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Bone Scan With SPECT/CT Demonstrated C1 to C2 Involvement in Rheumatic Arthritis

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Abstract: An 80-year-old man was treated with rituximab for active rheumatoid arthritis until 2019, now controlled with Salazopyrin, prednisolone, methotrexate, and folic acid. However, laboratory data showed elevated C-reactive protein and erythrocyte sedimentation rate. Whole-body bone scan showed bony and joint destruction to the upper cervical vertebra (C spine), bilateral shoulders, wrists, finger joints, ankles, and left knee. SPECT/CT localized the upper C spine uptake to the C1/C2 joint and adjacent C1 and C2 with C1/C2 subluxation. C spine CT showed vertical atlantoaxial subluxation and bony erosions.

Key Words: bone scan, bony erosion, C1/C2 subluxation, rheumatoid arthritis, SPECT/CT

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REFERENCES

1. Gillick JL, Wainwright J, Das K. Rheumatoid arthritis and the cervical spine: a review on the role of surgery. *Int J Rheumatol*. 2015;2015:252456.
2. Manczak M, Gasik R. Cervical spine instability in the course of rheumatoid arthritis—imaging methods. *Reumatologia*. 2017;55:201–207.
3. Grassi W, De Angelis R, Lamanna G, et al. The clinical features of rheumatoid arthritis. *Eur J Radiol*. 1998;27(Suppl 1):S18–S24.
4. Ziff M. General mechanisms of inflammation in rheumatoid arthritis. *Bull Schweiz Akad Med Wiss*. 1979;35:275–281.
5. Zhang T, Pope J. Cervical spine involvement in rheumatoid arthritis over time: results from a meta-analysis. *Arthritis Res Ther*. 2015;17:148.
6. Nguyen HV, Ludwig SC, Silber J, et al. Rheumatoid arthritis of the cervical spine. *Spine J*. 2004;4:329–334.
7. Wasserman BR, Moskovich R, Razi AE. Rheumatoid arthritis of the cervical spine—clinical considerations. *Bull NYU Hosp Jt Dis*. 2011;69:136–148.
8. Joaquim AF, Appenzeller S. Cervical spine involvement in rheumatoid arthritis—a systematic review. *Autoimmun Rev*. 2014;13:1195–1202.
9. Krauss WE, Bledsoe JM, Clarke MJ, et al. Rheumatoid arthritis of the craniovertebral junction. *Neurosurgery*. 2010;66:83–95.
10. Meikle JA, Wilkinson M. Rheumatoid involvement of the cervical spine. Radiological assessment. *Ann Rheum Dis*. 1971;30:154–161.
11. Lipson SJ. Rheumatoid arthritis in the cervical spine. *Clin Orthop Relat Res*. 1989;121–127.
12. Joaquim AF, Ghizoni E, Tedeschi H, et al. Radiological evaluation of cervical spine involvement in rheumatoid arthritis. *Neurosurg Focus*. 2015;38:E4.
13. Zikou AK, Alamanos Y, Argyropoulou MI, et al. Radiological cervical spine involvement in patients with rheumatoid arthritis: a cross sectional study. *J Rheumatol*. 2005;32:801–806.
14. Zoli A, Priolo F, Galossi A, et al. Craniocervical junction involvement in rheumatoid arthritis: a clinical and radiological study. *J Rheumatol*. 2000;27:1178–1182.
15. Papanthassiou D, Bruna-Muraille C, Jouannaud C, et al. Single-photon emission computed tomography combined with computed tomography (SPECT/CT) in bone diseases. *Joint Bone Spine*. 2009;76:474–480.
16. Choi YY, Kim JY. Nuclear medicine imaging in rheumatic diseases. *J Rheum Dis*. 2017;24:4–13.
17. Steinbrocker O, Traeger CH, Batterman RC. Therapeutic criteria in rheumatoid arthritis. *JAMA*. 1994;271:659–662.

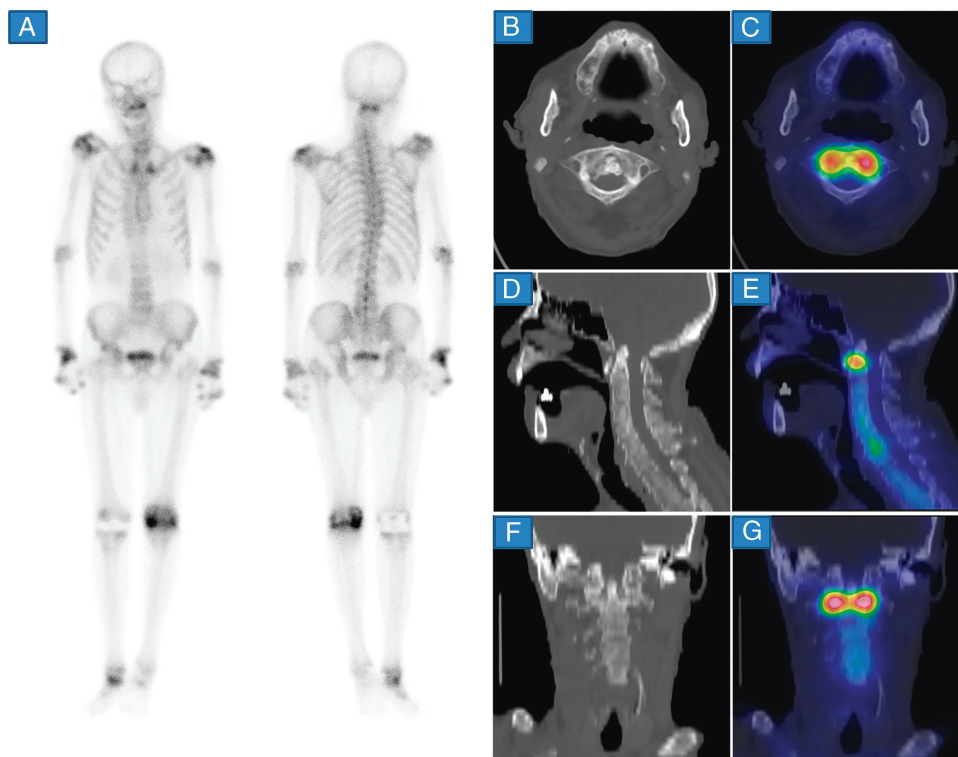


FIGURE 1. An 80-year-old man took rituximab until 2019 for active rheumatoid arthritis (RA), now controlled with Salazopyrin, prednisolone, methotrexate, and folic acid. However, laboratory data showed C-reactive protein level of 8.16 mg/dL, erythrocyte sedimentation rate of 52 mm/h, rheumatoid factor immunoglobulin M level of >200 U/mL, anti-cyclic-citrullinated peptide level of >340 U/mL, and cryoglobulin positive. Whole-body bone scan (A) showed bony and joint destructions to the upper cervical vertebra (C spine), bilateral shoulders, wrists, finger joints, ankles, and left knee. SPECT/CT (B and C, transaxial; D and E, sagittal; F and G, coronal; B, D, F, CT; C, E, G, fused SPECT/CT) localized upper C spine uptake to the C1/C2 joint and adjacent C1 and C2 with C1/C2 subluxation.

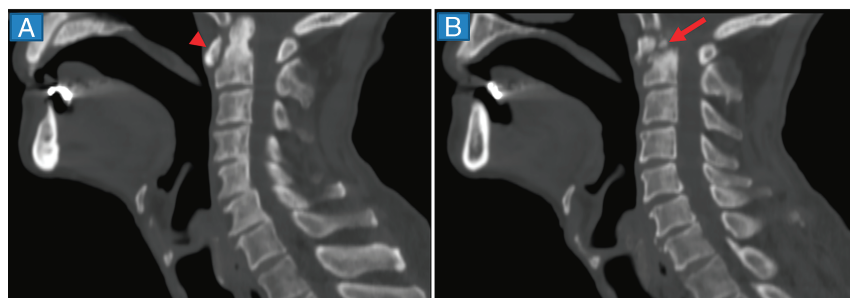


FIGURE 2. CT for C spines showed vertical atlantoaxial subluxation (A, arrowhead) and bony erosions (B, arrow). Note the anterior arch of C1 at Clark station II and the dens projects through the inferior margin of the foramen magnum.^{1,2} RA is an arthropathy with chronic diarthrodial joint inflammation.³ A complex series of inflammatory neovascularization including increased capillary permeability, perfusion of plasma proteins into the synovial stroma, and infiltration of cellular elements, as a result of polyarthritis and synovial thickening with progressive joint damage, bone erosion, cartilage destruction, and deformity.^{3,4} Although inflammatory arthritis of the small joints of the hands and feet is a common clinical manifestation, C spine involvement reportedly ranges 43% to 86%,⁵⁻⁷ probably the intense synovitis involved in the joints, progressing to bone erosion and ligament laxity, and toward deterioration.^{8,9} The most characteristic lesions are subluxations,^{10,11} including anterior, vertical, and subaxial subluxations.⁵ The atlas-axis (C1 and C2) articulation is a prime disease target.⁵ Cervical spine involvement can manifest as pain in the neck and head. In more advanced cases, it may initiate neurological defects, muscle weakness, and even death.² Precise diagnostics (including imaging) make patients receive proper qualification for surgery and early diagnosis possible.^{1,2} Routine plain radiographs are recommended for screening cervical instabilities in patients with RA.^{12,13} A CT scan is the diagnostic choice for bony evaluation by providing more details regarding visualization of erosions, anatomy, and the presence of ankylosis and pseudarthrosis, whereas MRI is the most sensitive modality for detecting C spine involvement in RA.^{9,12,14} Advantages of bone scan for evaluating multiple joint problems include its high sensitivity, good accessibility, low cost, and the possibility of whole-body imaging.¹⁵ Therefore, a bone scan is more sensitive in reflecting disease activity than clinical and radiographic evaluations.¹⁶ For focal abnormal uptake lesions detected on a planar bone scan, SPECT/CT may improve the diagnostic accuracy and contribute to the understanding of disease status in rheumatic diseases.¹⁶ Vertical subluxation is also known as cranial settling, basilar impression, atlantoaxial impaction, and superior migration of the odontoid.¹² In the sagittal plane, the Clark station criterion divides the odontoid process into 3 equal parts, “stations,” and determines the level at which the anterior arch of C1 falls.^{1,2} Station II, defined as the anterior arch of C1, falls at the middle third of the odontoid.^{1,2,17} This is the first case in the literature presenting C1 to C2 involvement in RA shown by bone scan with SPECT/CT.