**ANKLE FRACTURES: OSTEOPOROTIC and NEUROPATHIC**

* **INTRODUCTION**
	+ Osteoporotic Fractures
		- 3rd most common fracture in elderly patients
		- Among the most common fractures sustained by women
		- Peak incidence is in females 75 – 84 yrs.
		- Incidence rose from 369 in 1970 to 1545 in 2000
	+ Neuropathic Fractures
		- One in 10 Americans are afflicted with diabetes
		- Each year 260,000 Americans sustain ankle fractures, 25% require surgery
		- 6% of these patients are diabetics
	+ Medical co-morbidities of patients
		- Neuropathy (more often in diabetics)
			* 40% will develop this within first decade of onset
			* 10% have it at time of initial diagnosis
			* >50% of patients over 60 years of age have some form
			* Leads to delay in diagnosis and noncompliance of treatment
		- Arthropathy
			* Osteopenia
			* Abnormal osteoclastic activity
		- Angiopathy
			* ABI may be helpful but may be falsely elevated due to arterial calcinosis making vessel less compressible by the cuff
			* May need toe pressures or transcutaneous O2 measurements to evaluate flow
		- Delayed fracture and wound healing
			* Hyperglycemia produces nonenzymatic glycosylation of proteins
			* This alters the mechanics of wound healing
		- Immune dysfunction
			* Infection rate is higher in diabetics vs. nondiabetics
		- Malnutrition
		- Precarious soft tissues
		- Non-compliance
	+ Surgical treatment of ankle fractures in diabetics is associated with major complications (amputation, infection, nonunion) in 30-43% of patients
* **PATIENT EVALUATION**
	+ History
		- Mechanism of injury
			* High or low energy
		- Timing of injury
			* If fracture identified > 24 hours after injury need to check for neuropathy
	+ Physical Exam
		- Check skin for any lesions or wounds
		- Check circulation: may need to obtain toe pressure readings, transcutaneous O2 or TBI levels
		- Check for neuropathy using Semmes-Weinstein monofilaments- most often this is very obvious
		- May need a vascular consultation
	+ Laboratory
		- Check for malnutrition
		- Evaluate hemoglobin A1C levels
			* Levels > 6.5% higher rates produce more complications, poor outcomes and the need for more revisions
			* Post operative glucose < 200 is essential to minimize infection risk
	+ Radiographs
		- Standard AP, Lateral, mortise of ankle or films of foot
	+ Check circulation
* **TREATMENT**
	+ Goals
		- Stable bony anatomy of the foot or ankle
		- Restore function
		- **Prevent complications leading to loss of limb or death**
		- Patient fits easily in accommodative shoes
		- **Able to stand or weight bear for long periods**
	+ Non-operative care
		- Indicated for non-displaced stable ankle fractures that can tolerate WBAT
		- Beware of casting if neuropathic- skin checks essential
		- May need weekly or biweekly radiographs to document reduction
		- Protective braces may be needed for additional 2-3 months
	+ Operative care
		- **Golden Rule:** Double the amount of fixation, the time of non-weight bearing, the number of office visits and period of immobilization
		- **Shortening acceptable in Diabetics, avoids Starling’s principle**
			* Neuropathic Patients
			* Poorly controlled DM
		- Fusion
			* May be best option in some patients
		- **Extend beyond zone of injury**
			* **Use of strongest device tolerated by soft tissue envelope**
	+ **Fixation of the Ankle**
		- Standard small fragment fixation can be used on non-osteoporotic, non-neuropathic, palpable pulses, BMI < 25 with good sugar control. Otherwise think about locking systems
		- Additional treatment may be necessary
			* Transarticular fixation through the heel with Steinman pins
			* Trans-syndesmotic fixation of the tibia and fibula – **FIBPROTIB**
			* Neutralization ex fix may be necessary **– beware of pin loosening in neuropathic patients**
		- Intramedullary devices in the foot or ankle may be needed to obtain adequate fixation and alignment of the joints
		- Sometimes shortening bone may be necessary to obtain adequate contact
	+ Post-operative care
		- Immobilize and maintain touch down weight bearing longer than usual

**REFERENCES**

1. Pinzur MS, Noonan T. Ankle arthrodesis with a retrograde femoral nail for charcot ankle arthropathy. *Foot Ankle Int* 2005; 26: 545-549.

2. Hockenbury RT, Gruttadauria M, McKinney I. Use of implantable bone growth stimulation in charcot ankle arthrodesis. *Foot Ankle Int* 2007; 28: 971-976.

3. Thompson RB Jr, Clohisy DR: Deformity following fracture in diabetic neuropathic osteoarthropathy. Operative management of adults who have type-I diabetes. *J Bone Joint Surg-Am* 1993; 75: 1765-1773.

4. Flynn JM, Rodriguez-del Rio F, Piza PA. Closed ankle fractures in the diabetic patient. *Foot Ankle Int* 2000; 21:311-319.

5. Holmes GB, Hill N. Fractures and dislocations of the foot and ankle in diabetics associated with charcot joint changes. *Foot Ankle Int* 1994; 15:182-185.

6. Prisk VR, Wukich DK. Ankle fractures in diabetics. *Foot Ankle Clin n Am* 2006; 11:849-863.

7. Gandhi A, Liporace F, Azad V, Mattie J, Lin SS. Diabetic fracture healing. *Foot Ankle Clin N Am* 2006; 11:805-824.

8. Myerson MS, Edwards WHB. Management of neuropathic fractures in the foot and ankle. *J Am Acad Orthop* 1999; 7:8-18.

9. Fabrin J, Larsen K, Holstein PE. Arthrodesis with external fixation in the unstable or misaligned charcot ankle in patients with diabetes mellitus. *Lower Extremity Wounds* 2007; 6:102-107.

10. Caravaggi C, Cimmino M, Caruso S, Noce SD. Intramedullary compressive nail fixation for the treatment of severe charcot deformity of the ankle and rear foot. *J Foot Ankle* 2006; 45:20-24.

11. Jani MM, Ricci WM, Borrelli J Jr, Barrett SE, Johnson JE. A protocol for treatment of unstable ankle fractures using transarticular fixation in patients with diabetes mellitus and loss of protective sensation. *Foot Ankle Int* 2003; 24:838-844.

12. Cozen L. Does diabetes delay fracture healing? *Clin Orthop* 1972; 82:134-140.

13. Loder RT. The influence of diabetes mellitus on the healing of closed fractures. *Clin Orthop* 1988; 232:210-216.

14. Bibbo C, Lin SS, Beam HA, Behrens FF. Complications of ankle fractures in diabetic patients. *Orthop Clin N Am* 2001; 32:113-134.

15. Liu J, Ludwig, T, Ebraheim NA. Effect of blood HbA1c level on surgical treatment outcomes of diabetics with ankle fractures. *Orthop Surg* 2013;5:203-208.

16. Kannus P, Palvanen M, Niemi S, Parkkari J, Järvinen M*. Bone.* 2002 Sep;31(3):430

17. Bischoff-Ferrari HA et al. Fracture prevention with vitamin D supplementation: a meta analysis of randomized controlled trials. *JAMA* 2005 May 11th: 293(18);to 257-64.