

Analysis of risk factors for poor prognosis in conservatively managed early-stage spontaneous osteonecrosis of the knee



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ABSTRACT

Background: Management guidelines for early-stage spontaneous osteonecrosis of the knee (SONK) have not been established. The purposes of this study were to review the outcome of conservative treatment for patients with early-stage SONK and to examine clinical factors affecting the prognosis.

Methods: Diagnosis of early-stage SONK was made based on the criteria consisting of specific clinical features including magnetic resonance imaging (MRI) findings. During the study period, all patients with this diagnosis underwent standardized conservative treatment. The study population comprised 38 knees in 36 patients with a mean age at presentation of 66.4 years. The mean follow-up period was 34.9 months. During the treatment course, progressive joint space narrowing or collapse of bony contours identified in serial follow-up radiographs was regarded as indicating a poor prognosis. The significance of potential prognostic factors such as age, gender, obesity, coronal alignment, lesion size, and MRI findings was analyzed using a multivariate logistic regression analysis.

Results: The prognosis was defined to be poor in eight knees (21.1%). The multivariate logistic regression analysis for potential risk factors revealed that only varus alignment with a femorotibial angle (FTA) of 180° or more on the initial radiograph was significantly associated with the poor prognosis ($P = 0.01$, odds ratio 28.1) while no other factors significantly correlated with the prognosis.

Conclusions: Approximately 80% of patients with early-stage SONK could be managed successfully with conservative treatment without progression of the disease process. The presence of varus deformity (FTA of 180° or more) was significantly associated with poor prognosis complicated with progressive deformity and prolonged disability.

Level of evidence: Level IV, case series.

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1. Introduction

Spontaneous osteonecrosis of the knee (SONK) is a clinical entity characterized by acute onset of pain predominantly occurring in the elderly female population. At the beginning of clinical manifestation, routine radiographic examination usually reveals no abnormalities and the diagnosis in its early disease process is based on clinical characteristics and magnetic resonance imaging (MRI) findings.

The management strategy for SONK is constructed depending on the disease stage and level of disability. For patients with advanced stages presenting with severe deformity and disability or prolonged morbidity, surgical interventions such as arthroplasty, high tibial osteotomy, and osteochondral graft are indicated [1–4]. For patients with early-stage lesions, conservative management consisting of physical therapy,

application of a de-loading brace or lateral-wedge insole, and intra-articular hyaluronic acid injection are generally adopted as the primary options [5–7].

In general, favorable outcomes of the conservative management for early-stage SONK have been reported [5–7]; however, progression of the disease process requiring surgical treatment is occasionally encountered in our clinical experiences. Although there have been several studies examining risk factors for progression of bony destruction and deformity [1–3], those studies included subjects with mixed disease stages, and thus prognosis of conservative treatment for early-stage SONK has not been clarified. If the prognosis can be predicted at the beginning of the conservative treatment, this would greatly help in the construction of an effective treatment plan.

The purposes of this study were to examine the outcome of conservative treatment in our patient population and assess the effectiveness of our treatment regimen. Additionally, we attempted to examine how potential risk factors such as obesity, varus alignment, and lesion size affected the outcome of conservative treatment. We hypothesized that conservative can effectively prevent disease progression and induce

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clinical improvement for patients with early-stage SONK and there are certain clinical parameters influencing the prognosis.

2. Patients and methods

With institutional review board approval, we conducted a retrospective therapeutic case series study for a group of patients who presented with clinical features of early-stage SONK in the medial femoral condyle and underwent standardized conservative treatment. The review board of Hyogo College of Medicine approved this study (No. 1539).

A consecutive series of patients who visited our clinic and were diagnosed as early-stage SONK between 2004 and 2011 constituted the basis of this study. For the diagnosis of early-stage SONK, the following criteria were employed: (1) acute onset of pain less than two months before the initial presentation, (2) characteristic MRI findings as proposed by Lecouvet et al. [8] (a subchondral area of well-demarcated low signal intensity area on T2-weighted images, focal epiphyseal contour depression, or lines of low signal intensity located deeply in the condyle surrounded by bone marrow edema), and (3) radiological presentation coinciding with early-stage SONK [1,4] (stage 1 or 2 changes: no abnormality, flattening of the weight-bearing contour of the condyle, or oval radiolucency in the subchondral area).

The study population included 38 knees in 36 patients (12 males and 24 females) with the age at presentation ranging from 47 to 86 years (66.4 ± 9.6 years). During the treatment course, periodical clinical and radiological examinations with time intervals of one to six months were continued, and the follow-up period for each patient ranged from 24 to 76 months (34.9 ± 14.1 months).

Standardized conservative treatment measures consisting of a lateral wedge shoe insole, physiotherapy, intra-articular injection of hyaluronic acid, and administration of anti-inflammatory drugs as needed were applied to all patients. Although the use of a cane was recommended for protected weight-bearing, non-weight-bearing with the use of crutches was not advised considering the patients' compliance and functional ability. During the follow-up period, the patients' prognosis was deemed to be poor when progressive joint space narrowing or collapse of bony contour was detected in follow-up radiographs.

Clinical parameters examined for relationship with poor prognosis were as follows: age (age > 70 was defined as old age), gender, body mass index (BMI: BMI > 25 was defined as obesity), bone mineral density (BMD) of the lumbar spine (BMD < 70% of the young adult mean value was defined as osteoporosis), coronal alignment measured on an anteroposterior weight-bearing radiograph (femorotibial angle, FTA: FTA $\geq 180^\circ$ was defined as varus deformity) and lesion size measured on coronal MRI (lesion width > 50% of the overall width of the medial femoral condyle was defined as a large lesion), and MRI findings characterized by the presence of subchondral low signal intensity areas on T2-weighted images and contour deformities [8].

In the data presentation and analysis, continuous variables are presented as means \pm standard deviations and categorical variables are presented as frequencies and proportions. In the statistical analysis, a univariate analysis of potential risk factors was initially performed using Fisher's exact test. Factors that were found to have values of $P < 0.1$ in the univariate analysis were further analyzed in the multivariate logistic regression analysis. Results are summarized as odds ratios, 95% confidence intervals, and P values. All P values were two-sided, and $P < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS (version 19, SPSS Inc.).

3. Results

During the study period, the prognosis was deemed to be poor in eight of the 38 knees (21.1%). This group (poor prognosis group) included three females and five males with the mean age of 69.6 ± 14.5 years (range from 47 to 86 years). Among these eight knees, six knees went onto have surgery (four TKAs, one UKA, and one HTO) (Fig. 1). Consequently, our conservative treatment regimen had satisfactory results for 30 of the 38 knees (78.9%),

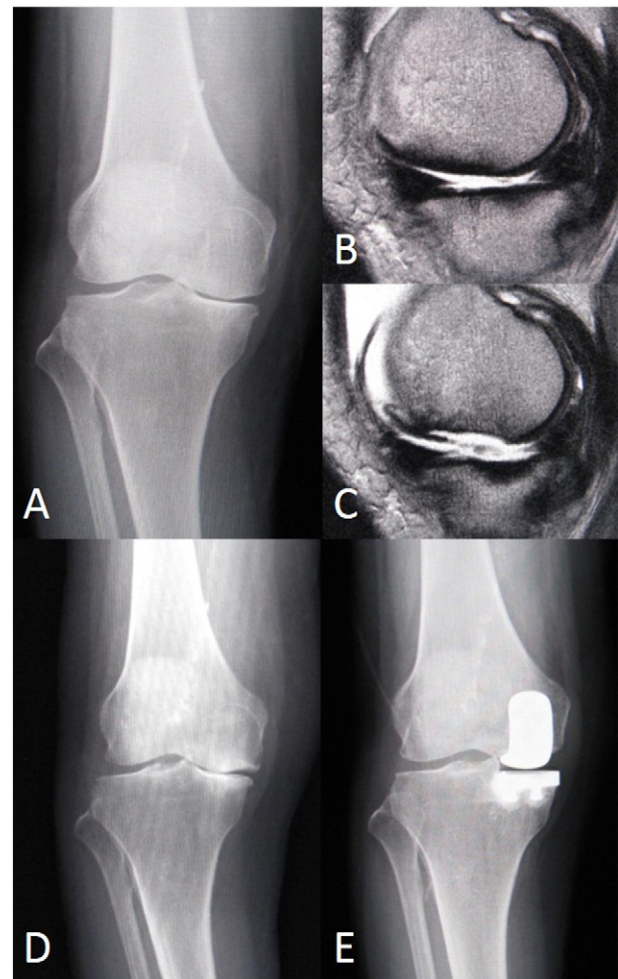


Fig. 1. Sequential radiological and MRI findings of a 78-year-old female patient presenting poor prognosis. (A) A standing anteroposterior radiograph at initial examination indicates stage 1 change. The femorotibial angle is 185° and varus deformity is evident. (B) Sagittal T2-weighted MRI at initial presentation shows typical osteonecrosis lesion. (C) At two months, the osteonecrosis lesion advanced to stage 4 on T2-weighted MRI. Unicompartmental knee arthroplasty was indicated for this patient (D).

which were categorized as the good prognosis group (Fig. 2). In this group of patients symptoms resolved at an average of 5.9 months (range, 2 to 12 months) after the initial clinical presentation.

We evaluated the amount of pain by four grades (severe, moderate, mild, and none) at the initial examination and the final follow-up. The pain score of the patients who underwent subsequent arthroplasty was checked before surgery. At the initial examination, all patients in both groups had severe or moderate pain. At the final follow-up, there were three out of the 30 knees in which patients with good prognosis complained of severe or moderate pain; however, in eight patients with poor prognosis, severe pain and moderate pain were noted in six and two knees respectively.

The univariate analysis for potential risk factors demonstrated that varus deformity with an FTA of 180° or more on initial radiograph was strongly associated with poor prognosis ($P = 0.01$, odds ratio 28.1). Other examined factors (age, gender, BMI, bone mineral density, lesion size, and findings in MRI) did not significantly correlate with the prognosis (Tables 1, 2). The subsequent multivariate analysis for factors of gender and varus deformity ($P < 0.1$ in the univariate analysis) revealed that only varus deformity on initial radiograph remained a significant risk factor ($P = 0.01$, odds ratio 28.1).

4. Discussion

The treatment strategy for SONK is dependent on the amount of joint destruction and disability. Efficacy of conservative treatment for patients with a less advanced disease stage has been shown by some studies. In these studies, treatment modalities such as lateral wedge insole, physiotherapy, and protected weight-bearing were employed leading to satisfactory results in the majority of the patients [1–3,5,6]. The present study showed that approximately 80% of the patients

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