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Detection of distal ulna and radius fractures using thermal imaging as a diagnostic tool on children in the Emergency Department setting.

By

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Abstract

Aims of the study

The aim of this pilot study was to examine whether a full phase III study would be beneficial in determining whether thermal imaging can be used as a diagnostic tool to detect distal ulna and radius fractures in children who attend the emergency department with an injury to their wrist when compared with the gold standard of X-rays.

Methods: Following ethical approval and informed consent, patients meeting the inclusion criteria with injuries to their distal forearms were recruited in to this investigation. The pilot study design was a quasi-experimental controlled trial of 67 patients evaluating whether thermal imaging could detect fractures in children's distal ulna and radius. All patients enrolled into this trial were treated in accordance with the European Thermography Association standard for carrying out diagnostic studies using infra imaging (Clark & DeCalcina-Goff, 1997). All of the children enrolled into this study had thermal images taken of their injured arm (case) and their uninjured arm (control). The thermal imaging took place alongside the X-ray, ensuring that the same person conducted the positioning of the child's wrist, thus ensuring consistency in image capture. The child was then treated appropriately in accordance to the X-ray results. The data from the thermal imaging was not analysed for six-months post the child's attendance at the ED in order to reduce the chances of interpreter bias.

Results: The results from this study found that there was a statistically significant difference in surface temperature of the injured arm when compared to the control (mean difference 0.90°C, 95% CI: 0.72 to 1.07, $p < 0.0001$). The magnitude of the difference is significant enough to suggest that a pathological change had taken place. Thirty-one out of thirty four children diagnosed with fractures on X-ray showed a

surface temperature difference of 1°C or greater when compared with the control (mean difference = 1.28, 95%CI .889 to 1.689). When the fracture group was compared with the injured non-fractured group, a mean difference of 1.084 °C (95% CI = 0.62 to 1.54,$p<0.0001$) was found. When compared with radiographs, thermal imaging returned a sensitivity of 91.18 % with a specificity of 87.85%; the sensitivity is increased to 96.7 % when the clinical examination is taken into account. In this study the likelihood ratio for the positive test was calculated to be 7.52 %. The negative likelihood ratio was calculated to be 0.1 %.

Conclusion:

This study has shown that thermal imaging may be useful in detecting fractures of the distal ulna and radius in children's wrists, however its diagnostic accuracy is questionable, returning a sensitivity of only 91.8% when compared with X-rays (96.8%) however,when used alongside clinical examination the results demonstrate a sensitivity of up to 96.7%. This study has demonstrated that thermal imaging can detect quantifiable differences in temperature, between an uninjured wrist, a soft tissue injury and a fracture. However its accuracy in diagnosing a fracture cannot be guaranteed and does not reach the accuracy of X-rays, which are considered to be the current diagnostic gold standard. A full phase III multi centered study would be useful in determining whether thermal imaging could be a useful adjunct to the diagnosis of fractures within the wider health care setting, to elucidate whether thermal imaging has a role in reducing the amount of unnecessary x-rays carried out on children with suspected fractures to their wrists.

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Declaration

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

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Acknowledgement and Dedication

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Dissemination:

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