Developing and Fractured Bones Are Invaded by Osteoblast Precursors, Not Mature Osteoblasts

To the Editor:

The origin of the osteoblastic cells that produce trabecular bone has been unknown, with many cellular sources considered, including the hypertrophic chondrocytes.1 At the beginning of endochondral ossification, mesenchymal condensations that prefigure the future long bones first develop into cartilage. As the cartilaginous template enlarges and becomes the shape of the future bone, chondrocytes in the central region stop proliferating, hypertrophy, and then die. The cartilaginous template is then invaded and transformed into the primary ossification center. The first committed osteoblast lineage cells appear in the perichondrium surrounding the mid-diaphyseal hypertrophic cartilage. Maes et al1 generated 2 transgenic mouse lines, using the Osterix and collagen I gene promoters to follow the fates of osteogenic cells during bone development. They found that the majority of the hypertrophic chondrocytes do not become osteoblasts. Their data showed that mature chondrocytes do not detectably contribute to the osteoblast/osteocyte pool in the central metaphyseal region. Osteoblast precursors move into the developing primary ossification center and then differentiate into bone-forming trabecular osteoblasts. The entrance of the osteoblast precursors into the primary ossification center coincides with the initial invasion of blood vessels. Osteoblast precursors may differ from mature osteoblasts in that they, like vascular endothelial cells, are able to respond to migratory signals from vascular endothelial growth factor. Mature osteoblasts remain on the outside of the developing bone and generate cortical bone. They are retained on and within cortical bone surfaces. The processes governing embryonic bone development are largely recapitulated during fracture healing, and Maes et al1 found that a similar co-invasion of osteoblast precursors and blood vessels occurs in the adult setting of bone repair. The infiltration of cartilaginous callus tissues by invading endothelium was closely associated with co-invasion of osteoblast precursors. Adult osteoblasts were markedly abundant in the peripheral portion of the callus. The data indicate that perichondrial lineage cells display differential destinies in developing bones. Osteoblast precursors predominantly move inside the bone to the trabecular region, while mature osteoblasts predominantly remain on the cortex.

Mark S. McMahon, MD
Boston, MA
doi: 10.3928/01477447-20110427-01

REFERENCES

Acute Traumatic Sternal Fracture in a Female College Hockey Player

To the Editor:

I read with interest the article “Acute traumatic sternal fracture in a female college hockey player” (http://www.orthosupersite.com/view.aspx?rid=67842) in the September 2010 issue of Orthopedics. The authors provided an excellent up-to-date summary of the investigation and management of a sport-related sternal fracture. However, I would like to bring 2 items to the attention of the Journal’s readers.

First, and most importantly, I must express my concern with the statement: “…a negative EKG sufficiency rules out any injury to the myocardium.” While I agree with the broad implication of the statement, I would add the proviso, which is indicative of current Australian Emergency Medicine practice for the investigation and management of a similar sternal fracture (personal communication, Associate Professor R.J. Dunn, Director Clinical and Academic Emergency Medicine, Royal Adelaide Hospital, South Australia), that at least 1 repeat EKG is recommended1 and that consideration be given to further investigation and observation of the patient should they have a history of cardiac disease.2

Second, throughout the article, reference is made to a report of a nondisplaced sternal fracture in a rugby footballer.3 I would like to point out that the game of Australian rules football, of which the described patient was a participant, bears only a passing resemblance to rugby (in either of its guises) and can be differentiated from the more earth-bound varieties of football by the high mark, a good example of which is demonstrated in a recent article.4

Robert J. Douglas, BA, BAppSc(Dist), BM, BS, FRACGP
Adelaide, South Australia

REFERENCES


Reply:
Although differing information exists in the literature on EKG recommendations for isolated sternal fractures, our recommendation of outpatient management of the athlete with an isolated sternal fracture, chest radiograph that is negative for other injury, and normal initial EKG was made after reviewing the data found by Rashid et al,1 Sadaba et al,2 Velissaris et al,3 and Peek et al.4 We agree with the statement “that consideration be given to further investigation and observation of the patient should they have a history of cardiac disease,” and appreciate this being brought to the readers’ attention. Our athlete was young and otherwise healthy, and we implied this in stating that “this type of patient can be followed as an outpatient,” but we agree that this clarification should be made.

We appreciate Dr Douglas’ point regarding the difference between rugby and Australian rules football and thank him for correcting our error.

David C. Flanigan, MD
Kendra McCamey, MD
Columbus, OH
doi: 10.3928/01477447-20110427-02

REFERENCES

Periprosthetic Femoral Fractures Associated With Hip Arthroplasty

To the Editor:
I read with interest the article “Periprosthetic Femoral Fractures Associated With Hip Arthroplasty” (http://www.orthosuper-site.com/view.aspx?rid=78070) in the December 2010 issue of Orthopedics. The paper was well organized and well written. However, a specific entity is missing: iatrogenic intraoperative crack or fracture. This is a well-known entity that has been recognized since noncemented press-fit implants were introduced.

In our unpublished series, we estimated the occurrence of iatrogenic intraoperative fracture at approximately 1% to 2% as a rule at the calcar, but also at the borders of the greater trochanter. It was noticed more frequently in revisions, but was present in primary procedures as well. It is often taken care of by cerclage wire with or without cementing the stem. This entity is occasionally unrecognized and leads to postoperative pain or late propagation into fracture.

David G. Mendes, MD
Haifa, Israel

Reply:
We appreciate the interest in our review article. A discussion of iatrogenic and intraoperative periprosthetic fractures was intentionally deleted from early revisions of the article. In retrospect, omission of the topic entirely may have been an error. Our institutional experience is similar to that of Dr Mendes: iatrogenic and intraoperative fractures occur infrequently overall but are more common in revision situations and with the use of cementless implants.

Because of the increasing prevalence of total hip arthroplasty (THA) in our aging populations, the incidence of periprosthetic proximal femur fractures appears to be rising. These patients frequently present to small- and mid-sized hospitals after falling in their home. The orthopedic surgeon may have subspecialty interest outside of THA but may be experienced in the routine care of patients with fragility fractures. We recognize the benefit of treating geriatric patients close to their home and openly admit that transfer of all such patients for subspecialty care is not possible, particularly in the rural setting. Therefore, the intention of our article was to educate the on-call orthopedic surgeon to the unique needs of patients with periprosthetic proximal femur fracture. We intentionally omitted a discussion of the iatrogenic intraoperative fracture as the etiology, presentation, and treatment of intraoperative periprosthetic fracture is usually encountered by surgeons experienced in THA during or following elective hip surgery and is often unique to the surgical exposures and implants in use.

Thank you for identifying this omission for the Journal’s readers.

Zhiyong Hou, MD
Shijiazhuang, China
Thomas R. Bowen, MD
Wade R. Smith, MD
Danville, PA
doi: 10.3928/01477447-20110427-35