

## WINTER SCOT 2025 RESEARCH FULL ABSTRACTS

### **FULLY AUTOMATED MEASUREMENT OF PAEDIATRIC CEREBRAL PALSY PELVIC RADIOGRAPHS USING MACHINE LEARNING: EXTERNAL VALIDATION USING A NATIONAL SURVEILLANCE DATABASE**

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The radiographic analysis required for a national cerebral palsy (CP) hip surveillance programme is resource intensive. BoneFinder® is a machine-learning tool that can automatically calculate Reimer's migration percentage (RMP) from pelvic radiographs. HipScreen is a smartphone application that can partially automate RMP measurement.

Three RMP measurement methods were compared across the same set of radiographs: 1) routine manual measurements performed by clinical experts from the CP Integrated Pathway Scotland (CPIPS) database, 2) automated measurements using BoneFinder® and 3) measurements performed by two clinicians using HipScreen.

509 AP pelvic radiographs (1,018 hips; mean age:7.4 years) were selected at random from the CPIPS database. GMFCS levels were I (n=69), II (n=37), III (n=97), IV (n=120) and V (n=186). The absolute mean difference in RMP between BoneFinder® and CPIPS measurements, BoneFinder® and HipScreen and CPIPS and HipScreen measurements was 6.3%, 4.6% and 5.2% respectively.

Interobserver reliability (ICC) of RMP measurement across the three methods was excellent (ICC = .92,  $P < .001$ , 95% CI .90–.93). Good to excellent ICC and correlation were found between BoneFinder® and CPIPS measurements (ICC = .87,  $P < .001$ , 95% CI .75–.93,  $r = .90$ ) and HipScreen and CPIPS measurements (ICC = .91,  $P < .001$ , 95% CI .87–.94,  $r = .93$ ). The area under the receiver operating characteristic curve for BoneFinder®'s and HipScreen's ability to detect a RMP  $\geq 30/\geq 40\%$  was .96/.98 and .97/.99, respectively.

Fully automated RMP measurements were highly reliable with clinically acceptable measurement error. BoneFinder® appears to perform well in analysis of radiographs in CP children who may have challenging radiographic anatomy.

### **THE INCIDENCE AND CLINICAL SIGNIFICANCE OF INCIDENTAL FINDINGS SEEN ON PRE-OPERATIVE CT PLANNING SCANS FOR HIP AND KNEE ROBOTIC ARTHROPLASTY SURGERY**

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The incidence and clinical significance of incidental findings identified on preoperative computerised tomography (CT) planning scans for hip and knee robotic arthroplasty is disputed. This study aimed to determine this within a single hip and knee arthroplasty unit.

A retrospective cohort study was performed for all patients that underwent CT planning scans for hip or knee arthroplasty at our institution over a 30-month period (Dec 2021 – May 2024). CT scan reports were reviewed and incidental findings noted. Incidental findings were graded by independent reviewers into one of three categories: no action required, further action may be considered, urgent action required e.g. potential malignancy.

1452 CT arthroplasty planning scans were identified over a 30-month period. A radiologist report was not provided in 48 (3.4%) cases, leaving 1404 available for further analysis. 592 (42.2%) incidental findings were noted, of which 244 (17.4%) were graded further action may be considered and 16 (1.1%) urgent action required. All patients identified as urgent action required received appropriate management.

We conclude that pre-operative CT arthroplasty planning scans have a high incidence (42.2%) of incidental findings, most of which most require no further management. A significant proportion (17.4%) of scans have incidental findings for which further action may be considered, whilst a small proportion (1.1%) have incidental findings for which urgent action is required. Pre-operative CT planning scans should receive a formal radiologist report due to the high incidence of significant incidental findings.



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### **PATIENT PRIORITISATION FOR LUMBAR DECOMPRESSION BY PRE-OPERATIVE PATIENT REPORTED OUTCOME MEASURES**

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Significant NHS waiting lists for Lumbar Spine Decompression necessitate further research to better prioritise patients. We aimed to investigate the association of pre-operative patient reported outcome measures (PROM) on the post-operative improvement following surgery. A retrospective cohort analysis on PROM data collected at Woodend General Hospital between January 2018 and June 2022. Excluding multilevel level decompression and revision surgery, all patients >16yrs undergoing lumbar decompression were included. Our primary outcomes were pre-operative, and 1yr post-operative, Oswestry Disability Index (ODI) and EQ-VAS questionnaires. Linear regression modelling on pre-operative ODI/EQVAS and the degree of improvement from pre-operative baseline at 1yr. This analysis was undertaken in R (version 4.4.1). A negative correlation of pre-operative ODI/EQ-VAS with the degree improvement at 1yr was found; with significant values for ODI and EQ-VAS of  $p = 0.0028$  and  $p < 0.001$ , respectively. These findings can be used to identify patients likely to benefit most from surgery, as well as better counsel patients considering lumbar decompression surgery. Pre-operative ODI >22 and pre-operative EQ-VAS <60 inferred a significant (95% confidence interval) likelihood of an improvement at 1yr. Furthermore, assuming a minimally clinically important difference of 15% (ODI) and 7% (EQVAS), a clinically detectable difference is predicted for pre-operative scores > 43 ODI and >9 EQVAS. This study supports lumbar decompression surgery for patients with the most debilitating pre-operative PROMs. This study also suggests cut off values for pre-operative PROMs which can aid patient counselling and timing of surgery. Further studies are however required to further characterise this relationship.

### **VIRTUAL REALITY FOR SURGICAL TRAINING AND SIMULATION IN ORTHOPAEDIC FRACTURE SURGERY**

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The use of VR in orthopaedic surgical training is currently limited, primarily utilised within the realm of arthroscopy and arthroplasty procedures. Orthopaedic trauma surgery represents a significant portion of orthopaedic workload and a core component of orthopaedic training. Currently, VR as an education tool within orthopaedic trauma surgery has very little evidence.

The aim of this study was to assess the utility of a new and novel VR simulation as a tool for training orthopaedic surgeons in the assessment and surgical management of ankle fractures.

Orthopaedic trainees completed a VR task, assessing ankle fracture patterns and planning surgical fixation. Mixed methods were used to evaluate the utility of VR to assess and plan surgical fixation, assessing confidence, competence and acceptability of the tool, in addition to thematic analysis of participants feedback of the VR software.

Following the VR exercise, participant confidence classifying ankle fracture patterns increased from 3.2 to 7.2 out of 10 ( $p < 0.01$ ). Confidence in ankle fracture fixation and surgical planning increased from 3.5 to 6.6 out of 10 ( $p < 0.01$ ). Themes from semi-structured group review of the VR platform included; improved visualisation of fracture patterns, better informed planning of surgical approach and improved fixation planning.

VR represents an effective educational tool for orthopaedic ankle fracture surgery. Benefits include increased trainee confidence identifying fractures requiring surgical fixation, with VR informing surgical approach and fixation principles. Orthopaedic trainees look forward to seeing an increase in the utilisation of VR within their training.



## WINTER SCOT 2025 RESEARCH FULL ABSTRACTS

### **SCOTTISH OPEN FRACTURES OF TIBIA (SOFT) AUDIT; A MULTI-CENTRE RETROSPECTIVE REVIEW OF ORTHO-PLASTIC MANAGEMENT OF OPEN TIBIAL SHAFT FRACTURES AT MAJOR TRAUMA CENTRES IN SCOTLAND**

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Open fractures of the tibia are associated with significant complications, for which attempts have been made to standardise and optimise their management.

In the UK, this standard is the British Orthopaedic Association Standards for Trauma (BOAST) guidelines. The Scottish Open Fracture of Tibia (SOFT) Audit is a national review of open tibial shaft fractures across all four Scottish Trauma Networks, which aims to provide a definite review of ortho-plastic care for open tibial shaft fractures in Scotland.

A retrospective audit of all adult patients who sustained open tibial shaft fractures in Scotland from June 2021 to June 2023 was performed. The primary outcome measure was compliance with BOAST guidelines. Secondary outcome measures included infection, return to theatre, soft-tissue failure, and amputation.

196 open tibial shaft fractures were identified. Common complications included infection (24%), return to theatre (17%), soft-tissue failure (9.7%) and amputation (7.1%). Complete compliance with BOAST guidelines was documented in 8.8% of cases. Significant variation was seen between geographical regions of Scotland. No significance was seen between compliance to BOAST guidelines and any of the secondary outcome measures. Multivariate analysis identified Grade 3 Gustilo-Anderson injuries as significantly associated with post-operative infection, post-operative infection significantly associated with return to theatre, and return to theatre significantly associated with soft-tissue failure and / or amputation.

This study demonstrates in Scotland there is scope for improvement in cohesion with national guidance including timing of antibiotic delivery, combined ortho-plastics approach, and soft-tissue cover within 72 hours of definitive fixation.

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### **IMPACT OF CRYOTHERAPY ON DISCHARGE RATES AND PAIN MANAGEMENT FOLLOWING KNEE ARTHROPLASTY**

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Successful management of postoperative pain can lead to reduced length of an inpatient stay and decreased health care costs. This project aims to assess the impact of cryotherapy following knee arthroplasty.

This is a prospective study involving 40 patients undergoing day case knee arthroplasty from 1st March 2023 until 24th June 2024. Twenty patients were part of the control group, mean age of 62.25, and 20 in the treatment group, mean age of 61.75. The treatment group patients received a second generation cryotherapy device, used from the immediate post-operative time until after their discharge.

The results of this study show 12/20 (60%) control group patients were discharged on the same day compared to 17/20 (85%) in the treatment group. The control group had an average of 2.9 (SD 2.72) doses of Oxycodone postoperatively, compared to 1.3 (SD 1.62) in the treatment group (95% CI,  $p=0.03$ ). Postoperative pain was also calculated. The control group reported 2.7/10 pain score on postoperative day 1 and 2.4/10 on day 7. In comparison, the treatment group reported 2.4/10 on day 1 and 2.1/10 on day 7.

Decreasing postoperative pain can directly reduce the cost of treatment by reducing inpatient stay and the usage of opioid analgesia. An overnight inpatient stay costs £941 whilst a dose of per os Oxycodone tablet costs £5.15. The main cryotherapy machine used in this study is provided for free to the NHS by the producing company (£116.90) whilst the consumable materials for each patient are estimated around £45. The overall postoperative cost can be reduced from £955 for the control group to £51 for the treatment group.

Implementation of advanced cryotherapy devices as a routine practice in postoperative knee arthroplasty cases could significantly reduce the associated health care cost and postoperative pain.

### **LIMB NECROTISING FASCIITIS AND TIME TO DEFINITIVE MANAGEMENT: A 10 YEAR COHORT**

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Necrotizing fasciitis (NF) is a time-critical surgical emergency that is challenging to diagnose early; delays result in higher rates of mortality and morbidity. We reviewed all cases where NF was considered a differential diagnosis, spanning January 2015 to August 2024, from a population of 800,000. The cohort was identified from NHS Lothian electronic health records and cross-referenced with Public Health Scotland.

NF was diagnosed intraoperatively in 46 patients. 59% were male, with a median age of 51 years (IQR 45-65). Associated comorbidities included diabetes (33%), obesity (26%), intravenous drug use (15%), and smoking (37%). 24% of patients resided in the most deprived areas, with scores in the bottom quintile of the Scottish Index of Multiple Deprivation. 85% presented to the Emergency Department, where clinical suspicion was raised at a median of 4.5 hours from triage, and 80% received appropriate antibiotic therapy. Following clinical suspicion, a surgical referral was made within 0-3 hours, with a median time from triage to referral of 5.2 hours (range 0.8-104). From referral, patients reached the operating theatre within 4 hours, with a total time from admission to theatre of 9.3 hours (range 2.8-111). 76% underwent debridement, and 24% required amputation. Of the survivors, 95% (42/44) required additional surgical interventions, including three amputations. Of those undergoing debridement, 71% required reconstructive plastic surgery, while the remaining wounds healed by secondary intention with negative pressure dressing. Despite surgical management, mortality was 20% (9/46).

Timely NF diagnosis remains challenging, often leading to delays in life-saving definitive surgical management.

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### FEMORAL STEM DESIGN INFLUENCES POST OPERATIVE PERIPROSTHETIC FEMORAL FRACTURE (POPFF) AND COMPLICATION RISK: 10 TO 15 YEARS FOLLOW UP OF 3199 TOTAL HIP ARTHROPLASTIES FROM TWO INDEPENDENT CENTRES

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As postoperative periprosthetic femoral fractures (POPFF) continue to increase in prevalence, understanding the underlying associated risk factors is important. The aim was to compare the survivorship and POPFF rate of a composite beam (CB) stem with a polished taper slip (PTS) stem.

Between 2008 and 2013, 3199 consecutive THAs were performed using either the Exeter V40 (PTS, n=2177) or the Lubinus SP II (CB, n=1021) femoral stem. Patient demographics and operative details were collected prospectively. Patient records and radiographic archives were reviewed at minimum 10-years following surgery to identify subsequent revision surgery, dislocation or POPFF.

At mean 11.8-year follow-up (10 to 15), 2214 patients (984/3198) remained alive. Mean patient age at surgery was 67.6 years (SD 11.2). Analysis of all-cause THA failure demonstrated CB stem survivorship of 97.3 % (95.3%-99.2%) and PTS stem survivorship of 95.8% (94.8%– 96.8%) at 13 years ( $P=0.001$ ). POPFF accounted for 49% of major reoperations (n=36/73) in the PTS group, where 86% of POPFFs underwent ORIF. Multivariate analysis controlling for age, sex, ASA class, and mortality demonstrated that a PTS stem (HR 5.17,  $P=0.002$ ) and older patient age at surgery (HR 3.19,  $P<0.001$ ) were significant predictors of POPFF. Risk of dislocation was higher in the CB group (RR 2.1, CI 1.0 – 4.3,  $P=0.03$ ).

Patients may be counselled that POPFFs are the main cause of major reoperation following PTS stems, most often treated with ORIF. Overall survivorship remains excellent in both CB and PTS stems and other factors may influence final implant choice.

### ACCELERATING CARE FOR KNEE INJURIES: IMPACT OF A NOVEL ACUTE KNEE INJURY VIRTUAL TRIAGE CLINIC ON TIMELY DIAGNOSIS AND TREATMENT

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Knee injuries are a common presentation to Emergency Departments (ED). Timely diagnosis and management are essential to improve outcomes. Variability exists in their management using conventional pathways and significant knee injuries can go undiagnosed, or delay to treatment, for conditions in which early intervention can affect natural progression, potentially compromising patients' recovery and function.

This project presents the first 102 patients referred by the ED to an innovative, acute knee injury virtual triage clinic which was introduced to improve referral process and management of knee injuries. Data analysed includes patient demographics, types of injury, and key time intervals from injury to virtual review, clinical assessment, further imaging and any subsequent surgery.

The cohort included 48 females (47.1%) and 54 males (52.9%), with a mean age of 30.08 years. Sports-related incidents caused 41.2% of injuries (42 patients), 27 of which (26.5%) were football-related. Patients were triaged in the virtual knee injury clinic an average of 2.32 days post-injury. 10 % were discharged directly from the virtual clinic. 58% of patients underwent urgent MRI scan. Anterior cruciate ligament injury (21.5 %) was the most common diagnosis. Surgical intervention was ultimately required in 24 patients (24%) with an average time to surgery from injury of 67 days (range 5-207).

The acute knee injury virtual triage clinic and enhanced referral process offers timely review compared to traditional ED pathways and facilitates early diagnosis, clinically appropriate management plans, and is efficient use of clinical resource to optimise patient care following knee injury.



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### **THE RISE IN URGENT SUSPECTED SARCOMA REFERRALS TO A TERTIARY REFERRAL CENTRE AFFECTING CLINIC WAIT TIMES. WHAT ARE THE NEXT STEPS?**

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On average, a GP will diagnose one sarcoma during their career. NICE guidelines recommend an ultrasound (within 2 weeks) for any unexplained, enlarging lump, and urgent referral (within 2 weeks) if this demonstrates a suspicious lesion. This study evaluated referral numbers and waiting times for urgent suspected cancer (USC) between 2019-24.

The number of USC referrals to the Grampian Sarcoma service have significantly increased; 221 USC referrals were received in 2019, 502 in 2020-22 and 689 in 2022-24.

In 2019, the mean time from referral to imaging and clinic was 42 and 62 days, respectively. In 2020-22, the mean time from referral to imaging and clinic was 54 days for both. Of the 183 referrals exclusively from GPs, 41% were diagnosed as normal variations or miscellaneous musculoskeletal conditions, 22% were diagnosed as benign lesions on history and examination alone. Overall, 44% of GP referrals were diagnosed without imaging or biopsy.

In the 2019, 2020-21, 2021-22 cohorts, there were 7, 5, and 6 sarcomas diagnosed respectively.

Since 2019, referral rates have almost doubled, whilst sarcoma incidence has not. Waiting times remain significantly higher than NICE guidelines. The reduction in waiting times from 2019 to 2020-22 can be attributed to the increase in clinics provided by the Sarcoma Surgeons, however continuing this is not sustainable and will impact on treatment of sarcoma. Evidently, a transformation in the referral pathway is required to reduce clinic waiting times for actual sarcoma referrals ensuring timely diagnosis and treatment of this rare but devastating cancer.

### **FUNCTIONAL OUTCOME AFTER REVERSE SHOULDER ARTHROPLASTY FOR THE TREATMENT OF ACUTE COMPLEX PROXIMAL HUMERAL FRACTURES**

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The use of reverse shoulder arthroplasty (RSA) for proximal humeral fractures (PHFx) has expanded in recent decades. However, data on functional outcomes post-RSA for PHFx remain limited. This single-centre observational cohort study aimed to evaluate functional outcomes in patients undergoing RSA for PHFx using a single fracture specific design of RSA.

Forty-six patients who underwent RSA using a Mathys Fracture Inverse prosthesis for acute complex three and four-part PHFx and fracture dislocations from 2014 to 2023 were prospectively reviewed. Procedures were performed by four fellowship trained shoulder surgeons. Patients were assessed independently at a minimum of one-year post-op. Outcome measures included time to functional recovery, range of motion (ROM) and patient reported outcome measures using the Oxford Shoulder Score (OSS).

Five males and forty-one females were included, averaging 71.4 years of age (range: 59-85 years). The mean follow-up duration was 50.6 months (range: 16-118 months). All patients regained independent self-care, and all previous drivers returned to driving. Objective ROM showed mean values for flexion, abduction, and external rotation of 134°, 121°, and 29°, respectively. The mean OSS was 43.6/48. Patient satisfaction averaged 4.7/5, with 93% of patients reporting being satisfied or very satisfied. Three patients (6.5%) experienced complications comprising one case of radial nerve neuropraxia, and 2 (4.4%) re-operations; 1 washout for infection and 1 two-stage revision.

In this study, RSA for acute PHFx or fracture-dislocation using a fracture specific prosthesis was associated with high rates of return to independence, high satisfaction scores and favorable patient reported outcome measures.

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### **THE CLINICAL EFFECTIVENESS OF THE MODIFIED SINGLE-SCREW SCARF OSTEOTOMY IN COMPARISON TO THE TRADITIONAL TWO-SCREW SCARF OSTEOTOMY: AN OBSERVATIONAL STUDY**

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This observational study investigated the clinical effectiveness of two-screw versus single-screw scarf osteotomies in hallux valgus deformities.

Forty-eight hallux valgus deformities were reviewed between 2019 and 2024. Patient demographics, operative details, radiological outcomes, and patient-reported outcome measures (PROMs) were reported. Manchester Oxford Foot Questionnaire (MOxFAQ) and visual analogue scale (VAS) documented the PROMs. A cost analysis was conducted.

Fourteen (29.2%) cases underwent traditional two-screw osteotomies. In this group, hallux valgus angle (HVA) decreased from 37.4° to 19.6° ( $p<0.001$ ) and the intermetatarsal angle (IMA) reduced from 16.5° to 8.9° ( $p=0.004$ ). The raw MOxFAQ reduced from 37.8 to 27.4 ( $p=0.139$ ) and the VAS score decreased from 7.4 to 3.3 ( $p=0.012$ ). Complications were rare, with only 2 (14.3%) superficial infections. The remaining 34 (70.8%) cases underwent single-screw osteotomies. The single-screw group saw a HVA reduction from 34.7° to 12.6° ( $p<0.001$ ) and an IMA decrease from 15.5° to 7.8° ( $p<0.001$ ). The raw MOxFAQ score reduced from 39.4 to 10.4 ( $p<0.001$ ) and the VAS scores decreased from 6.6 to 2.5 ( $p=0.002$ ). Complications included 3 (8.8%) superficial infections, 2 (5.9%) intraoperative fractures and 2 (5.9%) cases with complex regional pain syndrome. The cost of a two-screw scarf osteotomy was £395.14 compared to a single-screw osteotomy costing £197.57.

The single-screw scarf osteotomy is non-inferior to the two-screw scarf osteotomy. Although these findings have not been widely proven, two-screw scarf osteotomies cost roughly double that of single-screw scarf osteotomies. This highlights a potential approach to reducing healthcare expenditures while maintaining patient care through financial and sustainable solutions.

### **OUTCOMES OF FIXATION OF POSTEROLATERAL TIBIAL PLATEAU FRACTURES: A RETROSPECTIVE REVIEW OF 90 PATIENTS**

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Tibial plateau fractures are common but involvement of the posterolateral aspect of the plateau occurs in only 11% of cases. This study aims to evaluate the outcomes of posterolateral tibial plateau fractures treated by internal fixation.

We reviewed a cohort of 90 patients with posterolateral tibial plateau fractures. Patient records and radiological investigations were reviewed, and patient reported outcome measures (PROMs) including the Oxford Knee Score (OKS), Lower Extremity Function Score (LEFS), a visual analogue pain scale (pVAS), and overall satisfaction were collected.

Half of the patients were male ( $n=45$ ). The mean age was 50 years and the mean follow-up was 51 weeks (4-260). There were 59 AO type B fractures (65.6%) and 31 (34.4%) were type C. High energy trauma was responsible for 59 (65%) of cases.

A standard lateral approach was used in 56 patients (62%), and combined medial and lateral approaches in 29 cases (32%). There was a significant improvement in the radiographic parameters of gap and step-off postoperatively ( $p<0.001$ ). The rates of loss of reduction, post-traumatic OA and conversion to TKR were 11.2%, 21.3% and 3.4% respectively.

Patient reported outcome questionnaires were obtained in 39 (47.6%) patients. Significant drops in function were demonstrated in the OKS ( $p<0.001$ ), LEFS ( $p<0.001$ ) and pVAS ( $p<0.001$ ). Mean patient satisfaction with the procedure was 2.5 (1= very satisfied, 5= very dissatisfied).

In summary, though surgery is effective in achieving fracture reduction, postoperative sequelae including loss of reduction, post-traumatic OA and decreased patient function are common.