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Radiation Therapy of a Case of Ledderhose's Disease: A Rare Benign Nodule of the Plantar Aponeurosis

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Abstract:- Ledderhose's disease, or plantar fibromatosis, is a rare benign condition characterized by the excessive proliferation of connective tissue in the plantar aponeurosis, leading to slow-growing nodules. Although it usually presents unilaterally, bilateral involvement occurs in about 25% of cases. The exact cause is unknown, but associations with diabetes mellitus, liver disease, and repeated trauma have been noted. Treatment options are diverse, with surgery often being the primary approach, but radiation therapy has emerged as a promising alternative.

We present the case of a 70-year-old Moroccan man with a painful plantar nodule, diagnosed with Ledderhose's disease. Initial measures were insufficient, leading to the use of radiation therapy. The patient received Three-Dimensional Conformal Radiotherapy (3D-CRT) at a dose of 30.0 Gy, administered in two courses. Following treatment, the patient experienced significant symptom relief and a notable reduction in nodule size. Although surgery was eventually required due to disease progression, it is noteworthy that radiation therapy effectively delayed the need for surgical intervention.

I. INTRODUCTION

Plantar fibromatosis, also known as Ledderhose's disease or Morbus Ledderhose, is a rare benign condition of unknown etiology, first described by George Ledderhose in 1894 [1]. In this disease, excessive proliferation of connective tissue leads to the formation of thick collagen fibers, resulting in slow-growing, irregular masses or nodules primarily located in the central band of the plantar aponeurosis [2,3]. While Ledderhose's disease typically presents unilaterally, approximately 25% of cases involve bilateral disease [4].

The exact cause of Ledderhose's disease remains unclear, but it is frequently associated with conditions such as diabetes mellitus, liver disease, alcoholism, use of anticonvulsants, and repeated trauma to the soles of the feet [4].

Due to its unknown etiology and low incidence, there is no standardized treatment strategy for Ledderhose's disease. Surgical intervention is often the primary treatment, with various operative techniques including local or wide excision, subtotal or radical fasciectomy, with or without skin grafting [5,6,7]. Conservative treatment options include the use of orthotic devices, physical therapy, local steroid injections, and weight reduction [8].

Recently, radiation therapy has been shown to alleviate symptoms and slow the progression of Ledderhose's disease [9,10,11].

In this report, we discuss the case of a 79-year-old patient with a plantar nodule resulting from Ledderhose's disease, who was treated with radiation therapy at our facility. The case is presented to explore the details of the treatment approach and to evaluate its effectiveness.

II. CASE REPORT

A 70-year-old Moroccan man, retired from an office job, presented with a 10-year history of a palpable nodule in the medial plantar region of his left sole. The nodule was painful and interfered with prolonged standing, leading to a suspicion of Ledderhose's disease.

The patient reported no comorbidities, family history related to this condition, medication use, or alcohol consumption.

Upon initial examination, his feet appeared flat with no visible deformities. The patient did not exhibit a noticeable limp. Palpation of the left sole revealed a firm, painful nodule within the plantar fascia, partially adherent to the skin. The neurovascular status of the foot was normal.

Foot radiographs showed no calcifications or other notable changes. However, magnetic resonance imaging (MRI) of the foot revealed a nodule in the middle fascicle of the superficial plantar aponeurosis, measuring 11x10 mm (Figure 1).

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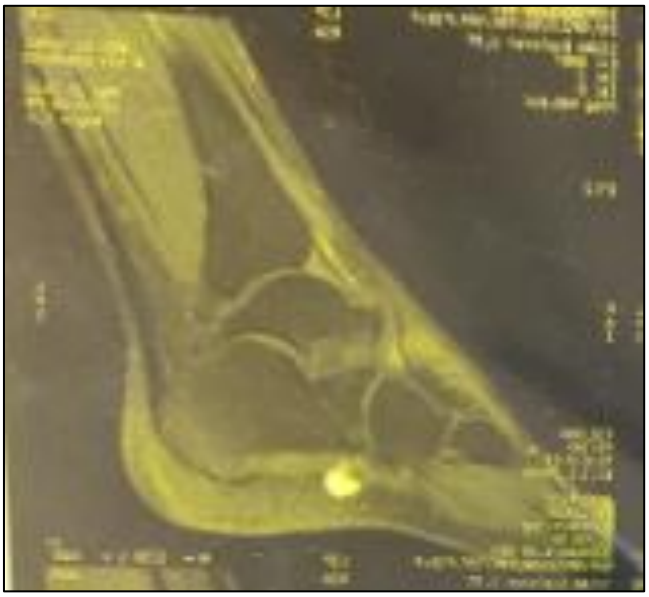

Fig 1. Sagittal MRI Showing the Nodule in the Middle Fascicle of the Superficial Plantar Aponeurosis.

A diagnosis of Ledderhose's disease was made, and the patient initially received conservative treatment, including a nonsteroidal anti-inflammatory drug, custom-made silicone insoles, and weight reduction. However, due to persistent symptoms, radiation therapy was proposed.

The patient was informed of the scientific interest in his case, consented to the proposed treatment, and agreed to the publication of this report.

During the simulation CT scan, the patient was positioned supine with the knee flexed and the soles of the feet on the table. The left foot was immobilized using a deformable mask, which was utilized throughout all treatment sessions (Figure 2).

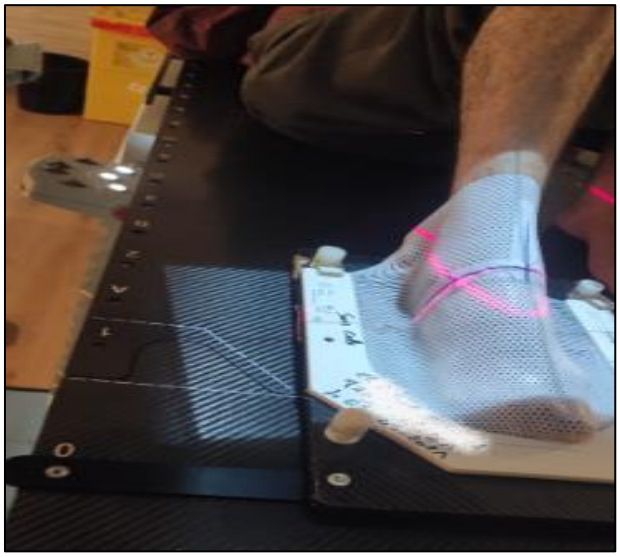

Fig 2. Method of Immobilization for the Foot

The target volume was delineated with the assistance of MRI images, encompassing the nodule with an additional 1 cm safety margin (Figure 3).

Three-Dimensional Conformal Radiotherapy (3D-CRT) technique was selected, employing 6 MV X-ray photons from a linear accelerator. The dose fractionation involved two courses of radiation therapy, each consisting of 5 sessions of 3.0 Gy delivered on consecutive days, separated by a 8-week interval, for a total dose of 30.0 Gy.

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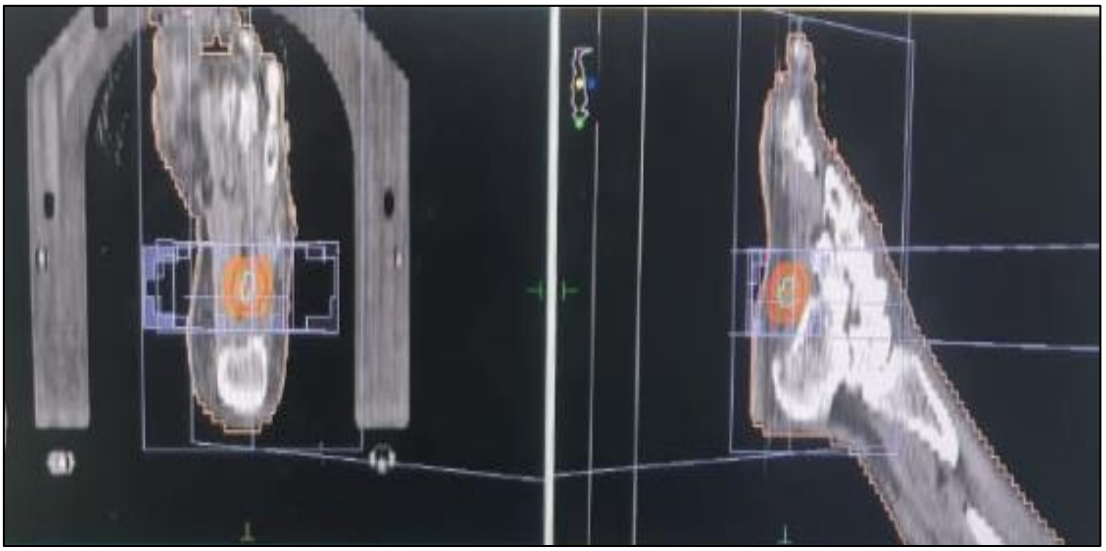

Fig 3. Delineation and Dosimetry Used

The patient tolerated the planned dose well, with no acute radiation toxicity reported aside from radiodermatitis, classified as RTOG grade 1 [12].

Three months post-treatment, the patient experienced side effects such as skin dryness and reduced sensation. However, he reported a reduction in plantar pain and improved walking comfort. Six months later, MRI of the left foot showed a 20% reduction in the size of the plantar nodule.

At the two-year follow-up, the patient experienced a recurrence with an increase in nodule size, resulting in difficulty walking, which necessitated a subtotal plantar fasciectomy. The surgery resulted in good postoperative outcomes.

Histological examination of the excised tissue revealed fibroblastic proliferation with uniform, elongated nuclei. No mitotic figures were observed, and the margins were free of atypical spindle cells. Cytogenetic analysis was normal.

The patient expressed satisfaction with the radiotherapy, noting that it provided symptom relief and allowed for the postponement of surgical intervention.

III. DISCUSSION

Ledderhose's Disease refers to a rare and benign hyperplasia of the connective tissue in the plantar fascia, characterized by a slowly progressing nodular thickening, most commonly occurring in the central band of the plantar aponeurosis. This fibromatotic process gradually invades both the skin and deeper structures over time [2,3]. While Ledderhose's Disease typically presents unilaterally, it can also manifest in both plantar fascias [4].

This condition shares similarities with Dupuytren’s Disease, where the palmar aponeurosis is affected, leading to an association between Ledderhose's Disease and Dupuytren’s Disease in approximately 14.85% of cases [13]. However, this was not observed in the patient discussed in this report.

Males are twice as likely to develop Ledderhose's Disease compared to females, and although it can affect individuals of any age, it is more commonly seen in middle-aged and elderly men [5,14], similar to the case described here.

The presentation of symptoms varies; some patients may be asymptomatic, while others experience discomfort. When symptoms are present, they typically include pain and difficulty wearing shoes. The pain may range from moderate to severe and tends to worsen over time, especially when standing, due to the pressure exerted by the fibrous nodules on the foot's structures [2,15].

Diagnosis is primarily clinical, but imaging studies such as ultrasound and magnetic resonance imaging (MRI) are often utilized to confirm the condition [16].

Treatment strategies must be carefully considered, with conservative management often being the initial approach to mitigate symptom progression. Conservative options include intralesional injections of cortisone or collagenase [17], stretching exercises, orthotic devices, anti-inflammatory medications, physical therapy, shockwave therapy [18], and radiation therapy [10,11,19-21].

Radiation therapy has been recognized as a safe and effective option for managing various benign locomotor system diseases [22-25]. Several studies have explored the value of radiation therapy in the early stages of Ledderhose's Disease [10,11,19-21].

For instance, one study retrospectively reviewed the outcomes of 25 patients (36 feet) who received two courses of radiation therapy at a dose of 5×3.0 Gy, totaling 30.0 Gy. With a median follow-up of 38 months (range: 12–67 months), all patients experienced disease stabilization. Gait normalization was observed in 50% of patients, while 44%

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saw a reduction in the number of nodules, and 77% reported pain regression, similar to the patient in this case [21].

Another study by Gärtner et al. (2010) found that low-dose radiation therapy significantly reduced tumor size and symptom severity in patients with Ledderhose's Disease [26]. Similarly, research by Doyon et al. (2014) demonstrated substantial clinical improvement with radiation therapy, which was also associated with a lower recurrence rate compared to untreated patients [27].

In the present case, radiation therapy effectively alleviated symptoms and delayed the need for surgical intervention. These results are consistent with previous findings, which suggest that radiation therapy offers significant symptom relief and long-term disease control.

However, surgical treatment remains a key option for managing Ledderhose's Disease, particularly for well-defined and accessible nodules. Surgical procedures such as fasciectomy or partial fasciectomy have shown favorable outcomes in terms of symptom relief and disease resolution [28]. A study by Kwan et al. (2015) reported high rates of symptom resolution and functional improvement following surgical excision of Ledderhose's nodules [29].

The decision between radiation therapy and surgery should be tailored to the patient's specific disease characteristics, overall health, and treatment preferences. While radiation therapy offers a less invasive alternative for patients who are not suitable candidates for surgery or who prefer a non-surgical approach, surgery remains the gold standard for complete removal of fibromatotic nodules. In some cases, combining radiation therapy with surgical intervention may also be beneficial [30].

IV. CONCLUSION

In conclusion, RTH represents a valuable treatment modality for Ledderhose's Disease, offering a non-invasive option with promising results in terms of symptom management and disease control. Nevertheless, surgical treatment continues to play a critical role, especially in cases where complete excision is feasible. Future research should focus on optimizing treatment protocols, exploring combination therapies, and identifying patient subgroups that would benefit most from either approach.

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