

## Shortwave Diathermy Therapy in the Management of Pain and Functional Limitation in Femoral Head Avascular Necrosis: A Report of 4 Cases in a Tertiary Hospital in Nigeria

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**Abstract:** These case reports describe the therapeutic efficacy of a physiotherapy modality, the short-wave diathermy in the management of pain and functional limitation which are sequelae of avascular necrosis of the femoral head. Four patients who were primarily referred for physiotherapy by their doctors for assisted ambulation and infrared therapy were assessed and planned for Shortwave Diathermy (SWD) therapy. Two of the patients (A and B) who were compliant with their therapy had significant improvements in their conditions in terms of marked reduction in their pain (NPR score was from 7-2) and functional ability score (FAS was from C to A) while the other two patients C who did comply with and D who declined the treatment, respectively had their NPR scores still between 7 and 8 and FAS remained C, 5 months after presentation. It is concluded that SWD is effective in the management of avascular necrosis of femoral head and therefore should form a part of the holistic management plan for this condition. This is relevant, especially with the current global quests for effective, non-invasive means of achieving pain relief and optimal functional performance with little or no side effects in managing chronic diseases.

**Key words:** Shortwave diathermy, avascular necrosis, pain, functional limitation, efforts, physiotherapy

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### INTRODUCTION

Short Wave Diathermy (SWD) is a therapeutic electromagnetic device commonly used in medical practice with an operating frequency of 27.12 MHz which sets up radio waves with a wavelength of 11 m (Foster and Palastanga, 1992). Diathermy converts electromagnetic energy into heat thus, making it a deep heating modality (Colea and Eagleston, 1994).

It is believed to selectively heat muscles and is capable of heating tissues to the depth of 3-5 cm from the surface of the skin (Michlovitz, 1986; Vasudevan *et al.*, 1992).

SWD is believed to have physiological benefits of pain relief, hastening tissue healing process and resolution of inflammation (Balogun and Okonofua, 1988; Foster and Palastanga, 1992; Lamina and Hanif, 2008). It is also believed to induce muscle relaxation and make for increased joint flexibility (Foster and Palastanga, 1992) to enhance recovery from ligamentous injury and hematoma as well as promote decrease in joint stiffness and collagen tissue extensibility. Diathermy can heat larger body areas in one treatment as compared to ultrasound (Foster and

Palastanga, 1992; Low and Reed, 2000) and the heated area can be as large as the size of the diathermy applicator (200 cm<sup>2</sup>) (Draper *et al.*, 1999). SWD has also been found to possess longer lasting heat retention than ultrasound and have less heat decay than other known deep heating modality in electrotherapy (Draper *et al.*, 1999).

Application of SWD has been shown to have hyperemia, sedation and analgesia as the basic physiologic effects. The reduction in muscle spasm resulting from muscle relaxation is caused by an increased vascular supply to the treated area (Foster and Palastanga, 1992; Colea and Eagleston, 1994).

SWD is particularly valuable for lesions of deeply placed structures such as the hip joint which cannot easily be affected by other forms of electrotherapy and radiation. Other researchers have described its values in other chronic conditions like the pelvic inflammatory disease (Balogun and Okonofua, 1988; Laufer *et al.*, 2005; Lamina and Hanif, 2008; Lamina *et al.*, 2011) in pain and function in chronic osteoarthritis of knee joints (Marks and van Nguyen, 2005; Jan *et al.*, 2006) and in acute to sub-acute musculoskeletal conditions. Rattanachaiyanont and Kuptniratsaikul (2008) however,

also reported no additional benefit of shortwave diathermy over exercise program for knee osteoarthritis in peri and post-menopausal women in equivalence trial study.

Its comparative efficacy with cryotherapy in treating pain and swelling after radial fractures has been studied by Cheing *et al.* (2005). Its availability in many clinical settings, efficacy and clinical safety in managing various conditions but the need to further prove its efficacy by conducting clinical controlled studies has also been established by an Irish biophysics and bioengineering study (Shields *et al.*, 2002). Robertson *et al.* (2005) have studied the comparative effects of deep and superficial heating on tissue extensibility using SWD and concluded that deep heating by SWD in the absence of stretching is more effective than both superficial heating with stretching and no heating at all on tissue extensibility.

Till date, SWD efficacy in pain relief and functional restoration in patients with AVN has not been studied extensively and reported in literature. In addition, its effects in serving as better alternative to pharmacological method especially in terms of its safety of not exposing the patients to any side effects of drugs and possibly delay or serve as substitute for surgical intervention especially in young adults with AVN, needs to be studied and reported. Hence, study which presented case reports of patients with pain and movement difficulty treated with SWD. The aim was to ascertain its efficacy as an alternative to pharmacotherapy in the management of pain and functional limitation in adult patients with AVN.

## CASE REPORTS

### Case 1

**Patients' clinical history/presentation:** Patient A was a 32 years old female patient who was 1.64 m tall and weighed 72.0 kg referred for physiotherapy with a major complain of severe chronic pain and stiffness on the left hip associated with inability to walk independently. The patient's problem started when she was a kid with what she described as a snapping sound associated with pain on her left hip joint after she missed her step on attempt to cross a gutter. She was treated with antibiotics and analgesics which gave her slight relief and was able to participate in sports while in the secondary school though with limitation in range of motion of the left hip joint associated with slight tolerable pain.

About 5 years before, patient's pain became intolerable and had only a transient relief from analgesics and had to seek for physiotherapy (administered in form of Heat therapy Infra Red Radiation (IRR), massage with Non-Steroidal Anti-Inflammatory (NSAI) gel and ergometric exercise) on referral by her orthopaedic

surgeon. Patient stopped therapy after 3 months due to unremarkable effect on her major symptoms (pain and reduced functional ability) despite combination of physiotherapy with analgesics.

Her complaints became worse thereafter and she could no longer sit upright for long due to the associated groin pain and could not walk appreciable distance (100 m) due to severe pain.

Patient consulted several orthopaedic surgeons at this period and one suggested hemiarthroplasty after observing the process of necrosis of femoral head and distortions of the joint cavity on the patient's x-ray which had resulted in Limb Length Discrepancy (LLD) with attendant limping gait in this patient. Patient rejected the offer and saw another orthopaedic surgeon who admitted her for skeletal traction and placed her on antibiotics and analgesic for about 2 months. The pain persisted.

Patient A was later placed on Disease Modifying Anti-Rheumatic Drugs (DMARDs) and she complained of heaviness of the entire left limb, slight left pedal edema, Reduced Range of Movement (ROM) of both left knee and hip joints and very painful left hip joint (PRS = 7) with associated left quadriceps/hamstring muscles atrophy. She was then ambulated on a pair of axillary crutches post-traction.

Patient had 18 treatment sessions of physiotherapy using modalities of cryotherapy, IRR, Interferential (I/F) therapy, massage and ergometric exercise. These approaches resolved the foot swelling, relieved the knee pain and mobilized it but didn't help the hip joint pain appreciably (PRS was still 6).

Patient was referred 3 months later to the centre for physiotherapy with major complaints of chronic moderately severe left hip pain and functional limitation of the left lower limb.

On examination, patient A ambulated in with the aid of bilateral axillary crutches as a result of inability to bear weight on the affected leg due to severe pain. Real LLD of 3 cm muscle atrophy (quadriceps/hamstrings bulk, calf) and there was marked reduction in ROM on the left hip joint Active hip flexion on Straight Leg Raising (SLR) between 0-40° (goniometric measurement) was done though with difficulty due to muscle weakness and pain, movement beyond this range elicited pain. Left hip joint flexor Muscle Power (GMP) was 3+. There was tenderness on palpation around the left hip joint; very slight reduction in muscle tone; Skin Sensation Test (SST) was negative and Thomas's manoeuvre was positive. Patient's pain rating score on numerical pain rating scale was seven even with analgesics and functional activity score on Functional Activity Scale (FAS) was C (C = patient's ability to perform the activity with her left lower limb

severely limited by pain). No physical evidence of any on-going infections. Radiographic examination revealed obliteration of the left hip joint with evidence of necrosis of the head of the femur.

**Case 2:** Patient B was a 26 years old obese male who presented with a severe left hip joint pain and inability to walk independently. Patient ambulated with the aid of a cane associated with obvious discomfort into the clinic. Patient previously had two incidences of trauma to the same hip joint. He was first hit by a car on the left hip 25 months before presentation with what he described as minor injury which only resulted in pain and difficulty in walking that subsided after some weeks. He had a second trauma 11 months before presentation to physiotherapy clinic when he fell off a motor-bike that collided with a car and landed on his left hip. He was helped up from the scene of the accident due to his inability to stand unaided. Patient B was initially taken to a traditional masseur who carried out some forceful mobilization of the limb severally and rubbed with hot local preparations. Patient developed difficulty in ambulation and gradually began to limp on the left lower limb. He was later taken to an orthopaedic surgeon who after conducting physical and radiological examinations diagnosed avascular necrosis and suggested a hip replacement surgery (arthroplasty). Patient B parents refused the option and requested for an alternative measure. He was then advised to go for physiotherapy.

On examination, patient B presented with a severe chronic left hip joint pain (NPRS of 8, transiently relieved to 7 with tramadol), ambulated into the clinic with an antalgic limp gait aided with a cane and support from his dad, unable to initiate SLR due to both pain and muscle weakness, unable to flex the knee joint. There was a limb length discrepancy of 2 cm (both real and apparent length measurements), slight muscle atrophy associated with mildly reduced muscle tone. Patient rated C on FAS. Radiographs taken 1 month before presentation to physiotherapy revealed necrosis of the head of left femur which appeared smaller and showed lucency suggesting fragmentation and collapse.

He stated that his pain radiates to the groin and upper thigh, it is relieved by sitting and resting but aggravated by walking and stair climbing. There was marked tenderness on palpation of the left hip and thigh musculature and there were no paraesthesia in his lower extremities, no bowel and bladder dysfunction, no complain of any night sweats, fever or chills and no open wound. There was no metallic implant inserted on any part of his body. He had been constantly on pain killers.

**Case 3:** Patient C is a 31 years old lady who is a known sickle cell disease patient who presented with a severe chronic left hip and thigh pain and difficulty in walking unaided. Her activities of daily living were hindered by the symptoms. She has been on management (chemotherapy) of her orthopaedic surgeon for many years until about a year before presentation when she started experiencing serious difficulty coping with her activities of daily living due to severe pain. Patient who is a fashion designer, ambulated into the clinic with an obvious limp gait due to pain and LLD (2.5 cm difference). There was marked tenderness on palpation of the left hip joint, unable to carry out SLR test, marked muscle atrophy of the left thigh and leg, there was associated left knee joint pain. There was no sensory deficit on the left lower limb. She was on both daily analgesics and periodic intra-articular injections. Radiographs taken 2 months before presentation revealed signs of severe left hip secondary degenerative osteoarthritis following Perthe's disease. Her pain rating at presentation was 7 and score on FAS was C.

**Case 4:** Patient D is a 57 years old man who presented with severe chronic left hip joint pain of about 2 years duration. He ambulated with a limp gait with the aid of a cane. He had a history of trauma to the hip many years before the onset of the pain serious difficulty in ambulation. He is a known cigarette smoker. He has been on medications over the duration of the pain and had also tried traditional treatment but to no avail. Patient D had gross atrophy of the thigh musculature, tenderness on palpation of the left hip joint, unable to carry out SLR, pain on passive abduction and flexion of the hip and pain on the left groin on movement. He had not been able to drive his manually pedaled car for about a year due to his left hip joint pain while clutching. No paraesthesia on the affected limb. His pain rating on numerical scale was 8 despite being on medication (piroxicam three times daily) and his left lower limb function rated C on FAS. His radiographic reports stated that this patient had advance degeneration of the head of the left femur believed to be from avascular necrosis.

**Plan of treatment:** Patient A was screened for all contra-indications to SWD treatment, a pulsed SWD (Enraf nonius, Curaplus 403, made in Holland) was employed in the treatment of the patient. Patient was put in side-lying position with the treatment head of the machine put in contact with the patients' hip but with a felt (spacer) in between. Therapy dosage employed was 400  $\mu$ sec burst per second; 400  $\mu$ sec burst duration with

a peak root mean square amplitude of 200 W per burst and an average root mean square output of 24 W was administered three times weekly for 20 min each treatment session. Use of monopolar technique was utilized in this patient management.

Other adjunctive modalities used for patient A were Interferential therapy (I/F) (Enraf nonius, Sonoplus 464, Made in Holland) for 15 min, soft tissue mobilization (massage) with NSAI gel (piroxicam) and graduated strengthening exercises (active and resisted using dumbbells, bicycle ergometer). I/F therapy is a continuous wave/amplitude modulation device with pulse repetition rate of 100 Hz and frequency of 1.0 MHz and pulse duration of 2 msec. The chosen treatment intensity ranged between 45-85 mA.

Patient B family and social history screening for contra-indications to the use of deep heating modalities did not suggest any so, the therapists administered the continuous mode of SWD (same mode and make as previous patient) in the treatment of patient B. Positioning and technique of treatment were the same as for patient A. Therapy dosage, duration and frequency were the same as for patient A. Other adjunctive modalities used for this patient were Transcutaneous Electrical Nerve Stimulator (TENS) therapy (EMS 707, made in Taiwan) for 20 min, soft tissue mobilization (massage) with NSAI gel (piroxicam-based gel) and graduated strengthening exercises (active, static quadriceps and resisted exercises using dumbbells, bicycle ergometer). IRR and TENS therapies along with STM and mobilization exercises were also administered on the left knee joint for 20 min each treatment session.

Patient C was placed on the same treatment plan of SWD therapy and other adjunctive means 3 times a week for the first twenty-four sessions and review to plan the mode of continuing treatment and follow-up. Patient C commenced treatment had eight continuous sessions but began to miss her treatments due to financial difficulty to cope with transportation cost and treatment bill. She had another round of seven inconsistent sessions and was reviewed. Patient reported some degree of relieve from her pain (NPR score from 7-5) and mild improvement on FAS from C to B. Patient was encouraged to be consistent with therapy but was limited by finances.

Patient D was planned on the treatment means as for patient A but refused to attend the clinic for the treatment to be administered. However, he combined his drug therapy (analgesics) with local massage and scarification on the hip for months. He was being seen by his doctor who originally referred him for physiotherapy for injections and oral medications with complaint of severe pain.

**Outcome and reviews:** Patient A recorded a progressive reduction in her pain severity (PRS: 8-3) within the 1st 2 months, her dependency on daily analgesic consumption has reduced to a state of consumption only after heavy daily activities. Patient could do SLR up to 85° at the end of 2 months therapy. Her functional activity rating was B. Patient progressed to Partial Weight Bearing (PWB) on axillary crutches with a slight raise on her left shoe to correct LLD. Therapy continued with the above treatment plan.

Treatment frequency was changed to two-treatment sessions per week after 10 weeks duration of each session of SWD therapy reduced to 15 min per session. Patient A was ambulated on PWB with the aid of quadripod walking aid.

**Four months treatment:** Patient A was re-assessed after 4 months of treatment period. Patient reported almost no pain (NPS ~ = 1). No longer on any oral pain relieving medication even at her heaviest daily task which included travelling instance for hours had already commenced independent ambulation, Full Weight Bearing (FWB) without support at three and a half months; muscle girth had improved appreciably with no measurable difference between the quadriceps/hamstring and calf muscle bulks on both sides. Active hip flexion has increased to 90° without pain. Check x-ray ordered by patient's surgeon revealed that compared with previous x-ray, the hip joint was now visualized and there was then a regression of the necrosis of the LT hip joint. Patient A was then discharged on follow up.

**Follow ups post discharge:** Patient A was seen at 10 weeks, 9 and 15 months post discharge for re-assessment and reported that she could carry out her instrumental activities of daily living which regularly involved travelling without undue pain and reliance on oral drugs (analgesic); NPRS is 1; no more movement restriction at the hip joint (AROM 0-105°) on SLR test. Her functional ability score on FAS was A.

Patient B was reviewed after 2 months on therapy and was found to have improved significantly; NPR score had reduced to 2, patient could do SLR 0-85° without pain, though still ambulating with the aid of a cane on physiotherapists' advise for hip protection, considering the patient's body weight. Patient had to return to his original location to resume his work and therefore, discharged from treatment and reviewed 2 months later. He reported ability to carry out his daily activities without undue discomfort, his pain rated between 2-3 on NPR scale. His functional status on FAS scale was A at this time. No post treatment x-ray had been done by the time of this report to assess the state of the femoral head post treatment.

Patient C was followed up on telephone. Her case has remained the same as at the time of this report and still largely dependent on both oral medications and occasional intramuscular injections when the pain gets unbearable and patient has no financial means of procuring the analgesics.

Patient D symptoms had deteriorated grossly with more marked muscle atrophy, worse pain on standing and ambulation that had warranted his change to support with the aid of axillary crutches when his report was reviewed from his doctor's case note 7 months after initial presentation to physiotherapy. Patient D had to passively help his left lower limb to enter into the bed and car at the time of this report.

### CONCLUSION

Pain and movement difficulties are central to the practice of physical therapy. Historically, physical therapists have always played a major role in the management of patients with pain in primary, secondary and tertiary health care levels.

Although, SWD has been documented to cause relief of pain and improve function in many musculoskeletal conditions, to the knowledge of the researchers, its effects in ameliorating the symptoms or burdens of patients with AVN have not been investigated. The results of this study suggest that pain and movement restoration are enhanced by SW diathermy treatments in patients with avascular necrosis of the femoral head. The researchers opine that this treatment effect resulted from the efficacy of SWD to resolve the cheilus formation with adhesions that forms around the periphery of femoral head in association with contracture of articular capsule which causes pain due to its stretching effect over the peripheral cheilus avascular necrosis. This produces mechanical derangement resulting in limitation of hip motions. Follow-up of patient A over a year after management which revealed her independent function without marked pain and need for analgesics, walking aid and hospital admission along with 1 year post treatment radiological evidence of no progression of the femoral head necrosis but evidence of a more visible head was a further conviction us that the application of SWD treatment may have established the drill channel supply to the head of femur and improved the morphology of the joint cavity by a process of improved vascularisation of the femoral head. Patient B's condition improved markedly both in terms of pain rating and functional ability after twenty-four treatment sessions although, there was no post treatment radiograph to review the state of the femoral head and the joint cavity. Patients C and D who

either did not comply with the treatment plan or report for the treatment with SWD therapy still had their conditions almost the same or worse, respectively when reviewed months after presentation.

It is concluded that SWD therapy is effective in the holistic management of the avascular necrosis of head of femur. However, it is being advised that further studies on this non pharmacological and non-surgical method of management that will incorporate the post treatment radiographic evidence along with clinical findings used in this report be carried out.

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