

## Case Report

# Waardenburg syndrome associated with unicameral bone cyst of the proximal humerus: a rare case

Samarth L.\*, Seenappa T. S., Sheethal K. S.

Department of Orthopaedics, ESIC Model Hospital, Peenya, Bangaluru, Karnataka, India

**Received:** 27 May 2026

**Revised:** 13 July 2026

**Accepted:** 09 September 2026

### \*Correspondence:

Dr. Samarth L.,

E-mail: [drsam151095@gmail.com](mailto:drsam151095@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

Waardenburg syndrome (WS) is a rare hereditary neurocristopathy characterized by congenital sensorineural hearing loss and pigmentary abnormalities involving the skin, hair, and eyes. Orthopaedic manifestations are uncommon and association with benign bone lesions is exceedingly rare. Unicameral bone cyst (UBC) is a benign intramedullary cystic lesion commonly involving the proximal humerus in skeletally immature individuals. A 34-year-old female presented with pain in the right shoulder and wrist. Clinical examination revealed heterochromia iridis, dystopia canthorum, and congenital sensorineural hearing loss suggestive of Waardenburg syndrome. Radiographs, MRI, and CT imaging demonstrated a well-defined intramedullary cystic lesion involving the proximal humerus suggestive of unicameral bone cyst. The patient underwent curettage and bone grafting. Histopathological examination confirmed unicameral bone cyst. Postoperative recovery was uneventful with satisfactory radiological incorporation of graft and good functional outcome at six-month follow-up. Association of Waardenburg syndrome with unicameral bone cyst is extremely rare. Reporting such uncommon musculoskeletal associations contributes to better understanding of syndromic skeletal manifestations and their management.

**Keywords:** Waardenburg syndrome, Unicameral bone cyst, Proximal humerus, Heterochromia iridis, Curettage, bone grafting

## INTRODUCTION

Waardenburg syndrome (WS) is a rare congenital auditory-pigmentary syndrome first described by Waardenburg in 1951.<sup>1</sup> It is characterized by varying degrees of sensorineural hearing loss associated with pigmentary abnormalities involving the iris, skin, and hair. The estimated incidence is approximately 1 in 40,000 live births and it accounts for nearly 2–5% of all cases of congenital deafness.<sup>2</sup>

The syndrome is genetically heterogeneous and is associated with mutations involving PAX3, MITF, SOX10, EDNRB, and EDN3 genes.<sup>2,3</sup> The disorder results from defective migration and differentiation of

neural crest cells during embryogenesis. Depending upon clinical features and genetic mutations, Waardenburg syndrome has been classified into four major subtypes.<sup>2</sup>

Characteristic clinical manifestations include heterochromia iridis, dystopia canthorum, broad nasal bridge, synophrys, white forelock, and congenital sensorineural hearing loss.<sup>2,4</sup> Musculoskeletal manifestations are uncommon but may include upper limb anomalies, flexion contractures, muscle hypoplasia, and vertebral abnormalities, particularly in Waardenburg syndrome type III.<sup>5</sup>

Unicameral bone cyst (UBC), also known as simple bone cyst, is a benign fluid-filled intramedullary lesion most

commonly involving the proximal humerus and proximal femur.<sup>6</sup> The lesion is usually seen in children and adolescents; however, adult presentations have also been reported.<sup>6,7</sup> Although the exact etiology remains uncertain, theories include venous obstruction, trauma, and growth plate abnormalities.<sup>6</sup>

The coexistence of Waardenburg syndrome with unicameral bone cyst is extremely rare and, to the best of our knowledge, very sparsely reported in literature. This case reports a rare case of proximal humeral unicameral bone cyst in a patient with Waardenburg syndrome managed successfully with curettage and bone grafting.

## CASE REPORT

A 34-year-old female presented to the orthopaedic outpatient department with complaints of pain over the right shoulder and wrist for one month duration. The pain was insidious in onset, dull aching in nature, aggravated by shoulder movements, and relieved partially with rest and analgesics. There was no history of trauma, fever, constitutional symptoms, or previous pathological fractures.



**Figure 1: Clinical photograph demonstrating heterochromia iridis.**

On clinical examination, tenderness was present over the proximal humerus with mild restriction of terminal shoulder movements due to pain. Examination of the elbow was suggestive of lateral epicondylitis. Neurovascular examination of the right upper limb was normal.

General physical examination revealed characteristic features suggestive of Waardenburg syndrome including bilateral heterochromia iridis, dystopia canthorum, broad nasal bridge, and congenital sensorineural hearing loss. There was no evidence of cutaneous depigmentation or white forelock.

Plain radiographs of the right shoulder revealed a well-defined lytic lesion involving the proximal metaphyseal region of the humerus without cortical breach or periosteal reaction (Figure 3).



**Figure 2: Clinical photograph showing facial features suggestive of Waardenburg syndrome.**

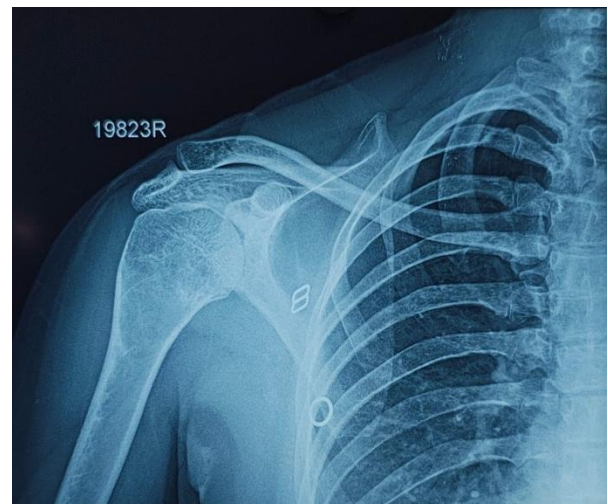


**Figure 3: Preoperative radiograph showing proximal humeral lytic lesion suggestive of unicameral bone cyst.**

MRI demonstrated a well-defined intramedullary cystic lesion measuring approximately 20×22×32 mm within the proximal humeral metaphysis. The lesion appeared hyperintense on T2-weighted images and showed high signal intensity on T1-weighted images suggestive of proteinaceous or hemorrhagic contents. No soft tissue extension, cortical destruction, or marrow edema was noted (Figures 4–7).

CT scan demonstrated a well-circumscribed intramedullary cystic lesion with intact cortex and no evidence of aggressive features (Figure 5). Differential

diagnoses considered included unicameral bone cyst and aneurysmal bone cyst.

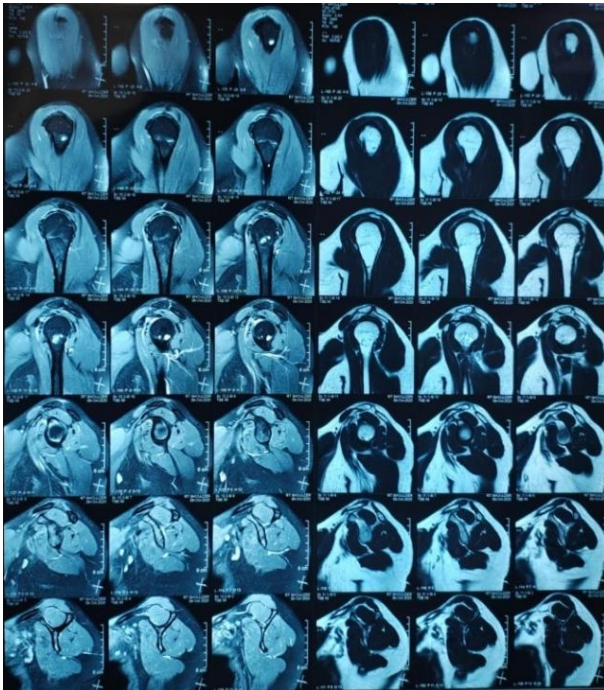


**Figure 4: MRI demonstrating intramedullary cystic lesion involving proximal humerus.**

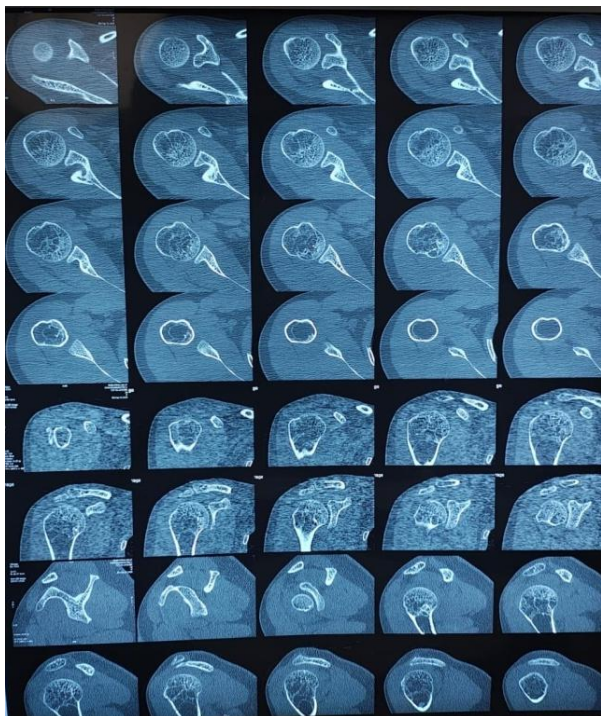


**Figure 5: CT scan showing well-defined proximal humeral cystic lesion.**

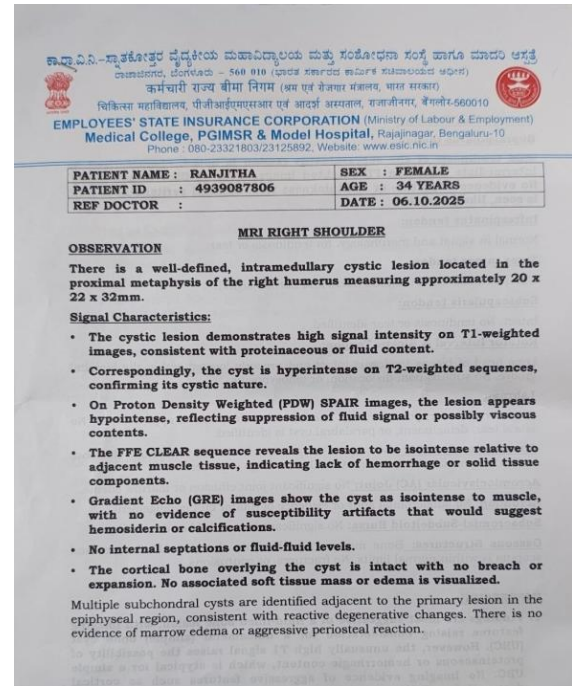


**Figure 6: MRI report describing proximal humeral cystic lesion.**

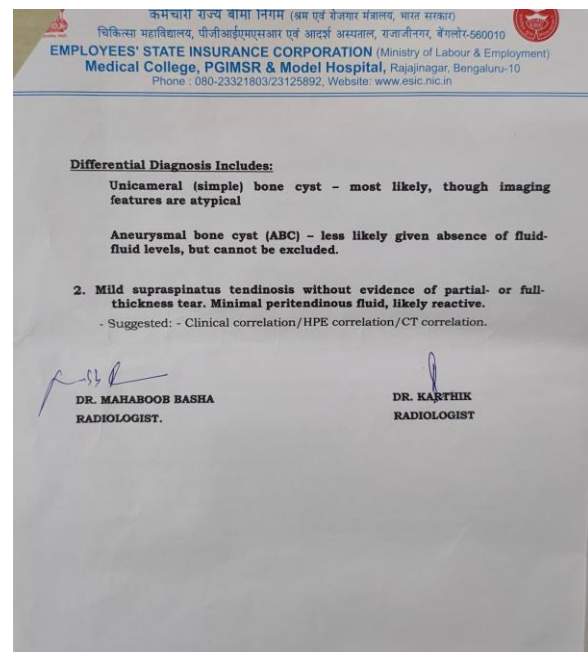


**Figure 7: MRI differential diagnosis suggestive of unicameral bone cyst.**

### **Surgical management**

Considering the symptomatic nature of the lesion and the risk of pathological fracture, surgical intervention was planned. Under general anaesthesia, curettage of the lesion was performed through a proximal humeral approach. The cyst cavity was thoroughly curetted and filled with bone graft.

The excised tissue was sent for histopathological examination. Histopathology demonstrated fibrovascular tissue lining with cystic spaces and absence of malignant cells, confirming the diagnosis of unicameral bone cyst.



**Figure 8: Immediate postoperative radiograph following curettage and bone grafting.**

Immediate postoperative radiographs demonstrated satisfactory filling of the cystic cavity with graft material (Figure 8). Postoperative recovery was uneventful and the patient was started on gradual shoulder mobilization exercises.

#### ***Follow-up and functional outcome***

The patient was followed up at 6, 12 and 24 weeks. At the six-month follow-up, the patient was pain-free with satisfactory shoulder function. Clinical examination demonstrated good range of motion of the right shoulder without instability or neurovascular deficit.

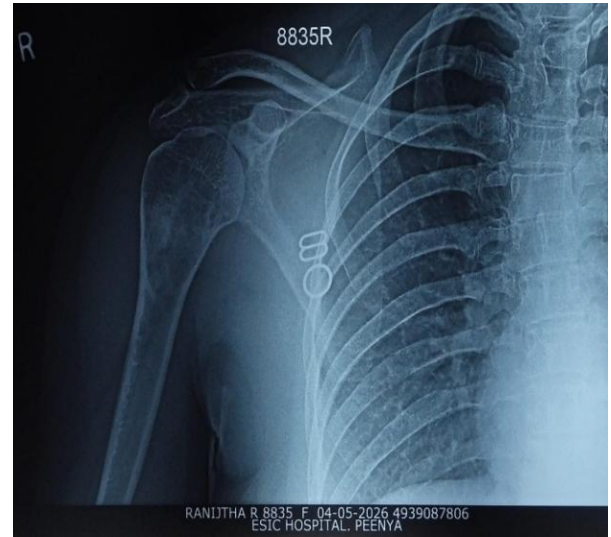


**Figure 9: Six-month follow-up radiograph showing satisfactory graft incorporation.**



**Figure 10: (a-d) Functional shoulder movements at six month follow up.**

Follow-up radiographs demonstrated satisfactory graft incorporation with no evidence of recurrence, pathological fracture, or progression of the lesion (Figure

9). Functional clinical photographs at follow-up demonstrated satisfactory shoulder movements and functional recovery (Figure 10).

## DISCUSSION

Waardenburg syndrome represents a spectrum of neural crest developmental disorders with variable phenotypic manifestations.<sup>2</sup> Defective migration of melanocytes derived from neural crest cells accounts for the characteristic pigmentary abnormalities and auditory manifestations.<sup>3</sup>

Orthopaedic manifestations in Waardenburg syndrome are uncommon and predominantly described in type III disease.<sup>5</sup> Previously reported skeletal abnormalities include muscle hypoplasia, limb contractures, syndactyly, scoliosis, and vertebral anomalies.<sup>5</sup> Association with benign cystic bone lesions is exceedingly uncommon.

Unicameral bone cyst is a benign fluid-filled lesion commonly affecting the metaphysis of long bones. UBC is a solitary intramedullary cyst lined by thin fibrous membrane and filled with serous fluid.<sup>6</sup> Although commonly encountered in children, adult presentation warrants thorough evaluation to exclude aggressive lesions.

Radiologically, UBC appears as a centrally located metaphyseal lytic lesion with cortical thinning and absence of periosteal reaction. MRI and CT are useful in assessing cyst characteristics, cortical integrity, and exclusion of soft tissue extension.<sup>6-8</sup>

Management depends upon lesion size, symptoms, risk of fracture, and patient age. Available treatment modalities include observation, steroid injection, decompression, curettage, and bone grafting.<sup>6</sup> Curettage with grafting remains a reliable treatment option in symptomatic lesions and lesions at risk of pathological fracture.

The coexistence of Waardenburg syndrome and unicameral bone cyst in the present case may represent a coincidental association. Nevertheless, documentation of such rare presentations is important as it contributes to the understanding of possible syndromic skeletal manifestations and may stimulate future research regarding neural crest disorders and bone pathology.

## CONCLUSION

Waardenburg syndrome associated with unicameral bone cyst of the proximal humerus is an extremely rare clinical presentation. Careful clinical evaluation combined with appropriate imaging is essential for diagnosis and management. Surgical curettage with bone grafting provided satisfactory clinical and radiological outcome in the present case. Reporting such rare associations contributes to the existing orthopaedic literature and improves understanding of possible skeletal manifestations in syndromic disorders.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Waardenburg PJ. A new syndrome combining developmental anomalies of the eyelids, eyebrows and nose root with pigmentary defects of the iris and head hair and with congenital deafness. *Am J Hum Genet.* 1951;3(3):195-253.
2. Read AP, Newton VE. Waardenburg syndrome. *J Med Genet.* 1997;34(8):656-65.
3. Pingault V, Ente D, Dastot-Le Moal F, Goossens M, Marlin S, Bondurand N. Review and update of mutations causing Waardenburg syndrome. *Hum Mutat.* 2010;31:391-406.
4. Tagra S, Talwar AK, Walia RLS, Sidhu P. Waardenburg syndrome. *Indian J Dermatol Venereol Leprol.* 2006;72(4):326-8.
5. Dourmishev AL, Dourmishev LA, Schwartz RA, Janniger CK. Waardenburg syndrome. *Int J Dermatol.* 1999;38(9):656-65.
6. Canale ST, Beaty JH. *Campbell's Operative Orthopaedics.* 14th ed. Philadelphia: Elsevier; 2021.
7. Rockwood CA, Wilkins KE, Beaty JH, Kasser JR. *Rockwood and Wilkins' Fractures in Children.* 9th ed. Philadelphia: Wolters Kluwer; 2020.
8. Noordin S, Allana S, Umer M, Jamil M, Hilal K, Uddin N. Unicameral bone cysts: current concepts. *Ann Med Surg (Lond).* 2018;34:43-9.

**Cite this article as:** Samarth L, Seenappa TS, Sheethal KS. Waardenburg syndrome associated with unicameral bone cyst of the proximal humerus: a rare case. *Int J Res Orthop* 2026;12:2044-8.