Our summer 2008 newsletter focuses on fracture healing problems. As more patients survive trauma as a result of improved pre-hospital care, orthopaedic surgeons are confronted with increasingly difficult fracture care challenges. Fortunately, new implant technology, advancements in biology and improved techniques in bone transport and transplantation are available to treat patients.

On another note, CFx has had a great scientific 2008, with numerous publications, grants and successful teaching initiatives. We continue to emphasize that the achievement of outstanding patient outcomes is built on the foundation of teaching, research and advanced clinical practice.

Wade Smith
Successful treatment of non-union fractures

More than 10 million Americans suffered a broken bone in the past year. The majority of fractures heal uneventfully with either nonoperative or operative treatment. Unfortunately, approximately 5 percent of these fractures do not heal properly and need further treatment to have full union of the bone.

A non-union is defined as a fracture that is not united after six to nine months, depending on the bone and type of fracture. By nine months, non-unions will likely not heal without further intervention. Non-unions are disabling physically and psychologically. Timely and appropriate treatments can help patients regain function and resume their lives.

Successful treatment of a non-union requires five basic steps:

1. Diagnosis;
2. Understanding the type of non-union;
3. Education of the patient;
4. Development of a treatment plan; and
5. Implementation of the plan.

The cardinal diagnostic finding for non-union is pain with activity at the fracture site. Patients presenting with a fracture and unresolved pain should be carefully evaluated for non-union. Important aspects of the history and physical exam include the timing and type of previous surgery, presence of open fractures or infection, and the degree of pain and limited motion in the affected extremity. Orthogonal and oblique X-rays may demonstrate lack of healing. Computed Tomographic scans can help in cases in which the X-ray evaluation is not definitive.

Once a diagnosis of non-union has been determined, the non-union must be classified as hypertrophic, oligotropic or atrophic. This step is critical as the classification will dictate treatment.

Hypertrophic non-unions are biologically active and require increased mechanical stability in order to heal. They do not require bone grafting, and exchange nailing, compression plating or compression external fixation can usually heal hypertrophic non-unions as long as the fracture site is not de-nuded of blood supply during surgery.

Oligotrophic non-unions have active biology but often require adjunctive grafting and/or increased mechanical stability in order to increase bone growth and volume. These non-unions also benefit from indirect reductions with minimal soft tissue stripping, even if grafts are used.

Atrophic non-unions are the most difficult to heal. In these cases, the bone is actually disappearing (atrophy), which may be caused by infection or a complete lack of local biological activity. Atrophic non-unions must be carefully screened for infection. They may require bone resection if the bone ends are infected or dead. Subsequent bone gaps may require vascularized bone or tissue transplants, bone transport, massive grafting and mechanical bone stabilization.

Proceeding with an operative plan and surgery requires significant discussion with the patient. There are many options depending on variables such as the non-union type, the length of disability, patient health and psycho-social factors. At CFx we believe that the surgeon’s duty is to be conversant with all possible treatments so that the treatment chosen is best for the individual patient. In some cases this may require consultation or referral.

After a treatment plan has been agreed upon by the patient and surgeon, the surgical team must develop the practical details of the operative plan. This requires a multidisciplinary approach involving the non-union surgeon, the microvascular surgeon, infectious disease, anesthesia and primary health care providers. The operative plan must have backup options. At CFx, our preference is to template and diagram using computer technology so that all aspects of the surgery have been considered and all implants fit the patient and are available. Good planning means good surgery.

Following surgery, aggressive physical therapy, and in many cases psychological therapy, is needed to help mobilize contracted joints, regain ambulation and overcome depression. The best looking X-rays often fail
Case 1

A 54 year old female with rheumatoid arthritis sustained a closed humeral shaft fracture after a fall. She was initially treated with an intramedullary nail, subsequently developed a nonunion treated with open reduction and internal fixation with plate screws and bone morphogenic protein (BMP). Unfortunately, a deep infection was developed. She was treated in another hospital with plate removal, external fixation, followed by locked plate fixation with antibiotic, methylmethacralate beads. Her infection persisted and spread, with hardware failure and an open, draining wound with protruding metal. She was subsequently referred to the Center for Complex Fractures at the Denver Health Medical Center. (Figure 1-1a and b).

Anteroposterior and lateral radiographs of the humerus taken at the time of presentation showing failure of the locking plate and an unstable, infected nonunion of the humeral shaft (Figure 1-2a and b).

Clinical appearance of the open wound and loose plate at time of surgery at Denver Health (Figure 1-3).

Anteroposterior and lateral postoperative radiographs following resection of dead and infected bone, placement of absorbable antibiotic beads and a complex ring fixator for distraction osteogenesis (Figure 1-4).

Radiographic and clinical appearance of the arm following 6 months of bone transport and wound management (Figure 1-5).

Radiographic appearance 15 months after our initial treatment. The bone is healed and well aligned (Figure 1-6).

The patient is highly functional and has returned to her activities including piano and pottery (Figure 1-7).
Case 2

A 31-year-old soldier was ambushed in Ramullah, Iraq, sustaining bilateral high velocity gunshot wounds with bilateral vascular injuries. After emergent revascularization and stabilization by U.S. medical personnel in Iraq, the patient was flown to Landstahl Medical Center for further treatment. He was then referred to Denver Health for definitive management of his fractures and open wounds.

The CFx team performed a staged reconstruction with minimally invasive plate fixation and a new form of autologous bone graft using the Reamer Irrigator Aspirator (RIA). This technique allows harvest of a large graft volume from the femoral canal through a 1.5 cm incision.

CFx physicians recently published this technique in Orthopaedics.

Pre-operative x-rays showing high energy open tibia fracture stabilized with external fixator (Figure 2-1 & 2-2).

Ria graft harvested from femoral shaft prior to implantation (Figure 2-3).

Radiographs 6 months after grafting and minimally invasive plate fixation, showing healing fractures (Figure 2-4 & 2-5).
Successful treatment of non-union fractures

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when post operative support of the patient is not maximized. However, the right diagnosis and surgical plan, combined with a dedicated therapy team, gives patients the highest chance to heal their bones and their lives.

A recent evaluation of the CFx data registry for non-unions found that more than 90 percent of patients achieve healed fractures and a return to work. This is an extraordinary number given the complexity and severity of these cases.

Non-unions and infected fractures can be healed successfully by a team of professionals dedicated to treatment of the most challenging orthopaedic cases.

Announcements

Joining the CFx Team

Anthony Sanchez, M.D. – August 18, 2008. Specializes in sports medicine, knee dislocation and trauma.

Chrystal Schroeder, DPM – August 4, 2008. Will join the diabetic limb salvage team specializing in foot and ankle pathology.

Matt Rudloff, M.D. – August 1, 2008. Dr. Rudloff is a recent graduate from the University of Tennessee Orthopaedic residency program and will be the 2008 - 09 orthopaedic trauma fellow.

Mark Tuttle, M.D. – September 15, 2008. Dr. Tuttle is a 2006 graduate of the University of Colorado School of Medicine Department of Orthopaedics, and will be the 2008 - 09 total joint fellow.

Acknowledgments

Kagan Ozer, M.D. – Chief of hand and microvascular surgery was recently promoted to associate professor University of Colorado Denver School of Medicine.

Phil Stahel, M.D. – Orthopaedic traumatologist was promoted to associate professor.

Dave Hak, M.D. – Orthopaedic traumatologist was promoted to associate professor.

University of Colorado Department of Orthopaedic Surgery Awards

Hector Mejia, M.D. – Received the resident research award for best paper 2008.

Laura DiMatteo, M.D. – Received the resident research award for best presentation 2008.

Navid Ziran, M.D. – Received the fellow research award for best paper 2008.

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For referrals call 303-436-3555 or 1-866-344-2334
Recent Publications


