As radiology residents learn musculoskeletal radiology, they are awash in fractures and other conditions with eponymic names, yet rarely learn about the people behind the names. Residents are also confronted with a dizzying array of measurements and classification schemes that may or may not be important to remember. This manuscript accompanies two lectures that review these eponymous fractures and conditions and the people for whom they are named, and some of the more relevant measurements in musculoskeletal radiology.

**UPPER EXTREMITY**

**Names:**

1. **Bankart Fracture:** When a shoulder is dislocated anteriorly, the humeral head may fracture the anterior inferior margin of the glenoid. If there is an osseous fragment, it is called a Bankart fracture; if it is purely a labral detachment, it is referred to as a Bankart lesion. These injuries are more common in patients who dislocate multiple times. Of course, Bankart lesions are not visible radiographically, but they will often be quite evident at MRI or MR arthrography, especially with ABER positioning. Bankart fractures are visible as small bone fragments at the anterior inferior margin of the glenoid. They often are visible on an AP view. They are more commonly evident on Westpoint views than axillary views. If one sees a fragment in this location, the patient has undoubtedly suffered one or more previous dislocations. Loose bodies usually won’t settle immediately adjacent to this portion of the glenoid but instead are seen in the axillary pouch, the posterior joint, or in the subcoracoid recess.

**Arthur Sydney Blundell Bankart** (1879-1951) was a British surgeon who specialized in orthopedics, neurosurgery, and pediatric surgery. Not only is there an injury that bears his name, but a curative procedure also, the Bankart repair. This open surgical reattachment of the labral/osseous fragment was quite challenging to the other surgeons of his day but was the only treatment that regularly led to recovery in these patients. Interestingly, in Bankart’s original 1923 report of four cases of recurrent shoulder dislocation he treated surgically, the injury he described was a separation of the joint capsule from the labrum, which was otherwise intact.
Dr. Bankart also advanced the cause of manipulative surgery of the foot, pioneered operations for sciatica and fusion of a painful sacroiliac joint, and developed methods to excise the hip in cases of tuberculous arthritis. He walked, talked, and operated very quickly, and was a man of great personal integrity who tolerated no careless approach to work among his pupils and colleagues nor unsound science.

2. **Barton Fracture**: With direct anterior or posterior blows upon the wrist, the dorsal or volar lips of the radial articular surface may be fractured. When this occurs, the radial fragment displaces and with it, the carpus. As such, this is a fracture-dislocation (or subluxation, more properly). When describing this injury, one often adds the descriptor “volar” or “dorsal” to the name Barton fracture, indicating which lip of the radius has been sheared off.

**John Rhea Barton** (1794-1871) was reared in central Pennsylvania and practiced surgery in Philadelphia. He was the first to describe the fracture-dislocation that bears his name, in 1838. He made correct assumptions about this injury purely based on physical examination, without the benefit of surgical or post-mortem examination and before the days of radiography. He was able to distinguish this injury from more common injuries such as Colles fractures and carpal dislocations, and he understood the unstable status of this injury after reduction.

Barton was a smooth and precise operator, and was said to seldom change position during surgery because he was equally skilled with either hand. He was willing to push the envelope in surgical techniques when logic dictated. For instance, he was one of the first to attempt laminectomy to improve the lot of a patient with paraplegia following a spine fracture, despite the fact that the concept had been broached a millennium before. He performed the first athroplasty, in which he created a pseudoarthrosis in the proximal femur to restore function to a traumatically fused hip joint. Also, he broke ground by performing a distal femoral osteotomy to restore normal alignment in a patient with a knee fused in flexion.

3. **Bennett Fracture**: Intra-articular fractures at the base of the thumb metacarpal may be simple or comminuted. The simple form, named the Bennett fracture, is nearly always accompanied by dislocation of the larger, distal fragment dorsally and radially. The smaller fragment remains attached to the trapezium.

**Edward Hallaran Bennett** (1837-1907) was an Irish surgeon and a younger colleague of Robert Smith. He shared Smith’s and Colles’ love for anatomy, and obtained many of his specimens of healed fractures from cadavers he dissected. He was the first to bring the antiseptic techniques of Lister to Dublin. His initial report on first metacarpal fractures was published in 1882, with two more detailed descriptions of the injury the bears his name published in 1886. At the meeting of
the Royal Academy of Medicine in Ireland in 1897, Sir William Stokes proposed that this lesion be named after Bennett.

4. **Colles Fracture**: As opposed to the injuries of the upper extremity suffered at various ages of childhood and young adulthood from a FOOSH (supracondylar, radial torus, radial head, scaphoid), adults over the age of 40 often sustain a dorsally angulated fracture of the distal radius without involvement of the articular surface. These Colles fractures are especially common amongst patients with osteoporosis, although these patients will sometimes sustain intra-articular comminuted fractures with significant trauma.

**Abraham Colles** (1773-1843) described the injury that bears his name in 1814, in his paper, “On the Fracture of the Carpal Extremity of the Radius.” He is regarded as the greatest of the Irish surgeons. Not only was he a great surgeon, but he was an outstanding teacher, to the point that his popularity helped give the Royal College of Surgeons the highest enrollment of any British medical school of the day. He was an ardent proponent of a broad education, having been a rare medical student with a liberal arts background, and decried the practice of focusing only on learning medicine or surgery but not both. Unlike many of his contemporaries, he also recognized the value of education in basic sciences. In fact, he revolutionized the teaching of anatomy, being the first proponent of regional dissections rather than organ-system dissections. He said, “…no man can know his own profession perfectly who knows nothing else; and that he who aspires to eminence in any particular science, must first acquire the habit of philosophizing on matters of science in general.”

He considered his *Practical Observations on Venereal Disease, and on the Use of Mercury* to be his greatest work. I am uncertain if it was a slight that he dedicated this work to Astley Cooper. In this work, he contradicted the opinion of the day, put forth by the eminent John Hunter, that secondary lesions of syphilis are contagious by direct contact. This passage is evidence to his sense of humor:

I may be told by some that men may contract syphilis by sitting in a public privy; to this I can only answer that I have never witnessed a single instance; nor did the late Mr. Obre, who had been for many years most extensively engaged in treating the venereal disease; for on asking him if he believed that the disease was propagated in this manner, he shrewdly answered, that is sometimes was the manner in which *married* men contracted it, but *unmarried* men never caught it in this manner.

5. **Essex-Lopresti Fracture**: Rarely, a longitudinal force against the outstretched hand and forearm will drive the radial head into the capitulum, fracturing the radial head, with an associated dislocation or subluxation of the distal radioulnar joint. In this setting, the primary site of pain is the elbow, which may be the only body
part radiographed. Excision of the radial head, still performed in some instances of isolated, comminuted radial head fractures, in this instance allows the radius to slide even more proximally, further distracting the distal radioulnar joint. In the setting of a radial head fracture, one should search for evidence of significant proximal migration of the radius; if present, this signifies disruption of the distal radioulnar joint, and the combined injuries require different treatment than isolated radial head fractures.

Peter Gordon Lawrence Essex-Lopresti (1916-1951) described this injury in two patients in the year of his death. After training in London, he joined the Royal Army Medical Corps, serving the airborne division, allowing him to catalog injuries associated with over 20,000 parachute jumps. Not surprisingly, a few years later his subsequent topic for the prestigious Hunterian Lecture was “The Mechanism, Reduction Technique, and Results in Fractures of the Os Calcis.”

6. Galeazzi Fracture: Fracture of the distal half of the radial shaft should raise suspicion of dislocation or subluxation of the distal radioulnar joint (DRUJ). This combination is the Galeazzi fracture, which is an unstable injury. If the dislocation goes unrecognized, the patient is likely to have a poor result, including limitation of motion, and possible loss of reduction and failure of fixation of the radial fracture. Close attention should be paid to the wrist for possible DRUJ dislocation in any case of fracture of the distal half of the radial shaft; the more distal the fracture, the more likely one is to find a dislocation. The typical fracture in these cases is at the junction of the middle and distal thirds of the radius. The ulna dislocates in a dorsal and ulnar direction.

Riccardo Galeazzi (1866-1952) was not the first to report the fracture that bears his name. That honor belonged to Astley Cooper. However, Galeazzi reported his series of 18 cases of this injury and his management of them. He was born in Turin and practiced in Milan. He made great contributions in the treatment of crippled children and rehabilitation of war wounded, having established the first Italian facility for the treatment of crippled children and several rehab facilities for Italy’s World War I wounded soldiers. He published over 130 papers on a wide variety of orthopedic topics and did much to advance the discipline of orthopedics in Italy.

7. Hill-Sachs Fracture: Nearly all shoulder dislocations are anterior, with the humeral head displace to a point along the anterior inferior margin of the glenoid tubercle. These dislocations are frequently accompanied by impaction fractures of the glenoid (or labral tear) and the humeral head. The latter is the Hill-Sachs fracture, a wedge shaped defect occurring along the posterior lateral superior surface of the humeral head. At radiography, these are best visualized on internally rotated AP views, in which the contour of the head will no longer be
smooth and round laterally. Many facilities, however, do not routinely perform this view. On a standard AP view, the defect is sometimes visible as a vertical line projecting a centimeter or less inside the lateral margin of the humeral head, and sometimes seen only as a subtle lucency in the region (not to be confused with the known pseudotumor of the humeral head). These lesions are both more likely to be present after multiple dislocations and more likely to result in recurrent dislocations, especially when large.

**Harold Arthur Hill** (1901-1973) and **Maurice David Sachs** (1909-1987) were radiologists in San Francisco. The lesion named after these men was previously known, but the exact mechanism and timing of the defect was uncertain. In their report of 119 cases of shoulder dislocations gathered in the decade ending in 1940, these radiologists showed the defect was due to direct impaction/compression of the humeral head.

8. **Kienbock Disease**: Sometimes called lunatomalacia, Kienbock disease is the name for osteonecrosis of the lunate bone. While this condition is idiopathic, it has a relatively high association (up to 75%) with negative ulnar variance, the condition in which the ulna is shorter than the radius. Early cases demonstrate heterogeneous sclerosis in the lunate on radiographs, occasionally with lucent fracture lines; this is followed by fragmentation and collapse of that bone. As reported by Kienbock, the changes frequently are most prominent proximally. When caught early, patients with negative ulnar variance may be treated with shortening of the radius or lengthening of the lunate. End-stage Kienbock’s can be debilitating and difficult to treat; one option is proximal row carpectomy.

**Robert Kienbock** (1871-1953) was born in Vienna and graduated from the Viennese School of Medicine in 1895. The timing was fortuitous for him. While subsequently traveling in Europe, he became familiar and enamored with the use of x-rays. A couple years after his return to Vienna, he opened his own radiology institute, and he embarked upon a career in radiology. He split his time between clinical diagnostic radiology and radiotherapy, as well as extensive research in both fields.

In 1900, he settled a controversy over whether skin burns from radiation therapy were due to the x-rays themselves or due to electrical fields produced by the machines (the former was the answer). Shortly thereafter, he showed that skin damage was proportional to the absorbed dose and that rapidly dividing cell populations were notably radiosensitive. He also pioneered the first techniques to measure radiation doses delivered to patients undergoing radiation therapy. Following a skull fracture resulting from a fall from a horse in 1910, his personality changed and he became more withdrawn. After presenting work on treatment of metastatic tumors in 1913, he focused more on diagnostic radiology. He described a number of musculoskeletal maladies, including rheumatic and tuberculous arthritis, chondromatoses, and skeletal echinococcosis, and was
working on the 9th volume of his *X-ray Diagnosis of Illness of the Bones and Joints* when his work was interrupted by strokes. He is one of the few early pioneers of radiology who did much experimentation but did not succumb to a radiation-induced sarcoma.

His later work was performed under some duress. When the Germans invaded Austria in 1938, they found that approximately 2/3 of the physicians in Vienna were Jewish, so Kienbock (who was not) saw many of his colleagues and friends suffer at the hands of the Nazis.

9. **Madelung Deformity**: Most common in adolescent girls, Madelung deformity is a condition in which the distal radius is shortened and curved in a volar and ulnar direction, with widening of the DRUJ and a triangular configuration of the carpals. The hand and wrist subluxate volarly. Some cases are acquired due to trauma or are related to dyschondrosteosis, but most are hereditary and bilateral. The condition may or may not cause pain and discomfort, as well as reduced range of motion.

**Otto Wilhelm Madelung** (1846–1926) was a German surgeon. After his early training and some time serving in a military hospital during the Franco-Prussian War, Madelung practiced in Bonn, with continued mentorship of the well known Carl Busch. He subsequently moved to Rostock and then Strasbourg. At the end of World War I, the French gained control of Strasbourg, and all of the German professors were replaced by French ones. Madelung was the last to go, and spent a time under house arrest prior to departing and retiring.

Despite the fact that others, including Guillaume Dupuytren and Joseph Malgaigne, had reported this wrist deformity earlier in the 19th century, Madelung was the first to give a complete and accurate description of the condition and to suggest a cause and discuss treatment. He first did this at the Congress of the German Society for Surgery in 1878 and then published his findings in more than a dozen cases. This work put Madelung on the map as an important surgeon in Europe. His fame increased with an extensive and informative description of bowel anastomoses and an extensive description of a benign lipomatosis of the neck now known as Madelung’s disease.

As with most of the surgeons discussed here, Madelung was both a surgeon and a professor. He applied himself diligently to both pursuits, and when preparing lectures his goal was to make them so important that the students did not feel they could afford to miss class.

10. **Monteggia Fracture**: Like the Galeazzi fracture, this is actually a fracture-dislocation of the forearm. In this instance, the fracture is of the proximal ulna and the dislocation of the radial head. If one sees a proximal ulnar shaft fracture,
one must scrutinize the radial head to exclude dislocation: in the normal state, the radial head aligns with the capitulum on all views. The Bado classification is commonly used to classify the combination of injuries: type I is an anterior dislocation of the radial head with apex-anterior angulation of the ulnar fracture; type II is the opposite—posterior dislocation of the radial head with apex-posterior angulation of the ulnar fracture; type III consists of a lateral dislocation of the radial head with a proximal ulnar shaft or metaphyseal fracture; and type IV is fracture of the proximal shafts of both the ulna and radius with anterior dislocation of the radius.

Giovanni Battista Monteggia (1762-1815) passed examinations to practice both surgery and medicine at an early age. His early years were notable for his extensive work as an anatomist, a subject in which he was made Instructor at the hospital in Milan. This work entailed many autopsies, and it was during one of these procedures that Monteggia contracted syphilis through a cut from a subject who had died of the disease. Presumably this event, and a similar one for one of his students, spurred his subsequent interest in and publishing of a text about venereal diseases.

Monteggia was proficient in several languages, and kept current in the medical and surgical literature from several countries. After he became professor of surgery, he published 2 editions of his lectures, which included numerous observations gleaned from the leading surgical minds of the world. In this effort, he was able to expose many Italian surgeons to foreign literature that otherwise would not have been available to them. In these compendia, he adjured his readers that:

The stimulus for all your work should be a desire for success, the voice of duty, but most of all the call of suffering humanity who await the help of your profession.

Among other accomplishments, his was one of the first descriptions of polio.

11. Ollier’s Disease: Also referred to as enchondromatosis, Ollier’s disease is a nonhereditary condition in which the patient has multiple cartilage lesions, including enchondromas and subperiosteal chondromas. The lesions are mostly or completely unilateral, and most of the lesions are in the extremities, although they may occur in the pelvis also.

On radiographs, the lesions often have a more bizarre appearance than typical solitary enchondromas, with striations, osseous expansion, and growth disturbances being common. Growth disturbances and pathologic fractures are the important secondary effects early in life, whereas the lesions must be followed in adulthood for the possibility of malignant transformation to chondrosarcoma. Malignant transformation is variably reported as occurring in 5-30% of patients. Malignant transformation is thought to be much more common in Maffucci’s syndrome, the condition of multiple enchondromas and soft tissue hemangiomas.
Leopold Ollier (1830-1900) was a surgeon in Lyon, France. He had a primary interest in bone and joint surgery, trauma surgery, and reconstructive surgery of the face and body including skin grafts. He was a strong proponent of the establishment of orthopedic surgery as a distinct discipline; this effort was at peril to his own reputation, since French surgeons of the time largely ridiculed the term orthopedist, which had referred previously to makers of braces and orthoses as well as physicians who attempted to straighten spines. He has been called the Father of Orthopedic Surgery.

Ollier is also considered to be the Father of Experimental Surgery. He was the first to routinely and successfully apply the principles learned in his animal experiments to humans. He worked with chickens, pigeons, rats, rabbits, cats, and dogs on his father’s farm and later in a veterinary lab in Lyon. His experiments helped him prove the integral function of the periosteum in bone formation (again, in the face of ridicule from his colleagues) and led to vastly improved methods of joint resection. He demonstrated that human bone autografts and allografts were likely to work, while xenografts (from alternate species) would not. He was one of the first to implement Lister’s and other aseptic techniques in the surgical theatre. His work with facial reconstruction led him to develop successful skin graft methods, which some consider his greatest contribution to surgery. Various images, busts, and statues commemorate Dr. Ollier. The statue placed on the banks of the Rhone was removed by the Germans in World War II to be melted down for munitions.

12. **Rolando Fracture**: While the Bennett fracture is a simple fracture at the base of the thumb metacarpal, the classic Rolando fracture is a T- or Y-shaped intra-articular fracture of that site. As in the Bennett fracture, a dislocation accompanies the Rolando fracture.

Silvio Rolando (1810-1941?) practiced in Genoa. He was a general surgeon whose specialty was genitourinary surgery. He was the third Milanese surgeon to have a fracture named after him, including Monteggia and Galeazzi.

13. **Smith Fracture**: A rare injury of the distal forearm is the Smith fracture, in which there is a fracture of the distal radius with volar displacement, as opposed to the dorsal displacement and angulation in the much more common Colles fracture.

Robert William Smith (1807-1873) was an Irish surgeon who no longer carries the fame of some of his better known contemporaries, such as Colles. He wrote the *Treatise on Fractures in the Vicinity of Joints*, in which he debunked some of the misconceptions of fractures and dislocations. Shortly thereafter, he published a book detailing the cases of two patients with neurofibromatosis, 33 years before the description given by von Recklinghausen. Smith had a zeal for pathologic
anatomy, and spent endless hours recording his findings in drawings and casts. He helped found the Pathological Society of Dublin, and Colles requested that his own autopsy be performed by Smith.

**Numbers:**

1. **Acromioclavicular (AC) Joint Width**: In a study of 151 normal subjects’ AP shoulder radiographs, evenly divided between genders and with 10 or 11 subjects in each decade between 20 and 90, Petersson and Redlund-Johnell determined that any female AC joint above 6 mm wide is abnormal. They determined that male AC joints above 7 mm are abnormal. Overall, the average width of the AC joint is about 3 mm. Also, the investigators showed that the width of the joint normally narrows with time, and past the age of 60 there is no lower limit of normal for AC joint width, as opposed to the glenohumeral joint, in which narrowing indicates arthritis regardless of age.

2. **Acromiohumeral (AH) Distance**: In their study of 175 AP shoulder radiographs, with equal numbers of men and women and evenly distributed from 10 to 90 years old, Petersson and Redlund-Johnell demonstrated an average AH distance of 10.2 mm in men and 9.5 in women. The lower end of the 95% range was 6.6 mm for men and 7.1 for women. Hence, they concluded that an AH distance under 6 mm is abnormal, and likely indicates a supraspinatus tear. Others have demonstrated that acute rotator cuff tears do not retract to the point to allow narrowing of the AH space, so the cuff tear that causes a reduced AH distance is a chronic one and likely not reparable.

3. **Wrist Instability Measurements**: There are several angles and measurements described in the wrist. I believe that the most important angle to measure is the scapholunate angle on the lateral view. A second angle one might measure is also on the lateral view, the capitolunate angle. With these measurements, one may determine if VISI or DISI is present.

   The lateral **scapholunate angle** is the angle formed between the axes of the scaphoid and lunate. The scaphoid axis is intuitive, being a longitudinal line bisecting the proximal and distal poles/surfaces. The lunate axis is drawn by dropping a line across the palmar and dorsal poles of the lunate and then taking its perpendicular. The angle between these two axes should be 30-60° (60-80° is indeterminate).

   The lateral **capitolunate angle** is the angle between the axes of the lunate (as above) and the longitudinal axis of the capitate. This angle should be 0-30°.

   **Dorsal intercalated segment instability (DISI)** occurs when the scapholunate ligament tears and the lunate is allowed to tip dorsally. A scapholunate angle
above 80° is diagnostic of DISI. As mentioned above, if this angle is between 60° and 80°, it is indeterminate for DISI.

**Volar intercalated segment instability (VISI)** occurs in the setting of lunatotriquetral ligament rupture, allowing the lunate to tip in a volar/palmar direction. A scapholunate angle less than 30° is diagnostic of VISI, as is a capitolunate angle greater than 30°.

The other measurement to remember is the width of the scapholunate space on the PA radiograph. When normal, this space is 2 mm or less. When it is wider than 4 mm, it is clearly abnormal, indicating scapholunate dissociation. From 2-4 mm, the measurement is indeterminate, with the diagnosis resting on clinical findings.

## LOWER EXTREMITY

**Names:**

1. **Blount Disease**: Infants occasionally are afflicted with a form of tibia vara that is due to a disturbance of growth in the medial tibial epiphysis. The epiphysis and metaphysis are diminutive medially and may be fragmented and deformed, causing tibia vara. The medial tibial metaphysis is depressed. There is varus of the lower extremity, but it is centered in the proximal tibia, unlike physiologic bowing, which is centered at the knee. The tibia is adducted without curvature. These patients will have an abnormal metaphyseal-diaphyseal angle, defined as greater than 12 degrees. Less common is an adolescent form of the condition. This condition may be due to abnormal progression of otherwise normal physiologic bowing.

**Walter Putnam Blount** (1900-1992), an American orthopedist, trained in Madison, Wisconsin and then traveled to Europe for further study. After returning to Wisconsin, he joined and eventually chaired the orthopedics department at Milwaukee Children’s Hospital and became a professor of orthopedics at Marquette. Among other accomplishments, he developed the Milwaukee brace for treatment of scoliosis, he pioneered the use of staples for epiphyseodesis, and he became an international leader in treatment of infections affecting bones, including tuberculosis and polio.

In 1963, Blount said, “I have been interested in scoliosis since 1928 when I studied various ineffectual methods of treatment in Europe. Most of the therapy was worse than no treatment at all.”
2. **Brodie Abscess**: In the setting of subacute or chronic osteomyelitis, one may encounter an abscess within the medullary space of the bone. On radiographs, these lesions are usually radiolucent, often with a poorly defined sclerotic margin. Cross-sectional imaging may reveal a sinus extending from the metaphyseal abscess to the physis in skeletally immature patients; this is a diagnostic finding. The rare lesion that occurs within the cortex may be confused with osteoid osteoma. These lesions are more common in children, in whom the lesions are usually metaphyseal in long bones.

**Benjamin Collins Brodie** (1783-1862) was an English surgeon, physiologist, and anatomist who practiced in London. He became well known and respected due to some of his public lectures, and was the personal surgeon of King George IV.

His most important contributions came in the study and description of diseases of the joints, culminating in his *Pathological and Surgical Observations in Diseases of the Joints*, which extended for 5 editions. However, the breadth of his research, publishing, and lecturing was notable, including widespread topics such as brain abscesses, genitourinary diseases, rectal diseases, and breast tumors. Additional topics included “On Quacks and Quackery” and “On the Use and Abuse of Tobacco.” In an age when amputation was often the rule, Brodie strove to preserve limbs whenever possible, and influenced others to do the same.

3. **Caisson Disease**: Also, known as compressed air illness, this is akin to decompression sickness in divers. Symptoms include “the bends” (joint and muscle pain), deafness, respiratory compromise, vomiting, paralysis, and sudden death. Osteonecrosis can be a by-product of this condition.

**Caisson** is not the name of a surgeon or radiologist, but a device. A caisson is a closed chamber used for working under water, such as in the construction of bridge piers and dams and ship repair. A deep caisson is sealed and water is pumped out. As the depth of the caisson increases, additional compressed air must be piped in to maintain a counter pressure to the surrounding water: for every 33.5 feet of depth, an additional atmosphere of pressure must be added. Before caisson disease was understood, workers would sometimes leave the compressed environment too rapidly and suffer the ill effects listed above.

The construction of the St. Louis bridge employed 600 workmen, with pressure in the caissons equaling 4.5 atmospheres. 119 of the workers were affected with this malady, 14 perishing.

Washington Augustus Roebling, an engineer who had distinguished himself in the service of the Union Army during the Civil War, worked with his father building bridges in civilian life. Shortly after beginning the construction of the Brooklyn Bridge, his father died and he assumed the role of chief engineer. His constant attentions to the details of the work and frequent and extended trips below surface
into the caissons resulted in Roebling contracting a severe case of caisson disease, crippling and nearly killing him. He then rented an apartment that overlooked the river, from which point he continued to monitor progress on the bridge and send frequent couriers with further instructions. The project that nearly killed Roebling was completed in 1883, more than a decade after its initiation.

4. **Charcot Joint**: Neurologic deficits often lead to a series of reactions and breakdown of one or more joints. These findings are not always centered about the joints, but can be localized within one or more bones. Charcot first described this condition in association with cases of tabes dorsalis but now his name is applied to this process occurring due to any neuropathy, also including diabetes, syringomyelia, alcoholism, amyloidosis, congenital indifference to pain, spinal dysraphism, and a host of other diseases, with even an idiopathic version recognized to affect the elbow and shoulder.

Radiographic findings progress from effusion and sometimes degenerative findings to severe involvement, in which there is disorganization, with both sclerosis and erosion, and fragmentation and malalignment. Distinguishing neuropathic arthropathy from infection may be impossible on radiographs and MRI, instead necessitating reliance upon clinical and laboratory features and scintigraphy.

**Jean Marie Charcot** (1825-1893) was a Parisian who spent 30 years as physician to the hospital of the Salpetriere. His descriptions and contributions range widely through pneumonia, liver disease, tuberculosis, renal diseases, gout, and endocarditis. He was especially known for his advancement of neurology and psychology, and he was a pioneer in psychotherapy. He was an able artist, and applied this talent to the depiction of patients with nervous disease as well as medical history.

5. **Chopart Joint**: The talonavicular and calcaneocuboid joints separate the hindfoot from the midfoot. Despite the fact that they are anatomically separate joints, together they are called Chopart’s joint.

**Francois Chopart** (1743-1795) was a Parisian surgeon. With Pierre-Joseph Desault, he published a text on surgical technique and he later wrote a 2-volume text on the urinary tract, the first to unify the organs of the urinary tract into one system of excretion. As with Lisfranc, Chopart’s name was applied to a joint because he performed an innovative amputation at the site, basing his technique on solid knowledge of the anatomy and function. Unlike Lisfranc, though, Chopart only carried out this operation once, and never published a description of it (one of his students did).
6. **Duverney Fracture**: Fractures of the iliac wing that do not involve the remainder of the pelvis are uncommon. This injury is the Duverney fracture.

**Joseph Guichard Duverney** (1648-1730) is considered the first modern academic surgeon. Soon after receiving his medical degree at age 19, he was appointed by King Louis XIV to the position of Professor of Anatomy and Surgery at the king’s medical school. Duverney focused primarily on anatomy and injuries of the bones. After appointment to the Academie des Sciences, another group funded by the king, Duverney pooled his efforts with other scientists to greatly advance the knowledge of comparative anatomy, which was one of his primary legacies. This group had the advantage of donations of specimens from the king’s zoo, including some rare beasts. Members of the king’s court attended these public dissections often.

From his comparative anatomy studies, Duverney wrote the *Traite de l’Organe de l’Ouie*, filled with original work. This book was widely circulated and translated, and for it he has been called the Father of Otology by some.

Twenty-one years after his death, a student of Duverney’s named Senac collated Duverney’s notes and published *Traite de Maladies des Os*. There is extensive anatomical support for the descriptions of fractures, dislocations, and bone diseases contained in this two-volume work, and in its pages are the description of a patient who suffered Duverney’s eponymic fracture and subsequently died of infection. One of the earliest descriptions of osteoporosis is also in this text.

7. **Freiberg Infraction**: This insult usually occurs in the second metatarsal head but occasionally will be seen in the 3rd. The radiographic findings are flattening of the 2nd metatarsal head, typically with sclerosis and sometimes a lucent line or fragmentation. This lesions occurs 3:1 in females. Current leading opinion suggests the cause to be a stress injury of the metatarsal head, often from tight shoewear with heels, leading to eventual osteonecrosis.

**Arthur Henry Freiberg** (1868-1940) was a surgeon who spent the bulk of his career as professor of orthopedic surgery at the University of Cincinnati. He spent time training in Europe. He was a well respected surgeon and researcher and shaped the course of orthopedics through his publishing and ardent committee work. He was an accomplished botanist and an amateur botanist.

8. **Jones Fracture**: There are two relatively common fractures of the base of the fifth metatarsal. The more common variety is an avulsion fracture, caused by traction of the insertion of the peroneus brevis tendon. That fracture may be transverse or oblique, and should not be confused with the normal longitudinal unfused apophysis at this site in the skeletally immature patient. Less commonly, one may suffer a transverse fracture of the proximal shaft of the 5th metatarsal, with no
intraarticular component. This latter is the Jones fracture. The typical mechanism is a twisting injury with inversion of the foot balanced against traction of the peroneus brevis. These fractures occur in a watershed vascular zone and are therefore difficult to heal, often requiring surgery. Stress fractures also occur at this location there probably is some overlap between stress fractures and Jones fractures.

**Sir Robert Jones** (1857-1933) was an early proponent of the use of radiography in the field of orthopedics. With Oliver Lodge, a professor of physics, Jones reported the first use of radiography to discern the location of a bullet, in a 12 year old boy’s wrist (probably the first published clinical radiograph ever). This report appeared in Lancet in February 1896, less than 2 months after Roentgen’s discovery was made public. Professor Lodge included a description of his technique. Of note, the exposure time for an AP wrist was 2 hours. His advocacy for radiology and radiologists is evidenced in this quotation from one of his papers, published shortly before his death:

> Radiography here, as in all branches of medicine, is an essential aid to diagnosis. No matter how experienced we may be, we cannot afford to dispense with it, even in the apparently simple and obvious case. Not only should we insist upon procuring a film, but it is equally important that we should welcome the radiologist’s reading of it. Some surgeons resent this and say, “Give me the film so that I can read it for myself,” but this is an arrogant and stupid attitude, and not to the patient’s advantage. In Liverpool, I constantly, and with profit, confer with my friend Thurstan Holland.

His reported a case of his eponymic fracture that was actually his own injury. He suffered the injury while dancing, and initially supposed he had torn his peroneus longus. He remarked several times, by the report of one of the other attendees of the dance, exclaimed, “*Most interesting*, most painful. I had no idea it could be so painful. *Most interesting.*” The following day he did a thought physical examination upon himself and determined his initial diagnosis was incorrect. He hobbled downstairs to radiology and requested an x-ray, which revealed his fracture.

9. **Legg-Calve-Perthes Disease (L-C-P):** Formerly termed an osteochondrosis, L-C-P is now known to be osteonecrosis of the femoral head in young children. This is an idiopathic phenomenon, occurring in boys more than girls, typical from age 3 to 8. When the disease occurs bilaterally, it is asynchronous. 6% of cases run in families, and it is rare in African Americans.

Radiographic findings of L-C-P include lateral soft tissue swelling and a small, fragmented, sclerotic femoral capital epiphysis with coxa magna eventually. So-called metaphyseal cysts just distal to the physis are thought to result from
disturbed endochondral ossification. Prognosis is variable, but tends to be better in boys and in those who manifest the disease at an earlier age.

Arthur Thornton Legg (1874-1939) was an American surgeon. He was a junior assistant surgeon at the Children’s Hospital in Boston when he described this disease. He remained at this facility for 39 years, and advanced the study of crippled children. He published 8 papers on coxa plana.

Jaques Calvé (1875-1954) was a French orthopedist who made a career of treating patients with bone and joint manifestations of tuberculosis. He started this at the Hopital Maritime on the north coast of France. Subsequently he raised funds for a new hospital in which to treat children with tuberculosis, funds largely coming from Americans living in France. In a series of 500 radiographs of pediatric hips in patients being treated for tuberculosis, he saw 10 that were not related to infection but had a different course. These 10 turned out to have L-C-P.

Georg Clemens Perthes (1869-1927) was a German surgeon with many interests. During his time as an army surgeon during the German war against China, he radiographed the feet of Chinese women; their feet had undergone traditional crushing and binding. After returning to Germany, he developed the technique of achieving hemostasis in limb surgery with a pneumatic cuff, and the use of suction drainage for empyema. His work in army hospitals during World War I led to texts on surgical management of nerve injuries and mandible fractures. Perthes has a special interest in the biological effects of x-rays and their therapeutic use. He was the founder of radiation therapy for warts, skin cancer, and breast cancer. He obtained the first radiographs of L-C-P, but unfortunately for him these were not published until 1914, after the first written account of the disease.

10. Lisfranc Fracture Dislocation: The Lisfranc ligament is that which joins the medial cuneiform to the base of the second metatarsal. However, essentially any pattern of fracture and dislocation at the tarsometatarsal joints is called a Lisfranc injury. These commonly involve several of the TMT joints, and the first metatarsal base may displace laterally with the other metatarsals (homolateral) or may displace medially (divergent). These injuries may be subtle on radiographs. In the normal foot, the margins of the second metatarsal and the medial cuneiform align on both the AP and lateral views. The other metatarsals also usually align nicely with the respective cuneiforms and cuboid. When there is offset between any of the bones at the TMT joints, Lisfranc fracture-dislocation should be suspected. This injury is bad enough when recognized and treated; if missed it can be devastating. CT scanning should be definitive.

Jaques Lisfranc de Saint Martin (1790-1847) was an apt French surgeon whose rapid and precise surgical techniques were undoubtedly appreciated by his patients, before the utilization of ether and general anesthesia. He never described the fracture-dislocation pattern that bears his name; instead, he developed a quick
amputation that could be performed rapidly at the tarsometatarsal joints. Reportedly, he honed this operation, during his service in Napoleon’s army, to the point that he could perform it in under a minute. Apparently, Lisfranc had a penchant for removing body parts, as he also developed methods of disarticulating the shoulder and removal of the uterine cervix; he is also recognized as having performed the first excision of a rectal cancer. Of Lisfranc, it was said, “so obsessive a scalpel-wielder that he lamented the passing of the Napoleonic age when the grenadiers had provided him with so many splendid opportunities for amputations.” Although he was initially trained by Dupuytren, they had a falling out and routinely aired their differences in public writing and their separate lectures. Apparently this sort of behavior was common well before the spat between Donald Trump and Rosie O’Donnell.

11. **Maisonneuve Fracture**: This fracture pattern is recognizable by the proximal fibula fracture that accompanies a severe ankle injury. External rotation is a primary mechanism for this injury. The high fibula fracture results from the force passing all the way up the interosseous membrane and exiting proximally and laterally. This implies significant instability for the ankle and leg, and if missed will lead to poor treatment results. At the ankle, associated injuries include a torn anterior inferior tibiofibular ligament, a posterior malleolar fracture, rupture of the ankle joint capsule, and a deltoid ligament tear or medial malleolar transverse avulsion. If a posterior malleolar fracture or medial malleolar avulsion is seen in the absence of a distal fibula fracture, one must search for the possibility of a Maisonneuve fracture and order radiographs of the leg to examine the rest of the fibula.

**Jules Germain Francois Maisonneuve** (1809-1897), a French surgeon and a student of Guillaume Dupuytren, was the first to describe external rotation as a contributing mechanism in the production of ankle fractures.

12. **Malgaigne Fracture**: Major trauma may disrupt the pelvic ring in two places, with vertical fractures (or disruption of the sacroiliac joint), essentially separating the pelvis into two halves. Such a pattern is often quite unstable and has been termed the Malgaigne fracture, but more recent, mechanistic classifications of pelvic fractures have nearly supplanted this term.

**Joseph Francois Malgaigne** (1806-1865) was a French surgeon and surgical historian who took many methods and much information from his legendary forebears, but who was not afraid to dispense with their (or anyone’s) wisdom if it was not supported by science. He was trained as a historian, among other things, and was fluent in Latin and Greek. He often went to source materials and read them in the original language, rather than relying on possibly faulty translations.

A champion of liberty, he was inspired when the Poles revolted in attempt to throw off Russian control in 1830. Malgaigne drew together a volunteer hospital
unit of surgeons and others to accompany the Polish army. From these efforts he nurtured a lifelong dislike of the cold.

Malgaigne honed his skills as a reviewer of medical literature as an associate editor for the popular Gazette Medicale de Paris. One of his reviews included the statement, “The work of M. X contains many things both new and good. Unfortunately the good things are not new, and the new things are not good.” In subsequent positions as editors, Malgaigne was able to influence his contemporaries by advocating animal experimentation and employing the statistical approach to medical research.

He wrote several texts and numerous papers. His most important works were the *Traite des Fractures et des Luxations*, a two volume work with an extensive atlas that exceeded all previous discussions of the treatment of fractures; *Manuel de Medicine Operatoire* was a pocket sized handbook of surgical operations comprising 800 pages, recognized throughout Europe as the most complete and best manual on the topic; and a compilation of the complete works of Ambroise Pare (1545-1590) that includes a history of surgery for the millennium leading up to Pare’s extensive career. In all three works, Malgaigne exhibited his ability to distill ideas and events to their core, to eliminate the unnecessary and the fraudulent, and to make order out of chaos.

In describing the complex pelvic fractures that bear his name, he commented that injuries to the underlying viscera were the principle risk, a contention we know to be true today.

13. **Osgood-Schlatter Disease**: Athletic boys, more than girls, aged 11-15, may suffer pain, tenderness, and swelling at the tibial tubercle. This malady is called Osgood-Schlatter disease, and is thought to be a traction apophysitis from repeated tension on the patellar ligament. Radiographs reveal soft tissue swelling anterior to the insertion of the patellar ligament, indistinctness and swelling of the ligament, and development of bone fragments in its distal aspect. A portion of the tubercle occasionally will suffer a displaced avulsion. MRI will show edema at the site and sometimes fluid in the deep infrapatellar bursa. It is important to note that the radiological findings must be supported by clinical findings of tenderness and swelling; if not, bone fragments within the ligament may simply represent accessory ossicles or the residua of now quiescent Osgood-Schlatter.

**Robert Bayley Osgood** (1873-1956), an American orthopedist, graduated from Harvard and practiced at Massachusetts General Hospital and the Children’s Hospital. He was well respected and wrote extensively, including authoring a history of orthopedic surgery. However, after his internship his first appointment was as roentgenologist of Mass General. Using this new technology, he studied disturbances of the tibial tubercle in adolescents and published (first) his findings in 1903. Osgood and his radiologist colleague, Walter J. Dodd, both contracted
skin cancers of the hand. Dodd, who remained in the profession, died of his. Osgood shortly turned to surgery, and his cancers we able to be removed surgically without shortening his life. Other research interests included metabolism in rheumatoid arthritis, transmission of polio, and trauma. Like many surgeons of his time, he cut his trauma teeth treating soldiers during World War I. He spent a great deal of time during the war as the lieutenant of Sir Robert Jones, whom he helped to establish British Orthopedic Association.

**Carl B. Sclatter** (1864-1934), a Swiss surgeon, had a primary interest in trauma. However, he was also the first to perform a successful complete gastrectomy.

14. **Paget Disease**: Also known as osteitis deformans, Paget disease of bone is common, occurring in 3 per cent of people over age 40. This condition is one of abnormal and excessive bone remodeling. Radiographic findings vary with the phase of the disease: in the active phase, osteolysis predominates, with classic findings of osteoporosis circumscripta in the skull and a blade of grass or flame shaped area of osteolysis extending into a long bone; with maturing, sclerotic findings may predominate, as in the cotton wool skull; the classic diagnostic features of the more quiescent stages included bone expansion and cortical and trabecular thickening. Involvement of the pelvis, spine, skull, and/or proximal femurs is typical. Clinical findings may include focal pain, increasing hat size, bowing of the femurs with banana fractures, basilar invagination, and cranial nerve deficits. Malignant degeneration is not rare, typically resulting in osteosarcoma or fibrosarcoma.

**Sir James Paget** (1814-1899) was both a tireless surgeon and an eminent pathologist. He was one of the founders of scientific pathology, and stands alongside Virchow as having made the microscope the indispensable tool of surgical pathology. One of his great works was his *Lectures on Surgical Pathology*. During his medical training, he discovered the pathogen for trichinosis. He also was an ardent student and teacher of physiology and anatomy, and an accomplished botanist, having published *Sketch of the Natural History of Yarmouth and its Neighborhood* during his apprenticeship.

Beside Paget disease of bone, his name is also attached to Paget disease of the breast (a sign of underlying breast cancer) and Paget disease of the penis. Although he would often spend 16 hours a day in clinical work (seeing up to 200 patients a day), he applied himself equally to pleasurable pursuits, including his love of music. He has also been described as one of the most delightful speakers of the era.

15. **Pellegrini-Stieda Disease**: After proximal tears of the medial collateral ligament of the knee, a band of ossification may be seen in the proximal distribution of the
ligament. Almost all significant MCL tears occur proximally. The ossification is just a historical marker of a prior injury and rarely thought to be of clinical significance. Thus, Pellegrini-Stieda syndrome or disease is neither a disease nor syndromic, but just posttraumatic dystrophic calcification.

Augusto Pellegrini (1877-1958) was a Florentine surgeon. He is known for advancing the use of prosthetic limbs.

Eugen Julius Karl Paul Alfred Stieda (1869-1945) was a German surgeon, with the majority of his career spent as head of the surgical department of the Red Cross Hospital Bertaheim.

16. Salter-Harris Fractures: For fractures involving the physis in patients who are not yet skeletally mature, the Salter-Harris classification system is widely accepted and nearly universally employed. In this system, the types are as follows:

I: Separation of the epiphysis from the physis, typically in a transaxial plane. This is purely a growth plate/cartilage injury, with no involvement of bone.

II: The most common type of physeal injury, in which the fracture involves the growth plate transversely and extends into the metaphysis. The metaphyseal fragment is usually triangular and the periosteum is typically intact along this fragment’s margin, though ruptured on the contralateral side. The classic location is the distal radius, comparable to a Colles fracture in an adult.

III: These fractures extend through the growth plate transversely and then extend through the epiphysis to the articular surface.

IV: Fracture traversing epiphysis, physis, and metaphysis. The most common example of this is the lateral condyle fracture of the distal humerus.

V: An uncommon injury that may be difficult to perceive. The physis is crushed by a longitudinally directed force, usually without displacement in the transverse plane. When unrecognized and/or untreated, these injuries usually result in growth disturbances at the involved physis.

Robert Bruce Salter (1924- ) is an orthopedic surgeon from Canada, now a Professor Emeritus, with ongoing research interests in animal models and continuous passive motion.

W. Robert Harris (1922-2005) was an orthopedic surgeon from Toronto. His interests included slipped capital femoral epiphysis, transplantation of epiphyses, amputations, and rehabilitation of injured workers. Professors Salter and Harris published their famous classification system in 1963.

17. Segond Fracture: With an acute injury to the knee, especially a twisting injury, one may occasionally see a thin longitudinal fleck of bone avulsed from the lateral surface of the tibial plateau, just below the joint line. This is the Segond
fracture, which is highly associated with a complete rupture of the anterior cruciate ligament. The fragment results from an avulsion by the lateral capsular ligament. This ligament is actually just a cordlike thickening of the lateral joint capsule. When a Segond fracture is identified, one can safely assume the presence of an ACL tear. More recently, a similar fragment has been noted along the medial side of the tibia. Termed a “reverse Segond,” this rare fracture is a harbinger of significant internal derangement, usually including a PCL rupture, and often accompanies a knee dislocation.

Paul Ferdinand Segond (1851-1912) was a French surgeon who focused primarily on urinary tract and gynecologic surgery. He perfected the transvaginal hysterectomy. He was also known as a knee specialist.

18. **Tillaux Fracture**: There are two types of this injury. In adults, a Tillaux fracture is an avulsion of the anterolateral corner of the tibial plafond; the anterior inferior tibiofibular ligament avulses this fragment during a twisting injury. In adolescents with partially fused physes, the lateral aspect of the distal tibial physis fuses last at the ankle, and the same mechanism of injury may cause a juvenile Tillaux fracture. These injuries are Salter-Harris III fractures, with the anterolateral portion of the distal tibial epiphysis pulled off.

Paul Jules Tillaux (1834-1904), a French surgeon, described Tillaux disease, in which women exhibit bluish brown cysts in their breasts.

**Numbers:**

1. **Ankle Fracture Classifications**: There are two classification schemes for ankle injuries with distal fibula fractures. The Weber system seems to be more popular among radiologists. It is simple to learn and apply. The class is based upon the location of the fibula fracture and its relationship to the syndesmosis. Specifically, fibula fractures above the level of the joint line imply disruption of the syndesmosis, which usually will mandate operative fixation of the syndesmosis. This classification system is as follows:

   - **Weber A**: Transverse fibula fracture at the tip, well below the joint line. This is an avulsion injury.
   - **B**: Spiral fibula fracture starting posteriorly and superiorly and extending inferiorly and anteriorly, such that it is best seen on the lateral view. The medial margin of the fracture exits the bone at the joint line.
   - **C1**: Oblique transverse fibula fracture just above the joint line. Best seen on AP view.
   - **C2**: Oblique fibula fracture 7-8 cm above the joint line.
The **Lauge-Hansen system** for classifying these fractures acknowledges some of the same principles as the Weber system, and also has four types of injuries. However, it is more detailed, breaking down each type into stages. Each injury type is named for its mechanism, and the injuries one finds with any type follow a predictable sequence, based on severity/grade of the injury. Hence, this system may help the surgeon predict what injuries are present based on the stage of a particular fracture. The scheme is as follows—please note that the 4 types correspond to the four Weber types in order:

**Supination-Adduction** (Weber A): 1. Distal fibula avulsion or lateral ligament tear. 2. Oblique pulsion fracture of the medial malleolus.

**Supination-External Rotation** (B): 1. Tear anterior inferior tibiofibular ligament. 2. Spiral fracture distal fibula exiting medially at the joint line. 3. Posterior malleolar fracture. 4. Transverse medial malleolar avulsion or deltoid ligament tear.

**Pronation-Abduction** (C1): 1. Medial malleolar avulsion or deltoid tear. 2. Anterior inferior tibiofibular ligament tear, +/- posterior malleolus avulsion. 3. Oblique fibular fracture about 1 cm above the joint.

**Pronation-External Rotation** (C2): 1. Medial malleolar avulsion or deltoid tear. 2. Anterior inferior tibiofibular ligament tear. 3. Fibular diaphyseal fracture 7-8 cm above joint. 4. Posterior malleolar fracture.

The correlation between these two classifications is expertly laid out in Mulligan’s article, listed in the references.

**Bernhard Georg Weber** (1927-2002), a Swiss orthopedist, nearly gave up medicine and surgery to pursue his dream of becoming an architect. During his surgical training at Zurich, though, he recognized that orthopedics would satisfy his interest in medicine and technology and his need for artistic expression. He advanced the techniques of fracture treatment beyond the existing principles of the AO, for which he worked for some time. Besides fracture treatment, he focused his interest on the hip joint, designing a new hip prosthesis with several subsequent improved models; nonunions; and tibial osteotomy to realign prematurely degenerated knees. In fact, he underwent this latter operation himself bilaterally to enable him to continue with two of his passions, skiing and tennis. His skill at skiing was such that he was certified as a championship instructor.

**Nils Lauge-Hansen** (1899-1976) was a Danish radiologist who developed the mechanistic approach to classifying ankle fractures described above. He carried out experiments on cadavers to determine which forces produced certain injury patterns.

2. **Ankle Joint Spaces**: Based on their review of 99 male and 99 female ankle radiographs, Jonsson et al. determined that the width of the ankle joint (between the tibial plafond and the talar dome) was 3.4 +/- 0.4 mm in males and 2.9 +/- 0.4 mm in females. Hence, the ankle joint should be at least 2.5 mm in women and
Sclafani examined 100 normal ankle radiographs and found that the maximum normal syndesmotic space was 5 mm on both the AP and 20° mortise views, and that the medial clear space could measure up to 5 mm on the mortise view.

3. **Bohler’s Angle**: In the setting of trauma, particularly axial loading to the lower extremity, one may suffer an impacted fracture of the calcaneus. On occasion, minimally comminuted fractures of the calcaneus may be surprisingly subtle. If there is joint depression, though, this should be evident using Bohler’s angle. On a lateral view of the ankle, one limb is drawn from the superior corner of the calcaneal tuberosity to the posterior aspect of the posterior subtalar facet. The second limb of the angle is then taken forward from the posterior facet to the anterior process of the calcaneus. Standard usage then subtracts this angle from 180. A normal Bohler’s angle is 25-40°, and when fractured it will be less than 25°.

**Lorenz Bohler** (1885-1973) was an Austrian surgeon who spent some time in South America as a member of the Austrian merchant marine, and at the Mayo. Those experiences put him in good stead as he organized a military hospital for fracture treatment during World War I. Convinced that this sort of facility would be useful in peacetime, he was the impetus behind the construction behind the Unfallkrankenhaus, or Accident Hospital, which he directed until his retirement. Bohler published a text on fracture treatment that was the authority in its day (1929) and translated into 8 different languages, with multiple editions. Among other principles, he advanced the concepts of early weight bearing and the use of physical therapy in trauma patients. He has been called the Father of Traumatology and the greatest authority on the treatment of fractures in the first half of the twentieth century.

In an effort to achieve traction, Bohler added pulleys and weights to a fracture frame developed during World War I by **Heinrich Friedrich Wilhelm Braun** (1862-1934). This frame subsequently became known as the Bohler-Braun frame and continues to be used today. Braun was a German surgeon who had a keen interest in various types of anesthesia, even writing a text on the topic, *Local Anesthesia: Its Scientific Basis and Practical Use*. Much of his knowledge of the practical application of local anesthesia came from his experiments on himself. Although he was an early proponent of the use and combination of ether and chloroform, Braun was so fond of the local anesthesia that he often undertook extensive facial operations using local anesthesia only. He was the first to use procaine in the clinical setting, and has been deemed the Father of Local Anesthesia.

4. **Center-Edge (CE) angle of Wiberg**: It has been shown that adults with acetabular dysplasia eventually develop degenerative arthrosis of the hip, but when there is
no subluxation present, it is not possible to predict if the degenerative disease will result at an early or late age. Nevertheless, these patients are subject to DJD of the hip. One measures the CE angle by dropping a vertical line to the center of the femoral head and another line from the center of the head to the lateral margin of the acetabulum. When this angle measures less than 20°, there is dysplasia; 25° and above is normal; and 20-24° is borderline.

**Gunnar Wiberg** (1902-1988) was a Swedish orthopedist who was a leader in many societies, associations, and medical entities. He was a spokesman for orthopedics internationally and an advocate for transfer of fracture patients to the orthopedics service when appropriate. Not only did he research hip dysplasia but he published studies on the patella and had a special interest in back and hip surgery.

He was an avid tennis player until shortly before his death. He had skill in carpentry, especially 18th century style chests of drawers. He started and funded a research fund for the orthopedics department he chaired from the proceeds from sales of wooden operating clogs he designed.

5. **Femoro-Tibial (Knee) Joint Space**: If one needs an absolute measurement, the medial knee joint space is abnormal if less than 3 mm. However, asymmetry with the contralateral knee is often a very useful finding and has been a mainstay for surgeons for decades. Hence, the AP and Rosenberg views are often performed with both knees on one image. The latter view is a PA view with the knee flexed 45°, and by definition includes both knees. Another rule is in common use: the lateral joint space should be approximately one and one-half times the width of the medial joint space.

6. **Hallux Valgus**: Hallux valgus is a very common painful condition of the foot. To accurately evaluate for hallux valgus, one must obtain **weightbearing** radiographs. The angle formed between the longitudinal axes of the first metatarsal and the great toe proximal phalanx is normally less than or equal to 15°. One should grade hallux valgus as mild (16-25°), moderate (26-35), or severe (>35). The first intermetatarsal angle, the angle between the axes of the first and second metatarsals, is normally less than 10°.

7. **Hip Joint Spaces**: Several studies, including those by Pogrund et al. and Armbruster et al., have documented the normal width of the hip joint space on radiographs. The average width of the joint is 4 mm superiorly, 4 mm axially (superiomedially), and 8-9 mm medially to the teardrop. The space does not normally diminish with age, and 3 mm is the lower limit of normal.
8. **Patella Alta**: In 1971, John Insall and Eduardo Salvati turned their exasperation with the current cumbersome and/or inaccurate methods for defining patella alta (high-riding patella) into a study. Their principle aim was to be able to determine when patellar realignment surgery for subluxating patellae should include a degree of “distalization [my term].” From lateral radiographs of 114 knees, they determined that the patellar ligament should be equal in length to the diagonal (longest) length of the patella on a lateral view, with no more than 20% difference between the two. Hence was born the Insall-Salvati ratio. Grelsamer and Meadows later became discouraged with the accuracy of the Insall-Salvati ratio in the setting of patellae with large, non-articulating inferior poles. From a similar study, they coined the modified Insall-Salvati ratio. The numerator for this ratio is the distance from the tibial tubercle (insertion of patellar ligament) to the inferior margin of the patellar articular surface. The denominator is the length of the patellar articular (dorsal) surface. This modified ratio should be less than two. These latter authors suggested both ratios be used in any given knee radiograph.

9. **Symphysis Pubis Width**: In a study of normal male and female radiographs of the pelvis (200 each), Vix and Ryu determined that normal was 5.9 mm +/- 1.3 mm, and in females, the normal range was 4.9 +/- 1.1 mm. Hence, a measurement less than 7 mm is quite likely normal.

10. **Tonnis Angle**: Another angle to determine acetabular dysplasia, one measures this by drawing a horizontal line laterally from the medial edge of the weight bearing portion of the acetabulum (at the top of the cotyloid notch) and a second line from this point out to the lateral edge of the acetabulum. Normal is less than 10°. When the angle is greater, the acetabulum is too steep. I have no idea who Tonnis was.

### SPINE

**Names**:

1. **Chance Fracture**: The original description of this injury was a purely osseous injury. Termed a seat-belt injury, this injury occurs when there is flexion of the spine with the fulcrum of the force in the anterior abdominal wall, such as when one abruptly stops a vehicle with a lap-belt in place. This causes distraction of the posterior and middle, and possibly anterior, columns of the spine, creating an unstable injury. A true Chance fracture consists of a horizontal splitting of the posterior elements and vertebral body; purely ligamentous and disc, and mixed soft tissue and osseous versions are now commonly lumped under the name Chance fracture. These injuries typically occur at the thoracolumbar junction or in the upper lumbar spine. When the anterior ligaments are also injured, this
injury may be a fracture-dislocation, carrying a higher incidence of neurological injury. With these fractures, one must always be alert to the high likelihood of injury to the bowel and other abdominal viscera.

**George Quentin Chance** was a British radiologist. In 1948, he described in detail the lumbar fracture pattern that bears his name. He recognized these injuries as unstable fractures, and commented, “When flexion of the spine exceeds normal limits something has to give way.”

2. **Jefferson Fracture**: Burst fractures of the C1 vertebra (atlas) have a very recognizable appearance on radiographs. On the open-mouth odontoid view, there is lateral displacement/splaying of both C1 lateral masses relative to the lateral masses of the axis (C2). On a lateral view, at least one fracture of the posterior arch of the atlas should be evident. These fractures are distinguished from hyperextension posterior arch fractures by the splayed lateral masses and pre-vertebral soft tissue swelling that always accompany Jefferson fractures. The C1 ring may be broken in two, three, or four places, but there must be disruption of both the anterior and posterior arches. The mechanism of injury is an axial load to the cranium, whether from a fall on the head, longitudinal projection from a motor vehicle collision, or an object striking the vertex. C1 lateral mass fractures, dens fractures, and distant cervical spine fractures are often present, as well as partial or complete rupture of the transverse ligament.

**Sir Geoffrey Jefferson** (1886-1961), an English neurologist and neurosurgeon, first reported a series of fractures of the atlas in 1920. His report included two fractures in patients and two museum specimens with C1 fractures. He also reviewed the other 42 cases of fracture of the atlas reported in the literature at the time and made certain observations about the clinical course and associated fractures. The fractures were not limited to the burst fracture of C1 that now bears his name but included posterior arch fractures, anterior arch fractures, and lateral mass fractures. He correctly deduced, by history and anatomic observations, the mechanism of injury resulting in the burst fracture and also opined about the possibility that extreme hyperextension may lead to isolated C1 neural arch fractures. Other pertinent observations were that the dens is the most common site if a second fracture exists and that death was more common in cases of multiple fractures than in cases with isolated C1 injuries.

Interestingly, the first patient described in his report was a pilot in the R.A.F. who flew his aircraft “into a bank of telegraph wires on a misty morning…travelling at about 120 miles an hour. He remembers seeing pieces of propeller, wing, and strut fly past him, and then nothing more. It appears that he was thrown out of the plane, and fell some distance on to his head.”
Jefferson served in a hospital at the eastern front at Petrograd, gaining skill in training gunshot victims. He was kept busy: in one week in 1916, he treated 340 soldiers and performed 33 major operations!

**Numbers:**

1. **Lumbar Spine Canal Sagittal Diameter:** As of yet, I have been unable to find a cross-sectional study that evaluates the normal sagittal diameter of the lumbar spinal canal. In 1965, Hinck et al. performed a study of adults and varying ages of children. They examined the lateral radiographs of normal spines. They determined that “…any lumbar sagittal diameter below 15 mm or above 25 mm should be regarded with suspicion.”

**SELECTED REFERENCES**