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Diagnostic Delay in Psoriatic Arthritis: Scope, Consequences, and the Role of Dermatologist-Led Screening

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ABSTRACT

Background: Psoriatic arthritis (PsA) is a chronic, inflammatory musculoskeletal disease that develops in approximately 25–30% of patients with psoriasis. Observational studies report that delays between symptom onset and diagnosis frequently range from one to more than five years, with considerable variation across healthcare systems and clinical settings. During this period, joint damage may accumulate and, in some patients, become irreversible. Despite the availability of validated screening instruments and increasingly effective therapies, PsA remains substantially underdiagnosed in dermatology settings.
Objective: This narrative review synthesizes published evidence regarding the scope of diagnostic delay in PsA, its associated clinical consequences, the structural barriers that sustain it, the performance characteristics of available screening tools, and current treatment approaches — with attention to separating approved therapies from those under active clinical investigation.
Methods: A narrative review of peer-reviewed literature published international treatment guidelines (GRAPPA, EULAR, ACR/NPF), and relevant academic sources was conducted. Because formal systematic review methodology — including pre-specified database searches, PRISMA flow, and quality appraisal — was not applied, findings should be interpreted as a synthesis of available evidence rather than a quantitative systematic analysis.
Key Findings: Diagnostic delays in PsA are associated with worse radiographic outcomes, functional impairment, and reduced quality of life in observational studies. Screening questionnaires (PEST, ToPAS, PASE, EARP) demonstrate moderate sensitivity and specificity in dermatology populations and are underutilized. International guidelines from GRAPPA, EULAR, and ACR/NPF converge on encouraging proactive musculoskeletal evaluation of psoriasis patients, though they differ in operational specificity. Approved therapies — including TNF inhibitors, IL-17A inhibitors, IL-23 inhibitors, and oral JAK/TYK2 inhibitors — have substantially improved PsA outcomes, yet a significant proportion of patients fail to achieve treatment targets. Investigational agents including

novel selective TYK2 inhibitors and exploratory topical compounds represent promising but not yet established additions to the PsA armamentarium.

Conclusions: Earlier identification of PsA in patients with psoriasis is associated with better outcomes in the available evidence. Dermatologists, who typically see psoriasis patients before musculoskeletal symptoms prompt rheumatology referral, are well positioned to support earlier detection through structured clinical inquiry and validated screening tools. Implementation of consistent screening practice, harmonization of guideline recommendations, and improved care coordination between dermatology and rheumatology represent the most practical avenues toward closing the diagnostic gap.

Keywords: psoriatic arthritis; diagnostic delay; screening; psoriasis; dermatologist; IL-17; IL-23; TYK2; GRAPPA; EULAR; early detection; treatment guidelines

INTRODUCTION

Psoriasis is a chronic, systemic, immune-mediated inflammatory skin disease affecting approximately 2–3% of the world's population — more than 125 million people globally — with substantial geographic variation in prevalence and disease burden.[12] Once regarded primarily as a dermatological condition, psoriasis is now understood to be a systemic inflammatory disease that increases the risk of comorbid conditions including cardiovascular disease, metabolic syndrome, depression, and inflammatory arthritis.[34] Among its most clinically significant complications, psoriatic arthritis (PsA) develops in approximately 25–30% of patients with psoriasis.[5,6] PsA is a heterogeneous, seronegative, inflammatory musculoskeletal disease that can affect peripheral joints, axial structures, entheses, and nail units, either alone or in combination.[7] In a proportion of patients, PsA follows a progressive, erosive course leading to irreversible joint damage, functional impairment, and disability if not identified and treated in a timely manner.[8,9]

A consistent and clinically important finding across observational studies is that PsA is frequently diagnosed late. Several population-based and registry studies report diagnostic delays that range from approximately one to more than five years from the onset of musculoskeletal symptoms, with considerable heterogeneity across healthcare systems, clinical settings, and study methodologies.[10,11] Cutaneous manifestations of psoriasis typically precede joint disease by an estimated three to eight years in the majority of patients,[12] creating a potential window during which dermatologists — who see psoriasis patients earliest and most frequently — could facilitate earlier detection.

Despite the availability of validated screening questionnaires and international guidelines that encourage proactive musculoskeletal evaluation, PsA remains underdiagnosed in dermatology settings. Studies have found that a substantial proportion of patients attending dermatology clinics — particularly those with more severe psoriasis — have unrecognized PsA.[13,14] The magnitude of this gap and its consequences for patients represent important, addressable clinical and public health challenges.

This narrative review aims to: (1) characterize the evidence on diagnostic delay in PsA and its associated clinical outcomes; (2) describe the structural and clinical barriers that contribute to underdiagnosis; (3) evaluate the performance characteristics and limitations of available screening instruments; (4) summarize current evidence-based

treatment approaches, with explicit distinction between approved therapies, drugs under clinical investigation for PsA, and early-stage experimental findings; and (5) identify practical steps to support earlier detection.

METHODS

Study Design

This paper is a narrative review. It does not constitute a systematic review: no pre-specified electronic database search strategy, PRISMA flow diagram, formal quality appraisal, or meta-analytic synthesis was conducted. The findings therefore reflect a selective, expert-informed synthesis of the available literature and should be interpreted accordingly. Narrative reviews remain a recognized format in clinical journals for synthesizing complex, multidomain evidence, but readers should be aware of the inherent risk of selection bias in evidence included.

Sources

Evidence was drawn from: peer-reviewed original research and clinical review articles published in indexed journals; international clinical practice guidelines from GRAPPA (2015, updated 2021), EULAR (2015, 2016 update), and ACR/NPF (2018, 2019); published epidemiological and registry data from Europe, North America, South Asia, and East Asia; and supporting academic dissertations and theses, which are used in a supplementary capacity only and are not treated as primary or high-level evidence. All cited sources are publicly available, peer-reviewed or formally published. No unpublished data, unreviewed preprints, or non-indexed sources are cited as primary evidence.

Scope and Structure

The review is organized around seven domains: epidemiology of diagnostic delay; disease pathophysiology and the skin-to-joint timeline; clinical consequences of delayed diagnosis; barriers to early detection; screening instrument performance; treatment landscape (approved, investigational, and preclinical, clearly separated); and recommendations for clinical practice. Where evidence is heterogeneous or limited, uncertainty is explicitly acknowledged.

EPIDEMIOLOGY OF DIAGNOSTIC DELAY: SCOPE AND VARIABILITY

Prevalence of Psoriatic Arthritis

PsA develops in approximately 25–30% of individuals with psoriasis, though estimates vary widely (6–48%) across studies, depending on disease definition, clinical setting, diagnostic criteria used, and whether screening was active or passive.[5,6,15] In population-based studies, the prevalence of PsA in the general population has been estimated at approximately 0.1%, and at 0.67% in United States adults.[16,17] In South Asian populations, including India, reported rates are lower (approximately 8–9% among psoriasis cohorts), though underreporting is a recognized limitation of existing data from low-resource settings.[18,19] PsA affects men and women approximately equally and most commonly presents between the ages of 30 and 50 years.[20]

The Diagnostic Delay: Evidence and Variability

Observational studies consistently document a delay between the onset of musculoskeletal symptoms and the formal diagnosis of PsA. The duration of this delay varies substantially across study populations, healthcare systems, and methodological approaches. Several cohort studies and registry analyses report mean delays of approximately one to more than five years.[10,11,21] Haroon and colleagues found that a diagnostic delay exceeding six months was associated with worse radiographic and functional outcomes even after adjustment for disease duration.[21] A population-based survey reported an average delay of approximately five years from the onset of musculoskeletal symptoms to diagnosis, though this figure reflects a specific study context and should not be generalized as a universal benchmark.[10] The variability in reported delay reflects genuine differences in: the threshold at which patients seek care; the availability of rheumatology services; the primary specialty managing psoriasis; and whether active screening programmes are in place. In settings with integrated dermatology-rheumatology pathways or structured screening, delays may be substantially shorter.[22] This heterogeneity underscores that diagnostic delay is not a fixed biological constant — it is a modifiable clinical and systems variable.

Undiagnosed PsA in Dermatology Settings

Studies conducted in dermatology clinics have found that a proportion of patients with psoriasis have unrecognized PsA at the time of their dermatology appointment. Haroon and colleagues reported that 41% of patients with severe psoriasis attending a tertiary dermatology center had undiagnosed PsA.[13] Mease and colleagues found a 30% prevalence of rheumatologist-diagnosed PsA among psoriasis patients in European and North American dermatology clinics.[14] Importantly, these figures derive from selected, predominantly severe or tertiary-care populations and may not be generalizable to all dermatology settings or to patients with mild psoriasis. The true prevalence of undiagnosed PsA across unselected dermatology populations is likely lower, though the evidence base is limited.

What the available data consistently support is that a clinically meaningful proportion of psoriasis patients attending dermatology clinics have joint disease that has not been identified — and that active screening increases detection rates compared with passive ascertainment.[13,14,23]

THE SKIN-TO-JOINT CONTINUUM: PATHOPHYSIOLOGY AND TIMING

Shared Immunopathology

Psoriasis and PsA share a common immunopathological foundation centered on dysregulation of the IL-23/Th17 axis. IL-23, produced by myeloid dendritic cells and macrophages, drives the differentiation, expansion, and survival of Th17 cells, which produce IL-17A, IL-17F, and IL-22.[24,25] These cytokines act on keratinocytes to produce the epidermal hyperproliferation characteristic of psoriatic plaques, and on entheseal structures and synovial tissue to drive the inflammatory cascades associated with joint damage.[26,27] TNF-α plays an additional role, promoting osteoclastogenesis via RANK-L and inhibiting osteoblast differentiation, thereby contributing to bone erosion.[28]

A clinically distinctive feature of PsA, in contrast to rheumatoid arthritis, is the coexistence of bone erosion and pathological new bone formation — including syndesmophytes and

enthesophytes — in the same patient.[29] This dual catabolic-anabolic bone phenotype reflects the complex crosstalk between cytokines including TNF-α, IL-22, and Wnt pathway mediators, and it is not fully corrected by TNF inhibition alone.[29,30]

The Enthesis as an Early Site of Disease

McGonagle and colleagues proposed that the enthesis — the anatomical site of tendon and ligament attachment to bone — may be the primary site of musculoskeletal disease initiation in PsA.[31] Preclinical studies in mouse models demonstrated that IL-23 acting on entheseal resident T cells produces entheseal-predominant inflammatory arthritis comparable to findings in human spondyloarthritis.[32] Clinically, enthesitis at the Achilles tendon insertion and plantar fascia may precede frank synovitis and represents an early, often underrecognized manifestation of PsA.[33]

Genetic Architecture

PsA has a strong heritable component. The recurrence risk ratio in first-degree relatives of PsA patients is substantially higher than for psoriasis alone or rheumatoid arthritis.[34] Susceptibility is associated with class I MHC alleles, including HLA-B*27, B*08, B*38, and B*39, which are differentially associated with specific clinical sub-phenotypes.[35] HLA-C*06, the allele most strongly associated with psoriasis susceptibility, does not appear to confer significant PsA risk — evidence of partially distinct genetic pathways between skin and joint disease.[35] Despite these genetic associations, no validated genotype-guided treatment selection protocol currently exists for PsA, representing a recognized gap in precision medicine for this disease.

The Clinical Timeline

In the majority of patients, psoriasis precedes PsA by an estimated three to eight years.[12] Approximately 1–3% of patients with established psoriasis develop PsA annually.[36] A minority of patients — estimated at approximately 15% — present with arthritis before cutaneous psoriasis is apparent.[37] Skin disease severity does not reliably predict joint involvement; patients with limited or hidden psoriasis (e.g., scalp, natal cleft, intertriginous sites) develop PsA at rates comparable to those with extensive plaque disease.[38] These features of the clinical timeline have direct implications for screening strategy: low PASI scores and limited skin involvement should not be used to reduce clinical vigilance for musculoskeletal symptoms.

CLINICAL CONSEQUENCES ASSOCIATED WITH DIAGNOSTIC DELAY

Structural Joint Outcomes

Observational evidence consistently associates delayed PsA diagnosis with worse structural and functional outcomes. Haroon and colleagues found that a diagnostic delay exceeding six months was independently associated with peripheral joint erosions, arthritis mutilans, and worse physical function scores, after adjustment for known confounders.[21] Approximately 50% of patients show radiographic evidence of joint damage within two years of clinical PsA assessment in prospective cohort studies.[8] Among patients with axial involvement, sacroiliitis progresses over time if untreated; observational data indicate that

37–52% of patients with axial PsA develop grade 2 or higher sacroiliitis within 5–10 years of follow-up.[39]

It is important to note that these associations are derived from observational studies and registries, and do not constitute proof of direct causation. Confounding by disease severity, patient-level factors, and healthcare access is possible. Nevertheless, the consistency of findings across independent cohorts strengthens the inference that earlier diagnosis and treatment initiation are associated with better long-term outcomes in a substantial proportion of patients.

Functional Impairment and Quality of Life

PsA, particularly with axial involvement, is associated with significant impairments in health-related quality of life. Registry data from the Corrona PsA/Spondyloarthritis Registry found that patients with axial PsA had worse pain scores, higher tender joint counts, more enthesitis, and greater impairment in physical function and work productivity compared to those without axial involvement.[40] Comorbid depression and anxiety are more prevalent in patients with psoriatic disease than in the general population, and psychological burden correlates with disease severity and duration.[41,42]

Treatment Response and Targets

International guidelines now recommend a treat-to-target approach, with minimal disease activity (MDA) or remission as the primary treatment goal.[43] However, treatment response rates vary substantially by drug class, patient population, prior therapy, and the specific endpoint assessed. In clinical trials, ACR20 response rates with approved biologics range from approximately 50–75% depending on the agent and population; MDA rates across biologic treatment groups in real-world studies range from approximately 30–57%.[44] A clinically meaningful proportion of patients fail to achieve treatment targets with initial or subsequent therapy, reflecting the disease's heterogeneity and the absence of validated predictive biomarkers. These limitations apply regardless of when treatment is started, but are compounded in patients who begin therapy after significant structural damage has accumulated.

Disease Burden in Lower-Resource Settings

In lower-resource settings, including parts of South Asia, the burden of undetected PsA may be disproportionately high. Clinical data from India document that PsA prevalence among psoriasis patients is comparable to Western estimates, yet access to rheumatology services, structured screening programmes, and approved biologic therapies is substantially more limited.[18,19] Global epidemiological data on PsA disproportionately reflect high-income Western cohorts, and the extent of diagnostic delay and its consequences in low- and middle-income settings remains insufficiently characterized.

BARRIERS TO EARLY DIAGNOSIS

Specialty Fragmentation

A primary structural barrier to timely PsA diagnosis is the organizational separation between dermatology and rheumatology. Psoriasis is managed predominantly by

dermatologists, whose clinical focus centers on skin disease activity and clearance. PsA, when eventually diagnosed, is managed predominantly by rheumatologists. For patients who manifest the musculoskeletal features of PsA while under dermatological care, the pathway to diagnosis requires either dermatologist-initiated screening and referral, or patient self-referral driven by symptom severity. Neither pathway is consistently operationalized.[45]

Clinical Heterogeneity of PsA

PsA presents across five recognized clinical patterns — asymmetric oligoarthritis, symmetric polyarthritis, axial spondyloarthritis, distal interphalangeal arthritis, and arthritis mutilans — and individual patients may exhibit features across domains simultaneously or sequentially.[7,46] This heterogeneity, combined with the absence of a disease-specific biomarker or serological test, means that PsA remains a clinical diagnosis requiring the integration of multiple findings.[47] Symptoms such as inflammatory back pain, enthesitis, or isolated dactylitis may be attributed to alternative causes, particularly when psoriasis is mild or not prominent at the initial presentation.

Skin Severity Does Not Predict Joint Risk

Clinical intuition might suggest that patients with severe psoriasis should be prioritized for joint screening. While severe cutaneous disease is associated with higher PsA prevalence in some studies,[48] patients with mild skin involvement also develop PsA at substantial rates, and the correlation between PASI score and PsA risk is imperfect.[38] Relying on skin severity as a screening threshold would therefore result in missed diagnoses across the spectrum of skin disease. This limitation argues for screening based on clinical symptoms and signs rather than skin severity alone.

Time Constraints and Workflow

Practical barriers in dermatology practice include consultation time constraints, the absence of musculoskeletal screening integrated into electronic medical record workflows, and the variable availability of licensed screening questionnaires.[49] These are implementation challenges rather than scientific limitations, but they are real and relevant. Any practical screening strategy must be compatible with the time and workflow realities of outpatient dermatology practice.

SCREENING INSTRUMENTS: EVIDENCE AND LIMITATIONS

Available Validated Questionnaires

Four questionnaires have been developed and validated specifically for PsA screening in dermatology settings:

PEST (Psoriasis Epidemiology Screening Tool): A five-item, free-to-use questionnaire with a threshold score ≥3 indicating PsA. Reported sensitivity 75–79%, specificity 70–85%.[50]

ToPAS (Toronto Psoriatic Arthritis Screen): Eight domains covering joint pain, stiffness, back pain, and nail changes; threshold ≥8 suggests PsA. Sensitivity 86%, specificity 73%. Not freely available in all jurisdictions.[51]

PASE (Psoriatic Arthritis Screening and Evaluation): Fifteen items assessing symptom frequency and functional status; sensitivity 82%, specificity 73%.[52]
EARP (Early Arthritis for Psoriatic Patients): Ten-item instrument; includes nocturnal back pain and morning stiffness. Sensitivity 85%, specificity 75%.[53]

Limitations and Implementation Challenges

These instruments perform reasonably well but have important limitations that must be acknowledged in any clinical guidance. A comparative validation study found that overall accuracy across tools is moderate (sensitivity 65–87%; specificity 34–85%) when applied to unselected dermatology populations.[50,51,52,53] Specificity in the lower range generates a non-trivial rate of false positives, with implications for over-referral to rheumatology services that may be capacity-constrained. The questionnaires were largely validated in tertiary or specialist settings and may perform differently in primary care or community dermatology.

Additionally, none of the existing tools is specifically validated for axial PsA detection; they capture some axial symptoms (back pain, stiffness) but are not optimized for this domain.[54] No single instrument has demonstrated sufficient accuracy to replace clinical examination and rheumatological assessment; they are best understood as triggers for further evaluation and referral, not as diagnostic tools.

Clinical Signs That Warrant Attention

Regardless of questionnaire use, several clinical findings at the dermatology visit have well-established associations with PsA and should prompt musculoskeletal inquiry. Nail disease — including pitting, subungual hyperkeratosis, and onycholysis — is observed in 80–90% of PsA patients and is more prevalent in those with PsA than in psoriasis patients without joint involvement.[55,56] Dactylitis (uniform soft tissue swelling of an entire digit) occurs in approximately one-third of PsA patients and is considered a marker of disease severity.[57] Achilles tendinopathy or plantar fasciitis that does not follow a mechanical pattern should raise suspicion for enthesitis.[33]

The PSA Clinical Mnemonic

Gottlieb and Merola proposed a practical three-domain mnemonic — **P** for joint **P**ain; **S** for **S**tiffness after inactivity or sausage digit (dactylitis); **A** for **A**xial symptoms — to aid rapid clinical recognition at dermatology visits.[54] The presence of any two of these three features was proposed as a threshold for formal questionnaire-based screening or rheumatology referral. While this mnemonic has not been independently prospectively validated, its simplicity and alignment with known clinical features of PsA make it a practical framework for busy clinical settings where structured questionnaire administration is not feasible.

TREATMENT LANDSCAPE: APPROVED, INVESTIGATIONAL, AND PRECLINICAL

Note: This section explicitly distinguishes between (a) therapies approved for PsA, (b) agents approved for psoriasis but under investigation for PsA, and (c) preclinical findings relevant to psoriasis pathophysiology. These categories are not interchangeable and are presented separately to ensure accuracy.

Approved Therapies for PsA

International guidelines from GRAPPA (2015, 2021), EULAR (2015, updated 2016), and ACR/NPF (2018, 2019) recommend a stepwise, domain-driven, treat-to-target approach to PsA management.[43,44,58] The guidelines converge on encouraging proactive musculoskeletal evaluation in psoriasis patients, though they differ in the specific operational detail of screening recommendations, and none mandates a standardized every-visit structured screening protocol. Clinicians should consult the source guidelines directly for current recommendations.

For peripheral PsA, NSAIDs remain first-line for symptom management. Conventional DMARDs (methotrexate, leflunomide, sulfasalazine) are used for peripheral disease but lack evidence for axial or entheseal manifestations.[58] Biologic DMARDs are recommended when NSAIDs or cDMARDs fail:

TNF inhibitors (adalimumab, etanercept, certolizumab pegol, golimumab, infliximab) are approved for PsA and have the longest track record. They demonstrate efficacy across peripheral arthritis, skin disease, enthesitis, and dactylitis, and limited evidence supports benefit in axial disease extrapolated largely from ankylosing spondylitis data.[59,60]

IL-17A inhibitors (secukinumab, ixekizumab) are approved for PsA and have demonstrated superiority over adalimumab on skin clearance endpoints in head-to-head trials, with comparable or superior joint outcomes in some analyses.[61,62]

IL-23 p19 inhibitor (guselkumab) is approved by both FDA and EMA for PsA and has demonstrated significant improvements in joint, skin, and enthesitis outcomes in the DISCOVER-1 and DISCOVER-2 Phase 3 trials.[63,64]

JAK inhibitors (tofacitinib, upadacitinib) are approved for PsA as oral agents. Upadacitinib demonstrated superiority over adalimumab on combined joint and skin outcomes in active PsA in the Phase 3 SELECT-PsA 1 trial. FDA-mandated boxed warnings for this drug class (serious cardiovascular events, malignancy, thrombosis) require careful patient selection.[65,66]

Investigational TYK2 Inhibitors: Approved for Psoriasis, Under Development for PsA

Tyrosine kinase 2 (TYK2) is a member of the JAK family and serves as a critical intracellular transducer of IL-23, IL-12, and type I interferon signaling, all of which are relevant to the pathogenesis of psoriasis and PsA.[67,68]

Deucravacitinib, an allosteric TYK2 inhibitor that binds the regulatory pseudokinase (JH2) domain, was approved by the FDA in September 2022 for moderate-to-severe plaque **psoriasis** — not for PsA. Phase 3 trials (POETYK PSO-1 and PSO-2) demonstrated approximately 58–60% PASI 75 response at week 16 with a favorable safety profile compared to apremilast.[69,70] Its development for PsA is ongoing in Phase 3 trials (NCT04908189, NCT04908202); Phase 2 data in PsA showed statistically significant ACR20 improvements over placebo, but regulatory approval for PsA has not been granted at the time of this writing.[71,72]

Additional TYK2 inhibitors under clinical evaluation include zasocitinib (TAK-279), ESK-001, brepocitinib (a TYK2/JAK1 inhibitor), and ropsacitinib (a TYK2/JAK2 inhibitor).[73,74,75,76] Phase 2b data for several of these agents demonstrate dose-dependent PASI improvements in psoriasis with safety profiles characterized by the absence of major cardiovascular events or thromboembolic complications observed in traditional JAK inhibitor trials.[73,74] Brepocitinib has Phase 2b data in PsA demonstrating ACR20 superiority over placebo, but is not yet approved for any indication.[75] The overall safety profile and long-term data for these agents require further characterization through ongoing trials before their role in PsA management can be fully defined.

Novel Topical Therapies: Approved and Approved for Psoriasis Only

Tapinarof (aryl hydrocarbon receptor-modulating agent) and roflumilast cream (PDE4 inhibitor) have both completed Phase 3 trials in plaque **psoriasis** with significant efficacy and are approved or under regulatory review for plaque psoriasis. Neither is approved for, nor has been specifically studied in, PsA.[77,78] They represent advances in topical management for the dermatological component of psoriatic disease, particularly relevant for the majority of patients with mild-to-moderate skin involvement.

Preclinical and Early-Stage Research: Psoriasis-Specific Findings

Translational research has identified novel mechanisms with potential relevance to psoriasis treatment. Inhibition of MutT Homolog 1 (MTH1) — an enzyme that prevents incorporation of oxidatively damaged nucleotides into DNA and is upregulated in psoriatic skin — has demonstrated antiproliferative and anti-inflammatory effects in preclinical mouse models of psoriasis.[79,80] Nitric oxide (NO) donors applied topically have similarly shown reduced keratinocyte proliferation and inflammatory infiltrate in imiquimod-induced mouse models.[81,82] These findings are preclinical and psoriasis-specific. They have not been evaluated in human PsA and should not be interpreted as evidence for PsA management. Their inclusion here reflects their potential future relevance to the accessible treatment of the dermatological component of psoriatic disease — a need specifically highlighted by the WHO's 2014 call for widely accessible psoriasis therapies.

TOWARD EARLIER DIAGNOSIS: PRACTICAL CONSIDERATIONS

The Role of the Dermatologist

Given that psoriasis typically precedes joint disease by years and that the majority of patients with psoriasis are managed in dermatology settings, dermatologists have a practical opportunity to support earlier PsA detection.[12,54] The new joint AAD/NPF guidelines explicitly recommend that dermatologists screen patients with psoriasis for

signs and symptoms of PsA.[83] This does not imply that dermatologists should diagnose or treat PsA — rheumatology expertise remains essential for confirmation and management. Rather, the dermatologist's role is to inquire, recognize clinical features that warrant further evaluation, and facilitate timely referral.

A Minimum Practical Screening Framework

Based on the evidence reviewed, the following minimum framework for musculoskeletal screening at dermatology appointments is clinically supportable:

Step 1: Brief verbal inquiry at each visit using the PSA domains: joint pain, stiffness after inactivity or dactylitis, axial symptoms. Two or more positive responses should prompt structured follow-up.[54]

Step 2: Routine nail examination: pitting, subungual hyperkeratosis, and onycholysis are associated with PsA and should prompt musculoskeletal inquiry in patients who have not reported joint symptoms.[55,56]

Step 3: If clinical features suggest PsA, administer a validated questionnaire (PEST is freely available and brief). A score ≥3, or the presence of dactylitis or unexplained enthesitis, should lead to rheumatology referral.[50]

Step 4: Document musculoskeletal inquiry in the clinical record longitudinally to enable tracking of symptom evolution over time.

This framework is not proposed as a rigorous protocol with validated implementation evidence but as a clinically reasonable, evidence-informed practice standard aligned with guideline intent. Formal prospective evaluation of screening implementation programmes in dermatology settings is needed.

Guideline Harmonization and Care Coordination

GRAPPA, EULAR, and ACR/NPF guidelines converge on the principle of proactive musculoskeletal evaluation in psoriasis patients but differ in operational specificity, population focus, and domain prioritization.[43,44,58] For practicing clinicians managing both psoriasis and PsA, navigating three sets of guidelines with different structures represents a real implementation barrier. A jointly endorsed, single-page clinical decision aid — developed collaboratively by international dermatology and rheumatology organizations — could lower this barrier substantially without requiring new clinical evidence.

Formalized care pathways linking dermatology and rheumatology services — including defined referral criteria, target time-to-appointment standards, and shared clinical records — have been proposed as structural solutions to the specialty fragmentation problem.[22] Evidence on the effectiveness of such pathways in PsA is limited but emerging; integrated care models represent an important area for future health services research.

Patient Awareness

Patients with psoriasis are frequently unaware of their risk for joint disease and may not spontaneously report musculoskeletal symptoms to their dermatologist, either because they attribute symptoms to other causes or because they are not aware of the connection between psoriasis and arthritis.[84] Written patient education materials — brief, accessible, and provided at the point of care — explaining the link between psoriasis and joint disease and encouraging patients to report relevant symptoms, represent a low-cost, practical complement to clinical screening.

DISCUSSION

Existing evidence indicates that PsA is frequently diagnosed later than is clinically optimal, and that diagnostic delays — though variable in duration across settings and studies — are associated with worse structural and functional outcomes in observational data. The mechanisms underlying this association are plausibly biological: inflammatory joint damage accumulates progressively and is not fully reversible with treatment once established. Dermatologists, who routinely see psoriasis patients during the period when joint disease is subclinical or early, are well placed to support earlier detection through structured clinical inquiry and validated screening instruments.

These conclusions are, however, subject to important limitations in the underlying evidence. The observational nature of most diagnostic delay studies limits causal inference; reported delay durations vary substantially across cohorts and may not be representative of all healthcare settings; the undiagnosed PsA prevalence figures cited in the literature derive largely from selected or tertiary populations; and the effectiveness of specific screening interventions in dermatology practice has not been rigorously evaluated in prospective trials with clinical outcome endpoints.

The treatment landscape for PsA has advanced considerably. Approved therapies — including IL-17A inhibitors, IL-23 inhibitors, and oral JAK inhibitors — offer substantial improvements over earlier standards of care, and emerging agents including selective TYK2 inhibitors show promise in both psoriasis (where deucravacitinib is now approved) and PsA (where Phase 3 data are awaited). Novel topical agents including tapinarof and roflumilast represent genuine advances for psoriasis treatment.[61,62,63,69,70,77,78] All of these therapeutic advances are, however, contingent on patients reaching diagnosis — a prerequisite that remains unmet for a substantial proportion of those with PsA.

Early detection and treatment can reduce or prevent irreversible disability in a meaningful proportion of patients with PsA. This is distinct from the claim that PsA itself is preventable — it is not, given its genetic and immunological determinants. What is potentially preventable, with appropriate clinical systems, is the avoidable accumulation of joint damage that occurs during periods of undiagnosed and untreated disease.

There are important areas where evidence is currently insufficient to support strong clinical recommendations. The effectiveness of structured dermatologist-initiated screening programmes on long-term joint outcomes has not been demonstrated in randomized controlled trials. The optimal screening interval, the best instrument for identifying axial versus peripheral PsA, and the impact of integrated dermatology-rheumatology pathways on patient outcomes require prospective evaluation. The field would benefit from well-designed implementation trials that measure not only detection rates but downstream clinical outcomes.

LIMITATIONS OF THIS REVIEW

This narrative review has several limitations that should inform how its conclusions are applied. First, as a narrative rather than systematic review, it is subject to selection bias in the evidence included. Studies with positive or clinically interesting findings may be overrepresented relative to negative or equivocal evidence. Second, the evidence base for diagnostic delay in PsA is largely observational, heterogeneous in methodology, and disproportionately derived from high-income, Western, tertiary-care settings. Generalizations to other healthcare contexts should be made cautiously. Third, the

literature on PsA screening tool performance, while moderately consistent, is based on studies conducted largely in specialist settings; real-world performance in community dermatology may differ. Fourth, the treatment landscape is evolving rapidly, and some statements regarding investigational agents may require updating as new trial data emerge. Fifth, academic dissertations were used as supplementary sources for certain data points; these represent lower levels of evidence than peer-reviewed publications and were treated accordingly.

CONCLUSIONS

The following conclusions are supported by the evidence reviewed, with the caveats noted:

1. **Diagnostic delay in PsA is a clinically meaningful and modifiable problem.** Observational evidence consistently associates delays in diagnosis with worse structural and functional outcomes. The duration of delay varies across settings but represents a window of lost treatment opportunity in a proportion of patients.
2. **A substantial proportion of psoriasis patients in dermatology settings have unrecognized PsA.** Available evidence, though derived mainly from tertiary or selected populations, indicates that active screening identifies cases that would otherwise be missed.
3. **Validated screening instruments exist but have moderate performance characteristics.** PEST, ToPAS, PASE, and EARP have acceptable sensitivity but variable specificity in dermatology populations. They function best as referral triggers rather than diagnostic tools, and their implementation in routine practice is limited.
4. **Dermatologists have a practical, evidence-supported role in earlier detection.** Brief structured clinical inquiry, nail examination, and recognition of dactylitis and enthesitis at dermatology appointments can support earlier identification and appropriate rheumatology referral.
5. **Approved therapies for PsA have substantially improved outcomes, but significant unmet needs persist.** TNF inhibitors, IL-17A inhibitors, IL-23 inhibitors, and JAK inhibitors provide effective disease control for many patients, but response rates vary and a meaningful proportion do not achieve treatment targets. Novel agents including selective TYK2 inhibitors are promising for psoriasis and under investigation for PsA.
6. **The distinction between psoriasis-approved and PsA-approved therapies, and between clinical and preclinical evidence, must be preserved.** TYK2 inhibitors are approved for psoriasis but not yet for PsA; novel topical mechanisms (MTH1 inhibition, NO donors) are preclinical findings in psoriasis only and should not be represented as PsA treatments at this stage.
7. **Early detection and treatment can reduce the risk of irreversible disability in a proportion of patients.** PsA itself is not preventable, but the structural damage accumulated during delayed or absent treatment is, in some patients, avoidable. This distinction matters for accurate communication with patients, policymakers, and the clinical community.
8. **Future research priorities are clear.** Prospective trials evaluating the impact of structured dermatologist-initiated screening on clinical outcomes, long-term safety and efficacy data for novel agents in PsA, improved screening instruments

with better specificity for axial disease, and health services research on integrated care models represent priority areas for advancing the field.

DECLARATIONS

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REFERENCES

1. Parisi R, Iskandar IYK, Kontopantelis E, Augustin M, Griffiths CEM, Ashcroft DM; Global Psoriasis Atlas. National, regional, and worldwide epidemiology of psoriasis: systematic analysis and modelling study. BMJ. 2020;369:m1590.
2. Griffiths CEM, Armstrong AW, Gudjonsson JE, Barker J. Psoriasis. Lancet. 2021;397(10281):1301–15.
3. Gelfand JM, Neimann AL, Shin DB, et al. Risk of myocardial infarction in patients with psoriasis. JAMA. 2006;296(14):1735–41.
4. Egeberg A, Gisondi P, Carrascosa JM, Warren RB, Mrowietz U. The role of the interleukin-23/Th17 pathway in cardiometabolic comorbidity associated with psoriasis. J Eur Acad Dermatol Venereol. 2020;34(8):1695–706.
5. Alinaghi F, Calov M, Kristensen LE, et al. Prevalence of psoriatic arthritis in patients with psoriasis: a systematic review and meta-analysis of observational and clinical studies. J Am Acad Dermatol. 2019;80(1):251–265.
6. Mease PJ, Gladman DD, Papp KA, et al. Prevalence of rheumatologist-diagnosed psoriatic arthritis in patients with psoriasis in European/North American dermatology clinics. J Am Acad Dermatol. 2013;69(5):729–735.
7. Ritchlin CT, Colbert RA, Gladman DD. Psoriatic arthritis. N Engl J Med. 2017;376(10):957–970.
8. Kane D, Stafford L, Bresnihan B, FitzGerald O. A prospective, clinical and radiological study of early psoriatic arthritis: an early synovitis clinic experience. Rheumatology (Oxford). 2003;42(10):1460–8.
9. Husted JA, Tom BD, Farewell VT, et al. A longitudinal study of the effect of disease activity and clinical damage on physical function over the course of psoriatic arthritis. Arthritis Rheum. 2007;56(3):840–849.
10. Ogdie A, Weiss P. The epidemiology of psoriatic arthritis. Rheum Dis Clin North Am. 2015;41(4):545–568.
11. Haroon M, Gallagher P, FitzGerald O. Diagnostic delay of more than 6 months contributes to poor radiographic and functional outcome in psoriatic arthritis. Ann Rheum Dis. 2015;74(6):1045–1050.
12. Tascilar K, Aydin SZ, Akar S, et al. Delay between the onset of psoriasis and arthritis in PsA patients from the PsART international cohort. Arthritis Rheumatol. 2019;71(Suppl 10):2854.
13. Haroon M, Kirby B, FitzGerald O. High prevalence of psoriatic arthritis in patients with severe psoriasis with suboptimal performance of screening questionnaires. Ann Rheum Dis. 2013;72(5):736–740.

14. Mease PJ, Gladman DD, Papp KA, et al. Prevalence of rheumatologist-diagnosed psoriatic arthritis in patients with psoriasis in European/North American dermatology clinics. J Am Acad Dermatol. 2013;69(5):729–735.
15. Gladman DD. Psoriatic arthritis. Baillieres Clin Rheumatol. 1995;9(2):319–29.
16. Ritchlin CT, Colbert RA, Gladman DD. Psoriatic arthritis. N Engl J Med. 2017;376(10):957–970.
17. Ruderman EM, Tambar S. Psoriatic arthritis: prevalence, diagnosis, and review of therapy for the dermatologist. Dermatol Clin. 2004;22(4):477–86.
18. Kumar R, Sharma A, Dogra S. Prevalence and clinical patterns of psoriatic arthritis in Indian patients with psoriasis. Indian J Dermatol Venereol Leprol. 2014;80(1):15–23.
19. Farheen SS. Study of arthritis in psoriasis [MD dissertation]. Dr. NTR University of Health Sciences, SVS Medical College, Mahabubnagar; 2018. [Used as supplementary source; not primary evidence.]
20. Coates LC, Helliwell PS. Psoriatic arthritis: state of the art review. Clin Med (Lond). 2017;17(1):65–70.
21. Haroon M, Gallagher P, FitzGerald O. Diagnostic delay of more than 6 months contributes to poor radiographic and functional outcome in psoriatic arthritis. Ann Rheum Dis. 2015;74(6):1045–1050.
22. Veale DJ, McGonagle D, McInnes IB, et al. The rationale for Janus kinase inhibitors for the treatment of spondyloarthritis. Rheumatology. 2019;58(2):197–205.
23. Elmets CA, Leonardi CL, Davis DMR, et al. Joint AAD-NPF guidelines of care for the management and treatment of psoriasis with awareness and attention to comorbidities. J Am Acad Dermatol. 2019;80(4):1073–1113.
24. Blauvelt A, Chiricozzi A. The immunologic role of IL-17 in psoriasis and psoriatic arthritis pathogenesis. Clin Rev Allergy Immunol. 2018;55(3):379–90.
25. Gaffen SL, Jain R, Garg AV, Cua DJ. The IL-23–IL-17 immune axis: from mechanisms to therapeutic testing. Nat Rev Immunol. 2014;14(9):585–600.
26. Ghoreschi K, Balato A, Enerback C, Sabat R. Therapeutics targeting the IL-23 and IL-17 pathway in psoriasis. Lancet. 2021;397(10275):754–66.
27. Lubberts E. The IL-23/IL-17 axis in inflammatory arthritis. Nat Rev Rheumatol. 2015;11(7):415–429.
28. Ritchlin CT, Haas-Smith SA, Li P, et al. Mechanisms of TNF-alpha- and RANKL-mediated osteoclastogenesis and bone resorption in psoriatic arthritis. J Clin Invest. 2003;111(6):821–831.
29. Lories RJ, Luyten FP, de Vlam K. Progress in spondylarthritis: mechanisms of new bone formation in spondyloarthritis. Arthritis Res Ther. 2009;11(3):221.
30. Mantravadi S, Ogdie A, Kraft WK. Tumor necrosis factor inhibitors in psoriatic arthritis. Expert Rev Clin Pharmacol. 2017;10(8):899–910.
31. McGonagle D, Marzo-Ortega H, O'Connor P, et al. Histological assessment of the early enthesitis lesion in spondyloarthropathy. Ann Rheum Dis. 2002;61(6):534–537.
32. Sherlock JP, Joyce-Shaikh B, Turner SP, et al. IL-23 induces spondyloarthropathy by acting on ROR-γt+ CD3+CD4–CD8– entheseal resident T cells. Nat Med. 2012;18(7):1069–1076.
33. De Simone C, Guerriero C, Giampetruzzi AR, et al. Achilles tendinitis in psoriasis: clinical and sonographic findings. J Am Acad Dermatol. 2003;49(2):217–222.
34. Chandran V. The genetics of psoriasis and psoriatic arthritis. Clin Rev Allergy Immunol. 2013;44(2):149–156.
35. Sundanum S, Orr C, Veale D. Targeted therapies in psoriatic arthritis — an update. Int J Mol Sci. 2023;24(7):6384. [Genetics subsection, citing HLA allele data.]

36. Christophers E, Barker JN, Griffiths CE, et al. The risk of psoriatic arthritis remains constant following initial diagnosis of psoriasis among patients seen in European dermatology clinics. J Eur Acad Dermatol Venereol. 2010;24(5):548–554.
37. Ritchlin CT, Colbert RA, Gladman DD. Psoriatic arthritis. N Engl J Med. 2017;376(10):957–970.
38. Merola JF, Li T, Li WQ, Cho E, Qureshi AA. Prevalence of psoriasis phenotypes among men and women in the USA. Clin Exp Dermatol. 2016;41(5):486–489.
39. Chandran V, Barrett J, Schentag CT, et al. Axial psoriatic arthritis: update on a longterm prospective study. J Rheumatol. 2009;36(12):2744–2750.
40. Mease PJ, Palmer JB, Liu M, et al. Influence of axial involvement on clinical characteristics of psoriatic arthritis: analysis from the Corrona Psoriatic Arthritis/Spondyloarthritis Registry. J Rheumatol. 2018;45(10):1389–1396.
41. Kurd SK, Troxel AB, Crits-Christoph P, Gelfand JM. The risk of depression, anxiety, and suicidality in patients with psoriasis: a population-based cohort study. Arch Dermatol. 2010;146(8):891–5.
42. Singh S, Taylor C, Kornmehl H, Armstrong AW. Psoriasis and suicidality: a systematic review and meta-analysis. J Am Acad Dermatol. 2017;77(3):425–40.
43. Coates LC, Kavanaugh A, Mease PJ, et al. Group for Research and Assessment of Psoriasis and Psoriatic Arthritis 2015 treatment recommendations for psoriatic arthritis. Arthritis Rheumatol. 2016;68(5):1060–1071.
44. Ogdie A, Coates LC, Gladman DD. Treatment guidelines in psoriatic arthritis. Rheumatology (Oxford). 2020;59(Suppl 1):i37–i46.
45. Gottlieb AB, Merola JF. Axial psoriatic arthritis: an update for dermatologists. J Am Acad Dermatol. 2021;84(1):92–101.
46. Moll JMH, Wright V. Psoriatic arthritis. Semin Arthritis Rheum. 1973;3(1):55–78.
47. Taylor W, Gladman D, Helliwell P, et al. Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum. 2006;54(8):2665–73.
48. Jadon DR, Sengupta R, Nightingale A, et al. Axial disease in psoriatic arthritis study: defining the clinical and radiographic phenotype of psoriatic spondyloarthritis. Ann Rheum Dis. 2017;76(4):701–707.
49. Mease PJ, Armstrong AW. Managing patients with psoriatic disease: the diagnosis and pharmacologic treatment of psoriatic arthritis in patients with psoriasis. Drugs. 2014;74(4):423–441.
50. Ibrahim G, Groves C, Chandramohan M, et al. Clinical and ultrasound examination of the Leeds Enthesitis Index in psoriatic arthritis and rheumatoid arthritis. ISRN Rheumatol. 2011. [PEST validation data as reported in Gottlieb & Merola, JAAD 2021.]
51. Gladman DD, Schentag CT, Tom BD, et al. Development and initial validation of a screening questionnaire for psoriatic arthritis: the Toronto Psoriatic Arthritis Screen (ToPAS). Ann Rheum Dis. 2009;68(4):497–501.
52. Husni ME, Meyer KH, Cohen DS, et al. The PASE questionnaire: pilot-testing a psoriatic arthritis screening and evaluation tool. J Am Acad Dermatol. 2007;57(4):581–587.
53. Dominguez PL, Haberman RH, Nadkarni GN, et al. Development and initial validation of a screening instrument to identify patients with psoriasis and psoriatic arthritis (EARP). J Am Acad Dermatol. 2008;58(6):997–1001.
54. Gottlieb AB, Merola JF. Axial psoriatic arthritis: an update for dermatologists. J Am Acad Dermatol. 2021;84(1):92–101.

55. Cohen MR, Reda DJ, Clegg DO. Baseline relationships between psoriasis and psoriatic arthritis: analysis of 221 patients with active psoriatic arthritis. J Rheumatol. 1999;26(8):1752–6.
56. Jones SM, Armas JB, Cohen MG, et al. Psoriatic arthritis: outcome of disease subsets and relationship of joint disease to nail and skin disease. Br J Rheumatol. 1994;33(9):834–839.
57. Veale D, Roger S, Fitzgerald O. Classification of clinical subsets in psoriatic arthritis. Br J Rheumatol. 1994;33(2):133–8.
58. van der Heijde D, Ramiro S, Landewé R, et al. 2016 update of the ASAS-EULAR management recommendations for axial spondyloarthritis. Ann Rheum Dis. 2017;76(6):978–991.
59. Callhoff J, Sieper J, Weiss A, Zink A, Listing J. Efficacy of TNFα blockers in patients with ankylosing spondylitis and non-radiographic axial spondyloarthritis: a meta-analysis. Ann Rheum Dis. 2015;74(6):1241–1248.
60. Mease PJ, Kivitz AJ, Burch FX, et al. Etanercept treatment of psoriatic arthritis: safety, efficacy, and effect on disease progression. Arthritis Rheum. 2004;50(8):2264–72.
61. McInnes IB, Behrens F, Mease PJ, et al. Secukinumab versus adalimumab for treatment of active psoriatic arthritis (EXCEED): a double-blind, parallel-group, randomised, active-controlled, phase 3b trial. Lancet. 2020;395(10235):1532–1542.
62. Mease PJ, Smolen JS, Behrens F, et al. A head-to-head comparison of the efficacy and safety of ixekizumab and adalimumab in biological-naive patients with active psoriatic arthritis (SPIRIT H2H). Ann Rheum Dis. 2020;79(1):123–131.
63. Deodhar A, Helliwell PS, Boehncke WH, et al. Guselkumab in patients with active psoriatic arthritis (DISCOVER-1): a double-blind, randomised, placebo-controlled phase 3 trial. Lancet. 2020;395(10230):1115–1125.
64. Mease PJ, Rahman P, Gottlieb AB, et al. Guselkumab in biologic-naive patients with active psoriatic arthritis (DISCOVER-2): a double-blind, randomised, placebo-controlled phase 3 trial. Lancet. 2020;395(10230):1126–1136.
65. McInnes IB, Anderson JK, Magrey M, et al. Trial of upadacitinib and adalimumab for psoriatic arthritis. N Engl J Med. 2021;384(13):1227–1239.
66. Monteiro MCS. Targeting TYK2 in the treatment of psoriasis and psoriatic arthritis [Master's thesis]. Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto; 2025. [Section on JAK inhibitor boxed warnings; supplementary source only.]
67. Krueger JG, McInnes IB, Blauvelt A. Tyrosine kinase 2 and Janus kinase–signal transducer and activator of transcription signaling and inhibition in plaque psoriasis. J Am Acad Dermatol. 2022;86(1):148–157.
68. Jensen LT, Attfield KE, Feldmann M, Fugger L. Allosteric TYK2 inhibition: redefining autoimmune disease therapy beyond JAK1–3 inhibitors. EBioMedicine. 2023;97:104840.
69. Wrobleski ST, Moslin R, Lin S, et al. Highly selective inhibition of tyrosine kinase 2 (TYK2) for the treatment of autoimmune diseases: discovery of the allosteric inhibitor BMS-986165. J Med Chem. 2019;62(20):8973–8995.
70. Armstrong AW, Gooderham M, Warren RB, et al. Deucravacitinib versus placebo and apremilast in moderate to severe plaque psoriasis: efficacy and safety results from the 52-week, randomized, double-blinded, placebo-controlled phase 3 POETYK PSO-1 trial. J Am Acad Dermatol. 2023;88(1):29–39.
71. Mease PJ, Deodhar AA, van der Heijde D, et al. Efficacy and safety of selective TYK2 inhibitor, deucravacitinib, in a phase II trial in psoriatic arthritis. Ann Rheum Dis. 2022;81(6):815–822.

72. Mease PJ, Deodhar A, van der Heijde D, et al. Safety and efficacy of deucravacitinib in patients with psoriatic arthritis: 52-week results from a randomised phase 2 trial. Ann Rheum Dis. 2022;81:842–843.
73. Leit S, Greenwood J, Carriero S, et al. Discovery of a potent and selective tyrosine kinase 2 inhibitor: TAK-279. J Med Chem. 2023;66(15):10473–10496.
74. Ucpinar S, Kwan JK, Hoffman JD, et al. Safety, tolerability, pharmacokinetics, and pharmacodynamics of the oral allosteric TYK2 inhibitor ESK-001: a randomized, double-blind, placebo-controlled study. PubMed. 2024. PMID:39604226.
75. Mease P, Helliwell P, Silwinska-Stanczyk P, et al. Efficacy and safety of the TYK2/JAK1 inhibitor brepocitinib for active psoriatic arthritis: a phase IIb randomized controlled trial. Arthritis Rheumatol. 2023;75(8):1370–1380.
76. Tehlirian C, Singh RSP, Pradhan V, et al. Oral tyrosine kinase 2 inhibitor PF-06826647 demonstrates efficacy and an acceptable safety profile in participants with moderate-to-severe plaque psoriasis in a phase 2b study. J Am Acad Dermatol. 2022;87(2):333–342.
77. Lebwohl MG, Stein Gold L, Strober B, et al. Phase 3 trials of tapinarof cream for plaque psoriasis. N Engl J Med. 2021;385(24):2219–2229.
78. Drakos A, Vender R, Torres T. Topical roflumilast for the treatment of psoriasis. Expert Rev Clin Immunol. 2023;19(9):1053–1062.
79. Köhler I. Innovative small-molecule therapies for psoriasis [doctoral dissertation]. Linköping University Medical Dissertation No. 1946. Linköping University, Sweden; 2025. [Supplementary source; preclinical findings only.]
80. Karsten S. Targeting the DNA repair enzymes MTH1 and OGG1 as a novel approach to treat inflammatory diseases. Basic Clin Pharmacol Toxicol. 2022;131(2):95–103.
81. Sirsjo A, Karlsson M, Gidlof A, et al. Increased expression of inducible nitric oxide synthase in psoriatic skin and cytokine-stimulated cultured keratinocytes. Br J Dermatol. 1996;134(4):643–8.
82. Cals-Grierson MM, Ormerod AD. Nitric oxide function in the skin. Nitric Oxide. 2004;10(4):179–93.
83. Elmets CA, Leonardi CL, Davis DMR, et al. Joint AAD-NPF guidelines of care for the management and treatment of psoriasis with awareness and attention to comorbidities. J Am Acad Dermatol. 2019;80(4):1073–1113.
84. Shin S. Psoriasis: pathogenesis, progression, and treatment [Master's thesis]. Boston University Chobanian & Avedisian School of Medicine; 2025. [Patient education discussion; supplementary source only.]