

Effect of Intravenous Zoledronic Acid on Pain and Functional Disability in Patients with Osteoporosis-Associated Chronic Low Back Pain: A Prospective Interventional Study

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Abstract: Background: Chronic low back pain is common in older adults and may coexist with osteoporosis and degenerative spinal changes. Zoledronic acid is an antiresorptive bisphosphonate used in osteoporosis; its association with changes in pain and function in this population warrants clinical evaluation. Aim: To evaluate changes in pain intensity and functional disability after intravenous zoledronic acid in patients with chronic low back pain associated with osteoporosis. Materials and Methods: This hospital-based interventional study included 41 patients aged over 50 years at the Department of Orthopaedics, between March 2023 and March 2025. Participants received a single 4-mg intravenous infusion of zoledronic acid diluted in 100 mL normal saline. Pain and disability were assessed at baseline, three months and six months using the Visual Analogue Scale (VAS) and Roland–Morris Disability Questionnaire (RMDQ), respectively. Results: The study included 21 male patients (51.2%) and 20 female patients (48.8%); mean age was approximately 63 years (range 51–79). The detailed results section reports mean VAS scores of 8.05 at baseline, 4.85 at three months and 2.95 at six months. Mean RMDQ scores were reported as 19.05, 12.07 and 6.95, respectively. The dissertation reports statistically significant improvement at three months ($p < 0.01$). Adverse effects were described as minimal, but event counts require verification from the original records. Conclusion: Pain and self-reported functional disability improved over six months following zoledronic acid administration in this single-arm cohort. Controlled studies are required to determine the magnitude of benefit attributable to treatment.

Keywords: Zoledronic acid; osteoporosis; chronic low back pain; Visual Analogue Scale; Roland–Morris Disability Questionnaire; bisphosphonates.

1. Introduction

Low back pain (LBP) is a major contributor to disability worldwide and is particularly prevalent among older adults. Its aetiology is multifactorial and includes degenerative changes of the intervertebral discs and facet joints, mechanical disorders, vertebral fractures and metabolic bone disease. Osteoporosis is an important skeletal disorder in this population because reduced bone mass and deterioration of bone microarchitecture increase skeletal fragility and susceptibility to fractures.

Osteoporosis may coexist with chronic low back pain through several mechanisms, including vertebral fragility fractures, altered spinal biomechanics and degenerative changes affecting the vertebral endplates. Appropriate evaluation of the underlying cause of back pain is essential before attributing symptoms to osteoporosis.

Zoledronic acid is a nitrogen-containing bisphosphonate that inhibits osteoclast-mediated bone resorption and is used in the management of osteoporosis. Although its skeletal benefits are established, the extent to which treatment improves chronic low back pain in patients without an acute vertebral fracture requires further evaluation.

Pain intensity and functional disability are complementary outcomes in chronic LBP assessment. The Visual Analogue

Scale (VAS) measures perceived pain intensity, while the Roland–Morris Disability Questionnaire (RMDQ) assesses the impact of back pain on everyday physical functioning. This study evaluated changes in VAS and RMDQ scores after a single intravenous infusion of zoledronic acid.

2. Materials and Methods

Eligibility criteria

Inclusion criteria were patients of either sex aged over 50 years with focal, insidious-onset low back pain lasting more than six weeks and symptoms not relieved by NSAIDs, opioids and physiotherapy, as specified in the study protocol.

Exclusion criteria included refusal of informed consent; vertebral body fracture; deranged serum electrolytes or liver/renal function; pregnancy or lactation; osteonecrosis of the jaw; other identified causes of back pain, including primary or secondary tumours and intervertebral disc prolapse; allergy to zoledronic acid; previous bisphosphonate therapy; and steroid therapy.

Baseline assessment

History and clinical examination were performed. Osteoporosis was assessed using the Singh index based on trabecular patterns on plain radiographs, as described in the dissertation. Investigations included renal and liver function

tests and serum electrolytes. Imaging included anteroposterior and lateral radiographs of the lumbosacral spine and an anteroposterior radiograph of the pelvis with both hips. Additional investigations were performed when clinically indicated.

Intervention and outcome measures

Each participant received a single 4-mg intravenous infusion of zoledronic acid diluted in 100 mL normal saline according to the study protocol. Participants were reviewed at three and six months. Pain was assessed using the VAS (0–10), and disability was assessed using the RMDQ (0–24); higher scores indicate greater pain or disability.

Statistical analysis and ethics

The dissertation reports that data were compiled in Microsoft Excel and analysed using SPSS. Descriptive statistics were used for demographic and clinical characteristics. Student's t-test and a significance threshold of $p \leq 0.05$ were specified. The exact test used for repeated measurements, effect estimates and confidence intervals should be confirmed from the original statistical output. Written informed consent was obtained. The institutional ethics committee name, approval number and date must be inserted from the official approval certificate before submission.

3. Results

Demographic characteristics

The study included 41 patients with chronic low back pain associated with osteoporosis. Mean age was approximately 63 years (range 51–79). There were 21 male patients (51.2%) and 20 female patients (48.8%).

Pain intensity

The detailed results and discussion sections of the dissertation report a mean VAS score of 8.05 at baseline, 4.85 at three months and 2.95 at six months, indicating a progressive reduction in reported pain intensity during follow-up.

Functional disability

The mean RMDQ score was reported as 19.05 at baseline, 12.07 at three months and 6.95 at six months. These values indicate an improvement in self-reported functional disability over the observation period.

Summary of Outcome Scores

Outcome	Baseline	3 months	6 months
Mean VAS (0–10)	8.05	4.85	2.95
Mean RMDQ (0–24)	19.05	12.07	6.95

The dissertation reports statistically significant improvement at three months ($p < 0.01$). Exact p-values and confidence intervals for each comparison should be verified from the original analysis. Adverse effects were described as minimal in the dissertation abstract; the number and type of events should be confirmed from patient records.

Data verification note: The thesis abstract contains different VAS and RMDQ values from the detailed results

narrative. All outcome values must be reconciled against the master chart and statistical output before journal submission.

4. Discussion

This interventional study evaluated changes in pain intensity and functional disability after intravenous zoledronic acid in 41 patients with chronic low back pain associated with osteoporosis. The principal observation was a progressive reduction in mean VAS and RMDQ scores over six months.

The mean VAS score decreased from 8.05 at baseline to 4.85 at three months and 2.95 at six months. The mean RMDQ score decreased from 19.05 to 12.07 at three months and 6.95 at six months. The concurrent changes suggest that improvement in perceived pain was accompanied by improvement in self-reported daily function.

Zoledronic acid inhibits osteoclast-mediated bone resorption and is an established treatment for osteoporosis in appropriately selected patients. These skeletal effects provide a rationale for studying outcomes in patients whose chronic back pain coexists with osteoporosis. However, improvement after treatment does not establish that the analgesic effect was directly mediated by changes in bone turnover.

Comparisons with previous research must account for differences in patient selection, vertebral fracture status, diagnostic criteria, dosing regimens and outcome measures. Results from selected populations, including patients with vertebral fractures or Modic changes, should not automatically be generalised to all patients with osteoporosis-associated low back pain.

The study has important limitations. It was a small, single-centre cohort recruited using convenience sampling, with no concurrent control group, random allocation or blinding. Therefore, the observed changes cannot be attributed exclusively to zoledronic acid, and generalisability is limited. Osteoporosis assessment relied on the Singh index rather than a reported DXA-based assessment. Complete effect estimates, confidence intervals and detailed adverse-event data should also be confirmed before publication.

Despite these limitations, the study provides preliminary clinical observations on pain and functional disability over six months following zoledronic acid administration. Larger controlled studies using standardised diagnostic criteria, prespecified outcomes and systematic safety monitoring are needed.

5. Conclusion

In this single-centre interventional study of 41 patients with chronic low back pain associated with osteoporosis, intravenous zoledronic acid administration was followed by progressive reductions in VAS pain scores and RMDQ disability scores over six months. These findings suggest potential improvement in pain and self-reported function. However, the absence of a control group and limitations in the available statistical reporting prevent a definitive

conclusion regarding treatment efficacy. Further controlled studies are required.

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