MSK POSTER PRESENTATIONS

P001 USGI in the foot and ankle - are we all playing by the same rules?

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Selective injections are a useful investigation in the diagnosis and treatment of tendon and joint pathology. This is especially true in the Foot and Ankle, with a high incidence of tendinopathies and 28 different bones. Most injections can be conveniently performed as an Outpatient under US guidance, with USGI referrals being generated from Orthopaedic Surgeons, Extended Scope Physios or General Practice. There is the potential for complications after injection of steroids, most notably the risk of tendon rupture in cases of tendinopathy. Referrer attitudes to this risk varies, some recommend use of a protective surgical boot. Uncertainty about the safety of undertaking an injection for a patient without a boot can lead to delay and a further appointment once one is organised.

We developed a comprehensive USGI Guidance document to ensure that injections are only undertaken for appropriate indications; that the optimum steroid volume and preparation is used; a protective boot is available; and that the referrer and sonographer give the same instructions for duration of boot use. Referring clinicians may deviate from the "rules" if they specify clear alternative instructions on the referral. All secondary care referring clinicians have agreed these "Default Settings" for USGI and aftercare. Since our multidisciplinary team adopted these agreed guidelines, there have been no instances where patients have had to reattend for injection after a preliminary USS. Clearly defined guidance agreed within the multidisciplinary team has strengthened our teamwork, reduced unnecessary appointments and afforded consistency in the care of our patients.

P002 Knees - a rheumatological perspective

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Great Western Hospital

Background: We hold weekly radiology-rheumatology clinical meetings. There are a large number of cases collected. We reviewed a series of knee related imaging and have constructed an educational poster as a result.

Purpose: The purpose of the poster is to provide an educational resource for radiologists, rheumatologists and radiographers.

Summary: The poster is divided into the following knee appearances:

1. Rheumatological conditions such as rheumatoid, psoriasis, pseudogout, Paget's disease and DISH.
2. Conditions that the rheumatologist should be aware of such as malignancy, infection and stress fracture.
3. Rare conditions such as scurvey and rickets.

P004 Intra and inter-operator variability in the manual segmentation of lumbar spine MR images using ImageJ©

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Background: The shape modelling of lumbar spine has been demonstrated as a powerful tool to quantify variations in spine morphology and also pointed out as a potential new predictor of several musculoskeletal conditions. As the segmentation of the lumbar spine is the first step of the shape model and is very often done manually, is important to measure inter and intra-operator variability.

Methods: 4 operators, each operator evaluated 30 images twice. Statistical Package for the Social Sciences (SPSS) software was used to calculate the Intraclass Correlation Coefficient (ICC) for intra and inter-operator variability.

Results: All of our ICC values are above 0.92 belonging to an excellent standard. The ICC for intra-operator precision ranged 0.990, 0.993, 0.993 and 0.988. The inter-operator ICC ranged 0.989 ($p<0.001$).

Conclusion: High precision was demonstrated for both inter and intra-operator assessment. Our results have shown that Y value ICC scores are considerably more consistent across all four operators than the X values. A potential theory to explain this could be that the anterior and posterior vertebral margins are harder to interpret due to distinguishing between surrounding soft tissue and bone, varying slice selection may also be a factor. All of our ICC values were clinically significant and to an excellent standard. Therefore, our results display that for our operators there was minimal variability which leads us to conclude that the operator has limited influence on the segmentation of the lumbar spine.

1. Ali H.A. Ali, Amy-beth Cowan, Jennifer S. Gregory, Richard M. Aspden & Judith R. Meakin (2012) The accuracy of active shape modelling and end-plate measurements for characterising the shape of the lumbar spine in the sagittal plane, Computer Methods in Biomechanics and Biomedical Engineering, 15:2, 167-172, DOI:10.1080/10255842.2010.518962
2. Meakin J, Gregory J, Smith F, Gilbert F, Aspden R. Characterizing the Shape of the Lumbar Spine Using an Active Shape Model. Spine. 2008;33(7):807-813
3. Meakin, J., Gregory, J., Aspden, R., Smith, F. and Gilbert, F. (2009). The intrinsic shape of the human lumbar spine in the supine, standing and sitting postures: characterization using an active shape model. Journal of Anatomy, 215(2), pp.206-211
4. Portney, L. G., & Watkins, M. P. (2009). Foundations of clinical research: applications to practice. (3rd ed.). Upper Saddle River, NJ: Prentice-Hall
5. Fleis, J. (1986). Design and Analysis of Clinical Experiments. New York: John Wiley & Sons

P005 **A systematic review to assess the impact of total knee replacement/arthroplasty/revision on bone mineral density**

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Background: The impact of total knee replacements, revisions, and arthroplasties on post-operative bone mineral density (BMD) is of great importance and currently no systematic review has been conducted to establish a consensus on when and where the greatest bone density changes are following surgery.
Method: A collection of databases were searched using pre-determined key terms; results were imported into Endnote, duplicates removed, and title and abstract screening was conducted by two independent reviewers. Full text screening was performed with data extraction and quality assessment undertaken on the final included papers. The outcomes included investigating BMD changes compared to baseline/contralateral knee at intervals of 3, 6, 12, 18, 24, 48, and 60 months post-surgery.
Results: After de-duplication, 957 papers were identified by searches. Title and abstract screening yielded 57 papers for full text screening, from which 32 papers were included in the review (five of these papers investigated bisphosphonates impact on BMD post-surgery). The highest reported bone loss in the tibia was at 24 months post-surgery of -41.3% on the medial tibial side, with the highest loss in the femur being at 24 months on the anterior aspect of the femur -40%.
Conclusion: The combined data demonstrated BMD loss post-operatively, with some of the highest losses reported at 24 months post-surgery. Furthermore, those treated with bisphosphonates showed an increase in BMD at 6 and 12 months, suggesting that post-operative bisphosphonates may mitigate peri- and post-operative bone loss.

P006 **Pilot study to investigate the impact and value of hot/immediate reporting of appendicular musculoskeletal emergency department plain images at the weekend**

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Background: Hot/immediate reporting is not a new concept but is seen as the 'Gold Standard' to ensure optimal care for Emergency Department patients. NICE 'Resource Impact Report' (2016), describes this service as 'providing a definitive written report of emergency department X-rays of suspected fractures before the person is discharged from the emergency department'. Immediate formal interpretation/reporting of plain images taken at the time of ED attendance is described as, reducing; missed fractures, discharge delays, recalls, incorrect treatment and potential litigation. Although been seen as the gold standard for many years, immediate reporting is not performed by all acute centres in the UK. Literature describes the key restricting factor to be lack of financial resource to staff immediate reporting. Immediate reporting has been in place 9am-5pm Monday to Friday for some time. Pilot gives opportunity to investigate the impact to patients if this service provided 9-5, 7 days a week.
Aims and objectives: To explore further if the expansion of the hot-reporting service could offer benefit to the ED service and positive impact to patients. Compare 'pre Hot' and 'Hot' reporting of MSK appendicular ED exams, by quantifying missed fractures, discharge delays, recalls, incorrect treatment and potential litigation. Qualitative feedback from ED and imaging staff as to value of service.
Method: 6 weeks 'Pre Hot' March/April 2017, 9am - 5pm, Saturday/Sunday: 6 weeks 'Hot' March/April 2018, 9am-5pm, Saturday/Sunday.
Outcomes: Pilot demonstrated a significant improvement in accuracy of patient outcome at the time of patient attendance in ED

1. Hardy, M et al. (2013) 'The impact of immediate reporting on interpretative discrepancies and patient referral pathways within the emergency department: a randomised controlled trial'. British Journal of Radiology. Vol 86 (no.1021); p. 20120112
2. Hardy, M et al. (2013) 'Is a radiographer led immediate reporting service for emergency referrals a cost effective initiative?' Radiography. Vol 19 (no.1); p. 23-27
3. NICE (2016) 'Putting NICE guidance into practice. Resource and impact report, trauma guidelines' (NG37-41) Figure 3.3

P007 **Commonly missed fractures in the emergency department: A pictorial review**

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Background: Radiological diagnostic errors in the emergency department commonly include missed diagnosis of subtle or radiographically occult fractures on plain radiographs. This may occur either due to misinterpretation or low sensitivity of plain radiographs in diagnosing these fractures. Fractures of hand phalanges and metatarsals are most commonly missed in an emergency setting, followed by those of distal radius, tibia, and foot phalanges. Cross sectional imaging (MRI or CT) is more sensitive and should be used in appropriate cases to establish diagnosis.
Purpose: Missed traumatic fractures are a common occurrence in emergency department. Knowledge of common pitfalls and use of appropriate alternate imaging aids in identifying radiographically occult fractures, reducing subsequent complications and morbidity.

Summary: A pictorial review outlining a variety of commonly missed fractures in the emergency department, along with tips and radiological signs to help identify occult fractures.

1. Mounts, J. et al. (2011) Most Frequently Missed Fractures in the Emergency Department, Clinical Pediatrics, 50(3), pp. 183–186
2. Smalley, C. et al. 2011. Most Frequently Missed Fractures in the Emergency Department, Clin Pediatr 2011;50:183. Journal of Emergency Medicine 41, 110
3. Crock, C, Deakin, A., Hansen, K., Schultz, T. J., and Hansen, K. (2015), Case Letter. Emerg Med Australas, 27: 177-178

P008 What every radiologist needs to know about pathological fractures

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Background: A pathological fracture is any fracture through an area of abnormal bone architecture. It can be either a benign lesion (e.g. haemangioma) or malignant lesion (primary bone tumour or metastatic deposit) or due to a diffuse process. Bone metastases are an exceedingly common spread of cancer and pathological fractures are seen in up to 29% of cases[1] causing a significant burden on services. Bone metastases are commonly seen in myeloma and in cancers arising from the prostate, breast, lung, and kidneys. The literature on the incidence of pathological fractures is scarce; although it has been cited that the age-adjusted incidence for pathological fractures is 87 per 100,000 population[2].

Purpose: Evaluating bone lesions and pathological fractures is a difficult task and there is little guidance available on this topic. We aim to make a comprehensive guide in assessing the common pathological fractures due to localised bone pathology.

Summary: This poster identifies the usual sites for pathological fractures. We describe different underlying bone lesions which are at risk of pathological fracture and their appearances across various imaging modalities. Plain film, CT and MRI appearances will be discussed. We aim to describe the subtle differences in morphology that can be appreciated to help the radiologist determine the underlying aetiology. We highlight the difference between pathological and stress fractures, and visit a criteria for determining risk of fracture.

1. Buggay D, Jaffe K: Metastatic bone tumours of the pelvis and lower extremity. Journal of Surgical Orthopaedic Advances [01 Jan 2003 12(4): 192-199]
2. Amin S, Achenbach SJ, Atkinson EJ, Khosla S, Melton LJ 3rd: Trend in fracture incidence: a population-based study over 20 years. Journal of Bone and Mineral Research [Mar 2014, 29 (3): 581 -589]

P009 Incidental vertebral fractures: are we under-reporting them?

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Background: The early diagnosis of osteoporosis may facilitate effective intervention with bisphosphonates, calcium, and vitamin D, which can reduce the risk of future fragility fractures (NICE, 2018). Incidental diagnoses of vertebral fractures on CT may be the first sign of osteoporosis, yet we suspected these fractures may be under-reported. We aimed to investigate for under-reporting of vertebral fractures within our trust.

Method: We retrospectively considered 500 consecutive CT scans across three hospitals for inclusion. Exclusions were on the basis of 1) insufficient field of view; or 2) high pre-scan probability of vertebral fracture (known malignancy or trauma, previously reported vertebral fractures, or clinical suspicion). Junior doctors in the radiology department double-reported all included scans utilising a semiquantitative method (Genant et al., 1993), and a consultant musculoskeletal radiologist subsequently reviewed all suspected vertebral fractures. Finally, we compared the original scan reports to our assessment of vertebral fracture status.

Results: We included 199 scans, with a mean patient age of 65 years and 113 (57%) male patients. Fifteen (8%) scans contained new or previously unreported vertebral fractures, which were not reported in eight (53%) of the original scan reports. All eight reports commented upon the skeleton, but six (75%) dismissed the skeletal changes as purely degenerative. Ten out of 13 (77%) unreported fractures were located between T7 and T12.

Conclusion: Vertebral fractures were under-reported incidental findings in our trust. We encourage all radiologists to report incidental vertebral fractures.

1. Genant, H., Wu, C., van Kuijk, C. and Nevitt, M. (1993) Vertebral fracture assessment using a semiquantitative technique. *Journal of Bone and Mineral Research,* 8(9), pp.1137-1148.
2. National Institute for Health and Care Excellence, (2018) *Osteoporosis overview*

P010 Audit of reporting of incidental (prevalent) vertebral fracture in chest abdomen and pelvis (CTCAP) reports

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[1]Derriford Hospital, University Hospitals Plymouth NHS Trust; [2]Royal Osteoporosis Society

Background: Up to 70% of vertebral fractures (VFX) remain undiagnosed[1] despite an association with excess mortality[2,3], hip fracture and further VFX[4,5]. Diagnostic imaging departments have a role in fracture prevention by reporting incidental findings of prevalent VFX in reports of scans including the thoraco-lumbar spine, and alerting referrers to their significance. This study investigated reporting of incidental finding of VFX on cross-sectional imaging including the thoraco-lumbar spine in routine clinical practice at a large tertiary centre.

Method: Data was pooled from two separate audits investigating prevalence of VFX in cross-sectional imaging and patients with hip fracture with previous imaging in 5 years prior to fracture (from Q1 2015 of the National Hip Fracture Database).

81 CTCAP images (47 consecutive non-selected CTCAP & 34 hip fracture patients) were blind reviewed with sagittal reconstruction by a specialist reporting radiographer for VFX using the semi-quantitative method[6]. Verified radiology reports were scrutinised for corroboration of audit findings, and for reference to recommendation for further assessment or an alert of a significant incidental finding.

Results: VFX identified at audit: 34

Conclusion: Only 58% off patients had their vertebral fractures noted in the report of their CT scan, and none of the reports made any recommendation for further assessment for osteoporosis. This represents 17 important missed opportunities in this audit to treat underlying osteoporosis and prevent further fracture. Long-term outcomes for patients can be improved my more effective reporting of VFX, at a low cost in terms of time and financial investment. Implementing clinical guidance on the identification of VFX[7]could improve outcomes for patients.

1. NICE (TA161) Alendronate, etidronate, risedronate, raloxifene, strontium ranelate and teriparatide for the secondary prevention of osteoporotic fragility fractures in postmenopausal women. NICE 2008. Last updated August 2017
2. Kado DM, et al. (1999). Vertebral fractures and mortality in older women: a prospective study. Study of Osteoporotic Fractures Research Group. Arch Intern Med. 159(11): 1215-1220
3. Jalava T, et al. (2003). Association between vertebral fracture and increased mortality in osteoporotic patients. J Bone Miner Res. 18(7): 1254-1260
4. Black DM, et al (1999). Prevalent vertebral deformities predict hip fractures and new vertebral deformities but not wrist fractures. Study of Osteoporotic Fractures Research Group J Bone Mineral Res. 14:821-28
5. Melton LJ 3rd, et al. (1999) BL. Vertebral fractures predict subsequent fractures. Osteoporosis Int. 10:214-221
6. Ferrar L, Jiang G, Adams J, Eastell R, (2005) Identification of vertebral fractures: and update. Osteoporosis International. 16:717-28
7. Royal Osteoporosis Society, (2017) Clinical Guidance for the Effective Identification of Vertebral Fractures

P011 Case studies: Unreported incidental finding of vertebral fracture (VFX) on CT represents missed opportunity to prevent future hip fracture

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[1]Derriford Hospital

An audit of sagittal reformatted images of the spine was conducted in August 2017. We present two case studies where VFX were not identified or reported, resulting in a missed opportunity to treat and possibly prevent subsequent hip fractures.


Fig 1. Antero-posterior projection radiograph of the right hip


Fig 2. Single image of sagittal reformat of CT volume (VFX at T8 and T11).


Fig 3. Single image of sagittal reformat of CT volume (VFX at T3)

Case Study 1: 09/2014: Mrs A (70yo), referred for CTCAP to investigate rectal bleeding/malignancy. Report comment: 'bones are intact'.
02/2016: Patient sustained a right-impacted sub-capital neck-of-femur fracture (fig.1).
Referred for DXA.
Audit 2017 - Sagittal-reformatted 09/2014 images of the spine demonstrated VFX at T8 & T11 (fig.2)
Case Study 2: 02/2013: Mrs B (84), referred for CT thorax (CTT) following treatment for TB and onset of chest pain. Report comment: 'No aggressive bony lesion'. No recommendation for further assessment for osteoporosis.
05/2015: Follow-up CTT performed. No report comment on bones.
04/2016: Patient sustained a fractured neck of femur, treated by total hip replacement. Did not leave care and died in June 2016. Audit 2017 - VFX identified at T3 from 02/2013 CTT (fig 3)

Discussion: Both cases demonstrate very poor outcomes of a missed incidental finding of vertebral fracture on CT, even though the original referrals were for unrelated indications. If the fractures had been reported at the first opportunity, subsequent assessment and treatment for osteoporosis may have avoided subsequent hip fracture. New clinical guidance on the identification of vertebral fracture1 could be implemented to improve outcomes for this sort of patient.

1. Royal Osteoporosis Society, (2017) Clinical Guidance for the effective identification of vertebral fractures

P014 "Don't be afraid to use the f word!" improving identification of vertebral fractures and onward referral for bone health assessment (DXA) using a standardised reporting code in radiology

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The Mid Yorks NHS Trust

Introduction: Vertebral fractures are a predicator of further fracture with an increased relative risk of 5.4 for vertebral fracture[1]. Historically incidental vertebral fractures on plain film have been under reported (70% remaining undiagnosed). Ambiguous reporting language that does not include the word fracture in the report, has led to inappropriate treatment in many

of these patients[1].Over 55% of older women with hip fracture have evidence of a prior vertebral fracture hence the importance of identifying these fractures.
Purpose: The National Institute for Health and Care Excellence (NICE) TA161 recommends assessment of bone density for patients with vertebral fractures. The reporting team at this trust have developed a generic reporting code to identify the presence of fractures and highlight findings to the referring clinician. The aim is to identify patients with vertebral fractures and recommendations for DXA imaging in bone health assessment. This will identify those that require treatment in order to prevent future fractures. This poster will present audit data demonstrating the impact of using a generic reporting code for those with osteoporotic vertebral fractures and onward referral for DXA to assess bone mass.
Summary: To show effectiveness of generic reporting code in identifying vertebral fractures on plain film and recommending onward referral for DXA imaging to prevent future vertebral fractures.
1. National Osteoporosis Society (2017) Clinical Guidance for the effective identification of vertebral fractures NOS Bath

P015 Not every lump is a lipoma: unusual masses

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Great Western Hospitals NHS Trust

Background: Ultrasound requests principally from GP's for soft tissue lumps are invariably lipomas. However, from time to time unusual masses will present. We reviewed our archive of cases and present a pictorial review of these.
Purpose: This is to highlight alternate pathology to lipomas encountered in ultrasound by sonographers and radiologists.
Summary: Masses that raise concern of course include sarcomas, lymphomas and cancer metastatic nodes. Benign unusual masses include multiple haemangiomas, muscle hernias, ganglia, fat necrosis, calcification and panniculitis. The value of correlation with plain films and the need for MRI as appropriate are highlighted.

P016 T1 hyperintense vertebral lesions: beware of the nasty one - melanoma

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Background: On T1 weighted MRI sequence, vertebral metastases usually present as abnormal low signal intensity lesions on a background of mildly hyperintense bone marrow. T1 hyperintense vertebral lesions are generally considered benign. Malignant melanoma is an aggressive neoplasm that can involve virtually every organ system. Increased T1 signal intensity in melanoma has been well documented and is attributed to the T1 shortening effect of either melanin or blood products from intratumoral haemorrhage. T1 hyperintense melanoma metastases are more common in the central nervous system. The majority of vertebral metastases in melanoma are of low signal on T1.
Purpose: This poster aims to highlight that T1 hyperintense vertebral lesions are not always benign. Malignant melanoma can result in T1 hyperintense vertebral metastases. This is very rare and is dependent on the melanin content of the lesions. On T1 weighted sequences, hyperintense metastases can be easily masked by the background T1 high signal bone marrow. Hence it is advisable to perform additional sequences like STIR or post gadolinium T1 weighted sequence with fat saturation to bring these lesions to light.
Summary: Although T1 hyperintense vertebral lesions are usually benign, there are exceptions. Malignant melanoma vertebral metastases can appear hyperintense on T1 weighted image. As the background hyperintense bone marrow can mask these lesions on T1, additional postcontrast T1 fat saturation sequences or STIR images are advised, in the search for metastatic melanoma.
1. McMenamin, D.S. Stuckey, S.L. Potgieter G.J. (2007) T1 hyperintense vertebral column melanoma metastases. AJNR Am J Neuroradiol 28: 1817- 1818
2. Christopher, J. Hanrahan and Lubdha, M.S. (2011) MRI of spinal bone marrow: Part 2, T1 weighted imaging-based differential diagnosis. AJR, December 2011, Volume 197, Number 6

P017 An analysis of organ dose in the CT scan projection radiograph when used to assess scoliosis

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Background: Scoliosis is defined as a deformity of the spine with lateral curvature in the coronal plane. It requires regular X-ray imaging to monitor the progress of the disorder, therefore scoliotic patients are frequently exposed to radiation. It is important to lower the risk from these exposures for young patients. The aim of this work is to compare organ dose (OD) values resulting from Scan Projection Radiograph (SPR) mode in CT against projection radiography and EOS® imaging system when assessing scoliosis.
Methods: A dosimetry phantom was used to represent a 10-year old child. Thermoluminescent dosimetry detectors were used for measuring OD. The phantom was imaged with CT in SPR mode using 27 imaging parameters; projection radiography and EOS machines using local scoliosis imaging procedures. Imaging was performed in anteroposterior, posteroanterior and lateral projections.
Results: 17 protocols delivered significantly lower radiation dose than projection radiography ($p < 0.05$). OD values from the CT SPR imaging protocols and projection radiography were statistically significantly higher than the results from EOS. No

statistically significant differences in OD were observed between 10 imaging protocols and those from projection radiography and EOS imaging protocols (p >0.05).
Conclusion: EOS has the lowest dose. Where this technology is not available, we suggest there is a potential for OD reduction in scoliosis imaging using CT SPR compared to projection radiography. Further work is required to investigate image quality in relation to the measurement of Cobb angle with CT SPR.

P018 **Colles' fractures: Intra- and inter-operator precision of alignment measurements from projection radiographs pre- and post-manipulation under anaesthesia**

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[1]University of Exeter; [2]City University; [3]Royal Devon and Exeter NHS Foundation Trust

Background: Colles' fractures are a common injury often resulting from a fall onto an outstretched hand. These fractures are frequently associated with wrist deformity, which can result in problems using the wrist if not corrected. Most adult patients undergo manipulation under anaesthesia within the emergency department if fracture reduction is required. Measurements made on projection radiographs of the wrist can assist in the assessment of deformity and aid clinical decision making.
Methods: 96 wrist radiographs including 30 normal, 30 pre-MUA and 36 post-MUA cases had duplicate measurements on separate days of volar tilt (VT), radial height (RH) and ulnar variance (UV) measured by four trained operators. Intra- and Inter-operator precision errors were calculated using intraclass correlations (SPSS V25, IBM).
Results: Intraclass correlations for intra-operator precision ranged from 0.951 to 0.999, 0.842 to 0.979 and 0.980 to 0.996 (p<0.001) for VT, RH and UV respectively. The inter-operator intraclass correlations ranged from 0.867 to 0.986 for VT, 0.942 to 0.922 for RH and 0.957 to 0.987 for RH. There was variation in precision errors between the normal, pre-MUA and post-MUA cases, with post-MUA measurements demonstrating greater error than pre-MUA.
Conclusion: Good precision is demonstrated for all measurements demonstrating that there is no significant difference between different operators making them. While the measurements are more difficult to make with the cast in-situ, this does not impact significantly on the precision errors.

P019 **The reproducibility of near infrared spectroscopy markers of microvascular haemodynamics at the proximal tibia and gastrocnemius**

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Background: Near infrared spectroscopy (NIRS) allows real time measurement of microvascular haemodynamics in vivo by measuring changes in oxygenated and deoxygenated haemoglobin concentrations. This offers potential microvascular research applications in different disease states for both bone and muscle tissue. However, previous literature has called for evaluation of the reproducibility of NIRS measurements, particularly for bone tissue[1].
Method: Inter operator reproducibility was assessed by measuring the resting total oxygenation index (TOI) at the proximal tibia and lateral head of the gastrocnemius on 12 participants using 5 blinded operators. To assess intra operator reproducibility, and the response of NIRS during ischaemic events, 38 participants were tested at the same anatomical sites for haemodynamic markers during and immediately after occlusion of the blood supply at the thigh for four minutes. Testing was repeated on different days to account for natural biological variation.
Results: Inter operator reproducibility at the gastrocnemius and proximal tibia produced a within participant coefficient of variation (CV) of 2.7% (95%CI 0.0-5.5) and 3.8% (95%CI 0.4-7.1) respectively. The rate of oxygenation decrease during arterial occlusion (signifying oxygen extraction rate) produced a CV of 12.14% (95%CI 0.0-23.35) and 11.6% (95%CI 0.0-25.5) respectively. The rate of oxygenated haemoglobin recovery post occlusion release produced a CV of 12.02% (95%CI 0.33-23.71) and 13.5% (95%CI 0.0-27.9) respectively.
Conclusion: Results confirm that in the context of existing microvascular testing tools, near infrared spectroscopy has suitable reproducibility to warrant its use in future research on bone and muscle tissue haemodynamics at the proximal tibia and gastrocnemius.

1. Meertens R, Casanova F, Knapp KM, Thorn C, Strain WD. Use of near infrared systems for investigations of haemodynamics in human in vivo bone tissue: A systematic review. Journal of Orthopaedic Research. 2018 Oct;36(10):2595-603

P020 **Sonographers' management of work-related musculoskeletal disorders (WRMSD): An ideological dilemma?**

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Background: Contradictions within common sense and the governing ideologies of cultures and institutions are typically analysed as points of practical paralysis. Although rarely acknowledged in the imaging sciences, the work of Billig et al. (1988) highlights how dilemmas within ideology can also have enabling impacts on everyday thought; they can assist individuals in reasoning constructively about themselves and their social environments. The research reported in this paper explores the

manners in which practicing sonographers with work-related musculoskeletal disorders (WRMSD) manage their own professional lives. It draws particular attention to how the ideological dilemmas evident, while sometimes constrictive, can also reinforce the participants' positive self-identification.
Method: Extended semi-structured interviews with N=9 experienced sonographers working in the UK were conducted and provisionally analysed using Interpretative Phenomenological Analysis (Miller, Booth and Spacey, 2017). Core thematic areas that emphasised ideological contradictions were then further examined to highlight how participants specifically made sense of them.
Results: The key ideological tensions evident in the findings pertained to those between individuality and collectivity, and freedom and necessity. Evidence indicated that the participants often freely chose to work while injured, despite being aware of the prospective personal costs. In doing so, they underscored their own agency as professionals, and also their own commitment to a broader altruistic model that reinforced their identities as good healthcare professionals.
Conclusions: Ideological dilemmas provide a useful analytic framework for understanding some of the everyday aspects of working with injury in ultrasound. Further exploration of the conceptual facility thereof is recommended.
Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D. and Radley, A. (1988) Ideological dilemmas: a social psychology of everyday thinking. London: Sage.
Miller, P.K., Booth, L. and Spacey, A. (2017) 'Dementia and clinical interaction in frontline radiography: Mapping the practical experiences of junior clinicians in the UK', Dementia. doi: 10.1177/1471301217700742

P021 Accuracy of ultrasound guided caudal epidural needle placement

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Background: Caudal epidural injections are commonly used for surgical anaesthesia in children and for a variety of chronic pain conditions in adults. Successful delivery of medication requires a needle to be passed through the sacral hiatus and into the epidural space. Fluoroscopically guided caudal epidural injection is the current gold standard technique. Fluoroscopy, however, exposes patients to radiation and requires an intervention suite. An alternative is ultrasound guided injection, which avoids these drawbacks and has been shown to have 100% accuracy of needle placement into the sacral canal[1]. A literature review revealed that only one study involving 70 patients has examined the feasibility of ultrasound guidance, which possibly explains the lack of ultrasound adoption by many hospitals[1]. The aim of this study was to clarify whether this procedure can be performed safely under ultrasound guidance rather than fluoroscopy.
Method: This was a prospective study involving 50 consecutive patients who attended a district general hospital from May 2017 to November 2018 for a caudal epidural injection. Needle placement was performed under ultrasound by a musculoskeletal radiology consultant and then instantly confirmed with fluoroscopy.
Results: Accurate needle placement was achieved in 49 of 50 cases (98%) under ultrasound guidance. Conclusion This study increases the number of cases in the current literature by over 70% and confirms that accurate caudal epidural needle placement can be achieved under ultrasound guidance. This procedure is now done under ultrasound guidance in the hospital where the study was performed in.
1. Chen C.P., Tang S.F., Hsu T.C., Tsai W.C., Liu H.P., Chen M.J., Date E. and Lew H.L. (2004) Ultrasound guidance in caudal epidural needle placement. Anesthesiology; 101: 181 - 4

P022 Differences in calcaneal quantitative ultrasound measurements between adolescents participating in professional athlete training

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Background: There is increasing interest in measuring bone density in athlete populations to assess risk of stress fracture and following injury. Current reference data may not appropriately assess vulnerabilities in groups undertaking different elite sports due to the increased bone mass related to athletic participation[1]. The aim of this study was to compare the quantitative ultrasound (QUS) measurements of bone between professional and amateur academy footballers and professional ballet dancers.
Methods: 15 male amateur academy (16.9y±0.4), 25 male professional academy football players (18.3y±1.2) and 19 male ballet dancers (18.1y±1.0) were recruited. All had bilateral calcaneal QUS measurements. Means, standard deviations and a one way ANOVA were used to analyse the data (SPSS V25, IBM).
Results: Mean stiffness index was 117.6 ±18.7 for the amateur football players, 132.0 ± 13.1 for the professional academy players and 108.2 ±20.2 for the ballet dancers; these groups significantly differed from each other ($p<0.001$). The amateur footballers were significantly younger than the professional players and ballet dancers.
Conclusion: There are significant differences between groups participating in amateur and professional training in football. Ballet dancers have further reduced mean QUS measurements. While the amateur football players were on average 1.3y younger than the professional players and dancers, this was not sufficient to account for the differences measured. Professional academy players develop higher bone mass and current reference data may not be adequate to pick up those with bone

vulnerabilities in relation to training-load. Further research is needed to understand the lower QUS measurements in ballet dancers.

1. Vlachopoulos D, Barker AR, Williams CA, et al. The Impact of Sport Participation on Bone Mass and Geometry in Male Adolescents. Med Sci Sports Exerc 2017; 49(2): 317-26.

HEAD & NECK/NEURO

P023 4D Dynamic CT imaging of the eustachian tube - technique and future applications

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Already established in imaging of dynamic tracheal collapse, 320-slice multi-detector CT offers the unique opportunity to view the post nasal space airway and Eustachian tube ostium during swallowing using up to a 16 cm field of view and up to seven rotations in the same position. A 2,240 image dataset is acquired during coached swallowing at low dose and then merged into 2- and 3D movies. We aim to show, by volume rendered movies, the changes that occur in the orifice and the length of the Eustachian tube in a variety of benign pathologies of the post nasal space and tubes. We believe that nasal endoscopy and other conventional ways of tube demonstration have been unable to demonstrate the dynamic changes observed. The mean DLP was a modest 115.2 mGy.cm. The technique with dose minimisation and outcomes are discussed with reference to 12 cases studied over a 30 month period.

P024 Imaging features of Gorlin-Goltz Syndrome

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Background: Gorlin-Goltz syndrome (GGS) is a rare multisystemic disease with an autosomal dominant trait. Diagnostic radiology for assessment includes orthopantomogram, skull and chest radiographs and computed tomography scans. A 20-year-old male was diagnosed with GGS following a nine-year history of multiple jaw cysts and known hydrocephalus at birth. Initial presentation was at his dentist, which revealed two hard swellings on the buccal surface of the alveolar bone in the left mandible. An orthopantomogram revealed large radiolucent cystic lesions affecting the developing adult dentition. Further investigations revealed cysts in the maxilla whilst skull and chest radiographs showed falx cerebri calcification and multiple bifid ribs respectively. There was no known family history of the disorder. Following diagnosis, the patient underwent cyst enucleation. Histology confirmed odontogenic keratocysts. DNA testing revealed a significant patched (PTCH) gene defect indicative of a GGS diagnosis.
Purpose: To highlight the importance of a multidisciplinary approach to providing accurate diagnosis and better patient care. To highlight the importance of different radiologic imaging in GGS diagnosis, and to present the key radiological findings; this is important since early detection facilitates timely treatment.
Summary: This case demonstrates the diagnostic imaging-driven evaluation of a patient presenting with GGS and a past history of hydrocephalus, and that was subsequently treated via cyst enucleation. It focuses on how different members of the multidisciplinary team are needed in managing the dento-alveolar aspect, as well as of the importance of dermatological, orthopaedic and clinical geneticist involvement.

P025 A guide to the petrous apex for the general radiologist

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The petrous apex is routinely included on cross-sectional imaging of the skull. The paired triangular-shaped structures are directed toward the medial skull base. The petrous apex houses a number of vascular and neurological channels and has an intimate relation to the internal carotid artery, cavernous sinus and Meckel's cave. A variety of developmental, infectious, inflammatory, neoplastic and vascular pathologies may affect this region. The purpose of our review is to illustrate the anatomy of the petrous apex and clinically-important pathologies and normal variants which make the petrous apex an important review area to the general radiologist.

P026 Review of imaging in advanced head and neck cancer; compliance with NICE quality standard for use of PET-CT

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Background: Upper aerodigestive tract cancers commonly present late due to lack of symptoms in low-stage disease. Advanced imaging modalities, particularly positron emission tomography with CT (PET-CT), play a central role in accurate staging of advanced disease, contributing significantly to management planning and prognostication. This review was undertaken to evaluate use of the range of advanced imaging, both to measure local compliance with NICE quality standards, and to identify patterns of presentation, particularly in cases with advanced disease. Through retrospective review of 115 patients discussed in a specialist Head & Neck Multidisciplinary team meeting over a three month period in 2018, cases were identified that met the