Case Report

Physical Medicine and Rehabilitation of Knee Osteoarthritis Grade 3-4 with Valgus Deformity

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ABSTRACT

Introduction: Osteoarthritis is an arthritic disease caused by joint cartilage damage that affects an estimated 302 million people worldwide. Factors that increase the risk of OA include being a woman, being over 45, obesity, bone deformities, joint injuries, and repetitive strain on specific joints. Osteoarthritis is the leading cause of disability among older adults and requires high healthcare and rehabilitation costs. The primary focus of treatment is symptom management and maintenance or restoration of functional capacity. The PMR programs include therapeutic exercises, modalities, education, and lifestyle modification (knee joint conservation). We aimed to determine the impact of the PMR program, combined with pharmacological therapy, on 3rd-4th grade OA patients.
Methods: A woman, aged 62 years, diagnosed with right knee OA grade 3-4 with valgus deformity. The subject has chronic and progressive knee pain by the visual analog scale (VAS) was 4-5, limited range of movement (ROM) in the right knee, and low back pain. The patient performed a medical rehabilitation program combined with pharmacological therapy at Mitra Husada Pringsewu Hospital for 6 weeks, and it was evaluated.
Results: Patient in comparison before and after treatment, pain was reduced from VAS score 4-5 to 3-4, ROM from extension-flexion angle 15-90^o to 5-110^o, Q angle remained the same, and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score was decreased from 11-5-34 to 9-3-30.
Conclusion: A nonpharmacological and pharmacological therapy combination in medical rehabilitation programs is needed to reduce pain, improve ROM, and improve the patient's quality of life.

Keywords: *Knee Osteoarthritis, Medical Rehabilitation Program, Pain, Range of Motion, Knee Valgus, Q angle, WOMAC score, Quality of Life.*

INTRODUCTION

Osteoarthritis, according to the American College of Rheumatology (ACR), is an arthritic disease caused by joint cartilage damage. Affecting around 302 million people worldwide, OA is the most common form of arthritis and a primary cause of disability among older adults. The knee, hip, and hand joints are the most typical sites for this condition.[1-3] The 2018th Basic Health Research in Indonesia revealed that the prevalence of joint disease increases with age, with the highest being in the group of 75 years and over (around 18.95%).[4] OA in the weight-bearing joints of the lower extremities is very common. Knee OA is the most diagnosed form of arthritis, and it's expected to affect more people as they live longer and obesity rates go up.[1-3,5] Depending on the source, roughly 18% of women and 10% of men 60 years and older have symptomatic knee osteoarthritis.[1]

The risk of OA is higher in those over 45, women, obese individuals, and people with bone deformities or joint injuries. Jobs with repetitive joint stress also increase risk.[1] While initially considered a "wear and tear"

condition of cartilage, OA is now understood as a chronic disease affecting all parts of the joint (cartilage, meniscus, ligaments, and surrounding muscles) and arising from various factors.[2,3,6-8] OA involves cartilage damage, bone remodeling, and joint inflammation, resulting in pain, stiffness, swelling, and impaired joint function.[2]

Pain or functional limitations are the usual presenting complaints. Patients typically complain of joint pain that is worse with weight bearing and improved with rest. Due to its chronic and progressive nature, thus interferes with daily activities.[2,3] Decrease of muscle strength due to inactivity because of pain, caused by knee joint deformity, and the pain worsening, which leads to disability. Knee OA causes pain and disability, resulting in high healthcare and rehabilitation costs. Disability from knee OA is influenced by many things, including social factors, severity of the x-rays, knee pain, other

health problems (like high blood pressure, diabetes, and high cholesterol), and mental health.[5]

The primary focus of treatment is symptom management and maintenance or restoration of functional capacity by combining nonpharmacological and pharmacological interventions. Patient management should include lifestyle modifications, dietary interventions, and a physical exercise program, with emphasis on both aerobic activity and exercises to strengthen the muscles surrounding the knee joint.[2,3,5,8,9] Therapeutic exercises like strengthening, stretching, and aerobics can help improve joint stability and reduce pain. Methods to lessen stress on joints include losing weight, using knee braces, and employing walking aids like canes.[2]

CASE REPORT

A 62-year-old woman complaining of right knee pain for more than 2 years. The pain has gotten worse in the last 6 months. VAS is 4-5 and worsens during activities such as walking, standing for a long time, praying, and going up/down stairs. Pain felt for less than 30 minutes, and reduced by rest, and taking medication from a doctor. The pain doesn't radiate, but recently the patient has also had low back pain. Low back pain (VAS 3-4) was felt for 2 weeks, localized, worsened during activities, and reduced by rest. The patient also complained of stiffness for about 15 minutes in the morning and crepitation on the right knee during movement.

The patient said she still can perform his daily activities such as toileting, cooking, cleaning the house, but she was praying in a sitting position, and has not participated in religious activities near the house for the last 1 month. The patient lives with her husband, who is 65 years old, and undergoes her rehabilitation program accompanied by her son. Her husband is a retired civil servant, while her son is an elementary school teacher in another city, and he can accompany her during the holiday school season.

She denied a history of hypertension, diabetes, and history of trauma. There was an unknown history of knee OA in the

family. She admitted that she had more body weight of bodyweight than now. Her social economy was middle class, and her daily activity was doing household chores. She felt that daily activities were disturbed because of the pain.

Figure 1. Posterior (a) and Anterior (b) View of The Patient Standing Position

Figure 2. Right lateral (a) and left lateral view (b) of the patient standing position

Physical Examination

On the general examination, she walked with an antalgic gait. She was compos mentis, vital signs were normal. Body height was 156 cm, with a weight of 70 kg, the body mass index (BMI) was 28,76 kg/m$^{2.}$ (1st degree obesity). The head, neck, abdomen,

and upper extremities were within normal limits, whereas paralumbar muscle spasm was found in the torso. Neurological manual muscle testing (MMT) of the upper extremities was 5555/5555, and lower extremities were 5555/4444 due to the pain. From the knee examination, there was mild oedema on the right knee, with no redness and muscle atrophy. There was pain in palpation, no palpable warmth, but there was crepitation during passive and active movement, positive patellar grind test, and positive valgus stress test.

The alignment of the knee was valgus, with the Q angle being 20 ° in the standing position and 16 ° in the supine position. There was a limitation in the range of motion of the right knee. It found there was a limitation in full passive extension and flexion; maximal extension was 15º, and flexion was 90º. The anterior drawer test, posterior drawer test, varus stress test, Lachman's test, and McMurray test were

negative. The left knee is within normal limits.

Figure 3. Anterior View of The Patient Supine Position

Supporting Examination

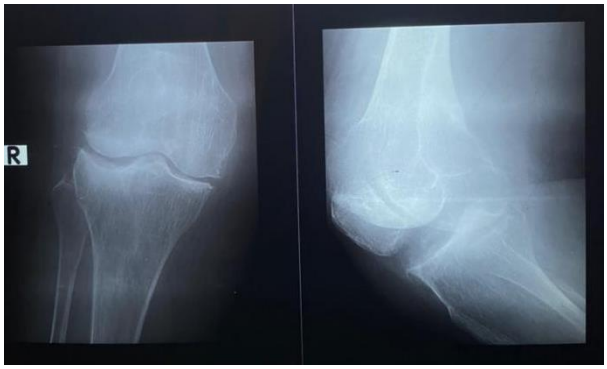

Figure 4. AP-Lat Knee X-Ray (January 2023)

Diagnosis

Based on anamnesis, physical examination, and supporting examinations, the patient's diagnosis was grade 3-4 OA of the right knee. Diagnosis functions according to the International Classification of Functioning, Disability and Health (ICF):

a. Body functions are sensation of pain, mobility of joint functions (b710), and antalgic gait/gait pattern functions (b770).

b. Body structures impaired in the patient were the structure of the lower extremity/valgus deformity (s750).

c. Activity limitation was carrying out the daily routine (d230).

d. Participation problems were limitations in doing housework (d640), community life (d910), and religion and spirituality activities and participation (d930).

e. Environmental factors were products and technology for personal use in daily living, such as a squat closet (e115), and design, construction, and building products and technology for building for private use, such as uneven contour in the home (e155).

Activities of daily living, functional mobility, gait, general health, and quality of life was measured by WOMAC index. The score was 11 for pain, 5 for stiffness, and 34 for difficulties that the patient had in doing daily physical activities.

Objective of Medical Rehabilitation Program

a. For the short term were reducing pain

measured by VAS, decreasing oedema on the right knee, maintaining and improving muscle strength, and ROM on the right knee.

b. Mid-term goals were orthosis measurement, orthosis fitting, orthosis uses, walking with orthosis and ambulation aid, education on orthosis maintenance, and ambulation aid.

c. Long-term goals were improving knee alignment and gait, preventing further complications (atrophy, stiffness), improving the patient's psychological condition of illness, optimizing her household activities, and reactivity in the community.

Management

The patient performed a medical rehabilitation program combined with pharmacological therapy. Pharmacological treatment included oral and topical nonsteroidal anti-inflammatory drugs (NSAIDs), a muscle relaxant, and sodium hyaluronic injection. Prescribed medications were sodium diclofenac 2x 50 mg, eperison HCL 2x 50 mg, and a topical NSAID. Arthrocentesis was also performed by neurologists to reduce knee swelling and pain.

In the Physical Medicine and Rehabilitation Department, the patient was managed conservatively with medical rehabilitation programs and home programs. The medical rehabilitation programs consist of cold therapy, modalities, therapeutic exercises such as strengthening exercises, endurance exercises, stretching exercises, dan ROM exercises. Icing of the right knee duration was 10-15 minutes. Modality was using Hi TENS (100 Hz genu D/S, duration 30 minutes, frequency 2x/week) and Short Wave Diathermy (SWD) (warm as tolerated, 30 minutes, frequency 2x/week).

Strengthening exercise: isometric strengthening exercise (if VAS>4) of the quadriceps and hamstrings, 80% contraction maximal for 6 seconds, then 12 seconds for rest. Repeat 4-6 sets 3 times a week. When Patient's VAS < 4, isotonic strengthening exercise is recommended with Frequency: 3x/week, Intensity: 50% 10-RM, Time: 6x repetition, 3 sets, Type: isotonic strengthening exercise,

Progressivity: increase 10 % per week if it's possible.

Endurance exercise, F: 5x/week, I: start low, go slow (heart rate: resting HR+20), T: 5 minute warming up, 20 minute main, 5 minute cooling down, T: Endurance exercise, P: increase duration if it's possible by cycling or swimming.

Education for patient was to lose weight to ideal BMI, avoid going up and down stairs or hiking, sitting in a short chair, sitting on the floor, squatting, standing and walking (knee joint conservation), motivated to follow the medical rehabilitation program regularly, using an ergonomic chair and table while doing housework, doing sports that have a non-weight bearing/low weight bearing on the knees, such as swimming or cycling. If it is impossible to avoid going up and down stairs, we taught the patient to go up the stairs starting with the healthy side and go down the stairs starting with the painful side of the knee.

Education of family members to assist/support the patient in completing the rehabilitation program and assist her to alleviate pain and become independent in the activities of daily living (ADL).

RESULT

The patient admitted that the pain was reduced, with a VAS was 3-4. Lower extremity muscle strengths were improved (upper extremities 55555/55555 and lower extremities 5555/5555) with ROM improvement. Low back pain was reduced, from VAS 3-4 to 2-3. There was no local knee edema and erythematous skin on inspection, no palpable warmth, but there

were still found the knee crepitation during passive and active movement, positive valgus stress test, positive patellar grinding test, and improvement of ROM limitation (from E-F angle 15-90^{o} to 5-110^{o}. The alignment of the right knee was valgus, with the Q angle being 20° in the standing position and 16° in the supine position. We recommend using orthoses such as a knee brace and a cane to reduce the biomechanical load on the affected compartment of the knee, thereby reducing pain and improving quality of life measured by the WOMAC score. The WOMAC score after Physical and Rehabilitation Medicine (PMR) programs was decreased, from 11-5-34 to 9-3-30.

DISCUSSION

OA is a degenerative joint disease that arises from the deterioration of joint cartilage. It involves various changes in the entire joint, such as cartilage loss, bone reshaping, the growth of bony spurs (osteophytes), and inflammation of the synovial membrane.[1,9] OA has the potential to affect any or all of the three primary knee compartments: the medial, patellofemoral, or lateral compartments. The involvement of the lateral compartment can lead to a knock-knee deformity. Arthritis in one part of the knee can potentially spread to another part over time because the way stress is distributed across the knee changes.[2,3]

The typical presenting complaints consist of pain or functional limitations. Patients commonly report experiencing joint pain that is exacerbated by carrying weight and relieved by rest. In this case, the patient experiences several functional disorders, such as a sensation of pain for more than 2 years, and impairment mobility of the knee joint. The patient admits that the activity factor that's disturbed was carrying out daily routine, whereas the participation factor was a limitation in household tasks, community, and religion and spirituality activities. The patient was affected by environmental factors, including the presence of a squat closet and irregular contours within their home. The primary symptoms observed in patients are pain and reduced function, so the therapy objectives are focused on pain reduction and enhancement of mobility.[10]

The diagnosis is determined through a comprehensive assessment that includes anamnesis, general inspection, and measurements such as palpation, ROM examination, gait, and radiological imaging using X-ray. The American College of Rheumatology (ACR) classification criteria for knee OA are a widely employed approach in the categorization of knee OA. In the ACR Clinical/Radiographic classification criteria, the presence of knee pain with at least one of the following three items, along with osteophyte in knee X-Ray, can classify the knee OA in patients:

a. Age> 50 years old
b. Morning stiffness < 30 minutes
c. Crepitus on knee motion

Based on clinical and radiographic criteria from ACR and Kellgren and Lawrence classification, the patient was diagnosed with Grade 3rd-4th right knee OA. The patient presents with obesity and a 62-year-old age as risk factors.

The prevalence and incidence of OA are most strongly influenced by advanced age. The precise mechanisms underlying joint damage remain uncertain; nevertheless, it is believed that joint injury may arise from a combination of factors, including oxidative damage, thinning of cartilage, weakening of muscles, and impaired proprioception. The progressive aging process is associated with a decline in the tensile qualities of cartilage, primarily due to the accumulation of glycation, which subsequently leads to mechanical failure. [11, 12]

Table 1. Kellgren and Lawrence Grade of OA Classification[2]

Grade	Description
0	No radiographic findings of osteoarthritis
1	Doubtful narrowing of joint space and possible osteophytic lipping
2	Definite osteophytes with possible narrowed joint space
3	Definite osteophytes with moderate joint space narrowing and some sclerosis
4	Definite osteophytes with severe joint space narrowing, subchondral sclerosis, and definite deformity of bone contour

Analysis of two prospective cohorts by J. Wei et. al. (2019) showed that patients aged 50-79 years developed lateral and medial tibiofemoral OA (by radiographic evaluation) during the 60-month follow-up period. As age increased, so did the likelihood of both medial and lateral tibiofemoral OA, but this relationship was more evident in lateral tibiofemoral than evaluated by every 5-year increase in age.[12]

The female gender is also known as a risk factor for having OA.[1] Furthermore, the research showed that while female gender was not significantly associated with the risk of medial tibiofemoral OA, it was significantly associated with a higher risk of lateral tibiofemoral OA. Characteristics more common in women, such as a wider pelvis, a larger Q-angle, and a greater tendency for knock-knees, can increase

the stress on the outer part of the knee during activities where weight is put on the legs. This might explain why the previous finding was specific to that area.[12]

Obesity represents the foremost modifiable risk factor with the highest potential for influencing the treatment of the disease. Obesity puts more stress on joints, which is the main reason they wear out. On the other hand, obesity diminishes cardiorespiratory and large muscle endurance, leading to limitations in performing activities, and leads to disability. Fat tissue also releases substances like leptin, resistin, and adiponectin. These substances worsen joint damage.[1,2,11] The incidence of knee OA exhibited a twofold rise among individuals who are classified as obese.[12]

Controlling obesity is vital for individuals with knee OA as it helps lessen pain, improve knee function, and boost their capacity for aerobic exercise.[2,6,15] There exists empirical evidence indicating a notable decrease in pain levels and enhanced physical performance and functionality among elderly individuals following a therapy regimen encompassing modest weight loss and moderate exercise. By decreasing the BMI from a value over 30 to below 25, it is estimated that approximately 29% of cases of knee OA could be averted.[11] Moreover, it is worth noting that there is a progressive increase in clinically significant advantages associated with weight reduction of 5–10%, 10–20%, and greater than 20% of an individual's body weight.[9] Whereas the body mass index (BMI) of the patient remains unchanged following the implementation of the programs.

Knee OA is associated with restrictions in ROM and muscular weakening. The restriction in ROM primarily manifests during extension movements as a consequence of the shortening of the hamstring muscles. This shortening occurs as a result of maintaining a longer flexion position, which is typically done to alleviate discomfort experienced by the patient. Subsequent discomfort is induced by the contraction of the hamstring muscles, resulting in their reduced length. Exercise therapy for knee OA aims to enhance joint ROM, elongate muscles and

tendons, augment strength and endurance, and alleviate discomfort and loading on the affected compartment.[8]

Research has indicated that exercise has been associated with beneficial outcomes in terms of enhancing the strength of periarticular muscles and reducing the occurrence of biomechanical anomalies to attain functional knee motion. The precise process remains incompletely elucidated; nevertheless, it is hypothesized that endogenous opiate activation and facilitation of non-nociceptive input may be involved.[8] Therapeutic exercise, including aerobic exercises, strength training, stretching, and ROM exercises, has been shown to enhance joint control and alleviate pain.[2,3,10] The procedure was initiated with a gradual increase in angle, which was well tolerated by the patient.[2,8]

There is a theoretical basis suggesting that engaging in stretching exercises may potentially reduce discomfort. The reduction in length of the hamstring muscle leads to a restriction in the extension movement and an increase in the required energy expenditure. The act of shortening can also result in biomechanical abnormalities in the lumbar, hip, and knee regions, potentially leading to low back discomfort in the affected patient. The practice of placing a pillow beneath the bent knees, which is commonly preferred by patients in a supine position, should be discouraged due to the potential development of knee flexion contractures.[2]

Resistance exercises were administered to enhance the development of muscles responsible for stabilizing the affected joint and have demonstrated the ability to alleviate symptoms and enhance functional mobility, even in cases of severe osteoarthritis. The efficacy of this treatment protocol, however, predominantly hinges on the patient's capacity to adhere to calorie modifications and engage in physical activity.[8-10] However, the study from Soewito F et. al. included patients with knee OA with lower grade (grade 1-2, no lower extremity deformities, able to walk and perform standing exercises unaided).[8]

Cold therapy is commonly used to alleviate pain and reduce swelling in the

knee.[2,3,15] Additionally, we employed the utilization of shockwave therapy (SWD) as a means to mitigate pain and swelling, expedite the inflammatory response, and facilitate tissue healing in cases of chronic inflammation. SWD generates a fluctuating electromagnetic field that induces the motion of ions, deformation of molecules, and the generation of eddy currents. Consequently, this process leads to the production of heat within the underlying tissues. The observed enhancement in results may be attributed to a possible mechanism whereby an elevation in tissue temperature induces vasodilation. The enhancement of vascular function has the potential to expedite the inflammatory process through the facilitation of nutrient and oxygen delivery, as well as the elimination of metabolic waste products.[7,9] A study from

Ozan S et. al. (2019) found that both continuous and pulsed SWD are effective in alleviating pain and enhancing physical function.[20]

An experimental study from Yarusha et. al. showed that pain reduces and the activity level increases significantly using SWD for knee OA. The subjects received 20 minutes of SWD for 5 consecutive days.[7] A five-day SWD protocol might not produce the same results as the administration period observed in this patient. A systematic review and meta-analysis from Wang et. al. in 2016 indicated that short-wave therapy treatment is an effective approach for pain relief but does not improve physical function in knee osteoarthritis patients.[21]

Furthermore, Basar B and Erhan B (2020) revealed that SWD, TENS, and US effectively reduced pain and improved physical function in knee OA, as measured by VAS and WOMAC scores at post-treatment and 1-month follow-up.[19] The TENS method is rooted in Melzack and Wall's Gate Control Theory of pain. This theory suggests that non-painful stimulation, such as electrical impulses from TENS, competes with pain signals at the spinal cord

level. This interaction in the central nervous system ultimately decreases the sensation of pain. Another proposed way

TENS works is by triggering the body to produce beta-endorphins.[13,14]

Despite TENS widespread use, there is a dearth of scientific evidence supporting the effectiveness of this therapeutic method.[10,13] An experimental study by Basar B and Erhan B demonstrated that TENS significantly relieved pain and enhanced physical functions. Notably, TENS was found to be more effective in treating pain compared to other interventions examined (SWD and US). However, there are some differences in patient characteristics and duration of TENS administration that may influence differences in results. In the previous study, bilateral knee OA was included, but previous knee intra-articular injection and low back pain were excluded. Furthermore, SWD was only applied for 15 min, TENS for 20 min, and US for 5 min.[19] In contrast, S. Reichenbach et. al.'s randomized clinical trial concluded that TENS treatment did not significantly reduce knee OA pain compared to a placebo TENS treatment, according to WOMAC scores. However, these findings may not apply to patients with severe pain, who were not adequately represented in the study.[13]

In addition, we conduct assessments on postural alignment and strategies for joint positioning. Severe OA frequently exhibits deformity and impairs the integrity of surrounding soft tissue structures. The development of valgus deformity in the knee affected by OA is an ongoing process that is attributed to the remodeling of bone tissue and the contraction or elongation of soft tissues. The deformity can potentially arise from the distal femur, proximal tibia, or the articulation of the knee.

Valgus knee may arise as a consequence of OA affecting the lateral compartment of the knee. Those who are obese exhibit a greater likelihood of presenting with valgus knee.[3,15] The prevalence of valgus knee was higher than varus knee in overweight and obese patients (between men and women in the range of 19-75 years old). There was a significant adverse correlation between the Q angle and BMI. In contrast, the study found a stronger link between obesity and the risk of OA on the

medial tibiofemoral compared to the lateral tibiofemoral side.[12]

On average, the Q angle is 14 degrees for men and 17 degrees for women. The Q angle beyond 15-20 degrees is generally regarded as a potential factor in the development of knee extensor dysfunction and patellofemoral discomfort. [16] In the standing posture, the patient exhibited an elevated Q angle of 20 degrees. These alterations have the potential to cause many complications, including an increase in anterior knee discomfort, patellofemoral instability, and aberrant gait patterns.[17,18]

The presence of knee OA and associated deformities can lead to a substantial elevation in mechanical loads experienced by the knee during gait.[13] The patient's body posture is adjusted according to Kendall's postural alignment. Using supportive devices like canes can help reduce the stress on hip and knee joints. Canes are strongly recommended for people with knee and/or hip osteoarthritis when the condition in one or more joints significantly limits their ability to walk, keep their joints stable, or control pain, making the need for assistance clear. Braces are also suggested for individuals with knee OA to improve function by lessening the physical strain on the affected part of the knee. It is highly suggested that people with knee OA utilize tibiofemoral knee braces.[9]

The purpose of making adjustments to footwear is to potentially modify the biomechanics of the lower limbs and the walking pattern. The significance of appropriate footwear for individuals with knee and/or hip OA is expected to be substantial. However, existing research does not establish the most effective footwear type for enhancing specific outcomes related to knee or hip OA. The existing literature does not provide conclusive evidence about the effectiveness of lateral or medial wedged insoles.[9]

The development of progressive knee OA can lead to a decline in physical mobility and the occurrence of systemic problems associated with immobility and deconditioning. Medications, including NSAIDs, are often used as a second-line treatment for moderate to severe pain.

Both topical and oral NSAIDs are highly recommended for knee OA. However, using NSAIDs for a long time can cause side effects. Because of this, it's very important to carefully watch for any problems this patient might have.[3,9] In addition, we provide home visits to patients to propose modifications, such as the installation of elevated toilet seats, the placement of grab bars, and the utilization of ergonomic chairs for household tasks.

CONCLUSION

Knee OA is the cause of pain and disability that decreases the patient's quality of life and requires high-cost healthcare and rehabilitation. Nonpharmacologic and pharmacologic therapy, especially a good PMR program, is needed to reduce pain, improve ROM, and improve the patient's quality of life.

DISCLOSURES

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The authors confirm they have the necessary consent, allowing the patient's images and medical details to be included in this publication. While her name and initial will not be used and steps will be taken to protect her identity, but anonymity cannot be guaranteed.

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Conflict of Interest

The authors declare there is no conflict of interest.

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