

American Chiropractic College of Radiology
Academics Committee

Postgraduate Radiology Residency Program

Recommended Syllabus

Revised: 04-12-07

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Purpose of the ACCR syllabus

To create and maintain a universal platform, which residents actively enrolled within a diagnostic imaging residency program at an accredited chiropractic college, may use to reach an appropriate level of academic competency in diagnostic imaging as it relates to chiropractic and allied health care professions.

The following syllabus represents the work of the ACCR academics committee. Voting members of this committee include Department Chairs (or designated individual) of Diagnostic Imaging and Radiology Residency Directors from Council on Chiropractic Education (CCE) accredited Chiropractic Colleges. A “syllabus” subcommittee may be operational that serves the ACCR Academics Committee by keeping the syllabus current.

How to use the syllabus

The following suggestions are only recommendations and you should always consult your Residency director / Department chair for details on how to use the syllabus so that it fits within your specific program.

Textbooks

The majority of information you will need to learn about the syllabus topics will be through your residency director and found in imaging textbooks. Textbooks serve as a reference of experience and literature reviews performed by the authors, therefore serve as the author(s) opinion. Textbooks are written for a specific audience and therefore different textbooks on the same topic may present the material differently. For example, textbooks written for chiropractic students may present the material in a “big” picture format and are very useful in providing a general grasp of a topic while textbooks written for osteoradiologists or pathologists may present the material in a very detailed manner. You will also find in your course of study that different authors may not agree on some specifics. In cases when a disagreement occurs, it is recommended that the resident pick a reliable reference and quote that reference for that information. Radiology review books or manuals should not be used to gather initial information on a topic. These review manuals may offer assistance while studying for Part I boards, but should not be used until the start of the third year of residency.

The syllabus identifies two categories of textbooks:

1. **Required Reading:** Books the syllabus should generally follow and residents are expected to purchase.
2. **Suggested Reading:** Books that should be used in addition to the required text and should be available to residents within their department library

Residents should use the required book first, then look in a couple of suggested texts for any additional material. By applying this method, residents may obtain the scope and depth required to master a topic.

Taking Notes

Taking good notes is an essential part of a radiology residency. The following is only a suggestion, as everybody has different methods of taking notes and you should always consult your Residency director / Department chair for details on how to take notes so that it fits within your specific program. Residents who study only from old notes run two risks. The first is that you are dependent upon the person who originally took the notes for accurate information (old notes are “secondhand” information) and secondly, you will not gain the experience of “using” the required textbooks. By taking your own notes you will be able to look at radiographic examples in the book to help you identify the conditions you are studying at the viewbox. The goal of taking notes is to obtain your own opinions about the topics, and to gain ownership of your own information rather than relying on your predecessors in the residency.

Outline of note taking

Your notes will be your main review material when studying boards. “Good” notes will tell a story about a topic and contain the “big picture” as well as specifics. A suggested format includes:

- Epidemiology
- Diagnostic criteria / Clinical abnormalities / Laboratory abnormalities
- Pathologic manifestations
- Radiographic findings
 - Classic manifestations
 - Advanced / uncommon manifestations
- Advanced imaging
- Management / prognosis
- Associated diseases / DDX

How much or how little information should you gather on each topic or subtopic? This is the classic question for residents taking notes - the answer is an individual one. Information can be subdivided into:

- Essential: Basic information that serves as a foundation, the “big” picture. This may be general like the target areas of involvement of arthritis or specific like the classic radiographic appearance of an osteoid osteoma.
- Required: Detailed information that builds upon the foundation of essential knowledge. This represents material required

for a “working” understanding of the topic. This information may include such things as early, classic, and late radiographic manifestations, common and uncommon presentations, and a good differential diagnosis list.

Trivial: Very detailed information that may be controversial. It represents material on the very fringe of understanding of a topic or an associated disorder that is extremely rare. Sometimes this information is found in recent literature or is only alluded to in a textbook. The material in this section varies greatly from resident to resident.

Your notes should reflect about 90% of essential and required information and 10% of trivial information. You will also find that within the suggested format, you will probably have more trivial information in areas that you find personally interesting, such as radiographic manifestations or clinical data.

In general, your notes serve as a learning journal for your first two years of the residency. Learn good note taking skills early.

Studying

This part of the residency is the most important part, yet the one thing that is the most neglected. With clinic duties, sessions, teaching responsibilities, and note taking it is easy to see why this aspect is usually put off to the hour before session or the trimester before part I boards. A good personal schedule and some discipline are the only tools necessary to stay on top of the material. Use trimester / semester breaks wisely. Take some time to relax and study. It has been said that the difference between a good resident and a great resident is what they do during breaks.

American Chiropractic College of Radiology Academics Committee

Syllabus on Principles of Diagnostic Imaging and Radiation Health

Revised: 04-12-07

Time frame for completion: 7 weeks

Required Reading:

1. Curry TS, Dowdey JE, and Murry RC. Christensen's Physics of Diagnostic Radiology. Lippincott Williams & Wilkins 4th ed., 1990.

OR

2. Bushong SC. Radiologic Science for Technologists: Physics, Biology, and Protection. Mosby 8th ed., 2004.
3. Smith RC, Lange RC. Understanding Magnetic Resonance Imaging. CRC 1997.

Suggested Reading:

1. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
2. Guebert GM, Yochum TR, Pirtle O. Essentials of Diagnostic Imaging. Mosby-Year Book. 1995.
3. Taveras JM, Ferrucci JT, Dunnick NR, Higgins CB. Radiology: Diagnosis, Imaging, Intervention (Clinical text in five looseleaf volumes or CD-ROM edition) Lippincott Williams & Wilkins, 2001.
4. Bushberg JT, Seibert JA, Leidholdt EM Jr, Boone JM. The Essential Physics of Medical Imaging. Lippincott Williams & Wilkins 2nd ed., 2001.
5. Hall EJ, Giaccia AJ.. Radiobiology for the Radiologist. Lippincott Williams & Wilkins 6th ed., 2005.
6. Stark DD, Bradley WG. Magnetic Resonance Imaging. (Physics of MRI chapters) Mosby-Year Book, 3rd ed., 1999.

Essential topics:

A. History and development of x-ray

1. Discovery of X-Ray
2. Development of Radiology

B. Ionizing radiation

1. Electromagnetic Radiation
 - a. Electromagnetic spectrum
 - b. Wave concept
 - c. Particle concept
 - d. X-Ray
 - e. Gamma rays
 - f. Inverse square law
2. Particulate Radiation
 - a. Alpha particles
 - b. Beta particles

C. Basic physical science

1. Matter
2. Energy
3. Atomic Structure
 - a. Electron binding energy
4. Electricity
 - a. Alternating current
 - b. Direct current
 - c. Transformer

D. The X-ray machine

1. X-Ray Tube
 - a. Protective Housing
 - b. Glass Envelope
 - c. Cathode
 - i. Filament
 - ii. Focusing cup
 - d. Anode
 - iii. Stationary
 - iv. Rotating
 - v. Target
 - vi. Focal spot
 - Line focus principle
 - Heel effect
 - vii. Induction Motor
2. X-Ray Generator
 - a. Control panel (operating console)

- b. Line compensation
- c. Transformer
 - i. Step down (low voltage)
 - ii. Step up (high voltage)
 - iii. Autotransformer
- d. Low voltage circuit
- e. Filament circuit
- f. High voltage circuit
- g. Timer
- h. Rectification

E. Production of x-rays

- 1. Electron-target interaction
 - a. Anode heat
- 2. Bremsstrahlung radiation (general or braking radiation)
- 3. Characteristic radiation
- 4. X-Ray emission spectrum
 - a. Discrete x-ray spectrum
 - b. Continuous x-ray spectrum
- 5. Factors affecting x-ray emission spectrum
 - a. Tube current
 - b. Tube potential
 - c. Added filtration
 - d. Target material
 - e. Voltage wave form
- 6. X-Ray emission
 - a. X-ray quantity
 - b. X-ray quality
- 7. X-Ray tube rating charts
 - a. Radiographic rating chart
 - b. Anode cooling chart
 - c. Housing cooling chart

F. X-Ray interaction with matter

- 1. Classical or coherent scattering
- 2. Photoelectric effect
- 3. Compton effect
 - a. Scatter radiation
- 4. Pair production
- 5. Photodisintegration
- 6. Attenuation
 - a. Linear attenuation coefficient
 - b. Half-value layer
- 7. Absorption

G. Filtration

1. Inherent filtration
2. Added filtration
3. Total filtration
4. Compensating (density equalizing) filters

H. X-Ray beam-restricting devices

1. Aperture diaphragms
2. Cones and cylinders
3. Collimators

I. Grids

1. Grid ratio
2. Grid frequency
3. Types of grids
 - a. Linear
 - b. Crossed
 - c. Parallel
 - d. Focused
 - e. Moving
 - f. Stationary
4. Contrast improvement factor
5. Bucky factor
6. Grid cutoff
7. Air-gap technique

J. X-ray film

1. Film layers
 - a. Base
 - b. Emulsion
 - c. Supercoating
2. Film types
 - a. Screen type film
 - b. Direct exposure film
3. Formation of latent image
4. Film processing
 - a. Development
 - i. Replenishment
 - b. Stop bath
 - c. Fixing
 - d. Washing
 - e. Drying
 - f. Manual processing
 - g. Automatic processing

K. Intensifying Screens

1. Luminescence

- a. Fluorescence
- b. Phosphorescence
- 2. Screen construction
 - a. Protective coating
 - b. Phosphor layer
 - c. Reflective layer
 - d. Base
- 3. Phosphors
- 4. Screen speed
 - a. Intensification factor
- 5. Resolution
- 6. Quantum mottle
- 7. Screen-film combinations
- 8. Cassette
 - a. Screen-film contact
- 9. Care of screens
- 10. Fluoroscopic screens

L. Radiographic Quality and Quality Control

- 1. Film factors
 - a. Characteristic curve
 - b. Density
 - c. Contrast
 - d. Latitude
 - e. Image clarity (detail or definition)
- 2. Geometric Factors
 - a. Magnification
 - b. Distortion
 - c. Penumbra (geometric unsharpness)
 - d. Heel effect
 - e. Inverse square law
- 3. Subject factors
 - a. Subject contrast
 - b. Motion unsharpness
- 4. Quality Control (assurance)

M. Special X-Ray Equipment and Procedures

- 1. Fluoroscopy
 - a. Image intensification
 - b. Cine fluorography
- 2. Tomography
- 3. Stereoradiography
- 4. Magnification radiography
- 5. Xeroradiography
- 6. Computerized tomography (CT)
- 7. Ultrasound

8. Soft-tissue radiography
 - a. Mammography
9. Digital radiography
10. Computed radiography
11. MRI (to be covered under musculoskeletal imaging syllabus)

N. Quantities and units of radiation

1. Roentgen
2. Rad/Gy
3. Rem/Sv
4. Curie/Bq
5. Electron volt (eV)

O. Radiobiology

1. Types of ionizing radiation
 - a. Electromagnetic
 - b. Particulate
2. Absorption of energy from radiation
 - a. Excitation
 - b. Ionization
3. Fundamental principles of radiobiology
 - a. Linear energy transfer (LET)
 - b. Relative biological effectiveness (RBE)
 - c. Oxygen enhancement ratio
 - d. Law of Bergonié-Tribondeau
4. Radiation dose - response relationships
 - a. Linear
 - b. Nonlinear
 - c. Threshold
 - d. Non-threshold
5. Human responses to ionizing radiation
 - a. Immediate (early radiation effects)
 - i. Acute radiation syndrome
 - ii. Local tissue damage
 - iii. Hematologic depression
 - b. Latent (delayed radiation effects)
 - i. Leukemia
 - ii. Carcinogenesis
 - iii. Local tissue damage
 - iv. Life-shortening
 - v. Genetic effects
 - Doubling dose
 - Genetically significant dose (GSD)
 - c. Effects of embryonic and fetal irradiation

P. Principles of Radiation Protection

1. Personnel monitoring
2. Radiation protection guides (RPGs) and current recommended maximum accumulated dose (MPGs)
 - a. Maximum accumulated dose
3. Protective barriers
 - a. Primary
 - b. Secondary
4. Protection for operators
 - a. Short exposure time
 - b. Large distance between source and exposed person
 - c. Shielding
5. Protection for patients
 - a. ALARA
 - b. Selection of patients
 - c. Collimation
 - d. Filtration
 - e. Source to skin distance
 - f. Film-screen combinations
 - g. Optimum kVp
 - h. Gonad shielding
 - i. 10-day rule and replacement for 10-day rule
 - j. Film processing
 - k. Patient positioning

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Syllabus on Musculoskeletal Imaging

Revised: 04-12-07

- Part I: Normal Variants, Developmental/Congenital Anomalies & Skeletal Dysplasias
- Part II: Metabolic, Endocrine, and Nutritional Disorders of Bone
- Part III: Hematopoietic Disorders of Bone
- Part IV: Infectious Disorders of Bone
- Part V: Tumors and Tumor-Like Disorders of Bone
- Part VI: Articular Disorders
- Part VII: Physical injury of the Musculoskeletal System
- Part VIII: Magnetic Resonance Imaging of the Musculoskeletal System

Part I: Normal Variants, Developmental/Congenital Anomalies & Skeletal Dysplasias

Time frame for completion: 7 weeks

Required Reading:

1. Keats TE, Anderson MW. Atlas of Normal Roentgen Variants that may Simulate Disease. Mosby. 8th ed, 2006.
2. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Kuhn JP, Slovis TL, Haller JO. Caffey's Pediatric Diagnostic Imaging. Mosby. 10th ed. 2003.
2. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
3. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
4. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
5. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
6. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.
7. Wood BP. Pediatric CD-ROM, American College of Radiology (I-PD32CD). ACR Learning Files www.accr.org
8. Manaster BJ. Skeletal CD-ROM, American College of Radiology (I-SK32CD). ACR Learning Files www.accr.org

ESSENTIAL TOPICS

A. Defects of growth of tubular bones, spine or both

1. Manifested at birth -
 - a. Achondroplasia
 - i. Pseudoachondroplastic dysplasia
 - b. Chondrodysplasia
 - c. Metatrophic dwarfism
 - d. Diastrophic dwarfism
 - e. Thanatophoric dwarfism
 - f. Chondroectodermal dysplasia (Ellis-van Creveld syndrome)
 - g. Asphyxiating thoracic dysplasia (Jeune)
 - h. Spondyloepiphyseal dysplasia congenita
 - i. Cleidocranial dysplasia (formerly cleidocranial dysostosis)
2. Manifested later in life -
 - a. Dyschondrosteosis (Madelung's deformity)
 - b. Metaphyseal chondrodysplasia
 - c. Multiple epiphyseal dysplasia (Fairbank's disease)
 - d. Spondyloepiphyseal dysplasia tarda

B. Disorganized development of cartilage and fibrous skeletal components

1. Dysplasia epiphysealis hemimelica (Trevor's disease)
2. Hereditary multiple exostosis (osteochondromatosis or diaphyseal aclasis)
3. Enchondromatosis (Ollier's disease)
4. Enchondromatosis with cavernous hemangiomas (Maffucci's syndrome)
5. Fibrous dysplasia (Jaffe-Lichtenstein)
 - a. McCune-Albright
 - b. Cherubism

C. Abnormalities of density, cortical diaphyseal structure, or metaphyseal modeling

2. Osteogenesis imperfecta
 - a. Types I-IV
 - b. Congenita vs, tarda (Lobstein's disease)
3. Osteopetrosis
4. Osteopoikilosis
5. Osteopathia striata (Voorhoeve's disease)
6. Melorheostosis
7. Pyknodysostosis
8. Pachydermoperiostosis
9. Diaphyseal dysplasia (Engelmann's disease)
10. Metaphyseal dysplasia (Pyle's disease)

D. Dysostoses (malformation of individual bone, singularly or in combination).

1. Dysostoses with facial and cranial involvement
 - a. Craniofacial dysostosis (Crouzon's disease)

- b. Acrocephalosyndactyly (Apert's disease)
 - c. Mandibulofacial dysostosis (Treacher-Collins syndrome)
 - d. Marfan's syndrome – it seems a little odd having Marfans here?
2. Dysostoses with predominantly axial involvement
- a. Vertebral segmentation defects
 - i. Congenital/developmental blocked vertebra
 - ii. Klippel-Feil syndrome
 - iii. Butterfly vertebrae
 - iv. Hemivertebrae (anterior, posterior, lateral)
 - v. Occipitalization
 - vi. Transitional segments
 - vii. Epitransverse and paracondylar processes
 - viii. Sprengel's deformity
 - ix. Spina bifida occulta and vera (manifesta)
 - x. Diastematomyelia
 - xi. Caudal regression/sacral agenesis
 - Sirenomelia (mermaid syndrome)
 - xii. Agenetic or hypoplastic odontoid
 - xiii. Os odontoideum
 - xiv. Os terminale of Bergmann
 - xv. Schmorl's nodes
 - xvi. Nuclear impression
3. Dysostoses with predominantly appendicular involvement
- a. Developmental hip dysplasia
 - b. Glenoid dysplasia
 - c. Elbow dysplasia
 - d. Proximal focal femoral deficiency

E. Constitutional diseases of bone with known pathogenesis

- 1. Primary metabolic abnormalities
 - a. Idiopathic hypercalcemia
 - b. Mucopolysaccharidoses
 - MPS-I: Hurler's syndrome
 - MPS-I-S: Scheie
 - MPS-I-H-S: Hurler-Scheie
 - MPS-II: Hunter
 - MPS-III: Sanfilippo (subtypes A,B,C,D)
 - MPS-IV: Morquio's (subtypes A,B)
 - MPS-VI: Maroteaux-Lamy
 - MPS-VII: Sly
 - c. Fibro-osseous dysplasia progressiva
- 2. Chromosomal abnormalities
 - a. Trisomy 21 (Down's syndrome)
 - b. Trisomy 13-15
 - c. Trisomy 16-18
 - d. Klinefelter's syndrome

e. Turner's syndrome

F. Collagen disorders

1. Marfan's
2. Homocysteinuria
3. Ehlers-Danlos syndrome

G. Phakomatoses with skeletal involvement

1. Neurofibromatosis I (von Recklinghausen) – to be fully covered in neuroimaging section
2. Encephalotrigeminal angiomatosis (Sturge-Weber-Dimitri)
3. Tuberous sclerosis (Bourneville's disease)

H. Miscellaneous entities

1. Progeria
2. Holt-Oram syndrome
3. Infantile cortical hyperostosis (Caffey's disease)
4. Pectoral aplasia dysdactyly syndrome (Poland's syndrome)
5. Amelia
6. Hemimelia

Part II: Metabolic, Endocrine, and Nutritional Disorders of Bone

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
2. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
3. Manaster BJ. Skeletal CD-ROM, American College of Radiology (I-SK32CD). ACR Learning Files www.accr.org
4. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
5. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
6. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
7. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.

ESSENTIAL TOPICS

A. Metabolic disorders

1. Osteoporosis
 - a. Quantitative bone mineral analysis
 - i. Radiogrammetry
 - ii. Photodensitometry
 - iii. Single Photon and x-ray absorptiometry
 - iv. Quantitative computed tomography
 - v. Quantitative ultrasonography
 - vi. Quantitative MRI
 - vii. Clinical bone densitometry
 - b. Generalized osteoporosis
 - i. Senile and postmenopausal
 - General radiographic changes
 - Radiographic changes in the spine
 - Radiographic changes in the hip
 - Fractures (acute and insufficiency)
 - Reinforcement lines
 - ii. Idiopathic juvenile
 - iii. Other endocrine, metabolic, and iatrogenic causes
 - c. Regional osteoporosis
 - i. Immobilization and disuse
 - ii. Complex regional pain syndrome (reflex sympathetic dystrophy syndrome)
 - iii. Transient regional osteoporosis (transient bone marrow edema)
 - iv. Transient osteoporosis of the hip
 - v. Regional migratory osteoporosis
2. Rickets and osteomalacia
 - a. Radiographic diagnosis
 - b. Clinical syndromes
3. Hypophosphatasia
4. Hyperphosphatasia
5. Oxalosis
6. Paget's disease (to be covered fully here)

B. Endocrine disorders

1. Acromegaly
2. Gigantism
3. Hypopituitarism
4. Hyperthyroidism
5. Thyroid acropachy
6. Hypothyroidism
 - a. Cretinism

7. Renal osteodystrophy
8. Hyperparathyroidism
9. Hypoparathyroidism
10. Pseudohypoparathyroidism
11. Pseudo-pseudohyperparathyroidism
12. Cushing's disease
13. Addison's disease
14. Diabetes mellitus

C. Nutritional and toxic disorders

1. Hypervitaminosis A / retinoic acid toxicity
2. Hypovitaminosis C
3. Hypervitaminosis D
4. Lead poisoning
5. Phosphorus poisoning
6. Bismuth poisoning
7. Aluminum toxicity
8. Fluorine toxicity
9. Milk-alkali syndrome
10. Polyvinyl chloride toxicity

Part III: Hematopoietic Disorders of Bone

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
2. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
3. Manaster BJ. Skeletal CD-ROM, American College of Radiology (I-SK32CD). ACR Learning Files www.accr.org
4. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
5. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
6. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
7. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.

ESSENTIAL TOPICS

A. Anemias

1. Sickle cell anemia
2. Thalassemia
3. Iron deficiency anemia
4. Hereditary spherocytosis
5. Aplastic anemia

B. Lipidoses and histiocytosis

1. Gaucher's disease
2. Niemann-Pick disease
3. Fabry's disease
4. Multicentric reticulohistiocytosis
5. Langerhans cell histiocytosis
 - a. Eosinophilic granuloma (full discussion here)
 - b. Hand-Schuller-Christian disease
 - c. Letterer-Siwe disease
6. Lipoid granulomatosis

C. Marrow

1. Normal marrow anatomy and function
 - a. Trabecular bone
 - b. Red marrow
 - c. Yellow marrow
 - d. Marrow conversion
 - e. Variations in normal red marrow
2. MRI of normal marrow
3. Marrow pathology
 - a. Marrow proliferative disorders
 - b. Marrow replacement disorders
 - c. Marrow depletion
 - d. Vascular abnormalities
 - e. Amyloidosis
 - f. Systemic mastocytosis
 - g. Myelofibrosis

D. Bleeding disorders

1. Hemophilia
2. Bleeding diatheses and hemangiomas

E. Osteonecrosis

1. Terminology
2. Mechanisms
3. Histologic-radiographic correlation
4. Late complications
5. Idiopathic osteonecrosis (SONK)

F. Epiphyseal disorders and osteochondroses

4. Legg-Calve-Perthes disease
5. Freiberg infarction
6. Kienbock's disease
7. Kohler's disease
8. Panner's disease
9. Thiemann's disease
10. Osgood-Schlatter disease
11. Blount's disease
12. Scheuermann's disease
13. Sinding-Larsen-Johansson disease
14. Kummel's disease
15. Sever's disease
16. Ischiopubic osteochondrosis

Part IV: Infectious Disorders of Bone

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
2. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
3. Manaster BJ. Skeletal CD-ROM, American College of Radiology (I-SK32CD). ACR Learning Files www.accr.org
4. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
5. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
6. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
7. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.

ESSENTIAL TOPICS

A. Osteomyelitis

1. Routes of infection
2. Pathology
3. Radiology
 - i. Acute osteomyelitis
 - ii. Subacute and chronic osteomyelitis
4. Complications

B. Septic arthritis

1. Routes of infection
2. Radiographic-pathologic correlation
3. Complications

C. Spinal Infections

1. Routes of infection
2. Radiographic-pathologic correlation
3. Other considerations
 - a. Discitis
 - b. Sacroiliac joint infections

D. Specific organisms

- i. Bacterial infections
 1. Brodie's abscess
- ii. Mycobacterium
- iii. Fungal infections
- iv. Viral infections
- v. Parasitic infections

Part V: Tumor and Tumor-Like Disorders of Bone

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Huvos AG. Bone Tumors: Diagnosis, Treatment and Prognosis. WB Saunders. 2nd ed. 1991.
2. Unni KK. Tumors of the Bones and Joints. (Atlas of Tumor Pathology Series IV). Arp. 2005.
3. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
4. Keats TE, Anderson MW. Atlas of Normal Roentgen Variants that may Simulate Disease. Mosby. 8th ed, 2006.
5. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
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7. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
8. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
9. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
10. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.
11. Levesque J. A Clinical Guide to Primary Bone Tumors. Lippincott Williams & Wilkins. 1998.
12. Wilner D. Radiology of Bone Tumors and Allied Disorders. WB Saunders. 1981 [Out of print]

ESSENTIAL TOPICS

A. Bone-producing tumors

1. Osteoma
2. Enostosis
 - a. Osteopoikolosis
3. Osteoid osteoma
4. Osteblastoma
 - a. Conventional
 - b. Aggressive
5. Ossifying fibroma
6. Osteosarcoma
 - a. Conventional
 - b. Gnathic
 - c. Telangiectatic
 - d. Small cell
 - e. Intraosseous low grade
 - f. Intracortical
 - g. Surface high grade
 - h. Periosteal
 - i. Parosteal
 - j. Multicentric

B. Cartilage-producing tumors

1. Chondroma
2. Enchondroma
 - a. Ollier's disease
 - b. Maffucci's syndrome
3. Periosteal (juxtacortical) chondroma
4. Chondroblastoma
5. Chondromyxoid fibroma
6. Osteochondroma / exostosis
 - a. HME
 - b. Subungual exostosis
 - c. Nora's lesion
 - d. Turret exostosis
 - e. Dysplasia epiphysealis hemimelica (Trever's disease)
7. Chondrosarcoma
 - a. Conventional
 - b. Juxtacortical (periosteal)
 - c. Clear cell
 - d. Mesenchymal
 - e. Dedifferentiated

C. Fibrous connective tissue tumors

1. Non-ossifying fibroma / fibrous cortical defect
 - a. Jaffe-Campanacci syndrome

2. Periosteal (juxtacortical) desmoid
 3. Desmoplastic fibroma
 4. Fibrosarcoma
- D. Histiocytic or fibrohistiocytic tumors**
1. Fibrous histiocytoma
 2. Giant cell tumor
 - a. Goltz syndrome
 3. Giant cell reparative granuloma
 4. Malignant fibrous histiocytoma
 5. Cementoma
 6. Fibrous dysplasia
- E. Tumors of fatty differentiation**
1. Lipoma
 - a. Hibernoma
 - b. Juxta-articular adiposis dolorosa (Dercum's disease)
 2. Liposarcoma
- F. Tumors of muscle differentiation**
1. Leiomyoma
 2. Leiomyosarcoma
 3. Rhabdomyosarcoma
- G. Tumors of vascular differentiation**
1. Hemangioma
 2. Cystic angiomas
 3. Lymphangioma
 4. Glomus tumor
 5. Hemangiopericytoma
 6. Osteogenic osteomalacia
 7. Angiosarcoma
 8. Hemangioendothelioma
 9. Kasabach-Merritt syndrome
 10. Kaposi's sarcoma
 11. Massive osteolysis of Gorham
- H. Tumors of neural differentiation**
1. Solitary neurofibroma
 2. Neurilemmoma
 3. Neurogenic sarcoma (malignant schwannoma)
- I. Tumors of notochordal origin**
1. Chordoma
 2. Chondroid chordoma

J. Skeletal metastasis

1. Osteolytic
2. Osteoblastic
3. Mixed
4. Blow-out mets
5. Hypertrophic osteoarthropathy
6. Radionuclide scintigraphy
 - a. "Superscan"
 - b. "Flare" response

K. Marrow tumors

1. Ewing's sarcoma
2. Primary reticulum cell sarcoma of bone (lymphoma)
3. Plasma cell (multiple) myeloma
4. Plasmacytoma
5. Leukemia
6. Hodgkin's lymphoma

L. Tumors and tumor-like disorders of miscellaneous or unknown origin

1. Simple bone cyst
2. Epidermoid cyst
3. Aneurysmal bone cyst
4. Intraosseous ganglion cyst
5. Adamantinoma
6. Ameloblastoma
7. Synovial sarcoma
8. Brown tumor of hyperparathyroidism*
9. Pseudotumor of hemophilia*
10. Paget's disease*
11. Myositis ossificans
 - a. Pseudomalignant osseous tumor of soft tissue
 - b. Florid reactive periostitis
12. Langerhans cell histiocytosis

Part VI: Articular Disorders

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed, 2002.

Suggested Reading:

1. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
2. Manaster BJ. Skeletal CD-ROM, American College of Radiology (I-SK32CD). ACR Learning Files www.accr.org
3. Klippel JH, Dieppe PA. Rheumatology. Mosby-Year Book. 2nd ed. 2000.
4. Brower AC, Flemming DJ. Arthritis: In Black and White. WB Saunders. 2nd ed. 1997.
5. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
6. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
7. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
8. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.
9. Bellamy N. Colour Atlas of Clinical Rheumatology. Springer. 1989.
10. Klippel JH. Primer on the Rheumatic Diseases. 12th ed. 2001.

ESSENTIAL TOPICS

A. Articular anatomy

1. Fibrous articulations
2. Cartilaginous articulations
3. Synovial articulations
4. Supporting structures

B. Inflammatory processes

1. Rheumatoid arthritis
 - a) Epidemiology
 - b) Diagnostic criteria
 - c) Clinical abnormalities
 - d) Laboratory abnormalities
 - e) Soft tissue abnormalities
 - i. Edema
 - ii. Rheumatoid nodules
 - iii. Synovial cysts
 - iv. Sinus tracts
 - v. Rheumatoid lung
 - f) Radiographic findings
 - i. Classic manifestations (specific findings in target areas)
 - ii. Advanced manifestations
 - Ankylosis
 - Deformities
 - g) Advanced imaging
 - h) Management
 - i) Associated diseases
 - i. Felty's
 - ii. Sjogren's
 - iii. Caplan's
2. Juvenile chronic arthritis (based on clinical subgroups identified in Chapman)
 - a. Systemic- seronegative chronic arthritis / Still's disease
 - i. Adult Still's
 - b. Polyarticular (seropositive and seronegative)
 - c. Pauciarticular or monoarticular
 - d. Less common chronic arthritides in children
 - i. Juvenile onset adult type (seropositive) RA
 - ii. Juvenile onset ankylosing spondylitis
 - iii. Juvenile onset psoriatic arthritis
 - iv. Juvenile onset arthritis of inflammatory bowel disease (enteropathic)

3. Seronegative spondyloarthropathies
 - a) Ankylosing spondylitis
 - i. Epidemiology
 - ii. Diagnostic criteria
 - iii. Clinical abnormalities
 - iv. Laboratory abnormalities
 - v. Radiographic findings
 - Classic manifestations (specific findings in target areas)
 - Advanced manifestations
 - Ankylosis
 - Pulmonary changes
 - vi. Advanced imaging
 - vii. Management
 - viii. Associated diseases
 - Inflammatory bowel disorder
 - b) Psoriatic arthritis
 - c) Reactive arthritis
 - d) Enteropathic arthritides
 - i. Ulcerative colitis
 - ii. Crohn's
 - iii. Whipple's
 - iv. Post-surgical
4. Seropositive arthropathies / connective tissue disorders
 - a) Systemic lupus erythematosus
 - b) Scleroderma (progressive systemic sclerosis) and variants
 - c) Polymyositis and dermatomyositis (all types)
 - d) Jaccoud's arthropathy (rheumatic fever)
5. Mixed connective tissue disorders
6. Miscellaneous arthritic disorders / deformities
 - a. Behcet's disease
 - b. Relapsing polychondritis
 - c. Familial mediterranean fever
 - d. Tietze's syndrome
 - e. Arthritis mutilans
 - f. Lanois deformity
 - g. Main-en-lorgnette (opera glass hand)

C. Degenerative processes

1. Extraspinal osteoarthritis
 - a. Etiology
 - b. Radiographic findings
 - i. Typical degenerative disease (based on location/ distribution, according to the target approach)
 - ii. Atypical degenerative disease (Post-traumatic, iatrogenic, dysplastic, and osteonecrosis related degenerative disease)

- c. Complications
 - d. Miscellaneous
 - i. Inflammatory (erosive osteoarthropathy)
 - ii. Bull man's hands
 - iii. Driller's disease
 - iv. Kellgren's arthropathy (primary OA of the hands)
 - v. Kashin- Beck's disease
 - vi. Silastic implant arthropathy
2. Spinal degeneration
- a. Specific types
 - i. Intervertebral osteochondrosis
 - ii. Spondylosis deformans
 - iii. Uncovertebral joint arthrosis
 - iv. Apophyseal joint arthritis
 - v. Costovertebral joint osteoarthritis
 - vi. Osteoarthritis of transitional lumbosacral joints (Bertolotti's syndrome)
 - vii. Baastrup's disease
 - viii. Cock spur disease
 - b. Complications
 - i. Alignment
 - ii. Intervertebral disc displacement
 - Modic classification
 - Recurrent disc vs. post-surgical fibrosis
 - iii. Stenosis
3. Synovial osteochondromatosis
- a. Idiopathic
 - b. Secondary
4. Neuropathic osteoarthropathy
- a. Hypertrophic
 - b. Atrophic
 - c. Specific etiologies
5. Diffuse idiopathic skeletal hyperostosis
- a. Spinal
 - b. Extraspinal
 - c. Miscellaneous
 - i. Isotretinoin arthropathy (vit. A and its derivatives)
 - ii. Sternocostoclavicular hyperostosis
 - iii. RA-D.I.S.H.
6. Ossification of the posterior longitudinal ligament

D. Depositional processes

1. Gout
2. Calcium pyrophosphate dihydrate crystal deposition disease (C.P.P.D.)
3. Calcium hydroxylapatite crystal deposition disease (H.A.D.D.)
 - a. Milwaukee shoulder
4. Hemochromatosis
5. Alkaptonuria
6. Pigmented villonodular synovitis (PVNS)
 - a. Giant cell tumor of the tendon sheath (villonodular synovitis)
7. Multicentric reticulohistiocytosis
8. Wilson's disease
9. Amyloidosis
10. Xanthomatoses

E. Infectious arthropathy (see also infectious disorders of bone)

1. Pyogenic
2. Non-pyogenic, including sarcoidosis

F. Syndromes or diseases associated with arthritis/ arthralgia

1. Myositis ossificans
2. Pellegrini-Stieda disease
3. Tendinitis, peritendinitis, bursitis
4. Haglund's syndrome
5. Tenosynovitis
6. Fascitis
7. Carpal tunnel syndrome
8. Transient regional osteoporosis
9. Tumoral calcinosis
10. Interstitial calcinosis
 1. Calcinosis universalis
 2. Calcinosis circumscripta

G. Vascular or blood-related arthritides

1. Hemophilia
2. Hemoglobinopathies
3. Polyarteritis nodosa
4. Raynaud's syndrome/disease
5. Complex regional pain syndrome (reflex sympathetic dystrophy)
6. Henoch-Schonlein purpura
7. Hemarthrosis / lipohaemarthrosis

Part VII: Physical Injury of the Musculoskeletal System

Time frame for completion: 7 weeks

Required Reading:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed. 2002.
2. Rogers LF. Radiology of Skeletal Trauma. Churchill Livingstone. 3rd ed. 2002.

Suggested Reading:

1. Gehweiler. Radiology of Vertebral Trauma. WB Saunders. 1980.
2. Daffner RH. Imaging of Vertebral Trauma. Lippincott Williams & Wilkins. 2nd ed. 1996.
3. Schultz RJ. Language of Fractures. Lippincott Williams & Wilkins. 2nd ed. 1990.
4. Keats TE, Anderson MW. Atlas of Normal Roentgen Variants that may Simulate Disease. Mosby. 8th ed, 2006.
5. Manaster BJ, May DA, Disler DG. Musculoskeletal Imaging: The Requisites. Mosby. 3rd ed. 2006.
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7. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
8. Yochum TR, Rowe LJ. Yochum & Rowe's Essentials of Skeletal Radiology. Lippincott, Williams & Wilkins. 3rd ed. 2004.
9. Taylor JAM, Resnick D. Skeletal Imaging: Atlas of the Spine and Extremities. WB Saunders, 2000.
10. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.

ESSENTIAL TOPICS

A. Types of fractures

1. Complete, non-comminuted fractures
 - a. Oblique
 - b. Spiral
 - c. Transverse
 - d. Multiple
 - e. Avulsion
 - f. Chip
2. Comminuted fractures
3. Incomplete
 - a. Greenstick
 - b. Torus
 - c. Impacted
 - d. Infracrion
 - e. Buckling
 - f. Penetrating fractures
4. Epiphyseal fractures and dislocations
 - a. Salter-Harris Classification (1-9)
5. Pathologic fractures
6. Insufficiency fractures
 - a. Looser's zones (pseudofractures)
 - b. Others
7. Stress fractures

B. Fracture repair

1. Physiology
2. Complications
 - a. Delayed union
 - b. Nonunion
 - c. Malunion

C. Dislocations, subluxations, diastases

1. Axial
2. Appendicular

D. Instability

1. Axial
2. Appendicular

E. Fractures of the spine and pelvis

1. Hangman's fracture
2. Compression fracture
3. Transverse process fracture
4. Facet fractures

5. Clay-shovelers' fractures
6. Chance fracture
7. Teardrop fracture
8. Pillar fracture
9. Odontoid fracture
10. Jefferson's fracture (burst fx of C1)
11. Burst fracture (of vertebral body)
12. Malgaigne's fracture
13. Bucket handle fracture
14. Straddle fracture
15. Open book fracture (sprung pelvis)
16. Duverney's fracture
17. Dashboard fracture
18. Others

F. Fractures of the lower extremity

1. Femoral neck
 - a. Subcapital
 - b. Transcervical
 - c. Basicervical
 - d. Intertrochanteric
 - e. Peritrochanteric
 - f. Subtrochanteric
2. Pott's fracture
3. Jone's fracture (dancer's fracture)
4. Calcaneal fracture (altered Bohler's angle)
5. Oblique or spiral fractures of the diaphyses of the tubular bones
6. Tibial plateau fracture
7. Patella fracture
8. Toddler's fracture
9. Bumper or fender fracture

G. Fractures of the upper extremity

1. Flap fracture of the greater tuberosity of the humerus
2. Surgical neck fracture
3. Radial head fracture
4. Supracondylar fracture of the humerus
5. Olecranon process fracture
6. Monteggia's fracture-dislocation
7. Galeazzi's fracture-dislocation
8. Barton's fracture
9. Chauffeur's fracture
10. Colle's fracture
11. Smith's fracture
12. Bennett's fracture
13. Rolando fracture

14. Scaphoid fracture
15. Fractures of the shafts of the tubular bones of the upper extremity
16. Gamekeeper's thumb
17. Little leaguer's elbow

H. Fractures of the skull and facial bones

1. Linear
2. Depressed
3. Fractured diastasis
4. Basal skull fracture
5. LeFort fractures
6. Tripod fracture
7. Leptomeningeal cyst (complicaton)
8. Ping pong fracture
9. Blowout fractures

I. Fractures of the thoracic Cage

1. Golfer's fracture
2. Passion fracture (bear hug)
3. Complications
 - a. Spontaneous pneumothorax
 - b. Traumatic aortic aneurysm
 - i. descending thoracic aorta
 - ii. aortic arch
4. Scapula fractures
5. Clavicle fractures
6. Acromioclavicular joint injuries
7. Sternoclavicular joint injuries

J. Stress injuries

1. Stress Fractures
 - a. Fatigue
 - b. Insufficiency
2. Specific activities and locations:
 - a. Mid tibia (shin splints), pubis
 - b. Ballet dancer - mid tibia
 - c. Chronic coughing - lower ribs, dyspnea, first rib
 - d. Clay-shoveler's - cervicodorsal spinous process
 - e. Golfer's - ribs
 - f. Heavy pack-bearer - first rib
 - g. Long-distance runner - distal fibula, mid tibia
 - h. March fracture - metatarsal, other bones
 - i. Parachutist - proximal fibula
 - j. Pitchfork-handler - ulna
 - k. Standing - calcaneus, metatarsal sesamoid
 - l. Stooping - obturator ring

- m. Tic - clavicle
- n. Trapshooter – coracoid

K. Miscellaneous disorders

1. Heterotopic ossification (post traumatic myositis ossificans)
2. Battered child syndrome
3. Sudeck's atrophy
4. Post traumatic osteolysis
5. Bone contusion

Part VIII: Magnetic Resonance Imaging of the Musculoskeletal System

Time frame for completion: 14 weeks

Required Reading:

1. Kaplan PA, Dussault R, Helms CA, Anderson MW. Musculoskeletal MRI. WB Saunders. 2001.
2. Stoller DW. Magnetic Resonance Imaging in Orthopaedics and Sports Medicine. Lippincott Williams & Wilkins. 3rd ed. 2006.
3. Resnick D, Kang HS, Pretterklieber ML. Internal Derangements of Joints. WB Saunders. 2nd ed. 2006.

Suggested Reading:

Pathology:

1. Resnick D. Diagnosis of Bone and Joint Disorders. WB Saunders. 4th ed. 2002.
2. Stoller DW, Tirman P, Bredella M, Branstetter R. Diagnostic Imaging: Orthopaedics. AMIRSYS. 2003.
3. Berquist T. Body MRI CD-ROM, American College of Radiology (I-MRCD). ACR Learning Files www.accr.org
4. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. WB Saunders. 4th ed, 2003.

Principles of MR Imaging

1. Newhouse JH, Wiener JI. Understanding MRI. Little Brown. 1991
2. Curry TS III, Dowdey JE, Murry RC. Christensen's Physics of Diagnostic Radiology. Lippincott Williams & Wilkins. 4th ed. 1990.
3. Bushong SC. Radiologic Science for Technologists: Physics, Biology and Protection. Mosby. 8th ed. 2004.

ESSENTIAL TOPICS

A. Principles of magnetic resonance imaging

1. Fundamentals of magnetism, precession, and resonance
2. Making a magnetic resonance image
3. Parameters affecting the appearance of MR images
4. Manipulating extrinsic parameters to vary image contrast
5. Magnetic resonance: bioeffects and safety
6. Principles of echo planar imaging: Implications for the musculoskeletal system

B. Tendons and muscles

1. MRI of normal tendons
2. Tendon abnormalities
 - a. Degeneration
 - b. Tenosynovitis
 - c. Tendon tears
 - d. Tendon subluxation / dislocation
3. MRI of normal muscles
4. MRI of muscle trauma
 - a. Indirect muscle injuries
 - b. Direct muscle injuries

C. Articular cartilage

1. MRI of normal articular cartilage
2. MRI of cartilage degeneration

D. Temporomandibular joint

1. Imaging protocols for the TMJ
2. Normal anatomy of the TMJ
3. Bones
 - a. External auditory canal
 - b. Temporal fossa
 - c. Temporal articular eminence
 - d. Mandibular condyle
4. Bone marrow
5. Joints
 - a. Superior articular space
 - b. Inferior articular space
6. Menisci/Disk
 - a. Anterior band
 - b. Intermediate zone
 - c. Posterior band
7. Bilaminar zone (posterior attachment)
8. Muscles & Tendons
 - a. Pterygoid muscles

- b. Other muscles of mastication

E. Shoulder

1. Imaging protocols for the shoulder
2. Normal anatomy of the shoulder
 - a. Shoulder impingement syndrome
 - b. Rotator cuff tears (classification, prevalence)
 - c. Glenohumeral joint instability
 - d. Labral pathology
 - e. Biceps tenosynovitis and related pathology
 - f. Paralabral cysts
 - g. Occult bone injuries
11. Bone diseases
12. Joint diseases

F. Elbow

1. Imaging techniques and protocols
2. Normal MR anatomy
3. Specific abnormalities
 - a. Medial collateral ligament injury
 - b. Medial epicondylitis
 - c. Lateral epicondylitis and lateral collateral ligament injury
 - d. Posterior dislocation injury and instability
 - e. Bone contusions
 - f. Osteochondritis dissecans
 - g. Loose bodies
 - h. Os supratrochleare dorsale
 - i. Idiopathic synovial osteochondromatosis
 - j. Biceps tendon injury
 - k. Triceps tendon injury
 - l. Entrapment neuropathies
 - m. Olecranon bursitis
 - n. Synovial cysts
 - o. Synovial proliferation

G. Wrist and Hand

1. Imaging technique and protocols
2. Functional anatomy of the wrist and hand
3. Ligamentous anatomy
4. Interosseous ligament pathology / instabilities
5. Distal radioulnar joint
6. Triangular fibrocartilage injuries and treatment
7. Carpal tunnel syndrome
8. Abnormalities of the extensor and flexor muscles / tendons
9. Abnormalities of the joint synovium and capsule
10. Pathology of the fingers

H. Hip

1. Imaging protocols for the hip
2. Normal MR anatomy of the hip
3. Labral abnormalities
4. Synovial abnormalities
5. Muscle strains
6. Cartilage abnormalities
7. Osteonecrosis
8. Transient bone marrow edema

I. Knee

1. Imaging protocols for the knee
2. Normal MR anatomy of the knee
3. Meniscal abnormalities
 - a. Anatomical considerations
 - b. Meniscal degeneration and tears
 - c. Pitfalls in interpreting meniscal tears
4. Abnormalities of the medial supporting structures
 - a. Functional anatomy of the medial collateral ligament (MCL)
 - b. Location and mechanisms of injury
 - c. Tears and sprains
 - d. MCL or tibial collateral ligament bursitis
 - e. Semimembranosus tendon abnormalities
5. Abnormalities of the lateral supporting structures
 - a. Functional anatomy of the lateral collateral ligament (LCL)
 - b. Location and mechanisms of injury
 - c. Tears and sprains
 - d. Popliteus muscle and tendon injuries
 - e. Iliotibial tract abnormalities
 - f. Plantaris muscle injuries
 - g. Lateral capsular ligament injuries
7. Abnormalities of the anterior supporting structures
 - a. Patellar tendinitis
 - b. Patellar tendon tears
 - c. Patella alta and baja
 - d. Patellar bursa
 - e. Quadriceps tendon
 - f. Patellofemoral instability
 - g. Excessive lateral pressure syndrome
8. Abnormalities of the central supporting structures
 - a. Functional anatomy of the anterior cruciate ligament (ACL)
 - b. Mechanisms of injury of the ACL
 - c. Normal ACL imaging characteristics
 - d. ACL tears and sprains
 - e. ACL associated osseous injuries

- f. Functional anatomy of the posterior cruciate ligament (PCL)
 - g. Mechanism of injury of the PCL
 - h. Normal PCL imaging characteristics
 - i. PCL tears and sprains
9. Cartilage abnormalities
- a. Chondromalacia
 - b. Chondral and subchondral injury
 - c. Intraarticular bodies
 - d. Osteochondritis dissecans patellae

J. Ankle and Foot

- 1. Imaging protocols for the ankle and foot
- 2. MR anatomy of the ankle and foot
- 3.
- 4. Tendon injury
 - a. Achilles tendon rupture
 - b. Partial tears of the Achilles tendon
 - c. Achilles tendinitis
 - d. Tibialis posterior injuries
 - e. Tibialis anterior tendon injuries
 - f. Peroneal tendon abnormalities
 - g. Flexor hallucis longus abnormalities
- 5. Ligament injury
 - a. Lateral ligament complex injuries
 - b. Medial ligament complex injuries
 - c. Syndesmosis sprains
 - d. Soft tissue impingement
- 6. Medial tibial stress syndrome
- 7. Os trigonum syndrome
- 8. Compartment syndrome
- 9. Gastrocnemius-soleus sprain
- 10. Tarsal tunnel syndrome
- 11. Morton's neuroma
- 12. Plantar fibromatosis
- 13. Plantar fasciitis
- 14. Ganglia

K. Vertebral column

(See neuroimaging syllabus)

American Chiropractic College of Radiology Academics Committee

Syllabus on Chest Imaging

Revised: 04-12-07

Time frame for completing this course of study: 14 weeks

Required Reading:

1. Hansell, DM, Armstrong P, Lynch DA, McAdams HP. Imaging of Diseases of the Chest. Mosby, 4th ed., 2005.
2. Fraser RS, Coman N, Muller N, Pare PD. Synopsis of Diseases of the Chest. WB Saunders, 3rd ed., 2005.
3. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins, 7th ed, 1998.
4. Taveras JM, Ferrucci JT, Dalinka K, Dunnick NR, Higgins CB. Radiology: Diagnosis-Imaging-Intervention, Lippincott Williams & Wilkins, CD-ROM ed, 2003.
5. Brant WE, Helms CA. The Brant and Helms Solution: Fundamentals of Diagnostic Radiology. Lippincott Williams & Wilkins, 3rd ed, 2006.
6. Marchiori D. Clinical Imaging: with Skeletal, Chest and Abdomen Pattern Differentials. Mosby, 2nd ed., 2004.
7. de Christenson, MR. Chest CD-ROM, American College of Radiology (I-CH32CD). ACR Learning Files www.accr.org

Suggested Reading:

1. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. Saunders. 4th ed, 2003.
2. Reed JC. Chest Radiology -- Plain Film Patterns and Differential Diagnoses Mosby, 5th Ed., 2003.
3. Lange S, Walsh G. Radiology of Chest Diseases. Thieme Medical Publishers, 2nd ed., 1998.
4. Goodman LR. Felson's Principles of Chest Roentgenology: A Programmed Text with CD-ROM. WB Saunders, 3rd ed., 2006.

ESSENTIAL TOPICS

A. Methods of examination

1. Imaging procedures for the chest
 - a. Plain film radiography and digital radiography
 - i. "Routine" projections
 - ii. "Accessory" projections
 - b. Computerized tomography
 - c. Magnetic resonance imaging
 - d. Pulmonary angiography
 - e. Scintigraphy
 - f. Conventional tomography
 - g. Bronchography
 - h. Ultrasonography
 - i. Diagnostic pneumothorax
 - j. Fluoroscopy
2. Pathologic examination
 - a. Cytology
 - b. Biopsy

B. Anatomy of the normal chest (focus on conventional radiography)

1. Airspaces
 - a. Anatomic divisions (gross and histological)
 - b. Radiographic divisions
 - c. Pores of Kohn
2. Airways
 - a. Boyden's segmental anatomy
 - b. Canals of Lambert
 - c. Direct airway anastomosis
3. Pulmonary vascular system
 - a. Hila
4. The Pleura
 - a. Normal fissures
 - b. Accessory fissures
 - c. Pleural reflections
 - d. Apical pleural cap
5. Lymphatic system
6. Mediastinum
 - a. Anatomic divisions and contents
7. The diaphragm
8. Chest wall

C. Radiographic signs of chest disease

1. Lung diseases that increase radiographic density
 - a. Predominantly air space disease
 - i. Parenchymal consolidation (pathologic definition and radiographic criteria)
 - Rosette pattern
 - Acinar shadow
 - Air-alveologram
 - Air bronchogram
 - Silhouette sign
 - ii. Parenchymal atelectasis
 - Resorption atelectasis
 - Passive atelectasis
 - Adhesive atelectasis
 - Cicatrization atelectasis
 - Plate-like atelectasis (discoid, Fleischner's lines)
 - iii. Signs of atelectasis
 - Direct
 - Indirect
 - iv. Patterns of lobar & segmental atelectasis
 - b. Predominantly interstitial disease
 - i. Patterns of diffuse interstitial disease
 - Nodular pattern
 - Reticular pattern
 - Reticulonodular pattern
 - Micronodular pattern
 - Honeycomb lung
 - Mixed pattern (The I don't know pattern)
 - c. Combined airspace & interstitial disease
 - d. General signs in diseases that increase density
 - i. Characteristics of the border of a pulmonary lesion
 - Corona radiata
 - Riggler's notch
 - Tail sign
 - Pleural tag
 - ii. Change in position of the interlobar fissure
 - iii. Cavitation
 - iv. Change in size or position of intra-thoracic lesion(s)
 - Doubling time
 - v. Calcification
 - Local parenchymal calcification
 - Diffuse parenchymal calcification
 - Lymph node calcification
 - Pleural calcification

- vi. Localization of pulmonary disease
 - The silhouette sign
- 2. Radiographic alterations seen in diseases that decrease density
 - a. Alteration in lung volume
 - b. Alteration in vasculature
 - c. Bullae (all types)
 - d. Pneumatoceles
- 3. Radiographic signs of pleural disease (be general here, to be covered fully later)
 - a. Signs of pleural effusion
 - i. Typical arrangement of free pleural fluid
 - ii. Atypical distribution of pleural fluid
 - iii. Loculation of pleural fluid
 - b. Signs of pleural thickening
 - c. Signs of pneumothorax
- 4. Radiographic signs of extrathoracic lesions
 - a. Extrapleural sign
 - b. Rib destruction

D. HRCT patterns of diffuse lung disease

- 1. Reticular pattern
- 2. Nodular pattern
- 3. Parenchymal opacification
 - a. Ground-glass opacity
 - b. Mosaic attenuation pattern
 - c. Consolidation
- 4. Cystic airspaces
- 5. Decreased attenuation lung diseases
- 6. Distribution of infiltrative disease on HRCT

E. HRCT signs of airways disease

- 1. Large airways diseases
- 2. Small airways diseases
 - a. constrictive bronchiolitis
 - b. exudative bronchiolitis

F. Congenital malformations

- 1. Bronchopulmonary anomalies
 - a. Pulmonary agenesis, aplasia, & hypoplasia
 - b. Bronchopulmonary sequestration
 - c. Congenital bronchial cysts
 - d. Congenital bronchiectasis
 - i. Williams-Campbell syndrome
 - e. Congenital adenomatoid malformation
 - f. Congenital tracheobronchial stenosis
 - g. Congenital bronchial atresia

- h. Wilson-Mikity syndrome
- i. Congenital lobar emphysema
- j. Congenital tracheoesophageal & bronchoesophageal fistulae
- k. Pulmonary isomerism
- 2. Anomalies of the pulmonary arteries
 - a. Absence of the main pulmonary artery
 - b. Absence of the right or left pulmonary artery
 - c. Anomalous origin of the left pulmonary
 - d. Pulmonary artery stenosis or coarctation
- 3. Anomalies of the pulmonary veins
 - a. Congenital pulmonary venous stenosis or atresia
 - b. Anomalous pulmonary venous drainage
- 4. Anomalies of both arteries and veins
 - a. Hypogenetic lung (scimitar) syndrome
 - b. Congenital arteriovenous fistula
- 5. Miscellaneous vascular anomalies
 - a. Congenital pulmonary lymphangiectasis
- 6. Bony thorax
 - a. Intrathoracic rib
 - b. Cervical rib
 - c. Pseudoarthrosis
 - d. Neuroenteric cysts and anomalies of the spine

G. Infections of the lungs

- 1. Classifications of infectious diseases of the lung
 - a. Clinical classification
 - i. Acute
 - ii. Chronic
 - iii. Recurrent
 - b. Radiographic classification
 - i. Lobar
 - ii. Bronchopneumonia
 - iii. Interstitial
 - iv. Typical
 - v. Atypical
- 2. Bacterial pneumonias
 - a. *Streptococcus pneumoniae*
 - b. *Streptococcus pyogenes*
 - c. *Staphylococcus aureus*
 - d. *Bacillus anthracis*
 - e. Friedlander's (*Klebsiella*) pneumonia
 - f. *Escherichia coli*
 - g. *Salmonella*
 - h. *Proteus*
 - i. *Haemophilus influenzae*
 - j. *Pseudomonas aeruginosa*

- k. *Bordetella pertussis*
 - l. Aspiration pneumonia
3. Mycobacteria
- a. Non-tuberculous mycobacterium
 - b. *Mycobacterium tuberculosis*
 - i. Primary pulmonary tuberculosis
 - Parenchymal Involvement
 - Lymph node involvement
 - Airway involvement
 - Pleural involvement
 - Calcification
 - ii. Postprimary tuberculosis
 - Bronchogenic spread
 - Cavitation
 - Bronchiectasis
 - Tuberculoma
 - Healing of pulmonary tuberculosis
 - Dissemination to other organs
 - Miliary pulmonary tuberculosis
 - 1. Acute
 - 2. Chronic
 - iii. Surgical measures in pulmonary tuberculosis
 - Pulmonary resection
 - Thoracoplasty
 - Plombage
 - Cavernostomy or cavity drainage
 - Therapeutic atelectasis
4. Fungal infections
- a. Endemic diseases
 - i. *Coccidioidomycosis*
 - ii. *Histoplasmosis*
 - iii. North American *blastomycosis*
 - iv. South American *blastomycosis*
 - v. *Cryptococcus* (torulosis)
 - b. Opportunistic diseases
 - i. Moniliasis (*candidiasis*)
 - ii. Aspergillosis
 - Pulmonary aspergillosis
 - Primary invasive
 - Allergic bronchopulmonary aspergillosis
 - Aspergilloma
 - iii. *Mucormycosis*
 - iv. *Actinomycosis*
 - v. *Nocardiosis*
 - vi. *Pneumocystis jiroveci* (previously *carinii*)

5. Atypical pneumonia, viruses,..etc
 - a. *Mycoplasma pneumoniae*
 - b. Viruses
 - i. Influenza virus
 - ii. Respiratory syncytial virus (RSV)
 - iii. Measles virus
 - iv. Adenovirus
 - v. Cytomegalovirus
 - c. Chlamydiae
 - d. Rickettsiae
6. Parasitic diseases of the lung
 - a. Protozoa
 - b. Nematelminth (roundworm) infestation
 - i. *Ascariasis*
 - c. Platyhelminth (flatworm) Infections
 - i. *Echinococcosis*
 - ii. *Cysticercosis*
 - iii. *Schistosomiasis*

H. Diseases of altered immunologic activity

1. Connective tissue diseases (focus on lung manifestations)
 - a. SLE
 - b. Rheumatoid disease
 - c. Progressive systemic sclerosis
 - d. Dermatomyositis and polymyositis
 - e. Sjogren's syndrome
 - f. Relapsing polychondritis
2. Pulmonary vasculitis
 - a. Wegener's granulomatosis
 - b. Midline lethal granulomatosis
3. Bronchopulmonary hypersensitivity
 - a. Extrinsic allergic alveolitis
 - i. Farmer's lung
 - ii. Pigeon breeder's lung (bird-fancier's lung)
 - iii. Bagassosis
 - iv. Maple bark disease (Lang-wood workers)
 - v. Other occupational hypersensitivity states
4. Eosinophilic lung disease
 - a. Loffler's syndrome
 - b. Acute eosinophilic pneumonia
 - c. Chronic eosinophilic pneumonia
5. Miscellaneous conditions of altered immunologic activity
 - a. Goodpasture's syndrome
 - b. Idiopathic pulmonary hemorrhage

I. Inhalation diseases and pneumoconioses

1. Pneumoconioses
 - a. Silicosis
 - i. Eggshell calcification
 - ii. Progressive massive fibrosis
 - iii. Acute silicoproteinosis
 - iv. Silicotuberculosis
 - b. Coal worker's pneumoconiosis
 - i. Caplan's syndrome
 - c. Asbestosis
 - i. Malignant mesothelioma
 - ii. Bronchogenic carcinoma
 - d. Talcosis
 - e. Bauxite fibrosis (shavers's disease)
 - f. Berylliosis
 - g. Siderosis (iron oxide)
 - h. Baritosis (barium sulfate)
 - i. Stannosis (tin)
2. Inhalation of noxious gases and vapors
 - a. Silo-filler's disease (nitrogen dioxide)
 - b. Oxygen toxicity
 - c. Ammonia
 - d. Thesaurosis (hair-spray pneumonia)
3. Lung changes from drugs
 - a. Cocaine
 - b. Heroin
 - c. Nitrofuratoin

J. Pulmonary disease caused by aspiration of solid and liquid foreign materials

1. Aspiration of solid foreign bodies
2. Aspiration of gastric or oropharyngeal secretions
3. Aspiration of lipids
4. Aspiration of liquids

K. Neoplasms

1. Classification schemes of malignant pulmonary neoplasms
 - a. Treatment/prognostic classification
 - i. Non-small cell carcinoma
 - ii. Small cell lung carcinoma
 - b. Histologic classification
 - c. Staging system
 - i. TNM definitions
 - Primary tumor (T)
 - Regional lymph nodes (N)
 - Distant metastasis (M)

- b. Bronchogenic carcinoma (types, population, location, radiographic findings, treatment, prognosis)
- a. Squamous cell carcinoma (epidermoid)
- b. Small cell carcinoma
- c. Adenocarcinoma
 - i. Bronchiolo-alveolar adenocarcinoma
- d. Large cell carcinoma
 - i. Giant cell
 - ii. Clear cell
- e. Adenosquamous carcinoma
- c. Neoplasms of pulmonary neuroendocrine cells
- a. Carcinoid tumor
- d. Neoplasms of tracheobronchial glands
- a. Adenoid cystic carcinoma
- e. Miscellaneous epithelial tumors
- a. Pulmonary adenoma
- b. Malignant melanoma
- f. Lymphoreticular neoplasms and leukemia
- a. Hodgkin's disease
- b. Primary non-Hodgkin's lymphoma
- c. Secondary non-Hodgkin's lymphoma
- d. Leukemia
- e. Multiple myeloma (plasmacytoma)
- g. Metastasis
 - a. Hematogenous
 - b. Lymphogenous
 - c. Direct extension
- h. Benign neoplasms
 - a. Hamartoma
 - b. Bronchial adenoma
 - c. Leiomyoma
 - d. Fibroma
 - e. Neurofibroma
 - f. Hemangioma
 - g. Hemangiopericytoma
 - h. Lipoma

L. Embolic and thrombotic diseases

1. Pulmonary thromboembolism
2. Septic embolism
3. Emboli of extravascular tissues and secretions
 - a. Fat embolism
 - b. Bone marrow embolism
 - c. Amniotic fluid embolism
 - d. Embolism of neoplastic tissue
 - e. Miscellaneous tissue embolism

4. Emboli of foreign material
 - a. Air embolism
 - b. Barium embolism

M. Pulmonary hypertension and edema

1. General Considerations of pulmonary blood flow and pressure
2. Pulmonary hypertension
 - a. Precapillary pulmonary hypertension
 - b. Postcapillary pulmonary hypertension
 - c. Cor pulmonale
3. Pulmonary edema
 - a. Interstitial
 - i. Septal lines
 - ii. Kerley's A,B,C
 - iii. Perivascular blur/cuffing
 - iv. Hilar haze
 - v. Diffuse reticular pattern
 - b. Alveolar
4. Pulmonary edema associated with elevated microvascular pressure
 - a. Cardiogenic pulmonary edema
 - b. Pulmonary edema associated with renal disease
 - c. Neurogenic and postictal pulmonary edema
5. Pulmonary Edema Associated with Normal Microvascular Pressure
 - a. Specific forms of permeability edema
 - i. High-altitude pulmonary edema
 - ii. Re-expansion of lung at thoracentesis
 - iii. Pulmonary edema associated with severe upper airway obstruction

N. Diseases of the airways

1. Obstructive diseases of the upper airways
 - a. Acute
 - b. Chronic
 - i. Saber sheath trachea
 - ii. Relapsing polychondritis
 - iii. Tracheomalacia
2. Asthma
 - c. Atopic (intrinsic) asthma
 - d. Extrinsic asthma
3. Emphysema
 - e. Pericatricial emphysema
 - f. Bullous emphysema
 - g. Compensatory emphysema
 - h. Paraseptal emphysema
 - i. Vanishing lung
 - j. Alpha-antitrypsin deficiency emphysema

- k. Unilateral hyperlucent lung (Swyer-James-McLeod)
- l. Congenital lobar emphysema
- 4. Bronchitis
 - m. Acute Bronchitis
 - n. Chronic Bronchitis
- 5. Bronchiectasis
 - o. Cylindrical
 - p. Varicose
 - q. Saccular or cystic
 - r. Dyskinetic cilia syndrome
 - i. Kartagener's syndrome
 - s. Cystic fibrosis
 - t. Yellow nail syndrome
- 6. Broncholithiasis
- 7. Bronchiolitis

O. Diseases of the pleura

- 1. Pleura effusion
 - a. Specific causes of pleural effusion
 - b. Pleural effusion secondary to disease below the diaphragm
 - i. Meigs-Salmon syndrome
- 2. Chylothorax
- 3. Hemothorax
- 4. Empyema
- 5. Pneumothorax
 - a. Spontaneous
 - b. Tension
 - c. Traumatic (iatrogenic)
- 6. Pleural fibrosis
 - a. Apical pleural cap
 - b. Fibrothorax
- 7. Neoplasms of the pleura
 - a. Benign
 - i) Lipoma
 - ii) Fibroma
 - iii) Hemangioma
 - iv) Neurofibroma
 - v) Benign mesothelioma
 - b. Malignant
 - i. Metastasis
 - ii. Malignant mesothelioma
 - iii. Fibrin bodies
- 8. Pleural calcifications

P. Diseases of the mediastinum

1. Inflammatory diseases of the mediastinum
 - a. Acute
 - b. Chronic
2. Pneumomediastinum
3. Mediastinal hemorrhage
4. Anterior mediastinal masses (3 Ts and an H)
 - a. Thymic masses
 - b. Germ cell neoplasms
 - c. Thyroid masses
 - d. Lymphadenopathy (Hodgkin's lymphoma)
 - e. Other soft tissue tumors and tumor-like conditions
5. Middle mediastinal masses
 - a. Lymph node enlargement (primary and secondary)
 - b. Hernias
 - i. Hiatal
 - ii. Morgagni
 - c. Diseases of the esophagus seen on the chest radiograph
 - d. Aortic uncoiling, aneurysms
6. Posterior mediastinal masses
 - a. Neurogenic neoplasms
 - b. Posterior mediastinal cysts
 - c. Spinal lesions

Q. Diseases of the diaphragm and chest wall

1. Abnormalities of diaphragmatic position or motion
 - a. Unilateral diaphragmatic paralysis
 - b. Bilateral diaphragmatic paralysis
 - c. Eventration
 - d. Tenting
2. Diaphragmatic hernias
 - a. Hiatal hernia
 - b. Bochdalek hernia
 - c. Morgagni hernia
3. Subphrenic abscess
4. Neoplasms of the diaphragm
5. Accessory diaphragm
6. Abnormalities of the pectoral girdle and adjacent structures
7. Abnormalities of the ribs
8. Abnormalities of the sternum
 - a. Pectus excavatum
 - b. Pectus carinatum

R. Pulmonary disease of unknown origin/miscellaneous disorders

1. Sarcoidosis
2. Fibrosing alveolitis

- a. UIP
- b. DIP
- c. BIP
- d. LIP
- e. Hamman-Rich syndrome
- 3. Lymphangiomyomatosis
- 4. Tuberos sclerosis
- 5. Eosinophilic granuloma
- 6. Pulmonary alveolar microlithiasis
- 7. Familial dysautonomia (Riley-Day syndrome)

S. Diseases of the thorax caused by external physical agents

- 1. Effects on the lung of nonpenetrating trauma
 - a. Pulmonary parenchymal contusion
 - b. Traumatic lung cyst
 - c. Pulmonary hematoma
 - d. Fracture of the trachea and bronchi
 - e. Lung torsion
- 2. Effects on the pleura of nonpenetrating trauma
- 3. Effects on the mediastinum of nonpenetrating trauma
- 4. Effects on the diaphragm of nonpenetrating trauma
- 5. Complications of diagnostic biopsy procedures
- 6. Radiation injury of the lung

T. Cardiac imaging

- 1. Cardiac anatomy, physiology and methods of examination
- 2. Radiographic findings of cardiac disease
 - a. Variation in cardiac silhouette
 - b. Chamber enlargement
 - c. Abnormal mediastinal contours
 - d. Cardiac calcifications
 - e. Abnormal pulmonary vascularity
 - f. Abnormal pericardium
 - g. Others
- 3. Congenital Heart Disease
 - a. Cyanotic defects
 - i. Tetralogy of Fallot
 - ii. Pulmonary stenosis with atrial septal defect
 - iii. Complete transposition of the great vessels
 - iv. Tricuspid atresia
 - v. Persistent truncus arteriosus
 - vi. Ebstein's anomaly
 - vii. Total anomalous pulmonary venous return
 - viii. Partial anomalous venous return
 - ix. Eisenmenger's complex
 - b. Non-cyanotic defects

- i. Patent ductus arteriosus
 - ii. Atrial septal defects
 - iii. Lutembacher's syndrome
 - iv. Ventricular septal defects
 - v. Endocardial cushion defect
 - vi. Pulmonic stenosis
 - vii. Aortic stenosis
 - viii. Endocardial fibroelastosis
 - ix. Coarctation of the aorta
- 4. Anomalies of the aortic arch and its branches
 - a. Left aortic arch with right descending aorta
 - b. Right aortic arch
 - c. Double aortic arch
 - d. Aberrant right subclavian artery
- 5. Acquired cardiovascular disease
 - a. Valvular cardiac disease
 - i. Mitral stenosis
 - ii. Mitral insufficiency
 - iii. Mitral valve prolapse
 - iv. Aortic stenosis
 - v. Aortic insufficiency
 - vi. Pulmonary valvular disease
 - vii. Tricuspid valvular disease
 - b. Ischemic heart disease
 - i. Coronary artery disease
 - ii. Myocardial infarction
 - c. Cardiomyopathies
 - i. Dilated
 - ii. Hypertrophic
 - iii. Restrictive
 - iv. Right ventricular
 - Cor pulmonale
 - Uhl's anomaly
 - d. Cardiac masses
 - i. Thrombi
 - ii. Benign tumors
 - Atrial myxoma
 - iii. Malignant tumors
 - Metastasis
 - e. Pericardial disease
 - i. Pericardiac effusion
 - ii. Cardiac tamponade
 - iii. Pericardial cysts

American Chiropractic College of Radiology Academics Committee

Syllabus on Abdominal Imaging

Part I: Gastrointestinal System

Part II: Genitourinary System

Revised: 04-12-07

Part I: Gastrointestinal System

Time frame for completing this course of study: 8 weeks

Required Reading:

1. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
2. Baker SR, Kyunghee CC. The Abdominal Plain Film with Correlative Imaging. McGraw-Hill; 2nd ed, 1998.
3. Federle M, Jeffrey RB, Anne VS. Diagnostic Imaging: Abdominal. Saunders, 2005.
4. Taveras JM, Ferrucci JT, Dunnick NR, Higgins CB. Radiology: Diagnosis, Imaging, Intervention (Clinical text in five looseleaf volumes or CD-ROM edition) Lippincott Williams & Wilkins, 2001.
5. Rubesin SE. ACR Learning File on CD: Gastrointestinal. 2nd ed.

Suggested Reading:

1. Marchiori DM. Clinical Imaging: With Skeletal, Chest and Abdomen Pattern Differentials. Mosby. 2nd ed, 2005.
2. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. Saunders. 4th ed, 2003.
3. Begg, JD. Abdominal X-Rays Made Easy. Churchill Livingstone. 2nd ed, 2006.
4. Katz DS, Math KR, Groskin SA. Radiology Secrets. Lippincott Williams & Wilkins. 2nd ed, 2003.

ESSENTIAL TOPICS

A. Plain film abdomen

1. Normal abdominal organs
2. Normal abdominal gas patterns
3. Abdominal calcifications (radiographic appearance, etiology, clinical significance)
 - a. Concretions
 - i. Phlebolith
 - ii. Appendicolith
 - iii. Gallstones
 - iv. Pancreatic calculi
 - v. Prostate calculi
 - vi. Renal stones (to be covered fully elsewhere)
 - vii. Adrenal calcification
 - b. Cyst-wall
 - i. Echinococcal cyst
 - ii. Porcelain gallbladder
 - c. Mass
 - i. Calcified mesenteric lymph nodes (granuloma)
 - ii. Leiomyoma
 - iii. Cystic teratoma
 - iv. Injection granuloma (may look like concretion or cyst as well)
 - v. Renal mass
 - vi. Lithopedion
 - d. Conduit-wall
 - i. Abdominal aorta
 - Size, terminology, risk
 - ii. Iliac arteries
 - iii. Renal artery
 - iv. Vas deferens
 - e. Psammomatous
 - i. Cystadenocarcinoma
 - Meigs-Salmon syndrome
4. Bowel obstruction (simple vs. strangulated)
 - a. Small bowel
 - b. Colon
 - c. Volvulus
 - d. Intussusception
5. Paralytic (adymanic) ileus
 - a. Sentinel loop
6. Intestinal wall gas
7. Peritoneal space
 - a. air
 - b. fluid

- c. masses
- 8. Classification of pelvic types

B. Additional studies (including contrast studies)

C. Esophagus

- 1. Anatomy
- 2. Methods of examination
- 3. Motor and neurosensory disorders
- 4. Diverticula
- 5. Inflammation
 - a. Gastroesophageal reflux disease
 - b. Caustic agents, radiation, and oral medications
 - c. Infection
- 6. Motility disorders
 - a. Achalasia
 - b. Chaliasia
 - c. Chagas' disease
 - d. Scleroderma
- 7. Esophageal varices (uphill and downhill)
- 8. Neoplasms
 - a. Benign
 - b. Malignant
- 9. Esophageal trauma

D. Stomach and Duodenum

- 1. Anatomy
- 2. Methods of examination
- 3. Congenital anomalies
 - a. Failure of tubulation
 - b. Dextroposition
 - c. Duplication and diverticula
 - d. Congenital rests
 - e. Microgastria
 - f. Congenital hypertrophic pyloric stenosis
 - g. Annular pancreas
- 4. Gastritis, duodenitis, and ulcer disease
 - a. Rugal enlargement
 - b. Erosions
 - c. Ulcers
 - d. Perforated ulcers
 - e. Scarring
 - f. Hypergastrinism
- 5. Bezoars
- 6. Inflammatory diseases
 - a. Crohn's disease

- b. Celiac disease
- c. Menetrier disease
- d. Zollinger Ellison disease
- 7. Gastric and duodenal varices
- 8. Neoplasms
 - a. Primary benign
 - b. Primary malignant
 - c. Metastatic disease
- 9. Hiatal hernia
- 10. Polyps and polyposis syndromes

E. Small intestine

- 1. Anatomy
- 2. Methods of study
- 3. Congenital anomalies
 - a. Rotation anomalies (stages of arrest – 1st, 2nd, and 3rd)
 - b. Duplication cysts and Diverticula
- 4. Inflammatory conditions and infectious diseases
 - a. Infections (bacterial, Tuberculosis, parasitic)
 - b. Crohn's disease /granulomatous colitis
- 5. Motility disorders
 - a. Scleroderma
 - b. Transit time
 - c. Gallstone ileus
- 6. Metabolic and allergic disorders
 - 1. Celiac disease
 - 2. Dysgammaglobulinemia
 - 3. Behcet's syndrome (covered fully in arthritis)
 - 4. Lymphangiectasia
 - 5. Whipple's disease
- 7. Polyps
 - a. Solitary
 - b. Multiple
- 8. Neoplasms
 - a. Primary benign
 - b. Primary malignant
 - c. Metastatic disease
- 9. Hernias

F. Colon and rectum

- 1. Anatomy
- 2. Method of examination
- 3. Congenital anomalies
 - a. Tubulation defects
 - b. Colonic duplication
 - c. Failures of rotation

- d. Aganglionic megacolon
- 4. Inflammatory diseases
 - a. Specific organisms
 - b. Appendicitis
 - c. Idiopathic colitis
 - d. Ulcerative colitis
 - e. Crohn's disease
- 5. Motility disorders
 - a. Scleroderma
- 6. Ischemic colitis
- 7. Diverticulosis and diverticulitis
- 8. Polyps
 - a. Solitary
 - b. Multiple
- 9. Neoplasms
 - a. Primary benign
 - b. Primary malignant
 - c. Metastatic disease
- 10. Hernias

Part II: Genitourinary System

Time frame for completing this course of study: 7 weeks

Required Reading:

1. Juhl JH, Crummy AB. Paul and Juhl's Essentials of Radiologic Imaging, Lippincott Williams & Wilkins 7th ed, 1998.
2. Baker SR, Kyunghee CC. The Abdominal Plain Film with Correlative Imaging. McGraw-Hill; 2nd ed, 1998.
3. Federle M, Jeffrey RB, Anne VS. Diagnostic Imaging: Abdominal. Saunders, 2005.
4. Taveras JM, Ferrucci JT, Dunnick NR, Higgins CB. Radiology: Diagnosis, Imaging, Intervention (Clinical text in five looseleaf volumes or CD-ROM edition) Lippincott Williams & Wilkins, 2001.
5. Pollack H, Dyer R. ACR Learning File on CD: Genitourinary.

Suggested Reading:

1. Chapman S, Nakielny R. Aids to Radiological Differential Diagnosis. Saunders. 4th ed, 2003.

ESSENTIAL TOPICS

A. Methods of examination

1. Intravenous pyelography
2. Ultrasonography
3. Computed tomography
4. Retrograde pyelography
5. Renal angiography
6. Voiding cystography
7. Cystography
8. Renal scintigraphy
9. Hysterosalpingography
10. MRI

B. Anatomy

1. Normal urinary tract
2. Intravenous pyelogram
 - a. Normal urogram
 - b. Renal backflow

C. Kidneys and ureters

1. Congenital and developmental anomalies

- a. Anomalies in number, size and form
- b. Fusion anomalies
- c. Anomalies in position and location
- d. Ureteropelvic junction anomalies
- e. Duplication of the pelvis and ureter
- f. Anomalies in position of ureteral orifice
- g. Ureteral jet phenomenon
- h. Retrocaval ureter
- i. Ureterocele (simple and ectopic)
- j. Urachal anomalies
- 2. Calcifications
 - a. Calculi
 - b. Renal milk of calcium
 - c. Nephrocalcinosis
- 3. Infections
 - a. Pyogenic
 - b. Non-pyogenic
- 4. Inflammatory conditions
- 5. Trauma
- 6. Neoplasms
- 7. Vascular disorders
- 8. Other
 - a. Renal cystic diseases
 - i. Simple renal cyst
 - ii. Polycystic diseases
 - iii. Medullary sponge kidney
 - iv. Medullary cystic disease
 - v. Multicystic dysplastic kidney
 - vi. Peripelvic cysts
 - vii. Perirenal cysts
 - viii. Calyceal diverticulum
 - b. Hydronephrosis

D. Bladder

- 1. Congenital and developmental anomalies
- 2. Calcifications
 - a. Bladder wall
 - b. Calculi
- 3. Infections
- 4. Inflammatory conditions
- 5. Trauma
- 6. Neoplasms
- 7. Other
 - a. Vesicoureteral reflux
 - b. Obstructive uropathy
 - c. Neurogenic bladder

E. Urethra

1. Congenital and developmental anomalies
2. Calcifications
3. Infections
4. Inflammatory conditions
5. Trauma
6. Neoplasms
7. Other
 - a. Obstructive uropathy

F. Reproductive system

1. Male
 - a. Normal anatomy
2. Female
 - a. Normal anatomy

(more need to be put in for the male and female systems)

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Syllabus on Neuroimaging

Part I: Spine

Part II: Intracranial

Part III: Head and Neck

Revised: 04-12-07

Time frame for completing all three parts of this course of study: 17.5 weeks

Required Reading:

1. Grossman RI, Yousem DM. *Neuroradiology: The Requisites*. Mosby, 2nd ed., 2003.
2. Atlas SW. *Magnetic Resonance Imaging of the Brain and Spine*. Lippincott Williams & Wilkins, 3rd ed., 2002.
3. Som PM, Curtin HD. *Head and Neck Imaging*. Mosby, 4th ed., 2002.
4. Taveras JM, Ferrucci JT, Dalinka K, Dunnick NR, Higgins CB. *Radiology: Diagnosis-Imaging-Intervention*, Lippincott Williams & Wilkins, CD-ROM ed, 2003.
5. Juhl JH, Crummy AB, Kuhlman JE. *Paul and Juhl's Essentials of Radiologic Imaging*. Lippincott Williams & Wilkins, 7th ed., 1998.
6. Koeller KK, Smirniotopoulos JG. *Neuroradiology CD-ROM*, 2nd ed, American College of Radiology (I-NUCD2). ACR Learning Files www.accr.org
7. White, AA, Panjabi MM. *Clinical Biomechanics of the Spine*. Lippincott Williams & Wilkins, 2nd ed., 1990.

Suggested Reading:

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3. Harnsberger R, Hudgins P, Wiggins R, Davidson C. *Diagnostic Imaging: Head and Neck*. AMIRSYS (Elsevier), 2004.
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5. Chapman S, Nakielny R. *Aids to Radiological Differential Diagnosis*. Saunders. 4th ed, 2003.
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Part I: Spine

Time frame for completing this course of study: 7 weeks

Essential Topics

A. Biomechanics

1. Normal motion of the spine
 - a. Cervical
 - b. Thoracic
 - c. Lumbar

B. Vertebrae and intervertebral discs

1. Anatomy
 - a. Vertebrae
 - i. Vertebral bodies
 - ii. Facets and transverse processes
 - iii. Lamina and transverse processes
 - iv. Support ligaments
 - b. Intervertebral discs
2. Trauma
 - a. Mechanisms of injury
 - b. Stable fractures
 - c. Unstable fractures (3-column theory)
 - d. Ligamentous injuries
 - e. Traumatic disc herniation
 - f. Spondylolisthesis
 - g. Post-traumatic abnormalities
3. Degenerative diseases
 - a. Disc
 - b. Endplate
 - c. Spinal stenosis
 - d. Post-operative changes
 - i. Epidural scar
 - ii. Arachnoiditis
 - iii. Recurrent disc herniations and stenosis
4. Infections
 - a. Discitis/osteomyelitis
 - i. Acute
 - ii. Epidural
 - iii. Chronic low grade discitis
 - b. Tuberculosis
5. Neoplasms
 - a. Primary benign
 - i. Hemangioma
 - ii. Osteoid osteoma/osteoblastoma
 - iii. Aneurysmal bone cyst

- b. Primary malignant
 - i. Multiple myeloma
 - ii. Lymphoma
- c. Secondary
 - i. Metastases
- 6. Congenital disorders
 - a. Myelocele, myelomeningocele, lipomyelomeningocele, meningocele

C. Neurology and vascular supply

- 1. Neuroanatomy
 - a. Spinal canal
 - b. Spinal cord
 - c. Craniovertebral and lumbosacral junctions
- 2. Vascular anatomy
 - a. Intraspinial
 - b. Extraspinial
- 3. Trauma
 - a. Extrinsic cord compression
 - b. Cord contusion
 - c. Intraspinial hemorrhage
 - d. Syringomyelia
- 4. Infections/inflammatory diseases
 - a. Arachnoiditis
 - b. Meningitis
 - c. Abscess
 - d. Granuloma
 - e. Transverse myelitis
 - f. Multiple sclerosis
 - g. Acute disseminated encephalomyelitis
- 5. Neoplasms
 - a. Extradural
 - i. Neurofibroma
 - ii. Lymphoma
 - iii. Metastasis
 - b. Intradural extramedullary
 - i. Meningioma
 - ii. Neurofibroma
 - iii. Schwannoma
 - iv. Metastasis
 - c. Intramedullary
 - i. Ependymoma
 - ii. Astrocytoma
 - iii. Hemangioblastoma
- 6. Cystic lesions
 - a. Extradural
 - i. Tarlov's cyst

- ii. Terminal meningocele
 - b. Intradural extramedullary
 - i. Arachnoid cyst
 - c. Intramedullary
 - i. Syringohydromyelia
- 7. Congenital/developmental diseases
 - a. Syringohydromyelia
 - b. Arnold Chiari malformation
 - c. Diastematomyelia
 - d. Lipoma of filum terminale
- 8. Vascular disorders
 - a. Arteriovenous malformations
 - b. Spinal cord infarct

Part II: Skull and Brain

Time frame for completing this course of study: 7 weeks

A. Anatomy

1. Cranium
2. Brain
3. Embryology of brain development
4. Vascular anatomy

B. CNS Infections

1. Congenital/neonatal infections
2. Pyogenic infections
3. Encephalitis
4. Granulomatous infections
5. Parasitic infections
6. Infections in the immunocompromised host

C. White Matter Disease

1. Multiple sclerosis
2. Acute disseminated encephalomyelitis (ADEM)
3. Small vessel ischemic disease, hypertension, vascular disease
4. White matter changes in the elderly
5. Trauma (axonal injuries)
6. Demyelinating disorders

D. Trauma

1. Primary vs. Secondary
2. Focal lesions
3. Cortical contusions
4. Diffuse axonal injury (DAI) - shearing
5. Skull fractures: types, complications
6. Subarachnoid hemorrhage (SAH)
7. Subdural hemorrhage (SDH)
8. Epidural hemorrhage (EDH)
9. Parenchymal hemorrhage with differentials
10. Intraventricular hemorrhage
11. Ages of hemorrhage by CT/MR
12. Herniation syndromes
13. lacerations, complications
14. Non-accidental trauma
15. Superficial and soft tissue injuries (e.g. cephalohematoma)

E. Neoplasms and other masses

1. Tumor classification by histology
 - a. Primary brain tumors
 - i. Glial (neuroglial)

- ii. Non-glia
 - b. Metastatic tumors
- 2. Tumor classification by age and location
 - a. Extraaxial
 - b. Intraaxial
 - c. Supratentorial
 - i. Child
 - ii. Adult
 - d. Infratentorial
 - i. Child
 - ii. Adult
- 3. Tumor classification by specific anatomical area
 - a. Sellar/suprasellar
 - b. Pineal region
 - c. Cerebellopontine angle
 - d. Intraventricular
 - e. Skull base

F. Cerebrovascular disease

- 1. Ischemic cerebrovascular disease
 - a. CT and MRI findings
 - i. Diffusion weighted images (DWI)
 - b. Hemorrhagic vs. bland
- 2. Angiography
 - a. Normal anatomy & variants
 - b. Stenosis and occlusion
- 3. Hemorrhagic conditions
 - a. Intraparenchymal
 - b. Aneurysms
 - c. Intratumoral hemorrhage
- 4. Cerebrovascular malformations
 - a. AVM
 - b. Capillary telangiectasias
 - c. Cavernous angiomas
 - d. Venous malformation
- 5. Vasculitides

G. Congenital and developmental CNS disorders

- 1. Disorders of organogenesis
- 2. Disorders of neuronal migration & sulcation
- 3. Disorders of diverticulation and cleavage
- 4. Posterior fossa malformations and cysts
- 5. Disorders of histogenesis (phakomatoses)

Part III: Head and Neck

Time frame for completing this course of study: 3.5 weeks

A. Suprahyoid neck

1. Parapharyngeal space
 - a. Anatomy and contents
 - b. Neoplasms
 - c. Inflammation/Infections
 - d. Congenital lesions
2. Masticator space (tumors (mesenchymal))
 - a. Anatomy and contents
 - b. Neoplasms
 - i.
 - c. Inflammation/Infections
 - d. Congenital lesions
 - e. Pseudotumor
3. Parotid space
 - a. Anatomy and contents
 - b. Neoplasms
 - c. Inflammation/Infections
 - d. Congenital lesions
4. Carotid space
 - a. Anatomay and contents
 - b. Neoplasms
 - c. Inflammation/Infections
 - d. Vascular lesions
 - e. Pseudomass
5. Retropharyngeal space
 - a. Anatomy and contents
 - b. Neoplasms
 - c. Inflammation/Infections
 - d. Congenital lesions
 - e. Pseudomass
6. Oral cavity
 - a. Anatomy
 - b. Mucosal lesions
 - c. Sublingual lesions
 - d. Submandibular lesions
7. Mandible
 - a. Anatomy
 - b. Trauma
 - c. Neoplasms
 - d. Infections
 - e. Cysts
 - i. Odontogenic
 - ii. Nonodontogenic

B. Infrahyoid neck

1. Larynx
 - a. Anatomy
 - b. Neoplasms
 - c. Laryngocele
 - d. Trauma
2. Carotid space
3. Retropharyngeal space

C. Cystic neck masses

1. Congenital
2. Inflammatory
3. Vascular
4. Parenchymal
5. Neoplasms

D. Paranasal Sinuses

1. Anatomy
2. Infection/Inflammation
3. Neoplasms

E. Temporal bone

1. Anatomy
2. Masses of external auditory canal, middle ear and inner ear
 - a. Congenital
 - b. Inflammatory
 - c. Neoplasm
 - d. Vascular
3. Osseous pathologies
 - a. Otosclerosis
 - b. Paget disease
 - c. Fibrous dysplasia
 - d. Osteogenesis imperfecta
 - e. Trauma

F. Orbits

1. Lacrimal gland neoplasms
2. Extra-conal masses
3. Extra-ocular muscles (conal)
4. Intra-conal lesions
5. Intra-ocular disorders
 - a. Adult
 - i. metastasis
 - ii. melanoma
 - b. Child

- i. Retinoblastoma
 - c. Any age
 - i. Retinal detachment
 - 6. Trauma
 - a. Fractures of the orbital wall
 - b. Penetrating soft tissue injuries
 - c. Foreign body