

A Dissertation On
TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN
MANAGEMENT IN PERIARTHRITIS OF SHOULDER

Submitted by
Dr. V. ARUMUGARAJ, B.N.Y.S (Reg. No. 461611002)

Under the guidance of
Prof. Dr. N. MANAVALAN, N.D. (OSM), M.A (G.T), M.Sc (Y&N), M.Phil,
P.G.D.Y, P.G.D.H.M, P.G.D.H.H

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HOSPITAL, CHENNAI – 600 106.
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under my guidance and supervision in partial fulfillment of regulations of The Tamilnadu Dr.M.G.R.Medical University, Chennai for the award of degree of **DOCTOR OF MEDICINE (M.D) – (Naturopathy) BRANCH – I** during the academic period 2016 to 2019.

Date:

SIGNATURE OF THE GUIDE

Place:

Dr. N. MANAVALAN,

N.D.(OSM),M.A(G.T), M.Sc (Y&N), M. Phil,

P.G.D.Y, P.G.D.H.M, P.G.D.H.H,

Head of the Department - Department of Naturopathy,

Government Yoga and Naturopathy Medical

College and Hospitals, Chennai – 106.

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HOSPITAL, CHENNAI, TAMILNADU**

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I certify that the dissertation entitled “**TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHROSITIS OF SHOULDER**” is the record of original research work carried out by

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Place: Chennai.

SIGNATURE OF THE H.O.D

Date:

Dr. N. MANAVALAN,

N.D.(OSM),M.A(G.T), M.Sc (Y&N), M. Phil,

P.G.D.Y, P.G.D.H.M, P.G.D.H.H,

Head of the Department - Department of Naturopathy,

Government Yoga and Naturopathy Medical

College and Hospitals, Chennai – 106.

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND
HOSPITAL, CHENNAI, TAMILNADU**

ENDORSEMENT BY THE PRINCIPAL

I certify that the dissertation “**TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHRITIS OF SHOULDER**” is the record of original research work carried out by

Dr. V.ARUMUGARAJ, Department of Naturopathy, Government Yoga and Naturopathy Medical College and Hospital, Chennai – 600 106 submitted for the award of degree of DOCTOR OF MEDICINE (M.D) Branch – I (Naturopathy) under my guidance and supervision, and that this work has not formed the basis for the award of any degree, diploma, associate ship, fellowship or other titles in this University or any other University or Institution of higher learning.

Place: Chennai.

SIGNATURE OF THE PRINCIPAL

Date:

Dr. N.MANAVALAN,

N.D. (OSM), M.A (G.T), M.Sc (Y&N), M. Phil,

P.G.D.Y., P.G.D.H.M., P.G.D.H.H.,

Govt. Yoga and Naturopathy Medical

College and Hospitals, Chennai-106

**GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE AND
HOSPITAL, CHENNAI, TAMILNADU.**

DECLARATION BY THE CANDIDATE

I, **Dr. V.ARUMUGARAJ** I solemnly declare that this dissertation entitled

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MANAGEMENT IN PERIARTHRITIS OF SHOULDER”** is a bonafide and
genuine research work carried out by me at Government Yoga and Naturopathy Medical
College and Hospital, Chennai from July 2016 - June 2017 under the guidance and
supervision of **Dr. N. MANAVALAN**, N.D. (OSM), M.A (G.T), M.Sc (Y&N), M. Phil,
P.G.D.Y, P.G.D.H.M, P.G.D.H.H, Head of the Department - Department of
Naturopathy. This dissertation is submitted to The Tamilnadu Dr.M.G.R.Medical
University, Chennai towards partial fulfillment of requirements for the award of M.D.
Degree (Branch – I – Naturopathy) in Yoga and Naturopathy.

Place: Chennai

Signature of the candidate

Date:

(Dr. V.ARUMUGARAJ)

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GOVERNMENT YOGA AND NATUROPATHY MEDICAL COLLEGE

AND HOSPITAL, CHENNAI – 600 106.

CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Government Yoga & Naturopathy

Medical College and Hospital, Chennai reviewed and discussed the

application for approval “**TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHRITIS OF SHOULDER**” project work submitted by Dr. V.ARUMUGARAJ, 2 year M.D. Naturopathy, Post graduate, Government Yoga and Naturopathy Medical College and Hospital, Chennai.

The proposal is APPROVED.

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Date:

Signature of the Candidate

Place: Chennai

(Dr.V.ARUMUGARAJ)

LIST OF ABBREVIATIONS

AC	Adhesive capsulitis	MMP	Matrix Metalloproteinase
ANS	Autonomic Nervous System	MPk	Mud pack
ARR	Arthroscopic release and repair	NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
aROM	Active Range of Motion	NMDA	N-Methyl-D-Aspartic Acid
AMPA	a-Amino-3-Hydroxy-5-Methyl-4-Isoxazolepropionic Acid	P	Probability
DM	Diabetes Mellitus	ROM	Range of Motion
HMA	Hot mud application	SD	Standard Deviation
HTN	Hypertension	SPSS	Statistical Package for the Social Sciences
5-HT	5-Hydroxytryptamine	SPADI	Shoulder Pain and its Disability Index
MRI	Magnetic resonance imaging	TGF-beta	Transforming Growth Factor beta
MPT	Mud pack treatment	VAS	Visual Analog Scale

ABSTRACT

BACKGROUND

Periarthritis of shoulder (PAS) is a common painful musculoskeletal disorder of shoulder. Mud treatment has demonstrated to be effective in the administration of skin pathologies, rheumatic issue, musculoskeletal clutters, gynecological conditions, neurological protests and cardiovascular conditions. The present quasi experimental study was planned to evaluate the effect of hot mud application over the painful shoulder joint in increasing Range of motion of the shoulder – flexion, abduction and external rotation.

METHODS

A total of forty subjects, aged (40-65 yrs) were randomly assigned into the study group after satisfying the inclusion and exclusion criteria. Study group was assessed at baseline and after 15 sessions (alternate days in a month) for Shoulder pain and its disability index (SPADI) and range of motion.

RESULTS

The study group showed significantly improvement in both statistically and clinically in pain index ($P < 0.002$), disability index ($P < 0.007$), total SPADI score ($P < 0.002$), shoulder flexion ($P < 0.003$), abduction ($P < 0.002$) and external rotation ($P < 0.004$).

CONCLUSION

Fifteen session application of hot mud over painful shoulder joints of periarthritis patients causes vasodilatation and it infiltrates further into the muscle and consequently decreases the pain and increase the range of movements in shoulder joint.

KEYWORDS

Periarthritis of shoulder (PAS), Hot mud application, Shoulder pain and its disability index (SPADI), Mud therapy.

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1.0 INTRODUCTION

Periarthritis of shoulder (PAS) is a common painful musculoskeletal disorder of shoulder [1]. Frozen shoulder was first described by Duplay in 1872 and termed periarthritis. The key symptoms as described earlier i.e gradual onset of shoulder stiffness, severe pain, especially at night and restriction in active and passive range of movement of the shoulder, were initially attributed to inflammation of the subacromial and sub deltoid bursae [codman,1911].In 1945 Neviaser was the first to described fibrosis and adhesions in the shoulder capsule in 10 cases and suggested the term 'adhesive capsulitis' as a more accurate description of the condition (J.S.Neviaer,1945] [2]. Observational studies conducted with these findings and it is generally accepted that the shoulder capsule is the cause of symptoms in periarthritis shoulder [3].

Neviaser in 1945 who given the term 'adhesive capsulitis' for painful Stiffening of the shoulder [4]. Adhesive capsulitis (AC), also known as frozen Shoulder, is a common and painful musculoskeletal disorder. The shoulder is a Complex joint comprising 3 bones and multiple muscle groups, ligaments, and Tendons. Accompanying the inflammation of the joint is stiffness that greatly restricts the patient's motion and strength [5]. 'Frozen shoulder' was another word used by Codman Frozen shoulder, a term coined by Codman in1934, is an orthopaedic condition that is commonly encountered general practice. Codman used this term to describe a condition with symptoms of shoulder pain and discomfort that is slow in onset and located around the deltoid insertion. Patients generally complaint of an inability to sleep on the affected side. Restricted glenohumeral elevation and external rotation, together with unremarkable radiographic findings, are also observed [6]. The condition is commonly

reported burden of middle age between 40 and 65 and is rare in children age group and in manual labours and but it is slightly more common in women [7].

PAS is believed to have an incidence of 3% to 5% in the general population and up to 20% in those with diabetes [8], patients with PAS have a higher risk of having certain form of pre diabetic condition with an abnormal fasting glucose or impaired glucose tolerance test [9]. The loss of range is multi planar, with external rotation and abduction being the most affected restricted passive external rotation [10].

PAS classified into four distinct stages namely painful, freezing, frozen and thawing stages [11-13]. PAS associated with pain can cause an immobilization of a shoulder extended immobilization of a joint has been shown to cause several detrimental pathophysiologic findings including decreased collagen length, fibrofatty infiltration into the capsule recess, ligament atrophy resulting in reduced stress absorption, collagen band bridging across recesses, random collagen production, and reformed sarcomere number in muscle tissue [14].

The diagnosis of PAS is often one of marginalization. Early in the disease Process it may clinically appear similar to other shoulder conditions such as major trauma, rotator cuff tear, rotator cuff contusion, labral tear, bone contusion, subacromial bursitis, cervical or peripheral neuropathy. Likewise, a history of a previous surgical procedure can lead to shoulder stiffness. If a history of these pathologies is negative and radiographs do not determine osteoarthritis, then the diagnosis can be definite as a PAS. Nowadays, there are many intervention options are accessible for PAS, manipulation under anaesthesia which the shoulder is freed by rotation while the

patient is under short general anaesthesia. This can be undertaken as a day procedure [15], exercise therapy, electrotherapy, hydrotherapy [16], bupivacaine suprascapular nerve blocks using bupivacaine and methylprednisolone acetate in chronic shoulder pain [17], which are anti-inflammatories, intra-articular corticosteroid injections to reduce the inflammation and provide the pain relief [18], arthroscopic capsular release and repair a surgical procedure conducted under anaesthesia which the contracted tissue is released[19]. Most of Patients may also choose complimentary therapies like physiotherapy [20], arthroscopic capsular distention (also called hydrodilatation) which involves controlled dilatation of the joint capsule with sterile water under local anaesthesia [21].

It is a scientific and systemic manipulation of the tissue and muscle of the body. The main aim to improving the blood circulation and also strengthening muscles and bodily organs.so massage is an effective treatments for reducing shoulder pain [22].

MUD THERAPY

In naturopathy, among these five elements, earth is an integral component of the human body and has a specific effect on health and diseases. Mud is a mixture of inorganic and organic matter with water, which has undergone geological and biological processes under the influence of various physic chemical factors [23].

Naturopathy physicians prescribe mud therapy as one of the eliminative therapies. One of the unique properties of mud is that, it can absorb the heat and toxins from the body and eliminate these toxins in different ways. Mud therapy is a very simple and cost-effective treatment.

Preparation of Mud for Application

Source: The mud should be clean and taken from 122 -153 cm depth from the surface of ground. Free from contamination of stone pieces & chemical manures.

Preparation: Before using mud should be dried in sun rays, powdered and sieved to separate stones, grass particles and other impurities. It should be well heated and then sterilised. Take the mud fine powder and mix it with adequate amount of water (hot). Mix the mud powder with water and make mud as paste [24].

Mud has been used empirically in musculoskeletal and inflammatory joint diseases. Antiseptic and substances interchange capacity are attributed to (mainly) the inorganic components of mud [25]. Effects of mud-application include: increase in membrane electrical conductance, absorption phenomena, hyperemia, hidropoietic glands, enzymes and hormones activation. Scientific studies revealed that bath therapy increases skin temperature, impacts on cardiovascular systems, water-electrolytes balance, neurotransmission (central nervous system, neural conductibility), immune system, enzymes activation and metabolism mud, which contains organic and mineral ingredients, has been used in the treatment of several degenerative diseases [26].

The chemical analysis of mud does not only reveal hydrophilic organic substances, such as humic, fulmic, and ulmic acids, but also organic substances composed of fatty acids [27].

Since the time of Cleopatra, people have revered the mud found at the bottom of the Dead Sea and have used the rich mineral mix for healing baths and beauty treatments. Its high concentration of chloride salts of magnesium, sodium, potassium, calcium, and bromine help relax muscles, ease pain, and stimulate circulation, which makes it particularly useful in the treatment of dermatological conditions, such as psoriasis, acne, dandruff, eczema, and dry skin [28].

Thermal muds are hydrothermal or hydro thermalized pastes produced by primary or secondary mixing of clayey (geo) materials with salty thermo-mineral waters, accompanied by organic materials produced by the biological-metabolic activity of micro-organisms growing during the so-called “maturation” process. The routine applications of thermal muds (“peloids”) are: (i) local or total-body cataplasms for recovering chronic rheumatism, myalgias, neuralgias, osteoarthrosis and peri-arthritis of shoulder [29].

We found that pain score reduce in hot mud application compare to mustard application. Which suggest the main use of the treatment is to relieve rheumatic musculoskeletal pain [30].

The principle mechanism of action of mud packs and thermal baths appears to be its analgesic effect, related to a neuroendocrine reaction causing an increase of serum levels of opioid peptides such as endorphins and enkephalin [31]. Thermal muds are hydrothermal or hydro thermalized pastes produced by primary or secondary mixing of clay (geo)materials with salty thermo-mineral water,

accompanied by organic materials produced by the biological-metabolic activity of microorganisms growing during the so-called “maturation” process.

Diatoms alive within the thermal mud are able to produce proteins and lipids as the result of biotransformation by thio-bacteria [32]. Clay raw materials (NE Turkey) have been studied to determine their mineralogical and physicochemical properties and evaluation of their thermal mud characteristics. The following grain-size analysis revealed that the samples the highest percentage of smaller than 2 μm . The smaller size of particles attributed to their better thermal behaviour, since the smaller the clay particle. It was observed that the dominant clay mineral was smectite and other clay minerals were kaolinite, illite, mica and zeolite. Non clay minerals identified were quartz, calcite, plagioclase and feldspar. The degree of plasticity was high and very high except one sample which recorded moderate plasticity. The dense fragments of *Dreissena sp.* and *Congeria sp.* observed in the clay raw materials increased the biogenic carbonate. $\text{Na}_2\text{O}/\text{CaO}$ ratios in all samples were found to be lower than the swelling clay minerals because of high CaO contents caused by biogenic carbonate. Although, physicochemical properties such as CEC and SSA values were low because of very high biogenic [33].

Thermal mud therapy does not only improve range of movements in joint diseases, but also interacts with complex mechanisms underlying disease pathophysiology and mud pack therapy has shown significant decrease in the circulating levels of TNF- α and IL-1, correlated with joint pain relief [34].

In particular, the in-vitro experiments of percutaneous migration clearly indicate that for most elements, the amount transferred across the skin depends on their concentration in mineral water, the exchange able fraction of ions being negligible respect to high salinity of the water. A qualitative evaluation of indicates that all the most abundant “inorganic” elements of biological systems (Na, K, Ca, Mg, P,S, Cl), are transferred through the skin, as well as 15 of 18 essential or possibly essential trace elements (Br, Cr, Cu, F, Fe, I, Li, Mn, Ni, Se, Si, , Zn) [35].

2.0 AIMS AND OBJECTIVES

2.1 Aim: To evaluate the effect of hot mud application on pain and range of motion in patients with periarthritis of shoulder.

2.2 Objectives

2.2.1 Primary objective

To assess the shoulder pain and its restriction by SPADI (shoulder pain and its disability index).

2.2.2 Secondary Objective

To assess the range of motion (ROM) of the shoulder by Goniometer

1. Flexion
2. Abduction
3. External Rotation.

3.0 LITERATURE REVIEW

3.1 Introduction to PAS

Periarthritis of shoulder (PAS) is a musculoskeletal disorder with self-limiting condition in shoulder joint. Patients typically present with a traumatic history of progressive painful restriction in range of movement of the shoulder joint. They reveal a capsular pattern of limitation with external rotation and being the most affected followed by abduction in the level of the scapula and then finally flexion. In 1934 Codman described a diagnostic criteria which involves of idiopathic onset, painful restriction of all glenohumeral movements with limitation of flexion and external rotation without any radiological changes.

PAS associated with pain can cause an immobilization of a shoulder. Prolonged immobilization of a joint has been shown to cause several detrimental pathophysiologic findings.

3.2 Epidemiology

Prevalence of PAS is approximately 2-3 percent in the general population [36]. It is peaks among 40-65 years of age and infrequent in children. but women are more frequently affected than men, but there is no known genetic or racial preference.it is commonly affect in persons with insulin-dependent and non- insulin-dependent diabetes, and in those with pre-diabetes (glucose intolerance).

Persons with a history of PAS are at increased risk of developing the condition on the contralateral side. Recurrence side is also possible, especially in patients with diabetes.

3.3 PAS and Diabetes Mellitus

Studies have presented that correspondence between PAS and diabetes mellitus (DM), with the incidence of two to four times higher when matched with general population. It affects about 20% of people with DM and has been described as the most disabling of the common musculoskeletal manifestations of diabetes. The prevalence of diabetes in patients with PAS was 71.5% DM increases the risk of microvascular complications and believed to play a role in the developed of musculoskeletal complications [37].

3.4 History of PAS

Reeves, in a prospective study had a follow up for 5-10 years with 41 patients, out of them he have observed that 39% recovered completely, 54% had clinical limitation without functional changes, and 7% had functional limitation [38].Shaffer et al showed that 50% of his 61 patients with PAS had certain degree of pain and stiffness on an average of seven years after onset of the disease [39].

3.5 Phase of Clinical Presentation

Neviaser et al [40] and Hannafin et al [41] said that 4 stages in PAS, which have been correlated with clinical examination and histological features.

STAGES	SYMPTOMS	LENGTH OF SYMPTOMS	HISTOLOGICAL FEATURES
PAINFUL STAGE	Aching pain and moderate limitation of ROM	Less than 3 months	Synovitis and capsular hypertrophy
FREEZING STAGE	Severe pain and reduction of ROM	3 to 9 months	perivascular synovitis. Disorganized Collagen deposition
FROZEN STAGE	Stiffness is predominant. Pain may persist.	9 to 14 months	Dense and hypercellular collagenous tissue
THAWING STAGE	Minimal pain and a gradual improvement of ROM	15 and 24 months	Not investigated.

Table 1: Clinical and histological stages of PAS

3.5.1 Painful Stage

First stages in PAS is the painful stage, which is characterised by a progressive beginning of pain. It continues less than 3 months on the insertion of deltoid muscles and in ability to sleep on the affected side. Patients may report a mild restriction of ROM which perpetually resolves with the advise of local anaesthesia [42]. Arthroscopic perspectives demonstrates a hypertrophic, vascularized synovitis without grips or capsular contracture.

3.5.2 Freezing Stage

The second stage is also classified "solidifying stage" symptoms proceed for 3 to 9 months and are described by increasing of nocturnal pain while resting on the influenced side, also a significant loss of both active and passive ROM can be taken noticed. Arthroscopic view demonstrates a thickening of perivascular synovitis [42]. Histologically demonstrates perivascular and sub synovial scar development with deposition of disordered collagen fibrils with a hypercellular appearance, however no any inflammatory infiltration.

3.5.3 Frozen Phase

In frozen (or) "solidified stage [42] symptoms persists 9 to 14 months, the shoulder firmness is transcendent and pain may persevere towards the end of movement or during the sleep on the affected side. Arthroscopic examinations exhibit loss of axillary recess, patchy synovial thickening and biopsy shows dense hypercellular collagenous tissue.

3.5.4 Thawing Phase

The last stage is thawing or "defrosting stage". It is described by minimal pain and a gradual progression of ROM because of capsular remodeling. This stage happens somewhere in the range of 15 and two years [42]. Arthroscopic and histological correspondence has not been explored.

3.6 Physical Examination

Chronic PAS patients may lose characteristic swing of the arm that happens while walking. Shoulder support muscles atrophy can be taken note. Debilitated movement in the glenohumeral joint may result with irregular scapular development with active forward flexion of the affected shoulder. Physical examination of a patient with PAS can be uneasiness and require brief rest or delicate release their arm to demonstrate the moves. Palpation may yield dubious, diffuse tenderness over the anterior and posterior shoulder. Central tenderness over unequivocal structure is uncommon and its essence proposes differential determination or attendant pathologies, for example, rotator cuff or biceps tendinopathy.

PAS susceptibility can be raised when flexion, abduction, and external rotation were confined. Examination of the two shoulders can uncover the precise survey shortages of the influenced side. The patient should initially be solicited to actively test the breaking points from movement; if loss of movement is watched, the doctor may assist passively, with scapular adjustment to ensure a precise estimation of movement.

3.7 Clinical Presentation

Periarthritis shoulder is a clinical conclusion. The three all marks of solidified shoulder are active shoulder firmness, severe pain (particularly around night time) that results inability to sleep on the affected side and a close total loss of uninvolvement and active external rotation of the shoulder. Appropriate history-taking incorporates the onset and duration of symptom, site, function and preceding trauma. Past therapeutic and careful history is significant and relevant and should be obtained. On inspection, mild diffuse atrophy of the deltoid and supraspinatus in long standing cases is usually observed. The arm may be adducted and internally rotated. Tenderness would be positive on palpation of the glenohumeral joint. Both active and passive range of motion are affected, especially that of abduction and external rotation. Movement in the thoracoscapular joint, which may aid abduction, should be noticed.

The hallmark of PAS is decreased range of motion and shoulder pain there often idiopathic cause or trigger. The pain is often described as a poorly localized and deep ache. If the pain is localized, it is usually in the area of the anterior or posterior capsule. It may radiate to the biceps with progressive pain and stiffness when performing flexion, abduction and external rotation. Weakness is often correlated to pain or concomitant tendinopathy. Crepitus may be present on the involved side. Like other shoulder conditions pain may be impair sleep [43].

3.8 Pathogenesis of PAS

Neviaser noted that PAS condition was actually located in the capsule of the shoulder joint and therefore called adhesive capsulitis. Therefore the pathophysiological

process is believed to involve synovial inflammation and fibrosis of the shoulder joint capsule .with microscopic examination of the tissue one will find the majority of the cells to be fibroblasts with some mast cells also present. Cytokines such as transforming growth factor β and platelet –derived growth factor may contribute to the inflammatory process. Although the glenohumeral joint, synovial capsule is involved, much of the disease also involves structures outside the glenohumeral joint. These structures can include the coracohumeral ligament, rotator interval, subscapularis, musculotendinous and the subacromial bursa [44].

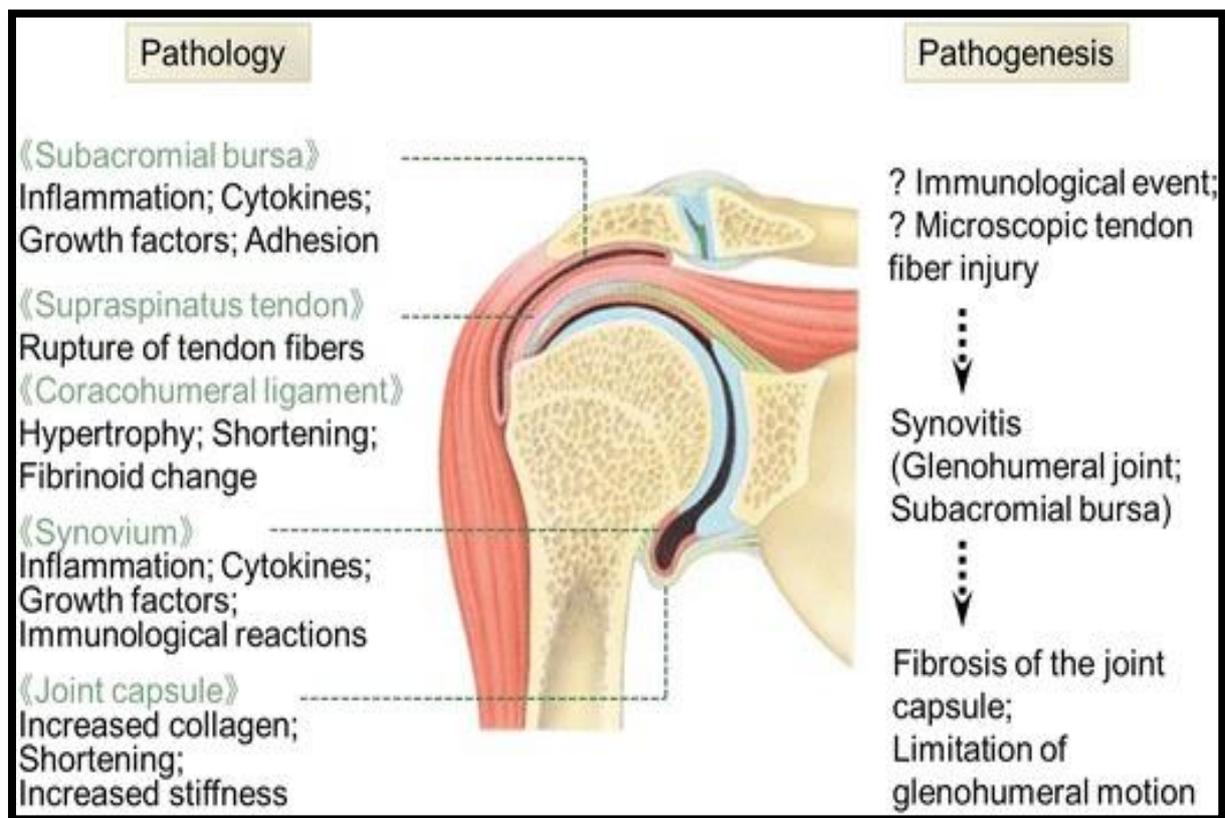


Figure 1: Pathogenesis of PAS

PAS includes both synovial inflammation and capsular fibrosis. Characteristically pain with restriction, it is most likely to have inflammation with fibrosis. Cytokines

such as tumour necrosis factor-alpha (TNF-alpha) and Interleukins (ILs) also cause synovitis in both the glenohumeral joint and subacromial bursa, however matrix-bound transforming growth factor beta (TGF-beta) may act as a persistent stimulus and resulting in capsular fibrosis [45]. Another likely initiator of synovitis is degeneration or injury of the rotator cuff tendon. Tendon injury may trigger induction of inflammatory mediators or fibrotic cytokines in the shoulder joint, where as partial rotator cuff tear may cause joint contracture [46].

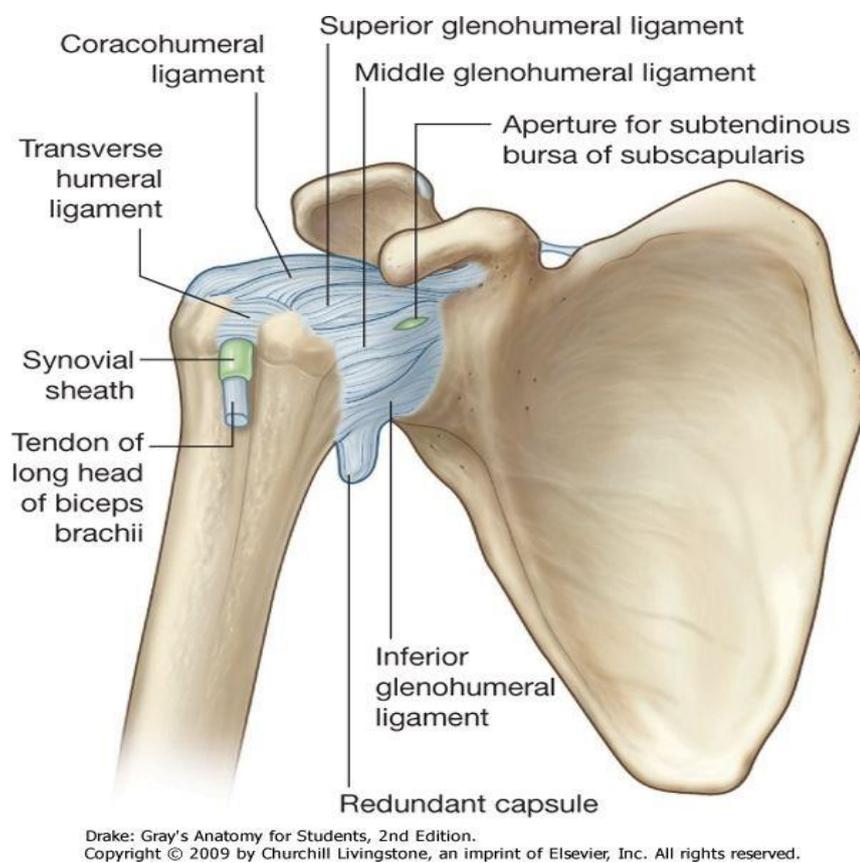


Figure 2: Capsule of right glenohumeral joint

Capsules of Right Glenohumeral Joint

The fibrous membrane of the joint capsule is thickened: antero superiorly in three locations to form superior, middle, and inferior glenohumeral ligaments, which pass

from the superomedial margin of the glenoid cavity to the lesser tubercle and inferiorly related anatomical neck of the humerus superiorly between the base of the coracoid process and the greater tubercle of the humerus (the coracohumeral ligament); between the greater and lesser tubercles of the humerus (transverse humeral ligament)-this holds the tendon of the long head of the biceps bronchi muscle in the intertubercular sulcus .Joint stability is provided by surrounding muscle tendons and a skeletal arch formed superiorly by the coracoid process and acromion and the coraco-acromial ligament [47].

3.9 Differential Diagnosis

Diagnosis of PAS is generally clinical. Other conditions that would be considered in a patient who presents with a stiffness, painful shoulder include acromio clavicular arthropathy, autoimmune disease (e.g., systemic lupus erythematosus, rheumatoid arthritis), cervical disc degeneration, biceps tendinopathy, glenohumeral osteoarthritis, neoplasm, rotator cuff tendinopathy or tear (with or without impingement), sub acromial and subdeltoid bursitis. PAS in the presence of related conditions is most appropriately defined as painful shoulder syndrome.

3.10 Diagnostic Testing

3.10.1 Laboratory

Blood glucose parameters should be the priority of the doctors as a result of high prevalence of diabetes and pre-diabetes in patients with PAS. Extra serological tests are normally not shown, however may be performed that they are suspecting any immune system or infectious conditions. C-reactive protein and erythrocyte

sedimentation rate levels may be raised in patients with PAS, however these tests are not specific or sensitive [48].

3.10.2 Imaging

Authoritative finding of PAS can be obtained distinctly through direct surgical observation. All things considered, this isn't generally essential. Other imaging strategies can be utilized to supplement the previous history and physical examination [49].

The glenohumeral joint capsule is comprising of soft tissue; consequently plain radiography may not be useful. it may, radiography can distinguish other shoulder pathologies. X-beams can be helpful to evaluate for pathologic fracture, avascular necrosis, calcific rotator cuff, progressed glenohumeral joint pain, and biceps tendinopathy.

Magnetic resonance imaging (MRI) isn't diagnostic for PAS. Capsular thickening can be seen on MRI, it may likewise accommodating in distinguishing different conditions, for example, subacromial bursitis and rotator cuff tendinopathy [50].

3.11 Conventional Interventions

3.11.1 Steroid injection

Steroid injection is one of the high need medication for PAS. Various Cochrane surveys have inferred that inevitable area of a subacromial or visually impaired glenohumeral injection is profoundly factor [51]. Ongoing Cochrane audit groups the outcome from twenty six heterogenous examinations and presumes that there is a little

transient advantage to steroid injection alone for PAS however the evidence is uncertain.

3.11.2 Anti-inflammatories

Employments of hostile to inflammatories or corticosteroids are the significant in the treatment of PAS. Non-steroidal anti inflammatory drugs (NSAIDs) may be utilized in brief pain relief [52].

No evidence has demonstrated to show that NSAIDs change the visualization of PAS. Be that as it may, NSAID's are included in the activity of hostile to irritation as well as creating pain relieving impact. So it very well may be sensible prime decision for PAS.

In addition, No comparative study has done on oral corticosteroids with placebo treatment or natural history of the PAS. Most studies have demonstrated that corticosteroids may reduce pain than recovery or placebo treatment however their results are not maintained long term

3.11.3 Intra-articular Corticosteroid Injections

Albeit high quality RCT of corticosteroid injection for treatment of PAS have not been done, accessibility of some evidence on intra-articular injections demonstrates that having transient advantage of their utilization. Negligible difficulties of utilizing this intrusive system like subacromial infusion or glenohumeral injections may be considered. Impediment of administrating injection is visually impaired with incorrectness of 60%. Advance clinical practice may have more noteworthy precision

[53]. This limitation can be overwhelmed by utilization of imaging strategies, for example, ultrasound guided joint injection.

3.11.4 Capsular Distension Injections

This method of treatment ought to be done under local anesthesia affected joint is injection with local analgesic to extend the capsule. This method is regularly inadequately tolerated because of pain that is experienced during the procedure of intra-articular injection. So capsular distention injections may be unfamiliar [54].

3.11.5 Surgical Treatment

The treatment of PAS should prompt the surgical treatment simply after conservative management has not given any advancement. There is no positive due date to mediate medical procedure. There is no definite deadline to intervene surgery. As a general rule patients should not noticing any progress in the symptoms, after taking some form conservative management for at least 2 months. Patients those who are having significant pain and limitations can proceed with surgical intervention.

3.11.6 Manipulation Under Anesthesia

manipulation under anesthesia strategy permits to reestablishing the ROM of the shoulder in the working theatre. Quick post operative physiotherapy can be required for this strategy [55]. Inconvenience of control is pain Disadvantage of manipulation is pain after recovering from the anaesthesia. It may be happening because of tissues stretched during the manipulation under anaesthesia. This can be potentially slow

recovery process. When it adding with surgical release it induces further surgical trauma to the shoulder and may cause slow rehabilitation.

3.11.7 Arthroscopic Release and Repair

Arthroscopy is an extra device for tending to the shoulder with PAS. Essential lesion are fixed coracohumeral tendon and rotator cuff interim with the contracted capsule including the axillary pouch on the affected joint. . These structures can be preserved by release with arthroscopic instruments. ROM of the shoulder can be maintained under arthroscopic release with manipulation, if necessary. The release can be executed either before, during, or after the manipulation [56]. The manipulation may need to precede the technique to gain access to the joint. Arthroscopy allows complete evaluation of the shoulder and its anatomy as well. Any pathology that may not have been diagnosed can be addressed with this procedure. This procedure may make postoperative ROM less painful and decreases the recovery period. Operative treatment of PAS has been shown to reduce the duration of the disease and to return ROM with good prognosis. Total recovery of pain-free ROM averages 2.8 months and time taken for formal physical therapy is 2.3 months [57].

3.11.8 Chinese Medicine Packet Plus Wax Therapy

The prepared Chinese medicine packet will be placed onto the shoulder joint followed by a warm paraffin cake [2–4 cm × 20 cm × 30 cm, 45–55°C) as a hot compress, fixed with a cotton pad, once a day for 20 minutes, totally for 4 weeks.

The Chinese medicine packet plus wax therapy relieves the symptoms of peri-arthritis of the shoulder, this trial will provide experimental evidence to establish therapeutic

guidelines and technical standards for Chinese medicine packet plus wax therapy for the treatment of periarthritis shoulder [58].

3.11.9: Effects of Deep and Superficial Heating in the Management of Frozen Shoulder

May our findings suggest that the addition of deep heating (using SWD) to stretching exercises is more effective than superficial heating (using Hp) or stretching alone in improving shoulder pain and function. Also, the addition of deep heating to stretching produces a significantly greater gain in shoulder ROM (flexion, external rotation with the arm by one's side, external rotation with the arm in abduction and in the hand-behind-back position) than does the use of a superficial heating plus stretching superficial heating therapy including paraffin baths, hot packs, mud application, balenotherapy and mineral water. The common action mechanism is to increase pain threshold by affecting sensory and muscle nerve and muscle nerve endings. Beta endorphin releasing and washing out the pain mediators by peripheral releasing and washing out the pain mediators by peripheral vasodilation also play a role in producing analgesia and sedation for the management of pain and to progress ROM of affected joint [59].

3.11.10: Physiotherapy

From this review, therapeutic exercises and mobilization therapy are strongly recommended for reducing pain, improving ROM and function in patients with stages 2 and 3 frozen shoulder. While high grade posterior mobilization along with self exercises is recommended for improving passive external rotation and abduction

ROM, high grade mobilization and mobilization with movement along with self exercises are recommended for improving function [60].

3.11.11 Patient Education

PAS is so painful and has a very slow progression of resolution. Patients should be educated the slow prognosis of the condition and inclusion of complication of the PAS.

3.12 MUD THERAPY

3.12.1 Introduction

Naturopathy is a normal and proof based arrangement of prescription giving medicines with common components dependent on the speculations of essentialness, toxemia and one self mending limit of the body and the standards of sound living. Indian Naturopathy incorporates Yoga alongside some old Indian ideas like – 'Panchabhuta based comprehension of wellbeing and disease [61].

Among the five components, earth is a basic segment of the human body and specifically affects wellbeing and ailments. Naturopathy utilizes every last one of these components as a helpful methodology as a result of their properties to treat the illnesses. In naturopathy, mud is one of the center restorative parts as a component of earth.

Mud is a blend of inorganic and natural issue with water, which has experienced topographical and organic procedures affected by different physicochemical variables [62].

Mud treatment can be characterized as the utilization of prepared mud either legitimately. Mud treatments has demonstrated to be effective in the administration of skin pathologies, rheumatic diseases, musculoskeletal clutters, gynaecological conditions, neurological protests and cardiovascular conditions. The mud demonstrations by weakening and retaining the dangerous substances of the body and at last dispensing with them from the body. The impacts of mud application include: an expansion in layer electrical conductance, retention wonders, hyperaemia and initiation of the hidropoietic organs, catalysts and hormones [63].

3.12.2 Planning of Mud for Application

Source: The mud should be spotless and taken from 122 - 153 cm profundity from the ground. Free from sullyng of stone pieces and substance excrements and sieved to isolate stones, grass particles and different polluting influences.

In the event that any uncertainty in its tidiness, it ought to be very much warmed and after that sanitized. Take the mud fine powder and blend it with satisfactory measure of water (hot). Mix the mud powder with water and make mud as paste [64].

3.12.3: Mud Allergy Test

Take the mud glue and apply on the forearm (1-2 cm) surface territory. Keep it for the time of 20-30 minutes. Wash it with the cold water. Keep the patient in perception for the time of 24 hours. Check for any hypersensitive response.

Counsel: not to utilize mud

3.12.4 TYPESAND HISTORY OF MUD

Types of mud

The Dead Ocean Mud

Since the season of Cleopatra, individuals have loved the mud found at the base of the Dead Ocean and have utilized the rich mineral blend for recuperating showers and excellence medicines.

Its high grouping of chloride salts of magnesium, sodium, potassium, calcium, and bromine help to loosen up muscles, ease torment, and animate dissemination, which makes it especially valuable in the treatment of dermatological conditions, for example, psoriasis, skin break out, dandruff, dermatitis, and dry skin [65].

Dead Ocean Mud rehydrates tired skin, profound purging and normally expanding course and makes the skin look and feel more youthful.

The wealth of the ocean offers the ideal antitoxin for dry, develop and touchy skin. Studies demonstrate that Dead Ocean mud showers can effectively reduce manifestations of fibromyalgia [66].

Ghiol Mud

Sapropelic mud from Ghiol Lake by the Dark Ocean is the gem of Romania. In 1890, at the General Piece from Paris, the Techirghiol mud got the brilliant decoration. It originates from an unpolluted territory and is antacid [pH = 8.2].

Dark Ocean Mud ("Namol") effectively affects degenerative rheumatic illnesses a wide range of calcification - (cervical, lumbar and dorsal spondylosis, cox joint inflammation, gonarthrosis, joint inflammation of the hands and feet, ceaseless lumbago), provocative rheumatic maladies (torment in the joints after intense articular ailment or contaminations in foci, rheumatoid spondylitis, rheumatoid joint pain) and articular rheumatic infections (tendinitis, tendomyositis, scapula humeral peri-arthritis, panniculosis, fibrillosis), also fringe and focal neurological disarranges (post-awful loss of motion and paresis of the appendages, polyneuropathies after the intense stage, sequelae after poliomyelitis, late sequelae after paraparesis and hemiparesis [67]).

Field Mud

Field mud originates from old frosty valley bowl that never depleted away enabling the field to hold the majority of its natural, mineral, and follow elements. Composition examination has demonstrated that the Field mud is interestingly rich in disintegrated vegetation, with over a 1000 plant stores: blooming herbs, seeds, leaves, blossoms, tubers, organic product, roots, and grasses.

More than 300 of which have perceived restorative properties. Dissimilar to other mud types, Torf Field Mud contains practically no mud [less than 3%) and comprises of natural build up of herbs, blossoms and grasses. Over time of thousands of years this build up was changed into a fine glue that effectively breaks up in the water, which has abnormal grouping of bio-minerals, follow components, nutrients, amino acids, plant hormones and unsaturated fats in an atomic structure that is simple for the human skin to retain.

Field mud is utilized not exclusively to enhance, yet in addition to fix huge number of diseases from portability issues, joint pain, gout, skin issues, for example, skin break out and hormonal irregularity to post medical procedure recuperation and muscle recuperation in game medication. Its activities are thermo-physical, biochemical, against maturing, calming, and characteristic anti-toxins. Since peat has chelatic properties (it ties overwhelming metal isotopes) it is an exceptionally solid characteristic detoxifier. It contains a high measure of humic and fulvic acids which are chelaters. Chelaters tie with substantial metals and different poisons and help to fend off them from the body tissues.

Biomass of Mud

The high carbon substance of the microbial biomass (0.06 mg/g) was natural skyline of the dirt profile contemplated. The offer of carbon of the microbial biomass in the carbon of the mud natural issue fluctuated from 0.5 to 1.4% Semaghiul and Dobrinas examined the remedial estimation of water and mud from the Salt Lake (LacuSarat) in Romania. They investigated the complete substance of Fe, Cu and Cr in the sapropelic mud. The outcomes demonstrate the presence of ionic trade between the restorative mud and human life form at the epithelial dimension.

Ognean et al. examined the connection between the mud's three enzymatic exercises and the helpful impact in different periods of the year by evaluating the phosphatase, dehydrogenase and catalase exercises in the eight lakes mud. The examples were gathered in February and June. The test results demonstrated a seasonal variety in dehydrogenase and catalase exercises (more prominent action in summer) and

phosphatase (more noteworthy action in winter). Mud, which contains natural and mineral fixings, has been utilized in the treatment of a few degenerative ailments. It has been recommended that valuable impacts of mud are identified with its nearby warm impacts, yet in addition to its synthetic parts. Not at all like hydrophilic components, the lipophilic segments of the mud separate have not been exactly portrayed so far. Three distinctive mud species (e.g., krenogen, tone, and fango) were broke down by utilizing gas chromatography-mass spectrometry. The synthetic investigation of mud does not just uncover hydrophilic natural substances, for example, humic, fulmic, and ulmic acids, yet in addition natural substances made out of unsaturated fats.

3.12.5 Physical Properties of Mud

Other than mineral retention, mud applications are exceedingly remedial because of mud's uncommon warm properties. Because of its high mineral substance, it is putting away the warmth in all respects effectively when it is warmed – it is thermopexic and it is letting the warmth put away amid the warming procedure to go to the body in all respects gradually – it has a diminished warm conduction (along these lines, connected warmed on the skin, the impression of warmth gotten by the body is decreased contrasted and a shower warmed at a similar temperature). The cool/heat holding capacities act to lessen swelling as well as energize blood dissemination more successfully than conventional cold/hot packs utilized in health centers today. Warmth supports the digestion, diminishes strong strain and invigorates the endocrine framework. The mud is engrossing the water like a wipe, being skilled, in a similar time, to soften it superbly – it is hydropexic. The result desires incorporate lessen

torment and swelling over influenced territories of the body, which makes it helpful in the treatment of joint inflammation [68].

3.12.6 Mineral Restorative Temperances of Mud

Warm mud applications open the skin pores permitting supplements in and acids out. It effectively draws out lactic corrosive and metabolic squanders from tissues. Humic substances, rich in mud, are successful chelators they tie with poisons, for example, substantial metals and expel them from the body for compelling detox. As your body part temperature ascends under the warm mud pack, the skin truly completes a trade of poisons for minerals from the mud. The skin's three layers can normally assimilate the structure of minerals and components of the mud. In Eastern Drug the skin is known as "The Third Lung" and because of its capacity to circle blood all through the vessels of the skin, this flushing out procedure of the skin's layers is considered to have comparable advantages of a cardiovascular exercise. Core sticks to the rationality of treating the skin from the back to front, which thus aids the help of sicknesses and upgrades the well being [69].

3.12.7 Impacts of Mud-Application

Mud shows Increment in film electrical conductance, retention wonders, hyperemia, hidro-poietic organs, compounds and hormones actuation. Logical investigations uncovered that shower treatment builds skin temperature, impacts on cardiovascular frameworks, water-electrolytes balance, neurotransmission (focal sensory system, neural conductibility), insusceptible framework, proteins actuation and digestion [70].

The examination of skin blood flow motion another way to deal with concentrate the microcirculatory Skin blood stream swaying, the supposed flowmotion, is an outcome of the arteriolar measurement motions, for example vasomotion, and it is thought to assume a basic job in favoring the ideal appropriation of blood stream in the skin microvascular bed. Examination of skin blood flowmotion, utilizing phantom investigation of the skin laser Doppler flowmetry (LDF) signal, demonstrated diverse flowmotion influxes of endothelial, thoughtful or myogenic intervened vasomotion starting point. Utilizing this technique in fringe blood vessel obstructive malady (PAOD) patients. Skin blood flowmotion because of various vasoactive substances exhibited a significant job of nitric oxide (NO) in controlling the endothelial part of vasomotion and an insulin activity on smooth muscle cells of skin microvessels. Every one of these information propose that the investigation of skin blood flowmotion can turn into a strategy to right on time and effectively recognize skin microvascular weakness in vascular sicknesses and to examine the systems of substances dynamic on skin microvascular bed [71]. So the impact of mending mud application relies upon sort, compound synthesis and nature of recuperating mud [72].

Mud pack treatment fundamentally improved the agony and practical status of patients with knee osteoarthritis, regardless of whether connected legitimately or covered with nylon. Direct application was observed to be predominant, which suggests substance properties of the mud add to the development of remedial effect [73].

Information demonstrated a huge decrease in agony and improvement in joint motility. Serum tryptophan, cysteine and citrulline were fundamentally higher than at

benchmark. No critical contrasts were seen in serum dimensions of the staying free amino acids [74].

Mud treatment impacts numerous biochemical procedures of the body, autonomously of the thermic incitement alone and the present paper records explicit increments of insulin development factor 1 and abatements of tumour putrefaction figure alpha serum of osteoarthritis patients following 12 days of mud pack application [75].

Mud pack treatment (MPT) impacts the serum dimensions of a few cytokines associated with chondrocyte digestion and in the pathogenesis of osteoarthritis. It diminishes IL-1 and TNF-alpha, engaged with ligament irritation and demolition, and increments of IGF-1 that impact the ligament. Study demonstrates a diminishing in PGE2 and LTB4 serum levels in every one of the peoples after MPT with no relationship between the PGE2 and LTB4 diminishes. So mud pack treatment applies a defensive impact on the ligament and can instigate help with discomfort by decreasing the incendiary reaction [76].

Tumour necrosis factor (TNF)-alpha assumes a well-characterized job in the pathophysiology of provocative joint illnesses and mud pack treatment, which can decrease TNF-alpha serum esteems, on explicit TNF receptor (s TNF-R) levels. Thermic and insect/provocative movement of mud pack treatment demonstrates complex association with the most well-known elements of incendiary and ligament corruption. Our outcomes recommend that the thermic segment of this characteristic treatment is for the most part associated with adjusting fiery response and ligament

harm through official of the circling TNF, which controls the initiation of the cells in charge of the generation of ace provocative cytokines [77].

Treatment of knee osteoarthritis with intra-articular hyaluronic corrosive infusions or mud-pack treatment yielded comparative outcomes in the present moment as far as practical improvement and relief from discomfort. Mud-pack treatment is a non invasive, entanglement free, and practical elective methodology for the preservationist treatment of knee osteoarthritis.

Mud pack treatment gives huge enhancements in agony, capacities, and personal satisfaction of patients with osteoarthritis. among detailed systems of activity of mud-pack treatment are decline in the dimensions of tumour necrosis factor-alpha (TNF- α) bringing about diminished fiery response and ligament harm, support of cartilaginous hemeostasis through diminishing serum dimensions of nitric oxide and myeloperoxidases, and decline in serum centralizations of incendiary go between for example, prostaglandin E2 (PGE2) and leukotriene B4 (LTB4). There is a general supposition that warm incitement initiates increments in serum dimensions of noradrenaline, cortisol, and beta endorphins prompting mitigating and analgesic impacts. Increments in the dimensions of chondro protective insulin-like development factor 1 (IGF-1) have likewise been accounted to Poensin et al. exhibited by laser-Doppler flowmetry that mud-pack treatment caused improvement of skin blood course, which was conceivably incited by nearby instruments, specifically transcutaneous particle exchange. Also, a few investigations recommended that sulfur minerals consumed by the skin may cause a pain relieving impact. Mazzulla et al.

suggested that sulfur in the mud actuated the generation of carotene, nutrients, and phytosterol in the skin network prompting a calming effect [78].

Thinking about the compound impact, It has been accounted for that substances in watery mud concentrates can penetrate crosswise over human full thickness skin in amounts that effectively affect unconstrained contractile action of smooth muscle tissue. Extensibility of collagen-rich tissues increments with warm incitement. Because of increment in the extensibility of collagen-rich tissues, the scope of movement of included joints improves, torment lessens, and muscle fit alleviates. The pain relieving impact of warmth might be because of expanded β -endorphin focus. It has been guessed that human skin can discharge noteworthy measures of narcotic peptides, altering the edge of agony under various boosts, for example, warmth or UV radiation [79].

Warmth have a mitigating impact, which may result from the expanded emission of cortisol and catecholamines instigated by warm pressure [6,20]. In addition, it has been speculated that mud pack treatment may influence emission of specific cytokines, yet related data is rare. Mud applications have mitigating impacts on the adjuvant-prompted joint pain in rodents. Anyway it could be hypothesized ace provocative cytokine TNF α and IL-1 β levels may be down-directed by methods for the neuro-endocrine response to the warm treatment [80].

3.12.8 Therapeutic Virtues of the Mud

Thermal mud applications open the skin pores permitting supplements in and acids out. It effectively draws out lactic corrosive and metabolic squanders from tissues.

Humic substances, copious in mud, are exceptionally viable chelators - they tie with poisons, for example, substantial metals and expel them from the body for successful detox. As your body part temperature ascends under the warm mud pack, the skin truly completes a trade of poisons for minerals from the mud.

The skin's three layers can normally retain the creation of minerals and components of the mud. In Eastern Medicine the skin is known as "The Third Lung" and because of its capacity to course blood all through the vessels of the skin, this flushing out procedure of the skin's layers is considered to have comparative advantages of a cardiovascular exercise. Yet, rather than draining the assortment of electrolytes and minerals, mud is adding them to the skin and lymphatic framework. Core clings to the logic of treating the skin from the back to front, which thus aids the alleviation of diseases and improves the well-being [81].

Impact of Warm Application on Body

Increases the surface temperature of the particular zone of the body where connected and animates its glow receptors, causing vasodilatation.

Impacts of Vasodilatation

Improves the blood stream (which helps in tissue digestion, builds supplements retention, evacuates squander items and diminishes venous blockage), lessens blood thickness, improves the conveyance of leukocytes and lymphatic flow increments because of increment in porousness of slender, which helps in expulsion of waste item and expanded supplement to cell. Then again, so as to keep up body temperature consistent, pre-optic zone of front nerve center energized and passes the drive of

perspiring to string through autonomic pathways and after that through thoughtful nerves to skin. Perspiring is the way toward expelling abundance heat from body.

Sodium and chloride particles are lost in plentiful perspiring. Amid this procedure forerunner liquid is discharged. They go through channel gradually so sodium and chloride particles are reabsorbed and there fixation tumbles to low. This fall, in grouping of particles lessens the osmotic weight of liquid to such a dimension, that water is likewise reabsorbed. Diminishing grouping of sodium and chloride particles permits logically better protection of salts.

Aldosterone is discharged because of diminishing centralization of sodium and chloride particles, which helps in better protection of salts. This procedure helps in support of electrolyte focus. Along these lines it helps in thermoregulation; it additionally helps in discharge of certain salts like smelling salts and by items thought about dangerous.

In a similar time, the mineral substance of mud is ingested through the pores, safeguarding the re-mineralization of the skin [82].

Mud has a spot as a non-pharmacological apparatus in certain clinical settings, for example, degenerative articular procedures, skin issue, and others. Babylonians knew its belongings. Fango therapy in joint inflammation patients appears to cause varieties in amino corrosive associated with ligament homeostasis, and furthermore produce decrease in torment evaluations in gonarthrosis. Mud alters nitric oxide, myeloperoxidase and glutathione peroxidase serum levels in ligament patients and beta-endorphin and stress hormones in patients influenced by osteoarthritis by

decreasing aggravation, torment and subsequently reduces the reason for pressure. Has been affirmed that the warm pressure related with Fango therapy, enacts the pituitary organ and the biochemical impacts of peat parts have beside their physical-warm impacts. Moreover, steroids and antimicrobial movement of certain helpful mud has been suggested [83].

Mud-shower applications prompted a significant decrease of paw volume in contrast with the controls, higher than that acquired by indomethacin treatment toward the finish of the treatment. Also, TNF and IL-1 serum dimensions were essentially brought in rodents submitted down to warm treatment and toward the finish of the investigation cytokines levels were like those seen in rodents treated with indomethacin. The back off of paw volume increment and the huge decline of TNF and IL-1 serum levels recommend a mitigating impact of mud-shower applications on rodent adjuvant arthritis [84].

EVIDENCES

Avabahuka is a stand out among the most common issues which impact generally in middle age gathering of patients. After Agni karma there is help of signs and side effects of Frozen Shoulder particularly on neighbourhood delicacy and firmness. No untoward impacts were observed over the span of treatment. The treatment connected was basic, conservative and required no hospitalization and should be possible at OPD level. Agni karma was effective in the administration of solidified shoulder and theory behind the investigation was observed to be right. Since the clinical examination was directed on a set number of patients, it may not be asserted as last. Definite

investigation on a huge example size ought to be directed to assess the efficacy of Agni karma in the administration of Frozen Shoulder Agni karma is a kind of solid fomentation this outcomes in decrease in irritation. Patrapindasweda is additionally a one of a kind system referenced in Ayurveda [85].

Thermotherapy as hot packs with taking consideration to stay away from singes for a time of 15-30 minutes over the shoulder joint and later the Maitland assembly is given. Post thermotherapy Maitland preparation is observed to be increasingly compelling and useful in improving shoulder work and lightening torment in peri-arthritis over the shoulder dynamic activation exercises [86].

No critical contrast was identified in ROM restrictions between patients in the left and right shoulder gatherings; notwithstanding, a noteworthy ROM improvement was noted in both dynamic and latent assembly measures. Thinking about this discovering, it tends to be inferred that the area of the sore morally justified or the left shoulder does not in itself influence the guess or the treatment result [87].

This examination has uncovered a measurably critical improvement in regard to every one of the spaces of the WOMAC score with essentially better enhancements in the hot mud than in revulsive application gathering. The discoveries of our examination show that all the three intercessions were equivalent in improving agony, handicap and useful personal satisfaction. Warm incitement prompts increments in serum dimensions of noradrenaline, cortisol, and beta-endorphins prompting mitigating and pain relieving effect [88].

3.12.9 MODERN THEORIES

3.12.9.1 Neurophysiological System

Sensory system is in charge of sensations, mental exercises, and control of the muscles and numerous organs. The sensory system is comprised of the cerebrum, spinal string, nerves, and tactile receptors. The sensory system can be separated into the focal and the fringe sensory systems. The focal sensory system (CNS) comprises of the cerebrum and the spinal rope. The fringe sensory system (PNS) is outer to the CNS. The PNS is isolated into two divisions. The tactile division, or afferent division, transmits activity possibilities to the CNS from tangible receptors, while the engine division, or efferent division, transmit activity possibilities from the CNS to effector organs, for example, muscles and organs. The engine division can be additionally subdivided into the physical engine sensory system, which transmits activity possibilities from the CNS to skeletal muscles, and the autonomic sensory system (ANS), which transmits activity possibilities from the CNS to heart muscle, smooth muscle, and organs.

Synapses of the Autonomic Nervous System

Parasympathetic nerve endings discharge one or two synaptic neurotransmitter. The neuron secretes acetylcholine, it is a cholinergic neuron; on the off chance that it secretes norepinephrine (or epinephrine), it is an adrenergic neuron. All preganglionic neurons of the thoughtful and parasympathetic divisions and all postganglionic neurons of the parasympathetic division are cholinergic. Practically all postganglionic

neurons of the thoughtful division are adrenergic, yet a couple of postganglionic neurons that innervate thermoregulatory sweat organs are cholinergic.

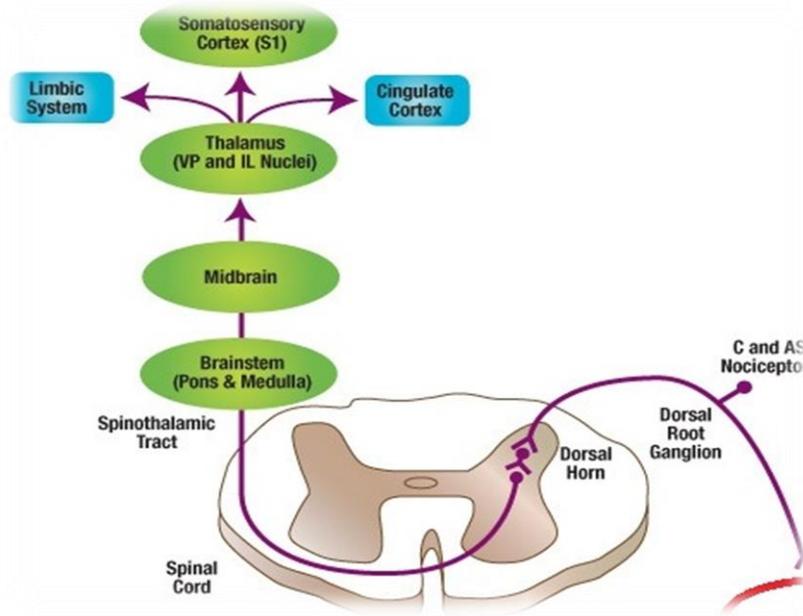


Figure 3 Gate control hypothesis

This hypothesis clarifies about the physiology of agony. Torment driving forces are first controlled and regulated in the substantia gelatinosa of the spinal line known as first useful entryway, at that point motivations leaves behind through inverse spinothalamic tracts called second practical gate [89]. When it achieves cerebral cortex, patients may feel torment. Wald has recommended presence of some other useful entryways, specifically paraventricular, contralateral cores of the thalamus and the average reticular development of the mid-mind. Incitement of thermo receptors makes congestion of the driving forces at the useful entryways and hinders the nerve motivations at that point give raises torment edge and absence of pain.

Door hypothesis stresses incitement of enormous, exceptionally myelinated (afferent A-beta strands) hinder the transmission of torment flag by generally little, nociceptive filaments with no myelination (A-delta and C strands) at the dimension of the spinal line. Little, unmyelinated C filaments are in charge of ceaseless and throbbing agony. Be that as it may, bigger A-delta filaments with insignificant myelination are in charge of quick transmission, intense and exceptional agony. It is conjectured that thermo incitement diminishes the impression of agony by expanding the initiation of A-beta filaments. In this way, Over-swarming of agony signal pathway may close the door of transmission in the spinal cord [90].

These objective cells are situated in the substantia gelatinosa of the dorsal horn. System of entry way control hypothesis.

HOT MUD APPLICATION

3.12.9.3 Motor Gate Hypothesis

The marvel of motor entry way hypothesis was clarified by Fernando in 1977. As indicated by hypothesis of motor entryway, useful motor gates are hindered in the obsessive conditions. System of motor entryway hypothesis contains efferent pathway which emerges from axons of foremost horn cells to the engine end plates. Also, Renshaw cells arranged in the ventro-parallel piece of the ventral horn of dim issue and cajal cells are in the middle of the road core of cajal are in synaptic association with foremost horn cells. Efferents give synaptic impacts to rensshaw cells, which are excitatory in sort. Renshaw cells thus to have axons which impact synaptic associations back to foremost horn cells [91].

Hyperactivity of the cells prompts an expansion in the inhibitory impact applied on foremost horn cells through Renshaw and Cajal cells including come back to impartial action. Ordinarily entryways arranged between foremost horn, renshaw cells and cajal cells are open [92].

3.12.9.4 Adrenergic Framework

Noradrenaline neurons that start from different pieces of the cerebrum including raphe cores, locus coeruleus, periaqueductal dark, and A1, A2, and A4-7 cores of the brainstem, which venture to the forebrain and slip along the dorsolateral tracts of the spinal line, assumes a crucial job in torment modulation [93].

3.12.9.5 Anti-fiery Hypothesis

Mud has a spot as a non-pharmacological device in certain clinical settings, for example, degenerative articular procedures, Fangotherapy in joint inflammation patients appears to cause varieties in amino corrosive engaged with ligament homeostasis, and furthermore produce decrease in torment evaluations in gonarthrosis. Mud adjusts nitric oxide, myeloperoxidase and glutathione peroxidase serum levels in ligament patients and beta-endorphin and stress hormones in patients influenced by osteoarthritis by decreasing irritation, torment and hence reduces the reason for pressure. Has been affirmed that the warm pressure related with Fangotherapy, actuates the pituitary organ and the biochemical impacts of peat parts have beside their physical-warm impacts. Besides, steroids and antimicrobial movement of certain remedial mud has been suggested [94].

3.12.9.6 Activation of the Diffuse Harmful Inhibitory Control Framework

Nociceptive contributions from tactile afferents are adjusted by plummeting hindrance from supraspinal and higher focuses. This marvel is known as diffuse toxic inhibitory control (DNIC). Anatomically, DNIC comprises of rising pathways from spinal line ventrolateral quadrant to the supraspinal focuses and plunging projections from supraspinal focuses of dorsolateral funiculi to the spinal dorsal horn [95]. DNIC is assumes an essential job, when two diverse harmful improvements are connected in the meantime, which implies a second upgrade outside the responsive field of the primary restrained neuron [96].

3.12.9.7 Hot Mud Application and PAS

Hot application is non-pharmacological, reasonable and most straightforward methodology which beneficially affects incessant joint pain. It causes vasodilatation and it infiltrates further into the muscle and consequently decreases the muscle spasm and pain [97].

Warmth assumes a typical major job in the beneficial impacts of hot mud treatment. This sort of exogenous thermic treatment decreases muscle compression; thus, muscle unwinding is related with alleviation from torment. Moreover, heat stimulates opioids and hypothalamic–pituitary–adrenal hormone secretions [Giusti et al., 1990; Vescovi and Coiro, 1993; Cozzi et al., 1995; Pizzoferrato et al., 2000], which alter irregular muscle conditions. Muscle unwinding is because of warmth act ion on neuromuscular spindles, which become less touchy to extending, with the consequent reduction of hypertonia and periarticular tissues imbition (Galzigna et al., 1998). Heat likewise

builds joint collagen augmentation, favoring extending furthermore, diminishing ankylosis and fibrotic withdrawal. Absence of pain is predominantly because of the limit of thermic stimuli [98].

At the point when mud blended with mineral water it is considered as a pelotherapy, on the off chance that it blends with paraffin it is called paramuds, same mud blended with ocean or salt lake water it is considered as balneotherapy [99].

High-dampness content is a significant factor for high warmth limit of the peloid when connected to the patient's body at 40–45 °C for 20–30 min. The warmth maintenance dispersal is likewise relying upon the granulometry (explicit surface) of the strong phase (Ferrand and Yvon, 1991) [100]. Beta-endorphin levels diminished altogether twelve days after the beginning of treatment plasma ACTH additionally diminished amid treatment. The abatement of this hormone was dynamic and endured after culmination of treatment. It might be proposed that warm treatment, by lessening irritation, decreased torment and along these lines reduced the reason for stress [101].

In 6 solid subjects submitted to fango treatment in the Euganean warm showers (Italy), the plasma convergences of beta-endorphin and ACTH expanded transitorily. These results associate with the arrival of these peptides by the pituitary in light of warm focusing. The pain relieving and hypothermic activity in charge of good toleration of warm pressure initiated by fango treatment, can be clarified by this expansion in plasma beta-endorphin. The rehashed brief increments in plasma beta-endorphin amid warm treatment result in dynamic improvement in articular and strong symptomatology [102].

Mud packs together with energizer treatment can impact the HPA pivot, animating expanded dimensions of adrenocorticotrophic hormone, cortisol and beta-endorphin serum levels. The release of corticoids in the blood and the expansion in beta-endorphin serum levels are trailed by a decrease in torment indications, which is firmly identified with an improvement in handicap, gloom and nature of life [103]. We found that torment score lessen in hot mud application contrast with mustard application. Which propose the primary utilization of the treatment is to diminish rheumatic musculoskeletal pain [104] the fundamental mechanical activity of the mud pack is warm remedial, its fundamental activity enables it to follow up on sub-atomic and compound procedures in degenerative conditions [105].

Mud pack treatment fundamentally improved the torment and useful status of patients with knee osteoarthritis, regardless of whether connected legitimately or covered with nylon. Direct application was observed to be predominant, which suggests substance properties of the mud add to the development of restorative effect [106].

In physiotherapy, fango (mud) application is an as often as possible utilized warmth treatment. The fundamental helpful impacts are because of the raised temperature of the various tissues with a noteworthy redistribution of blood towards the warmed area [107].

The gainful impact of mudpack treatment has been attributed chiefly to warm alone and to the ability of mud to keep up warmth moderately delayed time. Momentary warm pressure is known to alleviate pain. Warmth expands the secretion of norepinephrine, cortisol, and development hormone. Likewise the pain relieving

impact of warmth can atleast halfway be ascribed to expanded centralizations of endorphin [108].

Solidified shoulder, otherwise called peri-arthritis or adhesive capsulitis causes a critical loss of movement. So every patient was guided and given clarification about the methodology so as to make them mindful about the procedure of treatment. Composed consent of the patient was taken. Most weakness of the shoulder joint was altogether washed down with typical water and abhyanga was given with til-taila for 15 minutes toward hairs with the end goal of snehana. The preliminary medication was set up by blending Guda (Jaggery), Madhu and Ghrita in 4:2:1 proportion and warmed for 10-15 minutes to be kept up at a temperature of around 40-44 degree celsius [109].

The temperature of the blend checked before rendering the treatment. The readied blend connected on the influenced locale of shoulder joint with the assistance of spatula or brush. After 3-4 mint the blend ought to be cleared out and rehashed for multiple times. After the methodology ghritkumari mash ought to be aphanled. Patients were encouraged to keep the zone dry, clean, maintain a strategic distance from effort and injury. Same method proceeded up to 15 days [110].

A planned, multi-focus randomized, twofold visually impaired, fake treatment controlled clinical preliminary will enlist patients with peri-arthritis of the shoulder will identity randomized into treatment and control gatherings. In the treatment gathering, parcels will be drenched in a decoction of Chinese prescription. Arranged bundles will be set onto the shoulder joint pursued by warm paraffin cake, when daily

for 20 minutes, for about a month. In the control gathering, Chinese medication parcels will be supplanted by placebo treatment.

The Chinese medication bundle is a jump pocket containing Chinese herbs that enact to meridians to stop torment, advance blood dissemination by evacuating blood stasis, warm meridians to advance blood course, dissipate cold and calm arthralgia, which can be warmed and put straightforwardly on the influenced territory to improve nearby blood flow, quicken assimilation of provocative exudates, increment local sustenance, and mitigate muscle decay.

Wax treatment is a restorative technique utilizing paraffin wax as the crude material. As a result of its high warm limit, low warm conductivity and long cooling time, paraffin wax is a decent mechanism for hyperthermia conduction when in close contact with the body. Clinically, wax treatment is regularly utilized in the treatment of wind-cold-sogginess prompted torment [Dong et al., 2009; Meng et al., 2010; Zhou et al., 2012]. At the point when paraffin wax is warmed and remotely connected to an influenced territory, it warms tissues, widens veins, advances blood flow and expands cell penetrability. Due to the long term of warmth treatment, it has profound edeoma dissemination, hostile to irritation and absence of pain impacts. We will build up another Chinese prescription treatment for periartthritis of the shoulder by consolidating Chinese drug parcels and wax treatment. This consolidated treatment will be tried to decide if it can decrease torment actuating factors, dispose of irritation and postpone joint aging [111].

An examination detailed that the utilized method with hyper or isothermic mud prompted transient increment in the grouping of progesterone and estradiol in blood sera of ladies with ordinary and lacking hormonal capacity of corpus luteum. There was additionally a noteworthy ascent in discharge of adrenaline and noradrenaline in pee, especially after hyper thermic mud application. They referenced increment in the grouping of steroids was separated with the height influencing the convergence of gonadotropins, however likely because of their release from ovaries [112].

Solidified shoulder otherwise called glue capsulitis is debilitating sickness of shoulder causing torment and limited versatility of shoulder joint. There is critical decrease in torment and firmness is alleviated bringing about expanding scope of mobility Frozen shoulder can be adequately treated with agnikarma, patrapindasweda. Agnikarma is a kind of solid fomentation this outcomes in decrease in irritation. Patrapindasweda is additionally a one of a kind technique referenced in Ayurveda [113].

Warm increments in serum dimensions of noradrenaline, cortisol, and beta-endorphins prompting mitigating and pain relieving impact. Poensin et al showed that mud-pack treatment caused upgrade of skin blood dissemination, which was potentially prompted by nearby instruments, specifically transcutaneous particle exchange. Additionally, a few examinations proposed that sulfur minerals consumed by the skin may cause a pain relieving impact. Mazzulla et al suggested that sulfur in the mud incited the generation of carotene, nutrients, and phytosterol in the skin network prompting a mitigating impact and diminished serum dimensions of nitric oxide and myeloperoxidases, and decline in serum centralizations of fiery middle people, for example, prostaglandin E2 (PGE2) and(LTB4) leukotriene B4local hot applications

instigate vasodilatation, which thus expands blood stream, digestion, and viscoelasticity of connective tissue, bringing about goals of muscle fit and help with discomfort [114].

Thermotherapy as hot packs with taking consideration to maintain a strategic distance from singes for a time of 15-30 minutes over the shoulder joint and later the Maitland assembly is given. Post thermotherapy Maitland activation is observed to be progressively viable and helpful in improving bear work and easing torment in peri-arthritis over the shoulder active mobilization exercises [115].

4.0 MATERIALS AND METHODS

4.1 Subjects

A total forty subjects of both gender with age ranging between 40 and 65 years were participated in the study.

4.1.1 Description of the subjects and selection of samples

The study subjects were randomly recruited from the Government Yoga and Naturopathy Medical College and Hospitals, Arumbakkam, Chennai-106. The Subjects were recruited for the study from the above mentioned hospital after fulfilling inclusion criteria by screening of the subjects and by providing informed consent. Forty participants were screened through a routine medical check-up and those are satisfying the diagnostic criteria for PAS were recruited for the study.

4.1.2 Demographics

Contents	HOT MUD APPLICATION SINGLE GRUOP
Age (Mean \pmSD)	51.70 \pm 8.90
Subjects	40
Sex (Male/Female)	28/12

SD – Standard deviation

Table 2 Describes the demographic details of the subjects

4.2 Ethical Considerations

4.2.1 Ethical Clearance

Ethical clearance was sought from the Institutional Ethics Committee prior to the start of the study and the approval for the same was granted.

4.2.2 Written Informed Consent

Subjects who fulfilled inclusion criteria were apprised about the purpose of the study and their rights as research subjects. Informed consent form was administered in English and regional language Tamil. Sufficient time was given to each patient to go through the information sheet and their queries were answered. Their right to withdraw anytime from the study and the need for willingness to participate voluntarily in the study was explained. All the subjects expressed their willingness to participate in the study by giving a signed informed consent.

(A sample consent form and case sheet is enclosed as **Annexure I and II** respectively)

4.3 Screening of the Subjects

4.3.1 Criteria for Diagnosis [116]

The necessary criteria for the diagnosis of a PAS are:

(i) **History**

- Functionally significant restriction of shoulder motion
- Absence of history of previous major shoulder injury or surgery

(ii) **Physical examination**

- Limited glenohumeral motion in all directions

(iii) **Radiographs**

- No changes in cartilaginous joint space
- Absence of pathological changes other than osteopenia

4.3.2 Inclusion Criteria

1. Shoulder pain for at least 3 month and less than 12-month duration
2. Appreciable restriction of both active and passive motions with abduction and flexion not exceeding 90° and external rotation not exceeding 30°
3. Pain at night, with inability to lie on the affected side.
4. Age between 40 years and 65 years.
5. Both genders
6. Receiving no treatment in the last 4 weeks.
7. Providing written inform consent agree to co-operate for the hot mud application study and to follow instructions of doctors.

4.3.3 Exclusion Criteria

Participants will be excluded if they have:

1. History of major shoulder injury or surgery.
2. Clinical or radiological evidence of other pathologies that could possibly account for the symptoms.
3. Patients with cervical radiculopathy, paresis or other neurological changes in the upper limb on the involved side.

4. Presence of underlying fracture associated inflammatory arthritis, known renal or hepatic disease, haematopoietic disorder and malignancy.
5. Any psychological disorder or under any psychiatry drugs.
6. Painful arc between 40° and 120° abductions indicative of rotator cuff disease
7. Uncontrolled diagnosed neurological diseases, immunodeficiency, bleeding disorders and allergies.
8. Women in lactation, pregnant women,
9. Patients taking drugs such as NSAIDs or other pain killers.
10. Patients undergoing other trials.
11. Broken and inflamed skin
12. Fever

4.4 Study Design

4.4.1 Type of the design – Single group quasi experimental study

4.4.2 Randomization

In this trial, subjects were randomly assigned to hot mud application. , simple random method was done in this study. Each random number was carefully concealed by the principle investigator, not permitted to unfold until eligible patients were included in this trial with written informed consent.

Patients were not blind to the intervention. We were recruited forty subjects when they were stepped into out-patient department of Government Yoga and Naturopathy Medical College and Hospitals.

4.4.4 Trial Profile

The trial profile illustrates the study plan, flow of patients across data points, statistical analysis of data and results.

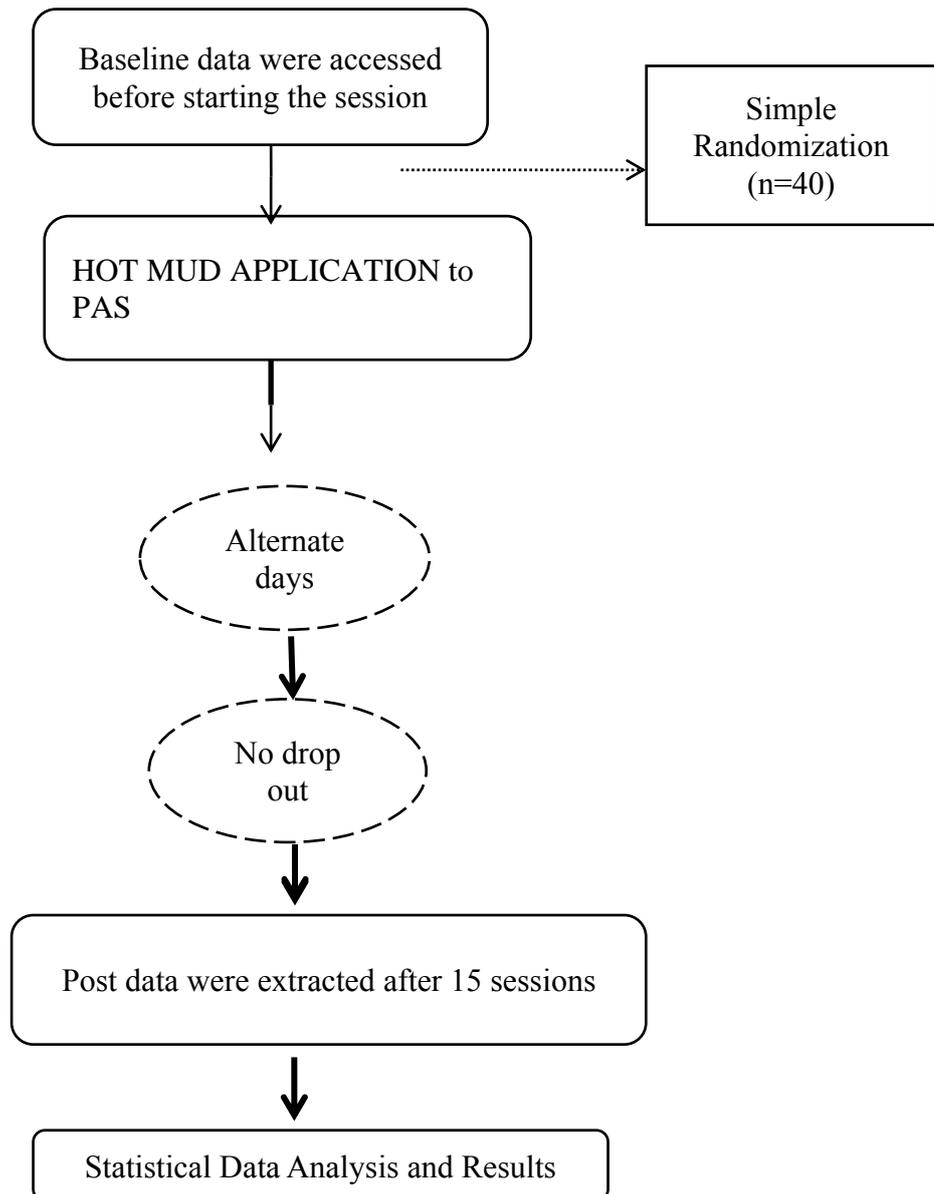


Figure 4: Trial Profile

4.5 Assessments

The base line and post-intervention assessments consisted of:

PRIMARY OUTCOME VARIABLES
Shoulder pain and its disability index (SPADI)
SECONDARY OUTCOME VARIABLES
Range of Motion (ROM) of Shoulder Joint
i. Flexion
ii. Abduction
iii. External Rotation.

Table 3: List of Primary and Secondary outcome variables

4.5.1 Primary Outcome Variables

4.5.1.1 Shoulder Pain and Its Disability Index (SPADI)

The Shoulder Pain and Disability Index SPADI are formulated to measure present shoulder pain and disability in an outpatient setting. It is a self-administered questionnaire that consists of 13 items that assess two domains; pain (pain symptoms, 5 items) and disability (physical function, 8 items).

The items of both domains were scored on a visual analog scale (VAS) ranging from 0 to 10, where 0 = no pain/no difficulty and 10 = worst pain imaginable/so difficult required help [117]. Domain scores was equally weighted, then added for a total percentage score ranging from 0 to 10, where 0 = best and 10 = worst.

Subjects were assessed twice in this study. Questionnaire was administered to the patient at the baseline after inclusion for the study and after completion of 15 sessions.

Instructions to the Subjects and Scoring

Subject was instructed to read the question carefully and asked them to mark circle on the score for each item that best represented their experience of their shoulder problem [118].

Subscale was summed and transformed to a score out of 10. Percentage was calculated out of each sub scale and also for the total score. A mean was taken of the two subscales to give a total score out of 10, higher score indicating greater impairment or disability. In each subscale patients are advised to mark only one item. If the item was not applicable to them and they are requested to pass to next question. Percentage was calculated by excluding the unanswerable item from the total score. If a patient marks more than two items that item was considered as non-applicable, no score was given (A SPADI questionnaire is enclosed as **Annexure III**)

4.5.2 Secondary Outcome Variables

4.5.2.1 Range of Motion

Ranges of motion (ROM) measurements are essential for the assessment and diagnosis of PAS. ROM is usually measured by using goniometer. The term goniometry is derived from two Greek words, *gonia* meaning angle and *metron*, meaning measure. Thus, a goniometer is an instrument used to measure angles.

Goniometers are created in a variety of sizes and shapes and which are usually constructed of either plastic or metal. We have used plastic goniometer for this study. Within the field of physical therapy, goniometry is used to measure the total amount of available movements at a specific joint. Goniometry can be used to measure both active and passive range of movements [119].

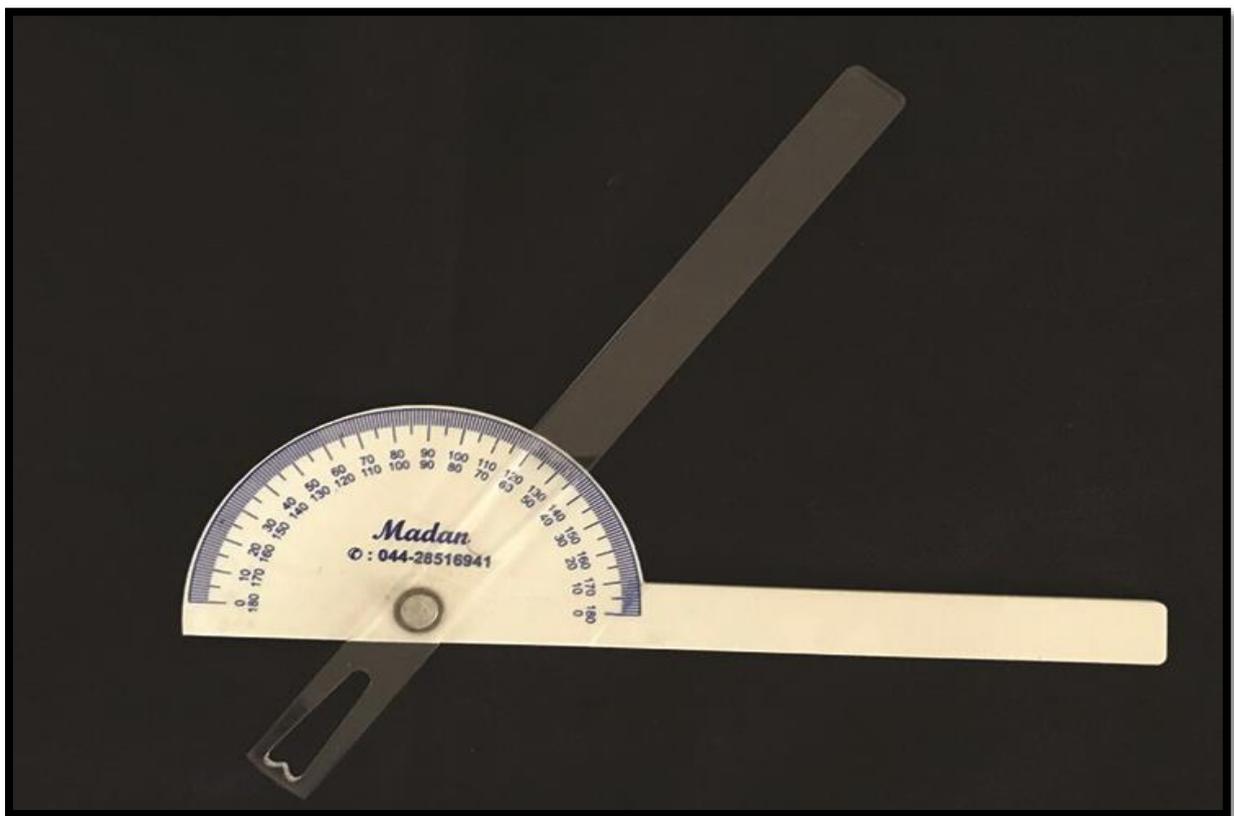


Figure 5 Goniometer

The patient was sitting on examination table for the testing. We explained about the examination of their affected shoulder joint. Active range of motion (aROM) of flexion, abduction and external rotation was assessed at neutral position.

4.5.2 A Shoulder flexion

Shoulder flexion is also referred to as forward flexion. Shoulder flexion is the motion of the shoulder when lifting the arm in front of the body over the head. Range of motion is measured with the side of the body and the arm straight. It is measured from neutral to the highest point the arm can be lifted over the head. We have advised the patient to do active ROM without any strain. Normal range of motion is 180 degrees.



Figure 6: Examination of shoulder flexion



Figure 7: Measuring shoulder flexion using goniometer

4.5.2.b Shoulder abduction

Abduction is a term that refers to a body part moving laterally away from the body and the shoulder joint, it refers to the arm swinging out from the side of the body, in an arm-fluttering motion. Range of motion is measured with the palm facing the side of the body and the arm held straight. It is measured from neutral and the arm hanging close to the body at the side of the thigh to the maximum point the arm can be lifted. We have instructed the subjects to lift as much they can. Normal range is 150 degrees.



Figure 8: Examination of shoulder abduction



Figure 9: Measuring of shoulder abduction using goniometer

4.5.2.c External Rotation

External rotation is also referred to as lateral rotation. It was measured in a neutral position with the shoulder adducted, the elbow flexed at the right angle, and the forearm parallel to the ground; the angle between the long axis of the forearm and the sagittal plane of the trunk was determined as a ROM of external rotation of shoulder joint. They were measured under the instruction that subjects should move their arm as far as they could. Normal range of motion is 90 degrees.



Figure 10: Examination of shoulder external rotation



Figure 11 Case history taking

4.6 Intervention

4.6.1 Hot Mud Application

Processed mud will be heated up to 42°C (107.6-degree F) with the use of hot water then it will be applied to the affected shoulder covering an area of 10 cm around the acromion process in sitting posture at room temperature for 10 minutes of alternate days for the period of 30 days.



Figure 12: Hot mud application

4.7 Data Extraction and Analysis

4.7.1 Data Extraction

The data was collected as primary outcomes and secondary outcome variables. The assessments were done on the before intervention starts (baseline data) and after completion of 15 session (post data). The data was organized in Microsoft Excel Sheets (Version 2010).

4.7.2 Data Analysis

Data were analysed using IBM SPSS 18.0. The data was checked for normality by Shapiro-Wilk test, for all the analysis, we present 95% confidence intervals and considered $p < 0.05$ as significant.

5.0 RESULTS

The present study was conducted to evaluate the effects of HOT MUD APPLICATION on Periarthritis of Shoulder (PAS) with primary and secondary variables viz. Shoulder pain and disability index (SPADI), Range of motion of the shoulder – flexion, abduction and external rotation. Where in data was extracted at baseline and post-intervention after 15sessions. And pre and post hot mud application intervention showed that significant changes ($P<0.005$) in the pain index, disability index, total SPADI score, shoulder flexion, abduction and external rotation. Hot mud application showed significant changes in the both primary and secondary variables. So hot mud application was significant in both statistically and clinically in pain index ($P<0.002$), disability index ($P<0.007$), total SPADI score ($P<0.002$), shoulder flexion ($P<0.003$), abduction ($P<0.002$) and external rotation ($P<0.004$).

Variables	HOT MUD APPLICATION		<i>p</i> Value
	Single group (n=40)		
	Mean ±SD		
	Pre	Post	
Pain Index (%)	82.56±61	59.95±12.01	<i>0.002</i>
Disability Index (%)	82.89±68	58.51±13.09	<i>0.007</i>
Total Score (%)	82.12±5.89	58.57±11.57	<i>0.002</i>

% - Percentage, SD – Standard deviation, *p* – Probability

Table 4 Results of Primary Outcome Variables

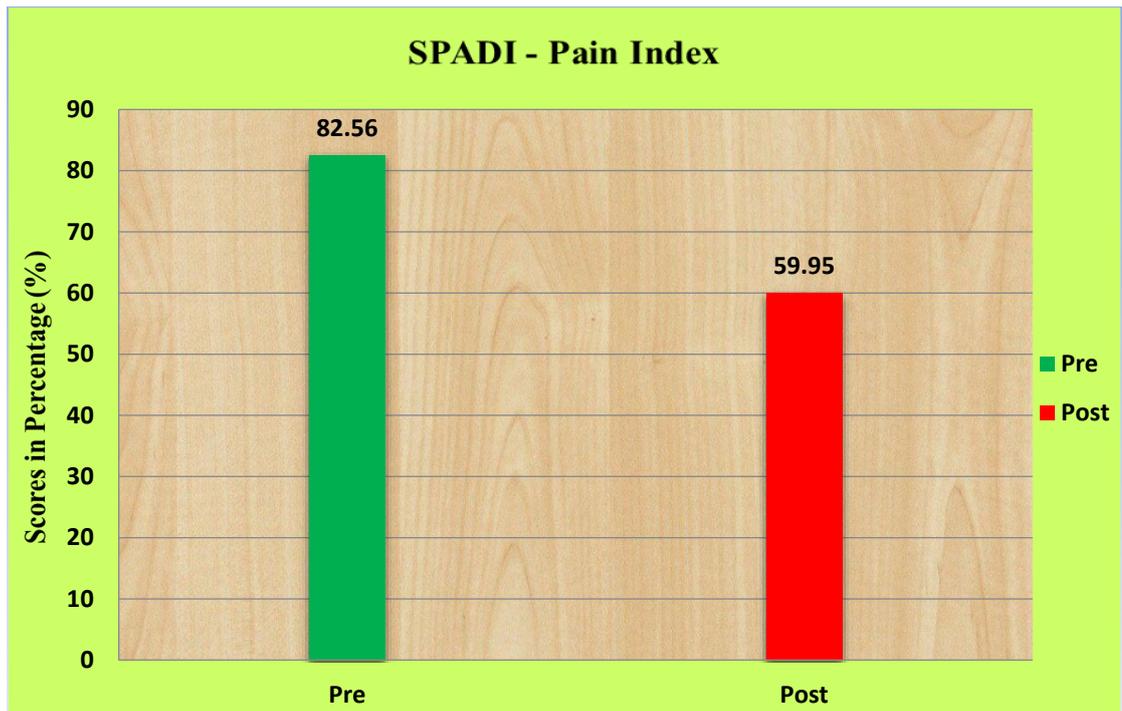


Figure 13: Comparison of SPADI - Pain Index (%) in a bar diagram.

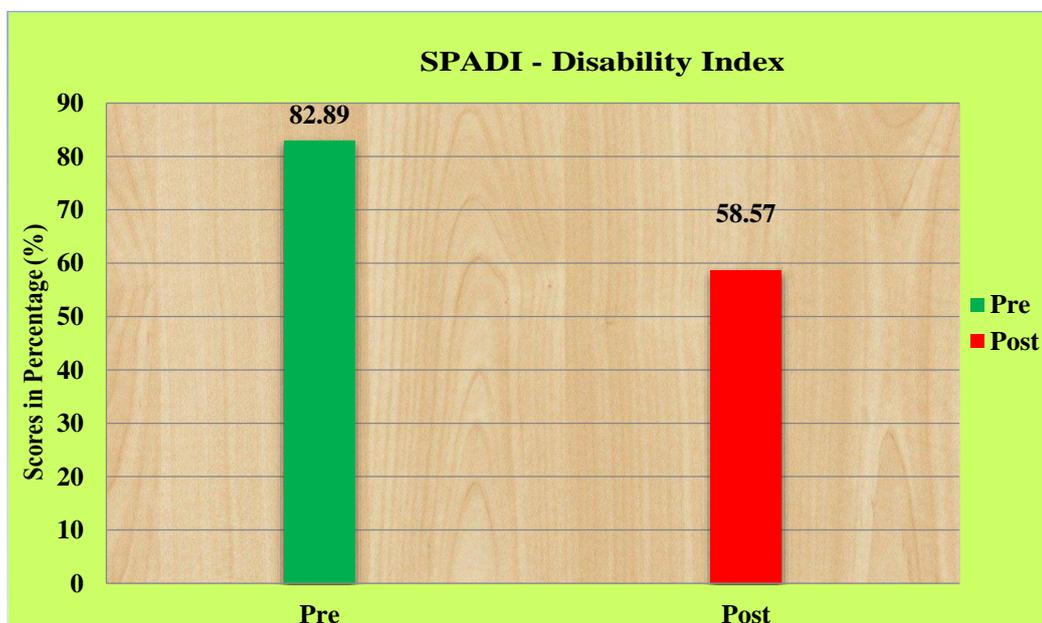


Figure 14: Comparison of SPADI - Disability Index (%) in a bar diagram

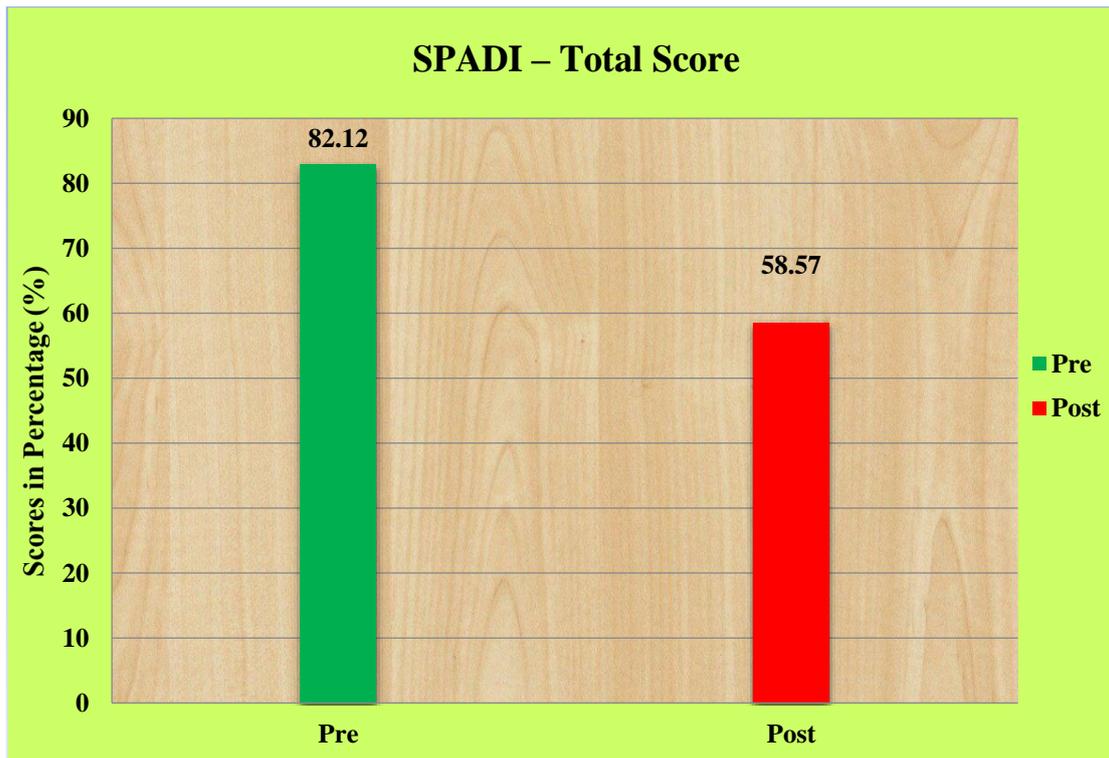


Figure 15 Comparison of SPADI – Total Score (%) in a bar diagram

Variables	HOT MUD APPLICATION		<i>p</i> Value
	Single Group (n=40)		
	Mean ±SD		
	Pre	Post	
Shoulder Flexion	84.07±4.98	104.82±4.86	0.003
Shoulder Abduction	83.37±5.49	103.85±4.49	0.002
Shoulder External Rotation	25.02±2.95	42.22±4.8	0.004

% - Percentage, SD – Standard deviation, *p* – Probability

Table 5: Results of Secondary Outcome Variables

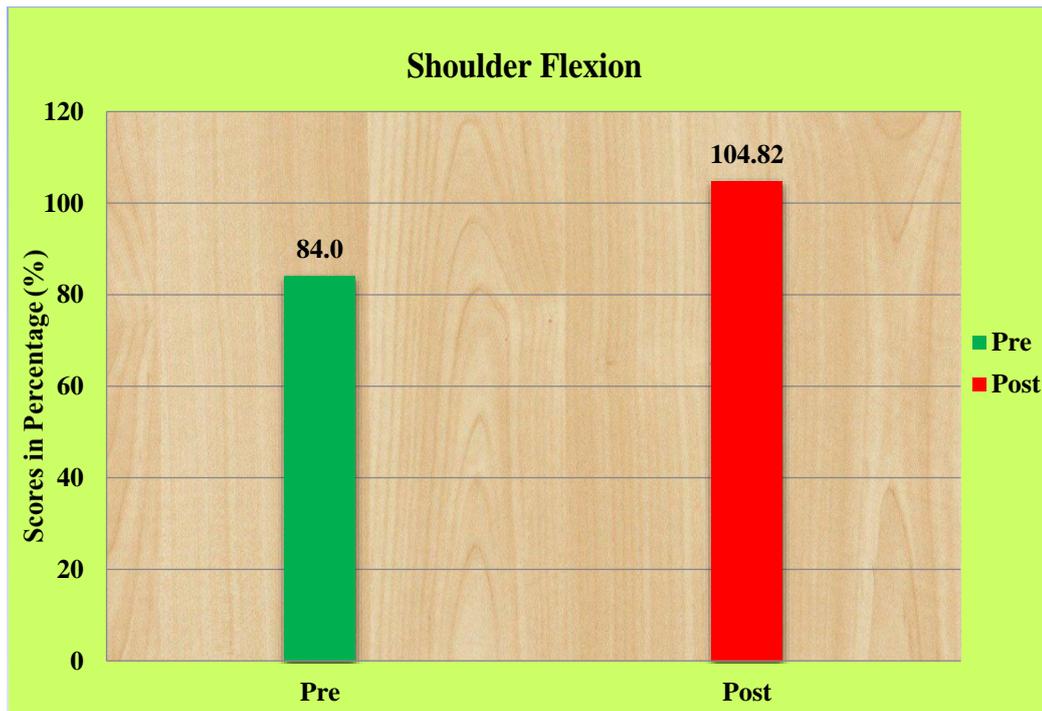


Figure 16: Comparison of Shoulder Flexion in a bar diagram

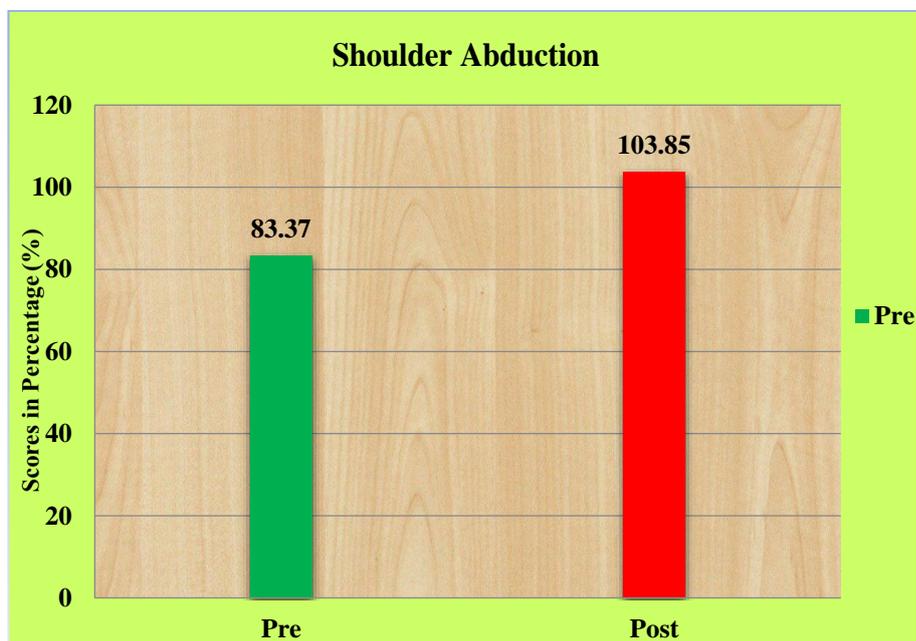


Figure 17: Comparison of Shoulder Abduction in a bar diagram

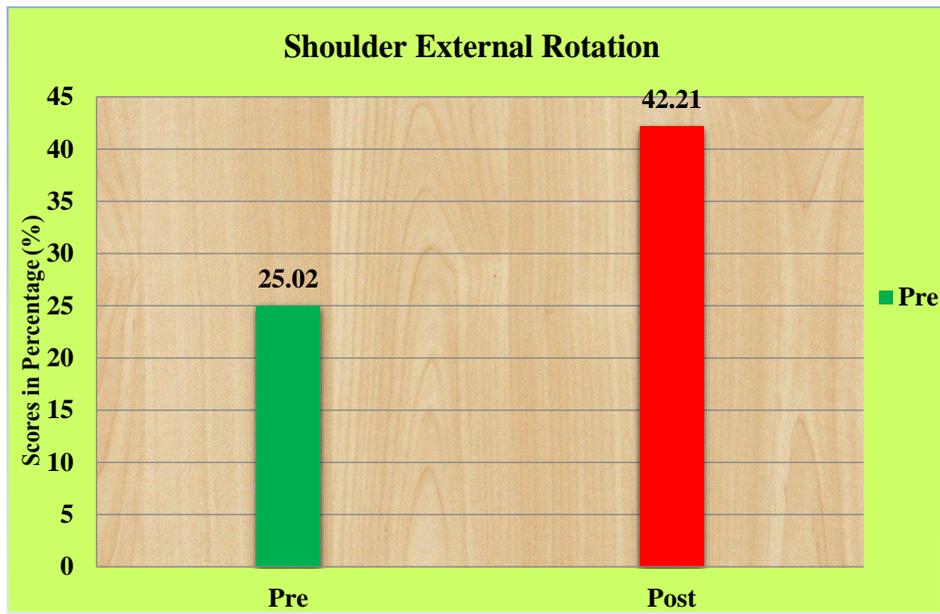


Figure 18 Comparison of Shoulder External Rotation in a bar diagram

6.0 DISCUSSION

The present study results shows that the hot mud application at a temperature of 42°C f for 10 minutes has significant improvement in reduction in shoulder pain and stiffness and improvement in physical motion and range of motion.

The result of the study revealed that HMA with show significant changes in the post test of primary and secondary outcomes. As the incidence is increasing mainly in this trial was conducted.

Systemic review of Green et al says that no adverse effect was seen, in this study also observed that no subjects were had any adverse changes during the 15 sessions on forty subjects. This study has no drop out. Subjects were consistence to the intervention. However in our study demonstrates that hot mud application was effective in management of pain and disability index and range of motion of shoulder on PAS subjects.

Our study also shows that symptoms of PAS like pain, restricted movements were improved after 15 session of hot mud application for 4 weeks. The main aim of the study was to evaluate effect of hot mud application in general to reduce pain intensity and patients global assessment, range of motion, improve the quality of life and health status in patient investigated the use of hot mud application treatment before and after in patients with Periarthritis of shoulder. We used patients global assessment (SPADI Shoulder Pain and Disability Index), range of motion(goniometry) these methods have been reported to be most satisfactory for assessing severity of pain, patients global assessment, range of motion.

Sixty subjects were randomly assigned to either group 1 (hot mud application) or group 2 (mustard application) The results showed significant difference in VAS in both groups. Group 2 showed significant reduction in WOMAC. Good improvement was seen in group 2 in right extension, left extension, physical functioning, social well-being, general physical health, compared to group 1. Rest of the variables in both groups had similar effects since there was not much significant change in both. The group 1 showed significant difference in pain (31.00 ± 67.42), when compared to group 2 (32.67 ± 72.42) [120].

May et al. in a study whether the addition of deep or superficial heating to stretching produces better clinical outcomes than stretching alone in the management of frozen shoulder. A significant improvement was seen in all groups in all outcome measures except for that of shoulder flexion range. The improvement in the shoulder score index and in the range of motion was significantly better in the deep heating group than in the superficial heating group.

Thus, our study indicates that hot mud application may reduce the shoulder pain, stiffness and improves the range of motion. Results reveals with significant changes ($P < 0.005$) in the pain index, disability index, total SPADI score, shoulder flexion, abduction and external rotation. Hot mud application showed significant changes in the both primary and secondary variables. So hot mud application was significant in both statistically and clinically in pain index ($P < 0.002$), disability index ($P < 0.007$), total SPADI score ($P < 0.002$), shoulder flexion ($P < 0.003$), abduction ($P < 0.002$) and external rotation ($P < 0.004$).

6.1 Limitations

- a) The sample size was relatively smaller.
- b) There was no follow-up in this study.
- c) Diurnal variations might have influenced the results.
- d) Other physical activities and diet in home might acted as confounding factors for this study.
- e) Mechanism of hot mud application in the management of pain, disability and ROM of shoulder still inconclusive.

6.2 Directions for Future Research

- a) This study should replicate with lager sample size.
- b) A randomized controlled trial with multi arm study could be better for definite conclusion.
- c) Strong methodology with follow-up is essential to support our result.
- d) Objective variables like digital goniometer; bio-markers for the pain can be used.

7.0 CONCLUSION

The present hot mud application study demonstrates that impact in the management of shoulder pain and its restriction which was estimated through SPADI and goniometer it help to measure the range of movements such as flexion, abduction and external rotation. Further research with a large sample size, objective variables and randomized controlled trial is justified to uncover precise changes in this field.

8.0 SUMMARY

Commencement of this investigation was remembering of the way that PAS is major musculoskeletal disability which burden the patient with everyday life action. PAS influences 2%-3% in general population and 20% of diabetic patients. periarthritis shoulder can cause painful and delayed immobilization of shoulder with diminished collagen length, fibro greasy penetration into the capsular recess, ligament atrophy resulting in diminished pressure assimilation, collagen band crossing over cross wise over recesses, irregular collagen production, and modified sarcomere number in muscle tissues. Mud treatment is a complementary and alternative therapy has been progressively perceived in western nations. Current evidence proposes that mud treatment is a substantial medication for treating musculoskeletal disorders.in this study we have utilized hot mud application as a medication. SPADI questionnaire and ROM such as flexion, abduction and external rotation are the factors used to measures the pain, disability and limitation of shoulder joint. Forty subjects were simple random method selected into intervention. Subjects assessed at baseline and at the end of 15 sessions for Shoulder pain and its disability index (SPADI) and the range of motion (ROM). Intervention was alternate days for four weeks. Overall hot mud application can be used as management of shoulder pain and restriction of shoulder joint with less cost effective and without any side effects.

9.0 REFERENCES

1. Buchbinderr GS. Effect of arthrographic shoulder joint distension with saline and corticosteroid for adhesive capsulitis. *Br J Sport.* 2004;38(4):384–385
2. solving the enigma of frozen shoulder luise hollmannsydney school of medicine the university of sydney 2017 p-2-3
3. (g. hand, athanasou, matthews, & carr, 2007; t. d. bunker & anthony, 1995) . bone & joint journal,(928-932).
4. neviaser js. adhesive capsulitis of the shoulder: a study of the pathological findings in periarthrititis of the shoulder. *j bone jt surg.* 1945;27:211–222.
5. codman ea. boston: thomas told. *the shoulder.* 1934;d
6. A review on frozen shoulder wong p l k, tan h c a department of orthopaedic surgery, sports medicine service, singapore general hospital, outram road, singapore 169608 wong plk, mbbch bao medical officer tan hca, mbbs, frcsg, frcse senior consultant
7. Robinson cm, Seah kt, Chee yh, Hindle p mi. frozen shoulder. *j bone jt surg br.* 2012;94(1–9).
8. Manske rc pd. diagnosis and management of adhesive capsulitis. *curr rev musculoskelet med.* 2008;1:180–9.
9. Tighe cb owj. the prevalence of a diabetic condition and adhesive capsulitis of the shoulder. *south med j.* 2008;101(6):591–5.
10. Ombregt L, Bisschop P T. A system of orthopaedic medicine. 2nd edn. London: *Churchill Livingstone.* 2003;
11. Hazleman bl. frozen shoulder. in: Rockwood ca jr, Matsen fa iii, editors. *the*

- shoulder. 2nd ed. philadelphia: wb saunders. 1990;
12. harryman dt, lazurus md rr. the stiff shoulder. in: rockwood cam matsen fa, wirth ma, lippitt sb, editors. the shoulder. 3rd ed. philadephia: saunders. 2004;
 13. Mangine RE, Ernst MJ, Eifert-Mangine M. Alternative techniques for the motion-restricted shoulder. In *The Athlete's Shoulder* 2009 Jan 1 (pp. 685-693). Churchill Livingstone.
 14. Einstein, A., B. Podolsky, and N. Rosen, 1935, "Can quantum-mechanical description of physical reality be considered complete?", *Phys. Rev.* 47, 777-780.
 15. Dodenhoff RM, Levy O, Wilson A, Copeland SA. Manipulation under anesthesia for primary frozen shoulder: effect on early recovery and return to activity. *Journal of shoulder and elbow surgery.* 2000 Jan 1;9(1):23-6.
 16. Bulgen DY, Binder AI, Hazleman BL, Dutton J, Roberts S. Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens. *Annals of the rheumatic diseases.* 1984 Jun 1;43(3):353-60.
 17. Shanahan EM, Ahern M, Smith M, Wetherall M, Bresnihan B, FitzGerald O. Suprascapular nerve block (using bupivacaine and methylprednisolone acetate) in chronic shoulder pain. *Annals of the rheumatic diseases.* 2003 May 1;62(5):400-6.
 18. Jones A, Regan M, Ledingham J, Patrick M, Manhire A, Doherty M. Importance of placement of intra-articular steroid injections. *BMJ: British Medical Journal.* 1993 Nov 20;307(6915):1329.
 19. Andersen NH, Johannsen HV, Sneppen O, Søjbjerg JO. Frozen shoulder.

- Arthroscopy and manipulation in general anesthesia, followed by early passive mobilization. *Ugeskrift for laeger*. 1996 Jan;158(2):147-50.
20. Buchbinder R, Youd JM, Green S, Stein A, Forbes A, Harris A, Bennell K, Bell S, Wright WJ. Efficacy and cost-effectiveness of physiotherapy following glenohumeral joint distension for adhesive capsulitis: A randomized trial. *Arthritis Care & Research*. 2007 Aug 15;57(6):1027-37.
21. Rizk TE, Gavant ML, Pinals RS. Treatment of adhesive capsulitis (frozen shoulder) with arthrographic capsular distension and rupture. *Archives of physical medicine and rehabilitation*. 1994 Jul 1;75(7):803-7.
- 22 Yeun YR. Effectiveness of massage therapy for shoulder pain: a systematic review and meta-analysis. *Journal of physical therapy science*. 2017;29(5):936-40.
23. Definition of naturopathy. pune: national institute of naturopathy. <http://punenin.org/attach/naturopathy.pdf> , accessed march 29, 2017
24. Rastogi R. Therapeutic uses of mud therapy in naturopathy. *Indian Journal of Traditional Knowledge* 2012; 11: 556-559
25. <http://www.mudbaths.gr/en/index.html/> 2011 [cited 10 march 2011]
26. Chadzopulu A, Adraniotis J, Theodosopoulou E. The therapeutic effects of mud. *Prog Health Sci*. 2011 Dec 1;1(2):132-6.
27. Odabasi E, Turan M, Erdem H, Tekbas F. Does mud pack treatment have any chemical effect? A randomized controlled clinical study. *The journal of alternative and complementary medicine*. 2008 Jun 1;14(5):559-65.
28. Ma'or Z, Henis Y, Alon Y, Orlov E, Sørensen KB, Oren A. Antimicrobial properties of Dead Sea black mineral mud. *International Journal of*

- Dermatology. 2006 May;45(5):504-11.
29. Veniale F, Bettero A, Jobstraibizer PG, Setti M. Thermal muds: perspectives of innovations. *Applied clay science*. 2007 Apr 1;36(1-3):141-7.
 30. Kumar D, KJ S, Shetty P. Comparative Study on the Effect of Hot Mud Application and Mustard Application in Patients with Osteoarthritis of Knee. Randomized Controlled Trial.
 31. Cozzi F, Carrara M, Sfriso P, Todesco S, Cima L. Anti-inflammatory effect of mud-bath applications on adjuvant arthritis in rats. *Clin Exp Rheumatol*. 2004 Nov 1;22(6):763-6.
 32. Veniale F, Bettero A, Jobstraibizer PG, Setti M. Thermal muds: perspectives of innovations. *Applied clay science*. 2007 Apr 1;36(1-3):141-7
 33. Kalkan E, Canbolat MY, Yarbaşı N, Özgul M. Evaluation of thermal mud characteristics of Erzurum (Köprüköy) clayey raw materials (NE Turkey). *International Journal of Physical Sciences*. 2012 Oct 23;7(40):5566-76.
 34. Kalkan E, Canbolat MY, Yarbaşı N, Özgul M. Evaluation of thermal mud characteristics of Erzurum (Köprüköy) clayey raw materials (NE Turkey). *International Journal of Physical Sciences*. 2012 Oct 23;7(40):5566-76.
 35. Tateo F, Ravaglioli A, Andreoli C, Bonina F, Coiro V, Degetto S, Giaretta A, Orsini AM, Puglia C, Summa V. The in-vitro percutaneous migration of chemical elements from a thermal mud for healing use. *Applied Clay Science*. 2009 Apr 1;44(1-2):83-94.
 36. Calis M, Demir H, Ulker S, Kirnap M, Duygulu F, Calis HT. Is intraarticular sodium hyaluronate injection an alternative treatment in patients with adhesive

- capsulitis? *Rheumatology international*. 2006 Apr 1;26(6):536-40.
37. Duplay ES. De la périarthrite scapulo-huméral et des raideurs qui en sont la conséquence. *Arch Gén Méd*. 1872;20:513–542.
38. Modesto C, Crespo E, Villas C AD. Adhesive capsulitis. is it possible in childhood? *Scand J Rheumatol*. 1995;24(4):255–6. 8.
- 39 Reeves B. The natural history of the frozen shoulder syndrome. *Scandinavian journal of rheumatology*. 1975 Jan 1;4(4):193-6.
40. Neviasser RJ, Neviasser TJ. The frozen shoulder. Diagnosis and management. *Clinical orthopaedics and related research*. 1987 Oct(223):59-64.
41. Neviasser AS, Hannafin JA. Adhesive capsulitis: a review of current treatment. *The American journal of sports medicine*. 2010 Nov;38(11):2346-56.
42. Wong PL, Tan HC. A review on frozen shoulder. *Singapore medical journal*. 2010 Sep 1;51(9):694.
43. Hand GC, Athanasou NA, Matthews T CA. The pathology of frozen shoulder. *j bone jt surg br*. 2007;89(b):928–32.
44. Wongplk, Tan HCA, Andrew Hwee CHYE Tan. A review on frozen shoulder.. *Singapore Medical Journal* september 2010. [https://www. research gate net](https://www.researchgate.net) publication. accessed on april 22nd, 2017.
45. Rodeo SA, Hannafin JA, Tom J, Warren RF, Wickiewicz TL. Immunolocalization of cytokines and their receptors in adhesive capsulitis of the shoulder. *Journal of Orthopaedic Research*. 1997 May;15(3):427-36.
46. Fukuda H. Partial-thickness rotator cuff tears: a modern view on Codman's

- classic. *Journal of Shoulder and Elbow Surgery*. 2000 Mar 1;9(2):163-8.
47. Grays anatomy 2 edition copy right 2009 capsules of right glenohumeral joint(page 671 – 672)
48. Bulgen DY, Binder A, Hazleman BL, Park JR. Immunological studies in frozen shoulder. *J Rheumatol*. 1982 Nov;9(6):893-8.
- 49 Emig E, Schweitzer ME, Karasick D, Lubowitz J. Adhesive capsulitis of the shoulder: MR diagnosis. *AJR. American journal of roentgenology*. 1995 Jun;164(6):1457-9.
50. Kim KC, Rhee KJ, Shin HD. Adhesive capsulitis of the shoulder: dimensions of the rotator interval measured with magnetic resonance arthrography. *Journal of shoulder and elbow surgery*. 2009 May 1;18(3):437-42.
- 51Eustace JA, Brophy DP, Gibney RP, Bresnihan B, FitzGerald O. Comparison of the accuracy of steroid placement with clinical outcome in patients with shoulder symptoms. *Annals of the rheumatic diseases*. 1997 Jan 1;56(1):59-63.
52. Van Der Windt DA, Van Der Heijden GJ, Scholten RJ, Koes BW, Bouter LM. The efficacy of non-steroidal anti-inflammatory drugs (NSAIDs) for shoulder complaints. A systematic review. *Journal of clinical epidemiology*. 1995 May 1;48(5):691-704.
53. Jacobs LG, Smith MG, Khan SA, Smith K, Joshi M. Manipulation or intra-articular steroids in the management of adhesive capsulitis of the shoulder? A prospective randomized trial. *Journal of shoulder and elbow surgery*. 2009 May 1;18(3):348-53.

54. Rizk TE, Gavant ML, Pinals RS. Treatment of adhesive capsulitis (frozen shoulder) with arthrographic capsular distension and rupture. Archives of physical medicine and rehabilitation. 1994 Jul 1;75(7):803-7..
55. Dodenhoff RM, Levy O, Wilson A, Copeland SA. Manipulation under anesthesia for primary frozen shoulder: effect on early recovery and return to activity. Journal of shoulder and elbow surgery. 2000 Jan 1;9(1):23-6.
56. Andersen NH, Johannsen HV, Sneppen O, Søjbjerg JO. Frozen shoulder. Arthroscopy and manipulation in general anesthesia, followed by early passive mobilization. Ugeskrift for laeger. 1996 Jan;158(2):147-50.
57. Nicholson GP. Arthroscopic capsular release for stiff shoulders. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2003 Jan 1;19(1):40-9.
58. Wang Y. Chinese medicine packet plus wax therapy for periarthritits of the shoulder: study protocol for a multi-center, randomized controlled trial. Clinical Trials in Degenerative Diseases. 2016 Jan 1;1(1):25.
59. Leung MS, Cheing GL. Effects of deep and superficial heating in the management of frozen shoulder. Journal of rehabilitation medicine. 2008 Feb 5;40(2):145-50.
60. Jain TK, Sharma NK. The effectiveness of physiotherapeutic interventions in treatment of frozen shoulder/adhesive capsulitis: a systematic review. Journal of back and musculoskeletal rehabilitation. 2014 Jan 1;27(3):247-73.
61. <http://punenin.org/attach/naturopathy.pdf> definition of naturopathy. pune: national institute of naturopathy., accessed march 29, 2017
62. Espejo L, Cardero MÁ, Garrido EM, Caro B, Torres S. Effects of mud pack therapy on patients with knee osteoarthritis. A randomized controlled clinical

- trial. In *Anales De Hidrología Médica* 2012 Jul 1 (Vol. 5, No. 2, p. 109). Universidad Complutense de Madrid.
63. Barnes PM, Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. In *Seminars in integrative medicine* 2004 Jun 1 (Vol. 2, No. 2, pp. 54-71). WB Saunders.
64. Rastogi R. Therapeutic uses of mud therapy in naturopathy. September 2014 140–147. *Indian journal of traditional knowledge* 2012; 11: 556-559
65. Ma'or Z, Henis Y, Alon Y, Orlov E, Sørensen KB, Oren A. Antimicrobial properties of Dead Sea black mineral mud. *International Journal of Dermatology*. 2006 May;45(5):504-11.
66. Proksch E, Nissen HP, Bremgartner M, Urquhart C. Bathing in a magnesium-rich Dead Sea salt solution improves skin barrier function, enhances skin hydration, and reduces inflammation in atopic dry skin. *International journal of dermatology*. 2005 Feb;44(2):151-7.
67. Tyagi M. A pilot study of agnikarma on frozen shoulder (avabahuka). (Doctoral dissertation).
69. Chadzopulu A, Adraniotis J, Theodosopoulou E. The therapeutic effects of mud. *Prog Health Sci*. 2011 Dec 1;1(2):132-6.
70. Chadzopulu A, Adraniotis J, Theodosopoulou E. The therapeutic effects of mud. *Prog Health Sci*. 2011 Dec 1;1(2):132-6.
71. Rossi M, Carpi A, Galetta F, Franzoni F, Santoro G. The investigation of skin blood flow motion: a new approach to study the microcirculatory impairment in vascular diseases?. *Biomedicine & Pharmacotherapy*. 2006 Sep 1;60(8):437-42.

72. Alekseenko NA, Kolker IA, Nikipelova EM, Filipenko TG. Determination of biological activity of therapeutic muds. *Likars' ka sprava*. 2005 Jun(4):37-8.
73. Odabasi E, Turan M, Erdem H, Tekbas F. Does mud pack treatment have any chemical effect? A randomized controlled clinical study. *The journal of alternative and complementary medicine*. 2008 Jun 1;14(5):559-65.
74. Bagnato G, De LF, Morgante S, Morgante ML, Farina G, Caliri A, Romano C, D'Avola G, Pinelli P, Calpona PR, Strega P. Clinical improvement and serum amino acid levels after mud-bath therapy. *International journal of clinical pharmacology research*. 2004;24(2-3):39-47.
75. Bellometti S, Cecchettin M, Galzigna L. Mud pack therapy in osteoarthritis: changes in serum levels of chondrocyte markers. *Clinica Chimica Acta*. 1997 Dec 10;268(1-2):101-6.
76. Bellometti S, Galzigna L. Serum levels of a prostaglandin and a leukotriene after thermal mud pack therapy. *Journal of investigative medicine: the official publication of the American Federation for Clinical Research*. 1998 Apr;46(4):140-5.
77. Bellometti S, Galzigna L, Richelmi P, Gregotti C, Bertè F. Both serum receptors of tumor necrosis factor are influenced by mud pack treatment in osteoarthrotic patients. *International journal of tissue reactions*. 2002;24(2):57-64.
78. Bostan B, Sen U, Güneş T, Sahin SA, Sen C, Erdem M, Erkorkmaz U. Comparison of intra-articular hyaluronic acid injections and mud-pack therapy in the treatment of knee osteoarthritis. *Acta Orthop Traumatol Turc*. 2010 Jan 1;44(1):42-7.

79. Odabası E, Turan M, Erdem H, Pay S, Güleç M, Karagülle MZ. The Effect of Mud Pack Treatment in Knee Osteoarthritis. *Turk J Rheumatol* 2009; 24: 72–6.
Disclosure of Interest: None declared DOI.;10.
80. Cozzi F, Carrara M, Sfriso P, Todesco S, Cima L. Anti-inflammatory effect of mud-bath applications on adjuvant arthritis in rats. *Clin Exp Rheumatol*. 2004 Nov 1;22(6):763-6.
81. Chadzopulu A, Adraniotis J, Theodosopoulou E. The therapeutic effects of mud. *Prog Health Sci*. 2011 Dec 1;1(2):132-6.
82. Carretero MI. Clay minerals and their beneficial effects upon human health. A review. *Applied Clay Science*. 2002 Jun 1;21(3-4):155-63.
83. Giacomino MI. Is mud an anti-inflammatory?. In *Anales de medicina interna* (Madrid, Spain: 1984) 2007 Jul (Vol. 24, No. 7, pp. 352-353).
84. Cozzi F, Carrara M, Sfriso P, Todesco S, Cima L. Anti-inflammatory effect of mud-bath applications on adjuvant arthritis in rats. *Clin Exp Rheumatol*. 2004 Nov 1;22(6):763-6.
85. Tyagi M. A pilot study of agnikarma on frozen shoulder avabahuka (doctoral dissertation).
86. Abudaheer KS, Sathishkumar S, Vijayananth V, Selvan KK. Efficacy of Post thermotherapy Maitland mobilization compared to the active mobilization exercises in improving the shoulder function and pain in periartthritis: a simple randomized clinical control trail. *International Journal of Medical and Health Sciences*. 2014;3(3):195-8.
87. Alptekin HK, Aydın T, İflazoğlu ES, Alkan M. Evaluating the effectiveness of

- frozen shoulder treatment on the right and left sides. *Journal of physical therapy science*. 2016;28(1):207-12.
88. Prashanth shetty; Selva kumar; Sujatha Dinesh. Comprehensive naturopathy treatment in the management of osteoarthritis of knee joint” *IAETSD Journal for Advanced Research In Applied Sciences*; 2014.
89. Melzack R, Wall PD. Pain mechanisms: a new theory. *Science*. 1965 Nov 19;150(3699):971-9.
90. Department of Biochemistry and Molecular Biophysics Thomas Jessell, Siegelbaum S, Hudspeth AJ. *Principles of neural science*. Kandel ER, Schwartz JH, Jessell TM, editors. New York: McGraw-hill; 2000 Jan.
91. Jayasuriya A . Feranado F. The motor gate theory - A neurophysiological model to explain the phenomenon of late motor recovery following use of acupuncture in paralytic conditions. *am j acupunct*. 1978;6(3).
92. Gunn CC, Ditchburn FG, King MH, Renwick GJ. Acupuncture Loci: a proposal for their classification according to their relationship to known neural structures. *The American journal of Chinese medicine*. 1976;4(02):183-95.
93. mj m. descending control of pain. *prog neurobiol*. 2002;66:355–474.
94. Giacomino MI. Is mud an anti-inflammatory?. In *Anales de medicina interna* (Madrid, Spain: 1984) 2007 Jul (Vol. 24, No. 7, pp. 352-353).
96. Le Bars D. The whole body receptive field of dorsal horn multireceptive neurones. *Brain Research Reviews*. 2002 Oct 1;40(1-3):29-44.
97. shilpa parag satralkar¹ , basvant dhudum², *international journal of science and research (ijsr)* effectiveness of application of warm compress with epsom salt to

reduce knee joint pain among women volume 7 issue 5, may 2018

98. tateo f, ravaglioli a, andreoli c, bonina f, coiro v, degetto s, giaretta a, orsini am, puglia c, summa v. the in-vitro percutaneous migration of chemical elements from a thermal mud for healing use. *applied clay science*. 2009 apr 1;44(1-2):83-94.

99. isabel carretero m. clay minerals and their beneficial effects upon human health. a review. *applied clay science* 2002; 21: 155–16.

100. fernando veniale a, antonio bettero b, pier giorgio jobstraibizer c, massimo settia, thermal muds: perspectives of innovations *applied clay science* 36 (2007) 141–147

101. pizzoferrato a, garzia i, cenni e, pratelli l, tarabusi c, [beta-endorphin and stress hormones in patients affected by osteoarthritis undergoing thermal mud therapy]. 2000 oct;91(10):239-45

102. giusti p, cima l, tinello a, cozzi f, targa l, lazzarin p, todesco scentro regionale di reumatologia e di studio del termalismo, regione veneto. stress hormones liberated by fango therapy. acth and beta-endorphin levels under heat stress *fortschritte der medizin* [1990, 108(32):601-603

103. bellometti s, galzigna l. function of the hypothalamic adrenal axis in patients with fibromyalgia syndrome undergoing mud-pack treatment. *int j clin pharmacol res*. 1999;19(1):27-33.

104. dr. dushyant kumar 1, dr. sujatha k j 2, dr. prashanth Shetty www.iosrjournals.org
comparative study on the effect of hot mud application and mustard application in

patients with osteoarthritis of knee. randomized controlled trial iosr journal of dental and medical sciences (iosr-jdms)e-issn: 2279-0853, p-issn: 2279-0861.volume 15, issue 9 ver. xiii (september. 2016), pp 13-19.

105.meijide r, mourelle l, et al, peloides en lasenfermedades del aparato locomotor, in legido soto jl and mourelleml, eds, investigaciones en el a´mbito iberoamericano sobre peloides termales, vigo, publicaciones universidad de vigo, 21, 2007, 277-290.

106.odabasi e, turan m, erdem h, tekbas f.does mud pack treatment have any chemical effect? a randomized controlled clinical study j altern complement med. 2008 jun;14(5):559-65. doi: 10.1089/acm.2008.0003

107.clijisen r, taeymans j, duquet w, barel a, clarys p , changes of skin characteristics during and after local parafango therapy as used in physiotherapy. official journal of international society for bioengineering and the skin (isbs) [and] international society for digital imaging of skin (isdis) [and] international society for skin imaging (issi) [2008, 14(2):237-242]

108.fer nando veniale a, antonio bettero b, pier giorgio jobstraibizer c, thermal muds: perspectives of innovations massimo setti received 20 february 2006; applied clay science 36 (2007) 141 – 147.

109. prof. p. d. gupta, agnikarma, prabhapublication, nagpur, 192, page no. 29.

110. tripathy l s, pnkj r n, otta. a pilot study of agni karma on frozen shoulder (avabahuka) ayurvedic medical college & pg centre, bidar, karnataka. , international journal of applied ayurved research issn: 2347- 6362

111. ye wang* chinese medicine packet plus wax therapy for periarthritis of the shoulder: study protocol for a multi-center, randomized controlled trial rehabilitation center, the first affiliated hospital of liaoning university of traditional chinese medicine, shenyang, liaoning province, china <http://www.clinicaltrials.gov> on thursday, april 11, 2019, ip:106.203.103.16]

112. kliniki g, instytutu p i, ginekologii p, akademii m. effect of hyper thermic and isothermic mud application on hormonal function of normal and insufficient corpus luteum in women. ann acad med stetini 1993; 39:133-46.

113. dhanokar ca1* and kanani vp2 management of frozen shoulder by agnikarma (therapeutic cauterization) and patrapinda sweda (herbal hot fomentation): a case study american journal of phytomedicine and clinical therapeutics issn 2321-2748 doi: 10.21767/2321-2748. vol. 5 no. 3:18.

114. pullan je, sujatha kj, shetty p, shetty gb. comparative study on effect of moist heat therapy and acupuncture as an adjuvant to a comprehensive naturopathy treatment in management of chronic neck pain-a randomized control trial. (september). 2016), pp139-144

115. syed abudaheer k1*, sathishkumar s2, vijayananth v3, karthika selvan k4 efficacy of post thermotherapy maitland mobilization compared to the active mobilization

exercises in improving the shoulder function and pain in periarthritis: a simple randomized clinical control trail

116.international journal of medical and health sciencesjournal home page:
<http://www.ijmhs.net> july 2014,vol-3;issue-3

117.williams jw jr., holleman dr jr. sd. measuring shoulder function with the shoulder pain and disability index. *j rheumatol.* 1995;22(4):727–32.

118.roach ke, budiman-mak e, songsiridej n ly. development of a shoulder painand disability index. *arthritis care res.* 1991;4(4):143–9.

119.mullaney mj, mchugh mp, johnson cp tt. reliability of shoulder range of motion comparing a goniometer to a digital level. *physiother theory pr.* 2010;26(5):327–33.

120. Kumar D, KJ S, Shetty P. Comparative Study on the Effect of Hot Mud Application and Mustard Application in Patients with Osteoarthritis of Knee. Randomized Controlled Trial.

121. Leung MS, Cheing GL. Effects of deep and superficial heating in the management of frozen shoulder. *Journal of rehabilitation medicine.* 2008 Feb 5;40(2):145-50.

ANNEXURE-1

INFORMATION SHEET

I am conducting a study on **“TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHROSIS OF SHOULDER”** in Government yoga and naturopathy medical college & hospital, Chennai and for that your participation may be valuable to us.

The purpose of this study is to know the effect of hot mud application in improvement in pain and range of motion in peri arthritis shoulder.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled. The results of the special study may be intimated to you at the end of the study period.

Signature of Investigator

Signature of Participant

Date:

ANNEXURE-2

INFORMED CONSENT FORM

Title of the study: “TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHRITIS OF SHOULDER”.

Name of the Participant :

Name of the Principal Investigator : Dr.V.Arumugaraj

Name of the Institution : Government Yoga & Naturopathy Medical College & Hospital, Chennai – 600 106

Documentation of the informed consent

I _____ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in

1. I have read and understood this consent form and the information provided to me.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.
5. I have been informed the investigator of all the treatments I am taking or have taken in the past _____ months including any native (alternative) treatment.
6. I have been advised about the risks associated with my participation in this study.
7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.
8. I have not participated in any research study within the past _____month(s).
9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.
10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.
12. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.
13. I have understood that my identity will be kept confidential if my data are publicly presented.
14. I have had my questions answered to my satisfaction.
15. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this

document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

For adult participants:

Name and Signature of impartial witness (required for illiterate patients):

Name _____ Signature _____

Date _____

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

Name _____ Signature _____

Date _____

ANNEXURE-3

INFORMATION TO PARTICIPANTS

Investigator: Dr.V.Arumugaraj

Name of Participant:

Title: “TO EVALUATE THE EFFECT OF HOT MUD APPLICATION ON PAIN MANAGEMENT IN PERIARTHRITIS OF SHOULDER”

You are invited to take part in this research/ study /procedure. The information in this document is meant to help you decide whether to take part. Please feel free to ask if you have any queries or concerns.

You are being asked to participate in this study being conducted in Government Yoga and Naturopathy Medical College, Chennai-106

What is the Purpose of the Research?

The purpose of this study is to evaluate the effect of hot mud application in improvement in pain and range of motion in peri arthritis shoulder.

The Study Design

Single group quasi-experimental study

Study Procedures

I have been informed that there will be pre and post assessments where non invasive methods will be used to measure range of motion & pain using Goniometer and SPADI questionnaire

A single group quasi experimental study design will be adopted in this study. Processed mud will be heated up to 42°C (107.6-degree F) with the use of hot water then it will be applied to the affected shoulder covering an area of 10 cm around the acromion process in sitting posture at room temperature for 10 minutes of alternate days for the period of 30 days.

Possible Risks to you - Nil

Possible Benefits to you- pain and range of motion will improve.

Possible benefits to other people

The result of the research may provide benefits to the society in terms of improving the range of motion and reducing the pain in peri arthritis patients.

Confidentiality of the information obtained from you

You have the right to confidentiality regarding the privacy of your medical information (personal details, results of physical examinations, investigations, and your medical history). By signing this document, you will be allowing the research team investigators, other study personnel, sponsors, IEC and any person or agency required by law like the Drug Controller General of India to view your data, if required.

The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

How will your decision to not participate in the study affect you?

Your decisions to not to participate in this research study will not affect your medical care or your relationship with investigator or the institution. Your doctor will still take care of you and you will not lose any benefits to which you are entitled.

Can you decide to stop participating in the study once you start?

The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during course of the study without giving any reasons.

However, it is advisable that you talk to the research team prior to stopping the treatment

Signature of Investigator

Signature of Participant

Date:

Shoulder Pain and Disability Index (SPADI)

Government Yoga and Naturopathy Medical College & Hospital, Arumbakkam,

Chennai-106

Name:

Id no. :

Date:

Please place a mark on the line that best represents your experience during the last week attributed to your shoulder problem.

Pain Scale: How severe is your pain?

Circle the number that best describes your pain where: **0 = no pain** and **10 = the worst pain imaginable**.

At its worst?	0	1	2	3	4	5	6	7	8	9	10
When lying on the involved side?	0	1	2	3	4	5	6	7	8	9	10
Reaching for something on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Touching the back of your neck?	0	1	2	3	4	5	6	7	8	9	10
Pushing with the involved arm?	0	1	2	3	4	5	6	7	8	9	10

Disability Scale: how much difficulty you have?

Circle the number that best describes your pain where: **0 = no difficulty** and **10 = so difficult it requires help**

Washing your hair?	0	1	2	3	4	5	6	7	8	9	10
Washing your back?	0	1	2	3	4	5	6	7	8	9	10
Putting on an undershirt or jumper?	0	1	2	3	4	5	6	7	8	9	10
Putting on a shirt that buttons down in front?	0	1	2	3	4	5	6	7	8	9	10
Putting on your pants?	0	1	2	3	4	5	6	7	8	9	10
Placing an object on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Carrying a heavy object of 10 pounds (4.5 kilograms)?	0	1	2	3	4	5	6	7	8	9	10
Removing something from your back pocket?	0	1	2	3	4	5	6	7	8	9	10