QUANTIFYING THE EFFECTIVENESS OF SILVER RING SPLINTS TO CORRECT SWAN-NECK DEFORMITY

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INTRODUCTION

Swan-neck deformity is a common symptom of rheumatoid arthritis affecting the fingers. It can be classified by hyperextension of the proximal interphalangeal (PIP) joint and flexion of the distal interphalangeal joint [1]. Methods to correct hyperextension of the PIP joint range from surgery to splinting techniques [2]. Silver ring splints (SRSs) were recently identified as a possible alternative to surgery and traditional thermoplastic splints because patient adherence was improved by their appearance [3]. The objective of this study was to investigate whether the SRSs restrict PIP joint hyperextension during a fine dexterity task.

METHODS

Eight participants diagnosed with rheumatoid arthritis and attending the Rheumatology Department at the Royal County NHS Hospital in Winchester, UK, were included in the study. All participants were right-hand dominant (1 male, 7 female; age 40-80 years, mean=62.8, ±12.04), had previously been prescribed bespoke SRSs and had worn the splints between 1½-4 years. Kinematic measurements were taken from 20 fingers (10 right and 10 left hands). A 6-camera Vicon 460 was used to collect the data, sampling at 100Hz. Twenty-six 3mm hemispherical markers were placed at standardized positions on the dorsal aspect of the hand and fingers. Marker positions and the associated kinematic measurement techniques in MATLAB® have been previously tested for validity and reliability [4].

Participants were asked to sit at a desk. Directly in front of them was an analogue timing unit linked to the Vicon and a small tripod object placed on a board. When instructed to start, the participant pressed the timer, lifted the object using a tripod grip posture (i.e. thumb, index and middle fingertips) from one point on the board to another, and then pressed the timer. Each participant repeated the task with both hands five times, with and without their splint. The kinematic trials were cropped between timer presses to indicate 100% of a task cycle. Waveforms were plotted in MATLAB® and described for each splinted finger. Descriptive statistics (minimum, maximum and mean angles, standard deviation and total ROM) were calculated. Improvement was defined as a decrease in the amount of hyperextension, or full correction from hyperextension for each individual. Paired samples t-tests were used to establish the statistical significance of any differences.

RESULTS AND DISCUSSION

Figure 1 shows the output from a sample participant illustrating an improved level of hyperextension at the PIP joint. It was observed that functional movement strategies, i.e. the patterns of movement, were unchanged when wearing the SRSs. The minimum angle calculated from each task was used as an indicator of pathological PIP joint hyperextension if a resultant negative angle was given. Table 1 summarizes these results. The difference between minimum angle with and without SRSs was used as an indicator of improvement when wearing the splints and showed that 40% (left) and 37% (right) of participants improved when wearing SRSs. Paired samples t-tests were undertaken on the minimum angle with and without splints and showed a statistically significant improvement when wearing SRSs (left: p=0.019; right: p=0.003).

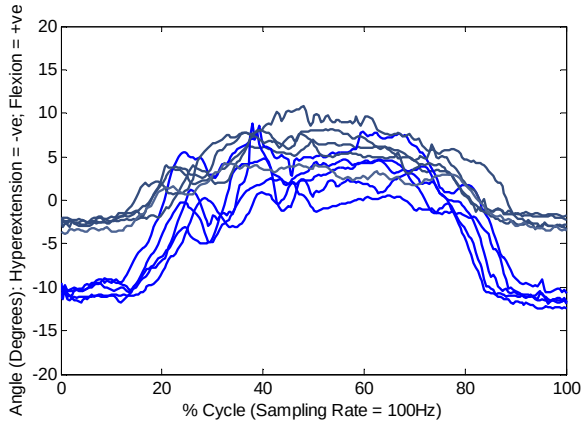

Figure 1: A sample participant (middle finger right hand) showing improved range of movement during repeated activity when wearing the SRSs.

CONCLUSIONS

SRSs are shown to significantly improve, but not correct PIP joint hyperextension during fine dexterity functional tasks. SRSs could be considered alongside other therapies when treating swan-neck deformity due to rheumatoid arthritis.

REFERENCES

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Table 1: Minimum PIP joint angles for all splinted fingers with and without SRS. Negative angles indicate hyperextension.

Joint Angle (Degrees)	Index		Middle				Ring			Little
Min Right WOS	12.92	-15.76	-3.96	-0.37	-32.45	-11.62	17.04	-19.60	-11.99	-29.47
Min Right WS	22.08	-6.97	11.29	5.51	5.15	-2.84	25.65	-16.52	-3.68	-12.82
Difference	9.15	8.79	15.25	5.88	37.60	8.78	8.61	3.07	8.31	16.65

Joint Angle (Degrees)	Index				Middle			
Min Left WOS	5.59	-19.68	-23.82	4.53	30.14	-5.87	-25.90	-7.63
Min Left WS	8.59	-2.76	-2.09	13.55	23.48	2.26	-15.34	3.53
Difference	3.00	16.93	21.73	9.02	-6.66	8.13	10.55	11.16