Editorial Commentary: Focal Cartilage Defects in Young Patients Indicate Autologous Chondrocyte Implantation Sooner Rather Than Later

Abstract: Articular cartilage lesions, whether acute or chronic, are among the most common and difficult-to-treat conditions of the knee in the adolescent and athletic population. The results from a study in this issue as well as some in the previous literature suggest that autologous chondrocyte implantation yields long-term improvement in function and symptoms and may be a viable treatment for young to adult athletes or patients with high physical demands and a long active lifespan. No intervention in the young symptomatic patient will yield inferior results because it appears that no treatment over time has deleterious effects. Treatment in young athletes should include (1) early stabilization of ligament injuries, (2) resurfacing chondral defects, (3) correction of malalignment, (4) restoration of meniscal integrity, and (5) utilization of a chondroprotective strategy with orthobiological interventions.

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Articular cartilage lesions, whether acute or chronic, are among the most common and difficult-to-treat conditions of the knee in the adolescent and athletic population. They may be isolated or associated with other comorbidities including meniscal of ligamentous deficiency, malalignment, or concomitant progressive osteoarthritis. The objectives are always to eliminate pain, resurface the lesions, protect the meniscus and articular cartilage, and prevent the onset and progression of osteoarthritis. The spectrum of options includes microfracture, microfracture plus (i.e., plus addition of cells, growth factors, and/or matrix) techniques, autologous chondrocyte implantation (ACI) with periosteum and with a collagen patch (off label in the United States), matrix autologous chondrocyte implantation (MACI, available only in Europe and Japan), osteochondral autograft, and allograft with or without orthobiological interventions. Navigation through an algorithmic multilevel and systematic approach in the young patient may be our most challenging issue we have in orthopaedics today.

The purpose of the article "Clinical Outcomes After Autologous Chondrocyte Implantation in Adolescents' Knees: A Systematic Review" by DiBartola et al.[1] was to perform a systematic review evaluating the use of ACI for the treatment of large articular cartilage defects in the adolescent knee. The focus was to determine the safety and efficacy in this young population and the associated patient or lesion risk factors that impact outcome.

The authors used library databases were searched systematically identifying a spectrum of patient-reported outcome scores based on proportion of adolescents achieving specific outcome quartiles at a minimum 1-year follow-up. The methodological quality of studies was evaluated by Coleman methodology scores. The major limitation in this study is the lack of controlled and randomized controlled studies to base decisions for clinical practice. The 5 case studies were determined to be Level IV Evidence. They reported on 115 subjects (mean age, 16.2 years) with mean lesion size of 5.3 cm^2 who underwent ACI with a periosteal cover, a collagen I to III scaffold membrane cover, or matrix autologous chondrocyte implantation. The spectrum of options reflects the generational 20-year evolution of technology. Multiple concurrent procedures were included in this series of patients and studies. When reported, this rate was as high as 59 concurrent procedures in 37 patients. The exact details of the procedures are unknown, but one would assume were ligament reconstruction, meniscal repair, or osteotomy. The authors found that all studies reported improvement in clinical outcome scores with the mean preoperative percentage 37% (standard deviation [SD], 18.9%) and the mean postoperative percentage 72.7% (SD, 16.9%). Graft hypertrophy was the most common complication (7.0%) and was most associated with the original Brittberg and Petersen 1994 ACI-P technique.

0749-8063/16685/$36.00
http://dx.doi.org/10.1016/j.arthro.2016.07.011

The overall percentage increase in clinical outcome scores was 35.7% (SD, 14.2%). Mean Coleman Methodology Score was 47.8 (SD, 8.3). The only patient- or lesion-specific negative prognostic factor that influenced clinical outcome was the longer duration of preoperative symptoms before intervention.

The results from this and other studies suggest that ACI yields long-term improvement in function and symptoms and may be a viable treatment for young to adult athletes or patients with high physical demands and a long active lifespan.[2] In addition, earlier studies have shown that ACI not only produces a hyaline-like repair tissue[3] but also results in improved efficacy,[3] cost-effectiveness,[4] long-term outcomes,[5] and return to sports.[2,6]

Overall, this study corroborates what we have learned about ACI in the last 20 years in the algorithmic treatment of large cartilage defects. What we can conclude from this study is that ACI is modestly effective and safe for large defects in a range of situations as a resurfacing technology. We can also infer that no intervention in the young symptomatic patient will yield inferior results because it appears that no treatment over time has deleterious effects. What we cannot conclude based on the limitations of this study is what is the best technique or approach in comparison. Therefore, we need to develop a comprehensive clinical approach for our youngest athletes in concept and technique.

In the 1990s, we were most concerned with which technique was optimal. Now we have learned several principles and perspectives in the management of the young athlete knee that has been traumatized and include the following:

1. Articular cartilage lesions occur in a multitude of etiologies and are associated with anterior cruciate ligament (ACL) tear, meniscus injury, osteoarthritis, and malalignment.
2. No single resurfacing technique is for all clinical situations; one size doesn't fit all. Osteochondral autograft, allograft, ACI, bone marrow aspirates, and microfracture and microfracture plus have application and a role in different and specific situations.
3. Systematically, each facet of the spectrum of pathology must be managed in a detailed and timely manner or results will be suboptimal in our youngest of patients. This may include preoperative interventions, surgical staging, and use of postoperative rehabilitation and prevention programs.
4. When managing youth athletic populations, consider implementation of injury prevention programs such as Prevent Injury and Enhance Performance and 11+ that result in statistical reduction in ACL injury and as a consequence cartilage defects.[7]
5. Using an appropriate ACL repair or reconstruction stabilization is a requirement to ensure meniscal and cartilage preservation.
6. If the meniscus is compromised or torn, it should be repaired and preserved. If that is not possible, then meniscal allograft replacement should be implemented in a timely manner to protect the cartilage surfaces even before there are significant symptoms. In the past, symptoms were our guide, but now experience has taught us that by that point the degenerative changes have already occurred.
7. In addition to resurfacing, meniscal preservation, optimal alignment, chondrofaciliation and chondroprotection, and disease modification must be considered with the use of orthobiologics. The use of glucosamine, hyaluronic acid, platelet-rich plasma, and perhaps stem cell interventions should be considered especially in our young populations where these details and proactive interventions matter the most.[8]

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