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Dysplastic Foot with Soft-Tissue Hypertrophy: Radiographic Features Suggestive of Proteus Syndrome

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Abstract

Introduction: Proteus syndrome is a rare, sporadic, and highly variable disorder characterized by asymmetric and disproportionate overgrowth of multiple tissues, including bone, skin, and adipose tissue. The condition results from somatic mosaic activating mutations in the AKT1 gene and may pose challenges due to its overlap in presentation with other congenital overgrowth syndromes.

Case presentation: This case report is of a 22-year-old female with a congenital, progressively enlarging deformity of the right foot and ankle. Radiographic evaluation revealed severe dysplastic changes involving metatarsals, phalanges, and tarsal bones with massive soft tissue hypertrophy but without aggressive or neoplastic features, suggesting the diagnosis of a localized overgrowth disorder consistent with Proteus syndrome.

Discussion: Asymmetrical patchy skeletal overgrowth with soft tissue hypertrophy in the absence of vascular malformations should raise the suspicion of Proteus syndrome during imaging. Among the overgrowth disorders, Proteus syndrome needs to be differentiated from Klippel-Trénaunay syndrome, neurofibromatosis type 1, and tuberous sclerosis complex. While radiographic findings are highly suggestive, they are not diagnostic, and genetic confirmation of the AKT1 mutation remains the gold standard.

Conclusion: Radiography is essential to identifying the specific features of the congenital overgrowth disorders and guiding a differential diagnosis. Recognition of characteristic imaging patterns can lead to early suspicion of Proteus syndrome and appropriate referral for genetic testing and multidisciplinary management of patients.

Introduction

Proteus syndrome is a sporadic, mosaic overgrowth disorder characterized by the asymmetric and disproportionate growth of multiple tissues, including bone, connective tissue, and skin. First described in 1979 by Cohen and Hayden, the condition was later named after the Greek sea god Proteus by Wiedemann et al., reflecting the highly variable features of the disorder. Its cause is a somatic activating mutation in the AKT1 gene, driving uncontrolled cellular growth and differentiation in the affected tissues.

Clinically, Proteus syndrome presents with asymmetric enlargement of the limbs, abnormal bone growth, nevi of the subcutaneous or connective tissue, and, sometimes, visceral overgrowth. Given its rarity and partial overlap with the phenotypic manifestations of other overgrowth disorders, like Klippel–Trenaunay syndrome, neurofibromatosis type 1, and tuberous sclerosis complex, diagnosis is not usually easy, particularly in situations where genetic testing is limited.

Radiologic evaluation remains crucial in the initial work-up, as the pattern of skeletal and soft tissue involvement may strongly suggest a congenital overgrowth disorder and provide direction for further workup. This report describes the radiographic features of a congenital dysplastic foot with soft tissue hypertrophy in an adult female, emphasizing key imaging clues suggestive of Proteus syndrome and underscoring the importance of differentiating it from similar conditions.

Case report

A 22-year-old female patient came to the emergency department with superficial lacerations on the right foot following a minor fall. On physical examination, gross enlargement of the right foot and ankle with multiple cutaneous nodules and disorganized toes was seen. The deformity had been present since birth and had gradually increased in size, but resulted in no major functional limitation or systemic symptom.

Radiographic examination of the right foot (Figures 1–3) revealed a markedly dysplastic osseous structure. The metatarsals and phalanges were wide, shortened, and misaligned. Oblique and anteroposterior radiographs revealed tarsal margins and loss of typical articulation patterns. The lateral projection demonstrated that the talus and calcaneus, while deformed, were recognizable and thus present in grossly abnormal form.

No calcifications or ossifications, cortical destruction, or periosteal reaction indicative of a neoplasm were seen. These findings corresponded to a diagnosis of a congenital dysplastic foot presenting with massive soft-tissue hypertrophy, most in keeping with a localized overgrowth disorder such as Proteus syndrome [2, 3].

Proteus syndrome is a rare mosaic segmental overgrowth disorder resulting from postzygotic activating mutations of the AKT1 gene, which causes asymmetric and disproportionate hypertrophy of bone, fat, and skin [4]. This is a rare phenomenon, and

such malformation can simulate neoplasms or post-traumatic deformities. Dysplastic radiographic talus and calcaneus support its congenital origin [5]. The radiologic features are only suggestive, with confirmation requiring correlation with clinical findings and molecular diagnosis for the AKT1 mutation.

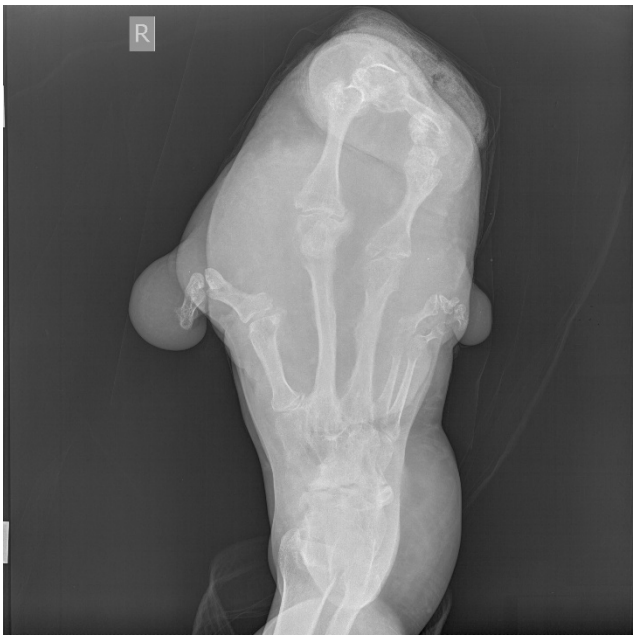

Figure 1. AP view of the right foot showing broad, shortened phalanges, loss of normal alignment, and massive soft-tissue swelling.

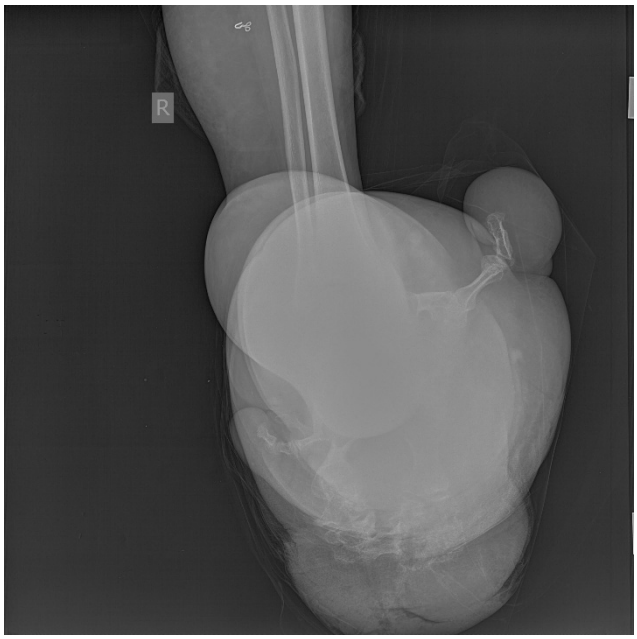

Figure 2. Oblique radiograph showing indistinct tarsal bones and deformity of the metatarsal structure.

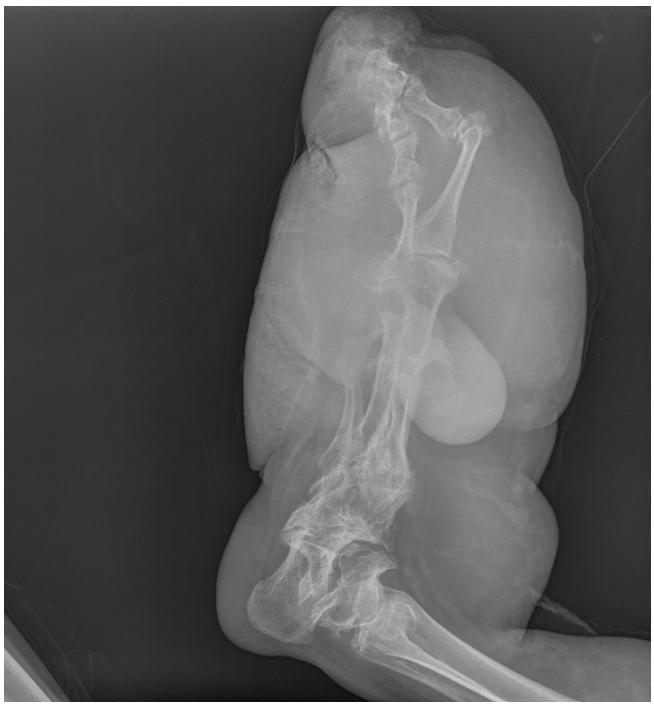

Figure 3.
Lateral view showing a dysplastic but discernible talus and calcaneus with hypertrophy of the anterior and plantar soft tissue.

Differential diagnosis

Many conditions will have overlapping radiographic features:

• Klippel–Trénaunay syndrome: limb hypertrophy with capillary–venous malformations and varicosities; vascular lesions are evident on Doppler or MRI, unlike in Proteus syndrome.

• Neurofibromatosis type 1: plexiform neurofibromas, cortical thinning, and café-au-lait macules; hypertrophy is neural/fibrous rather than primarily osseous

• Tuberous sclerosis complex: bone changes with cystic or sclerotic features may occur occasionally; cortical tubers and subependymal nodules on brain imaging

Proteus syndrome generally shows asymmetrical, patchy skeletal overgrowth and cerebriform connective-tissue nevi in the absence of vascular malformations typical of KTS, thereby aiding radiologic differentiation.

Given the benign radiographic appearance and the absence of any aggressive or systemic feature, conservative wound care was provided. The patient was informed that the disorder is a congenital, non-malignant condition and was also referred for orthopaedic follow-up.

Conclusion

Congenital dysplastic foot with soft-tissue hypertrophy is an extremely rare anomaly. Radiography plays an important role in the recognition of congenital overgrowth patterns and in distinguishing these from vascular or neoplastic causes. Asymmetrical skeletal dysplasia combined with soft-tissue overgrowth should raise suspicion for Proteus syndrome; however, confirmation requires genetic testing for the AKT1 mutation. Early radiologic recognition allows for appropriate referral and management.

Declarations

Ethical considerations

This work was developed respecting all bioethical principles, anonymity of the patient, and prior obtaining informed consent.

Conflicts of interest

The authors declare no conflict of interest for the development of this article.

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