Journal of Hip Preservation Surgery Vol. 4, No. 1, pp. 74–79
doi: 10.1093/jhps/hnx001
Research article

Labral reconstruction with tendon allograft: histological findings show revascularization at 8 weeks from implantation

Esther Moya Gómez[1]*, Carlomagno Cardenas[1], Emmanuelle Astarita[1], Vittorio Bellotti[1], Francesc Tresserra[2], Luis Gerardo Natera[3,4] and Manel Ribas[1]

1. Department of Orthopaedic Surgery, Hip Unit, University Hospital Quiron Dexeus, Street Sabino de Arana 5-19, Barcelona 08028, Spain,
2. Department of Pathology, University Hospital Quiron Dexeus, Street Sabino de Arana 5-19, Barcelona 08028, Spain,
3. Department of Orthopaedics and Traumatology, Hospital de la Santa Creu i Sant Pau, Universitat Autònoma de Barcelona, street Sant Quintí 89, Barcelona, Catalunya 08026, Spain and
4. Department of Orthopaedics and Traumatology, Hospital General de Catalunya, Street Pedro i Pons 1, Sant Cugat del Vallés, Barcelona 08190, Spain
*Correspondence to: E. M. Gómez. E-mail: esther.moya.gomez@gmail.com
Submitted 19 March 2016; Revised 13 July 2016; revised version accepted 22 January 2017

ABSTRACT

This description shows the histological findings of a peroneus brevis tendon allograft used for labral reconstruction, implanted 8 weeks before being retrieved due to a postoperative complication unrelated to the graft. As far as we have knowledge this is the first description about revascularization of an allograft used for hip labral reconstruction. The histological report of the removed peroneus brevis tendon allograft shows evidence of vascular ingrowth represented by small vessels with a thin muscular wall in all layers of the graft and cellular migration mainly represented by mature fibroblasts.

INTRODUCTION

It has been shown that the acetabular labrum has an important function in the normal biomechanics and stability of the hip [1]. Labral tears are associated to a poor sealing of the joint fluid resulting in increased frictional forces and premature osteoarthritis [2]. Traditionally, treatment options for acetabular tears have been debridement, reattachment and reconstruction with autografts or allografts [3–6].

Ligament reconstruction with allografts and autografts has been widely studied and described in literature. When comparing the clinical outcomes of allografts and autografts in anterior cruciate ligament (ACL) reconstruction, similar objective and patient-reported outcomes have been described [7, 8]. Based on this evidence, in our institution reconstructions of the acetabular labrums with allografts are performed since 2008 [6]. To our knowledge, there are no studies comparing allografts to autografts in the hip joint.

The use of allografts is related to a decreased operating time, no donor-site morbidity and increased tissue availability when compared to autografts. It has been shown that formation of adhesions in allograft intrasynovial tendon is lesser when compared to autograft extrasynovial tendon [9]. Allografts also involve disadvantages, like the risk of disease transmission, the potential for immune reaction, increased cost and delayed graft incorporation [8, 10].

There is no consensus about tendon allograft revascularization *in vivo*. There are many studies about allograft integration performed in animals and in human knee procedures. Some authors conclude that there is an incomplete healing of the central portion of the graft with superficial revascularization [11, 12]. Other authors state that allografts are populated with fibroblasts, and collagen bundles become aligned as in normal ligaments after 6 months [13, 14]. Complete cell population of tendon allograft has also been reported [15].

Fig. 1. (**A**) Antero-posterior hip radiography showing markedly coxa-anteversa with double line sign due to calcification of the posterior labrum. (**B**–**D**) MRI in short inversion time inversion recovery (STIR) signal, showing a sagittal (B), coronal (C) and axial (D) views of the left hip, where signs of chondrolabral delamination, associated with narrowing of the posterior joint space can be observed.

To our knowledge, there are no descriptions about revascularization of allografts in human labral reconstructions. In this description, we present the histological findings of an allograft retrieved 8 weeks after labral reconstruction.

CASE PRESENTATION

A 54 year-old woman attended our clinic with bilateral groin pain and functional hip impairment in April 2013. On physical examination the patient presented with limited external rotation of the hip, positive Faber test, positive impingement test and positive Ribas decompression test in both hips [16]. In addition, the patient referred bilateral trochanteric pain with negative Ossendorf test [17].

Radiography showed markedly coxa-anteversa with double line sign due to calcification of the posterior labrum (Fig. 1A). The magnetic resonance arthrography showed signs of chondrolabral delamination and calcification of the posterior labrum, associated with narrowing of the posterior joint space (Figs. 1B–D).

Conservative measures with viscosuplementation and non-steroidal anti-inflammatories were considered for a limited period, with no satisfactory response. The patient categorically refused the option of having a total hip arthroplasty. This patient was fully informed about the prognosis of a hip preservation surgery performed in osteoarthritic hip; and despite that, she assumed the expectations, and kept on demanding an alternative for her painful hip. The patient was then proposed to undergo for a labral reconstruction with a tendon allograft. Surgery was executed through a safe surgical hip dislocation [18]. A femoro-acetabular osteoplasty, resection of the calcified labrum and labral reconstruction with a peroneus brevis tendon allograft were performed. Microfractures were performed in the superior central-posterior articular surface (Ilizaliturri zones III-IV) and autologous fibrin was applied. The entire procedure was realized by the senior consultant of the hip unit of the institution (MR).

Postoperative recovery was accomplished during 8 days at the hospital. The patient showed a regular postoperative evolution with no complications, and started physiotherapy the day after surgery, according to our protocol for femoro-acetabular osteoplasties. Protected weight bearing and limitation of the range of motion were indicated.

At the clinic appointment 6 weeks after surgery, the patient attended with groin pain and radiographic signs of mild lateralization of the hip, reason why she was referred to another course of rehabilitation. Two weeks later, the patient was admitted at the emergency department with

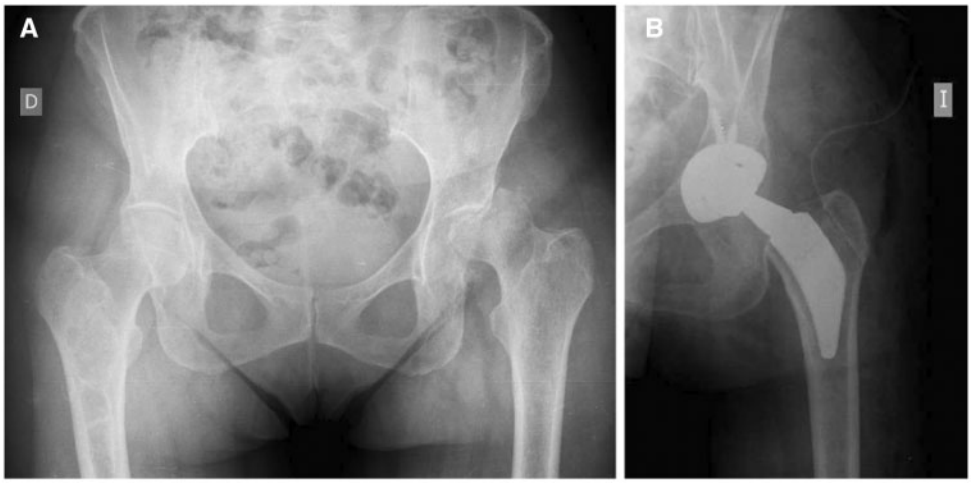

Fig. 2. (**A**) Antero-posterior hip radiography performed 8 weeks after labral reconstruction, showing a collapse of the femoral head. (**B**) Antero-posterior hip radiography in which the total hip arthroplasty with a short stem performed after collapse of the femoral head can be observed.

intense groin pain for the last few days, very irritable hip and inability to walk. Hip ultrasound and x-rays were performed, showing a collapse of the femoral head (Fig. 2A). This collapse might have been due to excessive trimming of the posterior acetabular wall, and thus destabilization of the femoral head. A necrosis of the femoral head was diagnosed, and the patient was finally indicated for a total hip replacement (Fig. 2B). During the operation, the entire allograft was excised and the sample was sent to the pathology department. The anatomic and histopathological studies of the graft showed fibrotic tissue with variable cellular density mainly composed by mature fibroblasts. The femoral head that was excised was also sent to the pathology department, and the final histological report concluded that, in fact, there was histopathological evidence of necrosis of the femoral head. Vascularization was observed in all sections of the tendon allograft. It mainly consisted on small vessels with a thin muscular wall (Figs. 3A and B). Some degenerative changes such as focal deposits of Alcian Blue material were seen (Fig. 4). Necrosis was absent in the allograft.

DISCUSSION

The main finding of this case report is the early vascularization of a tendon allograft used for a labral reconstruction in a human hip.

The important role of the labrum in terms of the biology, biomechanics and hip stability, has conferred a growing interest to acetabular labral reconstructions [1, 2]. Labral reconstructions are performed in cases where labral repair is not possible, and are mainly performed using autografts, and in fewer cases using allografts [5, 6].

With regards to acetabular labral reconstructions, Costa et al. perform massive labral reconstructions in patients with global-pincer femoroacetabular impingement and advanced labral degeneration by means of an acetabular rim trimming, femoral osteochondroplasty and labral reconstruction, performed through a surgical dislocation approach [19]. These authors described a series of four patients (age range: 20–47 years) at 1-year follow up. They concluded that, despite complex deformities and preexisting cartilage and labrum wear in this young cohort, 75% of the patients reported significant functional improvement after treatment of this condition. Another study conducted by Moya et al. described a cohort of 20 patients with nonrepairable labral tears, which underwent to labral grafting mainly by means of an arthroscopic assisted anterior mini-open approach. The clinical outcomes were considered satisfactory, reason why these authors concluded that labral reconstruction with tendon allografts provides relief of painful symptoms, and represents a reliable alternative for patients with nonrepairable labral tears that are not yet candidates for a joint replacement procedure [20].

Allograft tendon incorporation and revascularization have been widely described in the literature. Most of the studies have been performed in animals [10, 11, 15, 16]. Histopathological findings from the use of allografts have been described in anterior cruciate ligament (ACL) reconstructions [7, 8, 16] and flexor tendons of the hand [9]. It has been shown that allografts may involve a high

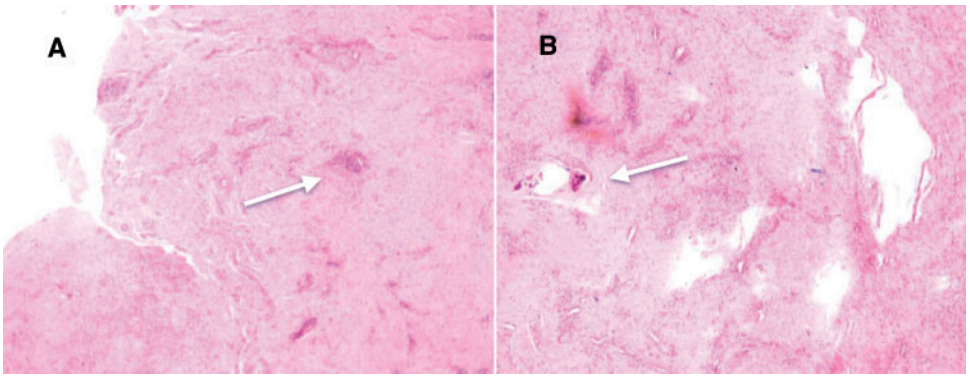

Fig. 3. (**A**, **B**) Serial cross-sections along the specimen (from vertex to the base), showing fibrous tissue with variable cellular density. There is vascularization composed by small vessels (white arrow) with thin muscular wall. The histological features are similar in the two localizations (hematoxylin and eosin x 200).

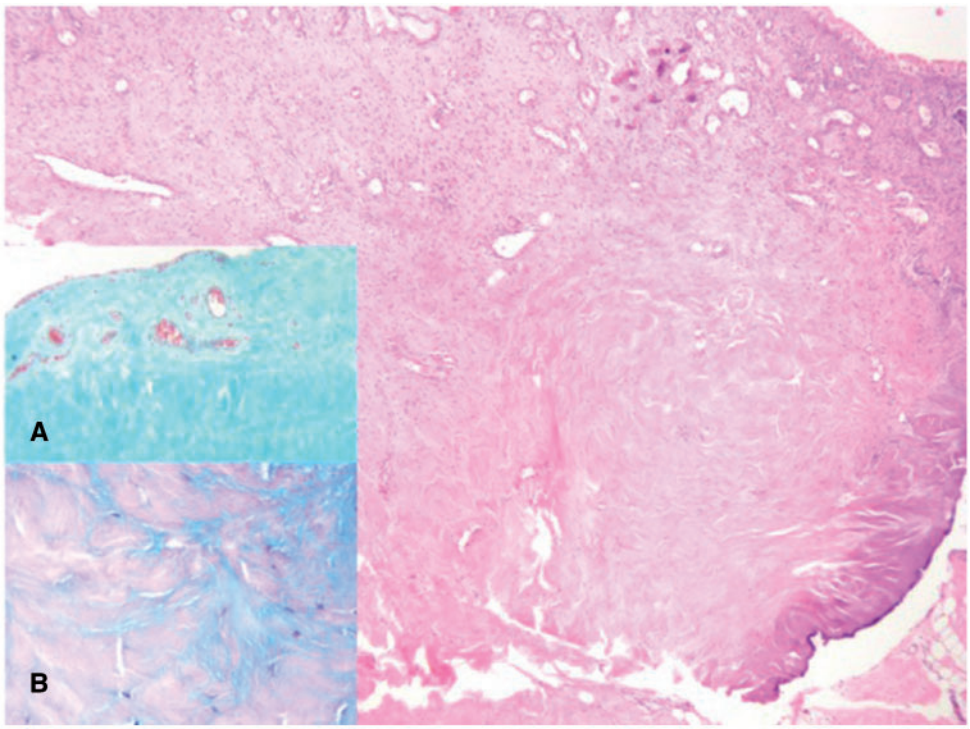

Fig. 4. This histological section corresponds to the vertex of the triangular specimen. Fibrotic hyaline tissue with vascularization at the top (hematoxylin and eosin x 40). The vessels can be seen more clearly with Gomori's trichrome stain (x40) (Insert A). Degenerative changes consisting in Alcian Blue deposition material could be focally seen (Alcian Blue x 40) (Insert B).

inflammatory reaction [12], but it has also been shown that freezing the allografts during preparation kills donor cells and may denature cell-surface histocompatibility antigens, resulting in decreased graft immunogenicity [21].

In ACL reconstructions, it has been shown that the allograft tissue undergoes a remodelling process that includes necrosis, revascularization, fibroblast proliferation, and collagen synthesis. After this process is complete, the implanted tissue histologically appears similar to the native ACL [22]. Likewise, animal studies have shown revascularization, and cellular ingrowth after meniscal allograft transplantation [23, 24]. We are aware that the biological behaviour and thus the graft revascularization of ACL reconstructions may be quite different from that of labral reconstructions with tendon allograft, in part because of the different way of reattachment of the graft. In spite of this,

and considering that (to our knowledge) allograft revascularization in the human hip has not been previously described, we considered relevant to bring up these two potentially different scenarios.

Allograft revascularization and incorporation to the host tissue is still a confusing subject with contradictory findings in the literature. Some authors conclude that allograft revascularization is only successful in the periphery of the graft, persisting an acellular zone at the central portion. On the other hand, some studies have shown a complete revascularization of allografts, with an increased vascular density when compared to autografts [16]. Other studies conclude that at 30 weeks the graft is completely revascularized [15].

In regards to AVN of the femoral head, it is considered a rare complication after a surgical hip dislocation procedure. In fact, the incidence has been described to be 0.05% in one series [25], and 0.06% in another series [26]. Both series of patients managed by the group of Ganz. In the case we are presenting in this report, the technique was performed according to the original descriptions made by Ganz [18]. In our unit, this is the first case of AVN after a hip surgical dislocation. Although we cannot elucidate a specific reason for the development of this regrettable complication, we suppose that this case might represent the fact that the risk of AVN with this technique is not completely absent.

In this case report, we describe the histological findings of a peroneus brevis tendon allograft used for labral reconstruction, implanted 8 weeks before being retrieved due to a postoperative complication unrelated to the graft. This description shows evidence of vascular ingrowth in all layers of the graft after 8 weeks from the index surgery, with cellular migration represented mainly by mature fibroblasts.

FUNDING

No financial support was received for this case report.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

1. Ferguson SJ, Bryant JT, Ganz R, Ito K. The influence of the acetabular labrum on hip joint cartilage consolidation : a proelastic finite element model. *J Biomech* 2000; **33**: 953–60.
2. Ferguson SJ, Bryant JT, Ganz R, Ito K. The acetabular labrum seal : a proelastic finite element model. *Clin Biomech (Bristol, Avon)* 2000; **15**: 463.
3. Espinosa N, Beck M, Rothenfluh DA *et al*. Treatment of femoroacetabular impingement: preliminary results of labral refixation. Surgical technique. *J Bone Joint Surg Am* 2007; **89 (Suppl 2 Pt.1)**: 36–53.
4. Larson CM, Giveans MR, Stone MR. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: mean 3.5-year follow up. *Am J Sports Med* 2012; **40**: 1015–21. doi: 10.1177/0363546511434578.
5. Geyer MR, Philippon MJ, Fagrelius TS, Briggs KK. Acetabular labral reconstruction with an iliotibial band autograft: outcome and survivorship analysis at minimum 3-year follow-up. *Am J Sports Med* 2013; **41**: 1750–6. doi:10.1177/0363546513487311.
6. Tey M, Erquicia JI, Pelfort X *et al*. Allogenic labral transplantation in hip instability following arthroscopic labrectomy. *Hip Int* 2011; **621**: 260–2. doi: 10.5301/HIP.2011.6524.
7. Rihn JA, Harner CD. The use of musculoskeletal allograft tissue in knee surgery. *Arthroscopy* 2003; **19**: 51–66.
8. Chang SK, Egami DK, Shaieb MD *et al*. Anterior cruciate ligament reconstruction: allograft versus autograft. *Arthroscopy* 2003; **19**: 453–62. doi:10.1053/jars.2003.50103
9. Karabekmez FE, Zhao C. Surface treatment of flexor tendon autograft and allograft decreases adhesion without an effect of graft cellularity: a pilot study. *Clin Orthop Relat Res* 2012; **470**: 2522–7. doi: 10.1007/s11999-012-2437-x.
10. Jackson DW, Simon T. Assessment of donor cell survival in fresh allografts (ligament, tendon, and meniscus) using DNA probe analysis in a goat model. *Iowa Orthop J* 1993; **13**: 107–14.
11. Curtis RJ, DeLee JC, Drez DJ Jr. Reconstruction of the anterior cruciate ligament with freeze-dried fascia lata allografts in dogs. *Am J Sports Med* 1985; **13**: 408–14.
12. Jackson DW, Grood ES, Goldstein JD *et al*. A comparison of patellar tendon autograft and allograft used for anterior cruciate ligament reconstruction in the goat model. *Am J Sports Med* 1993; **21**: 176–85.
13. Fu FH, Bennett CH, Latterman C, Ma CB. Current trends in anterior cruciate ligament reconstruction. *Am J Sports Med* 1999; **27**: 821–30.
14. Shino K, Inoue M, Hotibe S, Nagano, Ono K. Maturation of allograft tendons transplanted in the knee. *J Bone Joint Surg Br* 1988; **76**: 556–60.
15. Nikolaou PK, Seaver AV, Glisson RR *et al*. Anterior cruciate ligament allograft transplantation. *Am J Sports Med* 1986; **14**: 348–60.
16. Marín-Peña O. *Femoroacetabular Impingement*, 1st edn. Heidelberg, BE: Springer, 2012;87–8.
17. Ossendorf C, Bohnert L, Mamisch-Saupe N *et al*. Is the internal rotation lag sign a sensitive test for detecting hip abductor tendon ruptures after total hip arthroplasty? *Patient Saf Surg* 2011; **5**: 7. doi 10.1186/1754-9493-5-7.
18. Ganz R, Gill TJ, Gautier E *et al*. Surgical dislocation of the adult hip. *J Bone Joint Surg [Br]* 2001; **83-B**: 1119–24.
19. Costa Rocha P, Klingenstein G, Ganz R *et al*. Circumferential reconstruction of severe acetabular labral damage using hamstring allograft: surgical technique and case series. *Hip Int* 2013; **23**: 42–53. doi: 10.5301/HIP.2013.11662.
20. Moya E, Ribas M, Natera L *et al*. Reconstruction of nonrepairable acetabular labral tears with allografts: mid-term results. *Hip Int* 2016; **26**: 43–7. DOI: 10.5301/hipint.5000410

21. Noyes FR, Barber-Westin SD, Butler DL, Wilkins RM. The role of allografts in repair and reconstruction of knee joint ligaments and menisci. *Instr Course Lect* 1998; **47**: 379–96.
22. Arnoczky SP, Warren RF, Ashlock MA. Replacement of the anterior cruciate ligament using a patellar tendon allograft: An experimental study. *J Bone Joint Surg Am* 1986; **68**: 376–85.
23. Milachowski KA, Weismeier K, Wirth CJ. Homologous meniscus transplantation: experimental and clinical results. *Int Orthop* 1989; **13**: 1–11.
24. Jackson DW, McDevitt CA, Simon TM *et al*. Meniscal transplantation using fresh and cryopreserved allografts: an experimental study in goats. *Am J Sports Med* 1992; **20**: 644–56.
25. Sorel JC, Façee Schaeffer M, Homan AS *et al*. Surgical hip dislocation according to Ganz for excision of osteochondromas in patients with multiple hereditary exostoses. *Bone Joint J* 2016; **98-B**: 260–5. doi: 10.1302/0301-620X.98B2.36521.
26. Masse A, Aprato A, Rollero L *et al*. Surgical dislocation technique for the treatment of acetabular fractures. *Clin Orthop Relat Res* 2013; **471**: 4056–64. doi: 10.1007/s11999-013-3228-8.