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Diagnostic Utility of Musculoskeletal Ultrasound in Detecting Early Synovitis Compared with Clinical Examination

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ABSTRACT

Background: Early synovitis is an essential predictor of progressive inflammatory arthritis and it is a very important factor that defines the long-term joint performance. Clinical examination is the first diagnostic mechanism that might not be effective in identifying subtle synovial inflammation particularly at the early disease stage. The high-resolution visualization of muscle synovial hypertrophy, effusion, and microvascular activity is subject to musculoskeletal ultrasound (MSK-US) which can potentially benefit over routine physical examination.

Objectives: To assess the diagnostic value of musculoskeletal ultrasound versus standard clinical examination in the detection of early synovitis in adults with symptoms of inflammatory joints that have recently come about.

Methods: An interventional cross-sectional data analysis of diagnostic accuracy was done at tertiary care hospitals in Punjab, Pakistan, between June 2023 and May 2025. One hundred and twenty adults (120) with ≤ 6 months of joint symptoms were subjected to standard clinical evaluation and then MSK- US of wrists, metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints. The results of ultrasound were reported and interpreted in regards to OMERACT criteria. Sensitivity, specificity, predictive values and intermodal agreement were evaluated.

Results: Clinical testing identified synovitis in 52 out of 119 (43.3%), but MSK-US identified synovitis in 82 out of 119 (68.3%), identifying 30 more cases of subclinical inflammation. The ultrasound was found to be more sensitive (88.5) with a reasonable specificity (79.4) over clinical examination. Seventy percent nine out of ten ultrasound-positive joints had power Doppler activity, which is an indicator of active inflammation. The two methods showed moderate agreement (0.54).

Conclusion: Musculoskeletal ultrasound has better diagnostic performance than clinical examination in the early detection of synovitis. Its capability to expose subclinical synovial alteration indicates its necessity to be incorporated in the regular diagnostic courses to make timely therapeutic choices.

Keywords: musculoskeletal ultrasound, early synovitis, Power Doppler, rheumatoid arthritis, diagnostic accuracy, inflammatory arthritis.

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INTRODUCTION

Synovitis early identification lies at the core of the management of inflammatory arthropathies, especially rheumatoid arthritis (RA) where irreversible joint damage can start long before it can be detected[1]. The first pathological landmark of inflammatory arthritis is called synovitis and is characterized by thickening of synovial membrane, inflammatory cell invasion, angiogenesis and initial cartilage degradation[2]. The early detection of synovitis at this window of opportunity is critical to the prompt introduction of disease-modifying anti-rheumatic drugs (DMARDs) which are much more effective in the long run, functionality, and the likelihood of remission[3].

The most available and most commonly used technique of examining inflammation of the joints is clinical examination[4]. Tenderness, swelling, and loss of movement however, are subjective and may not be an accurate indicator of an early inflammation process[5]. Various studies have indicated that subclinical synovitis tends to be in the forefront of clinical manifestations,

hence the diagnostic lapses in the application of physical examination alone[6]. The sensitivity of clinical exam and inter-observer variability also make the accuracy of the test lower and particularly in the early disease due to the presence of the faint indicators of inflammation[7].

Musculoskeletal ultrasound (MSK-US) has come out as a very sensitive imaging tool, real-time imaging which has the capability of detecting early synovial abnormalities which are not palpable[8]. Higher resolution of grayscale ultrasound can detect a low level of synovial hypertrophy and joint effusion and Power Doppler image can show the presence of synovial vascularity and active inflammation[9]. These characteristics enable MSK-US to identify early inflammatory arthritis, project disease progression, and surveillance of therapeutic response more accurately than clinical examination[10].

With the current status of early arthritis clinics in Pakistan, which are developing, the inclusion of MSK-US in the regular diagnostic programs could significantly enhance the early diagnosis and treatment of inflammatory joint diseases[11]. Thus, the objective of the research is to assess the diagnostics of MSK-US versus clinical examination in the early identification of synovitis in adults with acute joint symptoms in tertiary care hospitals in Punjab[12].

MATERIALS AND METHODS

This cross-sectional diagnostic accuracy research would be carried out in the tertiary care hospitals of Punjab, Pakistan, during a two-year duration between June 2023 and May 2025. One hundred and twenty adult patients of age 18 through 65 years who presented with the early inflammatory joint symptoms of less than 6 months duration were consecutively recruited in outpatient rheumatology clinics. As patients with known rheumatoid arthritis, those who have used disease-modifying anti-rheumatic medications (DMARDs) before, undergone joint surgery, had traumatic injuries of the joint, cryptalline arthropathies, septic arthritis, or uncontrolled comorbid conditions were eliminated to provide a precise evaluation of early synovial inflammation.

Each of the enrolled participants received a standardized clinical assessment done by trained rheumatologists. The presence of clinical synovitis was determined by the inspection and palpation of the tenderness, swelling, warmth, and limitations of range of motion of the joints using the American College of Rheumatology (ACR) criteria. The bilateral examinations of the wrist, metacarpophalangeal (MCP), and proximal interphalangeal (PIP) in each patient were assessed and the clinical findings were documented using a structured proforma.

After the clinical work, musculoskeletal ultrasound (MSK-US) was conducted on all the patients by a skilled radiologist who had no knowledge about clinical results. High-frequency (1018 MHz) linear transducer was used to conduct ultrasound evaluation, where the machine presets were standardized in the imaging of small joints. Synovial hypertrophy and joint effusion have been determined by grayscale, whereas active synovial vascularity is determined by power doppler. Synovitis was classified in line with OMERACT criteria with the grading of both the grayscale and Doppler using semiquantitative grading (03).

Clinical and ultrasound measures data were compared to identify diagnostic performance. The sensitivity, specificity, positive and negative predictive values (PPV, NPV) and aggregate agreement (-statistics) were determined. The statistical analysis was done in SPSS version 26.0 with p-value below 0.05 taken as significant.

RESULTS

One hundred and twenty respondents were recruited, and all of them underwent clinical and musculoskeletal ultrasound (MSK-US) examinations. The findings are tabulated below and explained in respectively detailing paragraphs. The study population was mainly composed of females (78%), which is consistent with the fact that women are more prone to inflammatory arthritis (Table 1). The average length of the symptoms was brief (3.4 months), which supports the fact that the diseases were introduced early. The most common were MCP and wrist joints which is in line with the common pattern of rheumatoid arthritis in its early stages. The musculoskeletal ultrasound identified 82 cases of synovitis versus 52 cases of clinically detected cases and there were another 30 cases of subclinical inflammation (Table 2). This shows that clinical examination was not as sensitive as MSK-US because it missed 36.6% of true synovitis cases.

Synovial hypertrophy was observed in all US-positive joints, which proves its value as a fundamental diagnostic marker (Table 3). As an active inflammatory vascularity, power Doppler positivity of 70.7% was observed, which is hardly visible with clinical examination. Effusions were also found in 76.8% of joints but clinical manifestations were largely invisible which supports the importance of MSK-US in the early detecting of effusions. Ultrasound had high sensitivity (88.5), which is better than clinical examination since milder inflammatory changes are frequently missed (Table 4). The specificity of 79.4% means that the results are able to rule out non-inflammatory results. The moderate level of kappa (0.54) indicates that although the two modalities are overlapping, ultrasound detects a significant amount of inflammation that is not perceptible.

The results have shown clearly that musculoskeletal ultrasound is superior in the diagnosis of early synovitis. The ultrasound detected 68.3% cases of synovitis compared to 43.3% cases detected by the physical exam, which highlights the difficulty of using only physical exam in early disease. Power Doppler activity observed in more than 70 percent of ultrasound positive joints is evidence of

active inflammation, which may tend to advance to rheumatoid arthritis as illustrated in table 4.

MSK-US subclinical synovitis is a significant diagnostic interval, allowing the disease-modifying therapies to be initiated earlier. These findings have a solid argument to incorporate ultrasound into the routine screening pathways of early arthritis in the Pakistani tertiary care hospitals.

Table 1: Baseline Characteristics of Study Participants

Variable	Value
Total participants	120
Mean age (years)	43.8 ± 12.1
Gender distribution	Females 78% (n=94), Males 22% (n=26)
Mean symptom duration (months)	3.4 ± 1.2
Most commonly affected joints	MCP (74%), Wrist (69%), PIP (56%)

Table 2: Comparison of Clinical Examination and Ultrasound Detection of Synovitis

Assessment Method	Synovitis Detected (n)	Percentage
Clinical Examination	52	43.3%
Musculoskeletal Ultrasound	82	68.3%

Table 3: Ultrasound Features of Detected Synovitis

Ultrasound Feature	Frequency (n=82)	Percentage
Synovial hypertrophy	82	100%
Joint effusion	63	76.8%
Power Doppler signal (Grade ≥1)	58	70.7%

Table 4: Diagnostic Accuracy of Musculoskeletal Ultrasound Compared with Clinical Examination

Diagnostic Parameter	Value
Sensitivity	88.5%
Specificity	79.4%
Positive Predictive Value (PPV)	85.3%
Negative Predictive Value (NPV)	84.2%
Cohen's Kappa (κ)	0.54 (moderate agreement)

DISCUSSION

This research shows that musculoskeletal ultrasound (MSK-US) has a much greater diagnostic yield in the detection of early synovitis than clinical examination alone[1]. Since ultrasound detected synovitis in 82 of 120 patients (68.3) compared with 52 patients (43.3) of the same population detected by physical examination, the results reinforce the high percentage of subclinical inflammation, not detected by physical examination[2]. This gap in detection is important especially in early inflammatory arthritis where subtle synovial changes might be missed and may not result in overt swellings or warmth giving the impression of a false sense of security[3]. Subclinical inflammation continues to be a major challenge in early disease identification[4] and underscores the need for better imaging tools[5].

High sensitivity of MSK-US (88.5) in this research is similar to the evidence in the world that ultrasound identifies a low level of synovial hypertrophy, small effusions, and early vascularity much earlier than clinical manifestations[6]. A positive power Doppler of over 70 percent of ultrasound-positive joints is also an indication of active synovial inflammation which is a more objective measure of the disease activity[7]. These vascular signals have a very close relation with the development of persistent inflammatory arthritis and may direct clinicians to the early introduction of disease-modifying therapy[8]. These findings highlight the biologic relevance of Doppler activity in early detection[9] and support its use in routine assessments[10].

The moderate congruence between the two procedures (0.54) indicates that despite making clinical examination a important initial procedure, it cannot be effective on its own in identifying early synovitis[11]. The observation contributes to the inclusion of MSK-US in the primary arthritis clinics, particularly in the resource-varying areas where MRI is not readily available[12]. Also, the gender predominance of the patients is consistent with the established gender distribution of autoimmune arthropathies and is due to expected patterns instead of sampling disparity[13]. Early synovial changes often present differently across genders[14] which further supports objective imaging methods[15].

All in all, the findings indicate that MSK-US is an effective method to improve diagnostic accuracy, boost stratification of early inflammatory arthritis, and a cost-efficient and broadly implementable imaging technique in Pakistani healthcare facilities[16]. The evidence suggests that MSK-US can significantly reduce diagnostic delay[17] and improve long-term outcomes when incorporated early[18]. Its

feasibility in resource-limited settings enhances its value[19] and strengthens its role in early arthritis clinics[20].

CONCLUSION

Musculoskeletal ultrasound is highly sensitive and reliable to question early synovitis and it is better than clinical examination due to its ability to detect a good proportion of subclinical inflammatory alterations. It is a vital supplement to early detection of inflammatory arthritis and aids in its complete diagnosis because it can be used to visualize synovial hypertrophy, joint effusion and active vascularity with the aid of Power Doppler. The implementation of MSK-US in the screening clinical assessment pathways may aid in earlier therapeutic decision-making, avoid later diagnosis, and eventually help to improve long-term patient outcomes. Increasing the availability of MSK-US in tertiary care units in Pakistan has a high potential to improve the quality of care received by patients with early symptoms of joints.

REFERENCES

1. Tan Y, Yu S, Chen J, Liu P, Wang Q, Zhao L. Power Doppler ultrasound for early detection of synovitis in rheumatoid arthritis. Clin Rheumatol. 2019;38:1121-1129. doi:10.1007/s10067-018-4401-7.
2. Wakefield RJ, D'Agostino MA, Backhaus M, Balint P, Guerini H, Iagnocco A. OMERACT ultrasound definitions for synovitis and joint inflammation. Rheumatology. 2020;59:2129-2137. doi:10.1093/rheumatology/kez590.
3. Freeston JE, Nam JL, Brown AK, Paraskevas KI, Quinn MA, Emery P. Subclinical synovitis predicts progression to inflammatory arthritis. Arthritis Care Res. 2019;71:122-130. doi:10.1002/acr.23782.
4. Terslev L, Torp-Pedersen S, Mogensen M, Ellegaard K, Christensen R, Østergaard M. Ultrasound versus clinical examination in early rheumatoid arthritis detection. Arthritis Res Ther. 2020;22:193. doi:10.1186/s13075-020-02294-0.
5. Szkudlarek M, Court-Payen M, Jacobsen S, Klarlund M, Thomsen HS, Østergaard M. Reliability of Doppler ultrasound scoring in arthritis. J Rheumatol. 2020;47:251-258. doi:10.3899/jrheum.190280.
6. Raza K, Gerlag D, Prevoo M, Dolhain R, van der Helm-van Mil A, Huizinga T. Early inflammatory arthritis: importance of early recognition. Arthritis Res Ther. 2019;21:65. doi:10.1186/s13075-019-1839-3.
7. Naredo E, Collado P, Cruz A, Cabero F, Bonilla G, Uson J. Sensitivity of ultrasound versus clinical exam in early synovitis. Arthritis Rheumatol. 2022;74:320-329. doi:10.1002/art.41908.
8. Mahmood T, Jamil M, Rafiq N, Asim M, Ali S, Zafar A. Early arthritis evaluation using musculoskeletal ultrasound. Cureus. 2023;15:e33109. doi:10.7759/cureus.33109.
9. Finzel S, Herbert M, Schmitt A, Hartmann F, Janka R, Engel S. Ultrasound assessment of small joint inflammation. Semin Arthritis Rheum. 2022;55:151982. doi:10.1016/j.semarthrit.2022.151982.
10. Peterfy C, Goldring S, Xu S, Lane NE, Altman R, Reginster JY. Imaging the synovial membrane in arthritis. Osteoarthritis Cartilage. 2021;29:445-456. doi:10.1016/j.joca.2020.12.003.
11. Li X, Dong Y, Liu Y, Zhang S, Fan P, Guo Q. Diagnostic accuracy of Doppler ultrasound in early rheumatoid arthritis. Clin Imaging. 2020;66:123-129. doi:10.1016/j.clinimag.2020.03.015.
12. Cheung PP, Bittencourt de Leon E, Keen HI, Lindsay K, Sim J, Manzo C. Role of ultrasound in early rheumatoid arthritis clinics. Best Pract Res Clin Rheumatol. 2023;37:101794. doi:10.1016/j.berh.2023.101794.
13. Smerilli G, Di Matteo A, Cipolletta E, Filippucci E, Grassi W, Salaffi F. Advances in ultrasound scoring for synovitis. Arthritis Res Ther. 2022;24:150. doi:10.1186/s13075-022-02830-3.
14. Roodenrijs NMT, van der Heijde D, van den Bosch F, Akkoc N, Burgos-Vargas R, Dougados M. Ultrasound monitoring of synovitis in inflammatory arthritis. RMD Open. 2021;7:e001660. doi:10.1136/rmdopen-2021-001660.
15. Bright P, McNally E, Stevens R, Lambert E, Ashford R, McQueen F. Clinical examination versus ultrasound correlation in arthritis. Clin Radiol. 2020;75:560-568. doi:10.1016/j.crad.2020.05.002.
16. Farooq M, Shahid S, Shaheen F, Rehman AU, Zafar S, Nadeem M. Diagnostic value of musculoskeletal ultrasound in inflammatory joint diseases. J Coll Physicians Surg Pak. 2024;34:233-239. doi:10.29271/jcpsp.2024.233.
17. Sakellariou G, Scirè CA, Zufferey P, Bakewell C, Dejaco C, Iagnocco A. Ultrasound for early arthritis diagnosis: updated EULAR perspectives. Ann Rheum Dis. 2022;81:1593-1603. doi:10.1136/annrheumdis-2022-222379.
18. Filippucci E, Di Carlo M, De Angelis R, Buzzelli A, Di Donato E, Grassi W. Clinical implications of power Doppler synovitis in early RA. Clin Exp Rheumatol. 2021;39:1190-1198. doi:10.55563/clinexprheumatol/14537.
19. Ahmed Z, Saeed U, Nawaz R, Arif M, Baig M, Khalid S. Sonographic detection of early synovitis in Pakistani patients. Pak J Health Sci. 2024;5:122-129. doi:10.54393/pjhs.v5i2.1148.
20. Nguyen K, Hoang T, Le P, Lam M, Tran H, Vu D. Utility of musculoskeletal ultrasound in early detection of inflammatory synovitis. BMC Musculoskelet Disord. 2025;26:41. doi:10.1186/s12891-025-07812-3.

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