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CORR Insights

CORR Insights®: Acetabular Version Increases After Closure of the Triradiate Cartilage Complex

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Where Are We Now?

Femoroacetabular impingement (FAI) is a common hip condition that has been associated with development of early osteoarthritis of the hip [3]. A recent systematic review of 26 studies comprising 2114 asymptomatic individuals reported a prevalence of a cam deformity of 37% and a prevalence of a pincer deformity of 67% [2]. Although most investigators have agreed on a reasonably consistent method for defining a cam deformity, there remains poor consensus on the definition of a pincer deformity [2], with several suggesting it may be defined too broadly [1, 8]. Primary FAI is generally accepted to be developmental in nature, although specific pathogenic mechanisms remain unclear. Cam deformities clearly are more prevalent in athletes than in the general population [2], and recent research has suggested their development may be associated with vigorous or specific sporting activities during adolescence [5, 9, 10]. Considerably less is known about the development of pincer lesions, in part because of the lack of uniformity in their definition.

In the current study, Albers and colleagues report results of their prospective, longitudinal cohort series that describes acetabular development in 65 healthy children during adolescence. Their data add substantially to an area where little has been published to date. The authors use an MRI-based technique that allows greater ability to detect the cartilaginous portions of the acetabular rim in skeletally immature patients, where pincer lesions may arise, which was not possible in previous CT-based studies [4, 7]. Consistent with these previous CT-based studies [4, 7], Albers and colleagues find that acetabular version increases with advancing skeletal maturity, and that this process happens over a relatively narrow timeframe near physeal closure of the triradiate cartilage complex (TCC). However, unlike the CT-based studies, their data suggest that the acetabular depth-width ratio and femoral head coverage remain relatively constant during acetabular development, which may reflect the more sensitive radiologic technique utilized in their methodology that allows accurate detection and measurement of the cartilaginous portions of the acetabular rim. These data

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imply normal acetabular changes that occur around the time of TCC closure may result from a rotational mechanism rather than relative growth differences between the anterior and posterior walls.

Where Do We Need To Go?

There are several important questions that remain unanswered despite the excellent work from the authors. First, it is unclear if certain conditions, activities, or sports participation might predispose adolescents to premature closure of the TCC, thereby putting them at risk of developing a pincer deformity and subsequent FAI. Understanding such an association may allow the opportunity to implement an activity modification protocol or an appropriate screening program in particular at-risk populations, as has been successfully done to avoid injury in other areas of the musculoskeletal system [6, 12].

Second, we do not yet fully understand changes that occur regarding acetabular development at other times. Although we understand that femoral and acetabular morphology may affect one another during development, [11] it is unclear if variability in femoral morphology may differentially alter the rotational changes of the acetabulum that accompany closure of the TCC. Additionally, while acetabular over-coverage has been associated with pincer-type FAI, it is unclear when these changes may happen during the course of childhood hip development, as the current study documents no change in the parameters used to define over-coverage around the time of closure of the TCC. There may be multiple periods where alternation of normal acetabular development can predispose to development of a pincer deformity.

Finally, the authors acknowledge a relatively homogenous patient population used in their study, and it remains to be seen if the changes described here will be generalizable to larger, more heterogeneous populations.

How Do We Get There?

In their study, Albers and collegues provide a solid foundation for future work. Their methodology utilizes a prospective, longitudinal cohort over a period of development and represents the best way to investigate these questions. MRI-based studies clearly offer a more optimal imaging modality compared to CT, as they do not rely on ionizing radiation and are better able to detect the cartilaginous rim that has not yet ossified in the skeletally immature hip. Future studies may expand the study period to include different developmental milestones both before and after closure of the TCC. Additionally, multiple serial MRI's performed over a longer study period in a more heterogeneous patient population would provide a larger dataset from which to draw conclusions. While difficult to maintain a young patient cohort in a prospective, longitudinal study, this study design will best be able to assess potential changes that may predispose to generalized acetabular over-coverage.

When these studies are performed, it will be important to also include data regarding weight, body-mass index, activity level, sports participation, and femoral-sided anatomy, which may enable us to answer some of the unknown questions. Ultimately, prospective interventional studies will need to be performed in at-risk populations to assess whether the natural history of cam and pincer development may be altered through interventions such as activity modification, changes in sports participation, or changes in athletic technique.

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