

Dear Students,

Welcome to *140.05, the Introduction to Orthopaedic Surgery Elective*. Our department looks forward to meeting you over the next few weeks.

This elective was designed to provide clinical exposure to Orthopaedic Surgery in both the clinical and operative settings. During this rotation you will be placed on a two-week rotation with one of the many orthopaedic surgery subspecialty services (Arthroplasty/Joint Replacement, Spine, Sports, University Service (Parnassus Trauma), ZSFG (Trauma), Pediatrics, Hand, Tumor, or Foot & Ankle. Each service treats a unique mix of patients and musculoskeletal pathologies. You will be exposed to patient evaluation and treatment in three clinical arenas: outpatient clinic, inpatient wards/ER, and the operating room. Our goal is to offer students an example of how an orthopaedic surgeon treats conditions of the musculoskeletal system through history and physical exam, imaging evaluation, and then both nonoperative and operative treatment. We by no means expect a mastery of your assigned subspecialty in two weeks but we do hope you gain an understanding and appreciation of the basic principles.

The schedule for each rotation is unique and each day you may be assigned to a different location among the UCSF campuses (Parnassus, Mission Bay, ZSFG, Orthopaedic Institute). Your day will mirror that of the residents on your service. In general the day begins with morning rounds, followed by a morning conference, and then clinical duties (OR vs clinic). Please refer to the various subsections within this syllabus for more detailed instructions. If at any point questions or issues arise please contact either the residents on your assigned, your attendings or myself.

*Please feel free to reach out to me with any questions, concerns, or critiques. My email is Nicole.schroeder@ucsf.edu and my cell is (415) 845-9353. You will receive an email from Dan Peterson (Daniel.Peterson2@ucsf.edu) with your service assignment, attending and residents. His work phone is (415) 502-2579. **The best way to coordinate times/locations/etc is to touch base with the RESIDENT on your service.***

Sincerely,

Nikki S. Schroeder, M.D.

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Associate Residency Director, Dept. of Orthopaedic Surgery
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UCSF ORTHOPAEDIC SURGERY ELECTIVE SYLLABUS

Welcome to the UCSF Orthopaedic Surgery Service!

We hope you find this elective to be fun, educational, and eye-opening regardless of your future career objectives. All the faculty you will be working with enjoy working with medical students and love sharing our passion for the musculoskeletal system. Please come excited and ready to soak up as much as you can in your two weeks with us!

Orthopaedic Surgery Sub-specialties

You will be assigned to one of the many “services” within the Department of Orthopaedics umbrella. Orthopaedic surgery trends towards sub-specialization especially at academic tertiary referral centers such as UCSF. All faculty have completed a residency in addition to a post-residency fellowship to narrow and refine their practice. Though the various specialties treat different conditions, the basic diagnostic and operative principles are universal. Orthopaedic sub-specialties with the specific conditions treated are listed below:

- Arthroplasty (Joint Replacement) - arthritic conditions of the hip and knee including primary and revision hip and knee replacements.
- Orthopaedic Trauma (University service @ Parnassus and ZSFG) – traumatic MSK injuries including complex fractures, dislocations of the extremities and pelvis
- Sports Medicine – athletic and non-athletic injuries and conditions in patients of all ages to include rotator cuff tears, shoulder arthritis and instability, meniscus and cartilage injuries of the knee, ACL and other ligament tears and many others.
- Spine – traumatic and degenerative conditions of the cervical, thoracic and lumbo-sacral spine
- Pediatrics – MSK conditions and injuries in neonates, children and adolescents. Covers all areas of the body and conditions including broken bones, developmental deformities, manifestations of cerebral palsy, and scoliosis
- Hand and Upper Extremity – Injuries of the hand, wrist and elbow including trauma, nerve injuries, degenerative conditions, and congenital conditions.
- Foot and Ankle – injuries and disorders of the foot and ankle – sports injuries, arthritis, tendon injuries/dysfunction
- Oncology – benign and malignant tumors of the soft tissues and bones of the extremities and pelvis

Goals:

1. Gain general exposure to the various different types of orthopaedic practices and procedures
2. Define the basic principles of orthopaedic patient evaluation and treatment

3. Develop a 3D understanding of anatomy as it applies to orthopaedic injuries, diagnosis and treatment
4. Improve ability to read and interpret orthopaedic radiographs
5. Gain exposure to operative room scrubbing, surgical assisting, basic surgical skills

Keys to Success and general expectations:

- General Expectations:
 - **BE ON TIME and BE PROFESSIONAL** – we are a very fun bunch who love what we do and sharing it with anyone who will listen. This can be viewed as being more informal; however, we always aim to be professional). Try to key off the residents.
 - **KNOW/REVIEW ANATOMY** – surgery is based on anatomy. Review your basic MSK anatomy. You should be able to identify all bones. Muscles, ligaments, nerves, vessels etc you should know relative to a procedure you will be scrubbing into. Orthopedic Surgery often focuses on “approaches” to a specific location. *If you ask your resident what approach they will use for the case the next day you can easily figure out the relevant anatomy for the case by studying the approach.*
 - **BE ENGAGED** – if you show interest you will get more out of the rotation (the residents/attendings will give you a lot of useful advice for sub-Is if you’re engaged and show an interest in orthopedics).
 - **READ EVERY NIGHT** – prepare for the next day. If you know you have an ACL reconstruction the next day, read something about the ACL. If you have clinic, review physical exam maneuvers. A quick debrief with your residents at the end of the day can be helpful to get pointed in the right direction on what to read. Look at the required reading/resources at the end of the syllabus for additional help.
 - **COME TO GRAND ROUNDS AND DIDACTICS ON WEDNESDAY MORNING.** Typically there is a case conference at 630a,m followed by grand rounds at 730am and then lectures 830-1100am. Conference is in N225. Touch base with your residents to confirm.
- Rounding:
 - As part of the team you are expected to round with the residents on inpatients. Assist the team as they instruct. Depending on the service you are on, you may be required to round at one hospital then head to clinic at a separate hospital.
- Clinic:

- **Come to your first clinic in dress clothes unless instructed otherwise.**
 - Ask your attending as to what they expect. Some will have you shadow and see patients with them. Others will have you see patients independently and then have you present the patient.
 - In general, orthopaedic clinic history and physicals should be focused compared to your other rotations. Stick to the problem at hand and relevant issues as well as a focused MSK physical exam. Your presentations to attendings should likewise be succinct and with pertinent information (positive and negative findings). Different attendings want different levels of information on presentation.
 - Remind attendings and residents if they see an interesting physical exam finding that you would love to see/repeat that maneuver.
- In the Operating Room:
 - If you have not scrubbed in a while – TELL SOMEONE! We are happy to help guide you.
 - If you accidentally “contaminated yourself” when you are supposed to be sterile – TELL SOMEONE!! This happens to all of us and is easily remedied. Don’t accidentally touch your face or something unsterile and not tell anyone. You are only putting the patient at risk!
 - **Introduce yourself to the other members of the OR team when you first come in and ask if they would like you to write your name and year on the board**
 - Get your gloves before scrubbing and give to the circulating nurse to open for you unless you are comfortable opening them sterilely
 - Questions are always welcomed but keep in mind the situation. A stressful portion of the procedure is generally not a great time for questions like “Is that vessel supposed to be bleeding that much?” You can always ask “Is now a good time for a question?” if unsure.
 - Patients are not always asleep for orthopaedic procedures. Be mindful of what you say always....

EVALUATION AND FEEDBACK

We welcome all feedback for how to improve the rotation. Please feel free in your evaluations or informally to share your experience and how we can make the rotation better.

DUTY HOURS:

UCSF Department of Orthopaedic Surgery adheres to all duty hour restrictions for medical students, resident and fellows. No exceptions. *If you at any time feel pressured to violate this policy please notify Dr. Schroeder so the situation can be addressed immediately.*

ROTATION SPECIFIC INFORMATION

Arthroplasty

Attendings: Drs. Thomas Vail, Thomas Barber, Stefano Bini, Erik Hansen, Derek Ward, and Jeff Barry

Residents on service: R5, R2 + Fellow

Main locations: Parnassus (surgical cases), OI (clinics, occasional outpatient procedures)

General Schedule:

- rounding daily before other clinical duties
- OR running most days. Tuesday and Thursday are typically busiest days
- Wednesday noon conference (go over cases and imaging for the following week)
- Tues AM arthroplasty subject conference with rotating topic schedule
- Clinics also running most days

Bread and butter cases: total knee and total hip arthroplasties

Orthopedic Oncology

Attendings: Drs. Richard O'Donnell, Rosanna Wustrack, Melissa Zimel

Residents: UCSF Ortho R3, UCSF Fresno R2

Main Locations: UCSF Mission Bay Hospital, UCSF Moffitt-Long Hospital

Minor Locations: VA, ZSFG, (CHO)

Schedule (Rounding for med students at MB or ML is flexible)

- Monday: Rounding, then Wustrack OR at ML. Alternatively Zimel clinic at MB
- Tuesday: Rounding then Zimel OR at MB or Wustrack OR at MB (1 room)
- Wednesday: Rounding, then teaching at Parnassus. Followed by Zimel OR MB, O'Donnell OR MB, Wustrack OR at MB (2 of 3 operating)
- Thursday: Rounding, then Tumor Board at MB at 7 AM. Attending rounds 8-9 AM. Clinic with either Wustrack, Zimel, or O'Donnell to follow (all three in clinic)
- Friday: Rounding, then Wustrack clinic at MB (most common). Alternatives: Wustrack VA/ZSFG clinics, Zimel CHO clinic, or O'Donnell San Ramon clinic

Case Examples

- Open Biopsies
- Benign and Pathologic Tumor Excisions
- Fixation of Pathologic Fractures
- Lower Extremity Amputations
- Limb Reconstruction (Proximal Femoral Replacement, etc)

Foot & Ankle

Attendings: Drs. Kirstina Olson and Dan Thuillier

Residents: R2 and R5

Main locations: Clinic at the OI, OR at the OI and ML. Smaller outpatient cases are done at the OI, whereas larger foot fusions or ankle replacements are done at ML.

Schedule:

Monday- 8AM Clinic at the OI (Dr. Olson)

Tuesday- Pre-op conference at 6:45AM followed by OR at the OI (Dr. Thuillier)

Wednesday- Ground rounds and resident wide teaching followed by OR at ML (Dr. Thuillier)

Thursday- 6:45 F&A teaching followed by OR at the OI (Dr. Olson) or Clinic at the OI (Dr. Thuillier)

Friday- OR at ML (Dr. Olson)

Foot and ankle teaching is conducted on Thursday mornings and will rotate on the following topics:

- Anatomy and foot biomechanics
- Disorders of the first ray (hallux valgus, hallux rigidus)
- Diabetic foot and infections of the foot
- Arthritides of the foot and ankle
- Acute and chronic ankle injuries
- Tendon disorders (posterior tibial tendon dysfunction and flat foot)
- Neurologic disorders of the foot and ankle

Typical cases address a variety of foot and ankle pathology including ankle fractures, ankle and foot fusions, achilles tendon repairs, ankle arthroscopy and ligament reconstruction, total ankle replacements, and bunion corrections.

Sports

Faculty: Drs. Benjamin Ma, Christina Allen, Brian Feeley, Alan Zhang, Drew Lansdown, Elly Laroque, Nicholas Colyvas, Nirav Pandya

Welcome to the Orthopaedic Sports service. The service covers 8 faculty members, two fellows, two residents (an R4 and R2), and a number of non-operative and mid-level providers. The medical student rotation is usually coordinated by Dr. Drew Lansdown. The primary clinical location is at the Orthopaedic Institute at 1500 Owens street, though some procedures are still done in the main OR at Moffit-Long hospital on the Parnassus campus. There are a number of medical student appropriate texts that can be checked out from the OI clinic during the rotation. A generic schedule for a week would be as follows:

Monday - Clinic or OR at the OI, 530 pm - evening indications conference or didactics

Tuesday - Clinic or OR at the OI

Wednesday - Grand rounds and didactics at Parnassus, then Clinic or OR at the OI

Thursday - Clinic or OR at the OI

Friday - Clinic or OR at the OI

There are options for medical students to get involved with sports team coverage during the weekends. Interested students should contact Dr. Lansdown about availability during their rotation.

Common procedures: shoulder arthroscopy, knee arthroscopy, rotator cuff repair, meniscus debridement, ACL reconstruction, shoulder arthroplasty

Ortho Trauma – Gold Team

This team covers orthopaedic trauma at ZSFGH as well as elective ortho sports, hand and foot consults/surgeries.

Attendings worked with: Drs. Utku Kandemir (trauma and sports surgeon), Dave Shearer (trauma and foot/ankle surgeon), Saam Morshed (trauma surgeon), Antony Ding (trauma and hand surgeon), Richard Coughlin (trauma and foot/ankle surgeon), Nicole Schroeder (hand surgeon), Nicolas Lee (hand surgeon), Charles Parks (podiatrist)

Residents on service: R5 (chief), R4 (hand-focused resident), R3 (foot-focused resident), R2
Main Locations: San Francisco General Hospital

General Schedule:

AM rounds at 0600 every morning (except Wed AM): meet in 7A, room 20 of old hospital building. Front door code 7418*, room 20 code 1919.

Conference at 0700 every morning: 2nd floor of building 9 OTI (Orthopaedic Trauma Hospital)

Monday: OR all day

Tues: Hand clinic with Drs. Schroeder and Lee

Wed: Morning conference/teaching at Parnassus--speak to residents regarding time/location; PM clinic with Drs. Shearer and Coughlin

Thurs: OR all day

Friday: Hand OR, clinic with Drs. Morshed, Kandemir, and Ding

Cases are quite diverse and range from hip/knee/ankle/ar./forearm fracture fixation, complex pelvic ring/acetabular surgery, ACL reconstruction, meniscus debridement, any and all hand and foot surgeries. It's always a good idea to ask the resident about cases/approaches the night before, but there may be cases that you don't get a chance to prepare for (it's the nature of trauma). The residents/attendings understand this, so just do your best to look at the AO reference and Orthobullets apps before cases. You'll almost always have time in the morning after rounding. Pimping during operations may happen, but everyone just wants you to learn and enjoy the rotation. All the same applies to the Blue Team, and you can even ask to join Blue Team's cases if they interest you - if you've seen a ton of hip fractures, definitely try to see other cases as well!

Hand and Upper Extremity- OI

Attendings: Drs. Lisa Lattanza, Igor Immerman, Matt Masem, Nicolas Lee, Nikki Schroeder

Residents: R5, R2 and fellow

Main locations: The OI (second floor for the Hand clinics and OR), Moffitt Long Hospital (larger upper extremity surgeries will be done here), Mission Bay Hospital (occasionally Dr. Lattanza will have pediatric hand cases here)

General Schedule:

Monday: 0800 clinic at the OI with Dr. Lattanza

Tuesday: 0645 weekly resident led didactics followed by either OI clinic with Dr. Immerman or OI OR with Dr. Lattanza. Once a month at 1830 there is a fellow led didactic session instead of the morning session.

Wednesday: Grand rounds followed by residency-wide didactics until 1200, followed by OI clinic with Dr. Lattanza

Thursday: 0700 OR with Dr. Lattanza (usually at ML) or Dr. Immerman (OI)

Friday: 0645 Operative indications conference followed by OR with Dr. Lattanza (MB or OI) or OI clinic with Dr. Immerman.

Drs Masem, Lee and Schroeder also occasionally have clinic and cases at the OI, but the schedule is variable by week. For the weekly didactic schedule, talk to your resident about the upcoming topic. At indications conference, residents will go into detail about one of the more complex cases for the upcoming week to allow for conversation about the surgical indications and technique.

While in clinic, expect a wide variety of hand and upper extremity complaints. It is a great time to learn the basics of the hand physical exam, interpret imaging studies, and get exposure to the breadth of the field. Typical OR cases include carpal and cubital tunnel release, distal radius/finger fractures, elbow fracture fixation or replacement, nerve/tendon repair, and more complex pediatric upper extremity surgeries

Ortho Trauma – Blue Team

Ortho Trauma, Arthroplasty, Spine @ ZSFG

Attendings: Drs. Eric Meinberg, Meir Marmor, Paul Toogood (all 3 are Arthroplasty and Trauma), Trigg McClellan (Spine and Trauma), Amir Matityahu, Michael Cluck (spine)

Residents: R5, R4, R3, R2, R1

Location: ZSFG

General schedule

Mon: 6am rounds, 7am fracture conference, 7:30am post op conference, 8am attending rounds (multidisciplinary discussion of inpatients), 9am-end of day 3M clinic (Arthroplasty/Trauma)

Tues: 6am rounds, 7am fracture conference, 7:30am-end of day OR (Arthroplasty and trauma cases)

Wed: 7am fracture conference, 8am rounds, 9am-end of day OR (Arthroplasty and trauma cases)

Thurs: 6am rounds, 7am fracture conference, 7:30am teaching by R3, 9am Trauma/Spine 3M clinic

Fri: 6am rounds, 7am fracture conference, 7:30am-end of day OR (trauma cases)

Typical cases: total knee/total hip Arthroplasty, hip fractures, ankle fractures, tibia/femur fractures, septic joint incision and debridement, spine

Ortho University Service - Parnassus

A diverse rotation experience in orthopedic trauma that encompasses orthopedic emergency room/inpatient consultations, surgical fixation of fractures, and surgical repair/osteotomy and reconstruction of complex nonunion/deformity. The location site also provides possible exposure to other inpatient sub-specialities that include hip/knee arthroplasty, spine, oncology, foot/ankle, shoulder arthroplasty.

Common cases: Open reduction internal fixation of hip/femur/tibia/humerus.
Intramedullary fixation of hip/femur/tibia. Repair/bone grafting of nonunion.

Attendings worked with: Drs. Saam Morshed, Utku Kandemir, Dave Shearer, Paul Toogood, Eric Meinberg

Residents on service: R1 + R5 residents

Main Location: UCSF Parnassus campus

General Schedule:

M- Rounding then OR/orthopedic consultation

Tu- Rounding then OR/orthopedic consultation

Wed- Rounding then education then OR/orthopedic consultation

Thu- Rounding then OR/orthopedic consultation

Fri- Rounding, Trauma conference, then OR/orthopedic consultation

Spine

Attendings: Drs. Sigurd Berven, Shane Burch, Vedat Deviren, Lionel Metz, Bobby Tay, Alekos Theologis

Pediatrics

Attendings worked with: Dr. Mohammed Diab, Kristin Livingston, Eliana Delgado

Residents on service: UCSF R4

Main Locations: UCSF Benioff at Mission Bay

General Schedule:

Monday -- Rounding in am, then OR at 7:30 with Dr. Livingston

Tuesday-- Rounding in am, then OR at 7:30 with Dr. Diab

Wednesday -- Conference at 6:30 at Parnassus, followed by Grand Rounds at 7:30 and teaching at 8:45. After teaching head to Mission Bay to round on patients. Clinic with Dr. Diab at 1 pm.

Thursday - Education and Preop/Postop Conference at 6:30 am in Mission Hall on 5th floor,
followed by inpatient rounds at 7:45 and OR with Dr. Diab after rounds
Friday -- Inpatient rounds followed by clinic with Dr. Delgado or OR with Dr. Livingston

Bread and butter case examples: Supracondylar humerus fracture closed reduction
percutaneous pinning, Posterior spinal fusion for adolescent idiopathic scoliosis,
Periacetabular osteotomy / varus derotational osteotomy for hip dysplasia, flexible
nailing for both bone forearm fractures/tibia fractures/femur fractures, hip spica
cast application for femur fractures

AWESOME GENERAL KNOWLEDGE RESOURCES:

ORTHOINFO by AAOS

www.orthoinfo.org

Quick reviews of most general topics arranged by the AAOS

ORTHOBULLETS (HIGH YIELD RESOURCE)

www.orthobullet.com

Quick review outlines – resident level of knowledge but very comprehensive. Every
resident uses these regularly. Don't need an account to get access to the outlines.

***Download the free app on your phone to quickly review topics before cases or
seeing a patient

AO SURGERY REFERENCE

www.aosurgery.org

Great for trauma/fracture care. Goes through all parts of the body with review of
fracture types, recommended treatment and surgical approaches. There is a free
app as well – good quick reference before a trauma case you didn't have the ability
to prepare for.

The Young Orthopedist or OrthoClips– YouTube Channels

<https://www.youtube.com/channel/UCAIelr1RR0R6vfUgo0JVaxw/featured>

<https://www.youtube.com/channel/UCGKnwUkTQRPXSx6jVvrPtGw/videos>

Info is actually very good and well broken down for basic stuff like fracture healing,
xray interpretation etc.

If you know you are going into orthopaedics consider getting Netter's Concise
Orthopaedic Anatomy and Hoppenfelds surgical exposures in orthopaedics
textbooks. *Hoppenfelds is the go-to resource for reviewing surgical approaches.*

The Netter's book is a great overview of Orthopedic relevant MSK anatomy topics

Another classic textbook is Handbook of Fractures

THESE ARE NOT NEEDED FOR THE ROTATION BY ANY MEANS!!!

If you are going to do an orthopaedic sub-I get them. Otherwise any anatomy
textbook or google will be good for preoperative anatomy reviews.

REQUIRED READING/VIEWING FOR EVERYONE:

Please review the following before the end of the rotation. They cover very basic evaluation and diagnostics in orthopaedics. Additionally a few select articles on some of the most common or most emergent orthopaedic pathologies.

Orthopaedic History

This PDF is something from google – its basic but covers the level and key points we would expect you to hit.

<http://orthopaedics.uonbi.ac.ke/sites/default/files/chs/medschool/orthopaedics/Orthopaedic%20History%20and%20Physical%20Exam.PDF>

Orthopaedic Anatomy Sheets

This folder contains Anatomy sheets of the following: Spine, Foot & Ankle, Hip & Thigh, Knee, Shoulder, Hand & Elbow.

<https://ucsf.box.com/s/f3d3ed1n68g5s799u7aat7605q37into>

Orthopaedic Physical Exam

This PDF is by the AAFP but is a great overview of each subsection of the physical exam. Recommend reading the whole thing but definitely review applicable sections for the rotation you are on.

<https://ucsf.box.com/s/bd95ne6maua3dywg146a7cl09a1s5amc>

These videos cover most of the basic physical exam maneuvers separated out by location.

UCSF Faculty doing it but not greatest video quality – focus on knee, shoulder, elbow, wrist/hand, back, foot. These are more in-depth if you are interested in that:

https://www.youtube.com/playlist?list=PLb00F6wEYu9K_yrN4sRkPcQYvhckeFt66

A different source from Kansas:

https://www.youtube.com/playlist?list=PLijalQObzAG5b1NN0sjyMw_vAPYZE-Kc4

How to interpret an orthopaedic xray:

6 min video: <https://www.youtube.com/watch?v=3effy9aYnOs>

Basics of fracture healing

Basic science: https://www.youtube.com/watch?v=8iIRM5_SuG0

Clinical: <https://www.youtube.com/watch?v=v4et24SjRV0>

Common Orthopaedic Conditions:

Hip and Knee Replacement:

<https://ucsf.box.com/s/in9q0qfdcw25a1tw35cfqgn4lum3hfhj>

Carpal Tunnel Syndrome

<https://ucsf.box.com/s/hy1iuhbnovyj41xazt370rieq1lh6ojk>

ACL Tear

<https://ucsf.box.com/s/3sqq862fo5f9r1evea70xwgz9pqbl8h>

Rotator Cuff Tear

<https://ucsf.box.com/s/u7pi9vwksfuk5c7pw76rq1h07cu05911>

Hip Fracture

<https://ucsf.box.com/s/v6kcw95iq6otqz2dcfgi237fpq4gz06y>

Ankle Instability

<https://ucsf.box.com/s/tgejn2xhlmvj8k572pqzeb8vw9ecsi1s>

Supracondylar Humerus Fracture

<https://ucsf.box.com/s/emj5nuo2hlwmp6quc9uu51g2ehq193q1>

Spinal Stenosis

<https://ucsf.box.com/s/txwt4araduby4u1s35aahx16ckpsc1c8>

Osteosarcoma

<https://ucsf.box.com/s/4vg0gjm9qvci4nc57v1z26d3vkps92ox>

Orthopaedic Emergencies Everyone Should Know:

Open Fractures:

These involve an injury that breaches the skin and soft tissue and exposes the bone to the outside environment. There are “inside out” injuries (a bone spike pierces the skin and then goes back below the skin surface) and “outside in” injuries (a gunshot wound). Open fractures are graded I, II and III.

- Grade I open fractures have wounds less than 1 cm. in length.
- Grade II open fractures are wounds more than 1 cm. in length, but the wound is clean and there is no devitalized tissue.
- Grade III open fractures have contaminated wounds with devitalized tissue or have comminuted fractures with neurovascular injury. Grade III fractures are subdivided:
 - IIIA have contaminated wounds with minimal periosteal stripping and no neurovascular compromise;
 - IIIB are associated with significant periosteal soft tissue injury;
 - IIIC have significant periosteal stripping/soft tissue injury with associated vascular compromise or nerve injury.

Open fractures have a high incidence of complications including infection, nonunion and frank osteomyelitis.

Septic Arthritis:

Acute onset of pain, inflammation of a single joint that rapidly increases in severity should alert the physician of a septic arthritis. If septic arthritis is present, early diagnosis and treatment is a necessity. Swelling of the involved joint, erythema, induration, pain with range of motion or weight bearing can be seen. History may include fever, chills, sweats. A history of an injury involving a breach of skin around the joint may be elicited (fight bite). Recent bacterial infection may be in the history. Recent sexual contact should alert one to the possibility of gonococcal arthritis. Patients with immunosuppressive disorders are at increased risk, as are patients on steroids. Arthrocentesis of the involved joint is done—the cell count gives the physician an idea of the white cell content and character of the fluid. If there is a truly septic joint it must be irrigated and debrided immediately to prevent damage

to the articular surface from the pus. Treatment includes joint arthrocentesis, CBC, ESR, cultures of joint fluid; if fluid is suspicious for septic arthritis the patient undergoes I & D in the OR immediately and is placed on intravenous antibiotics.

Compartment Syndrome:

This is caused by elevated hydrostatic pressure in a closed fascial compartment. The elevated pressure may be muscle injury and swelling, bleeding into a compartment, vascular injury. It is a complication that can be seen with fractures, soft tissue injuries, post-operatively, with crush injuries or venomous bites. As the pressure increases capillary beds collapse shunting blood through the compartment via larger arteries. Venous beds collapse as pressure increases and venous outflow is compromised. This results in increased swelling, higher pressure and resultant ischemia. Clinically one should always be suspicious of compartment syndrome in a patient who complains of intense increase in severity of extremity pain.

The primary physical sign is increased pain. One can also see pain with passive stretching—gentle motion of muscles in the compartment elicits great pain.

Paresthesia is a fairly late sign—this indicates that the nerves in the compartment are being adversely affected by the ischemia. If the compartment syndrome is unrecognized or untreated this can eventually progress to a Volkmann's ischemia where the nerves are irrevocably damaged and the muscles become ischemic and necrose.

Firm, tense compartments are another physical sign. Compartment pressures are measured with a manometer and provide objective evidence of increased pressure. Pallor and pulselessness of the extremity are often late signs.

The treatment of compartment syndrome involves emergent surgical release of the compartment in the OR. Delayed primary closure of the skin may be done or the skin defect may be approximated with skin grafts with the swelling has resolved. Elevation of the involved extremity is used to reduce swelling.