Fresh osteochondral allografts in the knee: only a salvage procedure?

Alberto Gobbi[1], Celeste Scotti[2], John G. Lane[3,4], Giuseppe M. Peretti[2,5]

[1]Orthopaedic Arthroscopic Surgery International (O.A.S.I.) Bioresearch Foundation, Gobbi Onlus, Via GA Amadeo 24, 20133 Milan, Italy; [2]IRCCS Istituto Ortopedico Galeazzi, Via R. Galeazzi 4, 20161 Milan, Italy; [3]Departments of Bioengineering, Orthopedic Surgery, and Radiology, University of California, San Diego, La Jolla, California, USA; [4]Sanford Consortium for Regenerative Medicine, La Jolla, California, USA; [5]Department of Biomedical Sciences for Health, University of Milan, Milan, Italy

Correspondence to: Alberto Gobbi, MD. Orthopaedic Arthroscopic Surgery International (O.A.S.I.), Bioresearch Foundation, Gobbi Onlus, Via GA Amadeo 24, 20133 Milan, Italy. Email: gobbi@cartilagedoctor.it.

Abstract: The role of fresh allogeneic osteochondral allograft transplantation (OCA) in the cartilage repair algorithm has been long debated and this procedure is primarily considered as a salvage procedure, to be used when other, simple, techniques have failed. Gracitelli *et al.* in a retrospective comparison of patients who received OCA as primary treatment or as a salvage procedure, demonstrates that the outcome of this procedure is minimally influenced by a previous failed treatment and that OCA represents an effective solution for both primary and revision surgery of chondral and osteochondral lesions of the knee. In particular, optimal indications for OCA seem to be revision of previously failed bone marrow stimulation techniques with an impaired subchondral bone plate and primary treatment of large osteochondral defects.

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The optimal treatment for articular cartilage lesions is still debated and a matter of controversy among the sports trauma community. On the one hand, bone marrow stimulation techniques (e.g., the microfracture technique) are widely used as a simple and cost-effective first-line of treatment for young patients with small lesions and low functional demands (1). On the other hand, autologous chondrocyte implantation (ACI) techniques became popular in the last 20 years with more than 2,000 of cases and a growing body of literature reporting favorable results (2). However, the high costs of these procedures raised concerns on their sustainability and cost/effectiveness while patients with chronic symptoms typically have a worse outcome. The third alternative in the cartilage repair algorithm is an osteochondral allograft transplantation (OCA) procedure that is mostly regarded as a salvage procedure after more simple treatments have failed. However, OCA has been proposed also as an effective option for primary treatment of cartilage lesions, with satisfactory results reported in literature. The paper by Gracitelli *et al.* is particularly valuable because it sheds some light on the potential of OCA and its place in the cartilage repair algorithm (3). In addition, if offers the readers a good example on how informative a retrospective study can be, if designed properly.

Addressing patients with a failed cartilage repair procedure is currently challenging for orthopaedic surgeons because ACI typically results in a higher failure rate when used in this clinical scenario, compared to primary treatment. One of the reasons for this negative outcome seems to be the impairment of the subchondral bone environment caused by the traumatic event or by the bone marrow stimulation procedure itself. Both causes are equally relevant since they may lead to a stiffer and harder subchondral plate, osseous overgrowth, and cysts that can interfere with graft integration when performing an ACI procedure (4). For this reason, a procedure capable of addressing the subchondral bone is desirable in these patients and consistently, in the study by Gracitelli *et al.*, the authors OCA demonstrated

successful results for failed cartilage repair procedures with a comparable outcome to that of OCA for primary cartilage lesion. This finding is particularly relevant because it demonstrates that addressing the subchondral bone, when impaired, is of paramount importance for successful articular surface repair, and that OCA represents is a safe and effective option for these patients.

Another valuable message of this work is the role of OCA in the primary treatment of articular cartilage lesions. In the recent years, biomimetic scaffolds have emerged as simple and effective off-the-shelf solutions for osteochondral lesions of the knee with satisfactory clinical outcomes with stable results at midterm follow (5). However, concerns have been raised because of the persistent MRI abnormalities, although not always correlated to poor clinical results, regarding the subchondral bone and scaffold integration (5,6). These reports highlighted the need for a regenerative strategy capable to restore the subchondral bone or, even better, the osteochondral unit with functional tissue well integrated within the joint. As demonstrated by the work of Gracitelli *et al*., OCA has the potential to tackle the classical limitations of osteochondral repair and overcome the issues of subchondral bone regeneration and graft integration. From a biologic standpoint, bone itself is the best scaffold to regenerate bone. In light of this study, the satisfactory results reported in salvage cases most likely depend on the quality of the subchondral zone of the implant and on the natural integration between the cartilaginous and bony zones.

In detail, Gracitelli *et al*. compared long-term results (10-12 years) in patients receiving OCA as either the primary treatment or as a salvage procedure after a failed bone marrow stimulation procedure. Interestingly, both 10-year survivorship (87.4% and 86%, respectively) and failure rate (11% and 15%, respectively) are comparable while the main difference is the higher reoperation rate in patients receiving OCA as salvage procedure: 44% *vs* 24% in patients receiving OCA as primary treatment. According to the authors, this difference may result from the longer follow up in this particular group of patients and the relatively high reoperation rate from the characteristics of the patient populations as they are very young and active and therefore more susceptible to undergo further trauma. Taken together, these results highlight the value of OCA and support the inclusion of OCA in the cartilage repair algorithm, confirming its role as salvage procedure and further extending its indication to the primary treatment of chondral and osteochondral lesions. The almost insignificant impact of previous failed treatment can be considered an invaluable plus of OCA, especially compared to ACI procedures that, conversely, are negatively affected by chronicity of symptoms and previously failed surgeries.

The main limitations of OCA are the surgical procedure, which is more demanding than biomimetic scaffolds, and immunogenicity of the grafts. The paper by Gracitelli *et al*. provides some useful insights on both issues. Regarding the technique itself, the authors highlighted the importance of removing all damaged subchondral bone during cartilage lesion preparation in order to achieve a homogeneous bleeding surface, approximately 3 to 8 mm in depth. Of course, great care should be taken in graft sizing and fixation should be achieved by either press-fit fixation or by stabilization with bioresorbable pins. In addition, with respect to the well-known issue of immunogenicity of the grafts, the authors that the subchondral zone is vigorously irrigated with pulsatile lavage in order to remove the marrow elements from the trabecular bone and thus decrease immunogenicity of the graft. Of course, simple lavage does not solve the issue of immunogenicity when using fresh allogeneic grafts, which still remains one of the main concerns when using these implants. As recently reviewed, additional limitations to a wider application of OCA include graft availability, cost, difficult sizing and graft-defect matching, and a more technically demanding surgical procedure, compared to biomimetic scaffolds (7). Also, alternative methods to evaluate chondrocyte viability before implantation would be a useful decision-making tool (7). It has also to be noted that, for chondral-only lesions, Bone Marrow Aspirate Concentrate (BMAC)-based techniques have been developed in the last years, with good clinical results and tissue regeneration (8). In light of these recent studies, the use of OCA for chondral-only lesions does not seem to be indicated. However, the ideal indications for OCA, also supported by the paper by Gracitelli *et al*., seem to be revision surgery when the subchondral bone is impaired by a previous failed bone marrow stimulation procedure, and large osteochondral lesions that cannot be properly addressed with a biomimetic scaffold.

Overall, despite its retrospective nature, this paper provides an interesting insight on a controversial topic. However, other prospective studies comparing OCA with off-the-shelf biomimetic scaffolds are desirable in order to clarify the added value of OCA and to account for the higher technical demands and the immunogenicity concerns related to the use of fresh allografts.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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