

# PhD Thesis Keith Piper

## Interpretation of clinical imaging examinations by radiographers: a programme of research

### Abstract

#### Background

Studies which have investigated the interpretation of plain skeletal examinations by radiographers have demonstrated encouraging findings, however, the studies have not extended beyond this area of practice and radiographers' diagnostic performance for other more complex investigations has not been established. Comparisons of performance between groups of healthcare practitioners to date, has also been limited.

#### Aim

This research programme aimed to investigate the interpretation of clinical imaging examinations by radiographers, and other healthcare practitioners, in the provision of initial interpretations and/or definitive reports of plain imaging (skeletal and chest) and cross-sectional (magnetic resonance imaging [MRI] – lumbar/thoracic spine, knees and internal auditory meati [IAM]) investigations.

#### Methods

The eight studies utilised a variety of methodological approaches and included quasi-experimental and observational studies. One quasi-experimental study compared the performance of radiographers, nurses and junior doctors in initial image interpretation and another similar study included a training intervention; both utilised alternate free-response receiver operating characteristic curve (AFROC) methodology. Three of the observational studies investigated the ability of radiographers to provide definitive reports on a wide range of clinical examinations, including chest and MRI investigations, in a controlled environment. One large multi-centre observational study investigated the performance of radiographers, in clinical practice (A/E: skeletal examinations) during the implementation of a radiographic reporting service. The agreement between consultant radiologists' MRI reports of lumbar/thoracic spine, knee and IAM examinations was investigated in another observational study. The final study compared the reports of trained radiographers and consultant radiologists, with those of an index radiologist, when reporting on MRI examinations of the knee and lumbar spine, as part of a prospective pre-implementation agreement study.

## Results

The first AFROC study demonstrated statistically significant improvements after training, for radiographers ( $A_1=0.55 - 0.72$ ) and nurses ( $A_1=0.65 - 0.63$ ), although the radiographers maintained a better overall performance post training ( $p=0.004$ ) in providing an initial image interpretation of trauma radiographs of the appendicular skeleton. Radiographers also achieved statistically higher ( $p<0.01$ ) AUC values ( $A_1=0.75$ ) than nurses ( $A_1=0.58$ ) and junior doctors ( $A_1=0.54$ ) in the second AFROC study.

Three studies, which examined 11155 reports, were conducted under controlled conditions in an academic setting and provided evidence of radiographers' high levels of accuracy in reporting of skeletal A/E (93.9%); skeletal non A/E (92.5%); chest (89.0%); MRI lumbar/thoracic spine (87.2%), knees (86.3%) and IAM (98.4%) examinations.

In the multi-centre clinical study, the mean accuracy, sensitivity and specificity rates of the radiographers reports ( $n=7179$ ) of plain examinations of the skeletal system in the trauma setting was found to be 99%, 98% and 99%, respectively.

The considerable range of values for agreement, between consultant radiologists reports of MRI examinations of the thoracic/lumbar spine ( $k=0 - 0.8$ ), knee ( $k=0.3 - 0.8$ ) and IAM ( $k=1.0$ ) was similar to other studies and resulted in a reasonable estimation of the performance, in the UK, of an average non specialist consultant radiologist in MRI reporting. In the final study, radiographers reported in clinical practice conditions, on a prospective random sample of knee and lumbar spine MRI examinations, to a level of agreement comparable with non-musculoskeletal consultant radiologists (Mean difference in observer agreement  $<1\%$ ,  $p=0.86$ ). Less than 10% of observers' reports (radiographers and consultant radiologists) were found to be sufficiently discordant to be clinically important.

## Conclusion

The outcomes of this research programme demonstrate that radiographers can provide initial interpretations of radiographic examinations of the appendicular skeleton, in the trauma setting, to a higher level of accuracy than A/E practitioners. The findings also provide evidence that selected radiographers with appropriate education and training can provide definitive reports on plain clinical examinations (A/E and non A/E referral sources) of the skeletal system and the chest; and MRI examinations of the knee, lumbar/thoracic spine and IAM to a level of performance comparable to the average non specialist consultant radiologist. Wider implementation of radiographer reporting is therefore indicated and future multi-centre research, including economic evaluations, to further inform practice at a national level, is recommended.