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## A CLINICAL AND THERMOGRAPHIC STUDY OF LATERAL EPICONDYLITIS

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### SUMMARY

The diagnosis and management of many soft-tissue lesions remains difficult largely as a result of a lack of objective assessment. It is considered that thermography may fulfil this role.

During a therapeutic study of 56 tennis-elbow lesions, detailed clinical assessment was supplemented by serial thermography of the lateral elbow. A characteristic localized thermographic abnormality was found in 53 of the 56 affected elbows and only 3 of 60 (120 elbows) normal age- and sex-matched controls. Microcomputer analysis of the thermal gradient slope across the abnormal area showed a correlation with clinical state, reflecting recovery, and revealing a much smaller diurnal variation than was seen in the solely temperature-based parameters.

Clinical features do show some variability both with regard to the site of tenderness and degree of involvement of supination and pronation. While these differences may have pathological significance they do not appear to have prognostic importance.

Thermography is a useful objective method for assessment of tennis elbow and may aid the investigation and understanding of other soft-tissue lesions.

**KEY WORDS:** Epicondylitis, Thermography.

SOFT-TISSUE conditions constitute a significant proportion of the work load in general practice and in orthopaedic and rheumatology departments (65% of patients seen in the general rheumatology department in Cambridge). In industry they lead to lost productivity (1). They rarely justify or are amenable to biopsy or surgery so pathogenesis and pathology remain in doubt. Even when surgery is performed as in the case of resistant lateral epicondylitis, it is unclear if the histological appearances are representative of the majority of lesions which can resolve spontaneously or after conservative therapy. The preceding treatment may also modify the pathological appearance.

Whilst chronic repetitive activity is said to cause lateral epicondylitis its aetiology remains unclear. An enthesopathy (2) has recently been suggested as a unifying pathological basis for lesions including humeral epicondylitis and shoulder tendinitis but many other histological changes have been reported (3). Cervical spine disease with radiculopathy may mimic soft-tissue lesions like tennis elbow (4, 5), posterior interosseous nerve entrapment may have similar features (6, 7).

Investigation of most of these lesions has been hampered by lack of objective reproducible assessments which permit serial review. As a pilot study of tennis elbow suggested that thermography may produce a consistent abnormality this lesion was chosen for further study. Whilst its clinical diagnosis is usually simple, some differences in the site of localized tenderness have been noted (8).

Our aim was therefore to examine the clinical and thermographic features of tennis elbow with regard to their diagnostic and prognostic significance and the possible application of thermography to the investigation of other soft-tissue lesions.

### PATIENTS AND METHODS

Fifty patients with 56 tennis-elbow lesions were included in a therapeutic study of ultrasound, steroid injection and mock ultrasound (placebo). Criteria for inclusion were localized tenderness near the lateral epicondyle and pain on resisted wrist dorsiflexion.

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Patients with localized or generalized arthritis, abnormal ESR, positive Rose-Waaler or neurological symptoms or signs in the affected limb were excluded. Clinical assessment of severity at each visit included five parameters judged from 0 to 3. Severity of localized tenderness, pain on resisted wrist dorsiflexion, supination/pronation and ability to lift weights of  $\frac{1}{2}$ , 1, 2 and 4 lbs (0.23, 0.45, 0.90 and 1.80 kg) (weight test) were assessed. Grip strength was also performed with the elbow extended and forearm pronated. Summation of the parameters gave an overall clinical score. The exact site of tenderness and presence or absence of pain on resisted pronation and supination were recorded.

AGA 680M thermographs were taken of the lateral aspect of both elbows after 15 min stabilization at 20°C. All thermographs were taken at 1 m using a 0.5°C sensitivity setting. Data were then analysed via an OSCAR interface and recorded on tape, allowing numerical analysis of the grey areas in an area of interest (of constant size) using an Apple II microcomputer. The box centred over the abnormal area (position A) permitted mean and maximum temperature to be measured. Moving the box medially (position B) permitted the slope of the thermal gradient with distance to be calculated (Fig. 1).

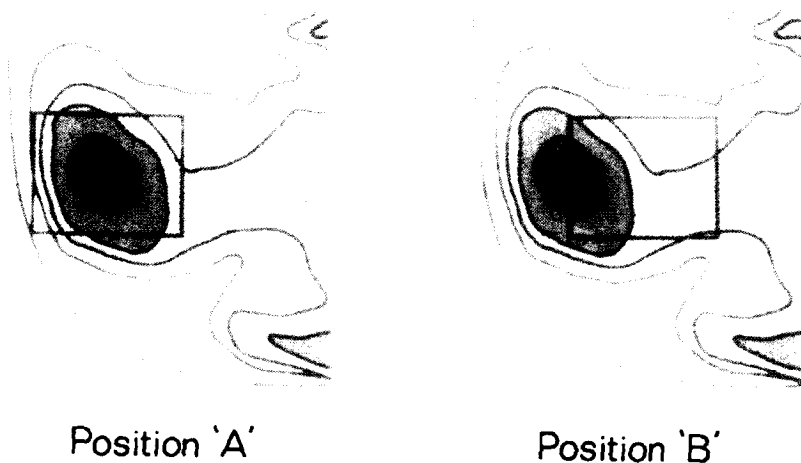


FIG. 1.—Positions of the region of interest for analysis of the thermographic data.

Patients were reviewed fortnightly until asymptomatic for at least 1 month, but thermographic analysis is based on the initial visit and the visit at 6 weeks (or on discharge if earlier). Ten patients were thermographed in the morning and afternoon and 60 age- and sex-matched normal controls (120 elbows) were also thermographed.

## RESULTS

### *A. Clinical*

Of the fifty patients, 34 were female and 16 male, the dominant arm was involved in 40 cases, the nondominant in four cases and six were bilateral. Mean age was 43 years and mean duration at presentation 4.5 months (range 1–12 months). Trauma initiated symptoms in three cases, eight were attributed to sport and seven to manual work, 38 had a spontaneous onset.

Tenderness was anterior to the lateral epicondyle in 39 patients (70%), posterior in 11 (19%) and variable in six (11%), but this did not correlate with pain on pronation or supination or other clinical or thermographic features and did not influence the response to local therapy.

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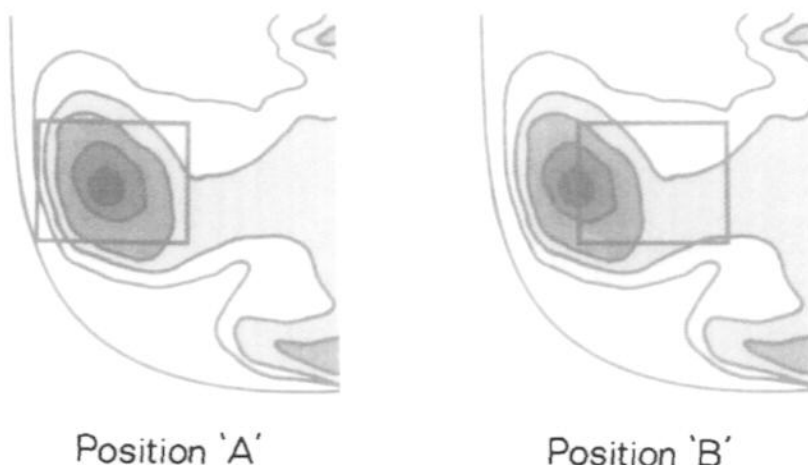


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*B. Thermographic*

Thermography of the affected elbow showed a discrete localized area of increased heat near the lateral epicondyle ('hot spot') in 53 of the 56 affected elbows, the centre being 1–3°C above the background isotherm (Fig. 2). A similar abnormality was found in only three of the 120 control elbows, the lesion never being more than 1°C above the background.

Contingency table analysis showed the difference to be significant ( $\chi^2 = 145.0$ ,  $p < 0.0001$ ). The normal pattern showed no specific features near the lateral epicondyle, although a negative thermal gradient was often present from the elbow joint towards the olecranon (Fig. 3).



FIG. 2.—Thermographic abnormality in tennis elbow.



FIG. 3.—Thermograph of the normal elbow.

A clear diurnal variation was detected in all 10 patients—the temperature tending to rise through the day (Table I). Both mean temperature and peak frequency showed a significant increase in the afternoon over the morning temperature. Maximum temperature also increased but this increase did not reach significance ( $p < 0.1$ ). Gradient slope analysis, however, showed minimal diurnal change ( $p > 0.5$ ) and also correlated well with the severity of the condition and reflected recovery ( $r = 0.49$ ,  $p < 0.02$ , Fig. 4). Mean and maximum temperature and peak frequency did not show this correlation.

Sixteen patients (30%) with unilateral tennis elbow also had a hot spot near the lateral epicondyle in the unaffected side, two later developing pain. The morphology of the hot

TABLE I  
DIURNAL VARIATION IN THERMOGRAPHIC PARAMETERS OF TEN TENNIS-ELBOW LESIONS

	a.m.		p.m.		Paired t test p
	$\bar{x}$	SD	$\bar{x}$	SD	
<i>Box position A</i>					
Mean temperature	30.84	0.94	31.88	0.69	<0.05
Maximum temperature	31.29	0.93	31.80	0.72	<0.1
Peak frequency	30.83	0.92	31.49	0.83	<0.02
<i>Box position B</i>					
Gradient slope	0.41	0.14	0.46	0.14	>0.5

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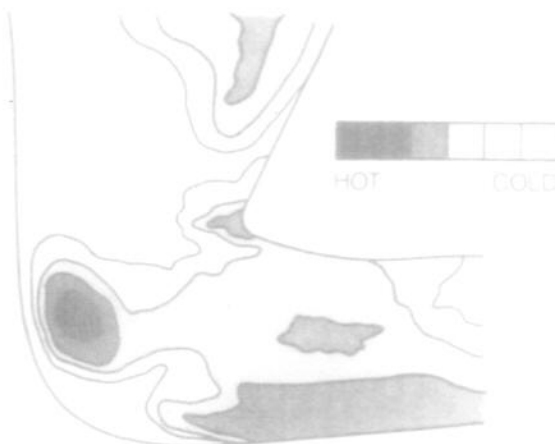


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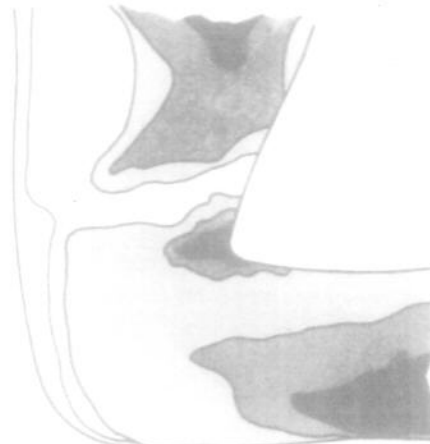


FIG. 3.—Thermograph of the normal elbow.

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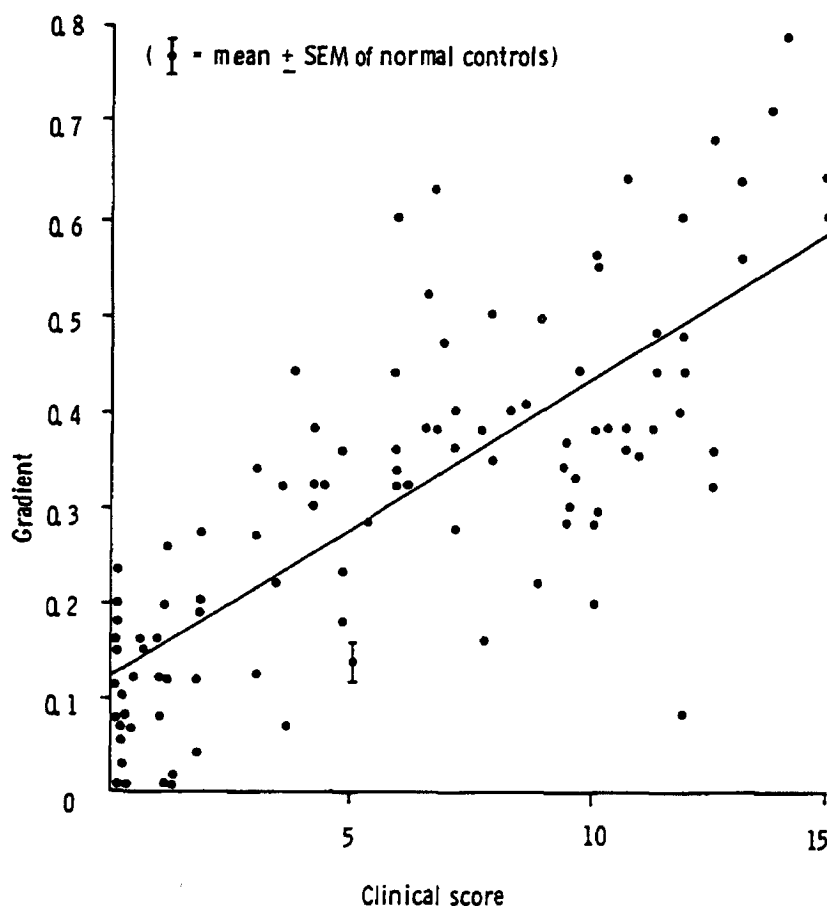


FIG. 4.—Correlation of thermographic gradient slope and clinical score.

spot was always similar to the affected side, but the peak temperature and gradient slopes were less.

#### *C. Clinical/thermographic outcome*

Mild ache and/or tenderness often persisted for weeks or months after full functional recovery (i.e. normal grip strength, weight test and painless resisted wrist dorsiflexion). Thermography reflected the clinical improvement with a fall in the peak temperature, the localized lesion often increasing in size before merging with muscle heat. Thermographic lesions persisted on discharge in 18 patients—nine still having clinical tennis elbow and others having continuing ache and/or tenderness (Table II). Seven contralateral elbows were also still abnormal on discharge. The three patients with consistently negative thermography failed to respond to local therapy—two later complaining of neck pain.

### DISCUSSION

Lateral epicondylitis produces some variability in the site of local tenderness and severity of pain on resisted supination and pronation. Whilst these differences may reflect different underlying pathology, they did not seem to influence the response to therapy nor



TABLE II  
CLINICAL AND THERMOGRAPHIC FEATURES ON DISCHARGE

Clinical features	Thermography		
	No.	Abnormal	Normal
Persistent tennis elbow	12	9	3*
Ache after use	17	2	15
Localized tenderness	7	5	2
Asymptomatic	20	2	18

\*All three remained persistently normal.

help in prognosis. The thermographic abnormality described was present in over 98% of painful elbows (irrespective of the site of tenderness), and analysis of the gradient across the abnormal area showed good correlation with clinical severity. The gradient slope showed far less diurnal fluctuation than the temperature-based parameters. Similar thermographic changes were found in over 30% of the asymptomatic contralateral elbows and only 3% of the normal controls and may indicate an underlying susceptibility in these patients, or more likely reflect the stress placed on the asymptomatic arm in order to protect the painful arm.

Cervical spine radiographs were no different from age- and sex-matched controls but a persistently normal thermograph in patients with clinical tennis elbow may reflect an undetected cervical root lesion. While the pathology of tennis elbow remains controversial, we feel that thermography mirrors clinical severity and offers definite possibilities for prospective study of this and other soft-tissue lesions and their noted associations.

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