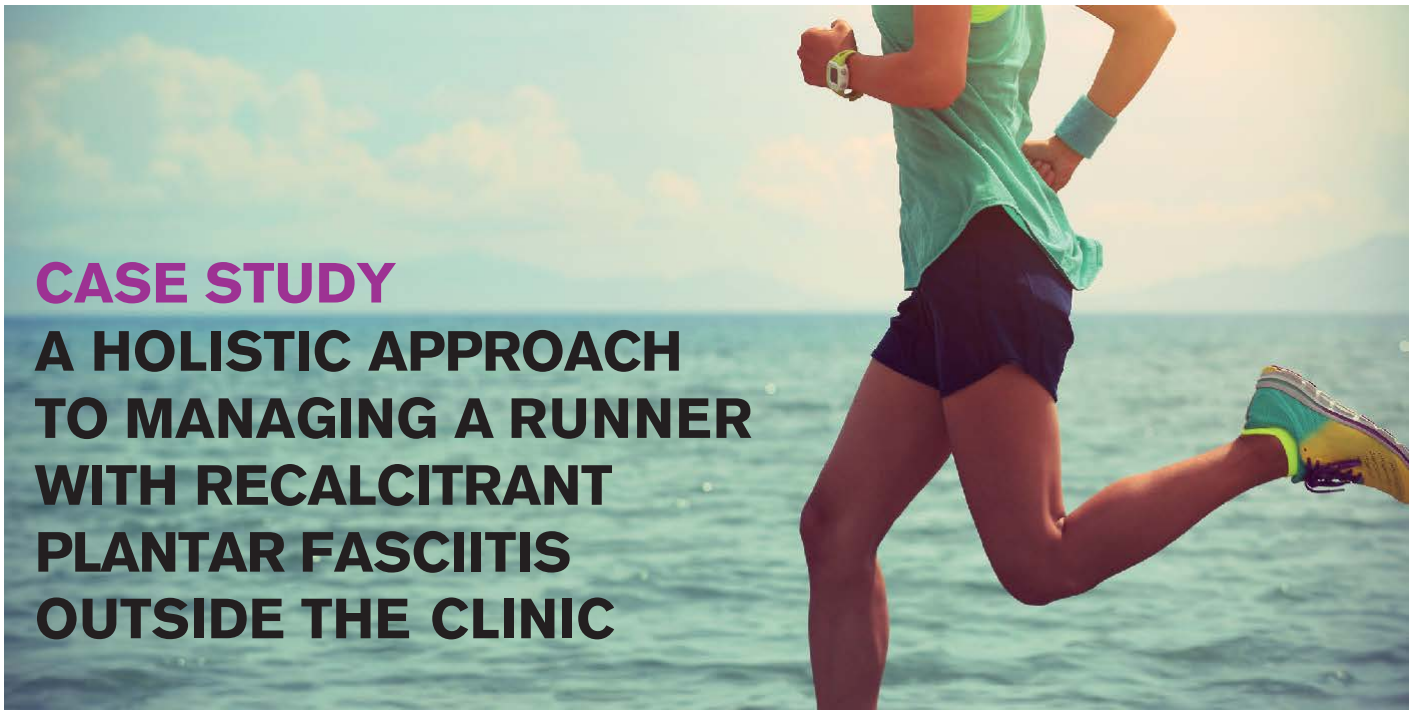


CASE STUDY
A HOLISTIC APPROACH TO MANAGING A RUNNER WITH RECALCITRANT PLANTAR FASCIITIS OUTSIDE THE CLINIC

This case study describes the use of run re-training and the monitoring of pain levels and weight-bearing activities in order to direct the prescription of appropriate training loads in a runner with recalcitrant plantar fasciitis

JAI SAXELBY
PHYSIOWORKS, SHEFFIELD TEACHING HOSPITAL FOUNDATION TRUST, SHEFFIELD, UK

DR JAVIER GAMEZ PAYA
UNIVERSIDAD EUROPEA DE VALENCIA, SPAIN

DR BEN HELLER
CENTRE FOR SPORTS ENGINEERING RESEARCH, SHEFFIELD HALLAM UNIVERSITY, SHEFFIELD, UK

CONTACT JAI.SAXELBY@NHS.NET

Treating the injured patient who is not improving is challenging; especially with limited objective data available of activity patterns between appointments. Such information would be invaluable in helping practitioners to identify the reason behind the non-improvement and suggest potential solutions.

The management of most chronic diseases includes some form of monitoring to check on the progress of the condition and to direct ongoing management.[1] When deciding to monitor a condition, several questions need to be asked, including what to monitor, when to monitor and how to adjust treatment.[1]

Load management is a key component in the rehabilitation of mechanical lower-limb injuries.[2] Podiatrists have more to offer than just orthoses when it comes to load-modification strategies.

CASE DESCRIPTION

A 62-year-old male with a 30-year history of running presented with a four-year history of right-sided plantar fasciitis (PF), having previously tried a number of treatments including: orthoses, low-dye taping, footwear advice, specific plantar fascial stretches, night splint and steroid injection. The runner reported daily PF pain levels of approximately 3/10 using a visual analogue scale (VAS).

He was running two to three times a week, which consisted of one or two, 6-8 km runs and one park run (5 km, plus warm-up and down). A baseline running assessment (qualitative video analysis) demonstrated a marked heel strike, forward lean of the trunk and an over-striding gait pattern (Figure 1).

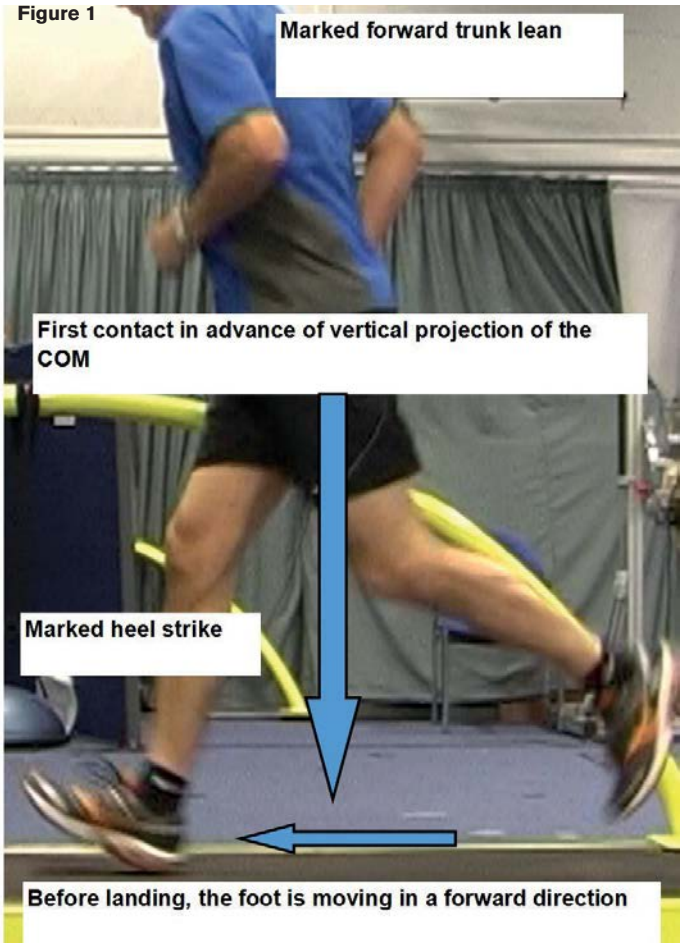
LOAD MANAGEMENT AND METHODS OF MONITORING

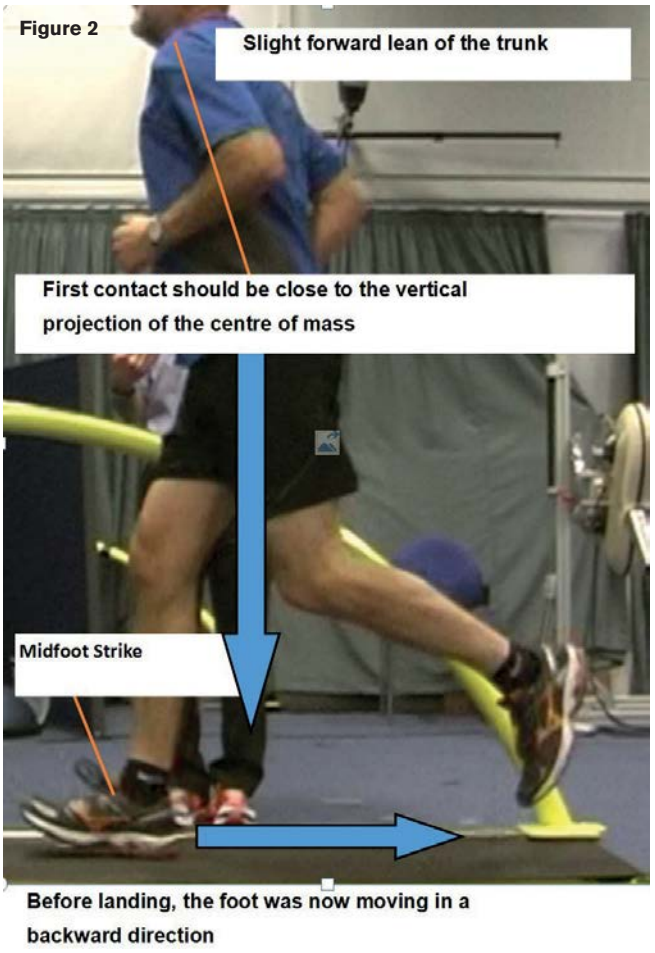
It was agreed to utilise a run re-training technique (Figure 2) in order to modify loading on the plantar fascia by reducing the subject's over-stride.[3] A novel type of shoe was utilised the FBR (patent N° ES1099206/EP3061361A1). This is the name of the concept and stands for 'faster, better running', and consists of a shoe modification, the floating heel (Figure 3) and five technical pillars:

THE FIVE TECHNICAL PILLARS

- Midfoot strike pattern - reducing vertical loading rates when compared to conventional and minimalist shoes. The foot should land parallel to the ground.
- Before landing, the foot is already moving in a backward direction. This will bring an active action of the foot and ankle during the stance phase, as well as an increased activation of the foot extensor muscles before landing, and also enhance the capacity for the passive structures of the foot and ankle to store elastic energy.[5]
- First contact should be close to the vertical projection of the centre of mass (COM), in order to reduce the over-stride.
- The running cadence should be the preferred cadence plus 3-5%.
- Trunk slightly leant forward (3-5°).

One of the priorities for run re-training is the need for technology to provide feedback and mobile monitoring of compliance[3]. The Runscribe™ (Scribelabs Inc, CA), is a nine-axis wireless inertial sensor that fits on the runner's shoe (Figure 4)





and measures a number of biomechanical parameters (Box 1).[6] It was used to measure and monitor foot contact position (foot strike pattern) when the patient ran (Figure 5).

In order to evaluate the effect of the intervention on the patient's symptoms, the patient was asked to record daily VAS scores for: (1) PF pain during the day and (2) first weight-bearing pain, and additionally to document other weight-bearing activities. These data were sent to one of the authors (JS) weekly via a secure email, ensuring maintenance of confidentiality of patient information. The author reviewed these reports and, depending on the reported pain levels, advised on the next week's training, i.e. whether it should be increased, maintained or reduced.

The FBR shoe was used for training, and the patient was instructed to run more upright ('run tall'), which resulted in the five technical pillars being achieved (Figure 2). Initially, it was agreed the patient would undertake three runs per week, of which two would use the FBR shoe, and a graduated running programme was given (Table 1). However, if his VAS score reached 5/10, the patient would stop and not run again until daily pain scores dropped below this level. This rationale was based on the pain monitoring system which uses the VAS scale to measures pain during activities, such as running; a VAS score of 0–2/10 is considered to be safe, whilst pain up to 5/10 is acceptable, as long as symptoms settle by the next morning.[7]

This approach has been used in the treatment of patients with Achilles tendinopathy, as it has been discovered that the use of physical activity such as running in the rehabilitation stage, when using the pain-monitoring system, is effective and has no negative effects when compared against standard treatment.[8]

Figure 1. Baseline running-initial contact

Figure 2. Run re-training-initial contact

RESULTS

Figures 6 and 7 show daily pain and first weight-bearing pain VAS scores during the intervention period, whilst Figure 8 shows the duration of each run. Figure 9 shows the biomechanical parameter-foot contact position. Table 2 shows the weight-bearing activities undertaken by the subject during the study period.

DISCUSSION

The patient's training levels had to be kept at approximately the same pre-intervention levels for the first eight weeks of the study before pain levels consistently reduced. The objective data that the longitudinal monitoring of pain scores provided gave the clinician information that allowed him to make more informed decisions when it came to prescribing the appropriate training levels for the patient without aggravating symptoms. The approach used was similar to that utilised in other studies.[7,8] However, neither of the previous two studies detailed how compliance was monitored by the clinician.

The Runscribe™ data provided the clinician with a valuable insight into what was happening biomechanically every time the patient ran. It clearly showed that the FBR shoe altered the foot strike pattern (from heel to midfoot) and what running activities were being undertaken. This fulfilled the need for activity monitoring during run re-training, i.e. technologies that provide efficient feedback and mobile monitoring of compliance,[3] for example, in this case one of the authors was able to monitor the patient's training from Spain.

Correlating the significant non-running weight-bearing activities with the daily pain scores identified that pain levels increased after such events. A systematic review found low-

FBR Session	Training Content
1	4 x 5 min continuous running (cr), rest, 2 min walking
2	2 x 10 min cr (rest 3 min) + 6 x (80m strides, rest 1 min) + 2 min cr
3	16 min cr
4	15 min cr + 4 x (80m strides: rest 1 min very gentle) + 5 min cr
5	2 x 12 min cr (rest 3 min)
6	15 min cr + 4 x (100m strides, very gentle rest, 1 min)
7	3x 10 min cr (rest 3 min)
8	20 min cr + 5 x (100m strides, rest, 1 min) alternating FBR and conventional
9	4x5 min continuous running (cr), rest, 2 min walking
10	2 x 15 cr (rest 3 min)
11	15min cr, 3 x 1min at medium pace, rest: 1 min 15 sec
12	25 min cr
13	15 min cr, 6 x 1min at medium pace, rest: 1 min 15 sec
14	2 x 18 cr (rest 3 min)
15	20 min cr + 2x5 x (100m strides, rest, 1 min) alternating FBR and conventional
16	30 min cr
17	20 min cr
18	25 min cr + 2x5 x (100m strides, rest, 1 min) alternating FBR and conventional
19	20x 20min cr

Table 1. FBR Run Programme

BOX 1. Runscribe

The Runscribe™ is a nine axis sensor that fits on the runner's shoe and measures a number of biomechanical parameters, including Pace, stride length, step rate, contact time, flight ratio, shock, Impact and breaking G,* foot strike type, pronation excursion, maximum pronation velocity.

After each run the data is downloaded to the runner's smart phone and Runscribe's™ secure server. The clinician can then review the data remotely.

*When the foot impacts the ground it goes through a very rapid change in velocity, this is called an acceleration and is measured with a three-axis accelerometer. It is not a force, but it correlates well with certain characteristics of impact forces at footstrike.

Figure 3 (right). Image of FBR 'Floating heel' modification

Figure 4 (below right). Runscribe™ *in situ*

Figure 3.

Figure 4.

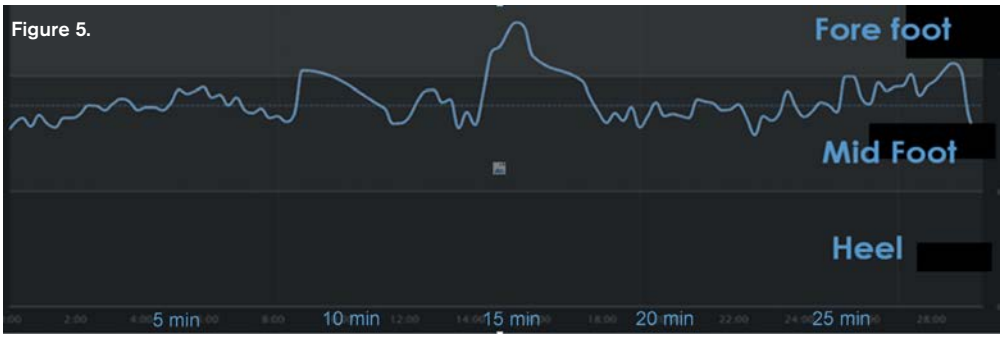


Figure 5.

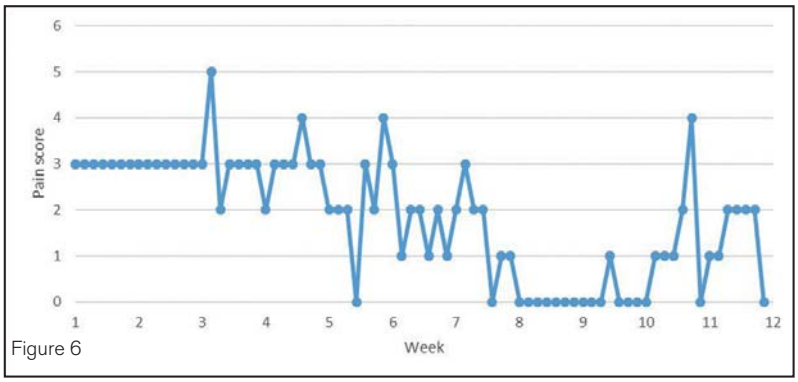


Figure 6

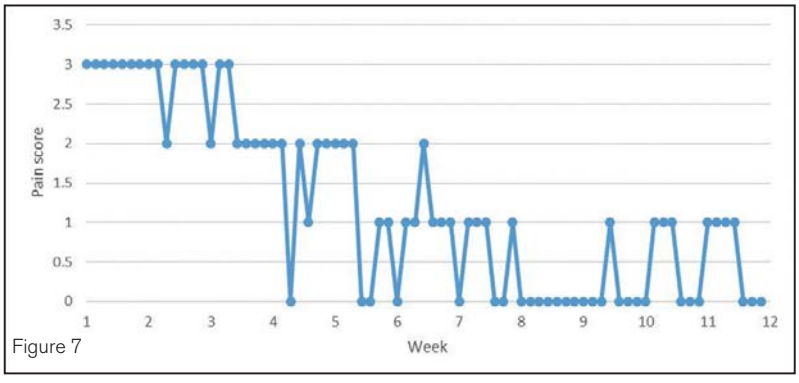


Figure 7

Figure 5. The Runscribe™ shows the foot contact position through the duration of a run when using the FBR technique outside the clinic. The vertical axis denotes the foot contact position i.e. heel, mid, forefoot, whilst the horizontal axis showstime

Figure 6. Daily pain scores

Figure 7. Daily pain on first weight-bearing scores

[11]

Day Week	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
1		Swim	Swim	6 hours standing	Cold	Park run normal shoes	FBR- 4x5min Run
2			FBR-2 x 10 min run		FBR-16 min run	Park run-normal shoes	7 hours standing
3		FBR-15 min run	Swim	FBR-2x12min run		FBR-15 min run + 3-mile run	
4	Swim Circuit training	FBR-3x10 min run	Swim	6-hour walk	FBR-20 min run	Park run normal shoes	FBR-4x5 min run
5	Swim Circuit training	FBR-2x15min Run	Swim	FBR-15 min + 3x1 min med pace Run		Park run normal shoes	
6	Swim Circuit training	FBR-25 min run		FBR-15 min + 6x1 min med pace Run		Park run-PB normal shoes	
7	Swim Circuit training	FBR-2x18 min run		5-hour walk	FBR-20 min Run	Swim	6.1m run, normal shoes
8	Circuit training	Run-3.6m normal shoes		Run-9.7m normal shoes		Run-6.09m normal shoes	
9			Run 6.8m normal shoes	FBR-30 min run 16		Run- 9.1m normal shoes	
10		Run-12.29 m normal shoes		Swim	FBR-20min Run	Park run Several hours gardening	
11	FBR-25 min run	Run- normal shoes		Fell run 6 miles fell shoes		FBR-2 x20min run	Swim
12				Run- normal shoes			½ Marathon completed normal shoes

Table 2. Weight-bearing and training undertaken during the study period

quality evidence of an association between PF and weight-bearing tasks, such as walking and standing on hard surfaces.[9] Having identified this early on, such activities were advised against in the latter part of this study; this modification may well have contributed to the patient's reduction in pain.

The FBR shoe did facilitate a change in running mechanics, from a heel to a midfoot strike, and this has been shown to reduce vertical loading rates when compared to conventional and minimalist shoes , and would be a sound biomechanical rationale for a mechanical therapy; however, the literature to support this is minimal.[3] The other consideration is that it took eight weeks before there was a noticeable change in symptom levels, and that training levels were controlled during this time, so how much of the recovery could be attributed to the FBR shoes and the consequent gait modification is in question. One possible alternative mechanism is that runners will initially experience some calf soreness when transitioning from heel to midfoot and, because of this, they may be more willing to reduce training loads in the early stages of the transition.

At the end of the process, a de-brief meeting was held with the patient, in order to obtain his thoughts and perspective. He made several comments in regards to how he felt about this treatment approach; these included:

'I felt part of a process'.

'That someone else was looking at things objectively (runners often don't)'.

'It felt like my care was being customised to me and my needs'.

CONCLUSION

This case study described two load modifying strategies; run re-training via FBR and training load advice informed by pain monitoring levels, and three methods of monitoring: Runscribe™, to measure biomechanical parameters when running (foot contact position), daily monitoring of pain levels and documenting of weight-bearing activities.

The outcome can be regarded as a success; as self-reported by the patient and by the fact that he finished the study period by successfully completing a half-marathon. The data suggest that the success was because of a combination of factors rather than just one.

Whilst it is not suggested that this approach be used in the management of every injured runner coming through the podiatrist's door, it is hoped the authors have presented some stimulating relection and options to consider, including:

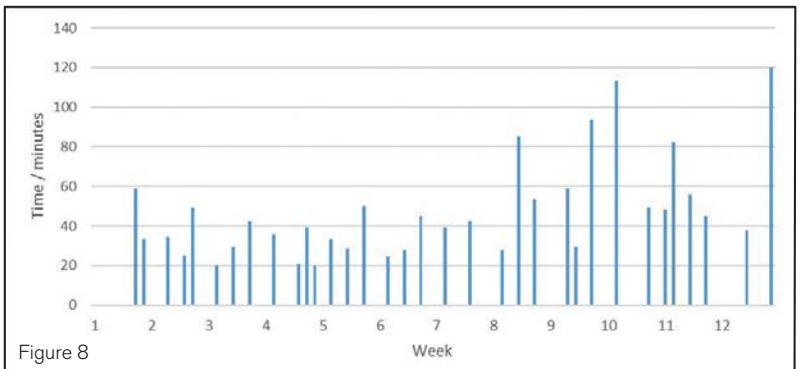


Figure 8

Figure 8. Run duration

Figure 9. Foot contact angle (average) during each run. The vertical axis is the foot contact angle (0-5 is a heel, 5-10 midfoot and 10-14+ forefoot strike). Thehorizontal axis is the week number

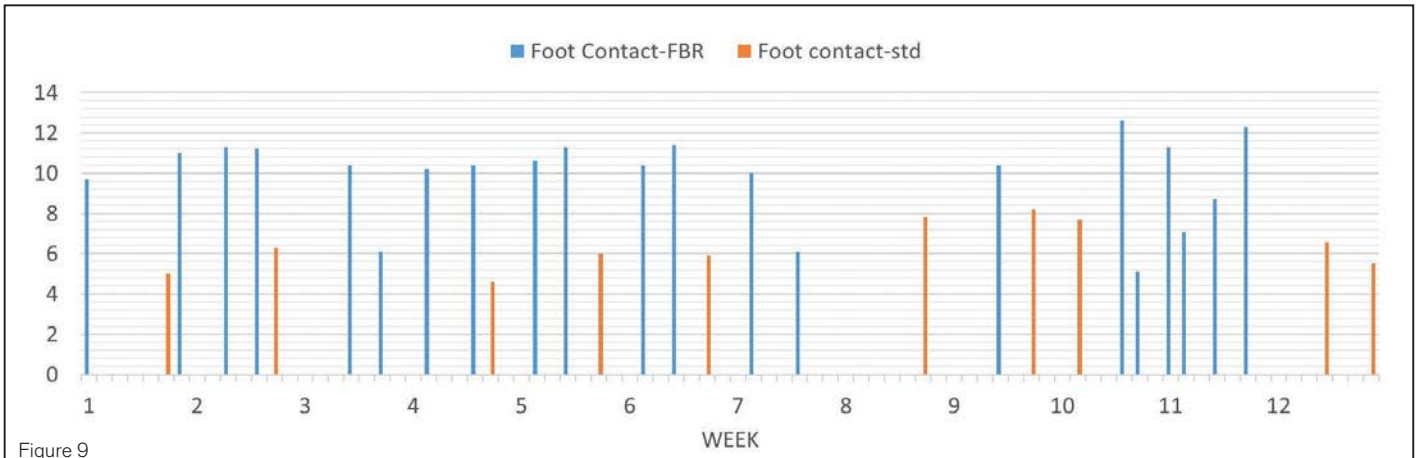


Figure 9

- The FBR shoe is a useful tool to aid run re-training, and is an easy way to change to a midfoot strike pattern if desired (the following link shows some examples- http://bit.ly/2tJxXZ8). It may also be a useful way to introduce podiatrists to run re-training as it uses the concept of dispensing a device (in this case a shoe modification rather than the usual orthoses to create the desired changes), which podiatrists are more familiar with.
- Although it did not offer immediate real-time feedback, the Runscribe™ did record biomechanical data from each run, providing previously unavailable objective information, i.e. what is really happening biomechanically, thus aiding the clinician in determining if the intervention was doing what it was supposed to be doing.
- Monitoring pain levels, VAS scores on a daily basis, documenting all weight- bearing activities and communicating them weekly via email is different from the typical clinical approach of reviewing patients every four to eight weeks. This approach offers objective data that the clinician can act upon immediately, addressing issues earlier, rather than at the review appointment when the issues have already surfaced.
- The clinician and patient should be mindful of significant non-running weight-bearing activities and the effect they can have on pain levels, so should factor this in when prescribing training programmes.

Disclaimer

None of the authors have any commercial interest in Runscribe or the FBR Shoe.

REFERENCES

1. Glasziou P, Irwig L, Mant D. Monitoring in chronic disease: a rational approach. *BMJ* 2005; 330: 644–648.
2. Gabbett T. The training-injury prevention paradox: should athletes be training smarter and harder? *Br J Sports Med* 2016; 50: 273-280.
3. Barton, CJ, Bonanno DR, Carr J, Neal BS, Malliaras P, Franklyn-Miller A, Menz HB. Running retraining to treat lower limb injuries; a mixed methods study of current evidence synthesised with expert opinion. *Br J Sports Med* 2016; 50:513-526.
4. Barnes A, Gamez Paya J, Castelli A, Heller B. Foot strike patterns in runners wearing floating heel, minimalist and conventional footwear. 33rd International Conference on Biomechanics in Sports, Poitiers, France, 29 June – 3 July, 2015.
5. Ahn, AN, Brayton, C.; Bhatia, T.; Martin, P. Muscle activity and kinematics of forefoot and rearfoot strike runners. *Journal of Sport and Health Science* 2014; 3:102-112.
6. Brayne, L, Barnes, A, Heller, B, Wheat, J. Using a wireless inertial sensor to measure tibial shock during running: agreement with a skin mounted sensor. In ISBS-Conference Proceedings Archive 2016; 33(1).
7. Thomee R. A comprehensive treatment approach for patellofemoral pain syndrome in young women. *Phys Ther* 1997; 77: 1690-1703.
8. Silbernagel KG, Thomee R, Eriksson BI, Karlsson J. Continued sports activity, using a pain monitoring model, during rehabilitation in patients with Achilles tendinopathy: A randomised controlled study. *Am J Sports Med* 2006; 35(6): 897-906.
9. Waclawski, E R, Beach J, Milne, A, Yacyshyn E, DrydenD M. Systematic review: plantar fasciitis and prolonged weight bearing. *Occupational Medicine* 2015; 65: 97–106.