Published online in http://ijam.co.in ISSN No: 0976-5921

*International Journal of Ayurvedic Medicine, Vol 15 (4), 2024; 1104-1109*

# Traditional Therapies for Modern Ailments: Ayurveda in Avascular Necrosis Management

**Case Report**

**Veena Durge[1], Smita Kadu[2*]**

1. PG Scholar, 2. Professor, Department of Kriyasharir, Dr. D. Y. Patil College of Ayurved and Research Center, Dr. D. Y. Patil Vidyapeeth (Deemed to be University) Pimpri, Pune, India.

## Abstract

Avascular necrosis (AVN), also known as osteonecrosis or ischemic bone necrosis, refers to the necrosis of bone tissue resulting from a compromised blood supply. The management of AVN is aimed at preserving structural integrity and functional capacity and alleviating pain. Various surgical interventions, including drilling, bone graft insertion, modified Whitman or Colonna reconstruction, and prosthetic insertion, are commonly employed to address the condition. However, these procedures are associated with high costs and a poor prognosis. The present patient exhibits a constellation of symptoms, including joint pain (*sandhishoola*), muscle wasting (*mansbalkshaya*), insomnia (*aswapna*), and persistent discomfort (*santata ruk*), which are consistent with the diagnosis of *asthimajjagata vata* according to Ayurveda. In the present study, a 45-year-old patient was managed with *Tiktaksheera basti* (medicated enema) and other internal medications. Throughout the treatment course, the patient was monitored for complications, with no adverse events observed. Symptomatic improvements were assessed using a questionnaire that graded signs and symptoms before and after treatment. Conservative management of AVN utilising Ayurvedic principles significantly relieves symptoms, improves the necrotic condition of the femoral head, and enhances quality of life. This case presents a unique opportunity to explore the efficacy and safety of Ayurvedic interventions in the management of bilateral femur AVN, offering valuable insights for future research and clinical practice.

**Keywords:** AVN, Bone necrosis, *Ayurveda, Asthimajjagata Vata, Tiktaksheera Basti.*

## Introduction

Avascular necrosis (AVN), also known as osteonecrosis, is a debilitating condition characterised by the death of bone tissue due to a lack of blood supply. The AVN of the femoral head is also primarily divided into two categories: first, traumatic; second, idiopathic. Because the arteries supplying the femoral head region are so small, damage there could result in a simple dislocation or a subcapital fracture of the femur, which would occur close to the head. (1) This results in the femoral head becoming necrotic. This condition primarily affects the joints, leading to pain, limited mobility, and potential joint collapse if left untreated. Conventional treatments for AVN often involve surgical interventions such as joint replacement or core decompression, which may not always provide satisfactory outcomes and come with their own set of risks and limitations.(2) In recent years, there has been a growing interest in exploring complementary medical approaches to managing AVN. Among these, *Ayurveda* offers a comprehensive framework for understanding the underlying causes of diseases and focuses on personalised interventions aimed at restoring balance to the body, mind, and spirit.

In *Ayurveda*, avascular necrosis (AVN) may be correlated with *Asthi-majjagata Vata* due to its similarity in signs and symptoms. The cause of *asthi-majjagata Vata*, also known as *Vatavyadhi*, is the vitiated *Vata* doṣa that resides in the Asthi and *Majja*. (3) It manifests as *bhedo-asthiparvana*, *sandhishula* (joint pain), *satata ruk*, *mamsabalakshaya*, and *asvapna*, which is associated with symptoms of acute traumatic neural disease. The most effective therapeutic method is to administer *snehana* (oleation) both internally and externally. Internal administration includes *pana* (internal oleation) and *Basti* (Therapeutic enema). External administration is carried out through *abhyanga* (Application of oil to body) with therapeutic oils. (4) Therapeutic enemas, which are given in the form of *saghrita ksheerBasti*, are the precise strategy in painful diseased circumstances of *Basti-vankshana-parshwa-uru-parwa-asthi*. (5) This case report describes an AVN of both hip joints. After a follow-up, the patient's symptoms had improved, and there had also been a regression in the radiographic classification of the illness.

### Patient Information

A 45-year-old male, driver by occupation, presented with complaints of persistent and severe bilateral hip pain even during resting positions, pain in

*** Corresponding Author:**

**Smita Kadu**

Professor, Department of Kriyasharir,
Dr. D. Y. Patil College of Ayurved and Research Center, Dr. D. Y. Patil Vidyapeeth (Deemed to be University) Pimpri, Pune, India.
Email Id: dr.veenamane@gmail.com

groin and difficulty walking. He reported that the pain had been gradually worsening over the past 6 months to 1 year, significantly impacting his quality of life and daily activities. Allopathic medication provided temporary relief, yet the pain persisted and intensified, spreading to the left knee joint with severity. Over the following eight months, the severity of nociceptive pain progressively intensified, leading the patient to seek additional medical evaluation. Imaging studies, including X-rays and magnetic resonance imaging (MRI), revealed characteristic findings consistent with bilateral femur avascular necrosis (AVN). Due to the limited response to modern medicine to alleviate pain and regain functionality of the hips, the patient opted to pursue *Ayurveda* treatment for managing his AVN.

**Patient History**

No any major illness.

Seven years prior, the patient was involved in a road accident resulting in an acetabular injury, which was treated conservatively with the application of a Thomas splint for support.

- Addiction: Patient had a history of long-standing habit of smoking cigarettes. (4-5 cigarettes per day)
- Maternal history: Hypertension
- Paternal history: No any

**Findings**

**General Examination:**

Patient had pulse rate: 78/min, blood pressure: 130/80 mm Hg. Respiratory rate:18/min. Temperature: 97.8$^0$ F.

**Systemic Examination**

The respiratory and cardiovascular systems were within normal limits. Patient was conscious and oriented, During the neurological examination, both lower limb reflexes and sensations were assessed using clinical methods, including the use of a tendon hammer and pinprick. The results indicated normal neurological function. Motor examination also yielded normal findings. Bilateral iliac region and hip tenderness were identified upon palpation. However, an altered gait pattern was observed during ambulation. Furthermore, examination of the range of motion in the bilateral hip joints revealed restricted movements.

***Ashtavidha Parikshan***

*Nadi* (~pulse) was *Vatapittaj, Jivha* (~tongue) was *Sama* (~coated), *Aakriti* was *Madhyam* (~medium built), *Mutra*(~Urine) was *peet*(~Yellow), *Mala*(~stool) was *kathina, Sparsha* was *Ushna.* Bowel habits were irregular. *Druk* (~vision) was normal with correction of refractive error.

***Dashavidha***

Examination showed *Vatapradhan Pittnubandhi Prakruti, Madhyam Sarata, Alpa Satva, Madhyam Samhanan, Madhyam Satmya, Avara Vyayamshakti, Taruna Vaya, Vikruti Vatapitta Pradhan, Abhyavaharan* and *Jaran Shakti* were *Madhyam*.

**Patient's daily routine**

- *Ahara* (diet): Vegetarian as well as non-vegetarian diet (3 times /day), *Sarvarasasatmya*
- *Vihara*: long driving hours
- *Nidra*(sleep): *Prakrut* before the onset of symptoms and disturbed since last 6 months due to hip joint pain.

**Investigations**

AVN of both hip joints showing grade III of the right hip joint and grade II of left hip joint were detected by magnetic resonance imaging.

**Diagnostic Assessment**

Patient was confirmed case of AVN diagnosed by MRI dated on 05/12/2022 (Image 1), shows bilateral Femoral Head Avascular Necrosis (AVN) graded as III on the right femoral head and II on the left femoral head.

**Image 1: MRI report before treatment**

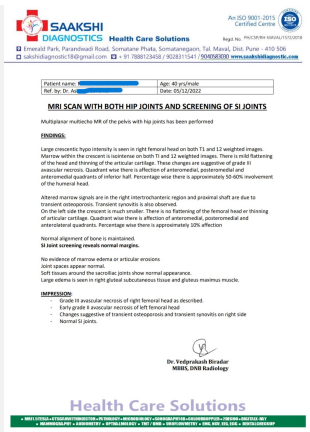
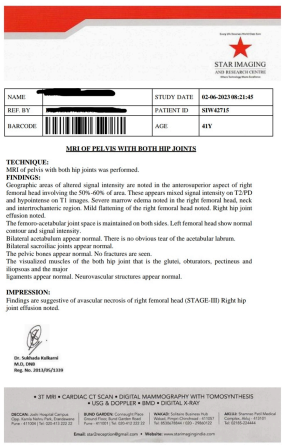



**Image 2: MRI report after treatment**




**Assessment criteria**

A goniometer was used to assess the hip joint's range of motion, including abduction, adduction, extension, flexion, internal rotation, and external rotation. Assessment, has been detailed in Table 1, was conducted employing subjective parameters and criteria, including signs and symptoms.

**Table 1: Assessment criteria for symptoms**

| Sr. No. | Symptom | Criteria | Grade |
|---|---|---|---|
| 1 | Pain | No pain while walking<br>Mild Pain while walking<br>Moderate Pain while walking<br>Severe pain while walking | 0<br>1<br>2<br>3 |
| 2 | Stiffness | No stiffness<br>Stiffness for 10 - 30 min<br>Stiffness for 30 - 60 min<br>Stiffness for more than 1 hr. | 0<br>1<br>2<br>3 |
| 3 | Movement of joints | Normal<br>Mildly restricted<br>Moderately restricted<br>Severely restricted | 0<br>1<br>2<br>3 |

| | | | |
|---|---|---|---|
| 4 | Radiating pain | Pain never radiates<br>Occasionally radiating<br>Mostly radiating<br>Radiating all the time | 0<br>1<br>2<br>3 |
| 5 | Gait | Unchanged<br>Occasionally changed<br>Walk with support<br>Unable to walk | 0<br>1<br>2<br>3 |
| 6 | Sleep | Normal<br>Occasionally disturbed<br>Frequently disturbed<br>Unable to sleep due to pain | 0<br>1<br>2<br>3 |

## Therapeutic intervention

In this patient, there is involvement of *Vata-kapha dosha; rasa, rakta, sira, asthi, and majja* as a *dushya*; *raktavaha, asthivaha, and majjavaha* strotas; along with *asthi-sandhi* as *vyadhi adhisthan* and *vyakta sthan*. The condition was diagnosed as *asthi-majjagata Vata*, and a line of management similar to *Vatavyadhi* was adopted. *Snehana* (oleation), *Swedana* (Fomentation), *Basti* (Therapeutic enema), *Nasya* (Intranasal administration), *Abhyanga* (Application of oil to body), *Utsadana* (specific massage with medicated paste), *Parisheka* (Streaming of medicated liquids for detoxification).are the lines of management for any *Vatavyadhi*. Thus, according to this line of management, *Panchatikta-ksheera Basti* in the form of *Yapana Basti* was administered. For the management of chronic *Vatavyadhi, Rasayana* and *YapanaBasti* are indicated for treatment. Hence, oral medications that have a *Rasayan* (Rejuvenative therapy) effect and an effect on the vitiated *Vatadosha, Asthi* (bone), and *Majja* (bone marrow) were also used.

**Timeline**

**Table 2: Timeline of interventions**

| Date | Treatment | ***Aushadha Sevan Kal* and Dosage** |
|---|---|---|
| Day 1<br>10/12/2022 | **Internal Medications:**<br>1) *Kaishor guggulu* | 500 mg twice a day |
| | 2) *Kokilakshadi churna vati* | 500 mg twice a day |
| | 3) *Ashwagandha ksheerpaka* | 250 mg Twice a day |
| | ***Panchakama*: *Tiktaksheera Basti with Mahatikta ghruta***<br>***Basti* preparation: *5 gm of each Powdered of Vasa, Patol, Nimba, Guduchi, Kantakari (total 25 gm) was added to 400 ml water and heated and reduced to 100 ml elaborate and paraphrase.*** 100 ml of decoction of *Panchatikta kwath* was mixed with the same quantity of milk and heated again to reduce it to 100 ml quantity. 50 ml *Mahatikta Ghrita* were added to this mixture and again stirred to make a homogenous emulsion. Before administering *tiktaksheera Basti*, the patient underwent local *Abhyanga* (Application of oil to body) with *Ashwagandha tailam* and *Mridu Swedana* (Fomentation). After this *Basti* was administered to the patient using 100ml syringe and no.9 simple rubber catheter. | 150 ml for 21 days |
| Day 15<br>25/12/22 | Similar continuation of all medications | Similar dosage and *Aushadha Sevan Kala* (as above) |
| Day 30<br>09/01/23 | Similar continuation of all medications | Similar dosage and *Aushadha Sevan Kala* (as above) |
| Day 45<br>27/01/23 | Similar continuation of all medications as above | Similar dosage and *Aushadha Sevan Kala* (as above) |
| Day 60<br>11/02/23 | Similar continuation of all medications as above | Similar dosage and *Aushadha Sevan Kala* (as above) |
| Day 75<br>26/02/2023 | **Internal Medications:**<br>*Drakshadi ghrita* | 10 ml early in morning for 3 months |

**Outcome and follow up**

Before and after the course of treatment, evaluations were conducted for flexion, extension, abduction, adduction, internal rotation, and external rotation. Table 3 displays improvements in the hip joint's range of motion.

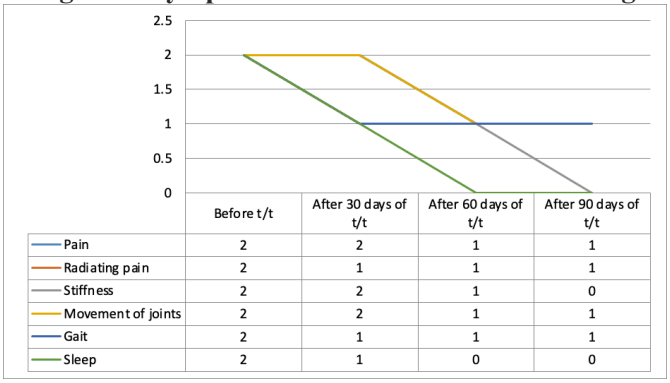
The range of movement in both legs exhibited noticeable changes. However, it was the left leg that showed remarkable improvement in all its movements.

Notably, the avascular necrosis in the left leg completely reversed, improving from grade 2 to grade 0 (image 2). In contrast, the right leg exhibited no noticeable improvement. This lack of progress in the right leg can be attributed to the patient not adhering to *nidanaparivarjana* (Avoidance of etiological factors), as he continued to drive load bearing vehicles regularly. The persistent and significant use of the right leg while driving likely impeded its recovery. Hence, improvement of left leg is presented below. The symptoms of pain, stiffness etc. were assessed by using various gradation has been shown in figure 1 for left leg.

**Table 3: Joint ranges in the bilateral hip joints in the event of avascular necrosis**

| Range of movement | | Before t/t (in degree) | After t/t (in degree) |
|---|---|---|---|
| Flexion | Right leg<br>Left leg | 50<br>60 | 56<br>80 |
| Extension | Right leg<br>Left leg | 34<br>40 | 42<br>52 |
| Abduction | Right leg<br>Left leg | 10<br>12 | 12<br>20 |
| Adduction | Right leg<br>Left leg | 30<br>48 | 34<br>48 |
| Internal rotation | Right leg<br>Left leg | 35<br>42 | 37<br>46 |
| External rotation | Right leg<br>Left leg | 30<br>36 | 34<br>40 |

**Figure 1: symptoms assessment chart for left leg**




## Discussion

Avascular necrosis, identified interchangeably as ischemic bone necrosis, aseptic necrosis, or osteonecrosis, manifests as the degeneration of bone tissue consequent to compromised blood flow. Modern medical strategies for AVN management predominantly revolve around pain mitigation and surgical interventions like joint replacement. In cases of avascular necrosis (AVN) affecting the femoral head, reduced blood supply is attributed to two primary factors: *Margavarodha*, which refers to the occlusion of blood vessels, and *Abhighata,* indicative of trauma. These conditions lead to the eventual necrosis of bone tissue. Furthermore, both *Margavarodha* and *Abhighata* contribute to the exacerbation and elevation of *Vata Dosha*, culminating in the depletion of *Asthi Dhatu.*

In the present patient, there is a history of *abhighata* leading to vitiation of *Vata* and *rakta*. Additionally, there is a history of a long-standing habit of smoking cigarettes. (4-5 cigarettes per day) aggravated the pathology. As the major vitiation of *Vata dosha Basti* emerges as a preferred treatment option for AVN within the spectrum of *panchakama* therapies, given its primary role in addressing *Vata dosha* imbalance (6), Additionally, *Basti therapy* offers ancillary benefits by ameliorating disturbances in *Pitta, Kapha*, and *Rakta Dosha*. (7) *Panchatiktaksheera Basti* was preferred with *mahatikta ghruta*. Avascular necrosis (AVN) primarily affects the blood (*Rakta*), bone (*Asthi*), and bone marrow (*Majja)* tissues. The therapeutic approach for *Asthimajjagata Vata* disorder often involves *Snehan*, whether administered internally or externally, to alleviate symptoms associated with this condition. In the case of patients with *Asthimajjagata Vata, Panchtiktakshir Basti* therapy is often prescribed. Basti was prepared as *Kshirbasti*, utilizing milk and various *Tikta* (bitter) [D18] *rasa* herbs, which are specifically recommended by *Acharya Charaka* for conditions affecting the bones (*asthigata vyadhis*). No adverse effects, including *Vata* aggravation commonly linked with *Niruha Basti*, were observed in this case. This absence of *Vataprakopa* can be attributed to the *Basti* formulation, which incorporated *Kshira* (milk) and *Sneha* (oil) in it. These ingredients possess *Vata*-pacifying properties, mitigating the potential for Vata imbalance typically associated with a standard *Niruha Basti* procedure. The Basti formulation was administered in a low volume, analogous to Matra Basti, as the patient was *alpa bala*. Remarkably, the symptoms were reduced accomplished with a minimal dose, eliminating the need to increase the quantity of Basti throughout the treatment. No any *vyapad* was observed. The body absorbed the maximum amount of Basti, and the *pratyagaman kala* for remaining amount of *Basti* was approximately 4-6 hrs. This therapy utilises ingredients such as *Tikta rasa, Katu Vipaka* and *Ushna Virya*, which collectively enhance the properties of Majja and aid in rebalancing the aggravated *Vata* Dosha while promoting normal *Dhatvagni* (Metabolic factors located in structural components) function to support increased nutrition delivery to the *Asthi Dhatu. Panchtiktakshir Basti* serves as the primary *Sneha*, and the *Tikta Dravyas* contribute to normal *Dhatwagni* function, ultimately facilitating enhanced nutrition to the bony tissue. Consequently, this treatment approach mitigates *Vata* imbalances and optimises tissue metabolism. Both *Snehan* and *Swedan* therapies are integral components of the treatment regimen for *Vata* Vyadhi. (8) Before *Basti*, local *snehan* was done with *ashwagandha* tail, as *ashwagandha* oil is recommended for *Raktagata Vata*, *Vata vikara*, *Mansavardhana*, and *Raktapitta*.

*Kaishor guggulu* has blood-purifying properties; it contains all the *tikta rasa dravya*, which help in *deepan* and *pachan*. *Kaishora guggulu* is indicated in *Vataja* illnesses and, with prolonged use, can be used to treat all diseases. Since *Kaishora guggulu* can stop the *Jara* process—the ageing-related tissue deterioration it might affect AVN

Due to its *Rasayana* and *Bruhana* qualities, *ashwagandha (Withania somnifera*) is beneficial for all forms of *Dhatukshya*. On bone tissue, it is also said to have anabolic effects. (9) *Ashwagandha* has *madhura, tikta rasa, madhura vipaka*, and *sheeta veerya*, which are beneficial for bone health. It's administered in the form of ksheerpaka. As there is much research on milk, it acts on bones by reestablishing bone homeostasis via the regulation of the growth hormone/IGF-1 axis, the calcium-vitamin D-PTH axis, and the bone remodelling rate. Milk consumption may raise the chance of preventing bone loss.

*Kokilakshadi churna* described in *Baishajyaratnavali* has content of *kokilaksha, guduchi*, and *pippali*. (10) According to previously published studies, *Hygrophila auriculata*, a powerful plant in *Ayurveda*, has proven effective in treating *Raktadushti*, along with *shoolahara, shopahara,* and *Vatashamaka* properties. This herb, with its *rasa* of Madhura (sweet) and *Tikta* (bitter), its *Madhura Vipaka* (sweet post-digestive state), and its *Shita Virya* (cool potency), has several medicinal uses that are good for blood purification and balancing. The cooling and detoxifying properties of *Tikta Rasa* and *Shita Virya* are vital for the treatment of inflammatory and toxic circulatory diseases. *Tinospora cordifolia* possesses *katu, tikta rasa*, and *madhura vipaka*. It is said to be a potent drug in *rakta* and *asthi* majjagata dushti. It has potent anti-inflammatory action. It raises local lymphatic and blood flow, which raises the metabolism of surrounding tissue. By increasing the release of certain inflammatory mediators, such as histamine, etc., it lowers inflammation. It relieves local stiffness with the physical impact of warmth, relieving pain. (11) *Pippali* is a *deepan* and *rasayan* drug. Piperine present in it increases the number of collagenous fibres in the matrix of bone tissue and areas of regeneration for stronger bones. (12) *Piper longum* has anti-inflammatory, analgesic, and anti-osteoporotic effects useful in AVN. (13)

After this treatment, the patient had relief from all the symptoms, but the *rasyana chikitsa drakshadi ghruta* was administered for the next three months. In avascular necrosis (AVN), there is a disruption in the blood supply to the femoral head. Since the *sira* (veins) and *kandara* (tendons) are considered the *upadhatu* (Supportive structural components) of *rakta dhatu* (blood), it is essential to use drugs that are *madhura* (sweet), *sheeta* (cooling), and *brihan* (nourishing) as *rasayana* (Rejuvenation and revitalization) for the nourishment of *raktavahi sira*. Consequently, *Draksha Ghrita* is administered to ensure the nourishment of local structures and the prevention of disease relapse.

The outcomes of this case illustrate significant improvements in pain reduction, moderate to good joint functionality, indicating restored mobility and reduced pain and stiffness levels, showing improvement in patient quality of life through an *Ayurveda* approach to avascular necrosis (AVN) management. Internal administration of medicines and specialized *Panchakarma* procedures, align with *Ayurveda* principles aimed at enhancing tissue regeneration, improving blood circulation, and restoring balance in bone tissue as above discussed probable mode of action of drugs.

The intervention also involved monitoring with MRI imaging to assess structural changes within the femoral head in reference with grades of AVN. Baseline and follow-up imaging documented the therapeutic progression, illustrating reduced symptomology and improved functional outcomes. The integration of these standard diagnostic tools in an *Ayurveda* treatment context offers a bridge between traditional and contemporary medical assessments, allowing for more thorough tracking of structural and symptomatic improvements.

Comparatively, studies by Gupta and Srivastava (2023) (14) observed similar improvements in patients with AVN, noting pain reduction and improved range of motion with *Panchakarma* therapy, particularly in patients treated with combined *Basti* treatments (e.g., *Vaitaran* and *Anuvasan Basti*), which target *Vata dosha* imbalances commonly seen in AVN. This aligns with *Acharya Charaka*'s emphasis on *Basti* as the primary therapy for *Vata* disorders, as it nourishes and restores functions of *Asthi dhatu* by addressing both localized and systemic dosha imbalances.

In addition, Verma et al. (2023) (15) reported sustained improvements in pain, joint function, and vascular flow in the femoral head when using *Panchatikta Ksheera Basti* in combination with *Panchakarma*, reinforcing its role as a beneficial, minimally invasive intervention for AVN. By comparing these findings, our case illustrates a potentially significant approach for AVN management, contributing evidence for the efficacy of *Ayurveda* in cases where standard care might favour surgical intervention or more invasive methods.

**Patient consent**

The patient was provided with informed consent in structured format. He was given a thorough explanation of consent, along with the advantages and disadvantages of the trial, and he willingly signed it and given consent to publish this article.

## Conclusion

One of the biggest therapeutic challenges in orthopaedics is femoral head avascular necrosis (AVN). The effectiveness of *Basti*, or medicated enema, and *Ayurveda* formulations in the treatment of AVN has been studied in this study. This case study delves into the journey of a patient diagnosed with AVN who opted for *Ayurveda* treatment. Through a comprehensive analysis of the patient's journey, including clinical outcomes, subjective experiences, and qualitative insights, this case study endeavours to provide valuable insights into the feasibility, safety, and effectiveness of *Ayurveda* interventions in the treatment of AVN. While the preliminary results are encouraging, rigorous, large-scale clinical trials are essential to substantiate these findings and elucidate mechanisms.

## References

1. Meena RL, Bhatted S, Dharmarajan P, Meena N, Kumar J, Nirmal H. Management of Avascular Necrosis through *Ayurveda* - A Case Study. J Res Tradit Med. 2017.
2. Lohiya A Jr, Dhaniwala N, Dudhekar U, Goyal S, Patel SK. A Comprehensive Review of Treatment Strategies for Early Avascular Necrosis. Cureus. 2023 Dec 14;15(12):e50510. doi: 10.7759/cureus.50510. PMID: 38226130; PMCID: PMC10788237.

3. Trikramji AJ, editor. Charaka Samhita. 5th ed. Chikitsasthana, 28th Adhyaya, 33rd verse. Varanasi: Chaukhambha Sanskrit Sansthan; 2006. p. 617.
4. Trikramji AJ, editor. Charaka Samhita. 5th ed. 2006. Chikitsasthana, 28th Adhyaya, 93rd verse. Varanasi: Chaukhambha Sanskrit Sansthan; p. 621.
5. Trikramji AJ, editor. Charaka Samhita. 5th ed. Chikitsasthana, 29th Adhyaya, 88th and 89th verse. Varanasi: Chaukhambha Sanskrit Sansthan; 2006. p. 631.
6. Tripathi B, editor. Astangharadyam. Sutra Sthana, Chapter 1, Verse 25-26. Delhi: Chaukambha Pratishthan; 2007. p. 20.
7. Shastri KA, editor. Susruta Samhita. Chikitsa Sathana, Chapter 35, Verse 6. 2012 ed. Varanasi: Chaukambha Sanskrit Series Publication; 2012. p. 189.
8. Kushwaha HCS, editor. Charaka Samhita. 28th Adhyaya, 75-78th verse. Chikitsasthana. 1st ed. Varanasi: Chaukhambha Sanskrit Sansthan; reprinted 2018. p. 745.
9. Khedgikar V, Kushwaha P, Gautam J, Verma A, Changkija B, Kumar A, et al. A proteasomal inhibitor promotes healing after injury and exerts anabolic effect on osteoporotic bone. Cell Death Dis. 2013 Aug 22;4(8):e778. doi: 10.1038/cddis.2013.294.\
10. Vaidya L. Baishajyratnavali by govindadas. chapter *Vata*raktadhikara, ver.16; Reprint edition Delhi:Motilal banarasidas. 2016,. Pg.369
11. Kumari A, Gunjan, Singh CB, Gaurav. A classical review on Guduchi Taila. J *Ayurveda* Integr Med Sci. 2023;8(10):160-3. doi: 10.21760/jaims.8.10.24.
12. Millennium Herbal Care. Pippali (Piper longum) [Internet]. Available from: https://www.millenniumherbal.com/pages/pippali-piper-longum-1.
13. Yadav V, Chatterjee SS, Majeed M, Kumar V. Preventive potentials of piperlongumine and a Piper longum extract against stress responses and pain. J Tradit Complement Med. 2016; 6:413-23. doi: 10.1016/j.jtcme.2015.11.001.
14. Gupta S, Srivastava S. An *Ayurveda* approach for the management of Avascular Necrosis (AVN) - A Case Study. J *Ayurveda* Integr Med Sci. 2023;8(5):265-270. doi:10.21760/jaims.8.5.46
15. Verma A, et al. *Ayurveda* management of femoral head of avascular necrosis with panchtiktaksheer majja *Basti* and mahamanjishthadi ghan vati: a case study. Int *Ayurveda* Med J. 2023;11(10):2609-2614. doi:10.46607/iamj3511102023

*****