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Foot orthoses for people with rheumatoid arthritis, involving quantitative and qualitative outcomes: protocol for a randomised controlled trial

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ABSTRACT

Introduction Rheumatoid arthritis (RA) involves changes to foot structure and function, and there is an association between RA and foot pain. This pain affects those patient's physical activity and experience of daily living. While there is clinical evidence for the value of foot orthoses (FO) on foot pain, there is a wide range of FO available and there is little evidence on the relative benefits of one orthoses type over another, especially in terms of their impact on physical activity and associated well-being. The aim of this study is to compare physical activity, general and foot health and foot health experiences in people with RA when wearing three different types of FO.

Methods and analysis A randomised controlled trial with three arms will compare the effects of (1) custom FO made using a direct adaptation technique, (2) custom FO made through a digital design and production process and (3) prefabricated orthoses. The primary outcome is physical activity measured using a GENEActiv bracelet. Secondary outcomes will be pain, function and disability and associated foot and general health evaluated using existing questionnaires. Semistructured interviews will identify patients' experiences of the orthoses and living with RA.

Ethics and dissemination The study has been approved by the Portal de Ética de la Investigación Biomédica de Andalucía ethical committee (SPAR-001). The results will be disseminated regardless of the magnitude or direction of effect.

Trial registration number NCT03170947; Pre-results.

Strengths and limitations of this study

- ► It is the first study that measures the effect of foot orthoses (FO) and the physical activity in patients with rheumatoid arthritis (RA).
- ► The combination of qualitative and quantitative data improves the overall knowledge of FO in patients with RA.
- ► The use of FO will be monitored by phone, but we cannot be sure that they use them everyday.

INTRODUCTION

The prevalence of foot involvement and foot pain in rheumatoid Arthritis (RA) is well documented, with an estimated 80%–90% of patients suffering foot pain in their lives.[1 2] The pain is due to structural and functional alterations associated with inflammation[3] and impacts on physical activity of patients with RA.[4 5] For example, Lee *et al* found that 42% of 176 patients with foot pain associated with RA failed to register any moderate/vigorous physical activity during a week-long evaluation.[6] Foot pain is strongly associated with a lack of physical activity.[7] Furthermore, there is good evidence that foot pain reduces a person's functional capacity and their quality of life[8 9] and qualitative studies concluded that there is a negative impact on emotions and social activities.[10 11]

Foot orthoses (FO) are used to reduce foot pain and preserve joint mobility and position, and through this their aim is to keep patients physically active.[12] It follows that the benefits of physical activity may be more accessible to patients using FO. A recent systematic review summarised the comparative effectiveness of the wide range of FOs suitable for patients with RA,[13] although differences in their effects were non-significant or data inconclusive. In addition, studies that assess foot biomechanics or foot conditions (eg, reduction of forefoot plantar pressure or pain) do not include any measure of physical activity and patients wider experience of living with RA.[14]

This trial was designed in response to gaps in the current evidence base concerning FOs effects and the expectation that patient physical activity and experience of living with RA is affected by FO use. Furthermore, there is a long-standing debate on the relative merits of different types of FO and this trial is a response to this debate.[15] We hypothesised that patients with RA and custom FO made

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either by direct adaptation technique or through a digital design and production process, will improve their activity level in comparison with patients with RA and prefabricated orthoses. Our null hypothesis is that we will not find any significant difference between results from each custom orthoses and prefabricated orthoses, related to improve their physical activity increasing the period time when the patient is standing or walking. The aim of this study is to compare physical activity, general and foot health, and foot health experiences in people with RA when wearing three different types of FO.

METHODS AND ANALYSIS

Study design and setting

The design is a randomised clinical trial with the parallel group, three-arm trial with 1:1:1 allocation ratio. A mix of quantitative and qualitative measures will be adopted to address the objectives.

Patients will be recruited from the Hospital Virgen de las Nieves, Granada (Spain) from December 2019 and randomised to one of the three groups, each receiving a different type of foot orthosis(online supplementary file 2). Randomisation will be achieved using software to generate the allocation sequence (Gerard E. Dallal. Randomization.com 2008. http://www.randomization.com) and allocation concealed in envelopes. An independent member of staff of Virgen de las Nieves hospital will perform the randomisation and allocation to groups.

Eligibility criteria

Patients aged 18 or over and satisfying 2010 RA classification criteria (approved by the American College of Rheumatology and the European League Against Rheumatism)[16] will be enrolled after giving informed written consent. Participants will be eligible if they have a history of bilateral subtalar and/or ankle and/or talonavicular pain, scoring at least 3.5 on a pain Visual Analogue Scale (VAS).[17]

Participants will be excluded if they present with concomitant musculoskeletal disease (eg, fibromyalgia), central or peripheral nervous system disease (eg, poliomyelitis) or endocrine disorders (eg, diabetes) and insensitivity to 10 g monofilaments applied to the medial and lateral plantar surfaces of the forefoot, and the plantar aspect of the great toe. Patients with a history of orthopaedic foot surgery, foot trauma in the last 6 months, those currently using FO or reliant on walking aids will be excluded.

Patients will be asked about the medication they use to monitor confounding variables during the period when using the FO.

Interventions

The systematic review by Healy *et al* concluded there is no gold-standard type of foot orthosis for people with RA.[18] The three different types of FO chosen for this trial reflect a range of orthoses used in practice.[19] They are all made from materials and shapes that are intended to reduce forefoot pressure, support foot structures and thereafter benefit the wearer in terms of reduced foot pain and associated disability. The primary differences between groups 1 and 2, and group 3, is the customisation of the FO to individual foot shape and orthoses materials. The primary difference between groups 1 and 2 is the method by which the FO are designed and manufactured, and the materials used for the orthoses. There are also differences between the groups in the cost of the orthoses. Participants will use the orthoses for 12 months and must wear the orthoses for 70% of the time they are wearing shoes to remain in the trial. Use of the orthoses will be determinate through the phone calls every month, understanding that one of the limits of this study could be that patients may not always provide a reliable answer.

Group 1

Custom orthoses will be made using a direct adaptation technique that involves a polyester resin and a combination of 1.2 mm Podiaflex for the rear and midfoot, and 0.8 mm Podiaflex for the forefoot. There will also be a top layer of ethylene-vinyl acetate (EVA) (30 ShoreA) of 1.5 mm and polyurethane (22 ShoreA) over the entire foot.

The shape of the orthosis is determined by heat moulding the resin to 90°C with a vacuum machine that combines heat and vacuum and placing the material against the foot (which is protected with a sock) under vacuum process. While the resin cools it takes the shape of the foot, while the heel is held a position described as subtalar joint neutral and the metatarsal heads pushed upwards to dorsiflex the ankle to a position of resistance.[20 21]

Group 2

Custom-made orthoses will be made using a digital process and from 2 mm polypropylene with an EVA (30 ShoreA) of 1.5 mm and polyurethane (22 ShoreA) top layer.

The FO shape is determined by a three-dimensional (3D) scan (shape scan 100/IBV) of the feet, taken in a standing position. The FO shape is determined by a 3D scan (shape scan 100/IBV) of the feet, taken in a standing position. Each orthosis will be independently designed for left and right foot.[22]

Group 3

Prefabricated orthoses will the OPCT-OC Comfort Standard (Podiatech, https://podiatech.es/). These full-length orthoses are available in increments of two European Union sizes and made from a base later of 5 mm EVA under the heel and arches, and 2.5 mm and 4 mm layers of EVA under the heel/arch and forefoot areas respectively. A top layer consists of EVA (30 ShoreA) of 1.5 mm and polyurethane (22 ShoreA). (figure 1)

The orthoses will not be modified through the process due to the nature of the study, as it is an assessment of 1 year and the FO will not change its structure or function much.

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Figure 1 Group 1 (A) direct adaptation technique posterior view, group 1 (B) direct adaptation technique medial view, group 1 (C) direct adaptation technique anterior view. Group 2 (A) CAD/CAM foot orthoses posterior view, group 2 (B) CAD/CAM medial view, group 2 (C) CAD/CAM anterior view. Group 3 (A) prefabricated orthoses posterior view, group 3 (B) prefabricated orthoses medial view, group 3 (C) prefabricated orthoses anterior view. CAD, Computer-Aided Design; CAM, Computer-Aided Manufacturing.

If there were any discomfort during the delivery of the orthoses, the technician will make any necessary modifications, such as reduce the material under the arch.

Primary outcomes measures

The primary outcome measure is physical activity which will be measured using the actigraphy GENEActiv bracelet from Activinsights (info@geneactiv.co.uk). This combines a validated accelerometery technology with data on wear time, activity intensity and/or body position such as sitting or walking.[23]

Participants will wear the bracelet for a 7-day period on four different occasions: 1 week before orthoses first use, 6th week of orthoses use, and after 6 and 12 months of orthoses use. Adherence with accelerometer use will be tested through the accelerometer itself, which indicates the period when the participants are not wearing it. Accelerometer will be deactivated when the patient stops wearing it.

Secondary outcomes measures

Secondary outcomes will be measures of pain, function and disability, and associated foot and general health. These will be captured using the following tools:

- VAS to measure pain, with extremes labelled as 'no pain' and 'worst imaginable pain'.[24]
- Foot and Ankle Ability Measure (FAAM). This is a questionnaire to measure changes in participant function and disability. It is designed to measure the effect of pathology and any associated deterioration of physical function. It has 29 items, with items 1–21 relating to 'activities of daily life' and 22–29 to 'Sports' subscales. Each question is scored 0–4, where 0 is 'unable to do' and 4 is able to achieve 'without difficulty'.[25]
- Foot-Health Status Questionnaire (FHSQ). This is a questionnaire which contains 13 items covering foot pain, foot function, footwear and general foot health.[26]

The VAS will be completed before orthoses uses, after the first week of orthoses use and 6 and 12 months of orthoses use. The FAAM and FHSQ will be completed before orthoses uses and 6 and 12 months after orthoses use commences (online supplementary appendix 1).

Also, participants characteristics will be recorded.

Qualitative outcomes

To explore participant expectations and experiences of the orthoses use while having RA, qualitative data will be collected using unstructured interviews prior to, and after 6 and 12 months of orthoses use. The initial interview topic list is:

- Tell me about your feet.
- Tell me about your physical activity.
- How much do your foot problems affect your activity?
- How much do your foot problems affecting your activity levels?
- Have your feet and any problems affected your quality of life?
- How important are your foot problems to you?
- How do you feel about wearing orthotic insoles?
- Do the orthotic insoles affect or impact your activity life?

Blinding and monitoring

Participants will be blind as to which group they are allocated to and will not see the other two orthoses designs.

Questionnaire data will be collected prior to the participant meeting clinician at each measurement point. Clinical appointments after first orthoses use will be at 6 and 12 months. All data will be entered into a database by a researcher independent of the clinician meeting participants, the process of making the orthoses and fitting the orthoses, and the researcher will be blinded to group allocation because the researcher will not have access to the treatment selection.

Due to the aesthetics of the three orthoses, the clinician cannot be blinded to group allocation, and the clinician will not take part in the data collection because the design, manufacturing, administration and modification of the orthoses are going to be done by three independent people. For the direct technique, a technician will undertake all design/manufacturing steps. For the digitally designed/manufactured orthoses, a technician will undertake all the necessary steps. One investigator will telephone participants once every 2 weeks to maintain contact, support good compliance and record use of orthoses. Adverse events will be recorded as part of monitoring and appropriate safety measures. Statistical analysis will be performed by a statistician blinded to the study aims.

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Sample size

The sample size will be determinate by application of the EPIDAT (https://www.sergas.es/Saude-publica/EPIDAT?idioma=es) programme. Sample size calculations are based on an analysis of covariance adjusting for baseline of the outcome variable(GENEActiv bracelet), and assume a between-person SD of 10% of increase of walking in the main outcomes actigraphy GENEActiv bracelet.[27] Following, the study will be designed to detect changes exceeding 0.8 (high effect size) with a type I error of 0.05 and a type II error of 0.2. This is based on prior recommendation of 15 participants per arm for pilot studies to estimate outcome variance and allows for a predicted attrition rate of 20% with a precision of ±5% with 95% confidence level.[28] Due to this, we will recruit 15 patients in each group.

Statistical analysis

Quantitative data will be assessed using SPSS (IBM SPSS Statistics: V.24, USA). Outcomes will be evaluated at 3, 6 and 12 months of orthoses use. The primary time point will be the long-term follow-up 12 months. Quality of data will be assured by using range checks for data values. The database will be stored in a secure file that will be only accessed by encripted login. Moreover, exploratory analyses will be carried out to check the integrity of data, and the normality of distributions, by evaluating the asymmetry and kurtosis, and the Kolmogorov-Smirnov test. Baseline data will be analysed to determine their distribution and potential differences between groups. If so, baseline data will be used to adjust the final analysis by multivariable analyses. For continuous outcomes, analysis of variance test will be used in case of homoscedasticity (it will be checked by the Levene's test). If homoscedasticity is not guaranteed, the Brown-Forsythe test will be used for hypothesis contrast. For qualitative outcomes, X^2 test will be used. Finally, a multivariable analysis will be carried out by using a linear regression model, introducing those factors that showed a significant association in the bivariant analysis, adjusted by baseline data.

The handle of missing data will be done across missing-data imputation process, to avoid pitfalls involved with listwise deletion. However, an analysis by intention to treat will be also performed, to compare the three analyses and to assess, in the absence of coincidence, the subgroups of patients who will not fulfil the study protocol, to identify possible causes of treatment dropout, before rejecting or accepting the null hypothesis

Interview analysis

The qualitative data derived through interviews will be assessed using thematical analysis and supported by NVivo (http://www.qsrinternational.com/nvivo-spanish).

This protocol will have some limitations due the nature of the study. First, we cannot claim that all patients will be using their orthoses the whole period of our study. This is because the study will be undertaken in Spain, where there are very high temperatures in summer. This may make it difficult for the patients to wear close-toed shoes, thus limiting the orthoses use and interfering with the adherence to the treatment.

Second, according to the patients' condition, they may suffer a flare-up during the study, which can alter their physical activity independently of the orthoses use.

ETHICS AND DISSEMINATION

The study has been awarded ethical approval from the committee of Portal de Ética de la Investigación Biomédica de Andalucía (PEIBA) (SPAR-001).

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval The study has been approved by the Portal de Ética de la Investigación Biomédica de Andalucía ethical committee (PEIBA)(SPAR-001).

Provenance and peer review Not commissioned; externally peer reviewed.

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