Benign Bone Tumors Part 2: Treatment Ross M. Wilkins, M.D., Medical Director

In the last newsletter, we reviewed the evaluation and diagnosis of benign bone lesions. In the current issue we cover treatment options for these diverse lesions. The objective of surgery is to totally eradicate the lesion and thereby reduce the risk of recurrence. Appropriate treatment relies on accurate tissue diagnosis, the aggressiveness of the tumor (staging), and its size and location.

Resection: What Has To Go?

Staging is critical when considering treatment options, i.e. the more aggressive the lesion, the more aggressive the treatment (see Table below). Three stages of benign bone lesions have been described by Enneking.1 Whereas stage 1 “latent” lesions may need no treatment, stage 2 or “active” lesions often require intralesional excision and stage 3 “aggressive” lesions usually require resection with extensive bony reconstruction. In general, treatment options apply to tumor type and corresponding stage.

The first consideration is “what has to go?” For a stage 1 lesion, simple intralesional curettage is adequate to remove the tumor and the chance of recurrence would be quite remote. Treatment of stage 2 tumors involves exteriorization or "unroofing" of the lesion through a wide cortical window, allowing for complete visualization of the cavity in order to remove all tumorous tissue. Wide excision is reserved for stage 3 tumors which have a higher risk of local recurrence. In areas of expendable bone, such as the proximal fibula, distal ulna, iliac wing, ribs, patella and scapular blade, the entire tumor can be resected with a normal tissue margin and the local area reconstructed without extensive morbidity.

Reconstruction: What Is Left?

Once the tumor has been adequately removed, reconstruction techniques are considered. The next consideration for the treating surgeon is "What is left?" Reconstructive decisions should take into account the structural competency of the area and the anatomic replacement of the excised bone and soft tissue. For example, after removal of the tumor, is there mechanically competent bone, a contained bony cavity, or a weakened (or potentially weakened) area that requires structural reconstruction?

When remaining structures are basically competent and strong cortical bone surrounds the lesion, the objective is to simply encourage normal trabecular bone to fill the defect and cortical bone to heal into the cortical window area. Small lesions (<1 cm) may require no grafting, however, some type of grafting procedure should be considered for larger lesions. Although autograft has traditionally been used to graft these bone defects, the complication rate of iliac crest bone harvesting approaches 20%, including chronic pain, infection, blood loss and nerve damage at the donor site. Numerous commercial bone substitutes which are both osteoconductive and osteoinductive have been developed as autograft alternatives. These combination products consisting of bioactive materials and biodegradable filler substances have been used successfully to reconstruct space-occupying lesions. As the biodegradable material vacancies the space, bone growth factors stimulate host bone to grow into the area.

More complex reconstruction is necessary when a major structural defect is left after tumor excision. No currently available bone substitute is approved for structural application; additional internal fixation is required by the FDA. Structural grafts therefore play a major role in the management of large bony defects. In addition, methylmethacrylate cement can be combined with other materials to reconstruct subchondral and periarticular areas.

For small structural defects, autograft bone such as iliac crest wedges or sections of autograft fibula are appropriate. However, to avoid morbidity at the harvest site, a similar allograft product is usually available. In these situations, it is best to avoid freeze-dried or high-dose radiated grafts (>2mrad), since both of these sterilization processes weaken the graft, make it more difficult to handle, and significantly alter the mechanical characteristics. Cortical allografts which have been sterilely procured and cryopreserved are most effective and the easiest to use. In structurally incompetent bone, rigid fixation, such as plate and screws, are required to achieve solid allograft-host healing. The union rate is not as reliable with intramedullary rods, even with locking screws.

The principles of treating benign bone tumors are illustrated in the following three cases. Salient features of excision and reconstruction are emphasized. These principles apply to similar tumors of the same stage.

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<th>Stage</th>
<th>Treatment</th>
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<td>Stage 1</td>
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<td>None</td>
<td>Local grafting</td>
</tr>
<tr>
<td>Stage 2</td>
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<td>Local grafting</td>
<td>Cementation</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Intralesional excision or resection</td>
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<td>Structural grafting</td>
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THE DENVER CLINIC PATIENT REFERRAL COORDINATOR

The Denver Clinic is proud to introduce Dianne LaKamp as Patient Referral Coordinator. This new position was created to streamline the scheduling process for new Denver Clinic patients who contact us via doctor referral, website or word-of-mouth. Dianne fills a critical niche for the team due to the increasing volume of "cold calls" from lay individuals seeking help with complex orthopedic problems. Besides serving on the Denver Clinic front line, Dianne is responsible for the regional outreach education program and the weekly Thursday conference.

A friendly, familiar face to PSL "old-timers", Dianne was one of the first patient representatives at PSL in the 1980’s - 90’s. Since then she has held similar positions at St. Anthony, National Jewish and VistaCare Hospice. She now feels like "she has come home" to PSL. Her experienced skill in handling patient-physician-hospital interrelationships, combined with her poise and compassion, make her a perfect fit for this position. Dianne’s forte is "customer service," and hers is the caring voice that will be the first and lasting impression for many Denver Clinic patients.
Case Study #1
Physician: Ross Wilkins, MD

Unicameral bone cysts (UBC) usually occur at the end of a long bone in skeletally immature patients. They remain troublesome in regard to diagnosis and treatment, and their etiology is poorly understood. Generally, the diagnosis can be established by patient age, tumor location, and a characteristic radiographic appearance. UBC can be active lesions which continue to grow and cause structural insufficiency in the local bone area with occasional pathologic fracture. UBC have three phases: active, latent, and involutional. If a lesion is involutional and asymptomatic, observation may be all that is needed. Large, active or latent UBC usually require surgery. Various injection techniques with materials such as methylprednisolone have been popular in the past; however, these methods have a recurrence rate of 15% to 88% after an average of three injections.

In this case, a 12-year-old boy had sustained three previous fractures of his distal tibia and undergone multiple unsuccessful percutaneous injections of methylprednisolone for a large active UBC. He had become tentative in his daily activities and refused to participate in physical education classes or sports. At presentation, preoperative plain films showed a multiloculated bone cyst of the distal tibial metaphysis (FIG. 1A). The lesion was curetted and percutaneously grafted with a mixture of bioassayed demineralized bone matrix 2,4,6 (AlloGro™, AlloSource, Denver, CO) and calcium sulfate pellets (Osteoset™, Wright Medical Technology, Arlington TN). Corticalization of the boundaries of the grafted areas is visible at 3 weeks (FIG. 1B) and the patient had resumed his athletic activities. Additional intramedullary remodeling is apparent at 3 months (FIG. 1C). The patient has maintained an active lifestyle, including downhill skiing and soccer.


Case Study #3
Physician: Ross Wilkins, MD

This 23-year-old young man with Down’s Syndrome was active and athletic, but began complaining of pain and swelling in his knee. Plain x-rays showed a pathologic fracture through a destructive lesion in his proximal tibia of which the differential diagnosis included an aneurysmal bone cyst, giant cell tumor or malignancy. It was felt advantageous for the patient to undergo definitive diagnosis and treatment.

At surgery, frozen section confirmed a giant cell tumor. A wide cortical window was made for visual access to the lesion (FIG. 3A) and a high speed burr facilitated curettage, especially at subchondral margins (FIG. 3B). A dental mirror (FIG. 3C) helped ensure thorough tumor removal and avoid injury to the neurovascular structures. Margins were considered clear when all visible remaining bone appeared normal. The cavity was coated with calcium sulfate and DBM (AlloMatrixTM, Wright Medical Technology, Arlington TN). Then, working from the articular surface outward, radio-opaque methylmethacrylate cement was digitally packed into the defect (FIG. 3D). This was performed under constant iced saline lavage to control temperature at the subchondral bone/cement interface and prevent thermal damage to healthy cartilage. In cases of intra-articular fracture, such as with this patient, the joint surface was manually reduced under direct vision as the cavity was cemented (FIG. 3E). Once the cement hardened, additional calcium sulfate and bioassayed demineralized bone matrix was layered on top (FIG. 3F). A drain was placed and bleeding was controlled. After wound closure and application of a compressive dressing, the patient was placed in a hinged knee brace. Immediately postop, he was started on passive motion and protected weight bearing.

This technique for treating giant cell tumors offers several advantages. First, extensive removal of tumor is possible which leads to lower recurrence rates. Secondly, the use of radio-opaque cement to reconstruct the joint surface provides immediate stability, allows early mobilization, and facilitates diagnosis of recurrences. Third, the use of bone substitute materials combining calcium sulfate and osteoinductive growth factors provides a stimulus for regeneration of the weight bearing cortical shell and a return to normal load bearing mechanics.

Case Study #2
Physician: Cynthia Kelly, MD

A 43 year old female was evaluated for pain and weakness in her right upper arm and shoulder for 2 months. She also complained of a grinding type sensation in her shoulder with activities. The patient had a history of chopping wood 9 months prior to her evaluation that was associated with aching and soreness; this resolved over 3 days with the use of anti-inflammatory medications. She had no complaints of neurovascular compromise in the extremity or constitutional symptoms on presentation. Past medical history was notable for Type II diabetes and hypertension.

Physical exam demonstrated no deformities about the right shoulder girdle, full glenohumeral range of motion, no axillary lymphadenopathy, and trace weakness with resisted abduction and rotation of the shoulder. Preoperative studies (FIG. 2A-B) revealed a calcified lesion within the humeral head associated with minimal endosteal erosion on MRI and suggestive of a cartilage-based tumor.

The patient underwent biopsy and resection of a cartilaginous neoplasm that proved to be consistent with a benign enchondroma. The defect was filled with calcium sulfate bone graft substitute material and demineralized bone matrix putty (Osteoset pellets and Allomatrix, Wright Medical Technology, Arlington TN). Postoperative films demonstrate the presence of the radiopaque pellets (FIG. 2C). Dissolution of the osteoconductive calcium sulfate pellets and ingrowth of new bone into the surgically created defect is visible at 2 months (FIG. 2D).

The patient had regained full function and strength of her shoulder after completing a course of physical therapy and has had no evidence of recurrence of the lesion after 2 years (FIG. 2E).


Mountain Mardi Gras Returns!

After a year absence from the Denver social scene, the Mountain Mardi Gras Benefit and Auction returned to Denver en force at the Belmar Center in Lakewood on Saturday, March 4th. A Naughty Night at the Moulin Rouge featured a cocktail soiree amidst hundreds of silent auction items, dinner buffet served by some of Denver’s finest restaurants, a floor show that amused the most discriminating of critics, stand-up comedian and sometime veterinarian, Dr. Kevin Fitzgerald, and dancing until the wee hours of the morning.

A committee of talented volunteers transformed the Belmar into the dark, fantastical underworld of the Parisian nightclub, the Moulin Rouge circa 1900. Most guests came in costume to reflect the style of the era or their interpretation of the theme. Frilly Can-Can dresses, head pieces, feathers, corsets, pin-stripe suits, bowler hats and woolen overcoats are some of the images available on the website www.blacktie-colorado.com/premiere_events/details.

This year’s signature event for the Limb Preservation Foundation raised over $100,000. Since inception of the Mountain Mardi Gras in 1992, the total funds dedicated to Saving Lives and Limbs is now at more than $1 million. The Limb Preservation Foundation program is now distinguished by three separate grant funds and one national program.
PRESENTATIONS

Colorado Orthopedic Trauma Symposium, Westminster CO, Feb. 17, 2006
Treatment of Non-Unions
David Hahn, M.D.

Veterinary Cancer Society, Sedona AZ, March 5-8, 2006
Advances in Limb Sparing for Human Osteosarcoma
Ross M. Wilkins, M.D.

American Academy of Orthopaedic Surgeons, Chicago IL, March 22-26, 2006
Humeral Nonunions: Use of the Pedicled Lateral Border of Scapula
Ross Wilkins, Bill Brown, Cindy Kelly, Anne Camozzi

American Association of Tissue Banks, Tucson AZ, March 28, 2006
Medical Record Review/Determining Donor Suitability
Ross M. Wilkins, M.D.

Continuing Education, Thessalonika, Greece, April 14-15, 2006
Bones and Bone Healing
Ross M. Wilkins, M.D.

Nursing Inservice, Presbyterian/St. Luke's Medical Center, Denver, May 18, 2006
Osteosarcoma & the Intra-Arterial Chemotherapy Protocol
Cindy Kelly, M.D.

Australian Orthopaedic Association, July 12, 2006, Queensland, Australia
Large Bone Defects
Ross M. Wilkins, M.D.

Mt. San Rafael Hospital, Trinidad CO, July DTBA
Hand Safety
Caring for the Patient with a Traumatic Limb Injury
David Schnur, M.D.

Montrose Memorial Hospital in Montrose, CO, July DTBA
Lumps & Bumps in Adult and Pediatric Orthopedics
Cindy Kelly, M.D.

EVERY THURSDAY

The Denver Clinic for Extremities at Risk hosts a multidisciplinary conference on Thursday morning from 7:00 – 8:00 a.m. in the Colorado Room North (across from the library entrance) at Presbyterian/St. Luke's Medical Center. Healthcare professionals are welcome to attend this CME-accredited program. If you have a patient that you wish to present either for discussion of a treatment plan or for input from the group, please notify Libby Mauter, Administrative Director, at 303-839-7337 or (800)262-5462.

RECENT PUBLICATIONS
