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CORR Insights

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CORR Insights®: Which Classification System Is Most Useful for Classifying Osteonecrosis of the Femoral Head?

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Where Are We Now?

Osteonecrosis of the femoral head (ONFH) generally presents in the third to fifth decade of life and is the final pathway of several conditions that eventually result in bone necrosis. The disease progresses in more than half of the patients who have it [9], leading to femoral head collapse and secondary arthritis. However, not all patients experience progression, and a few may experience resolution of the condition in its earlier stages [2].

Many attempts have been made to classify the disease process; there are at least 16 different classification schemes. Of these, only four have been commonly used [8]: Ficat and Arlet [3] (63%), Steinberg [13] (20%), Association Research Circulation Osseous (ARCO) [4] (12%), and system of the Japanese Orthopedic Association developed by the Japanese Investigation Committee (JIC) [14] (5%). Their common classification parameters include patient symptoms, MRI, and radiographic findings including size and location of the lesion, presence of a crescent sign, amount of head depression (collapse), and presence of acetabular changes.

In the early stages of ONFH, before collapse, the size and location of the necrotic lesion is considered an indicator and can be predictive of a collapse [12]. Methods to quantitate the lesion size and location include volumetric measurements (Steinberg [13] and ARCO [4]), angular measurements on the AP and lateral radiographic views (Kerboul [5]), index of angular sizes measured on mid-sagittal and mid-coronal slices of the MRI scan (Koo [6]), and location of the lesion in respect to the weight bearing surface (JIC [14]).

But each of these methods have their own pitfalls. Volumetric measurements may be too complicated for routine clinical use. Angular measurements can be influenced by lesion shape and distance from the articular surface. Location classification assumes that larger lesions are more lateral, but does not specifically evaluate lesion size. If the femoral head lesion is referenced relative to the acetabular weight bearing surface, this can be influenced by the positioning of the hip during the imaging study.

In their current study, Takashima and colleagues [15] conducted a retrospective study and compared the Steinberg (volumetric method), Kerboul (angular method), and Japanese Investigation Committee (JIC) (location) classification systems. They found that all of the classifications worked well in the sense that as the ONFH increased in grade within each classification, the risk of collapse likewise increased.

Where Do We Need to Go?

There remains plenty of room for improvement in the classification of ONFH. Many treatment recommendations are based on the classification of ONFH, but there is still no

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universal agreement on the best classification to use, and the commonly used classification systems lack intraobserver and interobserver reliability [11]. This makes it difficult for clinicians to consistently follow a patient over time and to communicate with each other. This may also account for some of the discrepancies among studies presenting results of various treatment options.

An effective classification system should be efficient to use in practice, it should possess both inter and intraobserver reliability, it should capably guide diagnosis and treatment decisions, and it should help clinicians and clinician scientists arrive at accurate prognoses. From a clinician's point of view, it would be most useful to have a system that would confidently identify the appropriate treatment option, such as nonsurgical treatment, hip preservation surgery, or hip replacement. In the current study, only the JIC classification system had 100% predictability for the absence of collapse or subsequent THA in the group classified as Type A. Despite this predictability for the more-medial lesions, when classifying the more lateral lesions (Type C2), 22% of patients did not show progression to collapse at 10 years followup. This could result in a substantial number of patients undergoing unnecessary THAs if surgeons assume that patients with the most-severe grade of ONFH would likely progress.

The ability to accurately predict prognosis for these patients is paramount for the clinician to counsel patients and determine the appropriate treatment. Assuming progression in everyone and recommending joint replacement will result in overutilization of this treatment, and although the results of THA have improved for patients with osteonecrosis of the femoral head [7], the number of revision THA in the 45-year-old to 64-year-old age group is on the rise [10]. Likewise, observation or attempt at joint-preserving surgery in all patients will subject some patients to unnecessary procedures or delay their return to an active lifestyle.

There has been progress in further defining the biology, biomechanics, and imaging of osteonecrosis [1]. However, much of this information is not currently incorporated into the common classification systems. It is simplistic to think that progression of ONFH is purely related to the size or location of the lesion. This disease process, although not yet fully understood, surely is influenced by a combination of factors affecting both the biology and biomechanics of the femoral head and any advances in a classification scheme should take this into account.

How Do We Get There?

Given the popularity of the four major classification systems, the likelihood that clinicians would use a new system is small. Therefore, the current systems should remain as the basic building blocks of any new system proposed.

Advances in imaging and image processing such as rapid three-dimensional (3-D) reconstructions of MRI scans, will make it easier to fully characterize the femoral head lesions for the clinician and researcher. Also, advances in functional MRI and scintigraphy should quantitate bone physiologic activity and add an additional biologic component to the classification system. Finite-element analysis of the necrotic bone, repair zone, and surrounding living bone, combined with the new information gathered from 3-D and functional MRI scans, could provide a predictive modeling for collapse. Finally, further defining what affect specific risk factors, individual characteristics, or genetic markers have on the progression are also likely to help in our prediction of femoral head collapse.

Any new or modified classification system would need further study to prove its validity and reliability. Of course, multicenter, randomized studies or registries provide great evidence, but are time- and resource-intensive. Takashima and colleagues [15] used the same population of patients to compare three different classification systems. Despite it being a retrospective study, bias was mitigated because each patient acted as his or her own control. This method can be used to further evaluate any new changes to the classification systems provided the new information is available retrospectively.

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