ijlpr 2023; doi 10.22376/ijlpr.2023.13.1.L218-223

International Journal of Life science and Pharma Research

ISSN 2250-0480

Case Report

Check for updates

Avascular Necrosis Through Ayurveda Perspective - A Case Report

Dr. Aman Chhabra[1*], Dr. Vaishali Kuchewar[2] and Dr. Twinkle Joshi[3]

[1]*PG Scholar, Department of Kayachikitsa, Mahatma Gandhi Ayurved College Hospital and Research Centre, Salad (H), DMIMS Wardha.*

[2]*Professor and HOD, Department of Kayachikitsa, Mahatma Gandhi Ayurved College Hospital and Research Centre, Salad (H), DMIMS Wardha.*

[3]*PG Scholar, Department of Kayachikitsa, Mahatma Gandhi Ayurved College Hospital and Research Centre, Salad (H), DMIMS Wardha.*

Abstract: Avascular necrosis is a pathological condition caused by a limitation in the microcirculation of the bone, causing its necrosis. Avascular necrosis (AVN)of the hip is a common condition that creates complex symptoms characterized by pain, impaired function, and structural breakdown. According to Ayurveda, it can be correlated with *AsthimajjagatVata*, which occurs due to the *Akshaya*(destruction)of *Asthi* and *Majjadhatus*. The present case report is of a 32-years old male patient diagnosed with Avascular necrosis of StageIII of the right hip and Stage II of the left hip as per Ficat and Arlet's classification of Avascular necrosis. He complained of pain in both hips, associated with the inability to walk a short distance and difficulty sitting without back support. The patient was treated considering the involvement of Vata dosha, Asthi-majjadhatu, and raktavahastrotodushti. The treatment protocol adopted in modern medicine for the management of Avascular necrosis is corticosteroids and hip replacement surgery. Hence, there is a need to encourage classical Ayurveda modalities like *Shodhan* and *Shaman* to manage Avascular necrosis. The main aim of this study is to assess the effectiveness of classical Ayurveda remedies in managing *Asthimajjagat Vata* in a patient with Avascular necrosis. In this case, the treatment was planned considering the predominant involvement of Vata dosha, Asthi & Majjadhatu, and Strotorodha. He was treated by applying the treatment principles of *Asthi-majjagatkshaya* caused due to *Margavrodhjanya Vataprakopa.* This case is being reported because it shows how combining the *Ayurveda principles of Shodhan* and *Shaman* was used. As a result, it significantly improved hip joints' walking, sitting, and movement. This case may motivate Ayurveda researchers to work on AVN.

Keywords: Avascular Necrosis, Asthimajjavrutavata, Microcirculation, Ayurveda Modalities, Shodhan, and Shaman

***Corresponding Author**

Dr. Aman Chhabra , 1PG Scholar, Department of Kayachikitsa, Mahatma Gandhi Ayurved College Hospital and Research Centre, Salad (H), DMIMS Wardha.

Received On 19 September, 2022
Revised On 16 November, 2022
Accepted On 29 November, 2022
Published On 2 January, 2023

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Dr. Aman Chhabra, Dr. Vaishali Kuchewar and Dr. Twinkle Joshi , Avascular Necrosis Through Ayurveda Perspective - A Case Report.(2023).Int. J. Life Sci. Pharma Res.13(1), L218-223 http://dx.doi.org/10.22376/ijlpr.2023.13.1.L218-223

1. INTRODUCTION

Avascular necrosis (AVN) is a condition caused due to occlusion of blood supply to the bones. It is also called Osteonecrosis[1]. It commonly affects people in their third to fifth decade of life[2]. AVN is a pathological condition caused by a limitation in the microcirculation to the femoral head's subchondral bone. This causes osteocyte destruction and eventual collapse. Avascular necrosis is a devastating disease that requires healthcare providers to be on the lookout for signs and symptoms. So, early diagnosis, prognosis, and treatment of the condition become necessary. The pathology of it is not yet clear, but various traumatic and non-traumatic causes are assumed with interferes with the blood supply of bone. In India, we see about 16,000 new cases of avascular necrosis every year, which eventually will require total hip replacement surgery at some point in time[3]. Most non-traumatic etiologies, more than 80%, involve chronic steroid usage and excessive alcohol intake. The second most frequent cause of avascular necrosis overall, after trauma, is steroid-associated avascular necrosis. Although there is evidence linking steroid use to avascular necrosis, the precise etiology is unclear and probably complex[4]. Fat emboli, fat cell hypertrophy that raises intraosseous pressure, endothelial dysfunction, hyperlipidemia, and abnormalities of the bone marrow's stem cell pool are just a few of the causes that may be to blame for the ischemia and eventual necrosis[5]. Alcohol-induced Avascular necrosis is also poorly defined, but it most likely results from variations in serum lipid levels, bone marrow fat cell growth and hypertrophy, blood vessel obstruction, elevated intraosseous pressure, and a subsequent lack of perfusion[6]. Avascular necrosis is frequently triggered by sickle cell illness. The femoral head is the most typical region of avascular necrosis in such cases[7]. Ischemia and bone infarction are caused by deformed and complex red blood cells obstructing blood flow. Avascular necrosis of the femoral head is widely documented to be linked to autoimmune and chronic inflammatory diseases, such as systemic lupus erythematosus (SLE)[8]. Although there have been reports of cases in individuals who are steroid naive[9], long-term steroid therapy is typically blamed for the condition's risk of development in these patients. In Ayurveda, there is no direct correlation between any diseases with Avascular necrosis, but *AsthimajjagatVata*, described under *Vatavyadhi*, can be correlated with it. According to Ayurveda, *Asthi* and *MajjavahaSrotodushti* may be caused due to *Abhighat* (Trauma) and *Margavrodh* (Thrombotic occlusion), which may cause local *Asthi-majja Kshaya*. Avascular necrosis is considered a debilitating disease. In modern medicine, no safe therapeutic measure is adopted. The treatment protocol adopted in modern medicine for the management of Avascular necrosis is corticosteroids and hip replacement surgery. Hence, there is a need to encourage classical Ayurveda modalities like *Shodhan* and *Shaman*in in the direction of Avascular necrosis. Therefore, this case has been reported. The main aim of this study is to assess the effectiveness of classical Ayurveda remedies in the management of *AsthimajjagatVata* in patients with Avascular necrosis.

2. CASE REPORT

A 32-year-old male patient, working as a sweeper in a hospital visited the outpatient department of Mahatma Gandhi Ayurveda College Hospital and Research Centre in November 2021, with pain in both hips since 2019. He could walk a short distance but needed a rest after it. He had difficulty sitting; he could not sit without back support.

2.1 Past History

According to the patient, he was asymptomatic 3 years back. On taking his history, he said he had taken some medicine for 2 months from a local doctor to gain body weight. Gradually he started experiencing mild pain in both hips because he took different painkillers frequently from the pharmacy. After some time, his pain got aggravated. Hence, he was advised for an MRI of both hips. The MRI showed AVN of Left hip FICAT stage III and right hip FICAT stage II. He had advised hip replacement, but he was not willing, so he opted for Ayurvedic treatment. Therefore, he visited the hospital for further management. He didn't have a history of any addiction.

2.2 Family History

The patient did not have any relevant family history.

2.3 Examination of Patient

2.3.1 General Examination

1. Pulse:- 76/min, regular
2. BP:- 130/80 mmHg
3. RR:- 18/min
4. Temperature: - 98.8 F

2.3.2 Specific Examination (Locomotor System Examination)

1. Inspection:- No local swelling or scar marks were observed.
2. Palpation:- No tenderness or local rise in temperature observed.
3. Range of Movement:- There was restricted movement of both hips

2.3.3 Hematological Investigations Were Within Normal Limits.

MRI Pelvis (dated 1/11/2021):- Showed bilateral avascular necrosis. The right and left hip stages were FICAT stage III and stage II respectively.

Following is the examination of the patient on Ayurveda parameters (Table no. 1,2)

Table 1: *Aaturbala Praman Pariksha* (*Dashavidha pariksha*)

Sr. No.	Examination	Observation
1.	*Prakruti*(Constitution of the patient)	*Vata-pitta*
2.	*Vikruti (Pathological variations)*	*Vatadosha, Asthi*and*Majjadhatu, Strotorodha*
3.	*Sara* (Quality of tissues)	*Madhyam*(Average)
4.	Samhain (Built of the body)	*Madhyam*(Average)
5.	*Praman*(Anthropometric measurements)	Weight: 50 kg, Height: 183 cm, BMI: 22.2 kg/m^2
6.	*Satmya*(Adaptability)	*Madhyam*(Average)

7.	*Satva*(Mental Strength)	*Madhyam*(Average)
8.	*Aahar Shakti* (Food intake and digestion capacity)	*Madhyam*(Average)
9.	*Vyayam Shakti* (Exercise capacity)	*Avar* (poor)
10.	*Vaya*(Stage of age)	*YuvaAvastha*(Young stage)

Table 1 Illustrates the *Aaturbala Praman Pariksha* (*Dashavidha pariksha*), which assess the physical as well as mental strength of the patient. The physical strength comprises the *Prakruti* (Constitution of the patient), *Vikruti (*Pathological variations), *Sara* (Quality of tissues), *Samhanan* (Built of the body), *Praman* (Anthropometric measurements), *Satmya* (Adaptability), *Aahar Shakti* (Food intake capacity), *Vyayam Shakti* (Exercise capacity), *Vaya* (Stage of age) and mental strength comprises the *Satva* (Mental Strength) of the patient.

Table 2: *Asthavidha Pariksha* (Eight folds of examination)

Sr. No.	Examination	Observation
1.	Naadi(Pulse rate)	74 beats/minute, Regular, Vata-Pitta
2.	Mutra*(*Frequency of micturition*)*	2-3 times a day, *Samyak*
3.	Mala*(*Bowel*)*	Miriam
4.	Jiva(Tongue)	Miriam
5.	Shabda(Speech*)*	Spashta
6.	Sparsha*(*Touch*)*	Anushnasheeta
7.	Druka*(*Vision*)*	Prakrita
8.	Akruti(Body built*)*	*Krusha*

Table 2 Illustrates the *Asthavidha Pariksha* (Eight folds of examination), which acts as a tool for the practical clinical assessment and diagnosis of the diseased condition. It is a part of *Rogi Pariksha* (analysis of the patient) very precisely, in which the patient's *Naadi* (Pulse rate), *Mutra* (Frequency of micturition), *Mala* (Bowel habit), *Jivha* (Tongue), *Shabda* (Speech), *Sparsha* (Touch), *Druka* (Vision) and *Akruti* (Body built) is examined.

2.4 Assessment Parameters

1. Pain assessment - The pain was assessed using numerical pain distress scale[10] (Figure 1)

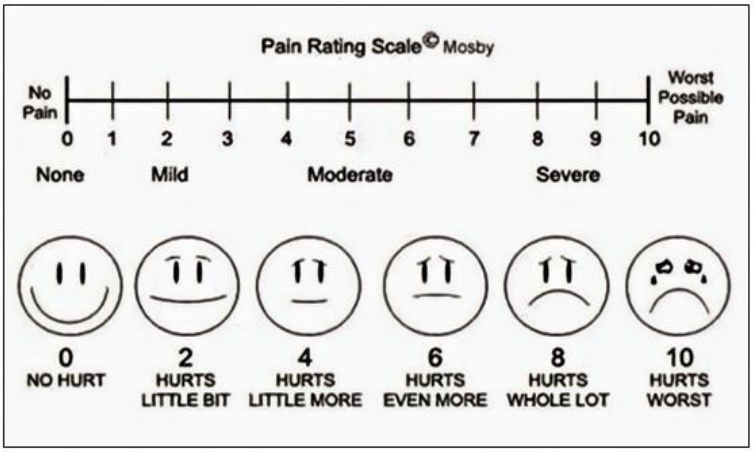

Fig 1: Numerical Pain Distress Scale

2. Range of motion of both hip joints– By Straight Leg Raising Test& the time taken for hip joint flexion, and distance between both legs after the abduction of the hip joint up to his total capacity.

- Following were the observations on the assessment of the patient (Table 3)

Table 3: Observations of Assessment parameters

Sr. No.	Heads	Right leg	Left leg
1	**Pain assessment score (3/11/2021)**	**6**	**6**
2	Straight leg raising test (3/11/2021)	70 degrees	70 degrees
3	Flexion time (The patient was asked to flex the hip joint up to his total capacity, and the time taken for flexion of the hip joint was assessed by a stopwatch for both legs separately) (3/11/2021)	6 seconds	14 seconds
4	Distance between both legs (Distance between both legs was assessed using the measuring tape by asking the patient to abduct each hip joint to the maximum having the other leg straight (3/11/2021)	65 cm	66 cm

Table 3 illustrates the Observations of Assessment parameters in the patient on the day of admission (3/11/2021) just before starting the treatment. The patient's overall condition was assessed in the right leg and the left leg. The assessment parameters used were Pain assessment score with the help of a Numerical pain distress scale, Straight Leg Raising test, Flexion time with the help of a stopwatch, and distance between both legs using a measuring tape.

2.5 Treatment

Following treatment was planned considering predominant involvement of *Vatadosha*, *Asthi* & *Majjadhatu* and *Strotorodha*. He was admitted for some Ayurveda procedures.

2.6 Management

The patient was advised to admit to the hospital for Ayurvedic therapeutic procedures. He was treated by applying the treatment principles of *Asthi-majjagatkshaya* caused due to *MargavrodhjanyaVata prakopa*[11] (Table 4).

Table 4: Illustrates the Treatment plan of 15 days (Duration -3/11/2021 to 18/11/2021)

Treatment Principle	Oral medications	Other treatment
Bruhan Treatment for *Asthi-majjadhatukshay* *Strotoshodhan* to eliminate *Margavarodha* (blockage of channels) and to improve local blood circulation	3/11/2021 to 18/11/2021-Panchtikta Ghruta- 20 mL once a day with lukewarm water on an empty stomach for 15 days 3/11/2021 to 18/11/2021-Tablet Asthiposhak 1 tablet twice a day after a meal for 15 days 3/11/2021 to 18/11/2021-KaishorGuggul (Dhutpapeshwar)-500 mg twice a day after meals for 15 days 3/11/2021 to 18/11/2021-*Sarivadyasava*20 ml twice a day after meal for 15 days 3/11/2021 to 18/11/2021-Shiv Gutika (Amruta) 500 mg twice a day after meal for 15 days	3/11/2021 to 18/11/2021-*MruduSnehan* (light massage) with & Sweden(fomentation) with Shashti ShaliPindaSwedafor 15 days 3/11/2021 to 18/11/2021- MatraBasti (Medicated enema) with Dashmool Tail -30 mL and Ksheerbala Tail-30 mL was administered every day for continuous 15 days. The average period of BastiPratyagamanKaal (Time of outflow of medicine) was 6-12 hours. No complications were observed during this period. 3/11/2021 to 18/11/2021-*Shigru* and *NirgundiPatrapottli*at lumbar, hip, and thigh region at night for 15 days

Table 4 Illustrates the Treatment plan of 15 days (Duration - 3/11/2021 to 18/11/2021), in which Shodhan therapy and Shaman therapy was employed. Shodhan therapy in the form of Mrudu Snehan (light massage), Sweden (fomentation) with Shashti ShaliPindaSweda for 15 days, 3/11/2021 to 18/11/2021, MatraBasti (Medicated enema) with Dashmool Tail -30 mL and Ksheerbala Tail-30 mL and Shigru and Nirgundi Patra Pottli Sweda at night. Also, Shaman therapy in the form of medications, which, mainly acts as Bruhan and Srotoshodhak.

3. OBSERVATIONS AND RESULTS

Fig 2: Administration of *Shashti-Shali Pinda Sweda*

- Following were the clinical observations after the completion of 15 days of treatment (Table 5 Outcome and Follow-up)

Table 5: Clinical observations and results

Sr. No.	Findings	Before treatment (3/11/2021)		After treatment (18/11/2021)	
1	Sitting capacity	Unable to sit without back support		Can sit comfortably without back support	
2	Pain gradation	6		4	
		Right	**Left**	**Right**	**Left**
3	Straight leg raising test	70 degrees	70 degrees	90 degrees	90 degrees
4	Flexion time	6 seconds	14 seconds	Less than 1 second	Less than 1 second
5	Distance between both legs	65 cm	66cm	90 cm	96 cm

Table 5 Illustrates the clinical observations and results before the start of treatment (3/11/2021) and after the completion of 15 days of treatment (18/11/2021). The assessment parameters as mentioned before were observed during treatment, and the observations are illustrated in the table. After the completion of 15 days of treatment, the sitting capacity of the patient was improved to such an extent that the patient was unable to sit without back support before the treatment. Still, after completing the treatment, he can sit comfortably without back support. According to the Numerical pain distress scale, the gradation of pain was reduced to 4, which was 6 initially before the treatment started. Also, the angle for the straight leg raising test improved significantly, from 70 degrees in both legs initially to 90 degrees after completion of the treatment. Flexion time was reduced from 6 seconds to less than 1 second in the right leg and 14 seconds to less than 1 second in the left leg. The distance between both legs also increased from 65 cm to 90 cm on the right side and from 66 cm to 96 cm on the left side.

4. DISCUSSION

The primary pathophysiology of Avascular necrosis is lack of blood supply to the femoral head due to various factors like smoking, long-term use of steroids, trauma, etc. In this patient, there was no such history of smoking, trauma, or alcohol abuse, but there was a history of medicine consumption for weight gain, which may contain steroids. This case report is critical because it emphasizes the use of classical Ayurveda remedies in the form of *Shodhan* and *Shaman* mode of treatment, thereby reducing the use of harmful corticosteroids and the risk of complications that may arise in hip replacement surgeries. According to Ayurveda, Avascular necrosis can be correlated with *Asthi-majjadhatukshaya*. Hence, this patient is treated with medicines and some procedures to remove the *margavrodh* and improve blood circulation. With this, *Bruhan* of *Asthi* and *Majjadhatu* was also given. *Snehana* (oleation) and *Swedana* (sudation) are first-line treatments for managing *Vata Vyadhi*[12]. *Snehan* is recommended for *AsthimajjagataVata* regardless given internal or externally[13].*Swedana* aids in easing the rigidity and stress over the joints and bones[14]. Therefore, Local (lumbar, hips, and lower limbs) oleation and sudation were given. It helps to remove waste products by increasing local blood flow and assisting venous blood drainage. *Sweden* produces local heat, which increases localized vascular and lymphatic perfusion and microvasculature metabolism[15]. *Shashlik-Shali Pinda Sweda* provides both medicine and heat. Moist heat therapy is believed to be more effective at heating tissues than dry heat because milk and water transfer heat faster than air[16]. Skin becomes more permeable through *Swedana*, helping absorb the medicine. *Shilajeet* as the main ingredient in *Shiva Gutika* act as *strotoshodhak* (cleansing the microchannels). It also enhances the absorption of other phytochemicals[17]. It also helps in the early recovery of degenerated muscles, bones, and neural systems[18]. *Kaishorguggul* and *Sarivadyasava* were given as *Shothahara* (edema-reducing), *raktaprasadana* (increasing circulation), and *Rasayana* (rejuvenation) properties. *Sariva* (*Hemidesmusindicus*) was shown to have the most muscular antiosteoclastic action without being toxic to osteogenic precursors in one investigation[19]. *PanchatiktaGhruta* was given to strengthen *asthidhatu* (bony tissue). *Tiktarasa* predominantly contains Vayu and Akashmahabhuta. As a result, it is attracted to the body elements with the same *mahabhautikatva* as *Asthidhatu* (bony). *Ghrita* (ghee) is agnivardhaka (increases body strength as well as metabolism), *vatashamaka* (Vata pacifier), and *balya* (increases body strength). Hence, this balances *Vata* and rejuvenates the body. *Ghrita* has the properties of *sanskarasyaanuvartana* causing an increase in the bioavailability of other drugs[20]. Thus, it aids in the breakdown of *asthimajjagatavata* pathology. Tab. Asthiposhak of Dhutpapeshwar pharmaceuticals contains Kukkutandatvakbhasma 100 mg, Asthisamhruta 100 mg, Arjuna 50 mg, ShuddhaLaksha 50 mg, Amalaki 50 mg, Ashwagandha 50 mg, Guduchi 50 mg, Shuddha Guggul 50 mg, Bala 50 mg, and BabboolaKwathq.s. as active ingredients, which was given to provide strength to the bones. Acharaya Gangadhar mentioned administration of *Basti* for the vitiated *Vata* below *Nabhi Pradesh* (Umbilical region)[21]. *Matrabasti* and other beneficial enemas have a hypo-osmotic solution, promoting blood absorption. Since every cell and tissue in the body is interconnected, the removal of *basti* of the morbid contents of the large intestine will undoubtedly have a good effect on every other system and aid in sustaining overall health. By better comprehending the connections between the gut's brain and the central nervous system, neuro gastroenterology enables us to examine the systemic effects of *Basti*. The cleansing effect of *Basti* is connected to how well disease-causing toxins can be excreted into the colon, where they may then be eliminated[22]. The main ingredient in KshiraBalaTaila, Bala, is a powerful neuroprotective herb that reduces pain, nerve irritation, and muscular stiffness. It is beneficial in *Asthikshay*[23]. *Dashmool Taila*, with its *Vatahar*, *Balya*, and *Brihan* properties because of its *Sneha Guna*[24], also helps to relieve *Asthi-majjaDhatuKshaya* when given together in the form of *MatraBasti*.

5. CONCLUSION

There was a significant clinical improvement with one month of treatment, as the patient's condition at the time of admission was very pathetic. The patient's pain was reduced according to the numerical pain distress scale. The sitting capacity of the patient also improved. And the assessment parameters and tests applied in the case study for the patient's diagnosis were also significantly enhanced. Therefore, from this case report, it can be concluded that Avascular necrosis in the early stage can be managed with Ayurveda intervention.

This case report can be helpful to conduct further research studies in the field of orthopaedics and in patients suffering from Avascular necrosis.

6. INFORMED CONSENT

Written informed consent was taken from the patient before starting the treatment.

7. AUTHORS CONTRIBUTION STATEMENT

Dr. Vaishali Kuchewar gave the appropriate guidance and for conceptualizing the manuscript and Dr. Twinkle Joshi gathered relevant data, which was needed for this study. All the authors discussed the outcome and contributed for the study.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

9. REFERENCES

1. Matthews AH, Davis DD, Fish MJ, Stitson D. Avascular necrosis, StatPearls [Internet]; Jan 2022 [cited 15/11/2022].
2. Horia B, Orban, Cristescu V, Dragusanu M& Blvd. Marasti. Avascular necrosis of the femoral head. Maedica J Clin Med. Jan 2009.
3. Isalkarumesh TNN. Oct;15(7):18 IST.
4. Although there is evidence linking steroid use to avascular necrosis, the precise aetiology is unclear and probably complex.
5. Xie XH, Wang XL, Yang HL, Zhao DW, Qin L. Steroid-associated osteonecrosis: epidemiology, pathophysiology, animal model, prevention, and potential treatments (an overview). J Orthop Translat. 2015 Apr;3(2):58-70. doi: 10.1016/j.jot.2014.12.002, PMID 30035041.
6. Jaffré C, Rochefort GY. Alcohol-induced osteonecrosis--dose and duration effects. Int J Exp Pathol. 2012 Feb;93(1):78-9; author reply 79. doi: 10.1111/j.1365-2613.2011.00798_1.x, PMID 22264288.
7. Adesina O, Brunson A, Keegan THM, Wun T. Osteonecrosis of the femoral head in sickle cell disease: prevalence, comorbidities, and surgical outcomes in California. Blood Adv. 2017 Jul 11;1(16):1287-95. doi: 10.1182/bloodadvances.2017005256, PMID 29296770.
8. Ning L, Changming Z, et al. Treatment of non-traumatic avascular necrosis of the femoral head [review]. Exp Ther Med. 2022;23:321.
9. Mok MY, Farewell VT, Isenberg DA. Risk factors for avascular necrosis of bone in patients with systemic lupus erythematosus: is there a role for antiphospholipid antibodies? Ann Rheum Dis. 2000 Jun;59(6):462-7. doi: 10.1136/ard.59.6.462, PMID 10834864.
10. Intranasal Splint removal after septal surgery optimum timing – scientific figure on ResearchGate. Available from: https://www.researchgate.net/figure/Visual-linear-analog-scale-0-10-numeric-pain-distress-scale-6_fig2_349090002 [cited 15/11/2022].
11. Chakradatta S. Text with English Translation, commentator, Charak Samhita, By PriyaVrat Sharma. 3rd ed. Varanasi: Chaukhamba Publishers; 2002. ChikitsaSthan. 22nd Adhaya, VatavyadhiChikitsaAdhyaya, 76th Shloka, page no. 192.
12. Harish Vd, Kushwaha CS, editors. Charaka Samhita. 28th Adhyaya 75-78th shloka Chikitsasthana. 1st ed. Varanasi: ChaukhambhaSanskriSansthan; reprinted 2018; 2009. p. 745.
13. Harish Vd, Kushwaha CS, editors. Charaka Samhita. 28th Adhyaya 93rd shloka Chikitsasthana. 1st ed. Varanasi: ChaukhambhaSanskriSansthan; reprinted 2018; 2009. p. 749.
14. Harish Vd, Kushwaha CS, editors. Charaka Samhita. 28th Adhyaya 80th shloka Chikitsasthana. 1st ed. Varanasi: ChaukhambhaSanskriSansthan; reprinted 2018; 2009. p. 746.
15. Shirota H, Goto M, Katayama K. Application of adjuvant-induced local hyperthermia for evaluation of anti-inflammatory drugs. J Pharmacol Exp Ther. 1988 Dec;247(3):1158-63. PMID 3264574.
16. Petrofsky J, Berk L, Bains G, Khowailed IA, Hui T, Granado M, et al. Moist heat or dry heat for delayed onset muscle soreness. J Clin Med Res. 2013 Dec;5(6):416-25. doi: 10.4021/jocmr1521w, PMID 24171053.
17. Dash B. Materia medica of Ayurveda. New Delhi: B Jain Publishers; 1991.
18. Harish Vd, Kushwaha CS, editors. Charaka Samhita. 28thAdhyayacommentry on 89th to 98th shloka Chikitsasthana. 1st ed. Varanasi: ChaukhambhaSanskriSansthan; reprinted 2018; 2009. p. 750.
19. Bucci LR. Selected herbals and human exercise performance. Am socii for ClinNutr. 2000;72:624S-6.
20. Di Pompo G, Poli F, Mandrone M, Lorenzi B, Roncuzzi L, Baldini N, et al. Comparative" in *vitro*" evaluation of the antiresorptive activity residing in four Ayurvedic medicinal plants. *Hemidesmus indicus* emerges for its potential in the treatment of bone loss diseases. J Ethnopharmacol. Jun 11 2014;154(2):462-70. doi: 10.1016/j.jep.2014.04.033, PMID 24786575.
21. Chopra RN, Chopra IC, Handa KL, Kapur LD. Chopra's indigenous drugs of India. 2nd ed. B Calcutta India: K Dhur of Academic Publishers; 1958.
22. Shukla GD, Pandey S, Anup, Thakar B. Pharmacodynamic understanding of Basti: A contemporary approach. Int J Pharm Biol Arch. 2012;3(4):893-6.
23. Dr. RashmiGangadharKurbet, Dr.JibiThankachan Varghese, et,al. Ayurvedic management of avascular necrosis (Asthikshay)- A case report. Eur J Mol Clin Med. 2020;07(11):8709-16.
24. Pravesh Srivastava GM, Garg G. Effect of Basti karma in the management of avascular necrosis of femoral head – A case study. Int J Ayurveda Pharm Chem. 2019;10(2):245-54.