Enclosed referenced case studies were obtained under the approved IRB research study by:

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Outline: Case Studies for PedCat from CurveBeam, LLC.

By Kent A. Feldman, DPM

The case studies selected are clinical and radiographic diagnostic challenges. The majority of case studies either have normal x-rays or x-rays that are suspicious for pathology, yet inconclusive.

Section 1: Foot Fractures

Case Study A: Acute Sesamoid Fractures

Case Study B: Charcot Neuropathic Anterolateral Calcaneal Fracture

Case Study C: Medial Navicular Tuberosity Fracture

Section 2: Foot Fracture Non-Unions

Case Study D: Fifth Metatarsal Styloid Process Avulsion Fracture Non-Union

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Section 3: Foot Subluxations and Dislocations

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Case Study I: Calcaneo-Navicular Tarsal Coalition + Cuboid-Navicular Coalition

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Case Study O: Bunionectomy Pre-Surgical Planning with Contraindication

Section 7: Detection of Osteomyelitis
Case Study P: Early detection of loss of bone cortex
Case Study Q: Early detection of loss of bone contour

Summary
Section 1: Foot Fractures

Case Study A: Sesamoid Fracture(s)

Clinical History: C.E. a 30 year old male sustained an acute injury to the right great toe and sesamoids while playing soccer. He sustained a hyperdorsiflexion / extension injury to the great toe. Upon presentation his first metatarsophalangeal joint was swollen and ecchymotic. The patient was tender upon palpation of the great toe joint and the sesamoid bones.

X-Ray Findings: (Figure 1) AP and Lateral non-weight bearing x-rays of the right foot demonstrated an obvious medial sesamoid fracture with displacement. The lateral sesamoid demonstrated a lucency suggestive, but not confirmative, for a fracture. A sesamoid axial radiograph did not provide any diagnostic benefit as the patient was unable to extend his great toe.

Case A (Figure 1): AP radiograph of medial sesamoid fracture and suspicious lateral sesamoid.

PedCat CBCT Findings: (Figure 2 & 3) The 2-dimensional reconstruction views/sections in the transverse plane clearly document a severely displaced right medial sesamoid oblique fracture and minimally displaced lateral sesamoid fracture. On the sagittal 2-dimensional reconstruction views / sections, the oblique lateral sesamoid fracture demonstrates 2mm of plantar displacement with excellent bony contact/apposition in the dorsal 4mm of the sesamoid.
Case A (Figure 2): PedCat CBCT transverse plane reconstruction demonstrating medial and lateral sesamoid fractures.

Case A (Figure 3): PedCat CBCT sagittal plane reconstruction of lateral sesamoid fracture displacement.

Clinical Relevance of the PedCat Study: The plain radiographs clearly demonstrated the medial sesamoid fracture, thus the PedCat did not alter the treatment course for treating the medial sesamoid. The plain radiographs were suggestive of a lateral sesamoid injury and the PedCat study clearly documented the lateral sesamoid fracture. Yet of even greater significance, the PedCat was able to provide diagnostic information regarding the geometric nature of the lateral sesamoid fracture. I could determine that there was enough bony contact to allow for bone healing with appropriate conservative care management.
Case Study B: Charcot Neuropathic Anterolateral Calcaneal Fracture

Clinical History: C.Y. a 60 year old female with severe diabetic neuropathy and a prior history of right foot Charcot neuropathic fractures presents complaining of a recent onset of left foot and ankle swelling. She had increased weight bearing activities during the holiday shopping season. She complains of a dull ache in the left lateral rearfoot. There is no history of a recognized acute injury.

X-Ray Findings: (Figures 1 & 2) AP, Medial Oblique and Lateral x-rays of the left foot demonstrate a previously fused hallux interphalangeal joint. The 3 views of the rearfoot are negative for fracture or dislocation.

Case B (Figure 1): Lateral radiograph of left foot. No evidence of fracture.
Case B (Figure 2): Medial oblique radiograph, no evidence of fracture.

PedCat CBCT Findings: (Figures 3 & 4) The 2-dimensional reconstruction views in the sagittal and coronal planes clearly demonstrate a minimally displaced (1mm) anterolateral calcaneal fracture. The fracture is also clearly demonstrated in the 3-dimensional reconstruction.

Case B (Figure 3): PedCat CBCT sagittal reconstruction of anterolateral calcaneal fracture.
Case B (Figure 2): PedCat CBCT frontal plane reconstruction of anterolateral calcaneal fracture.

Clinical Relevance of the PedCat Study: Without advanced diagnostic imaging, such as computed tomography or MRI, the appropriate diagnosis would not have been obtained. Thus appropriate care would not have been rendered. The PedCat study was of great benefit as it allowed for rapid diagnosis and treatment. The patient was diagnosed in office and she was immobilized and made non-weight bearing immediately allowing for fracture healing and stopping the progression of the Charcot pathology.

Case Study C: Navicular Tuberosity Fracture

Clinical History: M.H. a 45 year old female presents 2 months status post left foot and ankle eversion injury. She presents complaining of pain over the left medial navicular. Radiologists diagnosed her with a medial navicular fracture based upon x-rays and MRIs. The treating orthopedic surgeon diagnosed her with a symptomatic accessory navicular. Upon receiving P.T. her foot became more tender and she was referred for second opinion.

X-Ray Findings: AP, Medial Oblique, Lateral Oblique and Lateral views of the left foot demonstrate an enlarged medial tuberosity to the navicular. Fractures are not readily visible.

MRI Findings: The MRI radiologists noted edema within the medial navicular suggestive of fracture. The radiologist also noted the separation between the medial tuberosity of the navicular and primary navicular was irregular in nature with greater gapping distally than proximally. The radiologist concluded that this was enough evidence to diagnose a fracture rather than an accessory navicular.

PedCat CBCT Findings: (Figures 1, 2 and 3) The reconstructed views in all three planes document a medial navicular tuberosity fracture. The fracture is minimally displaced (gapped) distally with bony apposition proximally. The angular/ geographic nature of the fracture line
confirms the diagnosis of fracture as compared to differential diagnosis of an accessory navicular.

Case C (Figure 1): PedCat 3-D reconstruction of medial navicular tuberosity fracture.

Case C (Figure 2): PedCat CBCT transverse plane reconstruction of medial navicular tuberosity fracture.
Case C (Figure 3): PedCat CBCT sagittal plane reconstruction of navicular tuberosity fracture.

Clinical Relevance of the PedCat Study: Rather than being treated with physical therapy for a symptomatic accessory navicular, the patient was immobilized to facilitate bony healing.

Section 2: Foot Fracture Non-Unions

Case Study D: Styloid Process Fracture Non-Union

Clinical History: A 75 year old female, with a chronic pain syndrome (CRPS), presents complaining of an inversion injury to her left foot. Based upon the clinical exam and x-rays she was diagnosed with a left styloid process avulsion fracture. She was treated in an orthopedic walker boot for 3 months. As she had continued pain a CBCT study was performed documenting a styloid process fracture without bony healing. She was diagnosed with a fracture non-union. She was then treated with a bone growth stimulator and bony union was documented via CBCT.

X-Ray Findings: (Figures 1 & 2) The initial x-rays documented the styloid process avulsion fracture. Later x-rays could not distinguish between a partial union versus a non-union.
Case D (Figure 1): Medial oblique radiographs of styloid process fracture non-union

Case D (Figure 2): AP radiograph of styloid process fracture non-union.
CBCT Findings: (Figures 3 & 4) The reconstructed views in the transverse and sagittal planes demonstrate a displaced styloid process fracture that had not healed in 3 months confirming the diagnosis of a non-union. The fracture gap is most pronounced along the plantar margin with bony contact, but not bony bridging dorsally.

Case D (Figure 3): PedCat CBCT sagittal plane reconstruction of styloid process fracture non-union.

Case D (Figure 4): PedCat CBCT transverse plane reconstruction of styloid process fracture non-union.
Clinical Relevance of PedCat Study: The diagnosis of non-union was made thus directing definitive treatment: immobilization and the use of a bone growth stimulator. Bony union was documented 8 weeks later.

Case Study E: First Metatarsal Head Osteotomy Fracture Non-Union

Clinical History: R.Z. a 52 year old female, 6 months status post bunionectomy with metatarsal head osteotomy, presents complaining of persistent surgical pain.

X-Ray Findings: (Figures 1 & 2) AP and lateral radiographs demonstrate evidence of a prior first metatarsal head osteotomy. Lateral displacement of the first metatarsal head is noted on the AP view. There is a small cortical defect in the dorsal margin of the first metatarsal head, best seen on the lateral view. Thus the differential diagnosis includes partial union vs. non-union.

Case E (Figure 1): AP radiograph of suspected metatarsal head osteotomy non-union.
Case E (Figure 2): Lateral radiograph of suspected metatarsal head osteotomy non-union.

PedCat CBCT Findings: (Figures 3, 4 & 5) The 2-dimensional reconstruction views in the sagittal and transverse plane demonstrate a persistent fracture / osteotomy line within the first metatarsal head consistent with the diagnosis of fracture non-union. This is confirmed with the 3-dimensional reconstruction views.

Case E (Figure 3): PedCat CBCT transverse plane reconstruction of first metatarsal head osteotomy non-union.
Case E (Figure 4): PedCat CBCT sagittal plane reconstruction of first metatarsal head osteotomy non-union.

Case E (Figure 5): PedCat CBCT 3-D reconstruction of metatarsal head osteotomy non-union.

Clinical Relevance of the PedCat Study: The accurate diagnosis of non-union was made allowing for definitive care: Immobilization and use of a bone growth stimulator.
Section 3: Foot Subluxations and Dislocations

Case Study F: Lisfranc’s Midfoot Dislocation

Clinical History: J.K. a 28 year old female presents complaining of a painful right foot. She sustained an acute right foot injury 2 weeks prior to presentation. She is unable to bear weight on the right foot. She has been previously treated, on two occasions, by an urgent care. Two previous sets of x-rays were negative for fracture or dislocation. Her right foot is grossly swollen and ecchymotic.

X-Ray Findings: As the patient’s foot appeared to have sustained a severe acute injury non-weight bearing AP, Medial Oblique and Lateral views were obtained. All views were negative for fracture or dislocation.

PedCat CBCT Findings: (Figures 1, 2, 3 & 4) Since the plain radiographs were negative for fracture and since the suspicion for dislocation was elevated based upon the history and exam, a weight bearing CBCT study was performed. The 2-dimensional reconstruction transverse plane views demonstrate a classic Lisfranc’s midfoot dislocation: there is an avulsion fracture fragment between the medial cuneiform and the second metatarsal base, a 6mm diastasis between the medial cuneiform and the second metatarsal base, and a 2mm lateral shift of the second metatarsal base on the second cuneiform. The sagittal plane views demonstrate a dorsal subluxation / dislocation of the first metatarsal on the medial cuneiform. The sagittal, coronal, and transverse plane 2-dimensional reconstructions demonstrate avulsion fractures over the third metatarsal-cuneiform and fourth metatarsal-cuboid articulations. The 3-dimensional reconstruction confirms each of the 2-dimensional findings.

Case F (Figure 1): PedCat CBCT 3-D reconstruction of LisFranc midfoot dislocation.
Case F (Figure 2): PedCat 3-D reconstruction of 3rd cuneiform avulsion fracture.

Case F (Figure 3): PedCat transverse plane reconstruction of LisFranc fracture dislocation with cuboid avulsion fracture.
Case F (Figure 4): PedCat CBCT transverse plane reconstruction of diastasis between medial cuneiform and second metatarsal base with avulsion fracture.

Clinical Relevance of the PedCat Study: The study was diagnostic for the Lisfranc’s midfoot dislocation. The non-weight bearing x-rays were read as negative on 3 previous occasions. The PedCat study demonstrated the anatomic severity of the injury to both patient and physician. The study also was critical in developing a surgical plan.

Case Study G: Old Lisfranc’s Midfoot Fracture Dislocation with Chronic Arthritis

Clinical History: L.T. presents 2 years following a midfoot “sprain”. She has had chronic midfoot pain and swelling. She demonstrates a swollen midfoot with an increased bony diameter. She is tender with palpation of the tarsometatarsal joints.

X-Ray Findings: Weight bearing radiographs demonstrate slight joint space narrowing of the tarsometatarsal joints. Mild periarticular spurs are present. There is a suspicious diastasis between the lateral margin of the medial cuneiform and the medial margin of the second metatarsal base.

PedCat CBCT Study (Figures 1 & 2): The sagittal plane reconstruction demonstrates the lateral displacement of the second metatarsal base on the second cuneiform. There is a large intra-articular fracture fragment at the medial margin of the second metatarsal base. A diastasis is noted between the medial cuneiform and the second metatarsal base. The second and third tarsometatarsal joints demonstrate joint space narrowing and subchondral cysts.
Case G (Figure 1): PedCat CBCT chronic Lisfranc dislocation with post-traumatic arthritis.

Second metatarsal base avulsion fracture.

Case G (Figure 2): PedCat CBCT transverse plane reconstruction documenting chronic Lisfranc dislocation, lateral subluxation of second metatarsal cuneiform joint, diastasis between medial cuneiform and second metatarsal, joint space narrowing with bone cysts.
Clinical Relevance of the PedCat Study: The study demonstrates the malalignment of the tarsometatarsal joints and the severe post-traumatic degenerative changes through the midfoot. Palliative treatment will be rendered but the patient requires a midfoot fusion.

Case Study H: Lisfranc’s Midfoot Fracture Dislocation

Clinical History: B.Y. is a police officer who sustained a midfoot injury during an altercation. She presents complaining of midfoot pain. Previous exams performed by urgent care providers were negative for fractures or dislocations. She was diagnosed with a midfoot sprain.

X-Ray Findings: Non-weight bearing x-rays were read as negative. Thus the weight bearing PedCat study was performed.

PedCat CBCT Findings (Figures 1 & 2): The 3-D reconstruction of the bilateral feet demonstrated asymmetry between the tarso-metatarsal joints. The left foot demonstrates anatomic alignment of the tarso-metatarsal joints. The right foot demonstrates a diastasis between the second metatarsal base and the second cuneiform. The sagittal plane reconstructions demonstrate similar findings with a diastasis between the second metatarsal base and the medial cuneiform.

Case H (Figure 1): PedCat CBCT bilateral 3D reconstruction demonstrating right midfoot Lisfranc dislocation / subluxation.
Case H (Figure 2): PedCat CBCT transverse plane reconstruction of right Lisfranc midfoot dislocation compared to normal left foot.

Clinical Relevance of the PedCat Study: The weight bearing CBCT study provided the structural evidence to diagnose the patient with a Lisfrancs midfoot dislocation. The study aided in the diagnosis and was utilized for presurgical planning.

Section 4: Tarsal Coalitions

Case Study I: Calcaneo-Navicular and Cuboid-Navicular Coalition

Clinical History: L.S. is a 70 year old female who has been asymptomatic her entire life. She went for a 2 mile walk on the soft sand at the beach. Her right foot became swollen following the walk. She presents complaining of right foot pain and swelling.

X-Ray Findings: (Figures 1 & 2) The weight bearing AP, Medial Oblique and Lateral views demonstrate mild degenerative changes to the talo-navicular joint. There is a large anterolateral process of the calcaneus that extends upward and medial towards the navicular. These are suspicious findings suggestive of a calcaneo-navicular coalition.
Case I (Figure 1): Medial oblique radiograph of suspected calcaneo-navicular coalition.

Case I (Figure 2): Lateral radiograph of suspected calcaneo-navicular coalition.
PedCat CBCT Findings: (Figures 3, 4 & 5) The sagittal, transverse, and frontal plane reconstruction views demonstrate a narrow and irregular gap between the anterolateral process of the calcaneus and the navicular consistent with the diagnosis of a fibrous or cartilaginous calcaneo-navicular coalition. More surprising, the transverse plane view identified a cuboid-navicular coalition.

Case I (Figure 3): PedCat CBCT sagittal plane reconstruction of fibrous / cartilaginous calcaneo-navicular coalition.

Case I (Figure 4): PedCat CBCT transverse plane reconstruction demonstrating fibrous / cartilaginous calcaneo-navicular coalition.
Case I (Figure 5): PedCat CBCT transverse plane reconstruction demonstrating calcaneo-navicular and cuboid-navicular coalitions.

Clinical Relevance of the PedCat Study: The findings were significant as the calcaneo-navicular coalition was confirmed, but more importantly, without the PedCat study the cuboid-navicular coalition would not have been diagnosed.

Case Study J: Talocalcaneal middle facet coalition

Clinical History: 45 year old male presents complaining of medial foot and ankle pain. He has had very flat feet his entire life. Conservative care management included ice, NSAIDs, rest, custom foot orthotics and cortisone injections into an arthritic talonavicular joint.

X-Ray Findings: AP, Medial Oblique and Lateral weight bearing views of both feet demonstrated talar head beaking / spurring consistent with the diagnosis of tarsal coalition. The medial oblique view ruled out calcaneonavicular coalition. There was a great deal of bony superimposition between the talus and calcaneus on the lateral view due to severely pronated feet. Thus a talocalcaneal coalition could not be ruled in or out.

PedCat CBCT Findings (Figures 1 & 2): The 2-dimensional reconstruction views in the frontal, sagittal and transverse planes all demonstrate a fibrous or cartilaginous coalition of the middle facet of the subtalar joint (talocalcaneal). The 2-dimensional reconstruction views also demonstrate large bone cysts in the talar heads with talar head beaking and talonavicular joint degenerative joint disease.
Case J (Figure 1): PedCat CBCT sagittal plane reconstruction of middle facet talocalcaneal coalition.

Case J (Figure 2): PedCat CBCT sagittal plane reconstruction of middle facet talocalcaneal coalition.
**Clinical Relevance of the PedCat Study:** Based upon the clinical exam and radiographs the clinical suspicion for tarsal coalition was elevated. A CT or MRI study was indicated to identify the tarsal coalition. The PedCat study successfully identified the coalition and the talar bone cysts. As an added benefit was the weight bearing status. The alignment of the foot bones, in a weight bearing position, is critical to pre-operative and intra-operative surgical planning.

**Section 5: Foot Bone Tumors**

**Case K: Fourth Toe Enchondroma**

**Clinical History:** H.J. was referred for specialty care. She had been diagnosed by a radiologist with a pathologic 4th toe fracture due to a suspected enchondroma.

**X-Ray Findings (Figure 1):** The AP and Lateral digital (toe) x-rays demonstrate widening of the 4th toe proximal phalangeal midshaft with thinning and fracture of the cortices. A radiolucent bone tumor is present with central calcification.

*Case K (Figure 1): AP radiograph of suspected enchondroma right 4th toe.*
PedCat CBCT Findings (Figures 2 & 3): The sagittal and transverse plane reconstructions demonstrate the dilation or expansion of the proximal phalangeal mid shaft with thinning of the cortical margins. The pathologic fractures are visualized as well. The central calcification is also documented.

Case K (Figure 2): PedCat CBCT transverse plane reconstruction of suspected enchondroma right 4th toe.

Case K (Figure 3): PedCat CBCT sagittal plane reconstruction of suspected enchondroma right 4th toe.
Clinical Relevance of the PedCat Study: In many ways the PedCat study confirmed radiographic findings. With the measuring tools embedded in the DICOM viewing software it was possible to gauge the thickness of the remaining cortical walls. The measuring tools, plus the images, allowed me to determine the amount of bone graft needed to fill the defect. The PedCat images also assisted in developing strategies for fixating the fracture.

Section 6: Preoperative Planning

Case Study L: Fourth Metatarsalgia Following Second and Third Stress Fractures

Clinical History: D.S. presented in 2010 with second and third metatarsal stress fractures. She also had a severe bunion deformity. As she was going to be restricted in her activities to manage her stress fracture she had a concurrent bunionectomy with metatarsal base osteotomy. One year later she re-fractured her second and then her third metatarsal. She presents complaining of pain secondary to the fractures and pain beneath the 4th metatarsal.

X-Ray Findings: (Figures 1 & 2) The AP and Lateral weightbearing x-rays demonstrated the retained hardware in the first metatarsal base. The x-rays also document the second and third metatarsal stress fractures and bone callous. However, it is difficult if not impossible to identify the relative weight bearing position of the second, third and fourth metatarsals to one another or to the weight bearing surface.
Case L (Figure 1): AP radiograph of 2\textsuperscript{nd} and 3\textsuperscript{rd} metatarsal stress fractures. Preoperative planning for 4\textsuperscript{th} metatarsal head osteotomy.

Case L (Figure 2): Lateral radiograph of 2\textsuperscript{nd} and 3\textsuperscript{rd} metatarsal stress fractures. Preoperative planning for 4\textsuperscript{th} metatarsal head osteotomy.
PedCat CBCT Findings: (Figures 3, 4 and 5) The sagittal plane weight bearing reconstruction images, in addition to the DICOM viewing software, allow for measurements from the weight bearing surface to the inferior margins of the individual metatarsal heads. Thus the actual sagittal plane position of each metatarsal can be identified and measured.

Case L (Figure 3): PedCat CBCT sagittal plane reconstruction view of 2\textsuperscript{nd} metatarsal position to the ground.

Case L (Figure 4): PedCat CBCT sagittal plane reconstruction view of the 3\textsuperscript{rd} metatarsal position to the ground.
Case L (Figure 5): PedCat CBCT sagittal plane reconstruction view of the 4th metatarsal position to the ground.

Clinical Relevance of the PedCat Study: The sagittal plane measurements allows for preoperative surgical planning to calculate the amount of fourth metatarsal elevation is needed to restore an even metatarsal parabola.

Case Study M: Preoperative Evaluation of Post-Traumatic Midfoot Arthritis

Clinical History: M.K. sustained a gunshot wound, surgical debridement and infection to his midfoot 15 years ago. He presents complaining of increasing midfoot pain. Conservative care options have failed to control his midfoot pain.

X-Ray Findings: (Figures 1 & 2) The AP and Lateral weight bearing views of the left foot demonstrate radiodense particles in the midfoot secondary to the gunshot injury. The AP view shows mild narrowing of the second metatarsal cuneiform joint. The lateral view demonstrates dorsal spurs overlaying the midfoot. However the lateral view cannot identify whether the second, third or fourth metatarsal tarsal joints are involved.
Case M (Figure 1): AP x-ray preoperative planning for midfoot fusion.

Case M (Figure 2): Lateral x-ray preoperative planning for midfoot fusion.

**PedCat CBCT Findings:** (Figures 3, 4 & 5) The 3-D reconstruction demonstrates the bone spurs overlaying the second metatarsal cuneiform joint in addition to a narrow and irregular joint space. The 3-D view also demonstrates arthritic changes to the third tarsometatarsal joint. This is confirmed on the sagittal plane reconstruction views of the second metatarsal cuneiform joint. Both the second and third tarsometatarsal joints demonstrate joint space narrowing, periarticular spurs and subchondral cysts. The 4th tarsometatarsal joint is within normal limits.
Case M (Figure 3): PedCat CBCT 3D reconstruction demonstrating 2\textsuperscript{nd} and 3\textsuperscript{rd} metatarsocuneiform joint post-traumatic arthritis.

Case M (Figure 4): PedCat CBCT sagittal plane reconstruction of arthritic 2\textsuperscript{nd} tarsometatarsal joint.
Case M (Figure 5): PedCat CBCT transverse plane reconstruction of arthritic 3rd metatarsal cuneiform joint.

Clinical Relevance of the PedCat Study: The weight bearing aspect of the PedCat study demonstrates the functional alignment of the tarsometatarsal joints. Without weight bearing load the midfoot joints might not have been as narrow (bone on bone). The CBCT study clearly demonstrated the location of the arthritis and the level of severity. Thus the appropriate joints would be surgically corrected.

Case Study N: Hallux Rigidus Preoperative Planning

Clinical History: J.S. is 5 years status post right first metatarsal head decompression osteotomy and cheilectomy for the treatment of hallux rigidus. She presents complaining of recurrent stiffness and pain in the great toe joint.

X-Ray Findings: (Figures 1 & 2) The AP and Lateral weight bearing views demonstrate severe arthritis of the first metatarsophalangeal joint. There is loss of joint space and periarticular spurs.
Case N (Figure 1): AP x-ray of arthritic great toe joint.

Case N (Figure 2): Lateral radiograph of great toe arthritis.

**PedCat CBCT Findings:** (Figures 3 & 4) The transverse plane and sagittal plane reconstruction view of the great toe joint demonstrate very large bone cysts in the phalangeal base and the metatarsal head.
Case N (Figure 3): PedCat CBCT transverse plane reconstructions demonstrating bone cysts in the first metatarsal head and proximal phalangeal base.

Clinical Relevance of the PedCat Study: By identifying the size and location of the cysts, the surgical options were modified. Without identifying the cysts, the options included joint replacement or fusion. Once the cysts were identified, the procedure of choice is fusion. The PedCat study identifies the need to bone graft the cysts, at the time of fusion, and helps in identifying the most appropriate means of surgical fixation.
Case Study O: Bunionectomy Pre-Surgical Planning with Contraindication

Clinical History: C.J. presents with many podiatric concerns. While traveling in Europe she increased her daily amount of walking. When her right foot became sore and swollen she attributed her pain to her rheumatoid arthritis. She secondarily complains of a painful bunion deformity.

X-Ray Findings: (Figure 1) The AP weight bearing view demonstrates a second metatarsal midshaft stress fracture with a large bone callous, yet incomplete bony healing. The AP view also demonstrates a moderate hallux valgus and bunion deformity and rheumatoid periarticular erosion of the fifth metatarsophalangeal joint.

Case O (Figure 1): AP radiograph demonstrating bunion deformity, second metatarsal stress fracture and rheumatoid erosions of 5th metatarsophalangeal joint.

PedCat CBCT Findings: (Figures 2 & 3) The transverse and sagittal plane reconstruction images demonstrate a large bone cyst involving the majority of the first metatarsal head.
Case O (Figure 2): PedCat CBCT transverse plane reconstruction demonstrating a large bone cyst encompassing the majority of the first metatarsal head a contraindication for a metatarsal head osteotomy.

Case O (Figure 3): PedCat CBCT sagittal plane reconstruction demonstrating first metatarsal head cyst.

**Clinical Relevance of PedCat Study:** Without identifying the first metatarsal head cyst a first metatarsal head osteotomy would be the procedure of choice. However, such a procedure would be contraindicated with such a large cyst. A more appropriate procedure would be to debride and bone graft the cyst in addition to performing a proximal osteotomy or fusion.
Section 7: Detection of Osteomyelitis

Case Study P: Early detection of loss of bone cortex

Clinical History: P.M., ID# 2011-21. 61 y.o. white male with DM x 10 yrs. Examination shows an open wound with an exposed 5th metatarsal head.

X-Ray Findings: Plain x-rays were inconclusive for osteomyelitis.

PedCAT CBCT Findings (Figures 1, 2 & 3): Loss of cortex of the 5th metatarsal head. The findings on the PedCAT clearly demonstrate loss of bone cortex and erosions of the cortex that are consistent with acute osteomyelitis of the 5th metatarsal head.

Case P (Figure 1): Loss of cortex of the 5th metatarsal head, axial slice.

Case P (Figure 2): Loss of cortex of the 5th metatarsal head, coronal slice.
**Case P (Figure 3):** Loss of cortex of the 5\textsuperscript{th} metatarsal head, sagittal slice.

**Case Study Q: Early detection of loss of bone contour**

**Clinical History:** E.M., ID # 2011-22. 48 y.o. white female with DM x 10 yrs. Presented with an ulcer on the lateral side of her 4\textsuperscript{th} proximal interphalangeal joint of the right foot that has been present for 2 months. The ulcer was deep and probed close to bone.

**X-Ray Findings:** Plain x-rays were inconclusive for osteomyelitis.

**PedCAT CBCT Findings (Figures 1, 2 & 3):** Disruption of the cortex on the dorsal lateral aspect of the head of the proximal phalanx of the 4\textsuperscript{th} toe of the right foot. Loss of bone contour as seen in Figures 1, 2 & 3.

**Case Q (Figure 1):** Loss of bone contour on the dorsal lateral aspect of the head of the proximal phalanx of the 4\textsuperscript{th} toe, right foot, axial slice:
Case Q (Figure 2): Loss of bone contour on the dorsal lateral aspect of the head of the proximal phalanx of the 4th toe, right foot, coronal slice:

Case Q (Figure 3): Loss of bone contour on the dorsal lateral aspect of the head of the proximal phalanx of the 4th toe, right foot, sagittal slice:
SUMMARY

When diagnostic imaging is performed the practitioner is evaluating many facets of bone and/or joint health. Examples include whether a bone is fractured or not. If a fracture is present what is the anatomic location of the fracture? What are the size and relative position of the fracture fragments? Does the fracture extend into joint surfaces? The PedCat case studies presented answer each of these questions. Fractures are visualized including their anatomic location, the number of bony fragments, the orientation of the bone fragments and whether the fracture is intra-articular or not.

It is also important to document the stages of bony healing. Is a bony union present? A malunion? Or perhaps a partial union? The non-union case studies demonstrate the PedCat’s ability to image bony bridging or the lack of bony bridging.

Another indication for advanced imaging is to determine the relationship of one bony structure to another. Due to the PedCat’s ability to image feet and ankles in a weight bearing position, the practitioner has the ability to see the anatomic alignment of joints under physiologic load. This is ideal for the evaluation of midfoot subluxations and dislocations. The case studies presented demonstrate the alignment, or malalignment of the tarsometatarsal joints.

It is also important to assess whether there have been congenital malformations in which proper bony segmentation did not occur (tarsal coalitions). The PedCat images were able to identify both bony coalitions as well as fibrous / cartilaginous coalitions.

With many arthritic conditions the joint spaces are lost, marginal bone spurs occur and periarticular cysts develop. The PedCat can easily identify the “bone on bone” contact of severe osteoarthritis and allow for visualization and measurement of the joint space width. In the cases provided both normal joint spaces are visualized and documented as well as severely arthritic joints without adequate joint spaces.

Prior to my personal use of the PedCat, under the IRB Study, I was unaware of the severity and frequency of bone cysts. In the studies provided cysts were noted in the metatarsal heads, the metatarsal bases and in the talar head. The PedCat also documented marginal erosions of the metatarsal head consistent with the diagnosis of rheumatoid arthritis. The PedCat was also diagnostic in the evaluation of one bone tumor. Many times bony erosions are a reflection of osteomyelitis. The PedCat has documented early cortical erosions allowing for early detection of osteomyelitis.

And lastly, as a foot and ankle surgeon, the images provided by the PedCat were not only diagnostic, the studies are very beneficial for surgical planning. To my knowledge there are no other weight bearing computed tomography devices. The PedCat allowed for precise visualization of the bones of the foot without bony superimposition. This allowed for more precise and accurate assessment of the tarsometatarsal joint and the position of the metatarsal heads.