Effect of Osteopathy in Avascular Necrosis Of Hip Joint

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By

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1. INTRODUCTION

Hip osteonecrosis is a complex condition with an imprecise cause and unclear progression. Various treatment modalities are available like non-operative management, joint-preserving procedures, and total hip replacement (THR). Diagnosis at the onset of ailment can give results with non-operative or joint-preserving treatments before the femoral head collapses or the lesion becomes too large. Advanced stage which is indicated by a crescent sign, femoral head flattening, and acetabular involvement, makes joint-preserving options less effective, leading to total hip replacement(THR) more suitable. Statistics reflect that in the 20th century, results of, THR outcomes for osteonecrosis were poor, but newer techniques have significantly increased their efficacy.

There is no universal consensus on the most suitable treatment regime for different stages of the condition. Non-operative management like drugs and procedures such as extracorporeal shock wave treatment, electromagnetic therapy, and others, have shown efficacy in reducing pain and improving function during early stages. Joint-preserving procedures like core decompression or percutaneous drilling in early-stage disease may increase blood flow to the necrotic area by reducing intra-osseous pressure, thus alleviating pain and improving function. Osteopathy can serve as a complementary approach to managing avascular necrosis (AVN) of the hip, especially in its early stages. It may help alleviate symptoms and enhance overall joint function.

1.1 Osteopathy

It is a healthcare approach that uses manual manipulation of muscles and bones to improve overall health and focuses on hands-on therapy. A variety of approaches like stretching, massage, and joint adjustments to improve blood flow, reduce pain, and support the body's inherent healing mechanisms are used by the osteopaths. In this therapy it is believed that the musculoskeletal system of body's framework of muscles and bones, is key to overall health. Body is viewed as a connected system and imbalances or restrictions in this system as potential contributors to various health problems. emphasis is on the comprehensive approach of how different body systems connect and influence each other. This holistic perspective allows to address the root causes of health issues.

Being Drug-free and hands-on approach to pain relief and well-being it encompasses use of gentle manual techniques to improve the body's natural healing and overall health. It focuses on a holistic approach, considering how different systems work together. Variety of gentle techniques: techniques like muscle energy therapy, lymphatic drainage, fascial manipulation, and exercise therapy are the variety of these gentle approaches that help reduce pain, improve circulation in your muscles and tissues, and address structural imbalances.

The ultimate aim of the therapy is to

(i) To improve hemodynamics i.e. is blood flow across hip joint

(ii) To improve range of motion of hip joint in all anatomical planes and axis.

(iii) To reduce pain due to inflammation.
(iv) To reduce inflammation and edema
(v) To reduce amount of tension in hypertonic muscles and to increase the same in hypotonic muscles.
(vi) To improve proprioception of hip joint, and
(vii) To improve the overall quality of life.

2 LITERATURE REVIEW

2.1 Anatomy of the hip joint

The hip joint, where the thigh bone meets the pelvis, is a ball-and-socket structure. This super strong joint is one of the biggest in the body, offering a surprising range of motion. It allows one to stand, walk, run, and move with freedom, all while supporting the entire body weight. It can also be called as the body's weight bearing powerhouse. Figure 1 represents the anatomy of hip joint[2]

(i) Bones: The joint comprises Femur (thigh bone) the upper end of which forms the ball shaped head, the femoral head. This femoral head fits in the concave socket acetabulum in the pelvis which together forms the ball and socket structure of the hip joint.

(ii) Articulating surface: it comprises of the rounded head that is femoral head which articulates with the acetabulum of the pelvis. This femoral head is covered by femoral articular cartilage and the acetabular articular cartilage lines the surface of the acetabulum.

(iii) Articular cartilage: This joint relies on strong ligaments for stability. The strongest ligament in the body, the iliofemoral ligament, is located in the front and acts like a brake to prevent the hip from extending too far back. Another ligament in the front, the pubofemoral ligament, helps stabilize the joint and keeps the leg from moving outwards too much. Finally, in the back, the ischiofemoral ligament strengthens the capsule and prevents the leg from twisting inwards excessively. These ligaments work together to ensure the hip joint moves smoothly and safely during various activities.

(iv) Ligaments: The joint capsule is a fibrous sleeve that surrounds the hip joint, enclosing the joint cavity and containing synovial fluid to lubricate and nourish the joint. Various muscles that surround the hip joint and contribute to its stability and movement include the hip flexors, extensors, adductors, abductors, and rotators.
(v) Blood supply: The hip joint needs a good blood flow to stay healthy. This blood flow comes from several branches of the main arteries in the leg. These important arteries deliver blood to the bones, cartilage, and other tissues around the hip joint, keeping

everything working properly. the main arteries involved in supplying blood to the hip joint are

a) Medial Circumflex Femoral Artery which is the key supplier of blood to the hip joint. It arises from the deep femoral artery (profunda femoris artery) and branches into several smaller vessels that supply blood to the femoral head and neck.
b) Lateral Circumflex Femoral Artery: it is similar to the Similar to the medial circumflex femoral artery, and this too originates from the deep femoral artery. It supplies blood supply to the lateral aspect of the femoral head and neck, along with the surrounding soft tissues.
c) Obturator Artery: this artery originates from the internal iliac artery and branches into the hip joint via the obturator foramen. There, it supplies blood to the acetabulum and adjacent structures, including the ligaments and synovial membrane of the hip joint.
d) Superior Gluteal Artery: this one originates from the internal iliac artery and travels through the greater sciatic foramen to reach the gluteal region. Though it primarily supplies the gluteal muscles, also does it send branches to the hip joint, particularly the capsule and ligaments, and
e) Inferior Gluteal Artery: originating from the internal iliac artery, the inferior gluteal artery supplies the muscles and structures of the gluteal region, including some contributions to the blood supply of the hip joint.

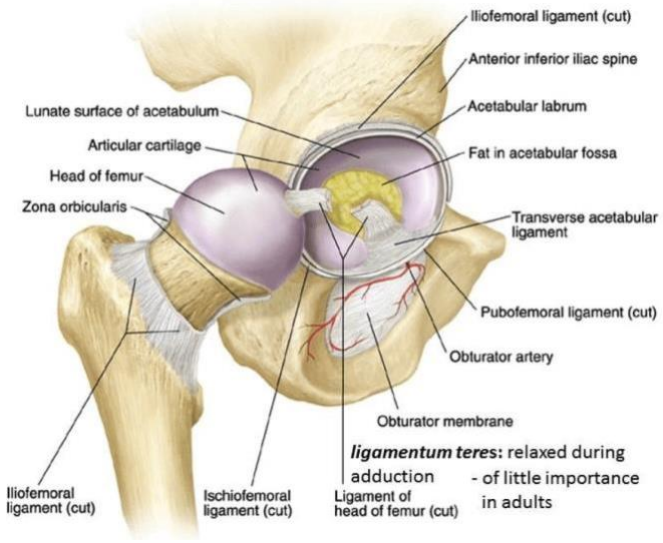

Figure 1: hip joint anatomy
Source: https://www.orthobullets.com/recon/12769/hip-anatomy

2.2 AVASCULAR NECROSIS OF HIP JOINT

Avascular necrosis (AVN) of the hip joint, also known as osteonecrosis or aseptic necrosis, is a condition where the blood supply to the bone tissue of the femoral head (the ball part of the

hip joint) is disrupted, leading to bone cell death and eventual collapse of the bone. This can cause pain, stiffness, and limited mobility in the affected hip.

2.2.1 Factors responsible for AVN

Several factors that can contribute to avascular necrosis of the hip joint are:

(i) Trauma: Injury to the hip joint, such as a fracture or dislocation, can damage blood vessels and impair blood flow to the femoral head.

(ii) Medical Conditions: Certain medical conditions, such as sickle cell disease, lupus, HIV infection, and certain types of cancer, can increase the risk of avascular necrosis by affecting blood flow or the body's ability to repair damaged tissue.

(iii) Steroid Use: Long-term use of corticosteroid medications, whether for medical conditions like asthma or autoimmune diseases, or for non-medical reasons, can increase the risk of avascular necrosis by impairing blood flow to the bones.

(iv) Alcohol Consumption: Excessive alcohol consumption can weaken bones and affect blood flow, increasing the risk of avascular necrosis.

(v) Joint Disorders: Certain joint disorders, such as rheumatoid arthritis and osteoarthritis, can also increase the risk of avascular necrosis.

2.2.2 STAGES OF AVN

Avascular necrosis (AVN) progresses through several stages as the blood supply to determine the the affected bone decreases and bone tissue begins to die. These stages help assess severity of the condition and govern treatment regime.

(i) Stage 1 (Preclinical): At this stage, there are typically no symptoms experienced by the patient. It is often detected incidentally during imaging studies such as X-rays or MRI scans.

(ii) Stage 2 (Early): In stage II, patients may experience mild symptoms such as pain or discomfort in the affected joint, particularly during physical activity. Imaging studies, such as X-rays or MRI scans, might reveal signs of bone changes, like areas of increased density (sclerosis) or small cracks (microfractures), indicating early bone death.

(iii) Stage 3 (Intermediate or Subchondral Collapse): it is the progression of stage II and pain experience may worsen along with limited range of motion and difficulty in performing daily chores. Imaging studies at this stage reveal partial collapse of the affected bone, typically manifested as crescent-shaped areas of bone loss or collapse in the femoral head.

(iv) Stage 4 (Advanced or Joint Collapse): In stage IV, there is significant collapse of the affected bone, resulting in joint deformity and severe functional impairment. Patients may experience chronic pain, stiffness, and instability in the affected joint, making everyday activities challenging. Imaging studies show extensive bone destruction and joint deformity, often requiring surgical intervention such as joint replacement.

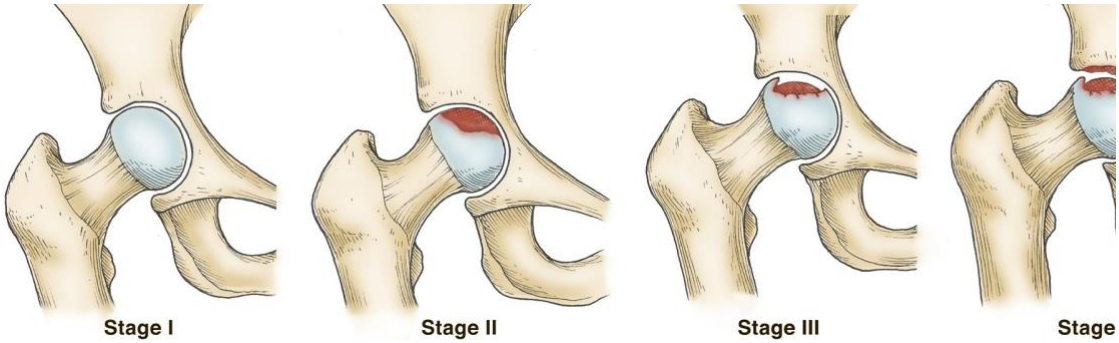

Figure 2: stages of Avascular necrosis of hip[3]

2.2.3 **ASSESSMENT**-

Assessment of avascular necrosis (AVN) is a combination of clinical evaluation, imaging studies, and sometimes laboratory tests that are used to determine the extent of bone damage, stage the condition, and devise treatment regime. Various tools of assessment of AVN are described as below

(i) Clinical Evaluation:

(a) Medical History: patients medical history is reviewed which may, include any risk factors for AVN such as trauma, corticosteroid use, alcohol consumption, or underlying medical conditions.

(b) Symptoms: The patient's symptoms, including joint pain, stiffness, decreased range of motion, and functional limitations, are assessed.

(c) Physical Examination: A thorough examination of the affected joint and surrounding structures is conducted to evaluate for signs of inflammation, joint instability, or deformity.

(ii) Imaging Studies:

(a) X-rays: X-rays are often the initial imaging modality used to evaluate AVN. They can show changes in bone density, joint space narrowing, subchondral sclerosis, and evidence of bone collapse.

(b) Magnetic Resonance Imaging (MRI): MRI is highly sensitive for detecting early signs of AVN, even before changes are visible on X-rays. It provides detailed images of bone, cartilage, and soft tissues, allowing for accurate staging and assessment of the extent of AVN.

(c) Computed Tomography (CT) Scan: CT scans may be used to provide additional information about bone structure and assess for complications such as fractures or joint collapse.

(iii) Staging using classification systems

(a) AVN is typically staged using classification systems such as the Ficat and Arlet system or the Association Research Circulation Osseous (ARCO) staging system, which categorize AVN based on the extent of bone damage and collapse.
(b) Staging helps guide treatment decisions and predict outcomes, with earlier stages often having more conservative treatment options available compared to advanced stages.

(iv) Subjective Assessment: in this the patient's subjective experience of their symptoms, including pain intensity, location, aggravating and alleviating factors, and how symptoms affect activities of daily living, is assessed.

(v) Objective Assessment:
(a) Range of Motion (ROM): active and passive ROM of the hip joint, including flexion, extension, abduction, adduction, internal rotation, and external rotation are observed and any limitations or asymmetries are noted.
(b) Muscle Strength: Muscle strength of the hip flexors, extensors, abductors, adductors, and rotators is evaluated using manual muscle testing or dynamometry.
(c) Muscle Length: The length of muscles surrounding the hip joint, such as the hip flexors, hamstrings, and hip rotators, is assessed through various muscle length tests.
(d) Joint Stability: The stability of the hip joint is assessed, including tests for ligament laxity and joint integrity.
(e) Functional Movement Assessment: Functional movements such as squatting, lunging, single-leg balance, and gait analysis are performed to evaluate movement patterns, compensations, and functional limitations.
(f) Special Tests: Specific orthopedic tests may be conducted to assess for conditions such as hip impingement, labral tears, or other hip pathologies.

(vi) Functional Assessment: it includes the assessment of activities of daily living (ADLs) or sports-specific movements may be performed to evaluate how hip joint dysfunction impacts functional tasks relevant to the patient's lifestyle or goals.

3: **METHODOLOGY OF OSTEOPATHYUSED IN TREATING AVN PATIENTS**

3.1 Tools of Osteopathic treatment[3]

The goal of osteopathic treatment is to improve overall health and well-being by enhancing the body’s natural ability to heal itself. Specifically, in the context of managing conditions such as avascular necrosis (AVN) of the hip, the goals of osteopathic treatment may include pain relief, improved function, healing through manual therapies and complementary methods. Tools of Osteopathy to achieve these goals are mentioned as below

3.1.1 Muscle energy technique (mets)-muscle energy technique

Andrew Taylor Still, the founder of Osteopathy medicine and pioneers like John Martin Littlejohn, laid the foundation for manual therapy techniques.

(METs) are a group of osteopathic manual therapy techniques used to treat musculoskeletal dysfunctions, restore muscle balance improve joint mobility and function. These constitute the active contraction of particular muscles against a controlled counterforce provided by the osteopathic practitioner. This contraction is used to address muscle imbalances, joint restrictions, and neuromuscular dysfunction. Reciprocal inhibition here, involves contracting one muscle group to inhibit the activity of its antagonist muscle group. This is followed by post-isometric relaxation which is the relaxation of muscles following a sustained contraction, which can help release tension and improve joint mobility. Autogenic inhibition occurs when a sustained muscle contraction activates Golgi tendon organs, leading to reflexive inhibition of the same muscle to prevent excessive tension or injury.

3.1.2 Lymphatic drainage

Lymphatic drainage, also known as lymphatic massage or manual lymphatic drainage (MLD), is a gentle therapeutic technique used to stimulate the lymphatic system and promote the removal of excess fluid, toxins, and waste products from the body. The lymphatic system being a vital part of the immune system, is responsible for transporting lymph fluid, which contains white blood cells, throughout the body that fight infection and maintain fluid balance.

It typically involves rhythmic, gentle massage strokes applied to the skin in specific patterns that follow the natural pathways of the lymphatic system. These massage strokes are light and repetitive, aim at stimulating the contraction of lymphatic vessels and encourage the movement of lymph fluid towards lymph nodes, where it can be filtered and processed. The direction of the massage strokes typically follows the natural flow of lymphatic fluid, moving towards lymph nodes located in regions such as the neck, armpits, and groin. Through this, lymphatic flow: is promoted which improves the circulation of lymph fluid, reducing swelling (edema) and promote the removal of toxins and metabolic waste products from tissues. The entire process reduces swelling, improves healing and provides relaxation and stress relief.

3.1.3 **Fascial release technique**

Fascia is a connective tissue that surrounds and interconnects muscles, bones, organs, nerves, blood vessels, and other structures throughout the body. It forms a continuous, three-dimensional web-like network that provides support, stability, and protection to the body’s tissues while allowing for movement and flexibility. Fascia plays a crucial role in proprioception and the transmission of mechanical forces.

Fascial release techniques are aimed at addressing fascial restrictions, adhesions, and dysfunctions to restore mobility, reduce pain, and improve overall function. These techniques target the fascial tissue, which surrounds and interconnects muscles, bones, organs, and other structures throughout the body. It is done in three ways mentioned as below:

(i) Myofascial Release (MFR): this involves applying sustained pressure and stretching to the fascial tissue to release adhesions and restrictions. Use of hands, fingers, or specialized tools to apply gentle, sustained pressure to areas of fascial tension or restriction, allowing the tissue to elongate and relax. This may direct where pressure is applied directly to the restricted area, or indirect myofascial release, where the tissue is gently stretched to facilitate release.

(ii) Trigger Point Therapy: in this the pressure is applied to hyperirritable spots within tight bands of muscle fibers that can refer pain to other areas of the body. This leads pain elevation and tension release

(iii) Fascial Manipulation: it is a hands-on therapy approach that targets specific areas of fascial restriction using precise, localized pressure and stretching techniques.

3.1.4 Joint mobilization technique

Joint mobilization techniques are generally categorized into different grades based upon the intensity and direction of the force applied. The commonly used grades are Grades I through V as outlined below

(i) Grade I: Small, oscillatory movements applied at the beginning of the range of motion to alleviate pain and reduce muscle guarding.

(ii) Grade II: Larger oscillatory movements within the mid-range of motion to stretch joint capsules, ligaments, and surrounding tissues.

(iii) Grade III: Large oscillatory movements near the end range of motion to stretch tight structures and improve joint mobility.

(iv) Grade IV: Sustained stretch applied at the end range of motion to further stretch tissues and increase joint mobility.

(v) Grade V: High-velocity, low-amplitude thrust techniques, also known as joint manipulations or adjustments, aimed at restoring normal joint mechanics and reducing joint restrictions.

3.1.5 Cranio-sacral-therapy

Craniosacral therapy (CST) is a gentle, hands-on approach that focuses on the craniosacral system, which includes the bones, tissues, and fluid surrounding the brain and spinal cord. It was developed by osteopathic physician Dr. John E. Upledger in the 1970s. it is based on the principle that subtle movements and rhythms within the craniosacral system reflect the overall health and functioning of the body. This therapy can be elaborated as below

It is base on inherent self-healing capacity of the body, the concept of the craniosacral rhythm, and the importance of balancing the craniosacral system to promote health and well-being. It is believed that restrictions or imbalances within the craniosacral system can contribute to a range of physical, emotional, and psychological symptoms and that gentle manipulation of the craniosacral system can help release tension, restore balance, and facilitate the body's natural healing processes.

A series of gentle, non-invasive techniques are applied with the hands to various parts of the body, including the skull, spine, pelvis, and other areas. Light touch and subtle movements are used to assess the craniosacral rhythm and identify areas of restriction or imbalance. Gentle palpation of the cranial bones, manipulation of the sacrum and spinal vertebrae, and subtle movements to release tension in the membranes and tissues surrounding the brain and spinal cord is done to encourage the body's natural self-regulation and self-healing processes by releasing restrictions and restoring balance within the craniosacral system.

3.1.6 Visceral manipulation technique

Visceral manipulation (VM) focuses on assessing and treating dysfunction within the visceral organs, including the intestines, liver, kidneys, stomach, and other organs of the abdomen and pelvis. It was developed by French osteopath Jean-Pierre Barral in the 1970s. The aim here is to improve the mobility, function, and alignment of the visceral organs to enhance overall health and well-being. It is based on the foundation that

Visceral organs are not only influenced by their own internal movements and functions but also by their relationship with adjacent structures, such as muscles, ligaments, and fascia. This suggests any dysfunction within the visceral organs, whether due to trauma, surgery, infection, inflammation, or chronic stress, can lead to restrictions in mobility and function, as well as secondary effects on surrounding tissues and organs. Therefore it addresses these restrictions and imbalances within the visceral organs and their associated structures to restore normal function and promote health.

3.1.7 Strain-counter-strain technique

Strain Counter strain (SCS), also known as Positional Release Technique (PRT) or Tender Point Technique, is a manual therapy approach developed by osteopathic physician Lawrence Jones in the 1950s. It is based on the principle of identifying and treating tender points or areas of muscle spasm through passive positioning of the body to achieve a state of reduced tension and pain relief. It is based on the principle that tender points or areas of muscle spasm are often associated with dysfunctional reflexes and hypertonicity in the neuromuscular system. Using passive positioning the body away from the direction of strain, the affected muscle or joint is put in a position of maximum comfort the position is held for a short duration of around 90 seconds, with the aim to reduce hypertonicity and reset the neuromuscular reflexes, leading to decreased pain and improved function.

3.1.8 Still technique

The Still Technique is also known as Osteopathic Manipulative Treatment (OMT) or Osteopathic Manipulative Medicine (OMM). It is a hands-on manual therapy approach developed by Dr. Andrew Taylor Still, the founder of osteopathic medicine, in the late 19th century. The Still

Technique forms the foundation of osteopathic practice and encompasses a variety of gentle, hands-on techniques aimed at diagnosing and treating musculoskeletal dysfunction, promoting health, and facilitating the body's self-healing mechanisms.
The goal of the Still Technique is to identify and address underlying structural and biomechanical dysfunctions through hands-on manipulation of the musculoskeletal system, thereby restoring balance and promoting optimal health. It covers a wide range of manual therapy techniques, including soft tissue techniques where Gentle manipulation of muscles, fascia, ligaments, and tendons is done to release tension, improve circulation, and promote tissue mobility. Also are used articulatory techniques which are passive movement of joints through their natural range of motion to improve joint mobility, reduce stiffness, and restore normal joint function. High-velocity, low-amplitude (HVLA) thrust techniques are a part of it and are quick, controlled movements applied to joints to restore proper alignment and function, often called "adjustments" or "manipulations."
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3.1.9 Balanced ligamentous tension technique

The Balanced Ligamentous Tension (BLT) technique is a manual therapy approach used in osteopathic medicine to address musculoskeletal dysfunction and promote health and well-being. Developed by osteopathic physician William G. Sutherland, BLT is based on the principle of restoring balanced tension within the ligaments and other soft tissues surrounding the joints to optimize joint mobility and function. It focuses on the interrelationship between the body's structure and function. Sutherland observed that imbalances or restrictions within the ligaments and soft tissues surrounding the joints could contribute to musculoskeletal dysfunction and compromise overall health. Areas of tension or restriction within the ligaments and other soft tissues are identified and gentle, precise manipulation is done to restore balanced tension and optimize joint mobility. Hands -on manipulation of the ligaments and soft tissues surrounding the joints is done to restore balanced tension and optimize joint mobility. These techniques are tailored to the individual needs and preferences of the patient and are applied in a gentle and non-invasive manner.

3.1 10. Spinal manipulation technique

Spinal manipulation, also known as spinal manipulative therapy (SMT) or spinal adjustment, is a manual therapy technique used to address musculoskeletal conditions affecting the spine and surrounding structures. The technique involves applying controlled, sudden force to specific joints of the spine, typically the vertebrae, with the aim of improving joint mobility, reducing pain, and restoring normal function. It is based on the principle that dysfunction within the spinal joints, such as restricted movement or misalignment, can contribute to pain, stiffness, and impaired function. Normal joint mobility and alignment is restored using SMT which alleviates pain, and improve overall musculoskeletal function. A quick, controlled thrust is applied to a specific joint

of the spine, often using their hands or specialized instruments causing the release of gas bubbles within the joint fluid.

3.1.11. Therapeutic exercises

Therapeutic exercise, like range of motion (ROM) exercises, strengthening exercises, flexibility exercises, balance and proprioception exercises, cardiovascular exercises, neuromuscular re-education, core stabilization exercises and functional training are prescribed to help patients recover from injury or illness, manage chronic conditions, improve physical function, and enhance overall health and well-being. These exercises are designed to target specific areas of the body, improve strength, flexibility, endurance, balance, coordination, and proprioception, and address impairments in movement and function.

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3.1.12. **Physiotherapy modalities**

Physiotherapy modalities refer to the various therapeutic techniques and interventions used by physiotherapists to manage pain, promote healing, improve mobility, and restore function in patients with musculoskeletal, neurological, cardiopulmonary, and other health conditions. These modalities encompass a wide range of treatment options, including physical agents, electrotherapy, manual therapy, exercise therapy, and other specialized techniques and make o component of osteopathy.

4. Study protocol and design

The study was conducted on the subjects visiting the clinic, Indoor. Patients with mild to severe condition of Avascular necrosis were considered for the study. No restriction on age or gender was put on the inclusion criteria. A total of 08 patients all males aged between 28 and 58 years were part of the study. The primary symptoms of the patients included pain, joint stiffness, limited range of motion, swelling and tenderness associated with deformed gait and uneven load distribution on lower limbs. A written consent was taken from the subjects to be part of the study and privacy and confidentiality of the patients was maintained.

4.1 Measure of result outcome: the efficacy of the treatment regime was measured in two fold manner

4.1.1 Data observation from plantar pressure plate: a plantar pressure plate is an instrument[5] shaped in the form of a flat plate with thousands of pressure measuring sensors embedded in it. When a person stands on it, a number of patient parameters are captured. Some of the parameters include:

(i) center of pressure of each foot and the entire body: and trajectory of center of pressure

The COP for each foot represents the point on the ground where the resultant pressure of the foot's contact with the ground is applied. This point shifts dynamically as a person walks or stands, reflecting changes in weight distribution and foot movement.
By examining the COP, clinicians can assess how pressure is distributed across the foot, identifying areas of excessive pressure that might indicate foot deformities[5,6], imbalance uneven load distribution amongst limbs etc
Comparing the COP trajectories of both feet can reveal asymmetries in gait, which may be due to injury, neurological conditions, or other musculoskeletal issues. for both foot and entire body. The COP for each foot moves slightly with every step, reflecting the rolling motion of foot as weight is transferred from heel to toe during walking. By analyzing the movement of the COP for each foot, healthcare professionals can gain insights into your foot function. When a persons both the limbs and spine are free of ailments, area of the trajectory of center of pressure for each limb and gait parameters reflect relative symmetry.

To measure the outcome of therapy patients were asked to stand on plantar plate for 30 seconds with eyes open and the area of the trajectory of center of pressure for each limb was observed prior to first therapy session and after each session. Typical images of the area of trajectory of center of pressure for each limb for eight consecutive sessions are shown in figure 3 a, b c, d, e, f and g.

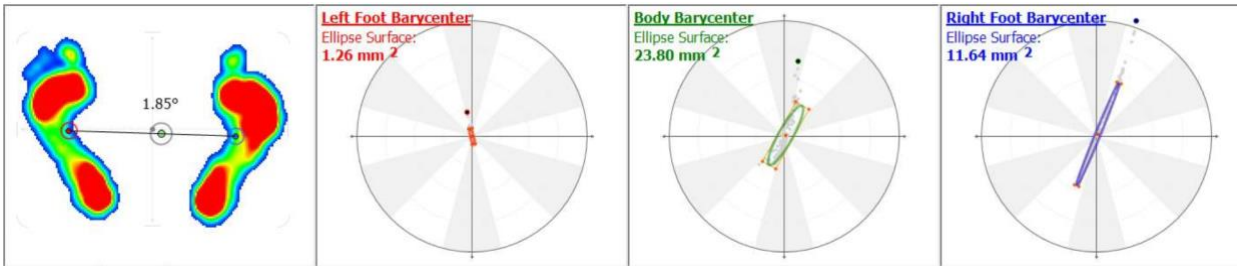

Figure 3 a before therapy

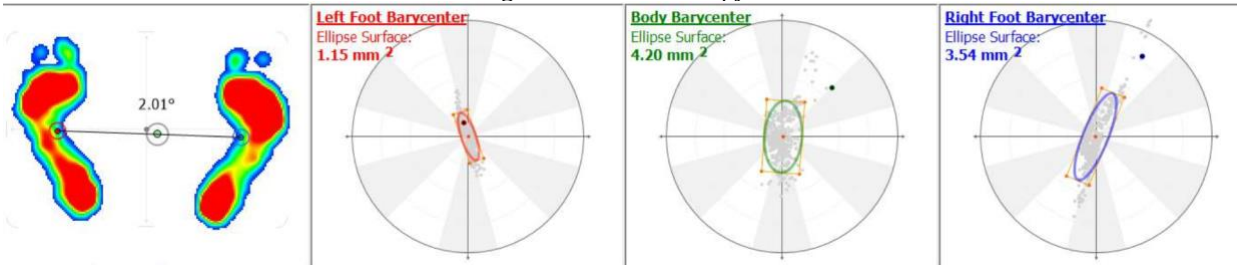

Figure 3 b after first therapy

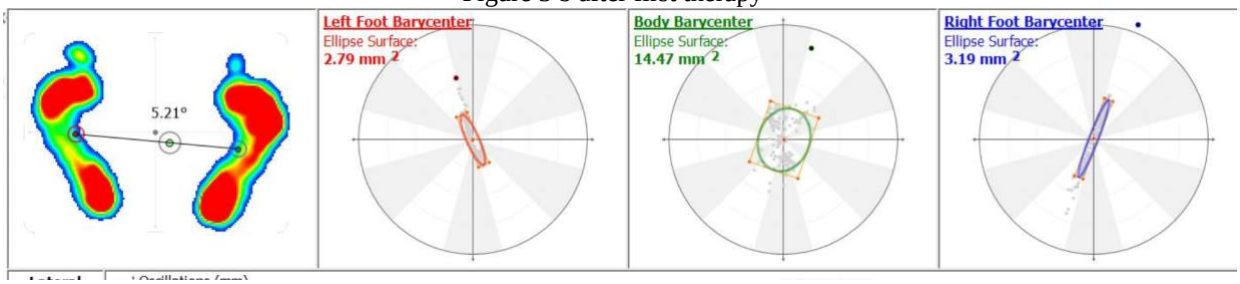

Figure 3 c After third therapy

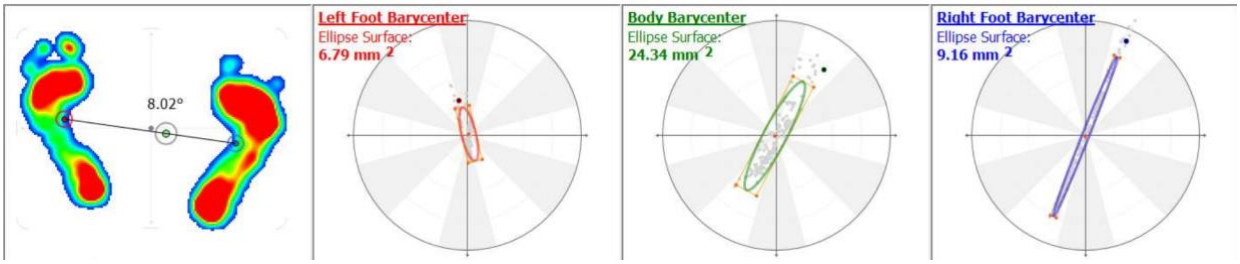

Figure 3 d After fourth therapy

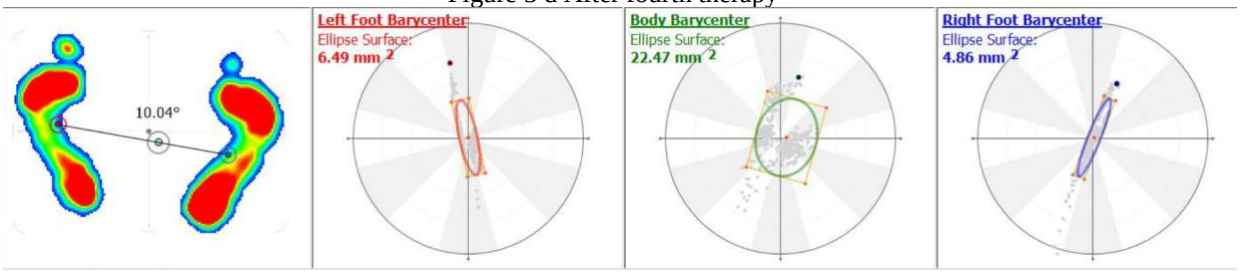

Figure 3 e After fifth therapy

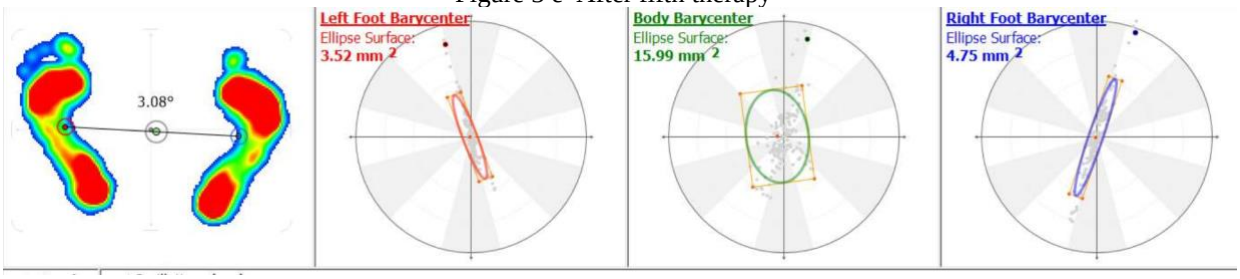

Figure 3 f After sixth therapy

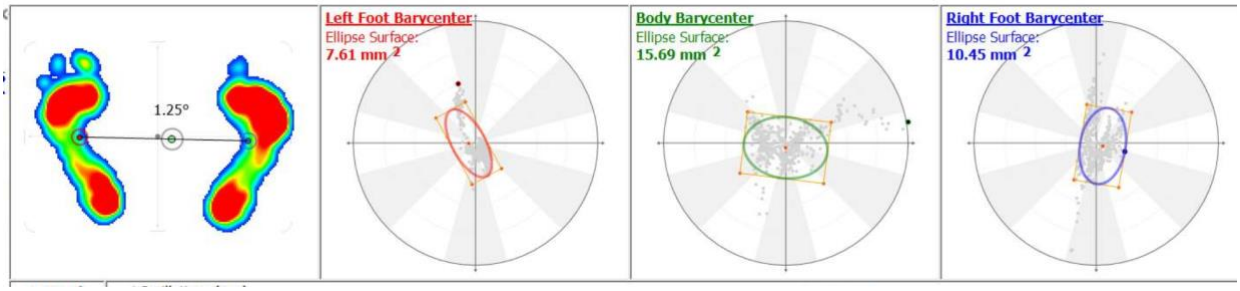

Figure 3 g After seventh therapy

Figure 3 Center of pressure trajectory area for boot foot reflecting similarity after subsequent therapy sessions.

4.1.2 Patient record and response sheets

These were made to keep a track of improvement over sessions. This sheet had yes no type of questions some of which were filled by the practitioner after observations and some questions were asked to the patients. Patients record and response sheet is put below

	Questions	yes	no
1	Increase in ROM of hip flexion.	6	2

2	Increase in ROM of hip abduction	5	3
3	Improvement in mobility	6	2
4	Improvement gait pattern	5	3
5	Improvement in proprioception and balance	5	3
6	Visible improvement in gait	5	3
7	Improvement in quality of life	6	2
8	Improvement in activity of daily living	6	2
9	Reduction in pain	5	3
10	Changes in X-ray	4	4
11	Improvement in muscle power..	6	2
12	Reduction in swelling and inflammation	5	5

Table 1: The summary sheet for patient record and response

4.2 Inference of result outcome-

From the summary sheet and the verbal patient response it was concluded that patients suffering from AVN preferred visiting my clinic to

(i) To relax and to reduce pain.
(ii) To improve quality of life.
(iii) To improve gait pattern.
(iv) To reverse AVN.
(v) Out of curiosity just to explore new therapies.

1. Follow-Up and Rehabilitation

Follow-up sessions on regular basis are crucial to monitor progress, adjust treatments, and introduce new exercises or techniques as the patient improves. Long-term rehabilitation might involve a gradual increase in activity levels, continuous ergonomic adjustments, and ongoing exercises to maintain strength and flexibility.

2. Summary

Osteopathy offers a comprehensive and holistic improvement in symptoms of Avascular necrosis through manual manipulation, facial release, muscle energy technique, lymphatic drainage, fascial release technique, joint mobilization technique, cranio-sacral therapy, visceral manipulation, strain-counter-strain techniques, still technique, balanced ligamentous tension technique, spinal manipulation technique, therapeutic exercises and Physiotherapy modality. As per the level of severity of the ailment, significant to mild improvement was reported as well as observed with the treatment regime consisting of osteopathy

5. References

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