4. Thermographic screening for scoliosis in adolescents

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SUMMARY. An on-going study into the possible application of thermography as a screening technique for idiopathic scoliosis is discussed. Preliminary results are presented, describing tbermograpbic patterns observed in both an asymptomatic group, comprised of schoolchildren who took part in a pilot screening study, and a symptomatic group.

Temperature contours over normal backs form a characteristic Y with a high degree of symmetry about the spine. In the obese the Y pattern is often found to develop into a *patterns, but symmetry is maintained. In patients suffering from scoliosis the thermographic symmetry is destroyed, and skin on the concave side of the curve is found to be raised in temperature. A particularly important observation is a marked asymmetry in anterior thermograms of scoliosis patients.

Key words: thermography; scoliosis.

Introduction

The possibility of thermographic screening for adolescent idiopathic scoliosis is being studied by the Thermography Unit at Saint Bartholomew's Hospital.

Adolescent idiopathic scoliosis is a distressing condition mainly affecting girls and describes a lateral curvature of the spine. It affects the lumbar and thpracic portions of the spine and occurs in otherwise normal, healthy children. Often the curve is associated with a rotation, and the spine can deteriorate seriously within a few years of the initial observation.

The aetiology of scoliosis has been discussed by James [1]. In boys, the age of onset is mainly within the first years of life, and when occuring in the first 3 years is termed infantile. Juvenile scoliosis is said to occur between the ages of 4 and 9 years, and adolescent idiopathic scoliosis is used for the 10 + age group. The incidence of adolescent idiopathic scoliosis peaks at about 14 years of age. However, these divisions are not merely convenient categories for the age of onset.

In infantile idiopathic scoliosis the curve is eight or nine times more common to the left, but in adolescence the curve is eight or nine times more common to the right. The following procedure is experimental, and the findings are preliminary. However it is hoped that thermography may prove to be of clinical value as more experience is gained.

Procedure for thermographic examination of the back

The procedure used is based upon the recommended procedure for the A-D study group (to be published). For thermography of the back, patients are asked to undress completely, and long hair is tied up. Equilibration in the standing position is preferred to sitting. If the patient must be seated, then the back should not touch any supporting surface. Lateral views have not been recorded so the arms are allowed to rest at the side of the body. Measurement, is carried out in a room at 19 ± l°C, after a 15 minute equilibration period. Care is taken to ensure that the patient's skin is free from oils and ointments. Cosmetics, particularly talcum

powder, are commonly used by adolescent girls.

The examination is carried out using an AGA 680 medical thermographic camera with a 15° X 15° lens. Thermograms are taken with the patient standing, arms resting by the side of the body. A temperature calibration source set at 32" C is included in the field of view, and a IO-colour isothermogram is recorded by photographing the image displayed on an AGA colour monitor. Temperature sensitivity of 0.5°C per colour was generally used, but on occasions thermal asymmetry can be more obvious using 1°C per colour. Monochromatic thermograms are also of value for displaying the locus of local maxima, and we routinely take monochromatic thermograms to accompany colour isothermograms.

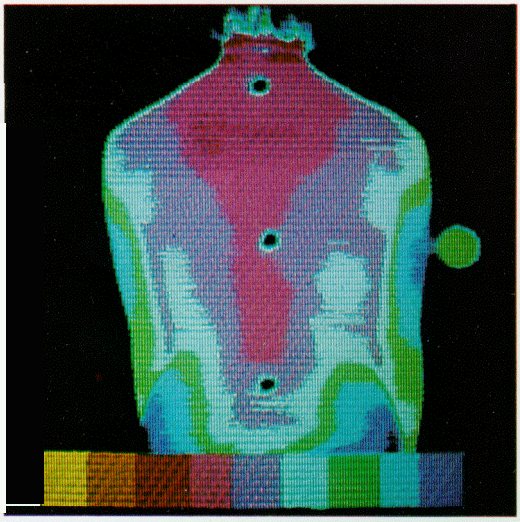

Fig. 1. Typical colour isothermogram of the Y pattern associated with normals. Sensitivity 1 °C/ colour. Temperature reference = 32 "C.

Screening study

66 boys and 47 girls have been examined on site at a large London comprehensive school in an effort to examine the feasibility of a school screening programme. The described procedure was found suitable for a mass screening programme, although the equilibration time was reduced to 10 minutes due to the numbers involved: 113 examinations in three days. Very few problems were experienced due to inadequate cooling.

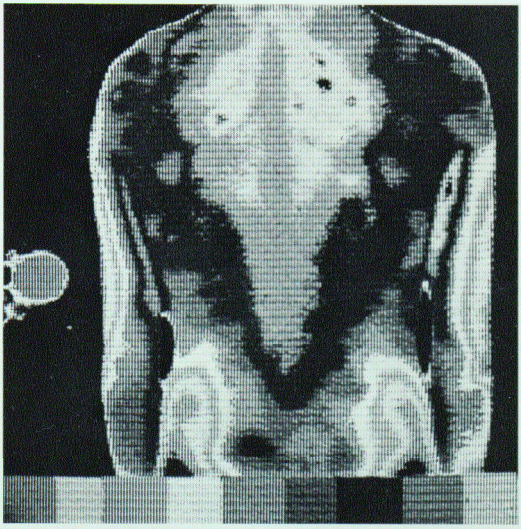

Fig. 2. Monochrome print of a colour isothermogram showing the V pattern, believed to be a normal variation of the Y pattern. Sensitivity 0.5°C/ colour. Temperature reference = 32 °C.

Thermographic patterns of the back

To date, six types of thermographic patterns have been recorded. These do not include sacro-iliac disease, or localised patterns due to spinal injury or metastases.

The normal thermographic pattern is characterized by a Y-shape, the high temperature over the vertebral column fanning out in the interscapular region (Fig. 1). A variation of the Y pattern which is sometimes seen is the V pattern, illustrated in Figure 2. In the obese, this pattern is modified to the T-shape, illustrated in Figure 3. Idiopathic scoliosis seems to be commonly associated with an area of increased temperature on the concave side of the curve (Fig. 4). In a symptomatic group, thermographic patterns have been found similar to the pattern reported by Abernathy, Ronan and Winsor[2] resulting from coarctation of the aorta (Fig. 5). The sixth pattern, observed during the

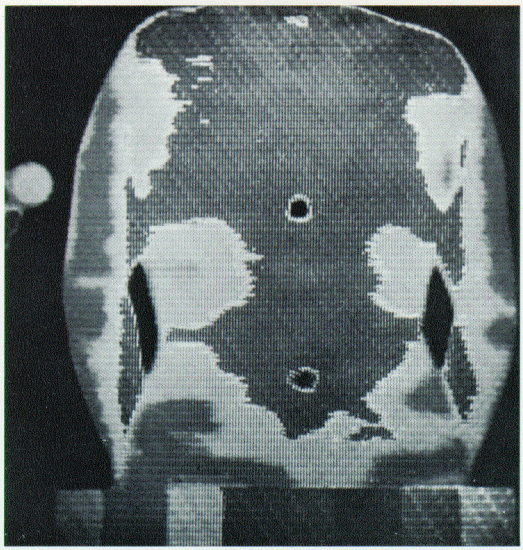

Fig. 3. Monochrome print of a colour isothermogram illustrating the effect of obesity on the normal thermographic pattern. Sensitivity 1°C/colour. Temperature reference = 32 °C.

Fig. 5. Monochrome print of a colour isothermogram illustrating the ↑ pattern. Sensitivity 0.5 °C/colour. Temperature reference = 32 °C.

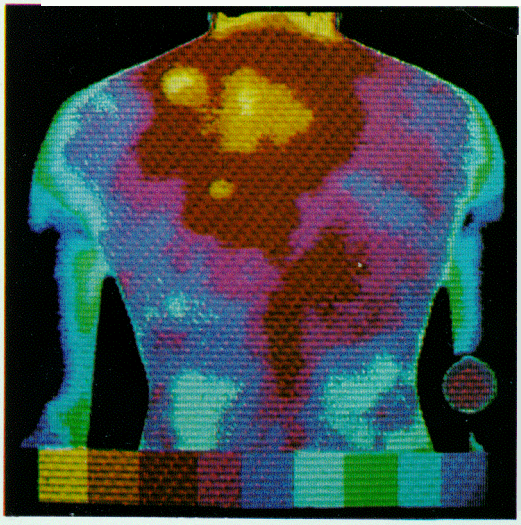

Fig. 4. Colour isothermogram showing the basic Y pattern associated with adolescent idiopathic scoliosis. Sensitivity 0.5 °C/colour. Temperature reference = 32 °C.

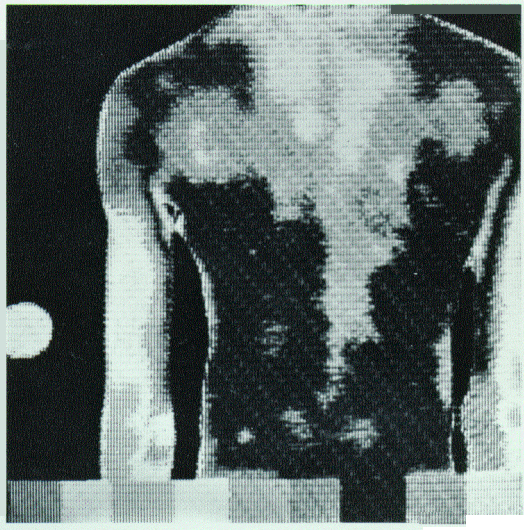

Fig. 6. Monochrome print of a colour isothermogram illustrating the Y pattern. Sensitivity 0.5 °C/colour. Temperature reference = 32 °C.

screening survey, is a Y which represents a band of increased temperature running down one side of the spine (Fig. 6), the significance of which is yet undecided.

In addition a marked asymmetry of the anterior view in scoliosis patients has been found (Fig. 7). but this also awaits further study.

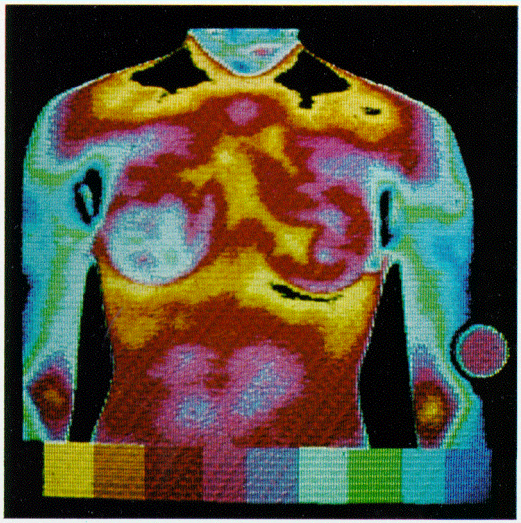

Fig. 7. Colour isothermogram illustrating the marked aaymmetry of anterior thermograms caused by scoliosis. Sensitivity 0.5 °C/ colour. Temperaturc reference = 32°C.

Future directions

Much further work remais to be carried out and the school screening study analysis will raise even more questions. It is not known to what extent abnormal patterns can be expected in a normal population or to what degree thermal asymmetry correlate with disease activity. Nor is it certain whether the pattern remains after the spine has stabilized. Serial examinations of both the symptomatic group and the asymptomatic group, may possibly answer some of these questions and lead to an understanding of the cause of the thermal asymmetry.

Thermographic examination of the back, as with all thermographic examinations, can involve several different clinical specializations, but the thermal patterns may carry a great deal of information which demands further exploration.

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