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Cancer and foot health: special podologic approaches to oncology patients

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ABSTRACT

Cancer comprises a heterogeneous group of diseases associated with substantial global mortality and morbidity. Therapeutic modalities for these diseases frequently produce adverse effects-most notably skin and nail toxicities, hand-foot syndrome (HFS; palmar-plantar erythrodysesthesia), and peripheral neuropathy-that can markedly diminish patients' quality of life. Podiatric care is therefore critical for preventing and mitigating these sequelae. In this review, we systematically examine the foot-related complications of cancer therapy, describe their underlying pathophysiology, and delineate multidisciplinary podiatric interventions. We also highlight the benefits of close collaboration between podiatrists and oncology specialists in maintaining foot health during treatment. Finally, we summarise the specific effects of chemotherapy, radiotherapy, and immunotherapy on the feet and provide evidence-based recommendations for their management.

Keywords: Cancer, foot deformities, nail toxicities, podological care

INTRODUCTION

Cancer is a complex, multifactorial group of diseases associated with high global mortality and morbidity rates.[1] Despite substantial advances in diagnostic and therapeutic techniques, preserving patients' quality of life and minimising treatment-related adverse effects remain core objectives of contemporary oncology care.[2-4] Achieving these goals is challenging because anticancer therapies can compromise not only physical health but also psychosocial well-being.

Foot-related complications occupy a prominent place among treatment sequelae. Chemotherapy, in particular, may cause skin and nail toxicities-onycholysis, onychomadesis, melanonychia, leukonychia, paronychia, nail thickening, brittle nails, and fungal infections-together with oedema, xerosis, hand–foot syndrome (HFS), and peripheral neuropathy, all of which markedly diminish quality of life.[3-5] Nevertheless, awareness of foot health remains limited and this domain is frequently neglected, jeopardising treatment success and patient comfort.[5,6]

Podiatry is a multidisciplinary discipline devoted to preserving and enhancing foot health by addressing cutaneous, nail, anatomical, and functional concerns.[7] Chemotherapy, radiotherapy, and immunotherapy are known to induce immunological, circulatory, neuropathic, and metabolic alterations that adversely affect the feet.[8] Resultant problems-including nail toxicities, HFS, oedema, xerosis, hyperkeratosis, and neuropathy-can directly impair quality of life and, in severe cases, necessitate dose modification or discontinuation of cancer therapy.[5]

Effective management of these adverse effects is therefore critical for sustaining both quality of life and adherence to oncological treatment. A holistic strategy-engaging patients, podiatrists, and oncology teams-is required for prevention, early detection, and treatment of foot-related conditions. Through tailored preventive and therapeutic interventions, podiatry not only alleviates symptoms but also supports the overall success of cancer treatment.

Accordingly, this review systematically evaluates the significance of foot health during cancer therapy, delineates common foot-related complications in oncology patients, and summarises evidence-based podiatric approaches for their prevention and management.

THE EFFECTS OF THERAPIES ON FOOT HEALTH: PATHOPHYSIOLOGY AND CLINICAL APPROACHES

Cutaneous Effects

Cancer chemotherapy, particularly with the introduction of newer agents, has been associated with an expanding spectrum of cutaneous adverse effects. The most frequent reactions include alopecia, mucositis, hand-foot syndrome (HFS), dermatitis, xerosis, nail abnormalities, and paronychia. From a podiatric perspective, xerosis, nail pathology, and paronychia are especially significant. Nail disorders may manifest as structural deformation, brittleness, or discolouration, whereas paronychia is characterised by periungual inflammation, pain,

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and swelling, all of which can markedly diminish patients' quality of life. These complications limit daily activities and may necessitate treatment interruption because of secondary infection. Consequently, early identification and management of chemotherapy-induced cutaneous toxicity are essential to preserve quality of life and reduce morbidity.[9,10-12]

Podiatric Approach

Podiatric management of chemotherapy-induced cutaneous toxicities requires comprehensive care that preserves skin and nail integrity, prevents complications, and maintains quality of life. Preventive measures for conditions such as nail disorders and paronychia include regular nail care, strict hygiene, and consistent use of barrier-enhancing topical agents. Appropriate footwear and orthotic supports reduce mechanical pressure, whereas antiseptic treatment or prompt referral for medical intervention is warranted when infection is suspected, as in paronychia. Barrier-repair emollients should be prescribed to minimise xerosis and desquamation. Working as part of a multidisciplinary oncology team, podiatrists can enhance patient comfort and support treatment adherence through early recognition and targeted management of cutaneous symptoms. These strategies are essential for mitigating chemotherapy-related adverse effects.[10-12]

Nail Toxicities

Chemotherapy-induced nail toxicities result from direct injury to the nail matrix, nail bed and periungual tissues. Common manifestations include Beau's lines, onychomadesis, melanonychia, onycholysis, paronychia, periungual pyogenic granulomas and secondary fungal infections.[13,14] These conditions compromise both appearance and function, restrict daily activities and predispose patients to serious sequelae such as bacterial or fungal infection. Prompt recognition and treatment, supported by targeted podiatric interventions, are essential to limit morbidity, preserve quality of life and prevent interruptions in chemotherapy.[9,13,14]

Beau's Lines and Onychomadesis

Beau's lines are transverse grooves that form when the nail matrix is damaged by toxic agents and are frequently observed in drug-induced nail abnormalities, where they can compromise fine motor function. By contrast, onychomadesis is a more severe manifestation, characterised by complete separation of the nail plate from the matrix, and is a recognised indicator of chemotherapy-related toxicity.[13,14]

Melanonychia and Pigmentation Changes

Melanonychia is a pigmentation change produced by melanin deposition in the nail bed and is most often associated with cytotoxic agents or epidermal growth factor receptor (EGFR) inhibitors. Nail pigmentation should therefore be monitored regularly, particularly for features that might indicate malignant melanoma, which can present in a similar manner.[13,14] Although longitudinal melanonychia is usually drug-induced, it can, albeit rarely, be an early sign of malignant melanoma-especially when the band is asymmetrical, dark, or progressively changing.[15,18]

Onycholysis and Severe Reactions

Onycholysis is characterised by separation of the nail plate from the nail bed and is frequently associated with chemotherapeutic agents, including EGFR inhibitors, taxanes and 5-fluorouracil.[6,18]

Paronychia and Periungual Abscesses

Paronychia is characterised by periungual inflammation, pain and swelling, and is frequently linked to treatment with EGFR inhibitors. Periungual abscesses, which result from infection of the surrounding tissues, are most often observed during the second month of therapy.[13,18]

Periungual Pyogenic Granulomas

Periungual pyogenic granulomas present as painful granulation tissue around the nail and have been linked to certain chemotherapeutic agents.[14]

Disruptions in Skin Barrier and Hyperkeratotic Areas

Skin rashes, xerosis, hyperpigmentation and hyperkeratosis are skin-barrier disturbances reported with agents such as cyclophosphamide, chlorambucil and related drugs.[12]

Ingrown Toenail

Ingrown toenails, resulting from altered nail growth, are frequently observed in patients receiving chemotherapy.[19]

Nail Fungus (Onychomycosis)

Onychomycosis, which often develops in the context of immunosuppression, typically presents with nail thickening, discolouration and structural deformity.[20]

Podiatric Approach

Effective management of chemotherapy-induced nail and skin alterations begins with early patient education and structured preventive strategies. Patients should receive detailed information before treatment about potential adverse effects and the measures required to mitigate them. Key preventive elements include the early use of emollients and the avoidance of mechanical trauma such as friction, pressure, irritants and adhesives. Careful footwear selection and strict foot-hygiene protocols further reduce infection risk, enhance quality of life and help maintain treatment continuity.[6]

Preventive and supportive measures must be integrated with the targeted management of specific nail and skin conditions. For Beau's lines or onychomadesis, regular nail trimming and nail-strengthening preparations are advisable. Pigmentation changes such as melanonychia require close surveillance for early signs of malignancy. In onycholysis, cleansing the affected area with antiseptics and offloading pressure with soft insoles are essential. Severe or refractory reactions warrant prompt referral to a dermatologist or oncology specialist.[13,14]

Paronychia and periungual abscesses require prompt, effective intervention to minimise the risk of secondary infection. Topical antiseptics should be applied to curtail microbial proliferation, and excessive moisture must be avoided to preserve periungual tissue integrity. Initial management of

periungual pyogenic granulomas includes meticulous hygiene and the application of protective dressings; more advanced lesions may necessitate surgical excision or cryotherapy in collaboration with dermatology specialists.[13-17]

Management of skin-barrier disruption and hyperkeratotic lesions should include barrier-restoring, hydrating formulations to promote epidermal regeneration. Pressure-relieving soft insoles can further reduce friction and alleviate symptoms. Ingrown toenails are best addressed with regular, appropriate trimming and, when necessary, podiatric corrective techniques. Onychomycosis requires topical or systemic antifungal therapy supplemented by mechanical debridement of the affected nail. Finally, maintaining nail hygiene and avoiding persistently moist environments are essential to limit pathogen proliferation and prevent reinfection.[18,20]

All of these strategies should be implemented within a multidisciplinary care model that fosters effective collaboration among podiatrists, dermatologists and oncology specialists. Early diagnosis, regular follow-up and timely application of evidence-based treatment protocols are essential for mitigating chemotherapy-induced nail and skin toxicities and for improving patients' quality of life. A holistic, team-based approach not only addresses current symptoms but also minimises the risk of future complications.

Hand-Foot Syndrome

HFS is a common skin reaction associated with chemotherapy, typically starting with numbness, tingling, and burning sensations on the palms and soles. These symptoms can progress to include edema, cracking, desquamation, or sharply demarcated erythema and may lead to blistering and ulceration in advanced stages. HFS is particularly linked to drugs such as PLD (pegylated liposomal doxorubicin), docetaxel, 5-FU (5-fluorouracil), capecitabine, and S-1 (a combination oral fluoropyrimidine chemotherapy composed of tegafur, gimeracil, and oteracil), with the risk heightened by continuous infusion or medications maintaining high serum levels. Although not life-threatening, HFS is painful and significantly impairs quality of life by restricting daily activities.[20] HFS is commonly classified into grades 1 to 3 based on clinical severity. Grade 1 is characterized by minimal skin changes such as mild erythema, edema, or hyperkeratosis; symptoms are typically painless and can be managed with moisturizers and protective measures to avoid irritation. Grade 2 involves blistering, desquamation, and painful hyperkeratosis that may limit instrumental activities of daily living; treatment includes topical corticosteroids, emollients, and, when necessary, chemotherapy dose adjustments. Grade 3 is marked by ulceration, severe pain, and significant restriction in self-care activities, often requiring treatment interruption, wound care, and infection prevention strategies. This grading system provides a valuable framework for guiding therapeutic decision-making.[21]

HFS is a frequent cutaneous reaction to chemotherapy that usually begins with numbness, tingling and burning of the palms and soles. These initial sensations may progress to oedema, fissuring, desquamation or sharply demarcated erythema and, in advanced stages, to blistering or ulceration. The condition is particularly associated with pegylated liposomal doxorubicin (PLD), docetaxel, 5-fluorouracil (5-FU), capecitabine and S-1 (a combination oral fluoropyrimidine that contains tegafur, gimeracil and oteracil). Continuous infusions or agents that sustain high serum drug levels further increase risk. Although not life-threatening, HFS is painful and significantly restricts daily activities, thereby impairing quality of life.[20]

Clinically, HFS is graded from 1 to 3 according to severity. Grade 1 involves minimal skin changes-mild erythema, oedema or hyperkeratosis-that are usually painless and managed with emollients and simple protective measures. Grade 2 is characterised by blistering, desquamation or painful hyperkeratosis that limits instrumental activities of daily living; treatment comprises topical corticosteroids, emollients and, when necessary, chemotherapy dose modification. Grade 3 presents with ulceration, severe pain and pronounced limitation of self-care activities, often necessitating treatment interruption, comprehensive wound care and stringent infection-control measures. This grading system provides a practical framework for therapeutic decision-making.[21]

Podiatric Approach

A comprehensive podiatric strategy is essential for mitigating HFS-related morbidity and improving patients' quality of life. Key measures include rigorous hand and foot hygiene, preservation of the skin barrier and routine use of hydrating products to minimize irritation. Proper footwear, soft insoles and toe protectors help to off-load pressure on vulnerable areas. In advanced cases characterized by desquamation, blistering or ulceration, scheduled follow-up is required for wound care and infection control. Patient education is equally important, fostering early recognition of cutaneous changes and timely preventive action. Collectively, podiatric interventions lessen HFS-related pain, support daily functioning and reinforce adherence to anticancer therapy.[7]

Early assessment of foot health can prevent minor issues from progressing into more severe complications. Regular maintenance of appropriate footwear and strict hygiene practices lower the risk of infection, thereby enhancing both quality of life and adherence to treatment. Supportive measures-particularly the use of urea-based emollients-help to mitigate cutaneous toxicities, reduce the incidence of hand-foot skin reaction (HFSR) and delay symptom onset. This strategy alleviates discomfort while effectively addressing scaling, erythema and fissuring.[6,21]

Beyond standard skincare and pressure-relief measures, recent studies emphasize the prophylactic value of localized cold applications-particularly cryotherapy-administered during chemotherapy infusion. By lowering drug perfusion to the distal extremities, cryotherapy significantly reduces both the incidence and severity of hand–foot syndrome, especially in patients treated with capecitabine or liposomal doxorubicin. Integrating this technique into podiatric preventive protocols

can enhance patient comfort and promote adherence to anticancer therapy.[20,22,23]

Peripheral Neuropathy

Peripheral neuropathy is a serious complication that causes sensory loss, impaired neuromuscular control of the lower extremities and balance disturbances, thereby increasing the risk of falls. Chemotherapy-induced peripheral neuropathy (CIPN) develops in response to agents such as taxanes, platinum compounds and proteasome inhibitors. It typically presents as numbness, tingling and neuropathic pain in the hands and feet. Symptoms persist long after the completion of chemotherapy in roughly 30% of patients and, in those treated with oxaliplatin, may endure for several years. CIPN therefore not only diminishes quality of life but can also necessitate dose modification or even discontinuation of anticancer therapy.[24,25]

Podiatric Approach

CIPN management benefits from a podiatric approach delivered within a multidisciplinary team to reduce symptoms, preserve mobility and enhance quality of life. Regular foot examinations are essential for early detection of neuropathic changes and for maintaining skin integrity. Footwear should be optimized to minimize pressure points, and cushioning insoles can provide further support. Barrier-restoring emollients are recommended for daily skin care, and strict hygiene protocols must be upheld.

Foot-protection measures are essential to prevent injury in the context of sensory loss, and any trauma or infection should trigger prompt intervention. Patients with balance impairment may benefit from assistive devices and targeted exercise programmers. Although novel treatments for neuropathic pain are under investigation, patient education remains crucial to foster active engagement in self-care.

When symptoms are severe, referral to the appropriate specialist should be made within the multidisciplinary team. Together, these measures help limit the quality-of-life reduction associated with CIPN, promote adherence to anticancer therapy and support overall well-being.[24,26]

Radiotherapy and immunotherapy can also produce cutaneous adverse effects that compromise foot health.[27] Radiotherapy may induce erythema, dryness, desquamation, fibrosis or oedema within the irradiated field, and these reactions can involve the lower extremities when treatment sites are located distally. Resultant skin changes weaken the dermal barrier and increase susceptibility to infection and ulceration. Immune-checkpoint inhibitors have been linked to inflammatory dermatoses, including rash and lichenoid eruptions, which may likewise affect the feet. Although less prevalent than chemotherapy-related toxicities, these reactions can cause discomfort, restrict mobility and diminish quality of life.[27,28]

Podiatric management should include regular skin assessment, liberal use of emollients, and protective dressings when indicated. Severe or persistent lesions warrant early referral to dermatology or wound-care specialists.[28]

THE ROLE OF PODIATRY IN ONCOLOGY PATIENTS

Podiatric Approaches in Maintaining Foot Health

Podiatry is essential to preventing and managing the skin and nail complications that arise during cancer therapy. By prioritizing early diagnosis and preventive care, podiatric interventions reduce adverse events and promote adherence to oncological treatment. Pre-chemotherapy education should therefore teach patients how to maintain skin integrity through regular moisturization and how to select footwear that minimizes friction and pressure.[6,17]

Podiatric Assessment and Intervention in Cancer Treatments

Podiatry forms an essential part of multidisciplinary care for patients receiving chemotherapy. Podiatrists should follow the assessment and intervention sequence detailed in **Table**. Nail toxicities such as Beau's lines, onycholysis, melanonychia and paronychia heighten infection risk and limit daily activities, thereby reducing quality of life. Effective management includes regular nail care, antiseptic treatment and referral to specialist services when necessary. Where structural deformities affect the nail matrix or surrounding tissues, protective devices are recommended and additional precautions taken to prevent infection.[6,14]

Podiatric care focuses on the early detection and management of HFS by prescribing pressure-reducing insoles and specialized footwear to maintain mobility and by applying barrier-enhancing products and wound-care protocols to halt the progression of cracking, blistering and desquamation.[17]

For CIPN, podiatrists perform regular foot examinations to identify neuropathic changes promptly and prevent sensory-related injuries. They improve balance by optimizing footwear and cushioning insoles, recommend emollients and strict hygiene to preserve skin integrity and incorporate targeted exercise programmers and assistive devices for patients with postural instability.[24]

Enhancing Patient Comfort Through Multidisciplinary Management

Podiatrists collaborate with dermatologists, oncologists and other healthcare professionals to deliver a multidisciplinary strategy for managing chemotherapy-induced adverse effects. This coordinated care pathway facilitates timely referral of patients with severe manifestations to the appropriate specialist. Regular follow-up and prompt intervention help to avoid treatment interruptions, thereby safeguarding overall health and sustaining quality of life.[6,7]

Beyond symptom relief, podiatric interventions are designed to prevent long-term complications. By improving physical comfort, they enhance adherence to therapy and contribute meaningfully to the overall success of cancer treatment. Consequently, podiatry plays a critical role in improving quality of life and reducing treatment-related challenges in oncology patients.[4-6]

Table. Podological assessment and intervention in cancer treatments

Cancer treatment phase	Common foot-related issues	Assessment focus & tools	Recommended interventions	Potential benefits/rationale
Pre-treatment (diagnostic/baseline evaluation)	- Pre-existing foot pathologies (e.g., calluses, corns, fungal infections) - Structural deformities (e.g., hammertoes, bunions) - Diabetic foot risk (if comorbidity exists)	- Thorough clinical examination (inspection, palpation) - Biomechanical assessment (gait analysis, foot structure) - Neurovascular assessment (monofilament, Doppler if needed)	- Treat pre-existing conditions (callus debridement, antifungal therapy) - Patient education on foot hygiene, footwear choices - Referral for custom orthotics if needed	- Reduces risk of complications during treatment (e.g., infection) - Ensures a baseline for monitoring changes - Improves patient comfort and mobility
During chemotherapy	- Chemotherapy-induced peripheral neuropathy: numbness, tingling, neuropathic pain - Nail changes (onycholysis, discoloration) - Increased risk of infection (immunosuppression)	- Sensory testing (tuning fork, monofilament) to track neuropathy progression – Regular nail inspection for discoloration, lifting - Skin integrity checks (fissures, ulcerations)	- Protective offloading or cushioning insoles to reduce pressure in neuropathic areas - Gentle nail care to prevent ingrown nails; sterile technique to avoid infection - Emollients to reduce skin dryness and cracking - Patient education on temperature checks (avoid burns/cold injury)	- Decreases pain and functional impairment - Early detection and management of potential infections - Maintains foot health despite immune compromise
During radiotherapy	- Radiation dermatitis on feet (if the treatment field includes lower extremities) - Skin dryness, desquamation, erythema - Risk of ulcerations on weight-bearing areas	- Detailed skin assessment (visual scoring scales like RTOG*) - Palpation for tenderness, edema, or fluid retention - Footwear assessment (ensure minimal friction)	- Use of non-adherent dressings and topical agents (hydrogels, silicones) for radiation dermatitis - Pressure offloading with cushioned footwear or insoles - Regular foot inspections to detect early skin breakdown	- Minimizes pain and risk of secondary infections - Promotes healing of irritated or damaged skin - Improves patient adherence to radiotherapy by reducing discomfort
During immunotherapy	Inflammatory skin reactions (rash, lichenoid eruptions), erythema, dryness involving the feet	Regular visual inspection for rash, desquamation, and irritation; assessment for discomfort and walking difficulty	Emollients for dryness, non-irritating skin cleansers, dermatology referral if widespread or persistent; cushioning insoles if mobility is affected	Reduces symptom burden, enhances mobility, supports treatment adherence through improved comfort
Post-surgery/post-transplant	- Edema or lymphedema in lower extremities - Surgical wound healing issues around incisions (especially if reconstructive surgery on/near foot) - Limited mobility / activity intolerance	- Edema/lymphedema measurement (tape measure, volumetric assessment) - Wound inspection (signs of infection, dehiscence) - Mobility assessment (gait stability, use of assistive devices)	- Compression therapy or garments for lymphedema - Gentle range-of-motion exercises, rehabilitation plan - Pressure-relieving insoles or specialized footwear for wound sites - Collaboration with physical therapy for gait retraining	- Facilitates faster recovery post-surgery - Reduces complications such as infection or prolonged edema - Enhances overall functional outcomes (improved walking ability, independence)
Palliative/end-of-life care	- Painful neuropathy, chronic wounds, or ulcers - Nail and skin pathologies often neglected - Reduced ability to self-care (mobility constraints)	- Pain assessment scales (e.g., VAS, numeric rating) specific to foot discomfort - Inspection for pressure ulcers, fungal infections - Family/caregiver involvement in foot care evaluation	- Comfort-focused foot care (nail trimming, callus reduction, gentle massage) - Appropriate offloading devices to prevent pressure ulcers - Coordination with hospice or home-care nurses for ongoing foot monitoring - Patient/caregiver education on daily foot checks	- Alleviates foot pain and discomfort, improving quality of life - Prevents secondary infections and complications in fragile patients - Provides dignity and comfort in palliative settings

Notes and References:
***RTOG (Radiation Therapy Oncology Group) scoring system is commonly used for grading radiation dermatitis severity.**
Common sources in scientific literature include:
- **Supportive Care in Cancer (Springer)**
- **Journal of the American Podiatric Medical Association**
- **Cancer Nursing (Lippincott Williams & Wilkins)**
- **European Journal of Oncology Nursing**

This table offers a broad overview; actual clinical practices may vary based on institutional protocols, patient comorbidities, and specific oncology team recommendations.

CONCLUSION

Cancer therapy can markedly diminish quality of life through skin and nail toxicities, hand-foot syndrome and peripheral neuropathy. These adverse effects cause physical discomfort and disrupt psychosocial well-being, sometimes even necessitating treatment interruption. In this context, podiatry is critical for preserving and restoring foot health in oncology patients. Podiatric care must be delivered within a multidisciplinary framework to facilitate early symptom detection and complication prevention. Core measures include patient education, regular foot examinations and evidence-based interventions tailored to the individual. Individualized care plans for nail toxicities and hand-foot syndrome, together with strict infection control, judicious footwear selection and pressure-relieving strategies, are indispensable for safeguarding skin and nail integrity. Embedding podiatrists in oncology teams promotes a holistic model of care. Such collaboration not only controls side effects but also improves treatment adherence and optimizes therapeutic

outcomes. Early podiatric intervention is particularly valuable for chemotherapy-induced peripheral neuropathy, helping to preserve mobility and reduce fall risk. Overall, the management of foot and nail complications underscores the pivotal role of podiatry in oncology. Prioritizing foot health can substantially enhance patient outcomes and quality of life. Raising awareness, deepening the integration of podiatrists into cancer-care teams, expanding clinical practice and fostering research are essential steps toward more comprehensive and effective supportive care.

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The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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