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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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**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<sup>[1]</sup>.

**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<sup>[1]</sup>. 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<sup>[1]</sup>. 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<sup>[1]</sup>. 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