Electromyography alterations in power and precision grasps in rheumatoid and psoriatic arthritis patients

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Summary

Impaired hand function in patients with rheumatoid arthritis (RA) and psoriatic arthritis (PsA) cannot solely be explained by acute hand inflammation. This study found that reduced grip strength may be linked to adaptations in the neuro-physiological system, as indicated by changes in waveform and amplitude electromyography (EMG) parameters of the flexor digtorium superficialis (FDS) and extensor digtorium communis (EDC). These findings contribute to a better understanding of the cause for hand impairments in RA and PsA and may aid to better differentiate these conditions.

Introduction

Hand function impairments are present in patients with RA and PsA. While concurrent inflammation in the hand and the resulting pain and swelling likely explain functional impairments during disease flare, reduced hand function is also observed in patients in clinical remission [1]. Persistent changes in muscles, tendons, and nerves may contribute to these impairments. This study aimed to identify differences in FDS and EDC muscle activity during two grasping tasks in RA and PsA patients compared to healthy controls (HC).

Methods

RA (ACR/EULAR 2010 criteria) and PsA (CASPAR criteria) patients (Internal Medicine 3 outpatient clinics Erlangen, Germany) and HC included in this study (Ethics #357_20B) were instructed to perform a set of different tasks, including grasping of cylinders, an isometric grip and extensor strength test, and power and precision grasps (two repetitions). EMG of the FDS and EDC (surface electrodes, Noraxon, USA, 1500Hz) were recorded. Data were post-processed following a standard protocol [2]. Amplitude parameters (root mean square (RMS), maximum (MAX)) for power and precision grasps (Vigorimeter, KLS Martin Group, Germany, Figure 1) were normalized to peak EMG activity across all tasks [2]. For both grasps RMS, MAX, new zero crossing (NZC) and enhanced wavelength (EWL) [2] (for extended time of > 50% MAX) were compared between the groups (linear mixed-effect models, stratified by sex, adjusted for age, hand dominance, and participant ID as random intercept term).

Figure 1: Precision and power grasp in measurement set-up.

Results and Discussion

187 participants were included (43 HC: 22/21 f/m, age 54±16; 69 RA: 47/22 f/m, age 53±14; 75 PsA: 38/37 f/m, age 54±14). For both grasps, female PsA patients had lower EWL in the FDS and EDC muscles, as well as lower grip strength in the power grasp compared to HC and RA (Table 1). For the power grasp RA patients showed higher RMS for both muscles compared to PsA patients (Table 1). Male patients had similar grip strength and EMG activity compared to HC (all p>0.05).

Table 1: Parameters with significant difference between the groups for the power grasp in female participants.

EMM (95%CI)	**HC (N=22)**	**PsA (N=38)**	**RA (N=47)**
Strength, kPa	73 (65-80)	51 (45-57) *, †	60 (55- 65) *
FDS EWL, 1/ms	24 (19-29)	16 (14 -19) *, †	22 (19-25)
EDC EWL, 1/ms	31 (27-35)	23 (20-26) *, †	29 (24-30)
FDS RMS, %	46 (40-52)	45 (41-50)	52 (48-56) †
EDC RMS, %	47 (42-52)	42 (38-46)	48 (44-51) †

Estimated Marginal Mean (EMM), Confidence Interval (CI), Flexor (FDS), Extensor (EDC), Enhanced Wavelength (EWL); Root Mean Square (RMS), p-value: HC-RA/PsA*< 0.05, PsA-RA†< 0.05

Conclusions

Female patients showed decreased grip strength compared to HC, with EMG alterations presenting lower EWL in PsA and higher RMS values in RA, while there were no differences in in males in this patient group. This supports previous findings of higher RMS values in functional tasks in female RA patients [3], suggesting increased muscle activation to perform the tasks. Impaired hand function is likely linked to neurophysiological changes and EMG analysis provides valuable insights into these disease-related adaptations.

Acknowledgments

This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – SFB 1483 – Project-ID 442419336, EmpkinS.

References

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