

ROBOT-ASSISTED ARTHROSONOGRAPHY (ARTHUR) WITH AI ANALYSIS (DIANA) FOR THE INITIAL DIAGNOSIS AND FOLLOW-UP OF RHEUMATOID ARTHRITIS: REAL-WORLD DATA FROM 355 PATIENTS WITH SUSPECTED ARTHRITIS

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BACKGROUND

Epidemiological data indicate an increased prevalence of inflammatory rheumatic diseases (IRD) [1]. For example, the global incidence of rheumatoid arthritis (RA) has risen from 11.66 in 1990 to 13.48 per 100,000 people in 2022 [2]. Early diagnosis and initiation of therapy are essential to prevent permanent structural damage and comorbidities in RA patients [3]. However, in some states, such as Schleswig-Holstein (SH) in northern Germany, there are differences in the availability of rheumatological care between urban and rural areas. Consequently, new models of early consultation and diagnostic and therapeutic approaches using AI-trained systems are needed. Automated robotic arthrosonography has demonstrated promising potential for the detection of IRD. Nevertheless, existing evidence is limited by the small number of studies conducted to date [3]. This study, which was initiated by the patient organisation Rheuma-Liga SH, aimed to evaluate the real-world use of fully automated robotic arthrosonography (ARTHUR) with AI analysis (DIANA) to detect arthritis activity.

RESULTS

1. A total of 355 individuals were included

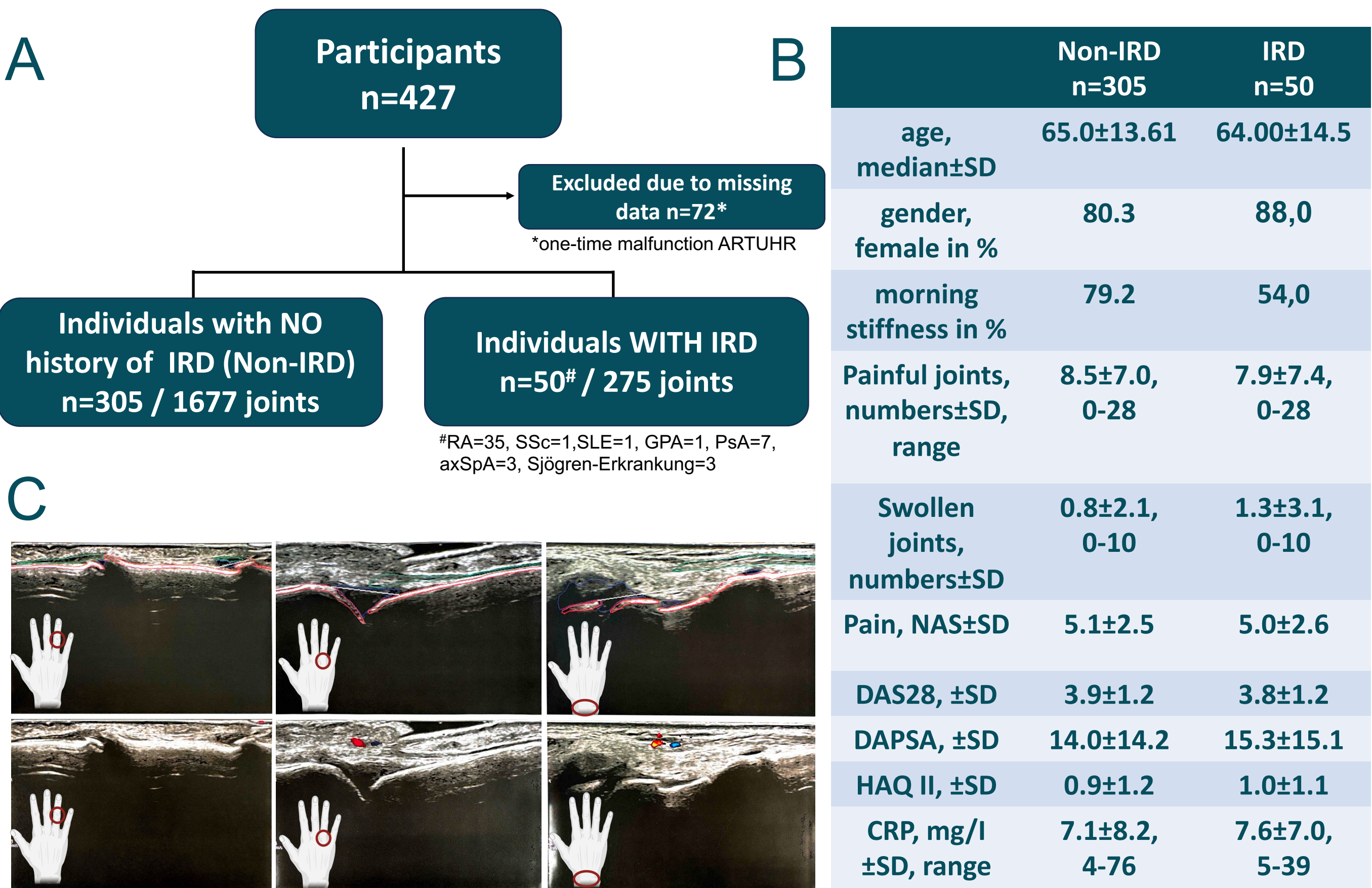


Figure 1: Recruitment flowchart and participants characteristics (A,B); C: sample images demonstration positive findings for synovial hypertrophy (EULAR OMERACT Synovitis Score 2-3)
IRD, Inflammatory Rheumatic Disease; RA, Rheumatoid arthritis; SSc, systemic Sclerosis; SLE, systemic Lupus erythematosus; GPA, Granulomatosis with polyangiitis; PsA, Psoriatic arthritis; axSpA, axial Spondyloarthritis

2. ARTHUR detect suspicious rheumatoid arthritis (RA) with an AUC of 0.9926 (Sensitivity: 97.35% / Specificity 100.00%)

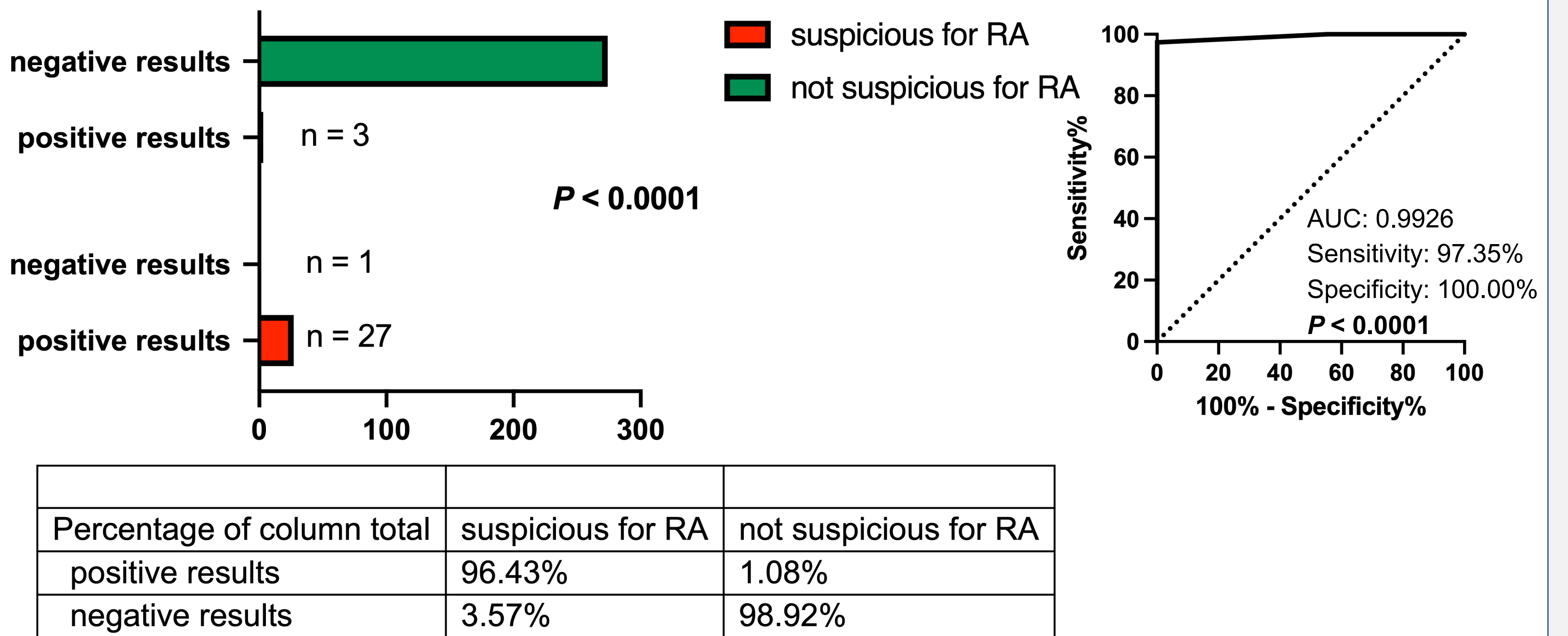


Figure 2. ARTHUR exam of the Non-IRD group (n=305). *Left:* a rheumatology specialist considered three participants to be false positives (3 of 30). Only one person with a negative ARTHUR result was detected as a false negative. *Right:* ROC-AUC: 0.9926, sensitivity 97.35%, specificity 100%, $P < 0.0001$, number needed to diagnose: 1.020 RA, Rheumatoid arthritis; ROC-AUC, Receiver Operating Characteristic-Area under the Curve

2. ARTHUR detect suspicious RA activity with an AUC of 1.0000, (Sensitivity: 100% / Specificity 100%)

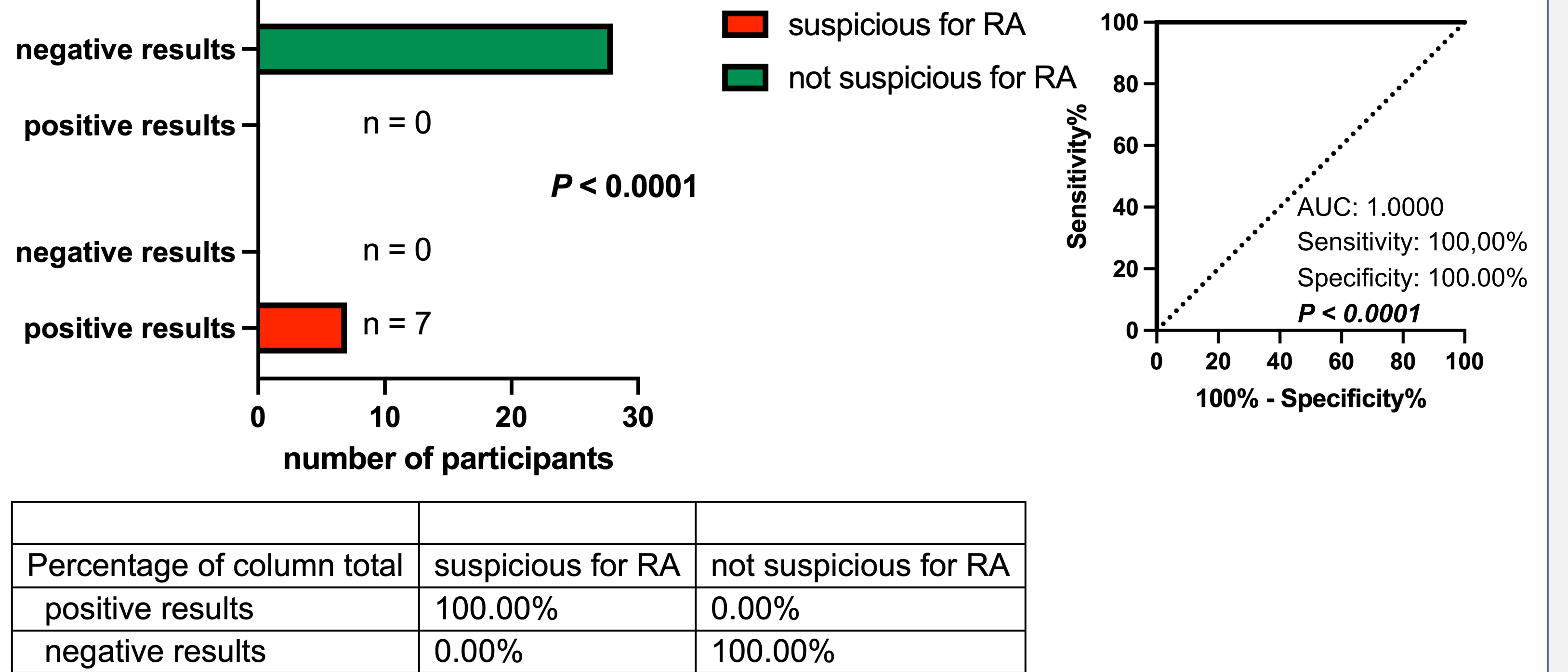


Figure 3. ARTHUR exam of RA patients (n=35). *Left:* ARTHUR identified 7 patients with active disease, with no false positives or negatives; *Right:* ROC-AUC: 1,000, sensitivity 100%, specificity 100%, $P < 0.0001$, number needed to diagnose 1.010 RA, Rheumatoid arthritis; ROC-AUC, Receiver Operating Characteristic-Area under the Curve

CONCLUSION

Fully automated robot-assisted arthrosonography with AI analysis demonstrated high sensitivity and specificity in detecting arthritis in patients with new-onset disease as well as in RA patients suspected of relapse

METHODS

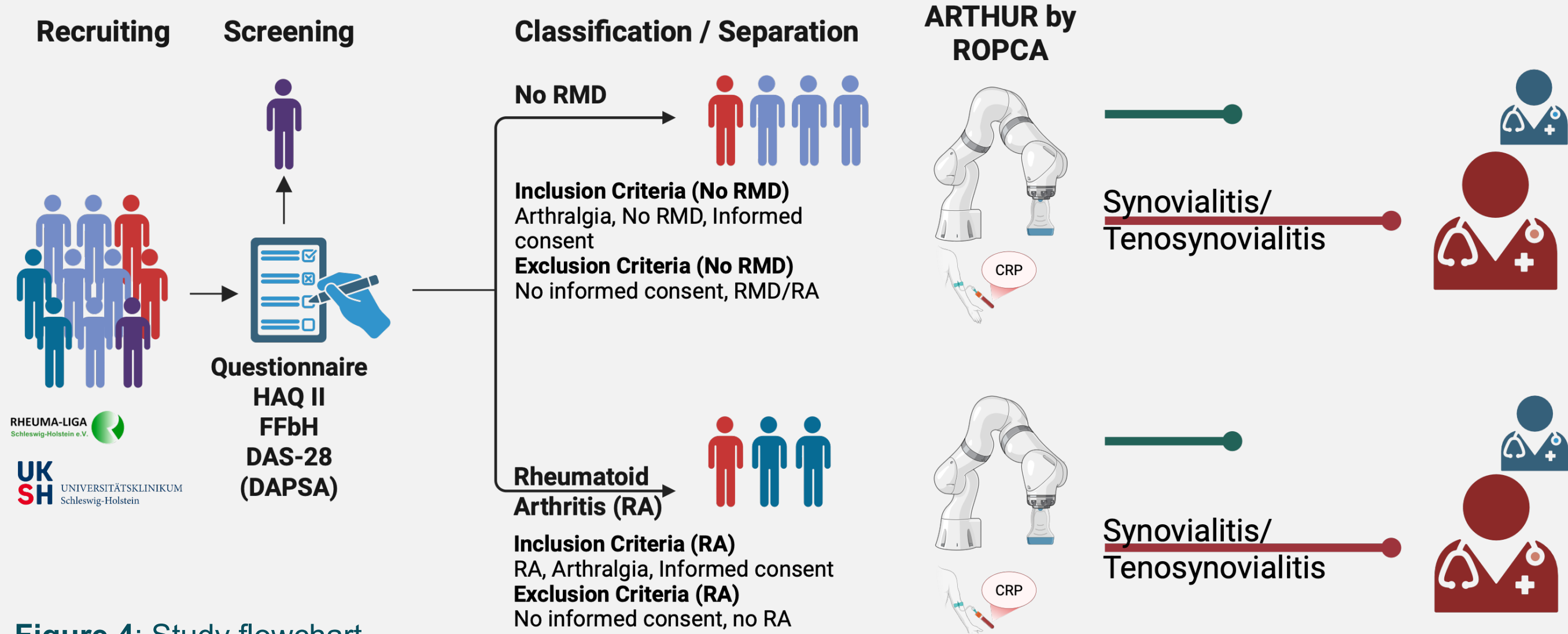


Figure 4: Study flowchart

- between october 2024 and november 2025, the Rheuma-Liga Schleswig-Holstein initiated a mobile contact point ("Rheuma-Truck") in different communities of SH
- ARTHUR detect arthronographic signs of inflammatory arthritis (Figure 1C) according to the OMERACT-EULAR synovitis criteria [4]
- Data were collected from participations with suspected new-onset or relapsing arthritis (age, sex, morning stiffness, joint pain and swelling score, and pain on a numeric analogue scale; Figure 1B)
- C-reactive protein was measured using an AFIAS POC system
- Health Assessment Questionnaires (HAQ-II) and Disease Activity Score-28 (DAS28) were administered (Figure 4)
- According to the DIANA AI analysis, participants with positive results were referred directly to a rheumatology specialist (Figure 4)
- Participants with elevated CRP and/or severe symptoms were referred to a rheumatology specialist after automated arthrosonography, even if the result was negative

PERSPECTIVE



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The Trans-Belt Medical Robotic Cluster is a cross-border initiative that connects Denmark and Germany in order to develop, test and accelerate the use of medical robotics, diagnostics and assistive technologies. (Project Period 2025-2028)

