J Orthop Sci (2005) 10:32–36
DOI 10.1007/s00776-004-0854-8

Journal of
Orthopaedic Science

Original article

Efficacy of different dosing schedules of etidronate for stress shielding after cementless total hip arthroplasty

Katsuyuki Yamaguchi[1], Kensaku Masuhara[2], Satoshi Yamasaki[2], and Takeshi Fuji[2]

[1] Department of Orthopaedic Surgery, Kaizuka City Hospital, 3-10-20 Hori, Kaizuka 597-0015, Japan
[2] Department of Orthopaedic Surgery, Osaka Koseinenkin Hospital, Osaka, Japan

Abstract Forty-four women who had undergone cementless total hip arthroplasty (THA) were selected for determination of the optimum dosage of etidronate in the treatment of stress shielding after surgery. Patients were 55–86 years of age. The patients were randomized into three groups. The control group (n = 17) was not treated with osteoactive drugs. The low-dose group (n = 12) and the high-dose group (n = 15) received 200 mg or 400 mg etidronate daily for 2 weeks, followed by 12 weeks of calcium supplementation of 500 mg/day. These patients received four cycles of therapy over 1 year postoperatively. Periprosthetic bone mineral density (BMD) was measured with dual-energy X-ray absorptiometry at 3 weeks, 6 months, and 12 months. At 12 months, bone loss in the low-dose and high-dose groups was significantly lower compared with the control group in Gruen zones 1 and 7. There were additional significant differences with regard to bone loss between the control group and the high-dose group in zones 2, 4, and 6. Our data suggest that high dosages are more effective in reducing postoperative bone loss after cementless THA.

Key words Etidronate · Dose–response relationship · Bone mineral density · Stress shielding · Cementless total hip arthroplasty

Introduction

Proximal femoral bone resorption is commonly seen following cementless total hip arthroplasty (THA). Bone resorption may reduce the stability of the femoral prosthesis and complicate revision surgery. We reported previously that cyclic therapy with etidronate could be effective against proximal bone resorption after cementless THA.[20,21] It has been reported that cyclic therapy with etidronate was effective in postmenopausal osteoporosis.[7,11,15,18] A controlled double-blind trial study of cyclic therapy in Japan reported that oral administration of 200 mg or 400 mg etidronate had a marked effect on the increase in the lumbar vertebral bone mineral density (BMD), but there was no difference between the 200-mg group and the 400-mg group.[5] Great care must be taken in modifying the dosage schedule to achieve maximum therapeutic effectiveness yet minimize the chance of toxicity. The aim of this study was to clarify the most effective dosage of etidronate in the treatment of periprosthetic bone resorption after cementless THA.

Materials and methods

Forty-four patients (44 hips) were enrolled in this study. All patients were postmenopausal women aged 55–86 years. They had osteoarthritis secondary to acetabular dysplasia and underwent primary THA with a cementless Lübeck prosthesis. The women were randomized into three groups, of which two groups received 200 mg or 400 mg etidronate disodium once a day in a 2-week cycle followed by 12 weeks of calcium lactate of 500 mg/day. This cycle was repeated four times, starting on the 7th day after surgery. The control group was not treated with drugs affecting the bone or mineral metabolism. One patient in the 400 mg group was excluded due to side effects attributed to etidronate. Therefore, 43 patients could complete this study. Details of the patients are given in Table 1. Informed consent was obtained from all patients.

Cementless THA was performed using the Spongiosa metal II Hip Prosthesis (S&G; ESKA, Lübeck, Germany), an improvement of the Lübeck I prosthesis.[10,12,16] In this system, the stem and metal socket of the prosthesis are made of cobalt-chrome-molybdenum alloy with a structure like cancellous bone (Fig. 1). We used both the extensively and proximally coated stems. The proximally coated stems have a circumferential

Offprint requests to: K. Yamaguchi
Received: May 6, 2004 / Accepted: October 4, 2004

Table 1. Baseline characteristics of patients

Characteristics	Control group (n = 17)	200-mg group (n = 12)	400-mg group (n = 14)	P value
Age (years)	68 ± 3	66 ± 6	70 ± 10	0.755[a]
Weight (kg)	52 ± 6	56 ± 8	56 ± 7	0.176[a]
Stem size				
90 mm	0	1	0	0.374[b]
100 mm	6	4	4	
110 mm	10	7	7	
120 mm	1	0	3	
Extent of porous coating				
Extensively coated stem	9	6	7	0.982[b]
Proximally coated stem	8	6	7	
Preoperative value				
Serum bone alkaline phosphatase (BAP) (U/l)	24.1 ± 8.4	26.9 ± 8.0	31.7 ± 9.7	0.229[a]
Urinary N-telopeptide breakdown product (NTX) (nmol/mmol Cr)	61.4 ± 23.1	81.2 ± 25.3	92.6 ± 50.3	0.124[a]

[a] As determined by the Kruskal–Wallis one-way analysis of variance (ANOVA)
[b] As determined by the χ^2 test

Fig. 1. Photograph showing the extensively coated stem (*left*) and the proximally coated stem (*right*)

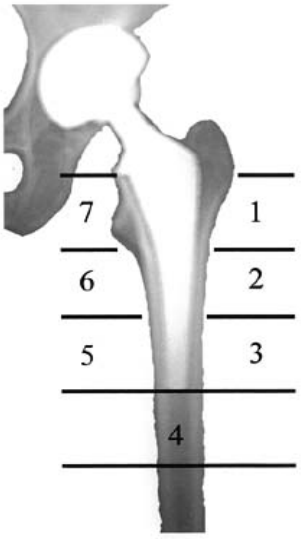

Fig. 2. Schematic drawings of the seven regions of interest according to Gruen et al.[6]

area on the proximal 60%. The operations were performed through a posterolateral approach. Partial weight-bearing was started at 1 week postoperatively and full weight-bearing was allowed at 3 weeks.

The periprosthetic BMD in seven regions of interest based on the Gruen zones[6] was measured by dual-energy X-ray absorptiometry (DXA) with a Hologic QDR 2000 (Hologic, Waltham, MA, USA) (Fig. 2). Patients were scanned using computer software (version 5.72; Hologic) that was used to analyze periprosthetic bone mineral content, area, and BMD in each zone. In our institution, the precision errors for BMD measurements ranged from 1.0% in zone 6 to 3.8% in zone 7. The index scan was done at 3 weeks postoperatively at baseline, and subsequent follow-up measurements were made at 6 and 12 months.

Following an overnight fast, we obtained blood and second-morning void urine samples. Serum bone alkaline phosphatase (BAP, enzyme immunoassay; SRL, Osaka, Japan) and urinary type I collagen N-telopeptide breakdown products (NTX, enzyme-linked immunosorbent assay; SRL) were measured preoperatively and at 6 and 12 months postoperatively. Urine creatinine was measured at the time of sampling.

The BMD ratio was calculated by dividing the BMD value of each scan during the follow-up by the value in the corresponding zone at 3 weeks postoperatively and multiplying by 100. The difference in BMD ratio in all three groups was examined for each zone at 6 and 12 months after operation to evaluate the effects of cyclic