Consequences of *Jalaukavacharana* In Histological Study of Osteoarthritis

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ABSTRACT

There is growing evidence that vascular pathology plays a role in the onset and/or progression of osteoarthritis, the most common joint disease (OA). Episodically reduced blood flow via the tiny capillaries in the subchondral bone near the ends of long bones, as well as reduced interstitial fluid flow in subchondral bone, are two possible explanations. Venous occlusion and stasis, as well as the development of microemboli in the subchondral veins, can limit blood flow. It's critical to know these potential aetiological causes so that more effective treatments can be developed to slow the progression of osteoarthritis. In this context, Leech therapy, also known as *Jalaukavacharana*, has a lot of promise for treating inflammatory, ischemic, and viral disorders. The saliva of the leech contains a variety of physiologically and pharmacologically active chemicals that have anti-coagulant, profibrinolytic, anti-platelet, anti-inflammatory, and anti-edema properties in the host's body. Arthritis, venous congestion, vascular disorders, abscess, and other similar conditions.

Key words: - ***Jalaukavacharana, Leech therapy, Hirudin, Osteoarthritis, Synovial Fluid.***

INTRODUCTION

The most common joint ailment in the world is osteoarthritis. Radiographic evidence of this disease is evident in the majority of people by 65 years of age in Western countries, and in roughly 80% of people over 75 years of age. Symptomatic osteoarthritis of the knee affects around 11% of people over the age of 64.

The data supporting the idea that vascular pathology may have a role in the onset and progression of osteoarthritis, the most common joint disease. Although osteoarthritis is characterised by gradual articular cartilage degeneration. Subchondral cysts, sclerosis, and osteophyte production are all signs of developed osteoarthritis. Multiple aetiologies contribute to the symptoms of osteoarthritis, which include joint pain, stiffness, and articular cartilage deterioration. Genetic and environmental risk factors for osteoarthritis [1-4], such as increased weight, female sex, joint dysplasias, malalignment and injury, clearly contribute to the establishment and progression of this condition. Despite the fact that cartilage is avascular, there is evidence that vascular issues may play a role in the development of osteoarthroses.

Nonsteroidal anti-inflammatory drugs (NSAIDs) are the most commonly prescribed drugs in modern medicine, although they have several side effects and are consequently unsuitable for long-term use[5]. *Raktamokshana[6]*, often known as bloodletting, is an ancient and crucial

parasurgical practise used in Ayurveda to treat a variety of ailments. Because of its medical properties, *Jalaukavacharana*, or leech therapy, has earned more attention around the world. Leech saliva contains a variety of biologically active components with anti-inflammatory and anaesthetic characteristics.. *Charaka Samhita* recommends If the symptoms worsen notwithstanding correct treatment of the vitiated *Doshas*, using *Raktamokshana*, which takes into account the role of the *Rakta*[7]. *Jalaukavacarana* (leech therapy) is a local *Raktamokshana* technique that is simple to use on a troublesome joint. Considering all these facts, this study is planned to study the histological view of osteoarthritis and to know the scienticfic explanation about therapeutic effect of *Jalaukavacarana* in the management of joint pain.

AIM & OBJECTIVES

- To Study the Histological aspect of osteo-arthritis
- To establish therapeutic effect of *Jaulaukavcharna* in restoration of synovial fluid.

LITERARY REVIEW

Histology of joints

The vasculature is involved in every process of bone formation, repair, and metabolism [8]. Both the marrow and the calcified bone tissue are served by the blood supply to the bones, and these two tissue types are functionally interconnected in terms of haemopoiesis, bone modelling, and remodelling [9]. The vascular supply of bone contains several arterial inlets and venous exits, with the nutritive artery, periosteal arteries, metaphyseal arteries, and epiphyseal arteries being the four arterial inputs in the case of long bones. Blood vessels are strategically situated for participation in the coupling of these processes, and blood vessels were found to be intimately connected with trabecular bone, especially at areas of bone resorption. The subchondral regions of long bones are particularly highly vascularized, suggesting high nutrient requirements [10]. Higher rates of bone blood flow are also associated with increased rates of bone remodelling [11]. Compromised blood flow in the subchondral bone, for whatever reason, could be harmful to the bone, but it also has consequences for the integrity of the avascular articular cartilage because of the subchondral bone's likely involvement in supplying nutrients to the avascular articular cartilage.

Bone blood flow and osteocyte viability

Blood flow in the bones serves a variety of purposes. The exchange of oxygen, nutrients, and metabolic waste with bone interstitial fluid, which is critical for osteocytes buried in the bony matrix, is one of them. Osteocytes are the most numerous cells in bone, and their essential ongoing roles in bone health, metabolism, and adaptation to loading are becoming increasingly recognised [12]. Although osteoblasts and osteoclasts play clear roles in episodes of bone remodelling, osteocytes are the most numerous cells in bone. Primarily, osteocytes play an important part in bone mechanosensing, which is mediated by interstitial fluid flow travelling via osteocyte lacunae, which is driven by both mechanical loading of bone and pulsatile blood flow [13].

Synovial Fluid

The synovial membrane is the inner membrane of synovial joints that secretes synovial fluid into the joint cavity. [14] Synovial fluid is a plasma ultrafiltrate that contains proteins taken from blood plasma as well as proteins produced by cells in joint tissues. [15] The fluid contains hyaluronan, which is released by synovial fibroblast-like cells, lubricin, which is secreted by articular cartilage surface chondrocytes, and interstitial fluid, which is filtered from blood plasma. [16] This fluid creates a thin layer (about 50 m) on the cartilage surface and seeps into microcavities and abnormalities in the articular cartilage surface, filling any empty space. [17] The synovial fluid reserve is effectively provided by the fluid in articular cartilage. The synovial fluid retained in the cartilage is mechanically pushed out during movement to keep a coating of fluid on the cartilage surface (so-called weeping lubrication). The functions of the synovial fluid include:

- Nutrient and Waste Transportation — The fluid provides oxygen and nutrients to the chondrocytes in the surrounding cartilage while also removing carbon dioxide and metabolic wastes.
- Molecular Sieving - pressure within the joint forces hyaluronan in the fluid against the synovial membrane forming a barrier against cells migrating into, or fluid migrating out of, the joint space.

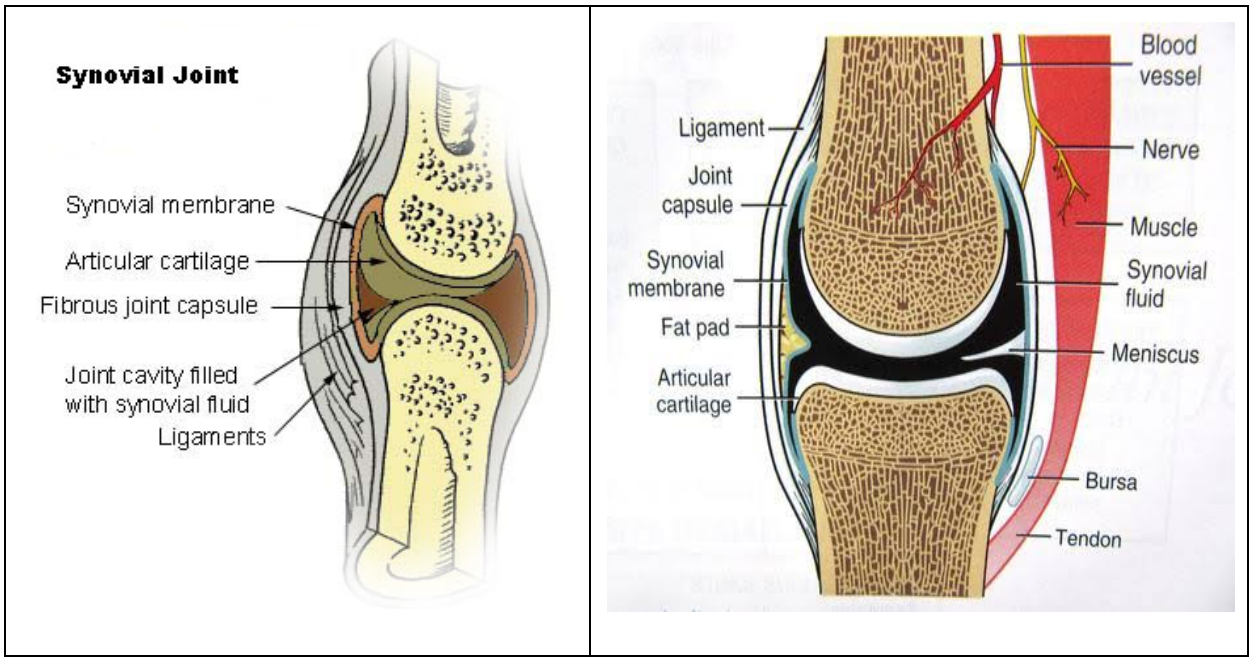

Figure 1.1 Showing Vascularity of Synovial joint

Review of Disease

Osteoarthritis, frequently referred as degenerative joint disease, is a condition that mostly damages cartilage. The slippery tissue that covers the ends of bones in a joint is called cartilage. Bones can glide over each other with healthy cartilage. It also aids in the absorption of movement shock. The top layer of cartilage breaks down and wears away in osteoarthritis. This permits the bones beneath the cartilage to rub against each other. The rubbing produces joint

pain, swelling, and a loss of motion. The joint may lose its typical form over time. Bone spurs may also form on the joint's margins. Broken pieces of bone or cartilage might float inside the joint area, causing extra pain and injury.

Primary (cataplexy) and secondary osteoarthritis are the two forms of osteoarthritis. There is no potential biomarker in idiopathic osteoarthritis, the most prevalent form of the disease. Secondary osteoarthritis is similar to idiopathic osteoarthritis in terms of pathology, but it has an underlying cause.

The coordinated action of osteoclasts and osteoblasts results in bone remodelling. The cause of bone remodelling is unknown, however it appears that these locations are targeted, and the basis for this targeting could be regions of osteocyte viability reduction [18]. The vitality of osteocytes is reduced by ischaemia, and osteocyte death leads to resorption of the dead bone segment has been demonstrated decisively using intravital imaging [19]. Osteocyte hypoxia is rapidly induced by removing mechanical loading from bone and thereby lowering interstitial fluid transport [20-22]. In vitro, serum-depleted osteocytes exhibit a higher rate of apoptosis, which can be partially alleviated by exposing these cells to fluid shear stress [23], which promotes expression of the cell pro-survival protein. As a result, osteocytes can sense mechanical signals in the form of fluid flow and, more significantly, appear to be reliant on fluid flow for survival. Microdamage to the bone matrix has also been demonstrated to cause osteocyte death [18]. In bone, the initial reaction to apoptotic osteocytes appears to be catabolic, with osteoclast precursors rapidly recruited and differentiated.

Relation between osteo-vascular pathology and osteoarthritis

Bone marrow oedema

Insufficient fluid flow surrounding osteocytes owing to any reason, such as limb unloading, venous stasis, or small vessel blockage, can lead to osteocyte death, osteoclast recruitment, and non-viable bone excavation. Repeated instances of this procedure at the ends of damaged long bones may result in changes in bone morphology and remodelling. Avascular necrosis, for example, might result in partial or total collapse of the subchondral bone.[24]

Ischemia from lower blood flow during exercise and reperfusion injury post-exercise would result in bone tissue damage. Bone marrow oedema in individuals with early osteoarthritis cannot be investigated histologically, however various investigations have attempted to connect MRI findings with histology in more advanced illnesses. Patients with end-stage osteoarthritis who underwent knee replacement were more likely than control sites to develop oedema, bone necrosis and trabecular abnormalities in the bone marrow [25]. It appears that bone necrosis and cartilage degeneration are associated with bone marrow oedema, which is an important early correlate of osteoarthritis (OA).

Subchondral Bone Ischaemia

Ischaemia reduces the supply of nutrients and oxygen from the subchondral bone to the overlying articular cartilage. The cartilage's dense subchondral vasculature, as well as the

subchondral mineralization zone's micro-channels, which allow communication between the bone and cartilage. Perfusion from subchondral vessels provides more than 50% of cartilage's glucose, oxygen, and water requirements [26]. There were changes in the chondrocytes of the articular cartilage caused by osteoblasts from osteoarthritis subchondral bone, but not control bone [27]. A communication between bone and cartilage components at the osteo-chondral junction could be important in health and disease.

Dynamics of Leech therapy In Osteo-arthritis

Jalaukavacharana is recommended in Ayurveda for sensitive or weak patients, female patients, elderly or too young patients with *Rakta-Pradoshaj Vikaras* (blood originated diseases). [28] *Vidradhi* (abscess), *Visarpa* (inflammatory skin disorders), *Gulma* (inflammatory condition of the belly), *Pidika*, *Kustha*, *Charmadala* (skin diseases), and other conditions benefit greatly from *Jalaukavacharana*. [29]

Leech therapy is widely utilised in modern medicine to treat a wide range of difficult medical and surgical disorders, including plastic surgery [30], osteoarthritis (Osteoarthritis and Rheumatoid Arthritis) [31-32], venous congestion[33], vascular diseases, and thrombophlebitis, among others.

Table 1: Components Of Leech Saliva That Exert Effects In The Host's Body –

Hirudin	Inhibits blood coagulation by binding to thrombin
Calin	Inhibits blood coagulation and collagen- mediated platelet aggregation
Destabilase	Dissolves fibrin and have thrombolytic effects
Hirustasin	Inhibits kallikrein, trypsin and chymotrypsin
Hyaluronidase	Antibiotic, increases the permeability of the host skin
Tryptase inhibitor	Inhibits proteolytic enzymes of host mast cells
Factor Xa inhibitor	Inhibits the activity of coagulation factor Xa.
Carboxypeptidase' A inhibitors	Increases the inflow of blood at the bite site
Histamine like substances	Vasodilator and increases the inflow of blood at the bite site
Acetylcholine	Vasodilator
Anesthetics substance	Anesthetic, this is equally potent to morphine.
Chloromycetyn	Potent antibiotic.

DISCUSSION

Existing treatments for osteoarthritis of the knee are limited,[34] thus new therapeutic techniques should be sought. As a result of its widespread use throughout medical history[35], leech therapy is not known to be studied in a modern scientific setting.

The observed effects could be explained by a variety of processes. First, aside from the thrombin inhibitor hirudin, several pharmacologically active compounds have been discovered in leech saliva, including histamin-like vasodilators, kallikrein, and tryptase inhibitors, as well as additional proteinase inhibitors and anaesthetics. [36-39] These chemicals may reach deeper tissue zones and possibly the joint area due to the simultaneous activation of another leech saliva component, hyaluronidase[40]. However, it is unclear if pain relief in osteoarthritis requires direct contact with the cartilage and subchondral bone. The many bioactive chemicals found in leech saliva may be just as pharmacologically strong as hirudin, causing significant effects in the periarticular tissue and surrounding structures.

Second, nociceptive activation plays a role in the development of chronic pain. [41] Leech therapy may provide pain relief by acting on antinociceptive receptors. It's improbable that a single reduction in nociceptive input would result in the long-term effects reported, such as enhanced joint function.

Anesthetic chemicals are also found in the saliva of leeches. These compounds most likely aid in the reduction of symptoms such as pain and soreness.

Antiinflammatory chemicals such as bdellins and eglins aid in the reduction of inflammation, resulting in a reduction in joint swelling. When the joint's inflammation goes down, the pain goes down, and the joint's limitation goes down with it.

In addition to hirudin, calin, and destabilase-like chemicals, leech saliva contains hirudin, calin, and destabilase-like substances, which enhance microcirculation by lowering blood viscosity. Corboxypeptidase The influx of blood at the bite site is increased by an inhibitor. Leech saliva also contains histamine-like compounds that serve as a vasodilator. These chemicals present in leech saliva improve microcirculation, reduce inflammation, and reduce stiffness and restriction of joint movement in this way. [42]

Patients' quality of life is improved through leech therapy. Because NSAIDs are the preferred treatment for osteoarthritis, which has numerous negative effects. We can avoid the dangers of analgesic medicines by using leech therapy.

CONCLUSION

In conclusion, traditional leech therapy for osteoarthritis of the knee appears to be a successful symptomatic treatment. The active chemicals in leech saliva, as well as their local release (in the synovial fluid), should be investigated further. No other pharmacologic agent currently has the same long-lasting effects after a single local dose. More research on the anti-inflammatory chemicals found in leech saliva could lead to the development of novel osteoarthritis-treating drugs. We may conclude from the above review study that leech therapy is effective in reducing pain, soreness, stiffness, crepitus, and edoema in osteoarthritis patients.

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