the femoral head was used. In one case there was extensive femoral osteolysis, but with a fixed component. The graft from the technique was sufficient for the acetabular and femoral revision.

One of the reviewed patients, a 47-year-old male, was previously operated in 1996 in which a total hip arthroplasty (metal-polyethylene) with cemented stem and threaded cementless acetabulum was used (**Figure 3(A)**, **Figure 3(B)**). He had significant impairment of function and pain in his right hip. It evolved with acetabular loosing and acetabular migration with important progressive osteolysis after 13 years of the primary procedure. The acetabular deficiency was of the cavitary type with lateral segmental defect classified as Paprosky IIIB [12].

Although it presented important posteromedial osteolysis, the femoral component was fixed, verified during intraoperative stability tests, and it was decided to keep the stem in place. The reconstruction of the right hip was performed using an acetabular reinforcement ring (**Figure 4(A)**, **Figure 4(B)**) with the autologous graft obtained from the homolateral iliac (**Figure 4(C)**, **Figure 4(D)**), in which the femoral head was stored, and with a cemented acetabular component. Posteromedial femoral osteolysis was treated with curettage and placement of the remaining iliac graft from the stored femoral head. The patient was kept without support for 3 months until showing signs of radiological consolidation

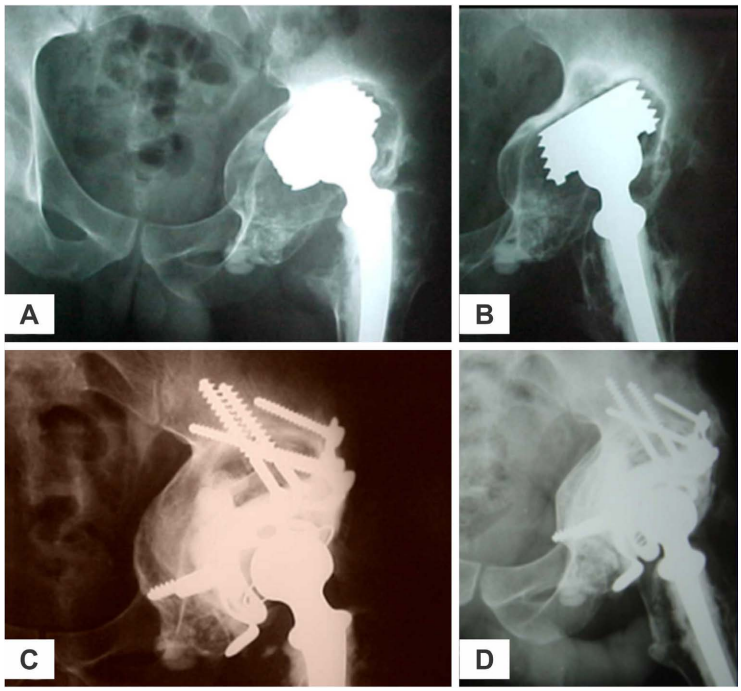

Figure 3. Case 1: (A) and (B) present the radiographic images of aseptic acetabular loosening in hybrid total hip arthroplasty; (C) post-operative radiographic images of acetabular revision with pelvic ring and iliac graft; (D) radiographic image 8 years after revision.

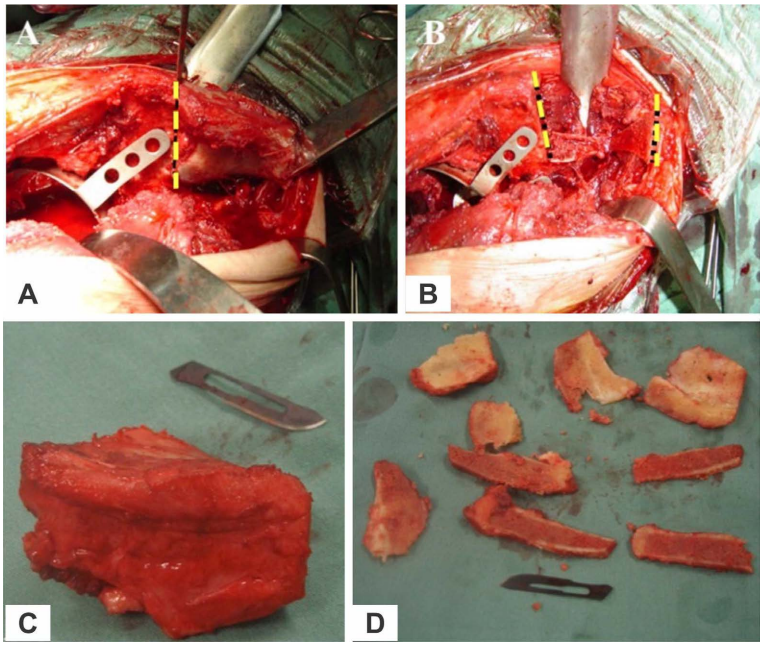

Figure 4. (A) Clinical image of removal of the iliac graft during the review of case 1; (B) final aspect of the iliac after removal of the graft; (C) graft obtained from the iliac for the revision; (D) volume of autologous bone graft resulting from removal (scalpel blade number 20 used for comparison).

(**Figure 3(C)**, **Figure 4(D)**), being progressively released to basic daily activities. He evolved with acceptable hip functions after 8 years of evolution, having a Harris Hip Score of 89 [13].

The second patient benefited by the technique was initially operated on in 1998, using a total hip arthroplasty with threadless cementless acetabulum and cementless stem. The 55-year-old male patient developed aseptic loosening of the acetabular component 11 years after the first procedure (**Figure 5(A)**, **Figure 5(B)**). He presented acetabular failure classified as Paprosky IIIA [12]. He exhibited significant impairment of right hip function. The femoral stem was fixed, and it was decided to keep it. The acetabular failure was grafted with the available iliac and the acetabular component was replaced by an uncemented spherical with two screws. The patient was kept without support for 3 months until showing signs of radiological consolidation, being progressively released to basic daily activities. He evolved with good hip functions after 10 years of follow-up (**Figure 5(C)**, **Figure 5(D)**), having a Harris Hip Score of 91 [13].

5. Discussion

The present research performed a retrospective study of patients who underwent THA surgery, in which the femoral head was transferred to the iliac for use in future revisions of total hip arthroplasty (autograft), and describes the proposed technique. The concept of an ectopic tissue bank, first described by Godina in 1986, included techniques and indications for storing body parts for later reimplantation [14]. Since then, similar alternatives for using the human body as a

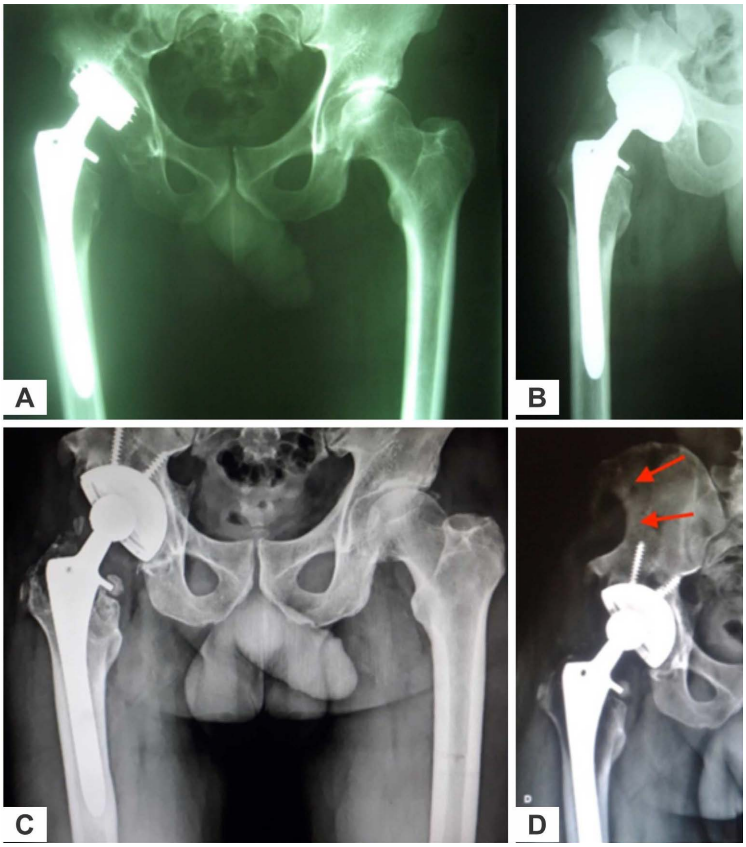

Figure 5. (A) Radiographic image of the pelvis in Case 2; (B) AP radiographic image of the right hip in the immediate postoperative period of the review; (C) radiographic view of the AP pelvis 15 years after the THA review; (D) right hip AP radiography showing removal of the ipsilateral iliac auto graft used in the revision (arrows).

storage location have been reported in other surgical medical areas with promising level of success. There are some studies in the literature in which fragments of the skullcap are temporarily stored in the abdominal wall for later grafting to the skull at a more favorable time [14]-[20], and plastic surgeons use the skin and vessels from a location for storing limbs (fingers, hands, feet, ears) for subsequent replantation [14]-[20]. Although the idea of storing the femur head in the iliac is innovative, the concept is already widely established in medicine.

We remind the reader that this work was written approximately 15 years after the last surgery was performed. There were less durable tribological pairs than currently and trabecular metal for total hip arthroplasty revisions were also less available. This type of article is unprecedented in the literature, a review was carried out in the main databases.

The arthroplasty for the treatment of hip diseases in young patients is still a controversial topic in orthopedics [6] [7] [21] [22]. Definitely, biological solutions still have a place in the contemporary therapeutic arsenal, although some others choose to indicate initial management preferably by prosthetics [21] [22] [23]. Improvements in material designs and surgical technique have led to increased confidence in the indication of THA in young and active patients [6] [7]

[21] [22]. The concept of bone preservation is being gradually superseded due to the excellent functional results obtained by total hip arthroplasty, even if it means a long-term review of the components [7] [9] [12] [21] [24]. Although there was a significant improvement in the materials used during the procedure, after a few years it is inevitable that a considerable proportion of patients progress to the need to replace the implants, mainly due to the aseptic loosening [2] [6] [12] [24].

When there is no immediate need for the use of the femoral head during total hip arthroplasty, it may have one of two destinations: to be neglected or stored in a bone bank. Most of the time it is disposed of in the trashcan, due to the fact that there is no structure for collecting bone banks available in all hospitals. However, there is a possibility not yet described in the literature: keeping it inserted in the patient's own iliac to be used in the future in a possible revision surgery, which is the proposed idea of the present research. Although we have not had any significant complications, it is known that some patients may progress with infection, paresthesia, meralgia, and wound dehiscence, abdominal hernia, among others [25] [26] [27] [28] [29].

The bone deficiency found in revision surgeries may be due to excessive bone removal during primary surgery, either intentionally or inadvertently, and mainly due to osteolysis, loosening and migration of prosthetic components over time [7] [8] [12]. Grafts are necessary to fill these bone defects and enable the fixation of new implants, both from a mechanical and biological point of view [26] [30]. An appreciable portion of these individuals will require grafting techniques to fill these present acetabular and femoral bone losses [9] [12] [24].

There are lots of reports in the literature about complications during graft removal [23], including fractures of the iliac wing during the process of major resections [28] [29]. Regarding the origin of bone grafts, they can be: autogenic, originating from the same recipient, allogeneic, originating from others individuals of the same species of the recipient and xenogeneic, coming from individuals of different species of the recipient, in addition to the current synthetic bone grafts [30]. To supply the lack of local bone without causing extra comorbidities to an already considerable surgical procedure, options were sought by grafting on other humans or even other animal species [10] [11] [30]. Although they share the advantage of not attacking a patient's donor site, they are not yet ideal alternatives. In revision surgeries for total hip arthroplasty, the allogeneic graft is widely used, but it requires a bone bank recognized and standardized with international standards [10] [12] [30]. Currently, we know that it is not a reality available in all locations, however, even so, it can transmit infectious and tumor diseases [10] [11]. Less frequently, xenografts are also used in arthroplasty revision surgeries; they are easy to obtain and have chemical and mechanical characteristics similar to human bone, although further research is still needed for further development [11] [30].

The iliac crest is the most common donor site due to its easy access, low mor-

bidity and the ability to supply cortical and medullar bone [8] [10] [14]. Autogenous bone grafts are widely used in orthopedics for their biological properties and non-immunological response compared to other materials [8] [9] [30]. They fulfill all three ideal requirements of a bone graft, being osteoconductive, osteoinductive and osteogenic [10] [30]. However, since the ipsilateral femoral head is routinely no longer available for review of total hip arthroplasty, the necessary amount of autologous iliac graft may not be sufficient for large bone failures. This was the driving force behind our research: the difficulties in obtaining large amounts of bone from tissue banks.

The technique described in this article has some limitations, including the increase in surgical time and blood loss, the need for a second procedure with a new incision to remove the inserted graft, in addition to the anti-aesthetic increase in volume of the operated iliac. It is worth mentioning, however, that we had no complications in storing the femoral head in the iliac and that the procedure was comparable to the removal of a conventional graft. Evidently, the use of the graft in these two cases does not allow definitive conclusions about the validity of the use of the present technique. The low number of patients who still benefit from the procedure is due to the fact that the time between primary arthroplasty and the revision may still take some years, especially with the continued evolution of the implants. However, our follow-up continues to be carried out, and in favor of the procedure, we can cite a simple, inexpensive solution with low complications, in addition to providing the best available graft: the patient's own graft.

6. Conclusion

This article presents an innovative technique for iliac femoral head autograft in young individuals undergoing total hip arthroplasty. Despite the improvements in non-autologous grafts, the femoral head autograft technique in the iliac may still offer the best bone graft in the future: the patient's own graft. It is not a complication-free procedure, but for young individuals specially selected, it can bring promising benefits.

Conflicts of Interest

The authors declare no conflicts of interest.

Work performed at the Orthopedics and Traumatology Service of the Santa Casa de Misericórdia of Porto Alegre, Rio Grande do Sul, Brazil.

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