EQUIPMENT REVIEW

Liquid crystal thermography in the diagnosis of scaphoid fractures

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INTRODUCTION

Liquid crystal thermography (LCT) is a quick, simple, non-invasive and inexpensive technique. It has been shown to be of use in the diagnosis of stress fractures (Devereaux *et al.*, 1984) and also in the diagnosis of deep venous thrombosis (Cook & Pilcher, 1974; Sandler & Martin, 1985). The present authors have assessed the performance of LCT in the diagnosis of scaphoid fractures.

MATERIAL

LCT consists of pliable latex sheets impregnated with cholestrol crystals which respond to different temperatures by emitting different wavelengths of light ranging from brown (cool) through yellow and green to blue (hot). These latex sheets form one wall of a sealed box with the opposite wall being made of perspex to allow the thermographic image to be viewed. The thermographic detectors are calibrated to react to different temperatures. Each one has a mean temperature and responds 2°C above and below this mean. There are eight detectors which respond to mean temperatures of 24, 26, 28, 29, 30, 31, 32 and 33°C.

Each box is airtight and has a valve through which air can be pumped to make the pliable latex sheet assume a convex contour which can be moulded around the subject under study. The box is held in a frame with a polaroid camera and a flash unit, thus a permanent picture of the thermographic image can be obtained (Novamedix Ltd, Whitchurch, England).

METHOD

Fifty patients presenting to the Accident and Emergency Department, Royal Hallam-

Fig. 1 Wire frame mounted on wall with hands positioned to present the anatomical snuff box.

shire Hospital, Sheffield, England, with a clinical diagnosis of fracture of the scaphoid were studied.

On day 10 following injury, both hands were rested on a wire frame in such a way as to present the anatomical snuff box. The frame was mounted on a wall to ensure elevation of the wrists in order to prevent venous pooling (Fig. 1).

After 1 min the thermographic detector was placed on the wrists and held until an image formed (Fig. 2). The detectors were changed until the image contained all of the colours indicated by the scale on the side of the detector. This allows the accentuation of any difference in temperature between the two limbs, irrespective of the ambient temperature.

The assumption is made that fractures are associated with increased vascularity and that this causes a difference in skin temperature between the injured and uninjured limb; it is this difference that is detected by LCT. Criteria for the interpretation of thermograms have been described (Cooke and Pilcher, 1974). A thermogram is considered positive if there is a homogenous area of increased temperature in the symptomatic limb compared with the symptomless limb (Fig. 3a). The scan is negative if there is a symmetrical temperature pattern in the two limbs (Fig. 3b).

Fig. 2 The equipment in place with the wrists correctly positioned, camera and flash unit mounted for photography.

Fig. 3 Polaroid film of scan. The different colours represent varying temperatures with brown (1) indicating cooler areas and green (2) and blue (3) hot: (a) shows a positive scan with a hot (blue) area in the region of the anatomical snuff box; (b) shows a negative scan with no difference between the two limbs.

RESULTS

Comparing LCT with conventional radiology the authors found there were three false negatives giving a sensitivity of 77% with seven false positive scans giving a specificity of 82%. The overall accuracy was 80%. If the scan is negative, then the negative predictive value is over 90%.

DISCUSSION

Liquid crystal thermography is a simple, quick and inexpensive technique, costing approximately £4000 for a complete system.

It is painless, there are no side effects and no exposure to radiation. The technique is non-specific and, as with all non-invasive techniques, has a degree of false positive and false negative results.

However, along with the other uses of LCT, i.e. in DVT (Sandler & Martin, 1985) and stress fractures (Devereaux *et al.*, 1984), the authors feel this would be a useful piece of equipment in the accident and emergency department.

REFERENCES

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