Benefits of wrist splinting in patients with rheumatoid arthritis

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Abstract

Objectives: The goal was to present the use of a functional wrist splint and its impact on hand function in patients with rheumatoid arthritis (RA).

Material and methods: The study group comprised 104 women aged 18–65 and diagnosed with RA, who were treated in the Rheumatology Clinic and Outpatient Department of the National Institute of Geriatrics, Rheumatology and Rehabilitation in Warsaw. The control group consisted of 40 healthy women in the same age group. Assessment of the hand function was the research method.

Results: Our results revealed substantially deteriorated function of the rheumatoid hand in relation to the healthy hand. The use of a wrist stabiliser is justified in patients with RA due to its beneficial impact, such as improved hand strength and dexterity and reduced pain. Based on the results obtained, it may be assumed that it is mainly patients with moderate and high disease activity who require stabilisation. The small number of patients in remission and with low disease activity was a limitation of the study. Hands with RA require an individual approach, and the most effective methods slowing down development of deformation should be sought. The results presented in this article may provide a starting point for further research on the most favourable wrist stabilisation in order to improve hand function in RA.

Conclusions: Our study showed that the hand function of women with RA is limited due to deteriorated grip quality and manual dexterity in comparison to healthy persons. Wrist stabilisation improves hand function in patients with RA.

Key words: rheumatoid arthritis, hand function, wrist splint.

Introduction

Rheumatoid arthritis (RA) is a systemic autoimmune disease. Symmetrical inflammation of small joints in hands and feet, pain, oedema and morning stiffness are the first symptoms. The chronic nature of the disease as well as constantly progressive joint destruction and deformation lead to disability. Rheumatoid arthritis affects 0.5–1% of the population, 60% of whom have wrist problems [1–3]. Patients withdraw from social life and quit their occupational activity due to limited hand function and its changed shape. Therefore, it is extremely important to look for effective methods to delay development of deformations. Wrist orthoses are often recommended to patients with RA. Wrist splints are more popular than immobilisation orthoses. The

goal of using the former is to protect the wrist during daily activities which may overstrain joints. The latter aims to bring patients pain relief and reduce signs of inflammation.

There are not many controlled trials on the effectiveness of wrist splints in rheumatoid hands, and the obtained data are inconclusive. Because of that we attempted to evaluate the benefits of wrist splint application in patients with RA [4, 5].

Material and methods

Patients

The study group comprised 104 right-handed women aged 18–65 diagnosed with RA, who were treated in

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Teresa Sadura-Sieklucka, Rheumatology Clinic and Outpatient Department, National Institute of Geriatrics, Rheumatology and Rehabilitation, 1 Spartańska St., 02-637 Warsaw, Poland, e-mail: teresa@sieklucka.com Submitted: 21.09.2018; Accepted: 23.11.2018 the Rheumatology Clinic and Outpatient Department of the National Institute of Geriatrics, Rheumatology and Rehabilitation in Warsaw. The RA diagnosis was verified in medical records. The control group consisted of 40 healthy right-handed women (with no hand dysfunction) in the same age group. The group of patients to be analysed further was divided into clinical subgroups depending on disease activity. Informed consent to the study was granted by all participants. The study was approved by the Bioethics Committee of the Institute of Rheumatology in Warsaw on February 28, 2013.

Methods

Assessment of hand function was the research method. A personal questionnaire was used in the subjective and objective study. Additionally, Disease Activity Score 28 (DAS28), hand examination and a hand function assessment chart were applied. The personal questionnaire included age, duration of the disease and pain intensity in right and left wrist at rest and during daily activities. Wrist pain was assessed using the Visual Analogue Scale (VAS). The patients determined the intensity of their symptoms on a horizontal axis marked with numbers from 0 (no pain) to 100 (the worst unbearable pain). Disease Activity Score 28 for RA with ESR (DAS28-ESR) was used to evaluate disease activity. The score is divided into four ranges: > 5.1 - high disease activity, 5.1-3.2 - moderate disease activity, 3.2-2.6 - low disease activity, < 2.6 remission [1, 6].

Hand function was assessed based on the value and quality of grip and manual dexterity. The value of grip comprises maximum and minimum strength, and endurance. The measurement was performed using a type 12-0248 hydraulic dynamometer calibrated in kg. The grip quality was evaluated based on whether it was possible to have a grip on a cylinder with a hand-shaped objects with a diameter of 2.5, 5 and 10 cm. The parameter measured was described using a scale in which 100% was given to patients whose hand and all fingers had full contact with the object. The score of 20% was subtracted in the case of each hand, metacarpus, metacarpophalangeal joints and individual phalanges not in contact. We used cylindrical grip, which is most limited in patients with RA [7].

Manual dexterity was evaluated using 2 tests. In the first one a patient had to turn a lock (Gerda II type) as many times as possible within 10 seconds, and in the second one a patient had to move and rearrange as many small balls (ø 1.8 cm) as possible within 10 seconds. All tests were performed 3 times with and without wrist stabilisation. The final result was the mean value of the tests. The wrist splint model was prepared in the

Fig. 1. The model of the wrist splint.

hand treatment laboratory in the National Institute of Geriatrics, Rheumatology and Rehabilitation (Fig. 1).

Statistical analysis

Analyses were performed using the commercial statistical package Statistica, ver. 9.0. The Kruskal-Wallis analysis of variance and the Friedman test were used, followed by the Mann-Whitney U or Wilcoxon test for comparison of two groups of unpaired and paired data, respectively. Relationships among parameters were analysed by means of Spearman's rank correlation coefficients (R_s). The χ^2 test was applied for categorical variables. The probability value of p < 0.05 was considered to be statistically significant.

Results

A summary of the results obtained without and with stabilisation of the right and left hand in the studied RA group depending on the activity of the disease and comparison with results obtained in the control group is presented in Table I. Significant differences in the number of subjects for the disease activity were observed in the group with: remission n = 5, low activity n = 6, moderate activity n = 55, and high activity n = 38. Hence the greatest statistical significance and the best clinical effects were observed in the more numerous patient groups.

In the study group a statistically significant improvement was observed in all tests when a wrist stabiliser was used, except for a grip on a cylinder with a diameter of 2.5 cm and 5 cm with the left hand. When comparing the control group and women in remission, there were statistically significant differences in strength and number of lock turns performed with the right hand as well as in the test assessing grip on a cylinder with a diameter of 10 cm without and with wrist stabilisation, and in the number of lock turns performed with an unstabilised left hand.

Tests	Hand	Control group n = 40	RA group n =104	Disease activity			
				Remission n = 5	Low n = 6	Moderate n = 55	High n = 38
Dynamo-	Right	30.2 ±7.8	11.9 ±9***	19.7 ±12.1*	20.2 ±18.3	12.6 ±8.1***	8.5 ±6.1***
meter <i>F-</i> max	Right stab.	28.5 ±7.9	12.8 ±9.3***###	19.6 ±12.7*	20.3 ±18.3	13.3 ±8.7***##	9.8 ±6.7***##
	Left	26.2 ±7.7	10.9 ±8.1***	19.5 ±14.4	16.9 ±15.7	11.5 ±7.1***	8 ±5.5***
	Left stab.	25.2 ±8.8	12.1 ±8.7***##	19.2 ±14.4	19.1 ±18.2	12.8 ±7.7***###	9.9 ±5.6***###
Lock turns	Right	13.3 ±3.4	8.2 ±3.4***	9.4 ±2.1**	8.6 ±2.7**	9 ±3.8***	6.8 ±2.6***
	Right stab.	12.8 ±3.4 ^{###}	8.8 ±3.5***###	10 ±1.9 ^{*#}	8.8 ±2.2**	9.7 ±3.8***###	7.3 ±2.8***###
	Left	12.3 ±2.9	8.2 ±3.4***	8.7 ±1.6**	8.1 ±3**	8.8 ±3.5***	6.5 ±2.7***
	Left stab.	12.1 ±2.3	8.4 ±3.9***###	9.9 ±1.7#	8.2 ±2.6**	9.4 ±3.6***###	6.8 ±2.6***###
Moving	Right	21.3 ±3.7	18 ±3.2**	18.5 ±3.2	18.2 ±3.2*	18.7 ±2.8***	16.8 ±3.6***
small balls	Right stab.	21 ±3.8 ^{##}	18.9 ±3.4**##	19.3 ±3.1#	18.9 ±3.2 [#]	19.7 ±3 ^{*###}	17.8 ±3.8***###
to place	Left	20.2 ±3.4	17.3 ±3.1**	17.3 ±3	18 ±3.3	18 ±2.6***	16.2 ±3.5***
	Left stab.	19.8 ±3.5 ^{###}	18 ±3.2**###	18.3 ±2.7#	18.4 ±3.3	18.8 ±2.8 ^{###}	16.9 ±3.5 ^{***###}
2.5 cm	Right	100	94 ±14.2	100	100	94.6 ±13	91.6 ±17.2*
	Right stab.	100	95.2 ±12.3#	100	100	95.3 ±12.2	93.7 ±14
	Left	100	93.1 ±12.4**	100	100	92 ±14.2*	92.6 ±10.8**
	Left stab.	100	94.2 ±12*	100	100	93.1 ±13.5*	94.2 ±11.3
.e. 5 cm	Right	100	92.3 ±13.5**	100	100	91.3 ±14.3*	91.6 ±13.7**
Cylindrical g	Right stab.	100	93.5 ±12 ^{*#}	100	100	91.6 ±13.7*	94.2 ±10.3*
	Left	100	93.1 ±11.7**	100	100	93.1 ±12.3*	91.1 ±12**
	Left stab.	100	94.2 ±11.7*	100	100	93.8 ±12.7	93.2 ±11.6*
10 cm	Right	100	72.3 ±21.8***	84 ±26.1	76.7 ±23.4**	72 ±23.6***	70.5 ±18.5***
	Right stab.	100	75.2 ±20.9***#	88 ±17.9	76.7 ±23.4**	74.2 ±24.5***	74.7 ±14.5***
	Left	100	71 ±19.7***	80 ±24.5*	76.7 ±8.2***	70.9 ±21.4***	69 ±17.8***
	Left stab.	100	73.5 ±19.4***##	84 ±16.7*	80 ±12.6***	72.7 ±21.2***#	72.1 ±17.7***#

Table I. Test results obtained by women, including control group and subgroups tested in different disease periods without and with stabilisation of the right and left hand

RA – rheumatoid arthritis; F-max – maximal force; stab. – wrist stabilisation; *p < 0.05; *p < 0.01; **p < 0.001 comparison between study and control group; #p < 0.05; ##p < 0.01; ***p <

A statistically significant effect is only observable in tests assessing manual dexterity of both hands.

A comparative analysis of the control group and the group of patients with low disease activity showed significant differences in the number of lock turns performed and the possibility of grasping a cylinder with a diameter of 10 cm by both hands with and without a wrist stabiliser as well as in the number of balls moved with the unstabilised right hand. Statistically significant stabilisation was noted in one test that assessed the number of balls moved by the right hand.

Comparison of the control group with the group of patients with moderate disease activity showed statistically significant differences in measurements assessing the value of grip and manual dexterity of both hands with and without wrist stabilisation, except for all tests involving endurance and the number of balls moved by the stabilised left hand. In tests assessing the possibility of grasping an object with the hand there are significant differences between both groups, except for grip on a cylinder with a diameter of 2.5 cm with the stabilised and unstabilised right hand and on a cylinder with a diameter of 5 cm with the unstabilised left hand. Statistically significant stabilisation was observed in all tests, except for measurements using cylinders. A significant improvement after stabilisation was noticeable only in a test involving the left hand using a cylinder with a diameter of 10 cm. Differences between the control group and the subgroup of patients with high disease activity are very pronounced in all tests, except for the possibility of grasping a cylinder with a diameter of 2.5 cm after stabilisation of both wrists.

Pain scale	Right	t hand	Left hand		
(range)	No stabilisation (%)	Wrist stabilisation (%)	No stabilisation (%)	Wrist stabilisation (%)	
None (0)	50 (48.1)	64 (61.5)	45 (43.3)	67 (64.4)	
Low (10–30)	18 (17.3)	21 (20.2)	25 (24)	25 (24)	
Moderate (40–70)	31 (29.8)	15 (14.4)	27 (26)	9 (8.7)	
Severe (80–100)	5 (4.8)	4 (3.8)	7 (6.7)	3 (2.9)	
р	0.	054	< (0.01	

Table II. Numerical and percentage distribution of women with rheumatoid arthritis without and with wrist stabilisation (right and left hand) according to the pain scale

Improvement of the parameters tested after stabilisation may be observed in tests assessing strength, manual dexterity and the possibility of grasping a cylinder with a diameter of 10 cm with the left hand. In other tests using cylinders there was a tendency for the parameter examined to be improved, but this tendency was not statistically significant (Table I).

The pain scale was divided into four ranges for the purposes related to this article (Table II): no pain (0), low pain (10–30), moderate pain (40–70) and severe pain (80–100).

A beneficial effect of a stabiliser is pronounced as far as pain assessment by patients in concerned. During a dynamometric test without stabilisation, 48.1% and 43.3% of women with RA reported no pain in the right and left wrist, respectively. When a stabiliser was used, the percentage of patients who did not feel any pain increased and was 61.5% and 64.4%, respectively.

The greatest shift in the number of patients towards less pain was observed in the case of moderate pain, as the percentage of patients with pain in the wrist of the dominant hand from 40-70 according to the VAS decreased from 29.8% to 14.4% after stabilisation. The stabilisation effect was even more pronounced in this range in the case of the second wrist, as the percentage of patients with moderate pain decreased from 26% to 8.7% after stabilisation. Furthermore, the percentage of patients who reported severe pain decreased after wrist stabilisation. Pain without stabilisation was reported by 4.8% and 6.7% of patients in the right and left wrist, respectively. After stabilisation the percentage of patients with severe pain decreased to 3.8% and 2.9%, respectively. The observed stabilisation effect on the dominant wrist was at the verge of statistical significance (p = 0.054) and in the case of the non-dominant wrist it achieved statistical significance (p < 0.01) (Table II).

All parameters examined in the tests negatively correlate with disease activity measured using DAS28 in both hands, indicating that hand function decreases when disease activity is increasing (Table III). After stabilisation of a given hand, correlations are weakened. **Table III.** R_s correlation coefficients between test parameters and DAS28 in women with rheumatoid arthritis

Test parameters	Hand	<i>R_s</i> between test parameters and DAS28		
		No stabilisation	Wrist stabilisation	
F-max	Right	-0.34***	-0.26	
(dynamometer)	Left	-0.30***	-0.28**	
Quantity	Right	-0.30**	-0.30**	
of lock turns in 10 s	Left	-0.30***	-0.35***	
Quantity of small	Right	-0.24	-0.19	
ball moves from place to place in 10 s	Left	-0.23	-0.22	
2.5 cm cylinder	Right	-0.18	-0.14	
	Left	-0.15	-0.09	
5 cm cylinder	Right	-0.14	-0.07	
	Left	-0.22*	-0.16	
10 cm cylinder	Right	-0.15	-0.13	
	Left	-0.16	-0.13	

*F-max – maximum force; *p < 0.05; **p < 0.01; ***p < 0.001.*

Discussion

It is a generally known and well-documented fact that hand function decreases in the course of RA [7–9]. Seyfried recorded a sixfold decrease in the strength of a hand affected by RA when compared with a healthy hand [10]. Woźniewski noted that hand strength of patients with RA is 40% lower than in healthy subjects [11]. Drużbicki et al. [12] revealed that average hand strength of patients and in the control group was 16.4 kg and 49.7 kg, respectively; i.e. the hand strength of patients was 33% of that of healthy people. Data obtained in our strength-assessing studies also revealed significant differences between the groups.

The strength of the right hand of patients with RA was 11.9 kg, which corresponds to 39% of healthy hand strength, whereas 10.9 kg is the average strength exhibited by patients, accounting for 42% of the strength of

healthy people. This shows that strength in RA is reduced to a greater extent in the hand that is used more often in daily life. This fact is confirmed by results of obtained by Fraser et al. [13], who observed 20% lower strength in the dominant hand in RA patients. Drużbicki et al. [12] did not observe any relationship between disease activity and strength in various grips and time in which the maximum grip strength is maintained. Prevoo et al. [14] noted a negative correlation between disease activity expressed by DAS28 and grip strength. These results confirm that hand strength decreases along with higher disease activity.

Average negative correlations between hand strength and DAS28 were also observed (maximum strength: right hand r = -0.34, left hand r = -0.32, p < 0.001). There is no unambiguous evidence for the effectiveness of wrist stabilisation in the literature of the subject.

Some authors noted a decrease in hand strength in their studies after stabilisation [15]. Biddulph [16] also recorded reduced grip strength (7.6%) in 8 patients with RA directly after stabilisation but at the same time its significant improvement (48.9%) after 10 days when a stabiliser was used. Anderson and Maas [17] observed contrary results. They noted improved grip strength (although not statistically significantly) directly after a commercial stabiliser was applied. Cytowicz-Karpiłowska [18] also observed a substantial increase in strength of particular phalanges, from 10% to 51%, after a wrist band was used. Similarly, Nordenskiold and Haskett et al. [19, 20] observed an immediate increase in the grip strength after a functional wrist orthosis was applied.

Analysis of all patients carried out as part of our studies showed a significant improvement of maximum strength when the stabiliser was applied (p < 0.001). It was 5.4% in the dominant hand and 6.2% in the non-dominant hand. A greater increase in strength after left wrist stabilisation is observable. This may be related to the fact that the non-dominant hand is less frequently used in daily activities, so its compensation mechanisms are less developed.

In RA, motor skills of the hands are reduced compared to those of healthy people due to extended reaction time, decreased movement speed and worsened coordination [21]. Our studies on a group of female patients revealed significantly greater difficulties with the test with a load (turning a lock) than with the test assessing precision of movement (moving balls). Similar observations were presented by Bączyk and Gacek [22], who stated that there are significant functional limitations in patients with RA. Daily activities involving the use of great strength posed the biggest difficulties for the patients.

Only a few scientific publications have assessed the impact of wrist stabilisation on manual dexterity and their results led to contradictory conclusions. For example, in their studies involving 3 women with RA Backman and Deitz [23] observed improved strength when a stabiliser was used but they did not note any improvement in the case of dexterity with stabilisation or noted deterioration. Another article reported a positive effect on wrist orthosis [24]. It was most pronounced in a test involving cutting.

Our studies revealed improved manual dexterity in patients using a stabiliser both in activities involving strength (improvement by 75% and 70% in right and left hand, respectively) and in activities involving dexterity (improvement by 86% and 63% in right and left hand, respectively). The test with a load revealed that the stabilisation effect becomes greater if disease activity is higher. When analysing whether it is possible to have a grip on an object with regard to disease activity, it may be stated that when the disease exacerbates, such a possibility is decreased and this limitation increases as the diameter of the object becomes greater.

Pain in the course of RA is constantly present. It has a decisive impact on patients' occupational activity and private life. It often prevents them from doing daily activities and self-care, substantially affecting the psychological well-being of patients. Kjeken et al. [25] showed an immediate, statistically significant (p < 0.01) effect of stabilisation on wrist pain during movement. Pagnotta et al. [26] also described a statistically significant decrease in symptoms during tests performed by patients with a stabilised wrist. Similarly, the authors of this article noted significantly decreased pain in patients during strength measurement after stabilisation of the wrist (right hand p = 0.054; left hand p < 0.01).

These results revealed substantially deteriorated function of the rheumatoid hand in relation to the healthy hand. The use of a wrist stabiliser is justified in patients with RA due to its beneficial impact, such as improved hand strength and dexterity and reduced pain. Based on the results obtained, it may be assumed that it is mainly patients with moderate and high disease activity who require stabilisation. The small number of patients in remission and with low disease activity was a limitation of the present study.

Conclusions

Hands with RA require an individual approach, and the most effective methods slowing down development of deformation should be sought. The results presented in this article may provide a starting point for further research on the most favourable wrist stabilisation in order to improve the hand function in RA.

The authors declare no conflict of interest.

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