Patients with polymyositis or dermatomyositis have reduced grip force and health-related quality of life in comparison with reference values: an observational study

Malin Regardt¹,²,³, Elisabet Welin Henriksson¹,², Helene Alexanderson²,⁴ and Ingrid E. Lundberg²

Abstract

Objectives. The aims of this study were to investigate hand function in PM and DM patients and compare this with reference values in healthy individuals and also to investigate if hand function correlated with activity performance and health-related quality of life.

Methods. An observational cross-sectional study was performed in 18 women and 13 men with PM or DM with established disease. Grip force and hand mobility were assessed by Grippit and Escola Paulista de Medicina – Range of Motion scale. Activity performance was measured with myositis activities profile and health-related quality of life instrument SF-36 (SF-36).

Results. Women and men with PM and DM with mean disease duration of 6.8 (5.5) years had a significantly lower grip force than gender- and age-matched healthy individuals (women 71% and men 60%). They also had significantly lower mean values in all dimensions of the health-related quality of life instrument SF-36 compared with the Swedish population. In patients with PM and DM, the grip force correlated significantly with the ability to perform domestic activities. In women with PM and DM, the grip force correlated significantly with the health-related quality of life dimensions vitality and mental health. There were no significant differences between patients with PM and DM regarding grip force, hand mobility, activity performance or health-related quality of life.

Conclusions. Patients with PM or DM have reduced grip force that could influence activity performance and health-related quality of life.

Key words: Polymyositis, Dermatomyositis, Activities of daily living, Activity performance, Grip force, Grip strength, Hand function, Quality of life.

Introduction

PM and DM are chronic inflammatory diseases characterized by muscle weakness and low muscle endurance, primarily in the proximal muscles [1–4]. Low muscle performance may have a negative effect on activity performance and physical function in these patients [2, 5]. Treatment of PM and DM is based on glucocorticoids and immunosuppressive drugs, and, although many patients respond with clinical improvement, several patients have a sustained disability that increases significantly during the disease course [6, 7] and a substantial number of patients are affected in their ability to function in their environment and manage their activities in daily life [5, 8, 9]. Such daily activities include getting up from a chair, walking up a stair, lifting objects and combing their hair [2, 8]. In addition to physical disabilities, these disorders may give rise to psychological consequences that negatively affect quality of life [6, 9, 10]. Notably,
Hand function in PM and DM

Table 1: Baseline characteristics for the participants and those who did not participate

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Participants (n = 31)</th>
<th>Patients who declined participation or could not be reached (n = 13)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (s.d.), years</td>
<td>56.1 (10.6)</td>
<td>57.4 (16.3)</td>
<td>0.76a</td>
</tr>
<tr>
<td>Disease duration, mean (s.d.), years</td>
<td>6.8 (5.5)</td>
<td>7.7 (5.8)</td>
<td>0.64a</td>
</tr>
<tr>
<td>Gender, women, n (%)</td>
<td>18 (58.1)</td>
<td>11 (84.6)</td>
<td>0.17b</td>
</tr>
<tr>
<td>Diagnosis, PM, n (%)</td>
<td>20 (64.5)</td>
<td>5 (38.5)</td>
<td>0.18b</td>
</tr>
</tbody>
</table>

Using independent-sample t-test and Mann–Whitney U-test, it was found that there were no significant differences between the participants and the patients who declined participation. aIndependent-sample t-test. bMann–Whitney U-test.

Patients with PM and DM, regardless of the disease activity, had a significantly lower health-related quality of life in comparison with population controls in all dimensions of the short form-36 (SF-36) questionnaire [10].

To be able to perform daily activities, hand function is an important aspect. The hands require mobility, grip force and absence of pain to be able to work effectively [11]. Hand function is affected in many rheumatic diseases either through arthritis or through skin changes as in SSc and may lead to reduced grip force [12, 13]. In patients with sporadic IBM, weakness of finger flexors is a striking problem [2]. Whether weakness of hand muscles may impair hand function in PM or DM has, to our knowledge, not been investigated. In addition, there are no studies that have investigated whether there is a correlation between hand function and activity performance and health-related quality of life in these patients.

In an earlier study, performed in our research group, we observed that a low grip force seemed to be a common problem in patients with PM and DM [14], but the extent and effect on activity performance and health-related quality of life has not been investigated. Thus, we designed this study with the aim to investigate hand function in PM and DM patients and compare this with reference values in healthy individuals, and we also wanted to investigate if hand function correlated with the activity performance and health-related quality of life.

Patients and Methods

Patients

Patients with definite or probable PM or DM according to criteria by Bohan and Peter [1] were included in the study. Exclusion criteria for participation were other diseases or injuries that could affect hand mobility and grip force; for example, other rheumatic or neurological diseases. A total of 50 patients diagnosed with PM or DM were identified and informed about the study through the myositis registry at the Rheumatology Clinic at Karolinska University Hospital, Stockholm, Sweden. Six of them were excluded due to an additional rheumatic disease that could affect hand function. Five patients could not be reached within the period of the study and eight chose not to participate.

The study included a total of 31 participants (18 women and 13 men): 12 had definitive and 8 probable PM, and 10 definitive and 1 probable DM. The demographic characteristics of the participants and those who declined participation or whom we could not reach are presented in Table 1. There was no significant difference regarding age, disease duration, gender and diagnosis between those who participated and those who declined participation or whom we could not reach (Table 1). The mean age was 56.1 (10.6) years and the mean disease duration was 6.8 (5.5) years. Medical treatment at the time of the study included different combinations of immunosuppressive agents: prednisolone, AZA, MTX, CSA, CYC, infliximab, IVIG and NSAIDs. Eighty per cent were treated with prednisolone and the mean daily dosage was 5.6 (4.9) mg. The mean serum level of creatine kinase (CK) was 5.7 (8.8) microcat/l (reference value: for women: <2.5 microcat/l and for men: <3.3 microcat/l). The mean value of ESR was 16.1 (17.3) mm and for CRP 10.3 (5.4) mg/l (reference value <10 mg/l). None of the patients had arthritis of their hands, 29% had interstitial lung disease and 32% had dysphagia. Thirteen per cent were anti-Jo-1 antibody positive. Ten patients had also undergone an impairment assessment using the functional index [15] at the time of the study. The median percentage and quartiles (Q1–Q3) of maximal capacity were 69% (54–78) and 71% (61–82) of the muscles on the right or left side, respectively. This measure indicates that the patients had a moderate to low functional impairment.

Study design

The study was an observational cross-sectional design, with measures from standardized assessments and self-administered questionnaires. Patients gave oral consent to participate, which was the requirement of the ethical committees in Sweden at the time of the study. The study was approved by the ethics committee at Karolinska University Hospital. The same occupational therapist assessed hand mobility and grip force and at the same visit, and the patients answered the self-administered questionnaires.

Measures

Grip force was measured in Newtons (N) using Grippit (Detektor AB, Göteborg, Sweden) [12], which is an electronic measure that gives a mean value, a maximum and a final value after a period of 10 s. Measurements are

Table 1: Baseline characteristics for the participants and those who did not participate
recorded every half a second during the 10-s test, and the higher the score the better grip force. The mean value over 10 s was used in the analysis in this study. Reference values for the Grippit instruments were available from a Swedish cohort of healthy individuals [12].

Hand mobility was measured by the Escola Paulista de Medicina – Range of Motion scale (EPM-ROM) [16], where the active joint mobility is measured with a goniometry. The EPM-ROM scale measures joint mobility in seven joints. Only joints involving the hand were measured (wrist, thumb and the MCP joint). The range of mobility varies from 0 to 3, where 0 is equivalent to full mobility and 3 indicates severe joint mobility limitations. The final score is calculated through the sum of the values on right and left side and is then divided by 2. This gives a scale from 0 to 21, where 0 indicates good joint mobility and 21 indicates severe joint mobility limitation [16].

Activity performance was measured by the myositis activities profile (MAP), a disease-specific questionnaire [17] measuring difficulty to perform activities in daily life during the past week. Difficulty is defined as how hard the activity is to perform and how important the activity is for the person to manage. Each activity is scored on a 7-grade scale (where 1 indicates no problem and 7 indicates impossible to do). The activities are divided into four sub-scales: movement activities, activities of moving around, self-care activities and domestic activities. The questions are ordered in rank and the median value and quartiles for every sub-scale is used in the results. An additional four single items are included in the MAP regarding social activities, avoiding over-exertion, work/ school work and leisure activities, which are presented in the result as the actual score [17].

Health-related quality of life was measured with the self-administrated questionnaire SF-36 [18, 19], which contains questions relating to self-experienced health in eight dimensions: physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role and mental health. The different dimensions range from 0 to 100, where 100 indicates good health-related quality of life. Values from gender- and age-matched individuals in the Swedish population were collected from SF-36 health questionnaire manual and interpretation guide [18].

Statistics

To describe grip force, hand mobility, activity performance, health-related quality of life and disease activity, mean (s.d.) values, median values, quartiles, CIs, independent-sample t-test and Mann–Whitney U-tests have been used. To compare patients with PM and DM to gender- and age-matched reference values regarding health-related quality of life using SF-36 [18] and grip force using Grippit [12], mean values, one-sample t-test and CIs have been used. The mean value for the reference groups was determined by collecting a gender- and age-matched mean value for each patient and then calculating a new mean value for the reference group. The differences between patients with PM and DM and also between women and men regarding grip force, hand mobility, activity performance and health-related quality of life were analysed by mean values, independent-sample t-test and Mann–Whitney U-tests. Pearson’s correlation coefficient, the respective Spearman’s \( \rho \) mean values and CIs were used to calculate correlations between hand mobility and grip force with regard to the variables activity performance, health-related quality of life, disease activity and disease duration. All statistical calculations were made in Statistical Package for the Social Sciences (SPSS; Chicago, IL) version 15. Level of significance was defined as \( P < 0.05 \).

Results

Grip strength in patients with PM or DM

The mean (s.d.) values in grip force for the total group, patients with PM or DM and women and men are presented in Table 2. Men were significantly stronger than women regarding mean grip force in the dominant hand, right and left hand (Table 2). There was no difference in grip force between PM and DM in the dominant hand, right and left hand; thus, the two patient groups were combined and the patients were sub-grouped based on sex when compared with data from gender- and age-matched healthy individuals from a Swedish cohort [12]. The mean grip force was significantly lower in men and women with PM or DM compared with data from gender- and age-matched healthy individuals in right and left hand (\( P < 0.001 \); Table 3). The grip force was 60.1% (24.7) for men and 70.5% (23.9) in women in comparison with healthy individuals. As a total, there were 10 women (55.6%) and 10 men (76.9%) who had a lower grip force in either both, left or right hand when compared with data from healthy individuals. There was no significant difference in grip force between right, left or dominant hand for men and women.

Hand mobility in patients with PM or DM

The hand mobility, measured with the EPM-ROM scale, in the total group had a median score and quartiles (Q1–Q3) of 3 (1.5–4.0) out of maximum 21, indicating small limitations in joint mobility. When dividing the group into PM, DM, women and men, the median score had a range from 3 to 3.5, which indicates a homogenous group. The most common joint mobilities that were affected in these patients were wrist flexion (76%), wrist extension (73%) and thumb flexion (60%). Only three patients had severe limitation (Score 3) in one or two joints. There were no significant differences between patients with PM and DM or between women and men regarding hand mobility.

Health-related quality of life in patients with PM/DM, women/men in correlation with data from the Swedish population

Patients with PM and DM had significantly lower values in all dimensions of the SF-36 score when compared with
data from gender- and age-matched individuals from the Swedish population (P < 0.05; Fig. 1) [18]. There was no significant difference in health-related quality of life between patients with PM and DM or between women and men (Fig. 2).

Activity performance in patients with PM or DM

Activity performance measured with MAP is presented in Table 2. The median in each sub-scale for the different patient groups (the total group, patients with PM or DM, women and men) did not vary significantly. The total group had a variation of median values from 2 to 5 points, which indicates a range from slightly difficult to very difficult. No one reported that any activity was impossible to do. There were no significant differences between patients with PM and DM or between women and men regarding activity performance.

TABLE 2 Grip force and activity performance in patients with PM or DM

<table>
<thead>
<tr>
<th>Grippit, N</th>
<th>Total mean (s.d.), n = 31</th>
<th>PM mean (s.d.), n = 20</th>
<th>DM mean (s.d.), n = 11</th>
<th>Women mean (s.d.), n = 18</th>
<th>Men mean (s.d.), n = 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant hand</td>
<td>188.7 (93.4)</td>
<td>192.7 (108.9)</td>
<td>181.6 (59.4)</td>
<td>150.8 (44.6)(^a)</td>
<td>241.2 (117.6)(^a)</td>
</tr>
<tr>
<td>Right hand</td>
<td>188.1 (93.6)</td>
<td>191.9 (109.3)</td>
<td>181.2 (53.1)</td>
<td>149.9 (44.9)(^b)</td>
<td>240.9 (117.6)(^b)</td>
</tr>
<tr>
<td>Left hand</td>
<td>174.5 (85.9)</td>
<td>172.1 (94.4)</td>
<td>178.8 (68.8)</td>
<td>136.4 (49.2)(^c)</td>
<td>227.2 (97.1)(^c)</td>
</tr>
</tbody>
</table>

MAP

<table>
<thead>
<tr>
<th>Total median (Q1–Q3), n = 31</th>
<th>PM median (Q1–Q3), n = 20</th>
<th>DM median (Q1–Q3), n = 11</th>
<th>Women median (Q1–Q3), n = 18</th>
<th>Men median (Q1–Q3), n = 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement</td>
<td>3.0 (3.0–4.0)</td>
<td>3.0 (2.0–4.0)</td>
<td>3.0 (2.0–4.0)</td>
<td>2.5 (2.0–4.3)</td>
</tr>
<tr>
<td>Moving around</td>
<td>4.0 (2.0–5.0)</td>
<td>4.0 (3.0–6.0)</td>
<td>3.0 (2.0–4.0)</td>
<td>4.0 (2.0–5.3)</td>
</tr>
<tr>
<td>Self-care</td>
<td>2.0 (1.0–4.0)(^d)</td>
<td>2.0 (1.3–4.0)</td>
<td>2.0 (1.0–3.3)(^d)</td>
<td>2.0 (1.0–4.0)</td>
</tr>
<tr>
<td>Domestic</td>
<td>3.0 (1.8–4.0)(^d)</td>
<td>3.0 (1.0–5.0)(^d)</td>
<td>3.0 (2.0–4.0)</td>
<td>3.0 (2.0–4.5)(^d)</td>
</tr>
<tr>
<td>Social</td>
<td>2.0 (1.0–4.0)(^d)</td>
<td>2.0 (1.0–4.0)(^d)</td>
<td>2.0 (1.0–4.0)</td>
<td>2.0 (1.0–4.0)</td>
</tr>
<tr>
<td>Avoid over-exertion</td>
<td>3.0 (2.5–4.0)(^a)</td>
<td>3.0 (3.0–4.0)(^a)</td>
<td>3.0 (1.0–3.3)</td>
<td>3.0 (3.0–4.0)(^d)</td>
</tr>
<tr>
<td>Work</td>
<td>4.0 (3.0–5.3)(^d)</td>
<td>4.0 (3.0–6.0)(^d)</td>
<td>4.0 (2.0–5.0)</td>
<td>4.0 (3.8–6.0)</td>
</tr>
<tr>
<td>Leisure</td>
<td>5.0 (3.0–6.3)(^d)</td>
<td>6.0 (4.0–7.0)(^d)</td>
<td>4.0 (3.0–5.0)</td>
<td>4.5 (3.0–6.0)</td>
</tr>
</tbody>
</table>

Using the independent-sample t-test, it was found that men were significantly stronger than women in the dominant hand. \(^a\)95% CI −152.2, −28.7; P = 0.006; right hand. \(^b\)95% CI −152.9, −29.2; P < 0.005; left hand. \(^c\)95% CI −145.1, −36.5; P < 0.002. The median in each sub-scale for activity performance for the total group. PM, DM, women and men did not vary significantly. \(^d\)One missing value. \(^e\)Two missing values.

TABLE 3 Differences in grip force between patients with PM/DM and data from matched healthy individuals [12]

<table>
<thead>
<tr>
<th>Grippit mean values in 10 s, N</th>
<th>Healthy individuals, mean (s.d.)</th>
<th>PM/DM, mean (s.d.)</th>
<th>Percentage of reference values, %</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women right hand, n = 18</td>
<td>212.4 (22.9)(^a)</td>
<td>149.9 (44.9)(^a)</td>
<td>71.2</td>
<td>−84.9, −40.2</td>
</tr>
<tr>
<td>Women left hand, n = 18</td>
<td>198.2 (25.8)(^a)</td>
<td>136.4 (49.2)(^a)</td>
<td>69.7</td>
<td>−86.3, −37.3</td>
</tr>
<tr>
<td>Men right hand, n = 13</td>
<td>407.7 (30.4)(^a)</td>
<td>240.9 (117.6)(^a)</td>
<td>57.3</td>
<td>−237.9, −95.7</td>
</tr>
<tr>
<td>Men left hand, n = 13</td>
<td>367.1 (40.8)(^a)</td>
<td>227.2 (97.1)(^a)</td>
<td>63.0</td>
<td>−198.5, −81.2</td>
</tr>
</tbody>
</table>

Using the one-sample t-test, it was found that women and men with PM or DM had significantly lower grip force than healthy individuals in both right and left hands. \(^a\)P < 0.0001.

Correlations between hand function and activity performance, health-related quality of life, disease duration and disease activity in patients with PM and DM

There was a significant negative correlation between grip force and the sub-scale domestic activities in the activity performance questionnaire MAP in patients with PM and DM (r\(^\prime\)s = −0.390; 95% CI −0.658, −0.035; P = 0.05; Table 4), indicating that a low grip force may result in lower scoring on the sub-scale domestic activities of the activity performance. There was also a significant negative correlation between grip force and the health-related quality of life dimensions vitality from SF-36 (r = 0.480; 95% CI 0.017, 0.774; P = 0.05) and mental health (r = 0.527; 95% CI 0.080, 0.798; P = 0.05) in women with PM and DM (Table 4). This means that a low grip force may have a negative effect on vitality and mental health as measured...
The correlations were low or moderate at that significance level. No other significant correlations were found between grip force and the two self-administered variables. There were no significant correlations between grip force and disease activity measured by serum levels of CK, ESR, CRP or daily prednisolone dosage and disease duration (Table 4). No significant correlations were found between hand mobility and the self-administered variables of activity performance or health-related quality of life.

**Discussion**

In this study, patients with established PM or DM had a significantly lower grip force in comparison with data from gender- and age-matched healthy individuals.
Furthermore, there was a significant negative correlation between grip force and activity performance regarding domestic activities and for women there was a significant negative correlation between grip force and the dimensions vitality and mental health in health-related quality of life measurement.

The grip force assessed by Grippit [12] was significantly reduced in comparison with data from gender- and age-matched healthy individuals for both men and women and in the left and right hand. In the healthy population, men have a significantly stronger grip force in both left and right hand in comparison with women [12]. This was also true for the men and women included in our study, suggesting that the low grip force in PM and DM is not a gender-specific clinical problem. There were no significant differences between patients with PM or DM regarding grip force, hand mobility, activity performance and health-related quality of life. Thus, we analysed the two clinical sub-groups together when we compared with the data from healthy individuals, but men and women were analysed separately.

To assess hand function, it is important to evaluate both mobility and grip force [11]. In our study, the low grip force, measured by Grippit, in patients with PM or DM is unlikely to be explained by impaired hand mobility measured by EPM-ROM scale, as these measures only indicated minor limitations. Reduced strength and a reduced dexterity in the distal muscles of patients with PM or DM have previously been reported to occur in a late phase of the disease [2]. This is in contrast to patients with IBM, where this is a typical characteristic finding often at the time of diagnosis [2, 20]. In our study, the patients had a disease duration that ranged between 1 and 22 years, and only 23% patients had disease duration for >10 years. Furthermore, we found no correlation between disease duration and grip force in our cohort of myositis patients. Therefore, long disease duration could not be the only explanation to the observed low grip force in our patients. Also, pain was not a major problem, as indicated by the low difference in the domain bodily pain compared with the other dimensions of the health-related quality of life measure SF-36 and also when compared with data from gender- and age-matched individuals from the population. From our study, we cannot explain the underlying disease mechanisms for the low grip force but a possible explanation is disease involvement of distal muscles in the arms. This hypothesis is supported by a report of similar signs of inflammation including histopathological changes, such as fibre regeneration and degeneration in both distal and proximal muscle groups [21].

Hand function is important when performing the daily activities [11]. Even though the grip force was reduced in
our study (in men to ~60% and in women to ~71%) when compared with data from gender- and age-matched healthy individuals, this is a less pronounced weakness compared with women with RA whose grip force is 20–25% of that in healthy controls [12]. The myositis grip force was more similar to patients with scleroderma, whose grip force varied between 46 and 65% when compared with healthy controls [13]. Even if the percentage decrease in grip force was less in women than in men, men were still significantly stronger than women. About half of the men had better grip force than all of the women in the dominant, right and left hand. The clinical significance of the low grip force in patients with PM and DM was suggested by the significant correlation between grip force and domestic activities in the disease-specific activity performance questionnaire MAP. These results confirm the importance of hand function in activity performance [11]. The median value for the total group was 3, which indicates somewhat difficult. Questions in the sub-group of domestic activities include vacuum cleaning which according to the results in RA [22] demands a mean value in grip force of 60 N and values below this were seen in occasional individuals with PM or DM. For women with PM or DM, there was also a significant correlation between grip force and the health-related quality of life dimensions vitality and mental health. Notably, the correlations were moderate and there were relatively few patients in this study; therefore, the results need to be confirmed in a larger study.

There was a significant difference between patients with PM and DM and data from individuals from the Swedish population in all dimensions of health-related quality of life measured with SF-36, which is equivalent to other studies on health-related quality of life in PM or DM [9, 10]. The investigated cohort represented 71% of the patients who were eligible for the study. The participants did not differ significantly from those who did not participate with regard to age, disease duration, gender and diagnosis. Our results indicate that impaired hand function and grip force have an impact on how patients with myositis experience their quality of life.

A limitation of our study is the lack of a control group. However, the advantage of using generic measurements like Grippit [12] to measure grip force and SF-36 [18, 19] for health-related quality of life is the access to population-based reference values. This information made it possible to make comparisons with a large number of gender- and age-matched individuals. Another limitation was the absence of a validated disease activity measures at the time of our study. As surrogate markers for disease activity, we used serum levels of CK, the inflammatory markers ESR and CRP levels and daily prednisolone dose. We found no correlation between grip force and these variables. Being well aware of the limitation using these measures, the relatively low CK, ESR and CRP levels and the low mean daily prednisolone dosage suggest that the patients were in a low-to-moderate phase disease activity at the time of study, but we could not determine whether muscle inflammation or muscle damage contributed to low grip force. Arthritis was not detected in the hands of the participants, which could have affected the grip force.

In conclusion, we have shown that grip force could be affected in patients with PM and DM and that this could have an impact on activity performance and health-related quality of life. In order to support patients in managing their disease, it is important to use this new knowledge and refer the patients to specific hand therapy and occupational therapists, and to measure the grip force in patients with PM or DM as well as to assist patients with assistive devices or ergonomic advice when needed. Whether low grip force is present at the onset of PM or DM or is affected by immunosuppressive treatment is not known and requires further studies. Preferentially, these should be done in large population-based cohorts.

Rheumatology key messages

- Patients with PM or DM have reduced grip force and low quality of life.
- Grip force could have an influence on activity performance and quality of life.

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