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Zoledronic acid infusion for lumbar interbody fusion in osteoporosis

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ABSTRACT

Background: Clinical outcomes of intravenous (IV) infusion of zoledronic acid (ZOL) for lumbar interbody fusion surgery (LIFS) remain unknown. We investigated the efficacy of IV ZOL on clinical outcome and bone fusion after LIFS.

Materials and methods: We retrospectively analyzed 64 patients with both degenerative lumbar spondylolisthesis and osteoporosis who underwent LIFS from January 2007 to April 2010. All patients were followed up for 2 y. Thirty-two were treated with an IV infusion of ZOL 3 d after surgery and a second injection 1 y later, and the other 32 patients did not receive ZOL. Preoperatively and every 3 mo postoperatively, oswestry disability index questionnaire and visual analog scale (VAS) scores for back and leg were compared. Preoperative and final postoperative follow-up to evaluate for subsequent compression fractures were also performed. Pedicle screw loosening, cage subsidence, and fusion rate were documented 2 y after surgery.

Results: At 2-y follow-up, a solid fusion was achieved in 75% of the ZOL group and only 56% of the control group. At final follow up, the incidence of final subsequent vertebral compression fractures (19% of the ZOL group and 51% of the control group, $P = 0.006$), pedicle screw loosening (18% of the ZOL group and 45% of the control group, $P = 0.03$), and cage subsidence >2 mm (28% of the ZOL group and only 54% of the control group, $P = 0.04$) were significantly lower in the ZOL group than in the control group. The ZOL group demonstrated improvement in VAS (for leg pain VAS, 2/10 for the ZOL group and 5/10 for the control group; for back pain VAS, 2/10 for the ZOL group and 6/10 for the control group) and oswestry disability index scores (7/25 for the ZOL group and 16/25 for the control group).

Conclusions: ZOL treatment has beneficial effects on instrumented LIFS both radiographic and clinically. Thus, ZOL treatment can be recommended for osteoporosis patients undergoing LIFS.

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1. Introduction

With an increasing percentage of elderly patients with osteoporosis undergoing spinal interbody fusion surgery, unfavorable functional outcomes and a high percentage of complications such as poor fusion rate and frequent subsequent compression fractures are major problems. Based on animal study data, some studies have supported the beneficial effect of zoledronic acid (ZOL) for promotion of lumbar spinal fusion. [1,2]. Many studies suggest that osteoporosis may unfavorably impact the fusion rate and thus, surgical outcomes [3,4]. Complications related to lumbar interbody fusion surgery (LIFS) in patients with osteoporosis are common [3]. Subsequent vertebral compression fractures, cage subsidence, and loosening of pedicle screws are most frequent after lumbar interbody surgery in osteoporosis patients [4–6]. Bisphosphonates, a class of antiresorptive agents, are known to increase bone mineral content by reducing bone turnover, thereby increasing bone strength and reducing the risk of fragility fractures [7]. However, published data show that oral bisphosphonates can be associated with poor adherence and compliance as well as gastrointestinal intolerance [8–10]. It is known that a once-yearly infusion of ZOL 5 mg is effective in the treatment of postmenopausal osteoporosis, and significantly reduces the risk of vertebral, hip, and other fractures [11,12]. Clinical studies, however, have shown that there is no association between ZOL treatment and non-union of the lumbar spinal bone [13] and in fact, the use of ZOL after lumbar interbody fusion in osteoporosis patients is still controversial because of concerns about its biological effect on bone remodeling, and there remains no consensus [1,2,5,13–17]. The purpose of this study was to examine the clinical outcome and effect on bone fusion of an immediate postoperative and an annual intravenous (IV) infusion of ZOL 5 mg after lumbar spinal interbody fusion surgery in patients with osteoporosis.

2. Materials and methods

2.1. Patients selection criteria

The study protocol was approved by the institutional review board at Taipei Tzu Chi Hospital, The Buddhist Tzu Chi Medical Foundation (registration code 01-X19-064). After the institutional review board approval, we retrospectively reviewed the medical records of patients (mean age, 70.7 ± 6.0 y; range, 59–86 y) with spinal osteoporosis treated with lumbar spinal fusion surgery between 2007 and 2010 and found 214 patients who met the inclusion criteria for this study. Inclusion criteria were [1] diagnosis of osteoporosis based on the World Health Organization criteria (t-score ≤ -2.5) [3] and [2] additional diagnosis of lumbar degenerative spondylolisthesis with spinal stenosis according to x-ray and magnetic resonance imaging studies. Patients who had previously undergone spinal surgery or who had spinal tumor, infection, or trauma were excluded.

The indications for LIFS were both clinically symptomatic and radiological evidence of severe one or two level degenerative lumbar spondylolisthesis. Both plain radiography and magnetic resonance imaging confirmed spondylolisthesis. Clinical symptoms and signs included both intractable low back and radiation leg pain. Neurogenic claudication was also noted for all patients before surgery. All these patients accepted conservative treatment (including bed rest, medical treatment, and rehabilitation therapy) at 6 mo but had poor response.

Details of patient backgrounds are shown in Table. All patients underwent decompression and LIFS of 1- or 2-level spondylolisthesis with pedicle screws (Xia Titanium 4.5-mm Spinal System, Stryker, Kalamazoo, MI) and a polyetheretherketone cage (Adaptive Vertebral polyetheretherketone Spacer Implant, Stryker) at each level with local bone graft consisting of lamina from the decompression area. No other osteoconductive products were used for spinal fusion. From this initial group of 214 patients, 32 patients (ZOL group) were treated with ZOL 5 mg

Table – Demographics and baseline characteristics of ZOL group and non-medication (control) group.

Variable	ZOL $n = 32$	Control $n = 32$	P value
Female, n (%)	27 (84.37)	26 (81.25)	1.01
Lumbar spine BMD t-score	−3.1 ± 0.59 Max −4.9, Min −2.5	−2.9 ± 0.5 Max −4.3, Min −2.5	1.00
Age (y)	70.8 ± 6.09 Max 82, Min 59	69.7 ± 6.02 Max 86, Min 59	0.50
BMI (kg/m^2)	31 ± 2.1	30 ± 1.8	0.75
Preoperative ODI	63.5 ± 6.3	64 ± 5.67	0.77
Immediate-postoperative ODI	25.6 ± 2.1	25.5 ± 2.55	0.95
Preoperative VAS of back	9.0 ± 1.1	9.1 ± 1	0.80
Immediate-postoperative VAS of back	2.25 ± 1.3	2.45 ± 1.5	1.00
Preoperative VAS of legs	9 ± 0.87	8.8 ± 0.9	0.8
Immediate-postoperative VAS of legs	1.6 ± 0.3	1.6 ± 0.5	0.8
Surgical level			
One level	23	24	0.78
Two levels	9	8	0.66
Total levels	41	40	1.00

BMI = body mass index.
Data expressed as (mean ± standard deviation) unless otherwise indicated. $P < 0.05$ was considered statistically significant.