THERMOGRAPHIC DIAGNOSIS IN ATHLETES WITH PATELLOFEMORAL ARTHRALGIA

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Pain in front of the knee is common in athletes and is often called patellofemoral arthralgia, but it is difficult to prove that the pain arises in that joint. Thermograms of 30 athletes clinically considered to have patellofemoral arthralgia were compared with those of a similar number of unaffected athletes matched for age and sex. A comparison was also made with thermograms of two older groups of 30 patients with knee involvement from either rheumatoid arthritis or osteoarthritis.

Twenty-eight of the athletes with patellofemoral arthralgia had a diagnostic pattern on thermography. The anterior knee view showed a rise in temperature on the medial side of the patella and the medial knee view showed that this temperature rise radiated from the patellar insertion of the vastus medialis into the muscle itself. The possible aetiological role of quadriceps muscle imbalance in athletes with patellofemoral arthralgia is discussed in relation to these findings.

Patellofemoral arthralgia occurred in 6% of patients attending the Cambridge Sports Injury Clinic (Devereaux and Lachmann 1983). The clinical diagnosis was often difficult to confirm. Radiology does not demonstrate cartilage damage until the later development of chondromalacia (Ficat and Hungerford 1977). Difficulties have also been encountered in confirming the clinical diagnosis by arthroscopy. Leslie and Bentley (1978) could find no abnormality with arthroscopy in 49% of knees which on clinical criteria were considered to have chondromalacia patellae.

Darracott and Vernon-Roberts (1971), reviewing the pathology of patellae removed for chondromalacia, noted osteoporotic changes in the trabecular bone which they considered were possibly due to derangement of the blood supply. Björkström and Goldie (1980), in a study of the arterial supply to the patellae, found that with an increasing degree of cartilage damage there was a corresponding change in arterial architecture, the vessels becoming more irregular and anastomotic. This would be expected to cause a temperature rise in the patellae of patients with patellofemoral pain and such an increase has been confirmed by thermography (Davidson and Bass 1978).

In the absence of accurate methods of confirming the diagnosis, effective treatment of athletes with patellofemoral pain is often difficult. This study attempts to define the thermographic pattern found in these patients and relates the findings to a possible aetiology for their symptoms.

PATIENTS

Thirty patients were included in the study. Thermography was performed if all the following symptoms and physical signs were present: (a) retropatellar pain related to exercise and aggravated by using stairs or by prolonged sitting with flexed knees; (b) pain on patellar compression against the femoral condyles with the knee extended; (c) medial patellar tenderness; and (d) pain on resisted patellar movement when the quadriceps was contracted whilst the patella was forcibly held downwards. Patients were excluded if they had any history of direct trauma to the patella or had had an episode of patellar dislocation.

These 30 patients were compared with 30 other athletes, matched for age and sex, who had clinically normal knees. Two other groups, each consisting of 30 older patients with rheumatoid arthritis or osteoarthritis of the knee, also had thermography performed.

METHODS

An AGA 680M Thermovision system was used with an OSCAR interface to record thermograms on magnetic tape as a digital image for later analysis with a GEMS image processor. Thermograms were taken with the patient seated after 15 minutes stabilisation at 20°C and at a distance of one metre from the camera. The anterior, medial and lateral aspects of both knees were viewed in each patient.
These thermograms use a seven-colour code from blue to white, increasing in temperature at 0.7°C increments. The circular calibration marker is a hot body fixed at 31°C, but the instrument has to be adjusted because the patient’s temperature varies; i.e., if the patient is cooler the reference will appear as a hotter isothermic colour, and vice versa.

The four illustrations on the left show both knees from in front; those on the right show one knee from the medial side.

**RESULTS**

In thermograms of the 30 athletes with normal knees a uniform pattern was noted. Thermography of the normal knee shows on the anterior view (Fig. 1) that the patella acts as a heat shield; the medial view (Fig. 2) shows gradual cooling from thigh and calf muscle towards the patella. Osteoarthritic knees (Figs 3 and 4) and rheumatoid knees (Figs 5 and 6) show diffuse increases in heat.

The athletes with patellofemoral arthralgia were 18 male and 12 female patients with a mean age of 23.3 years (range 11 to 51 years). Symptoms and/or signs involved the right knee in 18, the left in four and were bilateral in eight. All patients had normal radiographs of both knees, including skyline views of the patella. These athletes show, on the anterior view (Fig. 7), an increase of heat medially beside the patella, corresponding to the site of tenderness. The medial view (Fig. 8) shows an
increase in heat arising from the patella and radiating into the vastus medialis muscle.

Of these 30 patients, 28 showed this pattern in the painful knee. In six patients clinically considered to have unilateral involvement, the thermographic abnormality was found to be bilateral, but the asymptomatic side was less hot. Two patients had negative thermograms but no difference in the presentation or progress of these patients was noted.

With physiotherapy exercises and faradic stimulation to the vastus medialis muscle all the patients were asymptomatic at a three-month follow-up. As symptomatic improvement occurred, the heat abnormalities noted on thermography disappeared.

DISCUSSION

We have confirmed the thermographic findings of Davidson and Bass (1979) who reported that the patella is warmer in patients with patellofemoral pain. However, we did not find asymmetric patterns as helpful as they did, because there was bilateral involvement in 47% of our patients. In six patients this was not appreciated clinically, indicating that the thermographic abnormality may present before the development of significant symptoms.

The pattern we have described would appear to be diagnostic of patellofemoral arthralgia. A difference could certainly be detected between normal athletes, athletes with patellofemoral pain, and patients with rheumatoid arthritis or osteoarthritis. The abnormalities in thermographic pattern can be quantified to monitor progress in arthritis (Salisbury et al. 1983). With thermography we found a sensitivity of 93% and a specificity of 100% for patellofemoral arthralgia with the four different groups. The rise in temperature medially on the anterior view has not been commented upon previously although it can be seen in several of the figures from the previous thermographic study of patellofemoral pain (Davidson and Bass 1979).

In athletes it has been suggested that the symptoms of patellofemoral arthralgia are due to an extensor mechanism dysfunction (Dehaven, Dolan and Mayer 1979). Vastus medialis muscle inefficiency has been noted (Outerbridge and Dunlop 1975); when this muscle is treated with exercises (Kettelkamp 1981) and faradism (Williams and Street 1976), there is a reduction in the patellofemoral pain. Many other causes have, however, been postulated for chondromalacia patellae (Outerbridge and Dunlop 1975).

Thermography has demonstrated inflammation in the vastus medialis muscle extending to the patellar insertion. A similar pattern has been described at the insertion of the forearm extensor muscles in lateral humeral epicondylitis (Binder et al. 1983). The aetiology of tennis elbow is believed to be overexertion of the wrist extensors. Similarly, in athletes with patellofemoral arthralgia the vastus medialis may be overstretched by overdevelopment of the vastus lateralis. Such a mechanism would explain the pain in athletes who have no evidence of chondromalacia patellae on arthroscopy.

Many training programmes for athletes aim at strengthening the quadriceps muscle with the knee bent rather than straight. The vastus medialis contracts fully only in the last 10° to 15° of knee extension. Thus, training can result in the overdevelopment of the obliquely acting lateral component of the quadriceps muscle relative to vastus medialis (Sperryn 1983). This produces a relative weakness of the vastus medialis. In our patients we found that, as the power of the vastus medialis improved with specific physiotherapy, both the symptoms and the abnormal thermographic patterns gradually resolved. This would suggest that the strengthened vastus medialis muscle now balances the previously excessive lateral pull being exerted at the patella. The incidence of patellofemoral arthralgia in athletes may therefore be reduced if more attention is given to correct training of the quadriceps muscles.

Thermography is a rapid, non-invasive, and inexpensive method of confirming the clinical diagnosis of an incapacitating problem; results confirm its sensitivity and reproducibility. Radiology and arthroscopy can be reserved for the investigation of patients with an atypical thermogram or those who fail to improve after an adequate programme of vastus medialis exercises.

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REFERENCES


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