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ORIGINAL ARTICLE

Comparison between full and tapered dosages of biologic therapies in psoriatic arthritis patients: clinical and ultrasound assessment

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Abstract The primary objective of this study was to describe and compare clinical and musculoskeletal (MS) ultrasound (US) features between psoriatic arthritis (PsA) patients treated with full and tapered dosage of biologic (b) disease-modified antirheumatic drugs (DMARDs). The secondary objective was to compare clinical and MSUS features between PsA patients treated with bDMARDs with and without concomitant synthetic (s) DMARDs. We evaluated 102 patients with PsA treated with bDMARDs. The bDMARD dosage tapering had been made in patients with a maintained remission or minimal disease activity (MDA) according to their attending rheumatologist and with the patient acceptance. The bDMARD tapering consisted of the following: increase the interval between doses for subcutaneous bDMARDs or reduction of the dose for intravenous bDMARDs. The clinical evaluation consisted of a dermatologic and rheumatologic assessment of disease activity. The presence of B-mode and Doppler synovitis, tenosynovitis, enthesopathy, and paratenonitis was investigated by a rheumatologist blinded to drug dosage, clinical assessments, and laboratory results. Seventy-four (72.5 %) patients received full dosage of bDMARDs and 28 (27.5 %) received tapered dosage. The duration with biologic therapy and with current biologic therapy was significantly higher in patients with tapered dosages ($p=0.008$ and $p=0.001$, respectively). We found no significant differences between clinical, laboratory, and US variables, both for BM and CD between patients with full and tapered dosage and between patients with and without concomitant sDMARD. Clinical assessment, MSUS variables, and MDA status are similar in patients receiving full and tapered dosage of bDMARDs.

Keywords Biologic therapy · Doppler · Psoriatic arthritis · Spondylarthropathies · Ultrasound

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Background

Psoriatic arthritis (PsA) is an inflammatory spondyloarthritis associated with psoriasis. Worldwide, psoriasis prevalence varies from 2 to 3 % [1] and the prevalence of inflammatory arthritis among psoriatic patients varies from 6 to 42 % [2]. The clinical PsA features can include many patterns of not only joint involvement (i.e., distal, oligoarticular asymmetrical, polyarticular, and arthritis mutilans) but also its spectrum of extra-articular manifestations (i.e., enthesitis, dactylitis, spine, skin, and nail disease).

Despite the disease complexity, the treatment of PsA has changed dramatically over the recent years. There are data on the usefulness of synthetic (s) disease modified antirheumatic drugs (DMARDs) as well as on the efficacy of biologic (b) DMARDs, particularly tumor necrosis factor inhibitors [3]. The goal of all these therapies is to achieve remission or at least minimal disease activity [3]. Thus, assessment of PsA disease activity becomes crucial to reach and monitoring these objectives.

A wide range of composite scores had been proposed to assess PsA disease activity. Some of them were developed for other rheumatic diseases [i.e., Disease Activity Score (DAS) for 28 joints, for rheumatoid arthritis (RA) [4]; Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) [5], and Bath Ankylosing Spondylitis Functional Index (BASFI) [6], for ankylosing spondylitis], and others were developed specifically for PsA [i.e. Disease Activity Index for Psoriatic Arthritis (DAPSA) [7] and Composite Psoriatic Disease Activity Index (CPDAI) [8]]. Recently, there have been developed and validated criteria for minimal disease activity (MDA) that consider both articular and extra-articular manifestations [9, 10]. Nevertheless, in daily clinical practice, the PsA assessment is highly variable.

To date, the definition of PsA clinical remission has not been established, and proposed remission criteria have not been validated. Different studies have used RA scores (e.g., DAS28, ACR remission criteria) to assess clinical remission in PsA patients [11–13]. When compared with RA patients, a greater percentage of PsA patients were able to achieve remission, suggesting that it may be less difficult to aim for sustained remission in PsA than RA applying these criteria [13]. This may be explained because all of these scores are centered in joint involvement, which may be an incomplete approach to evaluate PsA patients. A recent study compared the relation between clinical scores, and musculoskeletal (MS) ultrasound (US) found that patients in MDA showed active inflammation at joint, tendon, and enthesis level and that none of the studied scores reflected the US inflammation at the joint, tendon, or enthesis level [14].

Regardless of the method used, once remission is achieved and sustained, the question is whether the treatment should be continued at full dosage, at a tapered dosage, or should be discontinued. For RA, EULAR recommends slow tapering by increasing the interval between doses or reducing the dosage as well as a tight control before and after this intervention [15]. However, for PsA, there are no recommendations for dosage tapering or discontinuation of biologic therapy, and literature data regarding maintained clinical remission is conflicting.

As B-mode (BM) US has been widely shown to be more sensitive than clinical assessment in detecting joint synovitis and enthesitis [16–24], and Doppler technique more accurately identifies inflammatory activity [19, 25–27]; our question was if patients with PsA with a tapered dosage of bDMARDs due to MDA or remission have more subclinical US-detected inflammation than patients with a full dosage of bDMARDs.

The primary objective of this cross-sectional study was to describe and compare clinical and MSUS features between PsA patients treated with full and tapered dosage of bDMARDs. The secondary objective was to compare clinical and MSUS features between PsA patients treated with bDMARDs with and without concomitant sDMARDs.

Patients and method

Patients

We included 102 patients [49 (48 %) females and 53 (52 %) males] with PsA (according to CASPAR criteria) [28] treated with bDMARDs from the Hospital General Universitario Gregorio Marañon, Madrid, Spain, who consecutively attended the Biological Therapy Unit from January to March 2014. General information and PsA features were registered at study entry. All patients had begun bDMARD therapy according to Spanish and European consensus on the use of biologic treatment in PsA [3, 29]. The starting dosage of bDMARDs had been determined by the patients' attending rheumatologist, according to the approved prescribing information (i.e., adalimumab 40 mg every other week, etanercept 50 mg once weekly, golimumab 50 mg once a month, infliximab 5 mg/kg every 8 weeks). In patients with a maintained remission or MDA according to their attending rheumatologist and with the patient acceptance, a dosage tapering had been made. The bDMARD tapering consisted of the followings: increase the interval between doses for subcutaneous bDMARDs or reduce the dose for intravenous bDMARDs.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local Ethics Committee of the Hospital General Universitario Gregorio Marañon (Madrid, Spain). The Informed Consent was obtained for all patients before any examination or test.

Clinical evaluation

The clinical evaluation consisted of a dermatologic and rheumatologic assessment of disease activity. Both assessments were performed blindly, in the same day. The evaluators were unaware of bDMARD dosage.

The dermatologic assessment was performed by a dermatologist for all patients and included the evaluation of psoriasis severity by the Psoriasis Area and Severity Index (PASI) [30]. For nail involvement, it was noted if there was presence or absence.

The rheumatologic assessment was performed by a rheumatologist for all patients. The following were evaluated:

number of tender joints (TJ) and number swollen joints (SJ) for 68 and 66 joints, respectively, and number of tender entheses [for 13 enthesis of Maastricht Ankylosing Spondylitis Enthesitis Score (MASES)] [31] and number of fingers affected by dactylitis. There were also recorded patient's global assessment of disease activity (PtGA), patient's pain assessment (Ptpain), and evaluator's global assessment of disease activity (EGA), all measured on a visual analogic scale (VAS) from 0–10.

For patients with peripheral involvement (according to the Assessment of SpondyloArthritis international Society classification criteria) [32], we calculated DAPSA and DAS28 indices. For patients with axial involvement (according to Assessment of SpondyloArthritis international Society classification criteria) [33], we calculated BASDAI and BASFI indices. For all patients, we calculated MASES index and Health Assessment Questionnaire (HAQ).

Minimal disease activity was defined as fulfilling five of the followings seven criteria: TJC ≤1, SJC ≤1, PASI ≤1 or body surface area ≤3, Ptpain ≤15 (on a VAS from 0 to 100), PtGA ≤20 (on a VAS from 0 to 100), HAQ ≤0.5, and tender entheseal points ≤1 [9].

Laboratory tests

Blood samples were taken the same day of clinical and US examination. The patients were tested for erythrocyte sedimentation rate (ESR, normal value <20 mm/h) and C-reactive protein (CRP, normal value <0.5 g/L).

Ultrasound protocol

For all patients, we performed a US examination [both in BM and color Doppler (CD)] immediately after the clinical evaluation. US assessment was performed by a rheumatologist with 2 years of experience in this technique, under the supervision of an experienced ultrasonographer. US investigator was blinded to drug dosage, clinical assessments, and laboratory results. US examination was performed using a Logiq E9 (General Electric Medical Systems, Milwaukee, WI, USA), equipped with a multifrequency linear probe 6–18 MHz. BM and CD machine settings were optimized before the study and standardized for the whole study.

The US evaluation consisted of 46 joints (i.e., bilateral wrist, elbow, MCP I–V, PIP I–V, DIP II–V, knee, ankle, MTF I–V), 40 tendons (i.e., bilateral wrist extensors, wrist flexor tendons, hand finger extensors and flexors tendons, tibialis posterior tendon, peroneus longus and brevis, feet fingers flexors), and 10 entheses (i.e., bilateral extensor tendons on lateral epicondyle, proximal and distal patellar tendon, Achilles tendon, plantar fascia). The recesses evaluated for each joint were as follows: wrist–radio-carpal joint, mid-carpal joint, elbow–anterior and posterior recesses, metacarpo-phalangeal (MCP) I–V, proximal (PIP) and distal interphalangeal (DIP) I–V–dorsal recess, palmar recess, knee–suprapatellar recess, medial and lateral parapatellar recesses, ankle–tibio-talar joint, and metatarsophalangeal (MTP) I–V–dorsal recess.

Synovitis and tenosynovitis on BM were evaluated and scored according to the OMERACT definitions and published scoring systems [34, 35]. In BM, synovitis was defined as the presence of abnormal hypoechoic intra-articular material [35] and tenosynovitis as abnormal anechoic and/or hypoechoic tendon sheath widening [34]. Enthesopathy was defined as abnormal hypoechoic (loss of normal fibrillar architecture) and/or thickened tendon at its bony attachment [35]. Paratenonitis was defined as an abnormal hypoechoic material around a tendon without synovial sheath.

Synovitis on BM was graduated using the semiquantitative grade scale: grade 0—absence, grade 1—mild, grade 2—moderate, grade 3—marked synovial thickening [36]. For CD synovitis, assessment and scoring was made according to the OMERACT-EULAR as follows: grade 0—no flow in the synovium, grade 1—up to three single spots signals or up to two confluent spots or one confluent spot plus up to two single spots, grade 2—vessel signals in less than half of the area of the synovium, grade 3—vessel signals in more than half of the area of the synovium [26]. Tenosynovitis on BM was graduated using a semiquantitatively grade scale: grade 0—normal, grade 1—minimal, grade 2—moderate, grade 3—severe. CD tenosynovitis was also scored on a semiquantitative scale: grade 0—no Doppler signal, grade 1—focal, grade 2—multifocal, and grade 3—diffuse [34]. CD enthesopathy was scored as the presence or absence of CD signal at the enthesis. CD paratenonitis was scored as the presence or absence of CD signal in the abnormal hypoechoic material around a tendon without synovial sheath

We calculated US counts for BM as a sum of all joints, tendons, and enthesis with B-mode synovitis (i.e., USC BM), tenosynovitis (i.e., USCT BM) or paratenonitis (i.e., USCP BM), and enthesopathy (i.e., USC Epat BM), respectively, and US counts for CD as a sum of all joints, tendons, and enthesis with CD synovitis (i.e., USC CD), tenosynovitis (i.e., USCT CD) or paratenonitis (i.e., USCP CD), and enthesopathy (i.e., USC Epat CD), respectively. For USC BM, we sum all joints with a synovitis grade higher than 0, and for USCT BM, we sum all tendons with a tenosynovitis grade higher than 0. We calculated US scores for BM as a sum of all grades of B-mode synovitis (i.e., USS BM) and tenosynovitis (i.e., USST BM) and US scores for CD as a sum of all grades of CD synovitis (i.e., USS CD) and tenosynovitis (i.e., USST CD).

Statistics

Statistical analysis was performed using SPSS, version 18.0 (SPSS, Chicago, IL, USA). Comparisons between

independent means were analyzed using the Mann–Whitney test. Comparisons of qualitative variables of clinical assessment and MSUS assessment were analyzed using the chi-square test. A P value <0.05 was considered significant.

Results

Demographics features

The mean±SD age was 52.4±10.7 years (range 29–77), and the mean±SD disease duration was 158.1±105.5 months (range 12–480). Five (4.9 %) patients had only axial involvement, 63 (61.8 %) had only peripheral involvement, and 34 (33.3 %) had both axial and peripheral involvement. Forty-seven (46.1 %) patients were treated with adalimumab, 28 (27.5 %) with etanercept, 9 (8.8 %) with golimumab, and 17 (16.7 %) with infliximab. One patient (0.9 %) was treated with tocilizumab due to the lack of efficacy of other bDMARDs in the presence of a very active disease, with a dosage corresponding to RA indications (8 mg per kg every 4 weeks), that we considered full dosage. The mean±SD duration from diagnosis until first biologic therapy was 95.12±93.82 months (range 0–470), the mean±SD duration with biologic therapy was 60±42.4 months (range 4–180), and the mean±SD duration with the current biologic therapy was 46±35.2 months (range 1–156) (Table 1).

Clinical findings

Of 97 patients with peripheral involvement, 57 (58.7 %) patients had at least one TJ and 19 (19.5 %) had at least one SJ. Of all 102 patients, 28 (27.4 %) had at least one tender enthesis. No patient presented with dactylitis. Table 1 displays the mean values of clinical variables. Of all patients with peripheral involvement, 47 (48.5 %) had MDA.

Of 102 evaluated patients, 29 (28.4 %) had current psoriasis lesions with a mean±SD value of PASI of 0.63±1.8 (range 0–15) and 24 (23.5 %) had nail involvement.

Ultrasound findings

We found BM and CD synovitis in 98 (96 %) and 19 (18.6 %) patients, respectively, BM and CD tenosynovitis at 17 (16.6 %) and 7 (6.8 %) patients, respectively, and BM and CD enthesopathy at 63 (61.7 %) and 7 (6.8 %), respectively. Table 2 displays the mean values of MSUS variables. Figure 1 shows an example of BM and CD synovitis.

Only one patient presented paratenonitis in one finger, without exhibiting CD signals.

Table 1 Clinical variables

Variables	Mean (SD)	Minimum	Maximum
Age	52.4 (10.7)	29	77
Disease duration (month)	158.1 (105.5)	12	480
Duration from diagnosis until firs bDMARD (month)	95.12 (93.82)	0	470
Duration with bDMARD (month)	60 (42.4)	4	180
Duration with current b DMARD (month)	46 (35.2)	1	156
TJC	2.88 (5)	0	30
SJC	0.4 (1)	0	5
MASES	0.8 (1.7)	0	9
BASDAI	2.2 (2)	0	7.6
BASFI	2.6 (2.3)	0	8
DAS28	2.2 (1.7)	0.5	4.99
DAPSA	10.5 (8.8)	0.1	44.2
PASI	0.63 (1.8)	0	15

bDMARD biologic disease modified antirheumatic drugs, *TJC* tender joint count, *SJC* swollen joint count, *MASES* Maastricht Ankylosing Spondylitis Enthesitis Score, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASFI* Bath Ankylosing Spondylitis Functional Index, *DAS28* Disease Activity Score for 28 joints, *DAPSA* Disease Activity Index for Psoriatic Arthritis, *PASI* Psoriasis Area and Severity Index

Comparison between full and tapered dosage of bDMARDs

Seventy-four (72.5 %) patients received full dosage of bDMARDs and 28 (27.5 %) received tapered dosage. No patient received an increased dosage of bDMARDs. Table 3 displays the bDMARS dosage characteristics in patients with tapered dosage. The mean±SD time with a tapered dosage was 24.8±11.6 months (rage 10–48). For 23 (22.54 %) patients, the duration with a tapered dosage of bDMARDs was greater than 1 year. Of 28 patients that received a tapered dosage, 12 (42.9 %) were treated with adalimumab, 8

Table 2 US variables

Variables	Mean (SD)	Minimum	Maximum
USC S BM	8.5 (4.8)	0	26
USC S CD	0.25 (0.5)	0	3
USC T BM	0.25 (0.6)	0	4
USC T CD	0.09 (0.3)	0	2
USC Epat BM	1.37 (1.3)	0	6
USC Epat CD	0.07 (0.2)	0	1
USS S BM	10.7 (6.7)	0	30
USS S CD	0.3 (0.8)	0	5
USS T BM	0.3 (0.9)	0	5
USS T CD	0.2 (0.9)	0	4

USC ultrasound count, *BM* B-mode, *CD* color Doppler, *S* synovitis, *T* tenosynovitis, *Epat* enthesopty, *USS* ultrasound score

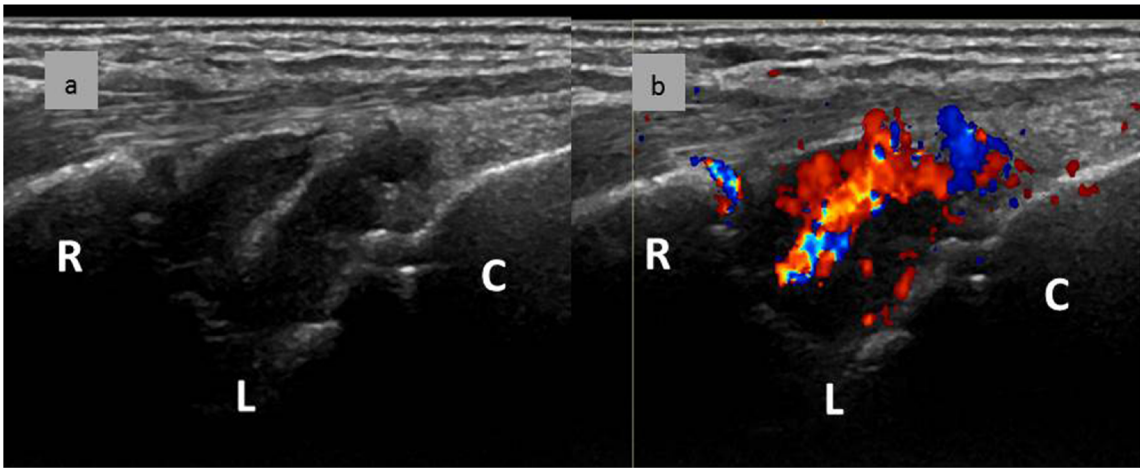

Fig. 1 **a** Longitudinal ultrasound image of the radio-carpal and mid-carpal joint that shows B-mode synovitis. **b** Longitudinal ultrasound image of the radio-carpal and mid-carpal joint that shows B-mode and Doppler synovitis; *R* radius, *L* lunate, *C* capitate

(28.6 %) with etanercept, and 8 (28.6 %) with infliximab. We found no significant difference regarding the percentage of patients with concomitant sDMARDs between patients with full (28, 27.5 %) and tapered (15, 14.7 %) dosage of bDMARDs (p=0.226). The duration with biologic therapy and with current biologic therapy was significantly higher in patients with tapered dosages compared with those on full dosage (p=0.008 and p=0.001, respectively). Table 4 displays the variables compared between patients with full and tapered dosage. For clinical and laboratory variables, we found no significant differences between both groups. Of 28 patients on a tapered dosage of bDAMRDs, 26 (92.85 %) had peripheral involvement. Of all 26 patients with peripheral involvement, 14 (53.84 %) had MDA. Of all 74 patients on a full dosage of bDMARDs, 71 (95.94 %) had peripheral involvement. Of all 71 patients with peripheral involvement, 33 (46.47 %) had MDA. We found no significant difference regarding percentage of patients in MDA between those with full and tapered bDMARD dosage (p=0.679).

We found no significant differences between US variables, both for BM and CD, between patients with full and tapered dosage (Table 3). Forty-four (59.5 %) patients with full and 20 (71.4 %) patients with a tapered dosage showed BM US enthesitis (p=0.375). Seven (9.5 %) patients with full dosage and no patient with tapered dosage showed CD enthesopathy.

Comparison between patients with and without concomitant sDMARDs

Fifty-nine (57.8 %) patients were treated only with biologic DMARDs, and 43 (42.2 %) patients were treated with both synthetic and biologic DMARDs. We found no significant differences between demographic, clinical, and MSUS variables between those with and without sDMARDs (Table 4). We found no significant difference regarding percentage of patients in MDA between those with (19, 19.6 %) and without (28.9 %) concomitant sDMARD dosage (p=0.880).

Discussion

Interest in reducing biologic therapy dosages in patients with inflammatory arthritis in clinical remission is growing [37–39]. This option could help physicians decrease side

Table 3 bDMARDs tapered dosage characteristics

Mean (SD) time between				
Subcutaneous	Patient no.	Administrations (days)	Minimum	Maximum
ADA 40 mg	12	23.58 (4.03)	21	30
ETA 50 mg	7	12.66 (4.54)	10	21
ETA 25 mg	1	15	NA	NA
Intravenous	Patients no	Mean (SD) mg/kg	Minimum	Maximum
IFX	8	3.77 (0.5)	3	4.5

ADA adalimumab, *ETA* etanercept, *IFX* infliximab

Table 4 Comparison of clinical and US variables between patients with full and reduced dosage and between patients with and without sDMARD

Variable	Comparison between patients with full and reduce dosage			Comparison between patients with and without sDMARD		
	Mean (SD) full dosage	Mean (SD) reduce dosage	*p*	Mean (SD) with sDMARD	Mean (SD) without sDMARD	*p*
Age (year)	51.64 (11.242)	54.43 (9.057)		53.05 (10.32)	51.93 (11.05)	0.707
Duration of disease (month)	148.47 (105.66)	183.71 (102.773)	0.093	152.63 (108.03)	162.17 (104.46)	0.578
Duration from diagnosis until first bDMARD (month)	90.89 (96.01)	106.14 (88.56)	0.239	97.14 (87.12)	93.62 (99.21)	0.568
Duration with bDMARD (month)	57.44 (44.89)	77.57 (31.56)	0.008	58.6 (40.58)	66.29 (4.83)	0.382
Duration with current bDMARD (month)	39.84 (34.65)	62.29 (32.04)	0.001	41.65 (33.54)	49.33 (36.44)	0.307
TJC	2.68 (4.26)	3.42 (6.79)	0.629	3.29 (5.51)	2.57 (4.69)	0.589
SJC	0.46 (1.04)	0.38 (1.16)	0.303	0.44 (1.11)	0.45 (1.04)	0.677
PtGA	3.77 (2.63)	3.09 (2.31)	0.28	4.03 (2.56)	3.25 (2.52)	0.135
Ptpain	3.12 (2.58)	3.14 (2.52)	0.781	3.28 (2.59)	3.02 (2.54)	0.67
EGA	1.84 (1.95)	1.11 (1.42)	0.071	1.79 (2.22)	1.53 (1.52)	0.891
MASES	0.93 (1.83)	0.75 (1.64)	0.486	1.33 (2.25)	0.56 (1.24)	0.089
PASI	0.61 (2.04)	0.67 (1.4)	0.806	0.76 (2.58)	0.53 (1.15)	0.969
ESR	11.75 (12.79)	8.54 (7.79)	0.398	11.98 (14.59)	10.07 (9.11)	0.906
CPR	0.57 (1.08)	0.32 (0.21)	0.665	0.74 (1.37)	0.32 (0.24)	0.167
DAS28	2.32 (1.22)	1.89 (0.98)	0.17	2.36 (1.30)	2.10 (1.07)	0.45
DAPSA	10.75 (8.22)	10.07 (10.4)	0.366	11.8 (9.36)	9.65 (8.35)	0.23
BASDAI	2.62 (2.2)	1.28 (1.07)	0.098	2.18 (2.25)	2.29 (1.91)	0.721
BASFI	3 (2.49)	1.57 (1.63)	0.115	2.68 (2.66)	2.53 (2.17)	0.797
USC S BM	8.72 (5.14)	8 (3.8)	0.761	8.67 (5.3)	8.41 (4.44)	0.984
USS S BM	11.09 (7.34)	9.86 (4.98)	0.752	11.26 (8.22)	10.39 (5.54)	0.922
USC S CD	0.28 (0.6)	0.14 (0.44)	0.217	0.16 (0.43)	0.31 (0.65)	0.278
USS S CD	0.41 (0.84)	0.29 (1.01)	0.19	0.28 (0.76)	0.44 (0.97)	0.252
USC T BM	0.31 (0.73)	0.07 (0.26)	0.103	0.28 (0.63)	0.22 (0.67)	0.357
USS T BM	0.42 (1.04)	0.07 (0.26)	0.096	0.35 (0.81)	0.31 (0.98)	0.355
USC T CD	0.11 (0.39)	0.04 (0.18)	0.411	0.14 (0.41)	0.05 (0.28)	0.11
USS T CD	0.3 (0.94)	0.18 (0.77)	0.576	0.37 (1.0)	0.19 (0.81)	0.074
USC Epat BM	1.35 (1.48)	1.43 (1.2)	0.574	1.33 (1.21)	1.41 (1.48)	0.955
USC Epat CD	0.09 (0.29)	0 (0)	0.093	0.09 (0.29)	0.05 (0.22)	0.408

TJC tender joint count, *SJC* swollen joint count, *PtGA* patient global assessment of disease, *Ptpain* patient assessment of pain, *EGA* evaluator global assessment, *MASES* Maastricht Ankylosing Spondylitis Enthesitis Score, *PASI* Psoriasis Area and Severity Index, *ESR* erythrocyte sedimentation rate, *CRP* C-reactive protein, *DAS28* Disease Activity Score for 28 joints, *DAPSA* Disease Activity Index for Psoriatic Arthritis, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASFI* Bath Ankylosing Spondylitis Functional Index ; *USC* ultrasound count, *USS* ultrasound score, *BM* B-mode, *CD* color Doppler, *S* synovitis, *T* tenosynovitis, *Epat* enthesopty

effects of therapy and costs in the health system. For RA, there is some evidence regarding the possibility of withdrawing or reducing the dosage of bDMARDs [37–39]. In fact, the last European recommendations for RA management take into account this possibility [15]. In PsA, Cantini et al. demonstrated that clinical remission can be maintained in a higher percentage of patients with early PsA when compared to RA patients after reducing adalimumab dosage [40]. In another study, Araujo et al. investigated if the discontinuation of PsA treatment (either synthetic or biologic therapy) without any dosage tapering can be feasible in patients in clinical remission. They found a high percentage of flares after therapy discontinuation and concluded that the chance to reach drug-free remission in these patients is low [41].

MSUS had proven to be more sensitive than clinical evaluation in detecting joint synovitis and enthesitis [16–24]. Recently, Husic et al. found that a considerable proportion of PsA patients with MDA had ultrasound-detected active

inflammation at the joints, tendons, peritendinous tissue, and entheses [14].

In concordance with previous studies in PsA patients, we found a high prevalence of BM synovitis [14, 42]. However, the prevalence of PD synovitis in our patients was low, regardless of whether the biologic dosage was full or tapered, whether they had concomitant sDMARD, or whether they were in MDA.

In our study, there were no significant differences between clinical and MSUS findings in patients on full and tapered dosages of bDMARDs. The only significant differences were found in the duration of biologic therapy and the duration of current biologic therapy. This is something expected, since the dosage of bDMARDs is tapered only after clinical remission is achieved and maintained for a time. Although only almost half of patients with a tapered dosage had MDA, there were no differences regarding the percentage of patients in MDA between those with tapered and full dosage. These findings are important as they show that patients with a tapered dosage of biologic therapy did not present a higher level of clinical and US inflammation. These optimistic findings invite the possibility of dosage reduction of bDMARDs also in PsA patients.

We want to emphasize that the study did not aim to compare the efficacy of different bDMARDs; thus, we did not compare clinical and US variables between the different bDMARDs.

Some limitations of our study should be mentioned. The number of patients with a tapered dosage was low. As it is not a randomized blinded controlled study, the decision to reduce biologic therapy dosage was made according to the attending rheumatologist's judgment, without a standardized protocol for all patients. Patients that are receiving tapered dosages of bDMARDs are maintained on the lower dosage thanks to the persistence of clinical remission state. This is a cross-sectional study, showing no data about the involvement during all the tapering period. Further controlled studies are needed to investigate long-term sustained remission after dosage reduction.

We should mention that we did not use US evaluation of the skin and nail mostly because of the lack of standardized scanning methods and scoring system of abnormalities.

In conclusion, clinical assessment, MSUS variables, and MDA status are similar in patients receiving full and tapered dosage of bDMARDs.

Key messages

Patients with a tapered dosage of bDMARDs did not show a greater subclinical US-detected inflammation.

Clinical variables did not differ significantly between patients with full and tapered dosage.

Clinical and US variables did not differ significantly between patients with and without concomitant sDMARDs.

Author contributions Iustina Janta, Lina Martínez-Estupiñán, Esperanza Naredo, and Lara Valor did the study design. Iustina Janta, Lina Martínez-Estupiñán, Lara Valor, Esperanza Naredo, Ofelia Baniandres Rodriguez, Ignacio Hernández Aragüés, María Montoro, Natalia Bello, Diana Hernández-Flórez, Michelle Hinojosa, Julia Martínez-Barrio, Juan Carlos Nieto-González, Juan Gabriel Ovalles-Bonilla, Carlos Manuel González, Francisco Javier López-Longo, and Indalecio Monteagudo performed the acquisition of data. Iustina Janta, Lina Martínez-Estupiñán, Esperanza Naredo, Lara Valor, and Luis Carreño Analyzed and interpreted the data. Iustina Janta, Lina Martínez-Estupiñán, Esperanza Naredo, Lara Valor, and Luis Carreño prepared the manuscript.

Conflict of interest Esperanza Naredo has received speaker fees from Abbvie, Roche Farma, Bristol-Myers Squibb, Pfizer, UCB, General Electric Healthcare, and Esaote. Esperanza Naredo has received research funding from UCB and MSD. Indalecio Monteagudo has received speaker fees from Abbvie, Roche Farma, Bristol-Myers Squibb, Pfizer, and UCB. Juan Carlos Nieto-González has received speaker fees from Abbvie, Roche Farma, Pfizer, and MSD. Francisco Javier López Longo has received speaker fees from Abbvie, Roche Farma, Bristol-Myers Squibb, Pfizer, UCB, MSD, and Actelion. Francisco Javier López Longo has received research funding from Abbvie and GSK. Lara Valor has received speaker fees from Abbvie, Roche Farma, Bristol-Myers Squibb, and Pfizer.

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