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CROSS-SECTIONAL STUDY

Correlation of Impaired Foot Function with Disease Activity and Structural Damage in Patients with Rheumatoid Arthritis

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Abstract

Introduction: Rheumatoid arthritis (RA) can affect foot, thus compromising the patient's gate and autonomy. We assessed the foot function RA patients by the Rheumatoid and Arthritis Outcome Score (RAOS) score, and investigated the associated factors to impaired foot function.

Patients and methods: A cross-sectional study including RA patients was designed. Data about demographic and clinical characteristics (disease features and podiatric assessment) were collected. Patients underwent a clinical interview to fulfill the RAOS questionnaire. Statistical analysis was performed to determine associated factors to impaired foot function.

Results: A total of 100 RA patients (92 female and 8 male) with a mean age of 56.63 ± 9.8 years were enrolled. About 70% presented foot pain, 46% foot deformities, and 70% foot structural damage. According to RAOS, the most impaired dimensions were: Sport and recreation, and quality of life. Lower RAOS scores were significantly associated with female, use of glucocorticoids, foot pain, higher disease activity and functional impairment. The most altered domains were Sport/Rec and QOL with respectively 55.4% and 49.5% scores under 50. Multivariable analysis in these domains showed significative association with disease activity, structural damage, and poor quality of life.

Conclusion: There is an unmet need for provision and monitoring of foot care in patients with RA especially in female, patients treated by glucocorticoids with high disease activity.

Keywords

Rheumatoid arthritis, Foot, Function, Patient health questionnaire

Abbreviations

RA: Rheumatoid Arthritis; DAS28: Disease Activity Score in 28 joints; RAOS: Rheumatoid and Arthritis Outcome Score; ACR-EULAR: American College of Rheumatology-European League against Rheumatism; BMI: Body Mass Index; RF: Rheumatoid Factor; ACPA: Anti-Cyclic Citrullinated Peptide; HAQ: Health Assessment Questionnaire; CRP: C-reactive protein; GC: glucocorticoids; csDMARDs: conventional synthetic Disease Modifying Anti-Rheumatic Drugs; bDMARDs: biological Disease Modifying Anti-Rheumatic Drugs; VAS: Visual Analogue Scale; MTP: Metatarsal-Phalangeal; IPP: Proximal Interphalangeal; ADL: Activities of Daily Living; Sport/Rec: Sport and Recreational activities; QOL: foot-related Quality of Life

Introduction

Rheumatoid arthritis (RA) is an inflammatory autoimmune disease, affecting primarily cartilage and bone of small and middle-sized joints, sometimes with additional systemic features [1]. The disease is characterized by early joint involvement of the hands and feet. Studies have shown that 13-34% of patients with RA initially present solely with foot or ankle symptoms, and approximately 90% of patients report painful feet or ankles symptoms at some time during the course of their disease [2].

In addition to pain and stiffness, foot involvement in RA has been shown to be an important cause of impaired function and muscle atrophy leading to disability and reduced quality of life [3]. At a late stage of the disease, foot deformities worsen the functional

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prognosis and impair walking ability [4]. This highlighted the importance of foot function assessment throughout the disease course. However, patients' foot assessment is not being fully met by rheumatologist clinicians. Savia de Souza, et al. [5], have shown that less than half (47%) of feet are examined in routine consultation and 54% of clinicians didn't examine feet routinely because they are not included in the disease activity score with 28 joints (DAS28). On the other hand, foot pain was not correlated to structural damage [6]. Multiple patient-reported outcome measures were developed to evaluate foot function in RA [7]. The Rheumatoid and Arthritis Outcome Score (RAOS) is an adaptation of the Knee Injury and Osteoarthritis Outcome Score [8], and is intended to evaluate symptoms and functional limitations of people with chronic inflammatory joint diseases and problems from lower extremities induced by treatment (medication, operation, physical therapy). This questionnaire also assesses the sport, recreation function and quality of life domains. Therefore, it can give a fuller picture of the lower limb involvement.

The aims of this study were to assess the foot function in patients with RA patients using the RAOS questionnaire, and to identify the associated factor of impaired RA foot function among patient and disease related parameters.

Methods

Study design and population

We conducted a cross sectional study over 12 months period (January- December 2021). Patients who met the American College of Rheumatology-European League against Rheumatism (ACR-EULAR) 2010 criteria for RA were consecutively enrolled [9]. Patients aged < 18 and > 80 years, having a history of recent injury or surgery to ankle or foot, comorbid disease affecting foot health (neuropathy, lumber radiculopathy, diabetes mellitus, inflammatory rheumatic disease other than RA, and endocrine arthropathies…) were not included to the study.

Data collection

Patient characteristics including demographic data, tabaco exposure, and Body Mass Index (BMI) were collected. Disease characteristics: disease duration, positivity of rheumatoid factor (RF) and anti-cyclic citrullinated peptide (ACPA), disease activity by Disease Activity Score in 28 joints (DAS28) and functional status by Health Assessment Questionnaire (HAQ) were recorded. At the time of inclusion, C-reactive protein (CRP) was measured and current medication was noted (glucocorticoids (GC), conventional synthetic Disease Modifying Anti-Rheumatic Drugs (csDMARDs), and biological DMARDs (bDMARDs).

Podiatric assessment

Feet pain were measured through Visual Analogue Scale (VAS) (0-100), and their distribution (forefoot, midfoot, hindfoot). Physical examination checked foot deformities (triangular forefoot, hallux valgus, supra adductus, quintus varus, clow toes, fibular deviation of metatarsophalangeal, metatarsophalangeal joints subluxations and rearfoot valgus misalignment), cutaneous lesions, number of swollen joint count of metatarsal-phalangeal (MTP), proximal interphalangeal (IPP), tenosynovitis, and plantar pressure on podoscope. Foot plain radiography was performed at baseline and evaluated structural damage (erosion, Hallux valgus, Sesamoid dislocation, Joint space narrowing, Fibular deviation of metatarsophalangeal).

All patients underwent a clinical interview to fulfil the RAOS score [10]. It consists of 42 items assessing five separate dimensions: Pain (nine items); Other Symptoms like stiffness, swelling and range of motion (seven items); Activities of Daily Living (ADL) (17 items); Sport and Recreational activities (Sport/Rec) (five items); and foot-related Quality Of Life (QOL) (four items). Answer options were given using five options (no, mild, moderate, severe, extreme) and each question can get a score from 0 to 4. Each of the five subscale scores was calculated as the sum of the items included. Raw scores are then transformed to a zero to 100 (worst to best scale). The level of impairment was considered according to the normalized RAOS score: Very bad foot function (RAOS score < 25), bad foot function (RAOS score between 25-50), moderate foot function (score between 50-75) and mild (score > 75).

Statistical analysis

Descriptive statistics were performed and indicated as mean (± standard deviation) for continuous variables. All qualitative data were expressed as frequency and percentages. The student's t test and correlation coefficients were used to test for significant associations between clinical characteristics and RAOS subscales, with significance set at the $p < 0.05$ confidence level. Multivariate analysis, assed by linear regression, of variables of the most altered subscales of RAOS, was used to determine which factors with $p < 0.2$ were likely to predict foot involvement in each subscale. All statistical analyses were done using SPSS for windows version 24.

Results

A total of 100 patients were included. The mean age was 56.63 ± 9.8 years [33-74] and the sex-ratio was 0.08. The median disease duration was 15.44 ± 10.32 years [1-46]. The mean DAS28 was 3.70 ± 1.5 [0.12-6.9]. Demographic and clinical characteristics of the study population were presented in Table 1.

Podiatric assessment revealed that up to 70% complained of foot pain, 46% have foot deformities, and 70% have structural damage. Podiatric evaluation and abnormalities were detailed in Table 2. The mean

Table 1: RA patients and disease characteristics.

Variable	N = 100
Female gender (%)	92
Age (years) ± SD (range)	56.63 ± 9.8 (33-74)
Tabaco exposure (%)	7
Height(m), mean ± SD (range)	9.97 ± 35.97(142-175)
Weight(kg), mean ± SD (range)	71.22 ± 14.61(40-109)
BMI (kg/m²), mean ± SD (range)	27.81 ± 5.1(17-40)
FR positivity (%)	64
ACPA positivity (%)	60
Erosive (%)	83.2
Use of Glucocorticoid (%),	69.3
Glucocorticoid daily dose (mg)	4.9
Use of csDMARDs (%)	74.3,
Methotrexate (%)	16.8
Sulfasalazine (%)	64.4
Methotrexate + Salazopyrine (%)	8.9
Leflunomide (%)	3
Use of bDMARD (%)	31.7
TNF inhibitors	13
IL6 inhibitors	13.9
Rituximab	5
CRP (mg/l), mean ± SD (range)	11.87 ± 14.7 (2.1-63)
DAS28, mean ± SD (range)	3.70 ±1.57 (1.2-6.9)
HAQ, mean ± SD (range)	0.92 ± 0.81 (0.2-2.8)

SD: Standard Deviation; RF: Rheumatoid Factor (IU/Ml); ACPA: Anti-Cyclic Citrullinated Peptide Antibody; Cs: Conventional Synthetic; DMARD: Disease Modifying Anti-Rheumatic Drugs; TNF: Tumor Necrosis Factor; IL: Interleukin; Min: Minimum; Max: Maximum; Kg: Kilogram; CRP: C Reactive Protein; DAS 28: Disease Activity Score 28; HAQ: Health Assessment Questionnaire

Table 2: Podiatric Assessment.

Category	Foot problem	N = 100
Articular features	Pain (%), mean VAS (1-100)	69.3 (36.99)
	Fore foot pain (%)	49
	Mid foot pain (%)	37
	Rare foot pain, n (%)	23
	Swollen joint count (MTP, IPP)	16
	Fibular tenosynovitis, n (%)	12
	Tibial tenosynovitis, n (%)	9
Cutaneous lesions (%)		55
	Callus	28.7
	Corns	18.8
Structural deformity (%)	Triangular forefoot	21.7
	Hallux valgus	46.5
	Supra adductus	8.9
	Quintus Varus	9.9
	Claw toes	25.7
	Fibular deviation of metatarsophalangeal	17.8
	Metatarsophalangeal joints subluxations	11.9
	Rearfoot valgus misalignment	13.8
	Plantar dimple atrophy	20.8
Podoscope (%)	Flat food	30
	Hollow foot	14
	Calcaneus Valgus	13
	Calcaneus varus	4
X-Ray (%)	Hallux valgus	53.5
	Sesamoid dislocation	20.8
	Foot Erosion	
	Erosion in the fifth metatarsal head in foot	
	Joint space narrowing	
	Fibular deviation of metatarsophalangeal	
	Calcaneitis in foot	

VAS: Visual Analogue Scale, MTP; IPP

Table 3: Mean scores of RAOS items.

RAOS items	Mean ± SD	Extrema
Pain	68.06 ± 27.51	0-100
Symptoms	71.63 ± 24.84	0-100
ADL	71.25 ± 26.71	0-100
Sport/Rec	38.76 ± 36.51	1-120
Quality Of Life	50.58 ± 32.27	0-100

RAOS: Rheumatoid and Arthritis Outcome Score, ADL: Activities of Daily Living, Rec: Recreational, SD: Standard Deviation

scores for each subscale of the RAOS were summarized on Table 3. The most impaired dimensions were: Sport and recreation, and quality of life. When looking at the distribution of the RAOS according to the normalized

Table 4: Distribution of patients according to standardized RAOS score of each subscale.

Domain	< 25	25-50	50-75	> 75
Pain, n (%)	5 (5)	18 (17.8)	24 (23.8)	40 (39.6)
Symptoms, n (%)	2 (2)	15 (14.9)	22 (21.8)	48 (47.5)
ADL, n (%)	3 (3)	14 (13.9)	24 (23.8)	46 (45.5)
Sport/Rec, n (%)	38 (37.6)	18 (17.8)	8 (7.9)	20 (19.8)
QOL, n (%)	24 (23.8)	26 (25.7)	12 (11.9)	23 (22.8)

RAOS: Rheumatoid and Arthritis Outcome Score, ADL: Activities of Daily Living, Rec: Recreational; n: number

scores, the level of impairment of each subscale was considered: Mild in pain, symptoms, and ADL (39.6%, 47.5%, 45.5% respectively), very bad in Sport/Rec (37.6%) and bad to very bad in QoL (49.5%) (Table 4).

Using univariate analysis, RAOS was significantly lower in female in the subscales Pain, Sport/Rec, and QOL (Table 5a). Regarding disease-related parameters, RAOS scores was negatively correlated with foot pain, CRP levels, DAS28, and HAQ (Table 5b). Corticosteroid intake and bDMARDs were associated to impaired foot function.

Concerning podiatric assessment, RAOS was significantly different according to pain distribution, and the presence of inflammatory arthritis. RAOS was significantly lower in the 5 dimensions in case of fore foot pain, MTP synovitis, IPP synovitis, and fibular tenosynovitis. Foot erosion, and specifically erosion in the fifth metatarsal head in foot was associated with worse RAOS in ADL, Sport/Rec and QOL (Table 5a).

Using multivariate analysis in subscales of Sport/Rec and QOL identified predictive factors of impaired foot function in RA: Higher HAQ scores, clinical inflammation (tenosynovitis, synovitis), foot erosion/damage, higher disease activity, and forefoot pain (Table 6).

Discussion

This study evaluated the correlation of RAOS with demographic data, disease characteristics and foot problems. It showed sever impairment in the following domains in descending order: Sport/Rec, Quality of Life, Pain, ADL and Symptoms. Thus, sport and recreation were the most altered area (38.76 ± 36.51. These findings are not surprising and were in line with previous studies [4,11]. The predictive factors altered RAOS scores were: Forefoot pain, higher disease activity (DAS28, synovitis, tenosynovitis), structural damage such as erosions and altered quality of life.

RAOS has proven to be a reliable, valid and responsive outcome instrument for people with chronic inflammatory joint diseases and lower extremity dysfunction [12]. It evaluated patients' perception of foot involvement in 5 domains (pain, symptoms, activity of daily living, sport and recreation, and quality of life). Using the patients-based approach was known to have produced higher rates of prevalence of foot involvement than those estimated using other methodologies, including examination and imaging [4].

Worse foot impairment in RA patients may be due to external component, such as the choice of foot wear. Many patients, especially women have considerable difficulty in obtaining footwear designed according to their deformities and aesthetically acceptable [13]. These outcomes are often associated with dissatisfaction and even depression. This finding is concordant with our results which highlighted that males have significantly better scores in the majority of the RAOS items (pain, sport and recreation, QOL), as previously reported in literature [14].

Borman, et al. [15] studying 100 RA patients, found that BMI correlates with foot dysfunction and considered that this finding was due to excessive mechanical loading of knee, ankle and foot joints [15,16]. Additionally, obese patients' response to treatment is lower, with lower likelihood of remission from the disease [17]. Moreover, in obese patients, measurement of lower limb pain and mobility may be influenced by increased global pain score [18]. All in all, it seems that the association between BMI and foot involvement is a complicated net result of different interrelated factors that may have opposing effects.

In this study higher disease activity, as evaluated by foot pain, CRP and DAS28, affected negatively foot function, as previously reported [11,19]. RAOS was negatively correlated to patients' disease activity, measured with (DAS28) in the 5 subscales with r ranging from -0.59 to -0.33. Hooper, et al. [19] which found that foot impairment was associated with fluctuations in disease activity. However, it is important to stress that some precautions must be taken when choosing the tool to measure disease activity. DAS28 is an instrument that takes into account 28 pre-established joints, but none of the feet. Using this instrument to measure RA activity may be misleading as it is possible that the foot joint are inflamed despite the patients having been classified in remission [20]. Wechalekar, et al. [21] evaluated 123 RA

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Table 5a: Correlation of the mean items of the RAOS questionnaire with qualitative variables.

	Pain		Symptoms		ADL		Sport/Rec		QOL	
	Mean ± SD	**p**	**Mean ± SD**	**p**	**Mean ± SD**	**P**	**Mean ± SD**	**p**	**Mean ± SD**	**p**
Sex: male	86.90 ± 15.69	**0.03**	84.18 ± 22.76	0.09	84.87 ± 17.24	0.11	65.00 ± 27.98	**0.03**	75.00 ± 27.38	**0.04**
Female	65.17 ± 26.62		68.51 ± 24.06		69.18 ± 25.67		37.11 ± 34.24		48.91 ± 31.15	
Clinical characteristics										
FR+	65.67 ± 26.75	0.52	68.92 ± 25.911	0.85	69.07 ± 25.05	0.4	38.59 ± 33.96	0.99	50.69 ± 31.98	0.74
FR-	69.55 ± 26.70		68.92 ± 23.92		73.31 ± 27.03		38.54 ± 36.34		48.32 ± 31.10	
ACPA+	66.48 ± 25.14	0.88	67.55 ± 24.29	0.66	68.74 ± 26.10	0.37	36.16 ± 34.40	0.18	49.12 ± 29.34	0.64
ACPA-	67.41 ± 32.63		70.19 ± 27.75		74.38 ± 27.61		48.40 ± 38.50		52.75 ± 38.57	
GC+	62.24 ± 27.34	**< 0.01**	65.22 ± 25.15	**0.01**	66.60 ± 26.26	**< 0.01**	34.78 ± 34.66	0.2	45.50 ± 31.99	0.07
GC-	84.41 ± 14.79		83.33 ± 18.12		85.62 ± 15.63		49.12 ± 33.73		64.71 ± 26.32	
CsDMARDs+	68.49 ± 26.39	0.12	71.60 ± 23.09	0.059	72.18 ± 24.86	0.08	41.16 ± 34.25	0.17	51.91 ± 30.72	0.32
csDAMRD-	57.29 ± 31.12		59.15 ± 27.84		60.29 ± 26.84		28.00 ± 34.73		43.36 ± 35.09	
b DMARD+	60.16 ± 27.45	0.06	61.38 ± 24.76	**< 0.01**	61.53 ± 26.37	**< 0.01**	24.83 ± 32.25	**< 0.01**	43.95 ± 33.46	0.144
b DAMRD-	70.94 ± 25.59		74.84 ± 21.79		75.79 ± 22.97		46.80 ± 33.89		53.97 ± 30.23	
Podiatric assessement										
Fore foot pain+	56.25 ± 23.78	**< 0.001**	61.90 ± 22.53	**0.003**	60.97 ± 22.93	**0.001**	28.83 ± 27.74	**0.008**	35.46 ± 23.09	**<0.001**
Fore foot pain-	75.44 ± 25.57		76.41 ± 23.99		78.12 ± 24.977		46.98 ± 37.18		62.38 ± 31.25	
Foot deformities+	65.42 ± 26.42	0.216	68.43 ± 24.23	0.211	69.03 ± 25.78	0.207	37.20 ± 34.73	0.164	48.53 ± 31.51	0.111
Foot deformities-	75.21 ± 26.75		77.47 ± 23.34		78.62 ± 22.05		51.54 ± 31.23		63.46 ± 28.85	
Synovitis of MTP and IPP joints of feet+	55.69 ± 22.68	**0.038**	63.75 ± 21.96	0.228	59.34 ± 22.66	**0.031**	15.50 ± 18.84	**< 0.001**	31.88 ± 19.54	**0.003**
Synovitis of MTP and IPP joints of feet-	69.44 ± 26.84		71.07 ± 24.63		73.01 ± 25.47		45.26 ± 35.04		55.29 ± 32.21	
Fibular tenosynovitis+	56.69 ± 20.89	**0.021**	62.70 ± 19.76	0.08	61.82 ± 21.21	**0.042**	22.22 ± 28.26	**0.002**	31.25 ± 19.76	**0.001**
Fibular tenosynovitis-	70.40 ± 27.56		72.16 ± 25.28		73.41 ± 26.26		45.64 ± 34.61		57.83 ± 32.05	
X-Ray										
Hallux valgus +	65.86 ± 25.40	0.65	68.49 ± 23.67	0.48	69.40 ± 24.66	0.39	34.75 ± 32.78	0.11	46.62 ± 30.82	0.18
Hallux valgus -	68.06 ± 28.59		71.43 ± 25.24		71.71 ± 26.54		45.92 ± 36.37		56.93 ± 31.82	
Foot erosion+	64.18 ± 25.69	0.18	67.42 ± 24.44	0.26	66.43 ± 24.81	**0.04**	29.64 ± 30.86	**0.002**	45.34 ± 28.34	**0.033**
Foot erosion-	71.9 ± 28.21		73.27 ± 24.35		77.23 ± 24.81		52.88 ± 35.81		59.82 ± 34.57	
Erosion in the fifth metatarsal head in foot+	62.35 ± 25.55	0.051	67.14 ± 23.59	0.298	65.46 ± 25.21	0.05	24.20 ± 28.34	**< 0.001**	42.47 ± 27.07	**0.006**
Erosion in the fifth metatarsal head in foot-	73.07 ± 26.03		72.52 ± 25.30		75.86 ± 24.72		53.18 ± 34.15		60.42 ± 32.64	
Calcaneitis+	85.19 ± 8.4	0.24	75.00 ± 12.87	0.70	81.37 ± 23.90	0.49	66.67 ± 41.63	0.16	19.09 ± 11.02	0.73
Calcaneitis-	67.24 ± 26.35		69.71 ± 24.24		71.62 ± 24.24		38.5 ± 34.31		52.08 ± 31.53	

RAOS: Rheumatoid and Arthritis Outcome Score, ADL: Activities of Daily Living, Rec: Recreational ; BMI: Body Mass Index QOL: Quality Of Life, RF: rheumatoid factor (IU/ml); ACPA: anti-cyclic citrullinated peptide antibody; standard deviation ; HAQ: Health Assessment Questionnaire; DAS 28: Disease Activity Score 28; CRP: C reactive protein

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Table 5b: Correlation of the mean items of the RAOS questionnaire with quantitative variables.

	Pain		Symptoms		ADL		Sport/Rec		QOL	
	r	p	r	p	r	p	r	p	r	p
Age	-0.12	0.23	-0.10	0.92	-0.16	0.11	-0.19	0.05	-0.07	0.46
BMI	-0.08	0.39	-0.10	0.29	-0.09	0.38	-0.10	0.33	-0.01	0.9
Foot pain (VAS), mean ± SD	**-0.69**	**< 0.01**	**-0.51**	**< 0.01**	**-0.62**	**< 0.01**	**-0.60**	**< 0.01**	**-0.61**	**< 0.01**
CRP, mean ± SD	**-0.28**	**0.005**	-0.169	0.101	**-0.231**	**0.024**	**-0.217**	**0.035**	**-0.21**	**0.035**
DAS28, mean	**-0.59**	**< 0.001**	**-0.50**	**< 0.001**	**-0.55**	**< 0.001**	**-0.33**	**< 0.001**	**-0.47**	**< 0.001**
HAQ, mean	**-0.52**	**< 0.001**	**-0.43**	**< 0.001**	**-0.57**	**< 0.001**	**-0.23**	**0.022**	**-0.37**	**< 0.001**

RAOS: Rheumatoid and Arthritis Outcome Score, ADL: Activities of Daily Living, Rec: Recreational; QOL: Quality Of Life; SD: Standard Deviation, n: number

Table 6: Multivariable analysis of the subscales of sport and recreation and quality of life.

RAOS subscales	Predictive factors for RAOS variation	p	Beta	Standard error	95% confidence interval	
					Lower Bound	Upper Bound
Sport and Recreational activities (Sport/Rec)	**Erosion in the fifth metatarsal head**	$< 10^{-3}$	-0,539	7,944	-54,936	-22,851
	Calcaneitis	0,002	0,375	19,954	25,500	106,096
	Fibulartenosynovitis	0,010	-0,294	3,422	-16,183	-2,362
	Radiographic Hallux valgus	0,016	-0,276	8,023	-36,319	-3,914
	HAQ	0,023	-0,265	5,775	-25,278	-1,954
Quality of life (QOL)	**Forefoot pain VAS**	0,041	-0,243	1,251	-5,127	-0,106
	DAS28(CRP)	0,020	-0,264	2,069	-9,101	-,798
	Synovitis of MTP and IPP joints	0,026	-0,261	1,791	-7,710	-0,521
	Foot erosions	0,030	-0,238	6,940	-29,371	-1,520

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patients after 6 months of treatment and showed that more than 20% of patients with ongoing foot synovitis met 28 joint count remission criteria. A probable explanation for our result, could be that foot and ankle inflammationmay be a reflect of systemic inflammation, since higher CRP levels were also correlated with poor foot function. In line with our results, Andrade PA, et al. [11], showed that degree of inflammation measured by CRP correlates with foot dysfunction. Thus, strict control over disease activity is a way to avoid loss of foot involvement.

Impairment of RA patients motor capacity can compromise their lifestyle through mechanical difficulties and insecurity, and may give up some activities in order to have time and energy for others. This was reflected, in our study, in the functional capacity assessed through HAQ, which showed worse scores and negative correlation with RAOS, with r ranging from -0.57 to -0.23. Studies have also shown that patients' assessment of changes in the shape or appearance of their feet were significantly better predictors of loss of valued life activities [22].

Corticosteroids are often required to rapidly control disease activity. However, they have been reported to induce oxidative stress in bone and in tendon and then reducing bone turnover and reduction in skeletal loading as would occur with muscle atrophy and sarcopenia [23]. Also, sarcopenia is a common comorbidity of RA as the two major risk of it are physical incapacity and chronic low-grade inflammation, both of which are hallmarks of RA. A systemic review in 2021 have shown that 25.4% of patients with RA had sarcopenia and that GC use was positively associated with sarcopenia (Odds ratio = 1.46) [24]. Moreover, Janssen an, et al. [25] have investigated the relationship of sarcopenia and foot function and have shown that it was associated with functional impairment and in activities of daily living. Similarly, in our study, worse RAOS score was significantly associated with the use of GC in item of symptoms, ADL and Sport/Rec.

Thirty percent of our patients were on biological treatment and had significant association with worse RAOS compared to those not on bDMARDs, in subscale of symptoms, Sport/rec and quality of life. Indeed, patients on biological drugs, have been on longer and severe passed time on uncontrolled joint synovitis, that may lead to fixed foot deformities [26,27]. Otter SJ, et al. demonstrated that patients receiving bDMARDs reported that foot examination was undertaken less frequently than RA patients bDMARDs naïve ($p < 0.001$) [27]. The limited time given to the physicians to evaluation drug response, especially by calculating DAS28, that unfortunually do not incorporates foot/ankle examination, may also support this hypothesis. Another consideration is that as more effective treatments become available; patients' goals will likely expand beyond simple preservation of the active daily living. It look like despite great progress in the disease management, a great deal of RA patients is still disabled by foot dysfunction [19].

Structural damage was a predictive factor of foot involvement in RA. Leeden, et al. [28] have shown that erosions in MTP and IPP are associated with increased pressure under the forefoot ($r = 0.2$, $p = 0.0020$) and then associated with additional pain during barefoot walking. As a result, a prolonged stance phase and delayed heel lift are related to disability in daily activities. Tuna, et al. [29] have shown that erosions were associated with higher pressure value under the fifth MTP, which had the higher erosion score, supports this opinion. Also, it is a classic knowledge that erosions mostly occur at the fifth MTP joint [30].

Also, foot deformities such as hallux valgus, may influence this pressure distribution. The new walking style that results may be due to biomechanical alterations due to deformities, tenosynovitis and metatarsal pain.

Given that our result suggests that foot involvement is common. We propose that rheumatologists consider including a specific question during the consultation about ankle and foot symptoms for all patients with RA, which may possibly lead to more patients needing their feet examining more regularly in clinic. Also, we should aim to suppress the disease activity to prevent erosions and consequent deformities.

However, this study has some limitations. The cross-sectional design in one rheumatological department with fewer effective is the first limitation of our study. The second limitation, the choice of the DAS28 score to measure disease activity that do not include ankle and foot joint. Also, HAQ, evaluated mainly the upper function and may underestimate foot involvement.

Conclusion

Females, higher disease activity, functional impairment and GC intake were negatively associated with RAOS subscales. This study may serve as a guide for future research to construct appropriate strategies for foot management in RA. Physicians should be encouraged performing the physical examination of lower limb, assessment and treatment of its problems. Individual proper medication and orthoses should be prescribed by the physicians and be monitored as a part of treatment in order to enhance quality of life of the patients suffering from this chronic condition.

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