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Low-Dose Radiation Therapy for Refractory Hand Osteoarthritis: A Case Report

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Case Report

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Abstract

Background

Hand osteoarthritis (HOA) is a common degenerative joint disorder affecting a substantial proportion of older adults, particularly at the distal interphalangeal and first carpometacarpal joints. Current management is largely limited to symptomatic therapies, and no disease-modifying treatment is approved. Low-dose radiation therapy (LDRT) has re-emerged as a noninvasive option for osteoarthritis, with observational studies suggesting anti-inflammatory benefit, though randomized trial evidence remains mixed. We report a case of severe, refractory hand osteoarthritis in a patient with limited pharmacologic options who was treated with LDRT.

Case presentation:

A 70-year-old White female with a more than 15-year history of progressive hand osteoarthritis presented with severe, refractory pain and functional limitation of the distal interphalangeal, proximal interphalangeal, and first carpometacarpal joints bilaterally. Her disease course included erosive changes, joint deformity, and prior arthrotomy with debridement, with only transient benefit from corticosteroid injections and surgical intervention. Systemic nonsteroidal anti-inflammatory drugs were contraindicated due to a history of Helicobacter pylori infection complicated by recurrent bleeding gastric ulcers, and disease-modifying therapies were not pursued due to insurance barriers. Given her advanced age, contraindication to NSAIDs, and limited surgical options, she was treated with LDRT to the bilateral hands, delivering 3 Gy in 6 fractions over two weeks. Her pain improved from 6–7/10 to near resolution by treatment completion, with improved grip strength and restored sleep and no reported adverse effects. Partial recurrence of pain (4/10) was noted approximately two months later, prompting consideration of a repeat treatment course.

Conclusions

This case illustrates the clinical course of a patient with severe, treatment-refractory hand osteoarthritis and multiple contraindications to standard pharmacologic therapy who experienced meaningful, though partially durable, symptomatic improvement following low-dose radiation therapy. Given the uncertainty in existing randomized trial data, further study is needed to clarify which patient phenotypes are most likely to benefit from this approach.

Background

Hand osteoarthritis (HOA) is a common degenerative joint disorder that increases with age and contributes substantially to pain and disability in older adults. A large community-based study suggested that ~ 40% of adults have radiographic evidence of hand OA, whereas 8–16% have symptomatic hand

OA (radiographic changes plus pain/aching/stiffness), most frequently affecting the distal interphalangeal (DIP) joints and thumb base [1]. Radiographic hand OA is common in older adults, increases with age, and is more prevalent in women [2]. For specific joints, the prevalence of thumb carpometacarpal (CMC) osteoarthritis in those over 75 years has been reported as high as 40% in women [3]. These findings underscore the substantial burden of HOA, particularly in aging populations.

Current treatment options for HOA remain limited and are primarily directed toward symptom relief rather than disease modification. Clinical practice guidelines from the American College of Rheumatology and Arthritis Foundation recommend a multimodal approach to OA management, including self-management programs and exercise, hand orthoses for first CMC joint osteoarthritis, and pharmacologic therapy such as oral NSAIDs. Topical NSAIDs and intra-articular glucocorticoid injections are also recommended in selected settings with conditional recommendations for HOA [4]. Despite these recommendations, the overall efficacy of available therapies is modest, and no disease-modifying treatments have been approved for HOA. A recent randomized clinical trial evaluating methotrexate in patients with HOA with synovitis suggested a potential benefit, though the evidence continues to evolve [5].

Low-dose radiation therapy (LDRT) has re-emerged as a potential noninvasive option for osteoarthritis, building on historical use of radiotherapy for benign conditions dating back to the early 20th century [6]. Typical LDRT regimens consist of a total dose of 3.0–6.0 gray (Gy) delivered in low-dose fractions of 0.5–1.0 Gy, administered two to three times per week over a period of approximately 2–3 weeks, with a second treatment series considered in nonresponders [7]. For context, a standard two-view digital screening mammogram delivers an average dose of 3.7 mGy [8]. In contrast, radiotherapy for osteosarcoma is typically delivered at much higher total doses (often ~ 55–70 Gy; median 66 Gy reported), aiming for durable local tumor control rather than anti-inflammatory effect [9]. Thus, while LDRT delivers a higher dose than a screening mammogram, it is a substantially lower exposure designed for anti-inflammatory rather than cytotoxic effects. These regimens are derived from European clinical experience and observational data and are intended to provide anti-inflammatory effects with minimal toxicity [7]. Although the risk of secondary malignancy is an important consideration, LDRT involves substantially lower radiation exposure than oncologic regimens and is generally regarded as a conservative treatment option, particularly in elderly patients [10].

Given the substantial burden of HOA, the limitations of current treatment strategies, and the variability in reported outcomes with low-dose radiation therapy, additional clinical data are needed to clarify patient selection and therapeutic benefit. This report presents a case of severe HOA managed with low-dose radiation therapy, contributing to the ongoing discussion regarding its role in care.

Case Presentation

A 70-year-old White female with a more than 15-year history of progressive HOA presented with severe, refractory pain and functional limitation predominantly affecting the distal interphalangeal (DIP),

proximal interphalangeal (PIP), and first carpometacarpal (CMC) joints bilaterally, especially of the left hand. Her medical history includes papillary thyroid carcinoma status post thyroidectomy, and gastritis with H. pylori infection complicated by gastric ulcers. Family history was noncontributory, with no known family history of inflammatory or erosive arthropathy.

Her symptoms initially began in the late 2000s with right thumb CMC arthritis and DIP joint pain, for which she received multiple corticosteroid injections beginning in 2009, with diminishing and ultimately inadequate relief. Over subsequent years, she developed worsening bilateral DIP arthritis involving the second through fifth digit, associated with progressive pain, stiffness, and deformity. By 2012, she had received at least four corticosteroid injections to affected joints, with only transient benefit.

Rheumatologic evaluation in 2014 revealed clinical evidence of osteoarthritis with bony hypertrophy of the DIP joints. Serologic testing including antinuclear antibody (ANA), rheumatoid factor (RF), and cyclic citrullinated peptide (CCP) antibodies were unremarkable. Initial radiographs were reported as without significant abnormalities; however, subsequent imaging demonstrated progressive degenerative changes consistent with erosive osteoarthritis. Pharmacologic management with acetaminophen failed to provide adequate relief. Tramadol was discontinued due to nausea, and topical diclofenac provided partial, temporary improvement. Systemic nonsteroidal anti-inflammatory drugs were contraindicated due to a history of Helicobacter pylori infection complicated by five prior bleeding gastric ulcers.

Between 2015 and 2018, imaging of the hands demonstrated worsening degenerative and erosive changes of the DIP joints, including suspected erosive components and recurrent digital mucous cyst formation. She underwent arthrocentesis and later arthrotomy with debridement and cyst excision of the left middle finger DIP joint in January 2018, which initially resulted in symptomatic improvement. However, within weeks, she developed recurrent pain and inflammation without evidence of infection, and further progression of erosive osteoarthritis was noted on follow-up imaging. A bone biopsy performed during this period was negative for osteomyelitis. Despite aggressive topical therapy and intermittent corticosteroid use, she continued to experience persistent pain, erythema, and swelling of the affected joints.

Over the ensuing years, her disease progressed with increasing joint deformity, bony prominences, and functional impairment, including difficulty with grasping and fine motor tasks. Serial radiographs demonstrated severe erosive osteoarthritis involving the DIP and PIP joints bilaterally, partial joint ankylosis, and advanced bilateral first CMC osteoarthritis with subluxation and intra-articular bodies. Chondrocalcinosis of the lunotriquetral ligaments was also noted. Surgical options, including arthrodesis and arthroplasty, were considered but were felt to offer limited benefit given the extent of disease and patient preference.

Multiple medical therapies were considered or trialed over time, including colchicine and short courses of systemic corticosteroids, which provided temporary symptomatic relief. Disease-modifying therapies such as methotrexate and denosumab were discussed but not initiated due to insurance barriers or clinical improvement. In September 2025, following a corticosteroid taper that resulted in significant but

transient improvement, the patient inquired about low-dose radiation therapy (LDRT) as a treatment option, having learned of its use for osteoarthritis in Europe and emerging studies in the United States. Radiographs of the bilateral hands obtained in March 2025 demonstrated severe erosive osteoarthritis of the DIP, PIP, and first CMC joints, with chondrocalcinosis of the lunotriquetral ligaments bilaterally (Fig. 1).

Given her advanced age, severe refractory erosive osteoarthritis, contraindication to systemic NSAIDs due to a history of gastric ulcers, limited surgical options, and persistent pain impairing quality of life and sleep, LDRT to the bilateral hands was initiated, delivering a total of 3 Gy in 6 fractions over 2 weeks. Her pain, initially rated 6–7/10, improved to 4/10 by mid-treatment and was substantially reduced by treatment completion. She tolerated therapy well, and by December 2025 reported near-complete resolution of hand pain, improved grip strength, and restored ability to sleep through the night, representing a marked improvement in both function and quality of life. No treatment-related adverse effects were reported. By February 2026, she reported pain returning to a 4/10.

Patient Perspective: Her hand pain, previously described as “electrode-like” and disruptive to daily activities and sleep, was “almost gone” by the end of treatment. She described a meaningful improvement in her ability to grasp objects and perform fine motor tasks and noted that the treatment allowed her to sleep through the night for the first time in years. She expressed interest in pursuing a second course of LDRT given her initial response.

The patient's disease course and treatment timeline are summarized in Table 1.

Table 1
Timeline of disease course and treatment

Date	Event
Late 2000s	Onset of right thumb CMC arthritis and DIP joint pain
2009	Corticosteroid injections initiated for affected joints
2012	≥ 4 corticosteroid injections administered to date; only transient benefit
2014	Rheumatologic evaluation; ANA, RF, CCP negative; bony hypertrophy of DIP joints noted
2015–2018	Progressive erosive changes and recurrent digital mucous cyst formation on imaging
January 2018	Arthrocentesis and arthrotomy with debridement and cyst excision (left middle finger DIP); initial improvement, recurrence within weeks
2018	Bone biopsy negative for osteomyelitis
2018–2025	Continued disease progression with joint deformity, ankylosis, and subluxation; arthrodesis/arthroplasty considered but deferred; colchicine and short corticosteroid courses trialed; methotrexate and denosumab discussed but not initiated (insurance barriers)
September 2025	Patient inquires about LDRT following transient benefit from corticosteroid taper
September–October 2025	LDRT administered to bilateral hands: 3 Gy in 6 fractions over 2 weeks
Mid-treatment (2025)	Pain improves from 6–7/10 to 4/10
End of treatment (2025)	Pain substantially reduced
December 2025	Near-complete resolution of pain; improved grip strength; restored sleep
February 2026	Partial recurrence of pain (4/10); repeat LDRT course under consideration

Imaging

Description of the Left Hand: No acute fracture or dislocation is identified. There are severe multifocal osteoarthritis involving the PIP and DIP joints, most pronounced in the second through fifth digits, with erosive changes noted in the left fifth PIP joint and the second through fourth DIP joints. Severe osteoarthritis of the first CMC joint is present. Chondrocalcinosis of the lunotriquetral ligament is also observed.

Description of the Right Hand: Severe osteoarthritic changes are present in the second through fifth DIP joints. Mild erosive changes are noted in the third through fifth DIP joints and the right fourth PIP joint. The first CMC joint demonstrates severe osteoarthritis with intra-articular bodies and dorsal radial subluxation of the first metacarpal base. Chondrocalcinosis of the lunotriquetral ligament is also observed.

Discussion

Mechanistic studies suggest that low-dose radiation therapy may modulate osteoarthritis progression through anti-inflammatory and mitochondrial-mediated pathways. LDRT has been shown to reduce expression of pro-inflammatory mediators such as matrix metalloproteinase-13 (MMP13), increase cartilage-associated proteins including collagen type II, and induce signaling via growth differentiation factor-15 (GDF15). In animal models, these effects were associated with reduced osteoarthritis severity and decreased osteoclast activity, providing biologic plausibility for observed clinical benefits [11]. Preclinical studies further support a mechanistic role for low-dose radiation therapy in osteoarthritis, demonstrating reduced cartilage degeneration, attenuation of synovial inflammation, and improvement in pain-related behaviors. These effects appear to be mediated by M2 macrophage polarization and suppression of neuroinflammation via an abscopal effect, defined as inhibition or reduction of the tumor outside of the target area of irradiation [12, 19]. This suggests that LDRT may influence both local joint pathology and central pain signaling.

In a retrospective study of nearly 500 patients treated for degenerative disease of the fingers and thumb according to German LDRT guidelines, approximately 70% of patients experienced improvement in pain, with superior outcomes observed at a lower single-fraction dose of 0.5 Gy compared with 1.0 Gy [13]. Additionally, a recent American retrospective case series of 69 patients and 168 joints reported significant and sustained pain reduction in approximately 80% of treated joints following low-dose radiation therapy for osteoarthritis, although the nonrandomized design and short follow-up limit causal interpretation [14]. Further support for the analgesic potential of low-dose radiation therapy comes from a large retrospective multicenter study of elderly patients with osteoarthritis. In this cohort of 970 patients and 1,185 treated sites, low-dose radiotherapy was associated with significant reductions in pain scores after treatment and at follow-up, with approximately two-thirds of treated sites demonstrating clinical improvement. Treatment response was similar across all age groups, including patients aged 85 years and older [15].

In contrast, a double-blind, sham-controlled randomized trial in patients with hand osteoarthritis found no significant improvement in pain, function, or inflammatory outcomes with LDRT compared with sham treatment at three months [16]. These findings highlight the ongoing uncertainty regarding the effectiveness of LDRT for OA patients. Although these trials have not demonstrated consistent benefit in unselected OA populations, this case suggests that selected patients with severe, refractory disease and limited medical/surgical options may experience meaningful symptomatic improvement with LDRT.

Dose–response relationships in LDRT for osteoarthritis have also been evaluated. In a randomized, blinded dose-comparison trial of patients with hand and knee OA, radiotherapy delivered at a standard low dose (3.0 Gy) was compared with a very low-dose regimen (0.3 Gy). At 12 months of follow-up, both treatment arms demonstrated sustained pain relief, with no significant differences between groups in pain, functional outcomes, or quality-of-life measures. Although a dose–response relationship was not demonstrated, the finding of comparable outcomes at lower radiation doses suggests that symptomatic benefit may be achievable with reduced radiation exposure [17].

In a retrospective foot and ankle OA cohort, treatment response after LDRT varied by clinical features. Younger patients and unilateral disease showed more favorable outcomes, whereas tarsi transversa involvement and bilateral symptoms were associated with less improvement [18]. These foot and ankle OA findings raise the possibility that anatomic site and patient factors influence LDRT response, although it remains uncertain whether the same predictors apply to HOA.

This report is limited by its single-patient, uncontrolled design, which precludes any causal inference between LDRT and the observed symptomatic improvement. A sham-controlled randomized trial in hand osteoarthritis has failed to demonstrate benefit of LDRT over placebo [16], and a placebo or expectation effect cannot be excluded in this patient, who actively sought out LDRT after independently researching its use. Her improvement also followed closely on a corticosteroid taper that itself produced transient benefit, raising the possibility of a residual or overlapping treatment effect rather than a response attributable to LDRT alone. Given her more than 15-year disease course, which included multiple prior instances of transient improvement followed by relapse, some portion of the observed symptomatic change may reflect the natural fluctuation of her disease rather than a durable treatment effect. Outcome assessment relied on unblinded, patient-reported pain scores without a validated composite instrument, and no follow-up imaging was obtained to correlate her recurrent symptoms in February 2026 with structural change. Finally, follow-up was relatively short (approximately five months from treatment completion), limiting conclusions about the durability of response.

Conclusion

This case highlights LDRT as a noninvasive treatment option that primary care physicians and hospitalists should consider for patients with severe, refractory hand osteoarthritis, particularly those with contraindications to NSAID therapy, such as chronic kidney disease or a history of gastrointestinal disease, who often have few remaining pharmacologic options. In this patient, LDRT was associated with marked improvement in pain, function, and quality of life without observed adverse effects. While randomized controlled trials have reported mixed results, emerging mechanistic data and observational studies suggest that selected patients, particularly those erosive disease phenotypes, may derive meaningful symptomatic benefit. Given the high prevalence of NSAID-intolerant patients encountered in primary care and inpatient settings, LDRT represents a low-risk option worth incorporating into the differential of hand OA management, warranting earlier consideration and referral rather than being

reserved as a last resort. Further well-designed prospective studies are needed to better define patient selection criteria and long-term outcomes.

Abbreviations

HOA: Hand osteoarthritis; DIP: Distal interphalangeal; PIP: Proximal interphalangeal; CMC: Carpometacarpal; LDRT: Low-dose radiation therapy; Gy: Gray; NSAID: Nonsteroidal anti-inflammatory drug; ANA: Antinuclear antibody; RF: Rheumatoid factor; CCP: Cyclic citrullinated peptide; MMP13: Matrix metalloproteinase-13; GDF15: Growth differentiation factor-15.

Declarations

Ethics approval and consent to participate: Approval was given by the patient.

Consent for publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions MR did the literature review and chart review and was a major contributor to the writing; CP provided clinical insight and critically reviewed/edited the manuscript. All authors read and approved the final manuscript.

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Figures



Figure 1

X-ray of the Bilateral hands (March 12th, 2025)