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RESEARCH ARTICLE
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A CLINICO RADIOLOGICAL STUDY OF DISABILITIES AND DEFORMITIES OF HANSEN'S DISEASE IN A TERTIARY HEALTH CARE CENTRE

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Abstract

Background: Hansen's disease remains a significant cause of preventable disability worldwide, with skeletal manifestations contributing substantially to patient morbidity. Despite advances in treatment, comprehensive documentation of clinical-radiological correlations in deformity patterns remains limited. This study aimed to evaluate the clinical features and radiological manifestations of disabilities and deformities in patients diagnosed with Hansen's disease.

Methods: A cross-sectional observational study was conducted at the leprosy outpatient department of a tertiary healthcare institution. Forty-one patients with confirmed Hansen's disease presenting with deformities underwent comprehensive clinical examination, routine laboratory investigations, and specialized radiological assessment. Demographic characteristics, disease classification, occupational factors, and radiological findings were systematically documented and analysed.

Results: Radiological bone changes were identified in 27 patients (65.85%), predominantly affecting males (77.78%, n=21) with a male-to-female ratio of 3.7:1. The majority of affected individuals were aged 26-55 years, with manual labourers comprising 29.63% of cases. Multibacillary leprosy demonstrated higher bone involvement, with lepromatous leprosy showing the highest prevalence (71.43%), followed by borderline lepromatous (70%) and pure neural subtypes (66.67%). Specific osseous changes included bone cysts (14.2%, n=4) and cortical thinning with irregularity (7.4%, n=3).

Non-specific radiological manifestations encompassed soft tissue alterations (40.7%, n=13), distal phalangeal resorption (37%, n=10), subluxation (14.8%, n=4), and flexion deformities (11.3%, n=3). **Conclusions:** This investigation demonstrates significant radiological abnormalities in Hansen's disease patients with deformities, emphasizing the critical importance of early case detection and grade-1 disability recognition. The findings underscore the necessity for enhanced healthcare worker training in nerve function assessment and early intervention strategies to prevent progression from grade-1 to visible grade-2 disabilities, thereby reducing long-term morbidity and improving patient outcomes.

Keywords: Hansen's disease, leprosy, skeletal deformities, radiological manifestations

Introduction

Hansen's disease, historically termed leprosy from the ancient Greek "lepra" meaning scaling skin condition, represents one of humanity's oldest recognized infectious diseases.[1] Named after German scientist Gerhard Armauer Hansen who identified *Mycobacterium leprae* in 1873, this chronic progressive infection primarily affects skin, peripheral nervous system, and other tissues, manifesting with diverse clinical presentations.[2–4] Skeletal involvement occurs in 15–29% of patients and serves as a crucial prognostic indicator.[5]

Despite significant advances in treatment through Multidrug Therapy (MDT) and increased public awareness, Hansen's disease remains both a medical and societal challenge due to its disfiguring potential.[6] Over 200,000 new cases are reported annually worldwide, with India accounting for more than 50% of global incidence.[7] The persistence of stigma, discrimination, and social ostracism continues to hinder disease eradication efforts, while delayed diagnosis and inadequate care contribute to preventable deformities.[6]

Bone alterations in Hansen's disease predominantly affect the phalanges of hands and feet, while nasal septum involvement occurs less frequently. Long bones and trunk bones are typically spared.[8] These changes may be classified as specific, resulting from direct *M. leprae* invasion and osteomyelitis,[9–11] or non-specific, secondary to nerve compromise, vascular impairment, and granulomatous infiltration.[12,13] Patients with longstanding disease demonstrate increased susceptibility to osteoporosis and pathological fractures.[14,15] Deformities are categorized as primary (direct bacterial effects including leonine facies, testicular atrophy, and reaction hands) or secondary (indirect consequences such as claw hand, foot drop, and ulcerative changes in insensitive extremities). Disability encompasses functional impairment affecting daily activities, even without visible deformity.

Need for the Study: Comprehensive documentation of clinical-radiological correlations in Hansen's disease deformities remains limited, particularly in contemporary healthcare settings. Understanding these patterns is essential for developing targeted prevention strategies, optimizing early intervention protocols, and reducing long-term morbidity. This study addresses the critical gap in systematic evaluation of skeletal manifestations and their clinical implications in Hansen's disease patients with disabilities and deformities.

Objective: To clinically and radiologically assess the disabilities and deformities associated with Hansen's disease in patients presenting to a tertiary healthcare center.

Materials and methods

This hospital-based cross-sectional study was conducted in the Dermatology, Venereology, and Leprosy (DVL) Outpatient Department of Jorhat Medical College and Hospital, Assam, India, a tertiary care centre serving a high leprosy burden region. Ethical approval was obtained from Srimanta Sankaradeva University of Health Sciences, and informed consent was secured in English

or Assamese. Consecutive sampling was employed to enroll 41 participants meeting inclusion criteria (adults with Hansen's disease-associated deformities) over a one-year period. Patients with non-leprosy deformities or declining consent were excluded.

The sample size was calculated using the formula $n=Z^2 \cdot p \cdot q/d2$, where $Z=1.96$ $Z=1.96$ (95% CI), $p=6.3\%$ $p=6.3\%$ (prevalence from prior studies), and $d=7.5\%$ $d=7.5\%$ (precision). Diagnosis adhered to WHO criteria: hypopigmented/erythematous lesions with sensory loss, thickened peripheral nerves, or positive acid-fast bacilli (AFB) on slit skin smears. Deformities were classified as primary (direct disease effects: leonine facies, clawing) or secondary (insensitivity sequelae: ulcers, contractures).

Data were collected via a pre-structured proforma, capturing demographics, clinical history, cutaneous/neurological examinations (sensory testing, motor deficits using MRC scale), and radiological assessments (X-rays of hands, feet, skull, and sinuses). Two dermatologists performed systematic evaluations, while radiologists interpreted imaging blinded to clinical findings. Quality assurance included pilot testing proformas and clinician calibration.

Statistical analysis utilized descriptive statistics (frequencies, percentages) for categorical variables (deformity types, disability grades) and mean/median for continuous data (age, disease duration). Subgroup comparisons employed Chi-square/t-tests (SPSS v.28). Analytical rigor, consecutive sampling, and radiological-clinical correlation strengthened validity.

Results

This cross-sectional study analysed 41 patients with confirmed Hansen's disease attending the Dermatology Outpatient Department at Jorhat Medical College and Hospital.

Demographic Characteristics

The study population demonstrated a bimodal age distribution, with the highest prevalence in the 26-35 years age group (41.46%, n=17), followed by 46-55 years (29.27%, n=12) and 36-45 years (24.39%, n=10). Patients over 55 years comprised 14.63% (n=6), while younger cohorts (under 15 years and 16-25 years) each represented 12.19% (n=5). Male predominance was evident with a 2.15:1 male-to-female ratio (68.29% males, n=28 vs. 31.71% females, n=13).

Occupational Distribution

Manual labourers constituted the largest affected group (29.27%, n=12), followed by homemakers (19.51%, n=8) and shopkeepers (17.07%, n=7). Unemployed individuals represented 9.76% (n=4), while businessmen and students each accounted for 7.31% (n=3). Agricultural workers (4.88%, n=2), service personnel, and teachers (2.44% each, n=1) comprised smaller proportions of the study population.

Clinical Classification and Reactional Episodes

Lepromatous leprosy was the predominant clinical form (34.15%, n=14), followed by equal proportions of borderline tuberculoid and borderline lepromatous subtypes (24.39% each, n=10). Pure neural leprosy occurred in 7.32% (n=3), while tuberculoid and histoid variants were least common (4.88% each, n=2).

Lepra reactions affected 41.46% (n=17) of patients, with Type 1 reactions showing higher frequency than Type 2 reactions (24.39% vs. 17.07%, respectively). The majority of patients (58.54%, n=24) remained free from reactional episodes throughout the study period.

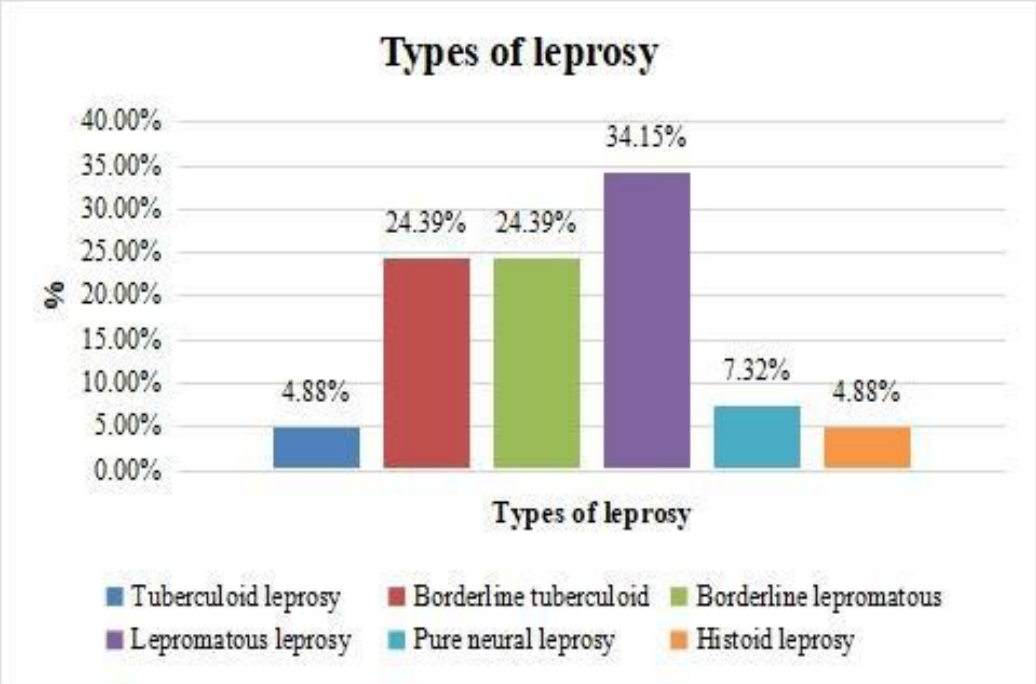

Figure 1: Distribution according to leprosy

Radiological Manifestations in Hansen's Disease

Radiological changes were identified in 27 patients (65.85%) with Hansen's disease. Age distribution showed equal representation in the 26-35, 36-45, and 46-55 year groups (22.22% each), with lower involvement in younger populations. A marked male predominance was observed (77.78% vs 22.22%; male-to-female ratio 3.5:1).

Manual labourers demonstrated the highest prevalence of radiological changes (29.63%), followed by homemakers and shopkeepers (18.52% each). Disease duration analysis revealed that 29.63% had illness duration exceeding four years, while 25.92% presented within one year of onset. Equal proportions (22.22% each) had disease duration of 1-3 years and 3-4 years respectively.

Table 1: Radiological changes in various types of leprosy

Type of Leprosy	Total Cases	Bone Changes - Absent	Bone Changes - Present
Tuberculoid Leprosy	2	1 (50.00%)	1 (50.00%)
Borderline Tuberculoid	10	4 (40.00%)	6 (60.00%)
Borderline Lepromatous	10	3 (30.00%)	7 (70.00%)
Lepromatous Leprosy	14	4 (28.57%)	10 (71.43%)
Pure Neural Leprosy	3	1 (33.33%)	2 (66.67%)
Histoid Leprosy	2	1 (50.00%)	1 (50.00%)
Total	**41**	**14 (34.15%)**	**27 (65.85%)**

Radiological Changes and Lepra Reactions

Bone involvement was more prevalent in patients without lepra reactions (43.90%, n=18) compared to those with reactional episodes (14.63%, n=6). Among patients with Type 1 reactions, bone changes and normal radiographs were equally distributed (12.19% each, n=5). Type 2 reaction cases showed bone changes in 9.75% (n=4) versus normal findings in 7.31% (n=3).

Pattern of Bone Changes

Non-specific bone changes in hands and feet were most common (59.26%, n=16), followed by specific bone changes in extremities (37.04%, n=10). Osteoporosis was documented in 33.33% (n=9) of cases, while cranial and paranasal sinus involvement occurred in 22.22% (n=6) of patients with radiological abnormalities.

Age-Related Distribution of Bone Changes
The 26-55 years age group demonstrated the highest prevalence of skeletal involvement. Non-specific bone changes peaked in the 46-55 years group (18.5%), while osteoporosis showed equal prevalence in 36-45 and 46-55 years groups (7.4% each). Cranial bone changes occurred predominantly in younger patients (16-25 years) and the 46-55 years cohort.

Disease Duration and Skeletal Involvement
Patients with ≤1 year symptom duration showed 11.1% specific and 7.4% non-specific bone changes. The 1-3 years group demonstrated 14.8% non-specific changes, 7.4% osteoporosis, and 12.1% cranial involvement. Those with 3-4 years duration exhibited predominantly non-specific changes (22.2%). Patients with >4 years duration showed the highest rates of specific (18.5%) and non-specific (25.9%) bone changes.

Occupational Pattern of Bone Changes
Manual labourers demonstrated the highest skeletal involvement across all categories: specific bone changes (18.5%), non-specific changes (25.9%), osteoporosis (7.4%), and cranial involvement (11.1%). Homemakers showed 7.4% each for specific and non-specific changes, with 3.0% osteoporosis prevalence. Other occupational groups demonstrated minimal bone involvement.

Table-2: Relation to the total number of patients in each type of leprosy

Types of leprosy	Specific bone changes	Non-specific bone changes	Osteoporosis	Bone changes in skull &paranasal sinuses
Tuberculoid leprosy	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Borderline tuberculoid	21.2%	19.7%	9%	0 (0.00%)
Borderline lepromatous	10.7%	42.4%	25.76%	10.60%
Lepromatous leprosy	29.9%	41.4%	0 (0.00%)	0 (0.00%)
Pure neural leprosy	38.8%	67.5%	31.57%	39.70%
Histoid leprosy	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

Lepra Reactions and Bone Changes
Patients without lepra reactions exhibited the highest prevalence of skeletal involvement across all categories: specific bone changes (21.2%), non-specific changes (44.45%), osteoporosis (18.5%), and cranial involvement (18.5%). Type 2 reactions showed higher rates of specific (11.1%) and non-specific (18.5%) bone changes compared to Type 1 reactions (7.4% and 11.1%, respectively). Osteoporosis was more common in Type 1 reactions (11.1%) than Type 2 reactions (3.7%).

Specific Radiological Changes
Bone cysts were the most prevalent specific change (14.8%, n=4), affecting both hands and feet. Cortical thinning/irregularity, sclerosis, and subarticular erosion each occurred in 7.4% (n=3) of cases, exclusively involving feet. Areas of destruction were rare (3.7%, n=1), while periostitis affected two cases.

Non-specific Radiological Changes
Soft tissue alterations were most common (40.7%, n=11), followed by distal phalangeal resorption (37%, n=10). Bone spurs and subluxation each affected 14.8% (n=4) of patients. Tuft erosions, flexion deformities, arthritis, fractures, and concentric absorption were equally prevalent (11.1% each, n=3). Joint cupping and tarsal bone disintegration occurred in 7.4% (n=2) of cases.

Cranial and Paranasal Changes
Skull and paranasal sinus involvement occurred in 21.1% (n=7) of patients. Maxillary antrum opacity, frontal sinus changes, and inferior turbinate hypertrophy each affected 7.4% (n=2) of cases. Periapical

cysts, interspinous ligament calcification, and external occipital protuberance prominence were documented in 11.1% (n=3) of patients.

Clinical-Radiological Correlations

Distal limb anesthesia, present in 85.36% of patients, showed strong associations with non-specific changes (45.71%) and specific changes (22.85%). Motor weakness (36.58%) correlated with non-specific changes in 73.33% of cases. Trophic ulceration (31.70%) demonstrated high association with both non-specific (76.92%) and specific (53.84%) bone changes. Digital clawing (23.6%) showed 84.6% non-specific and 53.8% specific bone changes. Finger/toe shortening (18.2%) demonstrated universal association with non-specific changes (100%) and frequent specific involvement (70%). Specialized manifestations including reaction hands, frozen feet, and foot drop (5.5% each) showed distinct radiological patterns, while leonine facies (3.6%) and depressed nasal bridge (1.8%) correlated with specific bone density alterations.

Discussion

This cross-sectional study examined radiological manifestations in 41 Hansen's disease patients at a tertiary care center over one year.

Incidence of Radiological Changes

The present study identified radiological changes in 65.85% of patients, consistent with Carayon et al's findings of 60–80%.[16] Other studies reported higher incidences (82–100%)[17,18,19,20,21,22] likely due to inclusion of only deformed patients.

Pattern of Bone Changes

Non-specific bone changes predominated (59.26%) over specific changes (37.04%), similar to previous reports by Chhabriya et al (66% vs 34%)[23] and Thappa et al (78.9% vs 22.4%).[20] Osteoporosis occurred in 33.33% of cases, comparable to Thappa et al's 28.9%.[20]

Demographic Associations

Male predominance (77.78%) with a 3.7:1 ratio paralleled Paterson et al's identical findings.[17] The 26–55 years age group showed highest involvement, consistent with Mohammad and Malhotra et al's observations.[16] Manual laborers constituted the largest affected group **(29.63%), reflecting occupational exposure patterns reported previously.[16,17]**

Clinical Correlations

Multibacillary leprosy showed higher bone involvement rates, particularly lepromatous (84.6%) and borderline lepromatous (63%) subtypes, aligning with previous studies.[20,23,16] Patients without lepra reactions demonstrated higher radiological changes (43.90%) compared to those with reactions.

Specific bone changes included bone cysts (14.8%) and cortical thinning (7.4%), while non-specific changes comprised soft tissue alterations (40.7%) and distal phalangeal resorption (37%). These findings correlate with clinical features, particularly anesthesia (85.36%) and motor weakness (36.58%).

The strong association between trophic ulceration and bone changes (76.92% non-specific, 53.84% specific) reflects the cascade of denervation, trauma, and secondary infection leading to skeletal complications.[24,25]

Study Strengths and Limitations

Strengths:

- Comprehensive clinical-radiological correlation analysis
- Systematic evaluation of multiple bone change categories
- Detailed demographic and occupational assessment

Limitations:

- Single-center study limiting generalizability
- Relatively small sample size (n=41)
- Cross-sectional design preventing temporal progression assessment
- Potential selection bias toward patients with existing deformities
- Limited long-term follow-up data for progression analysis

References

1. Mohammad, W., Malhotra, S. K., & Garg, P. K. (2016). Clinico-radiological correlation of bone changes in leprosy patients presenting with disabilities/deformities. *Indian Journal of Leprosy*, *88*, 83–95.
2. Singh, P. K. (2019, January 25). *Eliminate leprosy related discrimination, prejudice and stigma to end leprosy for good*. WHO Regional Director for South-East Asia.
3. Lendrum, F. C. (1954). The name "leprosy". *ETC: A Review of General Semantics*, *12*(1), 37–47.
4. Irgens, L. M. (2002). The discovery of the leprosy bacillus. *Tidsskrift for Den Norske Laegeforening*, *122*(7), 708–709.
5. Walker, S. L., & Lockwood, D. N. (2007). Leprosy. *Clinics in Dermatology*, *25*(2), 165–172.
6. Polycarpou, A., Walker, S. L., & Lockwood, D. N. (2013). New findings in the pathogenesis of leprosy and implications for the management of leprosy. *Current Opinion in Infectious Diseases*, *26*(5), 413–419.
7. Ankad, B. S., & Halawar, R. S. (2015). Bone involvement in leprosy: Early changes. *Radiology of Infectious Diseases*, *1*(2), 88–89.
8. Hopkins, R. (1928). Bone changes in leprosy. *Radiology*, *11*(6), 470–473.
9. Choudhuri, H., Thappa, D. M., Kumar, R. H., & Elangovan, S. (1999). Bone changes in leprosy patients with disabilities/deformities (a clinico-radiological correlation). *Indian Journal of Leprosy*, *71*(2), 203–215.
10. Nori, S. D., Thappa, D. M., & Siddarayu, N. (2004). Leprous osteitis presenting as bone cyst and erosions. *Dermatology Online Journal*, *10*, 17.
11. Job, C. K. (1963). Pathology of leprous osteomyelitis. *International Journal of Leprosy*, *31*(1), 26–33.
12. Møller-Christensen, V. (1965). New knowledge of leprosy through paleopathology. *International Journal of Leprosy*, *33*(3), 603–610.
13. Ramesh, V., & Kataria, J. K. (2017). Systemic involvement in leprosy. In B. Kumar & H. K. Kar (Eds.), *IAL Textbook of Leprosy* (2nd ed., p. 332). Jaypee Brothers Medical Publishers.
14. Ishikawa, S., Mizushima, M., Furuta, M., Ishikawa, A., & Kawamura, K. (2000). Leydig cell hyperplasia and the maintenance of bone volume: Bone histomorphometry and testicular histopathology in 29 male leprosy autopsy cases. *International Journal of Leprosy and Other Mycobacterial Diseases*, *68*(3), 258–266.
15. MacMoran, J. W., & Brand, P. W. (1987). Bone loss in limbs with decreased or absent sensation: Ten year follow-up of the hands in leprosy. *Skeletal Radiology*, *16*(6), 452–459. https://doi.org/10.1007/BF00350539
16. Paterson, D. E. (1955). Radiological bone changes and angiographic findings in leprosy with special reference to the pathogenesis of 'atrophic' conditions of the digits. *Journal of the Faculty of Radiologists*, *7*(1), 35–56.
17. Paterson, D. E. (1961). Bone changes in leprosy. Their incidence, progress, prevention and arrest. *International Journal of Leprosy*, *29*(4), 393–422.
18. McAlindon, T. E., Snow, S., Cooper, C., & Dieppe, P. A. (1992). Radiographic patterns of osteoarthritis of the knee joint in the community: The importance of the patellofemoral joint. *Annals of the Rheumatic Diseases*, *51*(7), 844–849.
19. Basu, S. P. (1962). Radiological observations in leprosy. *Indian Practitioner*, *52*, 53–59.

20. Thappa, D. M., Sharma, V. K., Kaur, S., & Suri, S. (1992). Radiological changes in hands and feet in disabled leprosy patients: A clinico-radiological correlation. *Indian Journal of Leprosy*, *64*(1), 58.
21. Lastória, J. C., & Abreu, M. A. (2014). Leprosy: A review of laboratory and therapeutic aspects – Part 2. *Anais Brasileiros de Dermatologia*, *89*(3), 389–401.
22. Ankad, B. S., Hombal, A., Sudhakar, R., & Naidu Varna, M. (2011). Radiological changes in the hands and feet of leprosy patients with deformities. *Journal of Clinical and Diagnostic Research*, *5*(4), 703–707.
23. Kumar, W. J., Kothari, S. Y., & Swamy, M. K. (2014). Deformities and bone changes in leprosy. *Indian Journal of Physical Medicine and Rehabilitation*, *25*, 13–17.
24. Reddy, K. B., Sreedevi, L., & Suryanarayana, S. (n.d.). Study of radiological changes of bones in leprosy patients.
25. Nori, S. D., Thappa, D. M., & Siddarayu, N. (2004). Leprous osteitis presenting as bone cyst and erosions. *Dermatology Online Journal*, *10*, 17.
26. Enna, C. D., Jacobson, R. R., & Rausch, R. O. (1971). Bone changes in leprosy: A correlation of clinical and radiographic features. *Radiology*, *100*(2), 295–306.