

The use of specially padded hosiery in the painful rheumatoid foot

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SUMMARY. Rheumatoid arthritis (RA) in the foot leads to foot deformity resulting in high forefoot pressures and pain. We have studied the potential of two types of specially padded hosiery (high and medium density padding) to provide pressure and pain relief in such patients. Foot pressures were measured in 18 patients with RA (mean age 56 years, range 30-71 years) using an optical pedobarograph. Pain was assessed by a visual analogue scale. Significant pressure reduction was found with the experimental hosiery (high density padding) compared to barefoot (10.8 ± 1.1 vs 15.9 ± 1.5 kg.cm⁻², (mean \pm SE); $P < 0.001$) but no difference existed between walking socks (medium density padding) and bare footsteps (12.4 ± 1.5 vs 14.1 ± 1.5 ; $P = \text{NS}$). Significant pain relief was reported in a 6-month cross-over trial of both types of hosiery, compared to their usual socks. We conclude that specially padded hosiery may be useful in providing pressure and pain relief in the painful rheumatoid foot.

Significant foot disease is present in more than 30% of patients with rheumatoid arthritis (RA).¹ Synovitis affecting metatarso-phalangeal joints causes pain, which is often an early symptom of RA. At later stages joint capsular and ligament involvement leads to disposition of the fibrofatty cushion which normally lies under the metatarso-phalangeal joints, toe subluxation and prominent metatarsal heads.² As a result high foot pressures develop under the forefoot exacerbating the pain and discomfort. A mild sensory neuropathy, of vasculitic or immunologic origin,³ has been described in RA and studies employing nerve conduction velocities have shown abnormal results in up to 40% of patients (4). Nevertheless, pain sensation is sufficiently preserved to protect patients from foot ulceration caused by abnormally high foot pressures in contrast to patients with insensitive feet who commonly develop ulcers at points of high pressures.⁵

Specially designed shoes and insoles which can accommodate the deformed foot and reduce the discomfort are usually recommended for rheumatoid patients with foot problems. We have shown that a specially designed hosiery with extra padding under the heel and forefoot can reduce abnormally high dynamic (walking) foot pressures up to 30% in diabetic patients⁶ and that this beneficial property can last for several months.⁷ In the present study we have studied the ability of this hosiery to reduce high foot pressures and associated pain in rheumatoid patients with foot problems.

PATIENTS AND METHODS

18 patients (7 males) with rheumatoid arthritis and painful feet agreed to take part in this study. All

fulfilled the 1987 American Rheumatism Association revised criteria for the classification of RA.⁸ Their mean age was 56 years, (range 30-71) and mean duration of disease 11.9 years (range 1-40). All patients were studied during a non-acute phase of the disease.

Walking (dynamic) foot pressures were measured using the optical pedobarograph as described elsewhere.⁹ Patients were firstly familiarised with the device and then three footsteps of each foot were recorded under the following conditions: walking barefoot, wearing the experimental hosiery with high density padding and wearing commercially available hosiery with medium density padding produced by the same manufacturer (Thor-lo Hosiery, Statesville, NC, USA). The composition of both types of socks is 85% acrylic and 15% stretch nylon. The density of the padding is increased under the forefoot and the heel while the midfoot is covered with lower density padding. The dorsum of the toes is also covered with thick padding protecting them from ulceration induced by ill-fitting shoes.

The highest pressure area under each foot was recorded (mean of the three footsteps). If the patient was unable to walk for a prolonged period of time, sufficient to permit all the above measurements, foot pressures were measured barefoot and with only one type of hosiery. In the latter case, the allocation as to which type they wore was random. All patients who had suitable shoes with enough space to accommodate the extra space required by the hosiery were invited to take part in a 6-month follow-up study. Of the 14 suitable patients, 4 (3 women) refused, the main reason being that the socks (which are white in colour) were not cosmetically acceptable. The remaining 10 were randomly provided with three pairs of

experimental or walking hosiery for the first 3 months and were switched to the alternative socks for the next 3 months. The foot pressures walking both barefoot and wearing the socks were measured at the beginning of each period. The pain relief achieved with the hosiery during the 3 months was recorded at the end of each period using a visual analogue pain scale as described elsewhere.¹⁰ In brief, it is a 100 mm horizontal graphic rating scale with the descriptive words slight, moderate and severe along the length of the line. Patients were also asked their overall opinion about the hosiery. Two patients defaulted their appointment at the 6-month visit for reasons beyond their control.

The study was approved by the Central Manchester Health Authority Ethical Committee. Non-parametric statistical analysis with Wilcoxon's matched pairs rank test was employed using the Minitab statistical software (Minitab, Inc, State College, PA, USA). Each foot was treated as a separate variable in the estimation of the foot pressure relief provided by the hosiery.

RESULTS

10 patients were tested with both walking and experimental hosiery but 8 were randomised either to experimental ($n=6$) or walking hosiery ($n=2$) for the baseline pressure studies. The reduction in mean peak pressure achieved with the experimental and walking hosiery is shown in Table 1. Significant pressure relief was achieved with the experimental hosiery compared to bare footsteps (10.8 ± 1.1 vs 15.9 ± 1.5 $\text{kg}\cdot\text{cm}^{-2}$ (mean \pm SE); $P < 0.001$) but no difference was found between walking socks and bare footsteps (12.4 ± 1.5 vs 14.1 ± 1.5 ; $P = \text{NS}$). No difference existed between the pressure measurements with barefoot at the 0 and 3 months visits in the patients who took part in the follow-up study (15 ± 1.7 vs 13.2 ± 1.7 ; $P = \text{NS}$, variability 12%).

Both types of hosiery reduced painful symptoms during the follow-up study (Table 2). A 51% reduction was reported with the experimental hosiery compared to patients own socks (pain score in mm; 30.0 ± 6.5 vs 61.6 ± 7.7 ; $P < 0.01$) and a 45% reduction with the walking socks (35.4 ± 9.8 vs 64.1 ± 9.1 ; $P < 0.02$). The diaries showed that socks were regularly

Table 2. Pain relief provided by the hosiery during 3 months regular usage

Test condition	Experimental hosiery	Walking hosiery	% reduction	<i>P</i>
Patients' own socks				
	30.0 ± 6.5		51	< 0.01
		35.4 ± 9.8	45	< 0.02

Mean \pm SE pain measured by a visual analogue scale (in mm)
Maximum pain = 100 mm, no pain = 0

used. No major changes in the medical treatment of the patients who participated in the follow-up study occurred this period. All these patients were satisfied with the socks and reported that they would like to continue wearing them.

DISCUSSION

The pain which accompanies foot deformity in RA contributes to the restricted mobility and subsequent loss of independence of affected patients.¹¹ Long term physical training during non-acute RA has been shown to improve the patients' general condition.¹² Several exercise programmes have been developed but walking is the simplest and can be easily achieved irrespective of available facilities and age. Specially designed extra depth shoes with enough space to accommodate both the deformed foot and insoles (which are thought to reduce high foot pressures) are usually recommended.¹³ Of those rheumatoid patients attending a hospital rheumatic diseases centre, about one third were found to require such special footwear.¹

The ability of padded hosiery to provide pain and pressure relief in the rheumatoid foot has not been studied previously. We have now shown that such hosiery may benefit rheumatoid patients with foot involvement. The experimental hosiery (with high density padding) reduced both foot pressures and pain under the foot during walking and standing. The walking socks (with medium density padding) also showed a tendency to reduce foot pressures and pain was significantly reduced suggesting that even small pressure reduction may lead to clinically important improvement.

Previous studies by our group using the same hosiery in diabetic patients with neuropathy and high

Table 1. Foot pressure relief achieved with the hosiery

Test condition	Bare foot	Experimental hosiery	Walking hosiery	% reduction	<i>P</i>
No of patients studied					
16	15.9 ± 1.5	10.8 ± 1.1		32.1	< 0.001
12	14.1 ± 1.5		12.4 ± 1.5	12.1	NS

Mean \pm SE peak pressure from the highest area ($\text{kg}\cdot\text{cm}^{-2}$)

10 patients were tested with both experimental and walking hosiery, but 8 were randomised to either experimental ($n=6$) or walking ($n=2$). For full details see text.

foot pressures have shown similar results. A 26–36% reduction in foot pressures under different areas of the foot was found for the experimental hosiery, and 8–20% reduction for the walking socks.^{6,7} The hosiery continued to provide satisfactory pressure relief after a long period of regular usage. The presence of insensitivity in these patients, secondary to severe neuropathy precluded us from assessing a symptomatic response in this group of patients. However, in the present study the potential role of this hosiery in pain relief has now been confirmed using one of the most sensitive and reliable techniques of pain assessment in longitudinal studies.¹⁰ A recent study by another group using the same hosiery has also shown that it reduces the occurrence of foot blisters in long distance runners.¹⁴

The walking hosiery is currently commercially available and is distributed through sports shops in most parts of the world. The experimental hosiery is expected to be released soon, but until then, tennis hosiery, produced by the same manufacturer, may be used as a substitute as it has been found in previous studies to provide the greatest pressure relief of all types of commercially available hosiery.⁷

The combination of padded hosiery and extra depth shoes may offer the patient maximum comfort. As the hosiery is thicker than usual socks, patients may need larger shoes than they usually wear. It thus seems reasonable to suggest that new shoes should be fitted while the patients wear the special socks. The use of hosiery with training shoes may also be beneficial to those patients who want to pursue more intensive activities such as running.

In conclusion, we have demonstrated that specially padded hosiery is useful in providing pressure and pain relief in the painful rheumatoid foot. Combination of this hosiery with specially designed shoes may be of most help in this group of patients.

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