Arthritis New Zealand Summer Scholarships Reporting Template

Name of Student
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Project Title
The association between dynamic plantar pressure and sonographic evidence of metatarsophalangeal joint synovitis in people with rheumatoid arthritis: a study protocol

Statement Regarding Arthritis New Zealand Sponsorship

I would like to thank Arthritis New Zealand for the grant and for giving me the chance to improve my research abilities while also expanding my understanding of rheumatology and arthritis.

Student's Personal Comment About Study/Experience

I am extremely grateful to have taken part in this research experience. I'd like to thank my supervisors Sarah Stewart, Belinda Ihaka and Catherine Bowen for their guidance throughout this project. Additionally, I would like to also thank all my lecturers who supported and encouraged me to go for this project last year. Initially, the project was slightly overwhelming having to learn several components to conduct and carry out this research. I was well supported however by my supervisors and was taught several skills within a short timeframe. I was taught how to use Ultrasound and Plantar Pressure techniques and given resources to further my understanding. I really enjoyed the data collection process as well as the data entry. It was interesting to gather individual results and then compare all of them and see similarities within the participants. Overall, I'm very appreciative of being the main researcher in this project and having the chance to undertake this. This study has made me think critically and consider the role of rheumatoid arthritis on how it impacts an individual and their lifestyle. It is also exciting to think about the possible treatment options and management strategies for those with RA in the future. Research is something I am passionate about and I hope to continue this journey and expand my knowledge through the possibility of postgraduate study.

Summary of the Project

a) project aims: Rheumatoid arthritis (RA) is an autoimmune disease characterised by pain, stiffness, and swelling, targeting the joint lining (synovial membrane) [1]. A common site of inflammation (synovitis) lies within the metatarsophalangeal joints (MTPJ) – or toe joints, which are the main source of foot pain. People with RA experience increased pressures underneath this area during weight-bearing activity as a result of foot deformities, including hammer toes, clawed toes, and hallux valgus (bunions) [2]. The aims of this summer student project were to (1) recruit participants with RA (2) undertake study visits to collect data related to demographics and medical history, patient-reported outcomes, plantar pressure assessment, and ultrasound imaging; (3) and to enter data and produce descriptive statistics using the data collected. Future work, outside of the summer project, will involve grading the ultrasound scans and analysing data to determine the association between plantar pressure and ultrasound evidence of synovitis.

Table 1. Participant demographic and clinical characteristics

N		35
Age, mean (SD), years		66.3 (13.4)
Ethnicity, n (%)	European	32 (91%)
	Asian	2 (6%)
	Latin American	1 (3%)
Gender, n (%)	Female	30 (86%)
	Male	5 (14%)
BMI, mean (SD), kg/m²		27.1 (6.8)
RA disease duration, mean (SD), years		22.2 (15.2)
Medications, n (%)	DMARDs	23 (66%)
	NSAIDs	11 (31%)
	Steroids	5 (14%)
	Biologic agents	4 (11%)
	Opiates	1 (3%)
	Antiplatelets	8 (23%)
	Anticoagulants	5 (14%)
	Antihypertensives	11 (31%)
	Hypoglycaemics	1 (3%)
	Psychotropics	8 (23%)
Comorbidities, n (%)	Hypertension	8 (23%)
	Cardiovascular disease	6 (17%)
	Depression	5 (14%)
	Asthma	2 (6%)

BMI = body mass index; RA = rheumatoid arthritis; DMARD = disease modifying anti-rheumatic drug; NSAID = non-steroidal anti-inflammatory

b) key results: Thirty-five people with RA attended a study visit at AUT North or AUT South campus where they had an ultrasound assessment of their MTPJs, a plantar pressure assessment during barefoot walking, and completed some questionnaires related to foot pain and disability. Characteristics of the participants are shown in **Table 1**. Many participants were taking multiple medications, with two thirds taking disease modifying anti-rheumatic drugs (DMARDs). The participants also reported other comorbid conditions, with hypertension and cardiovascular disease being the most common.

On average, participants reported experiencing mild foot-related disease activity and a mean foot pain visual analogue score of 37/100mm. Pressure underneath the feet was highest at the heel and forefoot, while the lowest pressure areas were observed in the toes (**Figure 1**). In total, 350 individual ultrasound images were obtained across the 35 included participants. The images are currently in the process of being graded, however, some examples are displayed in **Figure 2**, and show evidence of synovitis (via PD ultrasound and greyscale synovial hypertrophy).

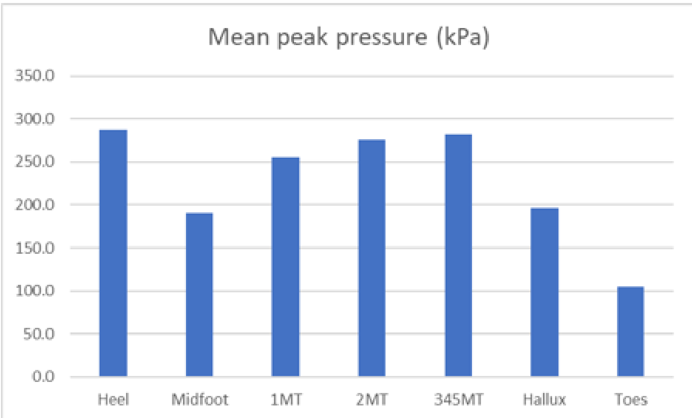

Figure 1. *Mean peak pressure values for each region of the plantar foot (kPa)*

c) discussion: Although further analyses are required to determine the association between ultrasound evidence of synovitis and plantar pressure in people with RA, the descriptive statistics have highlighted the extent of foot-related disability experienced in this population. Despite many patients taking disease-modifying anti-rheumatic medication and other forms of pain-relief, they still experience mild disease-related activity and pain associated with their feet. This is consistent with existing research involving people with RA which has shown that foot pain is the most common symptom reported [1-3]. The locations of foot pain identified in this study reflect the nature of foot disease in people with RA, in which inflammation and consequent structural changes tend to target the MTPJs and rearfoot which results in digital deformities and

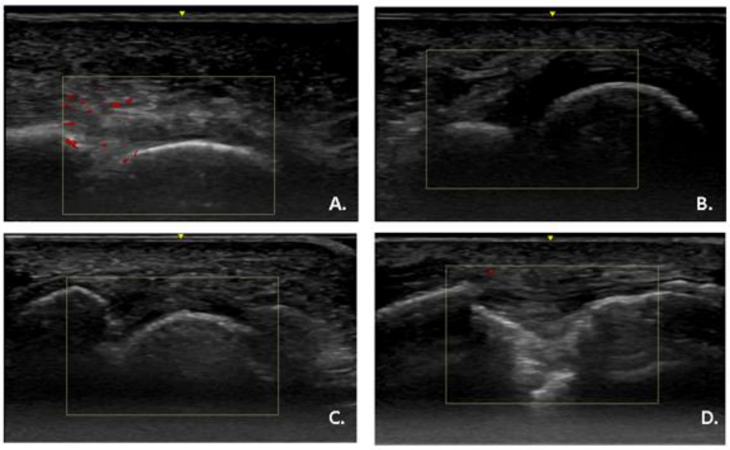

*Figure 2. Examples of ultrasound images obtained in this study (all longitudinal plane). **A** = right 4th MTPJ, PD grade 2, synovial hypertrophy grade 2; **B** = left 4th MTPJ, PD grade 0, synovial hypertrophy grade 2; **C** = left 5th MTPJ, PD grade 2, synovial hypertrophy grade 3; **D** = right 1st MTPJ, PD grade 1; synovial hypertrophy grade 2.*

hindfoot malalignment [4]. This in turn, alters foot function, leading to higher pressures and foot pain [5]. The pressure values observed in this study are similar to those in previous studies assessing pressure distribution in people with RA, in which pressure patterns differ from those without RA and are associated with foot pain and the presence of digital deformities [2, 5].

Based on a preliminary review of the ultrasound images, power doppler evidence of synovitis was not as frequent as expected. However, this is likely a result of machine sensitivity which doppler capability is highly dependent on [6]. This also reinforces the importance of assessing greyscale synovial hypertrophy as a measure of synovitis [7]. Research has shown that some people with RA may show an absence of power doppler signal, but still show severe synovial hypertrophy in the same joint, which is a major indicator of inflammation and predictive of future erosion and joint damage [8].

d) conclusion/key recommendation: In conclusion, the preliminary descriptive statistics from this research emphasise the degree of foot problems experienced by people with RA and the importance of plantar pressure systems and ultrasound imaging in assessing the impact of RA on foot function and underlying inflammation. The new knowledge generated from this study will contribute towards further work to inform modifiable risk factors in development of forefoot synovitis in people who have RA. Intervention trials such as the use of foot orthoses, footwear prescription, padded hosiery and gait rehabilitation strategies will be implemented in the future.

References

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