

Planned Verity scientific publications

Hirschmann A, Pfirrmann CW, Klammer G, Espinosa N, Buck FM: Upright Cone CT of the hindfoot: Comparison of the non-weight-bearing with the upright weight-bearing position. *Eur Radiol.* 2013 Sep 26. [Epub ahead of print] doi: 10.1007/s00330-013-3028-2

CONCLUSIONS: Cone-beam computed tomography (CBCT) offers new opportunities for musculoskeletal problems. Visualization and quantification of hindfoot alignment are possible in upright weight-bearing CBCT. Hindfoot alignment changes significantly from non-weight-bearing to weight-bearing CT. The weight-bearing position leads to a decrease in the fibulocalcaneal distance and talocalcaneal overlap. The naviculocalcaneal distance is increased in the weight-bearing position.

Koivisto, J, Kiljunen, T, Wolff, J, and Kortensniemi, M: Assessment of effective radiation dose of an extremity CBCT, MSCT and conventional x ray for knee area using MOSFET dosimeters. *Radiat. Prot Dosimetry Advance Access published July 3, 2013*, doi: 10.1093/rpd/nct162

CONCLUSIONS: Planned Verity effective dose is 12.6 μ Sv for a knee scan with total dose 4-7 times lower than MDCT, and 4 times higher than planar radiography. Taking into account the potential advantages of the CBCT technique, it can be regarded as a low-dose technique for 3D knee assessment.

Collan, L, Kankare, JA, Mattila, K: The biomechanics of the first metatarsal bone in hallux valgus: A preliminary study utilizing a weight bearing extremity CT. *Foot Ankle Surg.* 19(3), 155-161 (2013), <http://dx.doi.org/10.1016/j.fas.2013.01.003>

CONCLUSIONS: When evaluating hallux valgus, the 3D weight bearing CT might be the only imaging study needed. All relevant data can be obtained in a single study and also rotational changes can be measured accurately. Knowing the rotational status of the first metatarsal bone may also guide the surgeon in the operation room.

Koskinen, SK, Haapamäki, VV, Salo, J, et al. CT arthrography of the wrist using a novel, mobile, dedicated extremity cone-beam CT (CBCT). *Skeletal Radiol.* 42(5), 649–657 (2013). doi: <http://dx.doi.org/10.1007/s00256-012-1516-0>

CONCLUSIONS: A dedicated CBCT extremity scanner is a new method for evaluating the wrist ligaments and radiocarpal cartilage. The method has an overall accuracy of 82–86 % and specificity 81–91 %. For cartilage abnormalities, the accuracy and negative predictive value were high.

Tuominen, EKJ, Kankare, J, Koskinen, SK and Mattila, KT: Technical Innovation: Weight-Bearing CT Imaging of the Lower Extremity. *AJR* January 2013 200:146-148; doi:10.2214/AJR.12.8481

CONCLUSIONS: Cone-beam CT technology with new design and flexible gantry movements allows both supine and weight-bearing imaging of the lower extremities, with a reasonable radiation dose and excellent image quality. Weight-bearing CT of joints can provide important new clinical information in musculoskeletal radiology.

Salo, J., Töyräs, J., Joukainen, A., Jurvelin, J., Kröger, H. (2013): Rustovaurioiden kehittyvä diagnostiikka - nopein hoitotulosia parantava tekijä? *Suomen Ortopedia ja Traumatologia* Vol. 36, 256-261.

CONCLUSIONS: Routine clinical MRI is known to underestimate the area of cartilage and its sensitivity is 65 to 70%. We have tested CBCT accuracy in detecting cartilage defect in clinical patient series. Initial results show 56% detection rate for preoperative MRI and 94% detection rate for CBCT.

Kokkonen, H. T., Suomalainen, J.-S., Joukainen, A., Kröger, H., Sirola, J., Jurvelin, J. S., Salo, J. and Töyräs, J. (2014), In vivo diagnostics of human knee cartilage lesions using delayed CBCT arthrography. *J Orthop Res.* 2014 Mar;32(3):403-12. doi: 10.1002/jor.22521. Epub 2013 Nov 19.

CONCLUSIONS: The delayed CT arthrography provides a novel method for diagnostics of cartilage lesions. Potentially, it can also be used in diagnostics of cartilage degeneration. Due to shorter imaging times, higher resolution and lower cost of CT over MRI, this technique could provide an alternative for diagnostics of knee pathologies.

Matikka, H and Virén, T (2014): Radiation dose reduction in cone-beam computed tomography of extremities: evaluation of a novel radiation shield. Journal of Radiological Protection 34 (2014) N57–N63

CONCLUSIONS: Radiation shielding was found to significantly decrease the absorbed doses in elbow and knee imaging geometries. Furthermore, scattered radiation within the room was significantly reduced near the CT bore. The current results indicate that the radiation shielding should be used to reduce the absorbed dose to all patients, and especially in the case of pediatric or young patients and when multiple scans are taken (i.e. CBCT arthrography).

Koivisto J, Wolff J, Järnstedt J, Dastidar P, Kortenesniemi M. Assessment of the effective dose in supine, prone, and oblique positions in the maxillofacial region using a novel combined extremity and maxillofacial CBCT scanner. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014 Sep;118(3):355-62. doi: 10.1016/j.o000.2014.05.016. Epub 2014 Jun 14.

CONCLUSIONS: Head positioning has an important effect on the organ and effective doses. The Planmed Verity CBCT scanner effective dose results were comparable with those attained on 2 conventional CBCT devices and were considerably lower than the MSCT scanner results.

Colin F, Horn Lang T, Zwicky L, Hintermann B, Knupp M. Subtalar joint configuration on weightbearing CT scan. Foot Ankle Int. 2014 Jul 11. pii: 1071100714540890. Published online 11 July 2014 DOI: 10.1177/1071100714540890.

CONCLUSIONS: To our knowledge, this is the first weightbearing CT study describing the ST joint configuration on an asymptomatic cohort. The CT scans used in our study presented several advantages: the images collected, with patients being in an upright, weightbearing position, resembled the physiological situation of how the ST joint is normally stressed. The image quality of the portable extremity CT scanner was considered excellent, and furthermore, the detail and accuracy of CT provides the best method nowadays for evaluating hindfoot pathology and alignment.

Halonen KS, Mononen ME, Jurvelin JS, Töyräs J, Salo J, Korhonen RK. Deformation of articular cartilage during static loading of a knee joint – Experimental and finite element analysis. J Biomech. 2014 Jul 18;47(10):2467-74. doi: 10.1016/j.jbiomech.2014.04.013. Epub 2014 Apr 16.

CONCLUSIONS: Novel conical beam CT-scanners offer high resolution imaging of knee structures with i.a. contrast media, even under weight bearing. The present results improve understanding of the mechanisms controlling articular cartilage strains and meniscal movements in a knee joint under physiological static loading. Ultimately a validated model could be used as a noninvasive diagnostic tool to locate cartilage areas at risk for degeneration.

Huang AJ1, Chang CY, Thomas BJ, MacMahon PJ, Palmer WE: Using cone-beam CT as a low-dose 3D imaging technique for the extremities: initial experience in 50 subjects. Skeletal Radiol. 2015 Feb 5. [Epub ahead of print]

CONCLUSIONS: Average imaging duration was shorter for CBCT than radiographs (4.5 min vs. 6.6 min) and MDCT (7.6 min vs. 10.9 min). Average estimated effective radiation dose was less for CBCT than MDCT (0.04 mSv vs. 0.13 mSv). CBCT images yielded more

diagnostic information than radiographs in 23/51 cases and more diagnostic information than MDCT in 1/7 cases, although radiographs were superior for detecting hardware complications. CBCT performs high-resolution imaging of the extremities using less imaging time than radiographs and MDCT and lower radiation dose than MDCT.

Koivisto J, Kiljunen T, Kadesjö N, Shi XQ, Wolff J: Effective radiation dose of a MSCT, two CBCT and one conventional radiography device in the ankle region. *Journal of Foot and Ankle Research* (2015) 8:8. DOI 10.1186/s13047-015-0067-8. <http://www.jfootankleres.com/content/pdf/s13047-015-0067-8.pdf>

CONCLUSIONS: Compared with the conventional 2D radiographic device, this study showed a 14-fold effective dose for a standard MSCT protocol and between a 1.3-4 fold effective dose for standard CBCT protocols. The results of this study showed a large variability in the effective dose values attained on the CBCT devices using different scan modes and FOVs. Furthermore, when compared with MSCT devices, the two CBCT devices assessed in this study offer a promising low-dose, three-dimensional alternative for ankle imaging.

Hirschmann A, Buck FM, Fucentese SF, Pfirrmann CW: Upright CT of the knee: the effect of weight-bearing on joint alignment. *Eur Radiol.* 2015 May 1. <http://link.springer.com/article/10.1007%2Fs00330-015-3756-6>

CONCLUSIONS: Knee joint alignment changes significantly in the upright weight-bearing position using CT when compared to supine non-weight-bearing CT. Tibial tuberosity-trochlear groove distance (TTTG) is less pronounced in a weight-bearing position. The weight-bearing position leads to a decrease of the lateral patellar tilt angle. Cone-beam extremity CT offers upright weight-bearing examinations of the lower extremities

Review articles

Suomalainen A, Koskinen SK. Kartiokeilatietokonetomografia ja sen kliiniset sovellukset. (Cone-beam CT: a review). *Duodecim* 2013;129:1037-43.

Suomalainen A, Koskinen SK, Kortetniemi M. Kartiokeilatietokonetomografia (Cone-beam CT: a review). *Suomen Lääkärilehti* 2015, in press.

Book chapters

Vasenius, J: Die-Punch Fractures: Open and Arthroscopy-Assisted Fixation. Book Chapter in: *Distal Radius Fractures* 2014, pp 181-187. Love, LM., et al. (eds.) http://dx.doi.org/10.1007/978-3-642-54604-4_24 Springer Berlin Heidelberg 17 May 2014.

CONCLUSIONS: Reliable evaluation of radiocarpal and distal radioulnar joint congruency is not always possible with radiographs or image intensifier. Therefore preoperative computed tomograms or cone-beam computed tomogram with or without arthrography is valuable in preoperative planning.

Doctoral dissertations, master and bachelor theses

Kokkonen H. Development and Evaluation of Delayed CT Arthrography of Cartilage. *Dissertations in Forestry and Natural Sciences No 91*, 2012. http://epublications.uef.fi/pub/urn_isbn_978-952-61-0970-1/urn_isbn_978-952-61-0970-1.pdf

Holmen Jenssen, C and Kristoffersen, M: What advantages and disadvantages are there with the use of conventional radiography and Verity CT regarding fractures in the upper- and lower extremities? Bachelor thesis. Høgskolen i Gjøvik, Avdeling for helse, omsorg og sykepleie. Mai 2014 http://brage.bibsys.no/xmlui/bitstream/handle/11250/227348/1/CHJensen_MKristoffersen_2014.pdf

Planmed Verity scientific presentations

Mattila KT, J. Kankare J, Kortenesniemi M, et al. 2011: Cone beam CT for extremity imaging. EPOS at ECR 2011, Vienna.

Mattila KT 2011: Extremity CT. Oral presentation at Finnish Radiologic Society Winter Seminar

Mattila KT 2011: Role of CT -Do We Benefit of Weight-bearing CT? Oral presentation at 59th Nordic Radiologic Congress., 20th Nordic congress of Radiography, Mariehamn.

Kankare J 2011: Kartiokeila -TT:n käyttö muskuloskeletaali radiologiassa. Oral presentation at XXXV Sädeturvapäivät, Tampere.

Koskinen, SK et al. 2011: CT Arthrography in the Diagnosis of Wrist Ligament Tears using a Novel Mobile Dedicated Extremity Cone-beam CT (CBCT) Scanner. Poster at American Society of Emergency Radiology Annual Scientific Meeting and Postgraduate Course. Key Biscayne, FL.

Koskinen, SK et al. 2011: CT Arthrography of the Wrist using a Novel Mobile Dedicated Extremity Cone-Beam CT (CBCT). Poster at American Society of Emergency Radiology Annual Scientific Meeting and Postgraduate Course. Key Biscayne, FL.

Koskinen, SK et al. 2011: CT Arthrography of the Wrist Using a Novel Mobile Dedicated Extremity Cone Beam CT (CBCT). Poster at Radiologic Society of North America (RSNA) 2011, Chicago, IL.

Haapamäki et al. 2012: Scaphoid Fractures: Assessment of Fracture Healing after Screw Fixation Using a Novel Mobile Dedicated Extremity Cone-beam CT (CBCT) Scanner. ePoster at European Congress of Radiology (ECR) 2012, Vienna.

Koskinen, SK et al. 2012: CT arthrography of wrist ligament tears using a novel mobile dedicated extremity cone-beam CT (CBCT) scanner. ePoster at European Congress of Radiology (ECR) 2012, Vienna.

Salo, J. et al. 2011: Imaging of ex vivo iatrogenic cartilage lesions with CBCT (Verity). Initial Results of Foot and Ankle Imaging With a dedicated extremity CBCT (Verity). Oral presentation at the Finnish Orthopaedic Society Annual Meeting, Helsinki.

Yli-Kyyny, T et al. 2012: Initial Results of Foot and Ankle Imaging With a dedicated extremity CBCT (Verity). Oral presentation at NOF 2012 Tallinn.

Salo, J. et al. 2012: High resolution diagnosis of cartilage and meniscus damage with a novel extremity-CBCT. EPoster at ICRS, Montreal.

Mattila KT 2012: Imaging in Upper Extremity Trauma. Oral presentation at Nordic Forum for Trauma and Emergency Radiology.

Mattila KT 2012: Dedicated Extremity Coned Beam CT. Oral presentation at International Skeletal Society -meeting, Rome

Mattila KT 2012: - Radiologiaa Uutta ja Vanhaa Oulu, 20.09. 2012 Raaja-TT traumaindikaatiossa, radiologi Kimmo Mattila, TYKS

D. J. Wilson, M. S. Watson; Oxford/UK: Cone beam CT in the assessment of elbow pain after surgery. ePoster at European Congress of Radiology (ECR) 2013, Vienna.

A. Hirschmann, C.W.A. Pfirrmann, N. Espinosa, G. Klammer, F.M. Buck; Zurich/CH: Do sagittal and coronal alignment of the hindfoot change in upright weight-bearing position? Comparison of

upright weight-bearing and supine non-weight-bearing computed tomography. Oral presentation at European Congress of Radiology (ECR) 2013, Vienna.

A. Hirschmann, F.M. Buck, S. Fucentese, C.W.A. Pfirrmann; Zurich/CH: Weight-bearing CT of the knee: does the joint alignment change from supine to upright position? Oral presentation at European Congress of Radiology (ECR) 2014, Vienna.

D.J. Wilson, G.M. Allen, S. Bullock: Extremity CT and ultrasound in the assessment of ankle injuries – occult fractures. Oral presentation at European Congress of Radiology (ECR) 2015, Vienna. Insights Imaging DOI 10.1007/s13244-015-0387-z (2015) 6 (Suppl 1):S159 – S445.

Lee, DY et al.: 3D Computational Position Analysis based on the Articular Surface of Tarsal Bone: A Preliminary Study. ePoster at AOFAS 2015, Long Beach, CA.
<http://www.aofas.org/education/AM15%20ePosters/3dcomputationalpositionan.pdf>