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Frequency Specific Microcurrent for Treatment of Knee Osteoarthritis: A Case Report

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Abstract:

Knee osteoarthritis (OA) is a chronic degenerative joint disorder marked by cartilage destruction, inflammation, and functional disability. Conventional physiotherapy and analgesics often provide only temporary relief, while surgical options like total knee replacement are invasive and costly. Frequency Specific Microcurrent (FSM) therapy, which uses low-amperage currents paired with condition-specific frequencies, has shown potential in pain modulation and tissue healing but remains underexplored for knee OA.

Objective: This case report aimed to evaluate the therapeutic effects of FSM on pain, joint mobility, and function in a patient with severe bilateral knee OA.

Methods: A 62-year-old female with chronic bilateral knee OA and right thalamic stroke received 21 FSM sessions over seven weeks using FSM devices. Various frequencies were applied to relevant knee structures. Pain and function were assessed using the Numerical Rating Scale (NRS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Oxford Knee Score (OKS) before and after treatment.

Results: Post-FSM, there was a 90% pain reduction on NRS, improvement in knee flexion, and tenderness was markedly reduced. WOMAC scores showed a 93.2% overall improvement, and OKS improved by 90–100%. Radiographic evaluation revealed an increase in the medial joint space from 0–2 mm to 5 mm, suggesting structural changes. Improvements were maintained at a six-month follow-up.

Conclusion: FSM significantly alleviated pain, enhanced mobility, and improved joint function in this patient with chronic knee OA. The findings suggest FSM as a promising, non-invasive adjunct for OA management, warranting further controlled studies to validate its clinical efficacy and mechanisms.

Keywords: chronic knee osteoarthritis, joint cartilage repair, frequency specific microcurrent

INTRODUCTION

Osteoarthritis (OA) is among the most prevalent musculoskeletal disorders worldwide and a leading contributor to chronic pain, physical disability, and socioeconomic burden, particularly in older adults. In a recent analysis from the Global Burden of Disease Study, it is estimated that 7.6% of the global population is affected, with cases expected to rise steeply by around 80% by 2050 [1].

The degenerative process of OA involves progressive deterioration of the articular cartilage and subchondral bone under the influence of various mechanical and biological interactions [2]. These

pathological changes extend beyond cartilage to affect menisci, periarticular soft tissues, ligaments, and the synovium, collectively impairing joint stability and movement [3]. In addition to the wear and tear, there is also an abnormal remodeling of the joint tissues perpetuated by local inflammatory mediators [4]. The breakdown could be associated with elevated levels of matrix metalloproteinases (MMPs), cytokines (Interleukin-1, IL-17, IL-18, TNFα), and nitric oxide [2], [5]. Osteoarthritis can often be diagnosed in the hip, knee, spine, and hand; however, osteoarthritis of the knee is the most common joint disease, with 4307.4 cases per 100000 adults [1]. In another survey on nearly 17 million patients, the prevalence of knee OA was twice and almost three times that of hip OA and hand OA, respectively [6].

The knee functions as a weight-bearing synovial joint of the hinge variety. Also called the tibiofemoral joint, it exhibits "three degrees of freedom of angular motion" – flexion/extension, internal/external rotation, and adduction/abduction [7]. Enclosed within the same joint capsule is the patellofemoral joint [7]. The tibiofemoral and patellofemoral joints together make the knee complex [7].

In knee OA, the condition manifests as pain, stiffness, and reduced joint range of motion that negatively impact the activities of daily living (ADLs) [8]. Swelling is an important marker indicating inflammation in the synovial fluid that lubricates the joint [9]. It is compelling to know that synovial inflammation can also be seen with a meniscal injury [9], and most knee OA patients complain of medial knee pain, perhaps arising from the medial meniscus [10]. Another clinical symptom that follows cartilage destruction is genu varum or bow leg deformity, where medial compartment involvement is especially prevalent [11]. With this varus deformity, it was observed that the knee joint externally rotates about its proximal and distal joints [12].

Knee osteoarthritis has a multifactorial pathoetiology encompassing mechanical, hormonal, and metabolic influences. Advanced glycation end products (AGEs) accumulate with age and reduce the elasticity of the articular cartilage [13]. Joint hypermobility stresses the joint structures and increases instability [14]. Any physical trauma to the knee can precipitate local inflammation capable of structural decline [15]. A direct relationship between mechanical loading on the joint and obesity is observed [16]. Additionally, obese patients have extra abdominal adipose tissue that secretes adipokines, capable of worsening the pathology [9].

Notably, knee OA is higher in females, potentially due to reduced estrogen levels post menopause and biomechanical differences. Estrogen plays an important role in regulating cartilage health [17]. Its receptors are found in the chondrocytes and interact with various estrogen derivatives. Reduced estrogen levels and ovarian function in perimenopausal women contribute to chondrocyte senescence [18]. The human anatomy describes a broader pelvis for females, accounting for angular and rotational changes at the proximal hip joint that are directly congruent to the knee [17]. Also, a cross-sectional study by El-Shafawey et al. (2025) concludes a crucial correlation that low vitamin D levels deeply impact knee OA, which is common in postmenopausal women [19].

Radiological and clinical assessment remain essential for diagnosis. X-rays, ultrasonography (USG), magnetic resonance imaging (MRI), and computed tomography (CT) scans are generally considered for diagnosing osteoarthritis [12], [20]. Out of these investigations, X-rays are the most commonly prescribed, and the Kellgren and Lawrence classification is used to diagnose the severity of knee OA [21].

Management strategies for knee OA range from pharmacological and surgical procedures [22], [23] to physiotherapeutic interventions [22], [24], [25]. Physiotherapy provides a range of non-surgical treatment alternatives, ranging from various electrical modalities to joint mobilizations and exercises.

Electromedical equipment like interferential therapy (IFT) [26], transcutaneous electrical stimulation (TENS), laser, ultrasound therapy, and infrared radiation (IRR) have been used in conjunction with exercises to alleviate pain [27].

Dr. Thomas Wing devised microcurrent therapy (MCT) in the 1970s to treat pain and promote tissue healing. Microcurrents deliver electrical impulses below the sensory perception threshold [28]; hence, one cannot feel the current running through the body. This suggests that microcurrent must be of physiologic amperage. These currents are a thousand times less than TENS (mA) and are measured in microamperes (μA) [28]. 1 Ampere = 10^{-6} μA. Cheng et al. (1992) first documented that microcurrent alone accelerates adenosine triphosphate (ATP) production in the cells by 500 times when used in a range between 10 – 500 μA, and above 500 μA, ATP starts reducing [29]. The positive effects of microcurrent are well-documented for treating shoulder pain, knee pain [30], elbow pain [31], and accelerating tissue healing [32], fractures, and wound healing [28], [33].

Frequency specific microcurrent (FSM) adds the effects of frequencies to microcurrent therapy. FSM is an electrical modality that delivers precisely paired frequencies to particular body tissues using low-level microampere currents [34]. FSM is classified as a Class II medical device, listed under the TENS category; however, it is not TENS. The current can be delivered to the body via sticky pad electrodes [34] or alligator clip electrodes that clip onto warm, wet towels, placed directly over the patient's skin [35]. A frequency is often described as the number of oscillations in one second and is measured in hertz (Hz) [36]. It is proposed that certain frequencies may employ biological resonance mechanisms to counteract the effects of particular conditions within targeted tissues [29]. There is a specific frequency for every tissue in the human body with which it resonates. Therefore, to communicate with various body parts, Osteopaths devised a list of frequencies in the early 1920s [36], [37]. FSM is a 2-channel microcurrent device where channel A is thought to 'address a condition', and channel B 'targets a specific tissue' [38]. The combined effect of frequencies from both channels produces a resonance effect, capable of changing cell signaling and harmonizing them back to their natural frequency [39].

Since its inception in 1996, FSM has been widely used to significantly improve pain and disability, such as myofascial pain [28], [40], dissolve scar tissue [35], [41], relaxation, and post-exercise recovery [42], [43], treatment of fibromyalgia [44], macular degeneration [45]. Despite promising clinical evidence across various conditions, FSM's potential for treating knee OA remains unexplored. Therefore, the present study investigates the effects of Frequency Specific Microcurrent on pain and disability in patients diagnosed with knee osteoarthritis.

Patient details

A 62-year-old female patient was brought in on a wheelchair to a private clinic (Physio Solutions – The Advanced Rehab, Pune). Her primary complaint was bilateral knee pain for the last 5 years and a history of Right Thalamic stroke for 1 year. The patient was a housewife and led a sedentary lifestyle. During the second quarter of 2019, she decided to go on a vacation where she had to walk an average of 2 km/day, daily for a week. She described the terrain as mostly flat, although sometimes hilly, and bought herself a comfortable new pair of shoes in preparation. After returning, she gradually started experiencing pain in her left knee that was specific to the sit-to-stand activity as a part of her daily prayer. She used over-the-counter painkillers, topical analgesics, and hot fermentation, but the effects were short-lived. She continued the same for almost 2 years as she couldn't step out of the house due to COVID-19 restrictions

and health concerns. Slowly, the right knee started bothering, and she couldn't sit on the floor anymore.

The first X-ray, towards the end of 2021, revealed osteoarthritic changes. Therefore, the consulting orthopedic advised a bilateral total knee replacement (TKR) surgery. Reluctant to undergo one, she desperately looked for alternatives to alleviate her pain, such as homeopathy, ayurveda, herbal massages, and yoga, but unfortunately, they were not of much help to her. Conventional physiotherapy offered her a 20-minute electrotherapy session followed by exercises, but it was of temporary relief only. 2 years later, she found her walking aid in a stick; her pain had gradually worsened and began impacting her daily routine, emotions got the best of her, and hope began to fade away. Unanswered prayers, unsettling pain, and peer pressure, she finally decided to undergo a TKR surgery, but nature had different plans. Two weeks before the surgery due date, she had a stroke during sleep. An MRI suggested that it was a hemorrhagic stroke in the Right Thalamus. A month later, she was brought to the clinic for her stroke rehab.

Clinical assessment

The patient weighed 76 kg before the stroke, and her height was approximately 166cm; therefore, her BMI would be 27.6 kg/m^2, falling in the overweight category according to the World Health Organization (WHO) [46]. She was brought into the clinic in a wheelchair and transferred to the assessment couch manually. The patient complained of bilateral severe knee pain, the left more painful than the right. The severity of knee pain during knee flexion hinders the stroke assessment itself. While at rest, she rated her knee pain 3/10 bilaterally. The patient then rated her left knee pain 10/10 and right knee an 8/10 the moment she stood up, with 2 people assisting her from both sides and one stabilizing her ankle. She winced louder a second later when the left knee suddenly buckled. An 11-point Numerical Rating Scale (NRS) was used to quantify her pain levels during rest and activity [47].

On observation –

The patient was observed in a supine position. The left patella was in its resting position without any obvious tracking. There were no signs of local swelling or visible redness. Her left leg was placed in hip abduction and external rotation with 10° knee flexion and ankle plantarflexion. The patient was unable to extend her left knee further due to pain.

On palpation –

The author used a dial-type pressure algometer to quantify tenderness at the knee joint. Her tenderness was elicited at $1kg/m^2$ and graded as Grade 3 (severe tenderness with wincing and withdrawal) at her left knee medial joint line. The lateral joint line of the left and both the joint lines on the right were marked as a Grade 2 (mild tenderness with facial grimace and flinch).

Following the tenderness assessment, a bilateral knee range of motion (ROM) was evaluated using a plastic 360° universal goniometer. It was challenging for the patient to lie in a prone position; therefore, her ROM was assessed in supine. The supine lying position offers the highest diagnostic accuracy and reliability as an alternate position to knee ROM assessment [49]. The author required assistance from another therapist because of the severity of pain, a large girth size, and a lack of voluntary control on the left leg, forcing the hip into abduction and external rotation. Her left range was recorded as 5°- 85° and her right knee as 0° - 100°. Both the flexion ranges were met with an empty end feel, and the left 5° indicated an extension lag.

Manual Muscle Testing (MMT) on the right was a grade 5 for knee flexors and extensors. The left leg was flaccid and could not be muscle tested. Another important observation was bilateral hip adductor tightness, specifically the gracilis muscle. Palpating them felt like an increase in their tone. It was graded as grade 2 on the Modified Ashworth Scale (MAS) used to evaluate tone. Subsequently, deep tendon reflexes (DTRs) were assessed, revealing a hyperactive patellar reflex 3+ on the left and a 2+ grade to all other lower body reflexes bilaterally.

Lastly, a sensory examination was done for L1-L5, S1 & S2 dermatomes to rule out nerve pain. Fortunately, there were no signs of abnormal sensations bilaterally.

The orthopedic surgeon had already waived off the TKR surgery post-stroke after consulting her neurologist. The pain of this severe nature warranted immediate attention and was preventing the stroke treatment as well. Therefore, the author educated the patient and her relatives about managing her pain using FSM as a safe adjunct.

Materials and methodology

This study used 2 types of FSM modalities, both purchased from Precision Distributing, Vancouver, USA. Precision Care is a 2-channel, 3-digit-specific manual operating machine, designed to easily change frequencies while running, allowing the practitioner a lot of flexibility between programs.

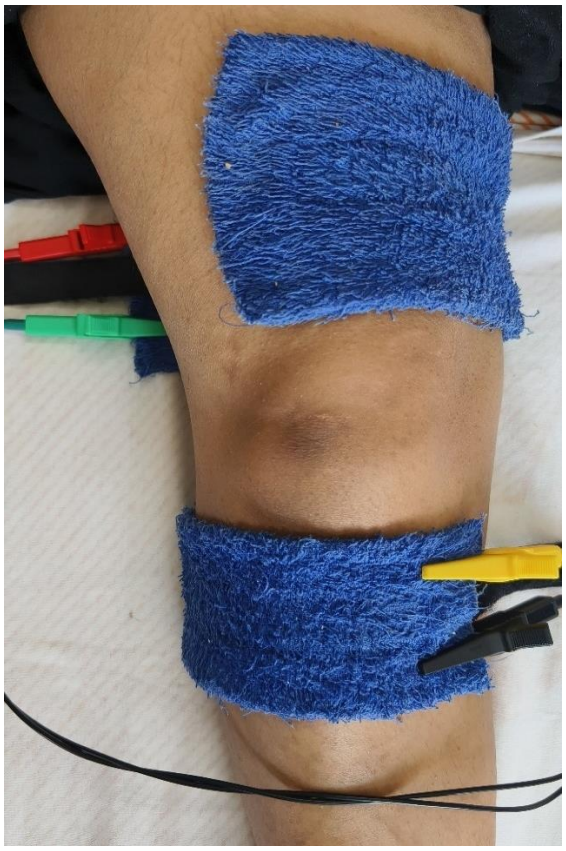
Figure 1. Precision Care FSM

Custom Care is a 2-channel, 3-digit-specific automatic machine pre-programmed according to the patient's needs. It comes with software that allows the practitioner to design a custom protocol for their patients and load it into the machine for further application.

Figure 2. Custom Care FSM

Alligator clips connect the FSM machine to the patient by clipping onto warm and wet towels, sandwiching the treatment area.

Figure 3. Electrode Placement using Alligator Clips



Outcome measures -

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a self-assessment questionnaire widely used to diagnose osteoarthritis. It is a 24-point questionnaire divided into 3 subscales to assess pain, function, and stiffness [50]. Each point of the questionnaire can be scored on a scale of 0-4, where 0 represents no pain and 4 represents extreme pain. The higher the score, the worse the respective subscale. The most recent intra-rater and test-retest reliability were found to be 0.87 and 0.65 for the WOMAC in Kannada, an Indian language [51].

Oxford Knee Score (OKS) is a 12-point self-assessment questionnaire. Like the WOMAC, each question on the OKS is scored on a scale of 0 to 4. The maximum score can be 48; higher scores indicate more difficulties [52]. OKS has good test-retest reliability, ICC 0.87 in an Indian study [53].

Numerical Pain Rating Scale (NRS) is an 11-point scale used to quantify pain. It is a linear scale from 0-10, where 0 represents no pain and 10 represents severe pain [54]. The patient is asked to mark his/her pain on the scale during activity and rest. Like the above-mentioned outcome measures, NRS was evaluated before starting and after completion of the FSM sessions. The ICC for NRS was 0.95, evaluated from an OA knee study. The study added that NRS was easy to administer among its alternatives in older adults [55].

Procedure and results

All the history taking, thorough evaluation, and pre-outcome measures were recorded on the first day, and the treatment began the following day.

Table 1. NRS obtained before treatment

Phase	Side	Condition	NRS (0–10)
Pre-FSM	Left	Rest	3
		Standing	10
Pre-FSM	Right	Rest	3
		Standing	8

The patient was treated for approximately 2 hours, four consecutive sessions, with both machines applied simultaneously to the right leg first. Frequencies that reduce inflammation (40Hz), repair and heal (124Hz) were used on channel A and were found to be the most effective in reducing pain. The other channel B had frequencies of various tissues in and around the knee – meniscus (214Hz), cartilage (157Hz), joint capsule (480Hz), fascia (142Hz), connective tissue (77Hz), adipose tissue (97Hz), ligaments (100Hz), and round tendons (191Hz). The next four sessions were conducted for the left leg, having a similar duration and with the same frequency combinations. At the end of these 8 sessions, the right knee was not tender anymore, and the left medial joint line was graded 1 (mild tenderness to palpation).

Table 2. NRS After 8 Sessions

Treatment	Side	Condition	NRS (0–10)
Post using 40,124/ (4 sessions)	Left	Rest	2
		Standing	4

Post using 40,124/ (4 sessions)	Right	Rest	0
		Standing	2

Frequencies are always described as what they are thought to be doing; thus, these combinations did not affect the knee ROM, which was the next goal. One frequency on channel A, from the same list of frequencies, is used to dissolve scar tissue (13Hz). It was hypothesized that nerves (396Hz), connective tissue (77Hz), round tendons (191Hz), ligaments (100Hz), and fascia (142Hz) could have been scarred. Persistent chronic inflammation (inflammation 3 months and above is considered chronic) leads to scar tissue development. Each pair was run for 10 minutes while performing gentle passive ROM, i.e., knee flexion and extension, progressively introducing the joint in a slightly new range. The author had one session for each lower extremity to address scarring of the given structures.

Table 3. ROM assessment before and after treating for scarring

Phase	Side	ROM (°)	Extension (°)	Flexion (°)	Improvement in Flexion (°)
Pre-FSM	Left Knee	5°–85°	5	85	—
Pre-FSM	Right Knee	0°–100°	0	100	—
Post–Scarring	Left Knee	0°–100°	0	100	**+15°**
Post–Scarring	Right Knee	0°–110°	0	110	**+10°**

Ten sessions were completed in 14 days. What was still unsettling was the tone in her hip adductors. According to the author, this tone was due to the lack of descending pain inhibition down the brainstem. Therefore, the frequency to reduce inflammation (40Hz) on channel A was paired against frequencies for the spinal cord (10Hz) and thalamus (89Hz) on channel B for 30 minutes each. Additionally, a frequency of increasing secretions (81Hz) in the cord to reduce the muscle tone was running parallel to the second machine. This pair took an hour, but relaxed the tight hip adductors. The changes after an hour's session are listed in Table 4.

Table 4. NRS After Treating the Higher Centers

Treatment	Side	Condition	NRS (0–10)
Post using 40/10,89; 81/10	Left	Rest	0
		Standing	1
Post using 40/10,89; 81/10	Right	Rest	0
		Standing	0

Table 4 provides an update on the patient's pain level after 11 sessions. The next challenge was to increase the stenosed joint space bilaterally. Therefore, 81Hz on channel A was paired against fascia, joint cartilage, connective tissue, and the synovium (386Hz) on channel B, 30 minutes per pair. For the next 10 sessions, 2 custom care machines were applied simultaneously for an hour. These sessions were planned twice a week for 5 weeks.

The patient had 11 sessions against her knee pain and 10 sessions to lubricate it. 21 sessions were

completed with the patient between 15/01/2025 and 06/03/1996 – 7 weeks.

The self-administering outcome measures were reevaluated after a month to observe the long-term effects of FSM therapy. The patient did not receive any physiotherapy during this period, as the family requested a month off to observe fasting.

Table 5. Pre and Post Values Using WOMAC

Assessment	Subscale	Pre-FSM Score	Post-FSM Score	Total Possible	% Improvement
WOMAC	Pain	10	0	20	**100%**
	Stiffness	3	1	8	**66.70%**
	Physical Function	31	2	68	**93.50%**
	Total	**44**	**3**	**96**	**93.20%**

Table 6. Pre and Post Values Using OKS

Assessment	Side	Pre-FSM Score	Post-FSM Score	Total Possible	% Improvement
OKS	Left Knee	30	3	48	**90.00%**
	Right Knee	16	0	48	**100%**

A graphical representation of the before-and-after outcome measure comparison.

Figure 4.

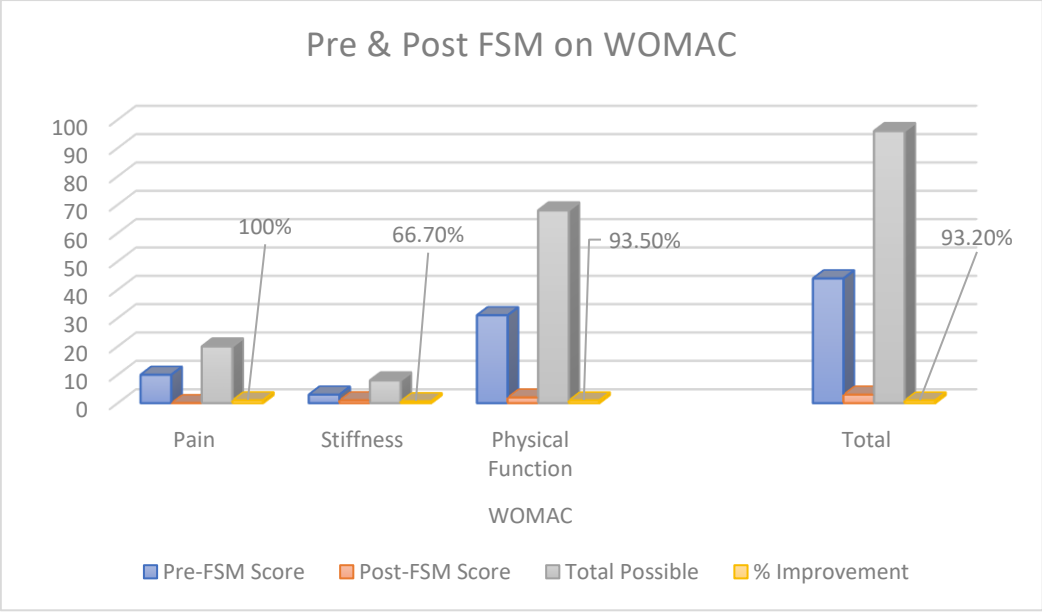
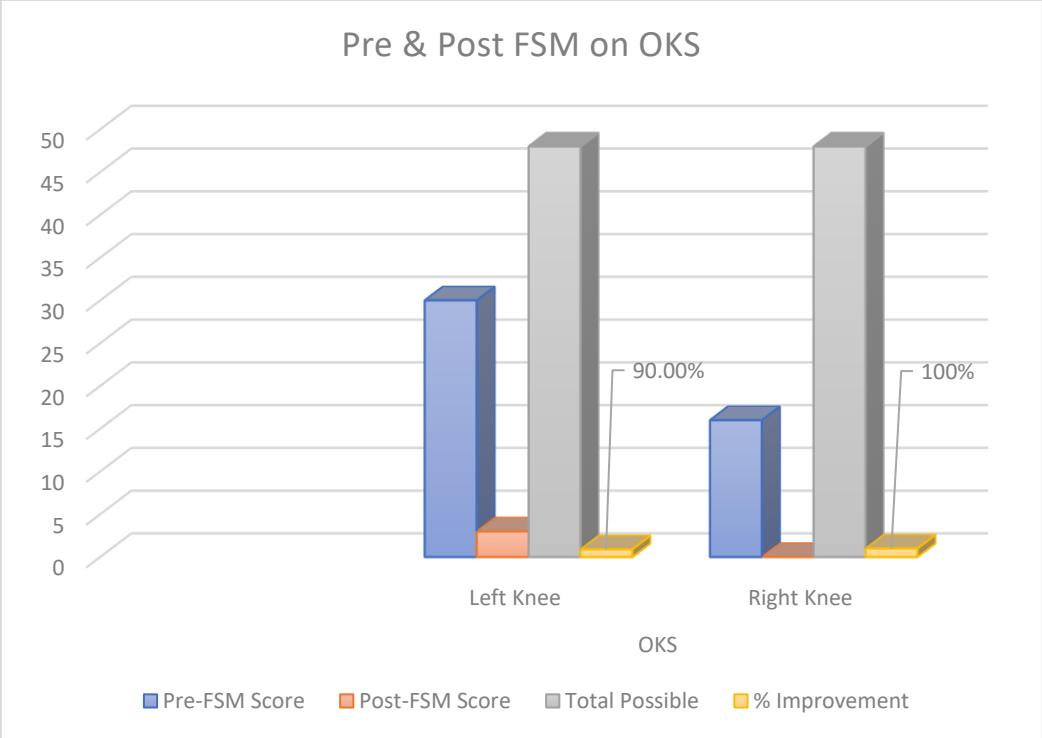


Figure 5.



The following are the before and after X-rays of this patient. Both X-rays were evaluated in standing.

Figure 6. Right Knee Before Treatment

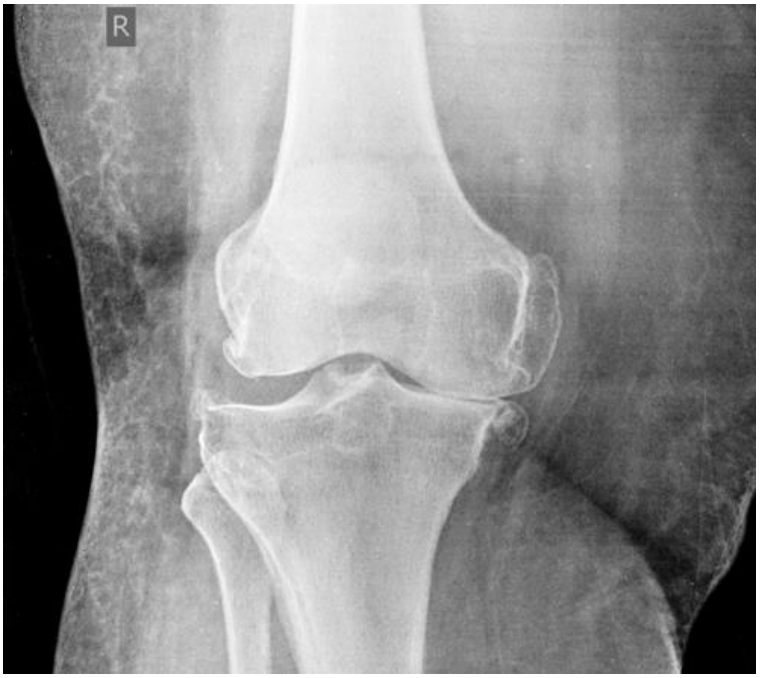


Figure 7. Right Knee After Treatment

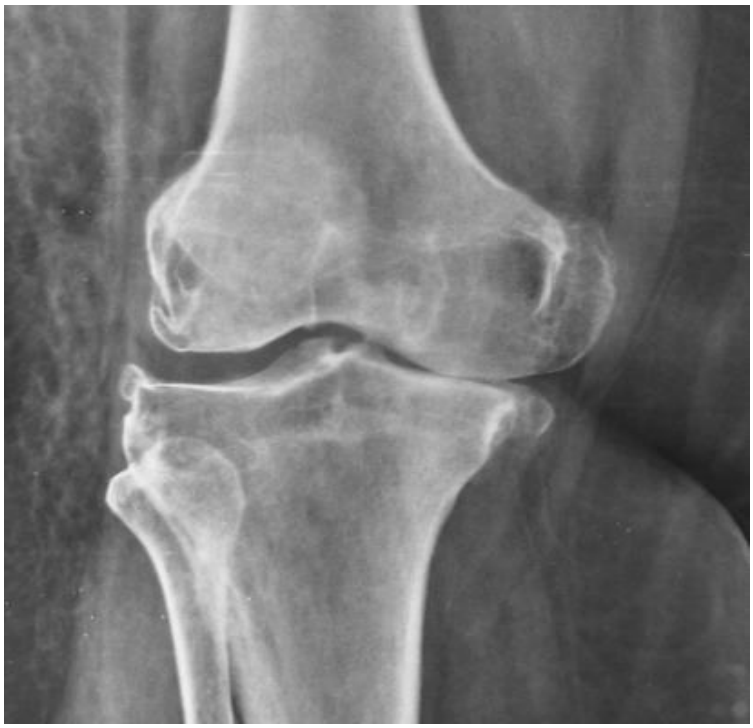


Figure 8. Left Knee Before Treatment

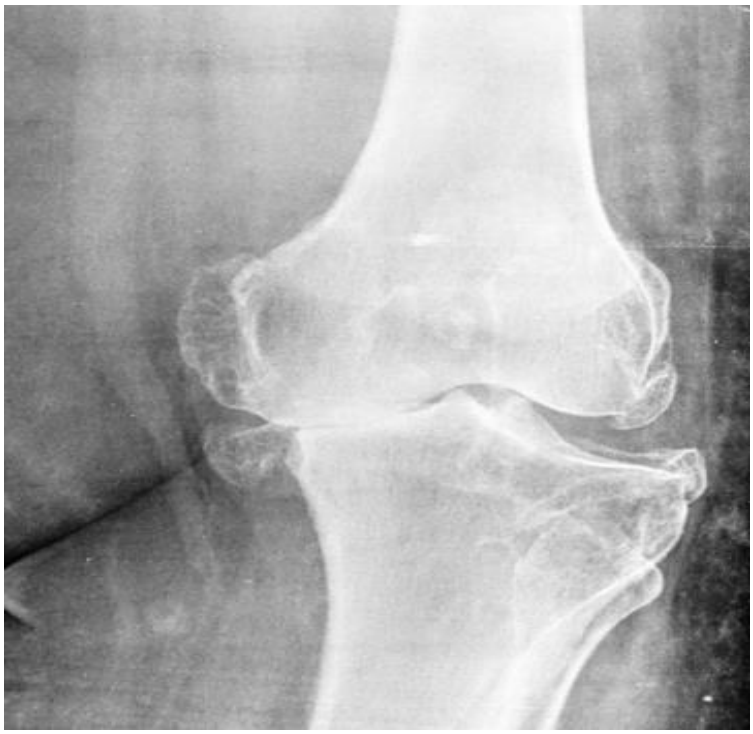
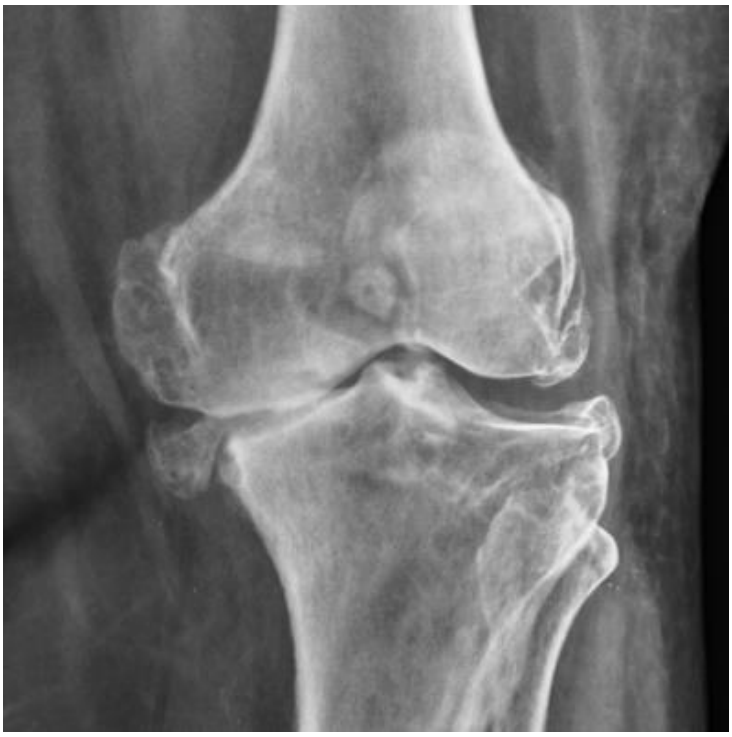


Figure 9. Left Knee After Treatment



The following tables compare the before and after values of the intra-articular joint spaces.

Table 7.

	Right Knee		**Left Knee**	
	Med fem cond – med tib plat (med. Edge)	**Lat fem cond – lat tib plat (lat. Edge)**	**Med fem cond – med tib plat (med. Edge)**	**Lat fem cond – lat tib plat (lat. Edge)**
PRE	2mm	10mm	nil	14mm
POST	5mm	8mm	5mm	9mm

Table 8.

	Right Knee		**Left Knee**	
	Med fem cond – med tib plat (midpoint)	**Lat fem cond – lat tib plat (midpoint)**	**Med fem cond – med tib plat (midpoint)**	**Lat fem cond – lat tib plat (midpoint)**
PRE	1mm	7mm	nil	11mm
POST	2mm	4mm	2.5mm	7mm

Discussion

This study examined the effects of Frequency Specific Microcurrent (FSM) in managing chronic knee pain of osteoarthritic origin. Globally, OA represents the fastest-growing cause of disability and accounts for a significant proportion of surgical interventions [56]. Not only is TKR an expensive procedure, but it also involves an average of 12.3 days of hospital admission [57]. Physiotherapy is of critical importance

immediately post-surgery, and it could take the patient almost a year to yield maximum benefits from this procedure [58]. TKR is a globally appreciated intervention in managing knee OA with a 'survival rate' of 85% after 13 years [59]. However, 20% patients remain dissatisfied after the surgery due to the likes of infection, instability, and malalignment [56], [58], [60]. Patients also look for ways to avoid joint replacement surgeries as they are expensive, fear of surgery, fear of prognosis, acceptance of pain and functional decline as a part of aging, or a previous negative self or peer experience [61], [62], [63]. A systematic review by Shamsi et al. (2020) discusses the effectiveness of physiotherapy for managing knee OA [28]. The best results were achieved with exercises combined with electrical stimulation and analgesics, but the treatment often takes months together [28]. The short-term effects of non-steroidal anti-inflammatory drugs (NSAIDs) with exercises have been promising in the long term, but the results were unavailing, and a majority of knee OA patients report persisting pain and functional impairment [64] and increased risk of gastrointestinal (GI) complications [65]. Anticonvulsant drugs could often be prescribed to address central pain sensitization, but not without side effects [66]. To the author's knowledge, there is no known modality to address central pain at its source specifically.

Frequency Specific Microcurrent (FSM) uses microcurrent to deliver precise frequencies to the target structures. Pairing the two frequencies on both channels is important to achieve the best results, creating a resonance effect. In the current study, FSM significantly improved the patient's pain and functional disability. The author also had a 6-month follow-up with the patient, wherein the above results were maintained.

The results from our study have been consistent with Adams & McMakin (2017), who described the frequency of reducing inflammation to bring pain levels down [42], and Curtis et al. (2010), who used the frequency to repair the micro and macro trauma in delayed onset of muscle soreness (DOMS) [67]. The author combined these frequencies with all the hypothesized intra and peri-articular knee structures that could be affected with a degenerative joint. The results support the hypothesis that FSM reduces inflammation and heals the damaged structures that produce local inflammation. Similarly, when the frequency to dissolve scar tissue is paired, resonance will cause vibrations that are sufficient to break adhesive bonds between structures, creating a friction in the process that, in turn, produces warmth [37]. This phenomenon allows the practitioner to move the joint into a new range and palpate for thixotropic changes. Wylde et al. (2011) talk about the pain that persists after replacement surgeries where the damaged tissue is replaced, highlighting the role of central pain modulators [68]. A study supporting this finding suggests that the gray matter area in the thalamus undergoes a reversible atrophy in chronic ailments, resulting in abnormal descending pain inhibition down the spinal cord [69]. Furthermore, the patient also had a hyperactive patellar reflex on the left. Inflammation in the cord interferes with inhibitory signaling. These factors highlight the need to address the spinal cord. Thus, the frequencies to reduce inflammation in the cord and the thalamus were used. Fortunately, our findings (Table 4) agreed with McMakin et al. (2005), who also used these frequencies to address fibromyalgia [45]. They described how pro-inflammatory cytokines contribute to the pathogenesis of chronic pain, and addressing the higher centers could quiet them [45]. This effect could be similar to the pro-inflammatory cytokines mentioned in the current study that catalyze cartilage metabolism. Overall, the use of 124Hz to repair and heal the target structures could have potentially closed the source of inflammation, followed by 40Hz to wipe off the residual inflammation.

It is widely believed that constant inhibitory signals are coming down the spinal cord from the brain to dampen reflexes, ensuring smooth and coordinated motor control. In case of a spinal cord injury,

inflammation, or brain inflammation, the reflexes are slowed down and cannot react in time to dampen the reflex. Therefore, this study attempted to use a frequency combination that would increase spinal cord secretions. This combination of 81Hz and 10Hz required an hour to completely relax the muscle tone and reduce the hyperactive patellar reflex to a 2+. The specific neurotransmitter could not be definitively identified; however, the observed relaxation of muscle tone and suppression of the hyperactive reflex align with the potential action of gamma-aminobutyric acid (GABA), as suggested by the author. While this functional evidence justifies the hypothesis, direct neurochemical proof of GABA's involvement is not yet available. GABAergic neurons in the brainstem also inhibit the ascending pain pathways that could result in central pain suppression [70]. Lastly, the frequency of increasing secretions was paired with a few joint structures. It was paired with the joint cartilage to produce extracellular matrix (ECM), a combination of type 2 collagen and proteoglycans. ECM imparts shape, tensile strength, and cartilage homeostasis [71]. Next, 81Hz was paired with the connective tissue. Its fibroblast cells secrete collagen, responsible for flexibility and resilience, and mast cells secrete hyaluronic acid, responsible for lubrication and shock absorption [72]. The fascia is a vast and integrated network that weaves around every organ, muscle, bone, and nerve in the human body. Fascia is appreciated for producing ground substances like hyaluronic acid that assist tissues to slide and glide better [72]. It is common knowledge that synovial fluid is present in every synovial joint in the body. It contributes to maintaining joint health from lubrication to nutrition, cushioning, and phagocytosis [73]. As a part of the body's natural aging process, synovial fluid decreases with age [74]. Therefore, the author paired the frequency to increase secretions with the synovial tissue, in an attempt to stimulate the synovial fluid inside the joint. The combined results of these last 10 sessions can be seen in Tables 7 and 8. A significant increase in the left medial joint space can be observed, and its antagonist lateral joint space has reduced back to normal.

The rationale for these outcomes could be cellular biophysics. All the healthy tissues conduct bioelectric current throughout the body, which could be altered with injury and inflammation. This injury has a higher electrical resistance than the surrounding tissue. Due to inflammation, healing may be impaired as electrical conductance and cellular capacitance are reduced. The ability of microcurrent to provide current flow to the tissues at physiologic amperage could reduce resistance to healing, support an active repair process in the damaged soft tissues, improve ion exchange, and boost cellular ATP [29]. Precise frequencies interact through resonance, change cellular signaling, and neutralize specific conditions by altering cell membrane configuration.

Limitations

MRI Imaging could have provided more detailed insights into soft-tissue remodeling, but it was not feasible due to the patient's current physical condition. Additionally, the current study observed the effects of FSM on a single patient. Controlled trials could help provide more generalized and statistically reliable results.

Conclusion

This case report supports the clinical potential of Frequency Specific Microcurrent therapy as an adjunct for managing chronic knee osteoarthritis. The marked improvements in pain, joint function, and radiographic joint space suggest that FSM could be a valuable noninvasive alternative where conventional physiotherapy provides limited relief. Broader studies are needed to establish mechanisms and validate

these early observations. FSM holds the potential to be a powerful and revolutionary tool in the hands of a visionary practitioner.

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