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INVESTIGACIÓN ORIGINAL

Clinical outcomes in patients with Ficat stage I and II spontaneous osteonecrosis of the knee treated conservatively at an institution in southwestern Colombia

Resultados clínicos en pacientes con osteonecrosis espontánea de rodilla estadio Ficat I y II manejados conservadoramente en una institución del suroccidente colombiano

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Abstract

Introduction: Knee osteonecrosis (ON) is a rare pathology with diverse clinical presentation and variable outcomes, sometimes leading to severe osteoarthritis.
Objective: To present the clinical outcomes in patients with spontaneous osteonecrosis of the knee (SONK) Ficat stage I and II treated conservatively at a clinic in southwestern Colombia following an institutional management protocol.
Materials and methods: Patients with suspected SONK treated conservatively between January 1, 2012, and December 31, 2022, were retrospectively analyzed. Clinical improvement was assessed at a 12-week follow-up based on radiological progression according to the Ficat classification and the presence of pain.
Results: A total of 24 patients were included: 13 left knees and 11 right knees. The mean age was 69.7 ± 7.4 years. 58.3% were women. Sixteen knees had SONK stage I and eight had stage II. At a median follow-up of 4 months (range 3 to 12 months), progression was observed in 16.7% of cases with Ficat stage I, and no progression in patients with stage II. A favorable response was observed in 83.3% of cases, with no disease progression and no pain.
Conclusion: In cases of early-stage osteonecrosis of the knee (FICAT I and II), conservative management offers good results with a low rate of disease progression. In patients with atraumatic knee pain, further studies (MRI) are recommended to obtain an early diagnosis and prevent joint morbidity following collapse.
Keywords: Knee; Osteonecrosis; Conservative Treatment (MeSH).

Resumen

Introducción: la osteonecrosis (ON) de rodilla es una enfermedad progresiva que eventualmente puede causar colapso subcondral y osteoartrosis severa si no es tratada. La ON espontánea de rodilla (SONK), el tipo de ON de rodilla más frecuente, afecta principalmente a mujeres y adultos mayores.
Objetivo: presentar los resultados clínicos en pacientes con osteonecrosis espontánea de rodilla - SONK estadio Ficat I y II tratados de forma conservadora en una institución del suroccidente colombiano siguiendo un protocolo institucional de manejo.
Metodología: estudio descriptivo retrospectivo realizado con datos de 24 pacientes con SONK estadios Ficat I o II tratados conservadoramente entre enero de 2012 y diciembre de 2022 usando un protocolo institucional. La eficacia del tratamiento se determinó con base en presencia de dolor y de signos de progresión radiológica de la enfermedad (clasificación Ficat) al final del seguimiento.
Resultados: la edad promedio de los pacientes fue 69,7±7.4 años, 58,3% eran mujeres, en 66,6% la SONK se clasificó como estadio FICAT I y en 54,2% la ON afectó la rodilla izquierda. La mediana de seguimiento fue 4 meses (RIC: 3-12 meses) y se observó progresión radiológica de la enfermedad en solo 16,7% de los casos pacientes (todos de Ficat I a II) al final de seguimiento. Ninguno de los pacientes en los que no se observó progresión radiológica (83,3%) refirió presencia de dolor al final del seguimiento.
Conclusión: el protocolo de manejo conservador usado en nuestra institución ofrece resultados satisfactorios evidenciado en la tasa de progresión de la enfermedad, y en ninguno de los pacientes se indicó manejo quirúrgico al final de seguimiento.
Palabras clave: Rodilla; Osteonecrosis; Tratamiento Conservador (DeCS).

Introduction

Knee pain affects approximately 25% of adults and is a common reason for seeking medical care in the general population, accounting for nearly 4 million primary care visits each year.[1] In these patients, a common imaging finding is bone edema, which can be attributed to multiple causes, such as bone contusion, infections, rheumatic diseases, or tumors.[2,3] However, there is another group of patients, generally between the ages of fifty and sixty, in whom knee pain and the finding of bone edema could be attributed to the presence of osteonecrosis (ON) of the knee or to primary bone edema.[2,4] ON can occur in various anatomical locations, with the knee being the second most affected site after the hip.[5,6] Knee ON is a progressive disease of the subarticular bone that can eventually lead to subchondral collapse and severe osteoarthritis.[5–8] It was first described in 1968 by Ahlback *et al.* as the spontaneous onset of a lesion that typically affected the medial femoral condyle;[5–7,9,10] however, subsequent studies identified patients with characteristics and symptoms that did not fully align with the initial descriptions, leading to its current classification into three distinct conditions: Spontaneous Osteonecrosis of the knee (SONK), secondary ON, and post-arthroscopic ON.[5-7,10]

SONK is the most common form[5,7] and, unlike secondary ON, its exact etiology is unknown due to its complex and multifactorial nature,[6–8] although two main theories have been proposed (an underlying traumatic event or vascular involvement).[10–13] It occurs predominantly in individuals aged ≥50 years, being more common in women (3:1 ratio) and in older adults (incidence of 3.4% and 9.4% in people aged ≥50 years and ≥65 years, respectively).[5–8,13–15]

Regarding its clinical presentation, SONK is typically unilateral (>95% of cases) and affects a single condyle, primarily the Medial Femoral Condyle (MFC).[6–8,11–13,15] The most common symptom is acute-onset, non-traumatic, and disabling knee pain. Generally, the pain is localized on the affected side of the knee, and patients report that it worsens at night and with weight-bearing activities.[5,7,8,10,12,14] Furthermore, the most common finding on physical examination is focal tenderness along the joint line, particularly over the MFC,[5,6,9,14,16] but the presence of mild effusion and reduced range of motion due to pain are also common.[7,8] When it comes to diagnosis, bone edema and focal subchondral lesions are cardinal signs,[7,8,10,11] which is why in patients with acute unilateral knee pain of unclear etiology and imaging findings of bone edema, clinical suspicion of SONK should be high.

Although the initial evaluation of patients with these clinical features includes knee X-rays (anteroposterior, lateral, and oblique views),[5,7] these are generally normal in the early stages of the disease, especially if not much time has elapsed since the onset of symptoms; therefore, the diagnosis is often missed in the early stages if more sensitive imaging techniques are not used.[5,7,8,10,12] According to the literature, magnetic resonance imaging (MRI) is the gold standard for diagnosing SONK in its early stages due, on the one hand, to its high sensitivity and specificity for detecting and evaluating bone edema, a cardinal sign of the disease present from its onset, and associated lesions;[5-8,16-19] on the other hand, to its usefulness in assessing the extent of the disease, including meniscal and chondral damage,[6,8,15] which is essential for designing the treatment plan.[8] Nevertheless, X-rays can aid in diagnosis in advanced stages, with the presence of radiolucency, sclerosis, and/or subchondral collapse and flattening of the affected condyle being typical findings.[5,7,8] In addition, laboratory tests should also be performed to rule out other causes of knee pain, such as infection or inflammatory arthritis.[8]

Staging and monitoring of disease progression are performed using X-rays.[6,7,14] There are two staging systems: the Koshino classification (stages 1–4), based on clinical and radiographic findings, and the Ficat classification (stages I–IV), based on chondral collapse and joint space narrowing evident on X-rays.[5–7,13] Treatment for SONK can be conservative or surgical, and the choice depends primarily on the size of the area of ON and the stage of the disease. Generally, conservative management is the first-line treatment for patients with osteonecrotic lesions <3.5 cm² and in early stages. In contrast, lesions >3.5 cm² require surgical management. Lesions between 3.5 cm² and 5 cm² show a high degree of radiographic progression, and those >5 cm² cause condylar collapse.[5–8,12,13,20] Conservative treatment includes measures such as protected weight-bearing, oral analgesics, nonsteroidal anti-inflammatory drugs, physical therapy, and the use of wedge insoles,[5,7,8,12-20] with satisfactory results in terms of symptom improvement and knee function in most patients if initiated in the early stages.[7,12] The use of bisphosphonates has also been proposed as a treatment alternative, as several authors have reported their potential efficacy in halting the progression of osteonecrosis; however, results are inconsistent across studies.[5,7,8,12] Another conservative management modality currently under study is pulsed electromagnetic field therapy, which has shown promising results in case series in terms of reducing pain, the size of the necrotic lesion, and the area of bone edema.[7,21] Regardless of the treatment protocol, if there is no improvement3–6 months after the start of conservative management, surgical intervention should be considered.[7,8]

Despite this, there are few studies reporting data on the clinical outcomes achieved with the various conservative treatment regimens used in these patients.[22] Given this, the objective of the present study was to present the clinical outcomes achieved in patients with Ficat stage I and II SONK treated conservatively at a healthcare facility in southwestern Colombia, following an institutional management protocol.

Methodology

Type of Study

Descriptive retrospective study.

Study Population Sample

The study population consisted of adults (>18 years) diagnosed with SONK who were treated conservatively at a tertiary care facility in Cali (Colombia) between January 1, 2012, and December 31, 2022. Patients with Ficat stage I or II SONK who were treated conservatively in the clinic's knee surgery department and for whom knee X-ray and MRI images were available in the institution's radiology system were included. Patients with an indication for surgical treatment (Ficat III or II), a follow-up period <12 weeks, or incomplete medical record data for the variables of interest were excluded.

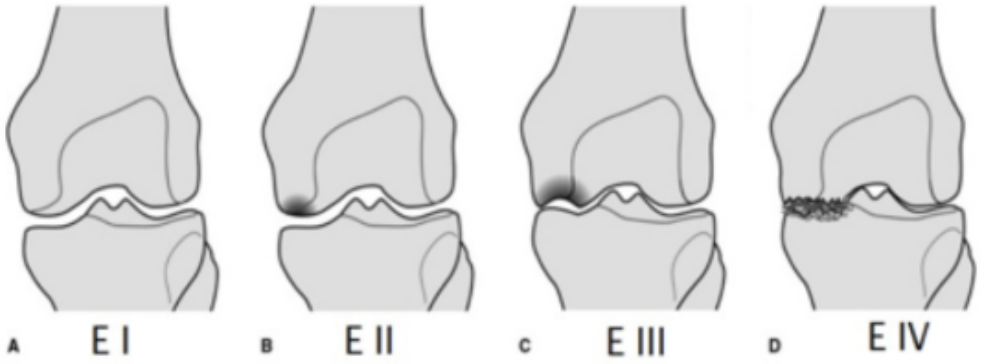
It should be noted that all patients presented with the classic symptoms and signs of SONK (acute, non-traumatic unilateral knee pain of moderate to severe intensity, with or without swelling; limping or difficulty walking; bone edema on MRI (Figure 1) that could not be explained by neoplastic, infectious, or degenerative pathology, and associated imaging findings such as subchondral lesions, crescent sign, or low signal in

the subchondral band, joint effusion, irregular joint margins, meniscal lesions [meniscal root, meniscal extrusion], or soft tissue edema).

The diagnosis was made after ruling out a history of rheumatic disease, gout, grade III or higher osteoarthritis, sickle cell disease, knee infection, joint effusion within the past year, knee trauma within the past 3 months, knee surgery, alcoholism, smoking, or prolonged use of corticosteroids. In addition, the lead author was responsible for the follow-up of all patients.

Procedures and Variables

Based on a review of the medical records, the following information was collected for each patient: Age; sex; laterality of the affected knee; BMI; FICAT stage at the time of diagnosis; follow-up duration; gait disturbance; history of diabetes; and presence of (self-reported during the initial physical examination) pain; functional limitation in activities of daily living; feeling like the knee buckled; and feel a block to knee motion. In addition, knee X-rays and MRIs were reviewed to obtain information on the following variables: Presence of angular deformity; structure of the knee affected by ON; associated MRI findings; and Ficat stage at the end of follow-up. Treatment effectiveness was determined based on radiographic progression (modified Ficat classification for the knee - Figure 1) and the presence of pain at the end of follow-up.



A. Stage I: No radiographic evidence of osteonecrosis of the knee. The femoral condyles appear normal, with no sclerosis and normal curvature.
B. Stage II: Signs of mottled sclerosis are evident, but the structure of the articular bone remains intact.
C. Stage III: presence of the crescent sign, which is indicative of a subchondral fracture.
D. Stage IV: collapse of the subchondral bone.
Figure 1. Modified Ficat and Arley Classification for the Knee[23]
Source: Adapted from Calvo *et al.*[24]

Description of the Conservative Treatment Initiated

According to the management protocol for patients with suspected SONK established at our institution, once the diagnosis is confirmed, those with early-stage SONK (modified Ficat I and II for the knee - Figure 1) and with symptoms that began less than 3 months should be treated conservatively. The conservative management protocol consists of analgesia with acetaminophen plus codeine or hydrocodone during the first 72 hours after diagnosis, weight-bearing protection (primary measure), use of Acetylsalicylic Acid (ASA) at antiplatelet doses, and vitamin D supplementation therapy (7,000 IU/week), vitamin C (1.5 g/day), and zinc (25 mg/day) until resolution of symptoms and confirmation

of remission of the osteonecrotic lesion. Given that available studies show controversial or no clinical benefit for bisphosphonates[25-27] and limited evidence for shockwave therapy,[2,28,29] these strategies are not used in our protocol. NSAIDs are also not used because they have been shown to delay bone healing.[30,31]

Once treatment has begun, monthly clinical and radiographic follow-up is performed to assess disease progression and symptoms and to determine whether the response has been adequate or whether surgical management is required. In addition, monthly follow-up should be conducted for at least 3 months and until symptoms resolve and there is radiographic confirmation of lesion remission, or a decision is made to change the therapeutic approach. The management protocol is presented in Figure 2.

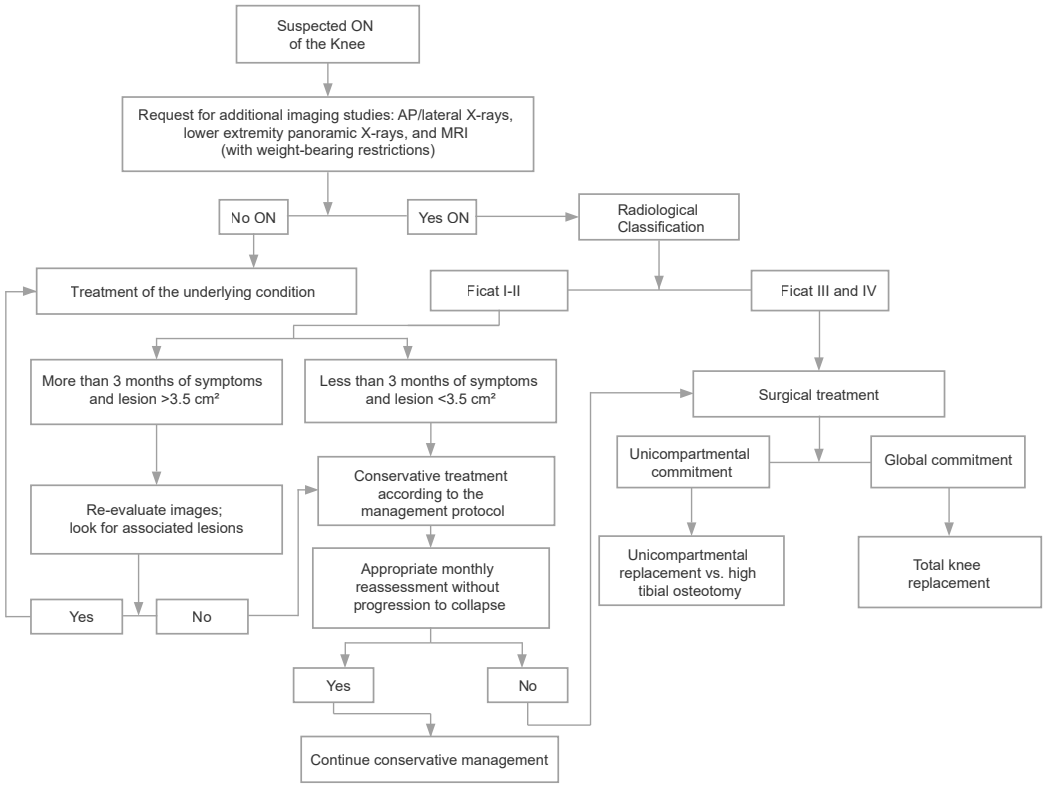


Figure 2. Flowchart of the Protocol for Managing Patients with Suspected Knee Osteonecrosis Implemented at the Healthcare Facility where the Study was Conducted
Source: Own elaboration.

Statistical Analysis

The data were entered and organized in a pre-designed template created by the authors in Microsoft Excel and then exported to Stata (version 17; StataCorp, TX, USA) for analysis. Data are described using absolute frequencies and percentages for qualitative variables, and means, medians, standard deviations, and interquartile ranges for quantitative variables, based on the results of the normality test (Shapiro-Wilk). Radiological progression (Ficat classification) between the start of treatment and the end of follow-up was assessed using the nonparametric McNemar test. A level of statistical significance of $p<0.05$ was considered.

Ethical Considerations

This study adhered to the ethical principles for conducting biomedical research on human subjects established in the Declaration of Helsinki32 and the scientific, technical, and administrative standards for health research set forth in Resolution 8430 of 1993 issued by the Colombian Ministry of Health and Social Protection.[33] It was also approved by the Research Ethics Committee of Clínica Imbanaco S.A.S., as per minutes CEI-783 dated June 14, 2023.

Results

A total of 29 patients with SONK were treated at the hospital between January 1, 2012, and December 31, 2022. Of these, 2 were excluded because they underwent surgical treatment (Ficat III), and 2 because their follow-up period was less than 3 months; consequently, 24 patients were ultimately included in the study.

The average age at diagnosis was 69.7±7.4 years; 58.3% were women; in 66.6% of cases, SONK was classified as Ficat stage I; and in 54.2% of cases, the condition affected the left knee. The average BMI was 28.4±4.1 kg/m², 79.1% were overweight or obese, and 12.5% had diabetes *mellitus*. Regarding the initial assessment, 100% of patients reported moderate to severe pain, 87.5% reported functional limitations in activities of daily living, and gait disturbance and angular deformity were observed in 66.7% and 52.3%, respectively. Regarding MRI findings, the meniscus was the most affected site (62.5%), and meniscal lesions, meniscal tears, and joint effusion were the most frequent associated findings (87.5% of cases each). The demographic, clinical, and imaging characteristics of the patients are presented in Table 1.

Table 1. Demographic, clinical, and imaging characteristics of patients with Ficat I and II SONK treated conservatively (n=24)

Variable	n (%)
Age (years), mean±SD	69.7±7.4
Sex	
Female Male	10 (58.3) 14 (41.7)
Laterality	
Right Left	11 (45.8) 13 (54.2)
IMC (kg/m²), mean±SD	28.4±4.1
Nutritional Status	
Normal weight Overweight Obesity	5 (20.9) 11 (45.8) 8 (33.3)
Diabetes *mellitus*	3 (12.5)
Functional limitation	21 (87.5)
Feeling of blockage	3 (12.5)
Sensation of giving way	4 (4.2)
Gait disturbance	16 (66.7)
Angular deformity	
No Genu varo Genu valgo	10 (41.7) 12 (50.0) 2 (8.3)

Variable	n (%)
Ficat classification at diagnosis	
Degree 1	16 (66.6)
Degree 2	8 (33.3)
Structure affected on MRI	
Medial condyle	15 (62.5)
Lateral condyle	2 (8.3)
Medial plate	6 (25.0)
Condyle and medial plate	1 (4.2)
MRI finding	
Joint effusion	21 (87.5)
Meniscal root tear	3 (12.5)
Meniscal injury	21 (87.5)
Meniscal extrusion	13 (54.2)
Depression or irregularity	2 (8.3)
Subchondral lesion	17 (70.8)

Source: Own elaboration
SD: Standard deviation; BMI: Body mass index; MRI: Magnetic resonance imaging.

The median follow-up was 4 months (IQR: 3–12 months). At the end of follow-up, disease progression was observed in only 4 patients (16.7%; FICAT I to FICAT II), for a total of 12 patients (50%) with FICAT I and 12 with FICAT II (Figure 3), with no significant differences in radiological progression between the time of diagnosis and the end of follow-up (p=0.125). In addition, the 20 patients who showed no signs of progression (83.3%) reported feeling no pain.

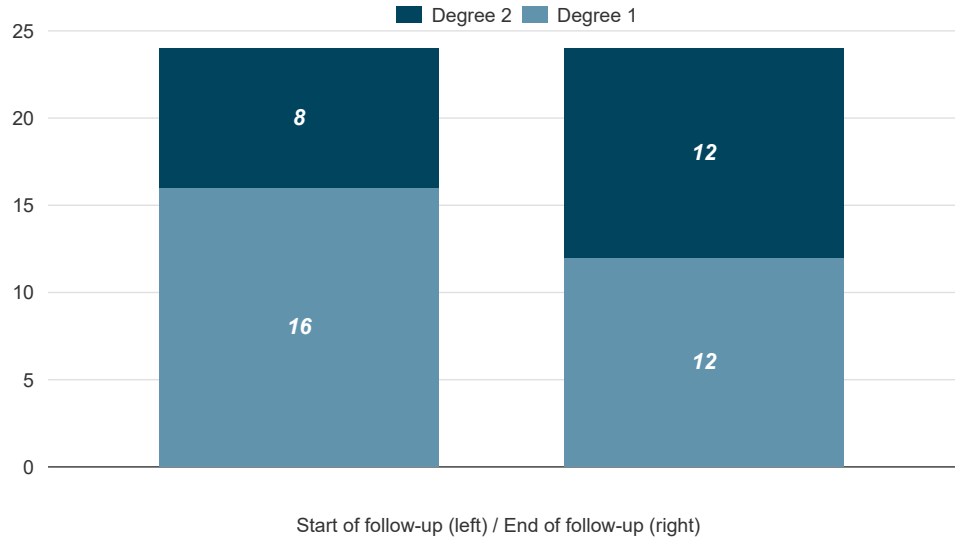


Figure 3. Distribution of SONK according to FICAT classification at the start of treatment and at the end of follow-up
Source: Own elaboration.

Discussion

The findings of this study demonstrate that the conservative management protocol implemented at our institution is effective for the treatment of early-stage SONK, as radiological progression was observed in only 16.7% of patients during follow-up (from Ficat I to Ficat II in all cases); consequently, the treatment approach was not modified

for any patient. Furthermore, based on clinical and radiographic findings, surgical management was not indicated in any of the patients at the end of follow-up; that is, conservative management was 100% effective. These results are consistent with those reported in the case series by Jordan *et al.*[12] (96% effectiveness in 40 cases without information on disease classification), and Yates *et al.*[19] (100% in 20 cases of stage I SONK in 14 patients). Other authors have reported lower effectiveness rates of 81.82%[34] and 75%.[35] Table 2 presents the main characteristics of studies on the effectiveness of conservative management protocols for SONK.

Table 2. Studies reporting data on the use of a conservative management protocol for SONK like the one implemented

Author	Country	Period of Study	Number of Patients	Koshino Classification at the Start of the Study (number of patients by stage 1/2/3/4)	Pre-collapse / Post-collapse Grouping (Koshino ↔ modified Ficat for the knee)*	Duration of Treatment	Conservative Management Protocol Used	Results
Aglieti *et al.*[34], 1983	Italy	1966-1980	105 knees (91 patients), of which 22 were treated conservatively.	0/6/7/6/3-	59% pre-collapse and 41% post-collapse.	The duration of treatment is not reported, but the average follow-up period (3.7 years) was reported.	Weight-bearing exercises, pain relief, and isometric exercises to strengthen the quadriceps.	Satisfactory clinical outcomes were observed in 18 of the knees (81.82%: excellent in 9 and good in 9) at follow-up. Significant differences were observed in knee function before and after treatment (70 points vs. 82 points; $p<0.05$). During follow-up, the osteonecrotic lesion had almost completely disappeared in one knee (4.54%), had improved in 8 (36.36%), remained unchanged in 7 (31.82%), and worsened in 6 (27.27%)
Marti *et al.*,[35] 2000	Switzerland	1992 - 1995	10 patients with medial compartment SONK, 4 of whom were treated conservatively (3 men, 1 woman; average age 59 years).	2/1/0/1	75% pre-collapse and 25% post-collapse.	3 months.	Pain relievers and partial weight-bearing.	Two patients showed clinical improvement after treatment; however, there were no significant differences in the mean Knee Society Score. Regarding radiological evaluation, progression of the lesion was observed in one patient (stage II to IV; 25%). Regarding MRI findings, edema decreased in 3 patients (75%), but the area of necrosis decreased in only 1 (25%).
Yates *et al.*,[19] 2007	England	2001 - 2003	20 knees (14 patients: average age: 52 years; 11 men; 3 women).	20/0/0/0	100% pre-collapse.	Patients were treated until their pain subsided. The average time from symptom onset to resolution was 4.8 months.	Weight-bearing restrictions or limitations on activities requiring full weight-bearing, along with pain relief using NSAIDs or acetaminophen.	All patients reported an improvement in their symptoms. In all cases with follow-up MRI (n=19), complete resolution of the abnormal MRI findings was observed, with an average time to resolution of 8 months.

Author	Country	Period of Study	Number of Patients	Koshino Classification at the Start of the Study (number of patients by stage 1/2/3/4)	Pre-collapse / Post-collapse Grouping (Koshino ↔ modified Ficat for the knee)*	Duration of Treatment	Conservative Management Protocol Used	Results
Jordan *et al.*,[12] 2015	United Kingdom	2001 - 2014	40 knees (37 patients: average age 55.3 years, 67.5% men).	Classification information not available.	No classification information is available, but it is inferred that 100% occurred prior to the collapse.	6 weeks Average follow-up period: 10 months.	Touch-down weight-bearing exercises under the supervision of the physical therapy department.	All 28 patients for whom scores on functional scales (Tegner, WOMAC, Lysholm, IKDC, EVA) were recorded at the time of symptom onset and at the final follow-up showed statistically significant improvements ($p<0.0001$).
Akamatsu *et al.*,[14] 2017	Japan	2009 - 2013	54 (27 underwent surgical treatment and 27 received conservative management; median age of 74 and 68 years in the conservative and surgical groups, respectively).	10/15/2/0	92.6% before the collapse and 7.4% after the collapse.	It does not specify; they only mention that the follow-up period was 12 months after the onset of symptoms.	Restricted weight bearing and daily activities and nonsteroidal anti-inflammatory medications	No information is provided on radiological progression; the study focuses on predictive factors during the initial assessment of a poor 1-year prognosis from symptom onset (AFT >180 and depth ≥20 mm on MRI). It describes only the initial assessment and does not provide information on radiological follow-up or patient progression.
Fujita *et al.*,[36] 2016	Japan	Not specified.	1 (72-year-old man)	0/0/1/0	100% post-collapse.	Approximately 4 months, although it is not specified directly, it is reported that, given the persistence of symptoms and evidence of disease progression on MRI 4 months after the initial evaluation, the patient underwent unicompartmental knee arthroplasty.	Initial nonsurgical treatment included restricted weight bearing on the affected lower leg, hyaluronic acid injections, and administration of NSAIDs	Persistent symptoms with evidence of progression (RNM).

*To facilitate comparison with previous series that used the Koshino classification, we grouped the lesions into pre-collapse (Koshino I–II / Ficat I–II) and post-collapse (Koshino III–IV / Ficat III-IV), since both classifications consistently distinguish between early stages without subchondral collapse and advanced stages with collapse and osteoarthritic changes.[5,7,37]
The article by Aglieti *et al.*[34] mentions a modified Koshino classification, in which they refer to a Stage V; however, the key distinction lies in the fact that, in this modified classification, the lesions grouped as pre-collapse stages are Koshino I, II, and III (with stages II and III being a subdivision of the former stage II, considering stage II to involve flattening upon weight-bearing, and stage III to involve chondral shadowing associated with clear pre-collapse sequelae), and the post-collapse stages remain Koshino IV and V without changes.
+The treatment performed in the included studies must be consistent with the institutional protocol we are describing: It is a conservative treatment based on restricted weight-bearing (RWB).
NSAIDs: Nonsteroidal anti-inflammatory drugs; MRI: Magnetic resonance imaging.

In the present study, the mean age was 69.7 years, which is higher than the mean ages reported in the studies by Yates *et al.*,[19] Jordan *et al.*[12] and Martin *et al.*[35] (52, 55.3, and 59 years, respectively), but lower than the median age reported by Akamatsu *et al.*[14] for patients who received conservative treatment (74 years) and the age of the patient described in the case report by Fujita *et al.*[36] (72 years).
In this regard, given that most studies reporting conservative management protocols for SONK involve older adults, it could be hypothesized that joint stress in this population - which is much lower than in younger patients - may play a protective role against disease progression, particularly considering that weight-bearing protection, a cornerstone of conservative treatment, might be more effective in this population. Nevertheless, it

should also be noted that SONK generally affects individuals aged ≥50 years, being more common in those aged 65 years,[5-8,13-15] and that low bone mineral density, a characteristic of the elderly population due to the progressive loss of bone mineral density after the sixth decade of life,[39], is a factor associated with the presence of SONK.8,[39]
The most affected anatomical structure was the medial condyle (62.5%) (Figure 4), followed by the medial meniscus (25%), which is like the findings reported by Jordan *et al.*[12] and Veloz-Serrano *et al.*[7]

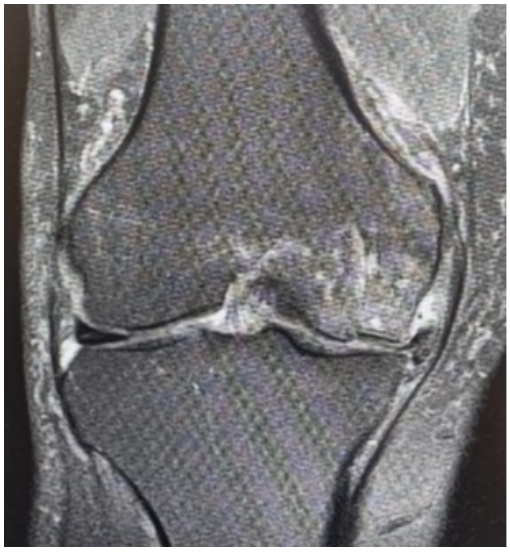


Figure 4. Magnetic resonance imaging of the right knee (coronal view). Bone edema is observed in the medial condyle, along with irregularity of the joint contour, a subchondral cyst, meniscal extrusion, and edema of the surrounding soft tissues
Source: Image obtained during the study.

In a study involving 54 patients with SONK who underwent either conservative treatment (n=27) or surgical treatment (n=27), Akamatsu *et al.*,[16] found that a femorotibial angle >180° and a chondral lesion depth >20 mm on the sagittal slice of the initial MRI (within the first week following the initial evaluation) were significantly associated with a higher risk of disease progression 1 year after symptom onset. Although it was not possible in our study to evaluate the association between progression to surgical management and angular deformity because femorotibial angle measurements were not available for all patients, a notable finding is that in no patient did SONK progress to a stage requiring surgical treatment.
Another finding worth noting is the high frequency of meniscal tears as an associated injury on MRI (87.5%), which is even more common than the presence of subchondral lesions (70.8%), a typical feature in the natural history of ON. In this regard, Chambers *et al.*[40], in a study that included 12 knees with SONK (11 patients), reported that 11 knees (91.67%) had a medial meniscal tear. Similarly, Nelson *et al.*[41] reported that of 34 knees with SONK (32 patients), 31 (91.18%) had a meniscal tear.
The literature has reported that meniscal extrusion is common in patients with SONK (63–100%);[42,43] however, in our study, the proportion of knees with meniscal extrusion was lower (54.2%). Finally, only 12.5% of patients had a meniscal root tear, a much lower proportion than the 62.2% described by Yamagami *et al.*[44] in 45 patients with SONK.

This study has several limitations that should be considered when interpreting the results reported here. First, the small sample size. Second, its retrospective nature implies a potential bias in the data, as it is not possible to guarantee the accuracy

of the data recorded in the medical records, especially considering that the analysis period spanned 10 years. Third, the absence of a control group (surgical management) prevents a comparison of the conservative treatment protocol regarding its efficacy in terms of SONK progression. Fourth, the short follow-up period (median of 4 months) makes it impossible to determine whether the concomitant presence of extrusion and meniscal tears is an incidental finding occurring simultaneously with ON or whether it is a predisposing factor. In this regard, prospective studies with longer follow-up periods, larger sample sizes, and the inclusion of control groups (surgical management) are required, as this will allow for a more rigorous evaluation of the effectiveness of conservative management protocols for SONK, such as the one used at our institution.

Conclusion

The conservative management protocol used at our institution yields satisfactory results, as evidenced by the disease progression rate, and none of the patients required surgical intervention at the end of follow-up.

Conflicts of Interest

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