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CORR Insights®: Epiphyseal Arterial Network and Inferior Retinacular Artery Seem Critical to Femoral Head Perfusion in Adults With Femoral Neck Fractures

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Where Are We Now?

The current evidence on vascular supply to the femoral head—evidence that could potentially guide new treatments for femoral neck fractures—is limited, fragmented, and variable [1, 2, 8].

This CORR Insights® is a commentary on the article “Epiphyseal Arterial Network and Inferior Retinacular Artery Seem Critical to Femoral Head Perfusion in Adults With Femoral Neck Fractures” by Zhao and colleagues available at: DOI: 10.1007/s11999-017-5318-5.

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Although controversial, the evidence does support the dominance of the inferior retinacular artery and its likely preservation after femoral neck fractures in order to maintain vascularity of the femoral head [1, 2, 4, 8].

In their anatomical study, Zhao and colleagues concluded that the epiphyseal arterial network and inferior retinacular artery systems could be two important structures for maintaining the femoral head blood supply after femoral neck fractures. The current study reinforces the conclusions of previous studies [1, 2, 4, 8] that favor inferior retinacular artery because of its potential to revascularize the avascular femoral head [1].

The conclusions by Zhao and colleagues are subject to a broader

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assessment of intraosseous and extraosseous vascular systems, which constitute a comprehensive composite combination. The intraosseous and extraosseous vascular systems, however, are not mutually exclusive when considering interrelated anastomotic channels for potential revascularization. The current study does not, however, specifically consider dynamic revascularization and relative contribution of the lateral circumflex artery to femoral neck with potential for nonunion [2].

Where Do We Need To Go?

Static three-dimensional visualization by micro CT offers finer images of the detailed arterial anatomy of the femoral head. But despite our ability to describe the blood supply to the femoral head, we still do not really know how that blood supply is interrupted by various injury patterns, and how to use what we know to decrease the risk of avascular necrosis (AVN) after hip fractures.

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It would be important to develop the ability to perform selective vascular investigations before surgery for patients with hip fractures in order to identify patients whose femoral heads should not be saved. By doing so, we could perhaps develop interventions that might be applicable after hip-fracture surgery in patients who are considered at high risk of AVN. We could even establish guidelines to vascular studies that we can use after surgery for effective monitoring. Noninvasive vascular studies using contrast-enhanced MRI could be used in the context of a joint-preserving surgical strategy that considers a patient's age and health status; the hope being that new imaging modalities might give us a great deal more usable information than we can infer from a fracture's classification alone. For example, patients aged 60 years or younger and physically fit individuals older than 60 should be candidates for vascular evaluation, localization, and quantification of residual blood supply and perfusion to the femoral head through noninvasive dynamic contrast-enhanced MRI (DCE-MRI), which facilitates relevant classification for prognosis, choice of intervention, and monitoring [4, 6].

Younger patients with residual blood supply are candidates for closed reduction and internal fixation for nondisplaced fractures, and generally closed or open reduction and fixation

for displaced fractures. Vascularized bone graft and osteosynthesis [3] may be considered for displaced fractures with compromised or absent residual blood supply. Patients older than 60 years of age may be treated with hemiarthroplasty or THA without vascular investigation.

Increased efforts to protect the key structures during early surgery, such as drilling and placement of implant(s) closer to the central region or appropriate quadrant(s) of the femoral head, may mitigate or reduce the risk of iatrogenic insult to the residual intraosseous vascular supply.

How Do We Get There?

Once suitable tools are available and diagnostic algorithms validated, the ideal management for femoral neck fractures will center on selective non-invasive vascular imaging, surgical strategies, minimization of secondary vascular insult during joint-preserving surgery, and managing AVN of the femoral head when it arises.

Randomized, controlled multicenter prospective studies are ideal for answering questions about when the femoral head should be preserved in this context. These studies should include DCE-MRI, and they should define and quantify residual blood supply in femoral neck fractures. Prospective

studies examining vascularized bone grafts in displaced fractures could be done, but randomized studies on this theme are logistically difficult to conduct. Retrospective studies, and possibly comparative studies with randomization may be relatively easy alternatives, but they have inherent limitations particularly regarding consistency of preoperative and postoperative vascular imaging. Anterior rotational osteotomy and posterior rotational osteotomy particularly in segmental osteonecrosis may also provide joint-preserving options for some patients [7].

Although high-quality evidence of current surgical practice now suggests little difference in overall reoperation rates within 24 months between sliding hip screw and cancellous screws [5], the question of blood supply remains germane with higher likelihood of AVN and conversion to hip arthroplasty in sliding hip screws during the surveillance period. In this context, separate studies for undisplaced and displaced fractures are needed to compare cannulated screws and sliding hip screws. These studies could involve contrast-enhanced MRI at some suitable period after surgery to facilitate monitoring of vascular status.

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