

A COMPREHENSIVE REVIEW OF AETIOPATHOGENESIS OF SCIATICA OF IVDP
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ABSTRACT

Background: Sciatica, a distinct cause for morbidity, is a cause for low back pain in the young and middle aged and refers to radiculopathy, involving either one or both of the lower extremities. IVDP of lumbar region, especially L4-5, L5-S1 region are the most important etiology for sciatica. IVDP as such is not explained directly in Ayurveda classics, but *Gridhrasi* is described as a disease with similar clinical presentation as that of Sciatica. The *Vyadhyavastha* of *Gridhrasi* can be assumed by various symptomatologies and it will coincide with the inflammatory or degenerative pathogenesis of sciatica. **Materials and methods:** Various sources extending from classical Ayurveda *samhitas*, textbooks of contemporary medicine and e-sources were accessed to review the concepts of sciatica and *Gridhrasi*. **Discussion:** the Ayurvedic description of *Gridhrasi* matches the symptomatology of Sciatica such as pain starting in the *Kati* and descending to *Nitamba*, *Uru*, *Janu*, *Jangha*, *Padam* along with *Stamba*, *Ruk* and *Toda*. *Sama avastha* of *gridhrasi* may be attributed to inflammatory pathogenesis and pure *vatika* symptoms may be attributed to degenerative pathogenesis.

KEYWORDS: IVDP, Sciatica, pathogenesis, etiology, *Nidana Panchaka*, *Gridhrasi*, *Vyadhyavast*.

BACKGROUND

Low back pain due to lumbar disc prolapse is a major cause of morbidity throughout the world. Clinically significant sciatica due to lumbar disc prolapse occurs in 4-6% of the population.^[1] The prevalence of sciatic symptoms reported in the literature varies considerably ranging from 1.6% in the general population to 43% in a selected working population. The burden of lumbar disc prolapse is of great importance in a developing country like India because of the increase in Jobs which require prolonged sitting in work stations in uncomfortable postures, continuous over exertion, jerky or jolting movements during travelling, excessive exercise or physical activities which enhances degeneration of disc etc creates undue pressure on the spine resulting in IVDP. Degeneration of intervertebral disc begins early in life as an indirect consequence of ageing. Prolapse of disc most often than not, occurs in the part of spine that is subjected to heaviest mechanical stress.^[2] The severity of this syndrome is enormously variable, from a brief and trivial episode to a long and difficult illness that occasionally requires surgical intervention. It often occurs between the 4th and the 5th lumbar vertebrae or between the 5th lumbar vertebra and 1st sacral vertebra, and often in youth and the middle-aged of 30-50 years, with predominance in males. Most commonly identified risk factors associated with lumbar disc herniation

includes young age, male gender, familial association, environmental factors, trauma and cigarette smoking.^[3]

Sciatica refers to unilateral or bilateral pain, numbness or paraesthesia along the course of the sciatic nerve, with or without muscle weakness etc. In approximately 90% of the cases, sciatica is caused by a herniated disc resulting in sciatic nerve compression. A lumbar disc becomes prolapsed when the soft, jelly-like material that comprises the centre of the disc pushes through the fibrous shell and into the spinal column.

The symptomatology of Sciatica of lumbar disc herniation is similar to the disease *Gridhrasi* described in Ayurveda. *Gridhrasi* is one among the eighty *Vata Nanatmaja Vyadhi*(diseases of *Vata* origin) and the word literally reflect the gait of the patient afflicted with the condition which resembles the gait of *gridhra*^[4] (vulture).

This article is intended to address the *Roga Pariksha*(examination of disease) aspects of Sciatica of lumbar disc herniation, through *Nidana Panchaka* of Ayurveda.

MATERIALS AND METHODS

Comprehensive and exhaustive literary review of classical Ayurveda treatises, textbooks of contemporary

medicine, published articles from journals and e-sources of contemporary and traditional medicine along with authentic medical websites.

Description of Sciatica and Gridhrasi

Sciatic neuralgia or sciatica is defined as pain in the distribution of the sciatic nerve, perceived as pain along the distribution of sciatic nerve due to ectopic activation of nociceptive afferent fibres in the sciatic nerve or its roots.

Historical Aspects

The ancient Greeks used the term sciatica, to describe pains or 'ischias' felt around the hip or thigh. Hippocrates himself noted this as a condition affecting men between 40 and 60 years and observed that this lasted for about 40 days before resolving spontaneously.^[5]

Italian anatomist Domenico Cotugno wrote the first book on sciatica in 1764, where he distinguished sciatica as a neurological condition from low back pain and for many years it was known as Cotugno's Disease.^[6] The intervertebral disc was first implicated as the etiology in sciatica in 20th century.

Gridhrasi has been described in detail in all samhitas of Ayurveda. It is a disease characterized by *Stambha*, *Toda*, *Ruk*, *Spandana*, affecting *Sphik*, *Kati* and then radiating to posterior aspect of *Uru*(Thigh), *Janu*(Knee), *Jangha*(Calf) and *Pada*(foot).^[7]

The synonyms given for *Gridhrasi* are:

- *Ringhini*^[8]: Used by vachaspati Misra, while commenting on Madhava Nidana, which, literally

means displacement, according to *Sabdakalpadruma*. It may be inferred to indicate prolapse of intervertebral disc material.

- *Randhrini*^[9]: This term indicates rupture or weakpoint.
- *Radhina*^[10]: Given in *Dipika* and *Gudarth Dipika* commentary of Sangdhara Samhita which literally mean pressing, compressing etc.

Charaka explains *Gridhrasi* in *Vatavyadhi* and describes the symptomatology as pain starting in the *Kati* and descending to *Nitamba*, *Uru*, *Janu*, *Jangha*, *Padam* along with *Stamba*, *Ruk* and *Toda* in *Vatika Gridhrasi* and associated with *Tandra*, *Gourava* and *Arochaka* in *Vatakaphaja Gridhrasi*.^[11] Acharya Sushruta pointed out the role of *Kandara dushti* and *Vata* in the pathogenesis of the disease.

Vagbata has described *Gridhrasi* as pain in the low back radiating to the foot and described *Khalli* as a condition in which the pain in *Gridhrasi* becomes extreme.^[12] Madhava nidana has included *Dehasya Pravakranta* and *Mukha Praseka* also as associated symptoms. Yogaratnakar and chakrapani described *Gridhrasi* similar to Charaka.

Aetiology of Gridhrasi and sciatica

Gridhrasi has been described as a *Vatavyadhi* and hence the *Nidana* of *Vatavyadhi* can be considered as the *Nidana* of *Gridhrasi* and they are as given in table 1.

Table 1: Compilation of possible etiology of Gridhrasi with their interpretation.

Category of Hetu	Hetu	Interpretation
Ahara Hetu	<i>Atiruksha Ahara</i>	Excessive dry food which is un-unctuos
	<i>Atiseeta Ahara</i>	Excessive cold food
	<i>Alpa Asana</i>	Intake of food in less than required quantity
	<i>Ati Laghu Ahara</i>	Excessive use of light food, which is not nourishing
	<i>Ati Katu-Tikta-Kashaya Ahara</i>	Excessive use of pungent, bitter, astringent foods
	<i>Asatmya Ahara</i>	Intake of incompatible food
Vihara Hetu	<i>Virudha Ahara</i>	Intake of mutually contradictory ahara
	<i>Atijagarana</i>	Excessive skipping of sleep, late sleeping habits.
	<i>Ativyavaya</i>	Excessive coitus
	<i>Vishamachesta</i>	Irregular and imbalanced posture and activities.
	<i>Dukhasayya</i>	Irregular sleeping postures
	<i>Divaswapna</i>	Sleeping during day time
	<i>Bharavahana</i>	Lifting weights
	<i>Vegarodha</i>	Suppression of natural urges particularly mala, mutra and vata
	<i>Athichankramana</i>	Excessive walking
	<i>Rathaticharya</i>	Excessive travelling in jerky vehicles
Manasika Hetu	<i>Prapedana</i>	Injury to back
	<i>Prapatana</i>	Falling from heights
	<i>Abhigata</i>	Injury to back
	<i>Chinta</i>	Excessive thinking
	<i>Soka</i>	Grief

	<i>Krodha</i>	Excessive anger
	<i>Bhaya</i>	Excessive fear
<i>Anya Hetu</i>	<i>Panchakarma Ayoga-Atiyoga-Mithyayoga</i>	Improper/ineffective/excessive execution of panchakarma procedures
	<i>Marmabhogata</i>	Injury to marma
	<i>Dhatukshaya</i>	Degeneration/Depletion of tissues

Sciatic neuropathy can be the result of any focal lesion of the nerve in the hip or thigh, distal to the lumbo-sacral plexus but proximal to the separation of the nerve into its distal branches. The lesion can involve demyelinating injury, axonal injury, mixed axonal and demyelinating injury, or partial or complete nerve discontinuity.^[13]

Etiology of sciatica

- Disc herniation in the L4, L5, S1 region
- Spinal canal stenosis
- Spondylolisthesis
- Traumatic: in association with femur fracture, hip dislocation or fracture etc
- Malignancy: Metastatic, bone or soft tissue sarcoma, sciatic neuroma, Hemangioblastoma
- Infections: discitis, abscess etc
- Vascular compression: Abnormal pelvic vein plexi, gluteal artery pseudo aneurysm
- Bony compression: osteophyte-sacro-iliac zygapophyseal joint etc.
- Muscular: piriformis syndrome.
- Gynaecological conditions like uterine fibroid etc.

In Sciatica of IVDP origin, the causes of intervertebral disc may be explored and the causes of IVDP are as follows:

- The natural aging process which gradually weakens the intervertebral discs making them susceptible to rupture
- Spinal trauma — Injuries that result from a forceful blow to the spine can cause immediate disc herniation.
- Repetitive stress — sitting for prolonged periods or repeatedly lifting heavy objects while bending at the waist can cause a series of small tears to develop in a disc's outer wall, tears that can worsen over time and lead to full disc herniation.
- Unhealthy body weight particularly in the abdominal region, can strain and damage the spinal components.
- Poor nutrition can deprive the intervertebral discs of the nutrients needed to remain supple and strong.
- Tobacco use
- Genetics

Pathogenesis of sciatica of IVDP origin and *Gridhrasi*

Intervertebral disc is composed of a central portion called the nucleus pulposus and an outer layer called annulus fibrosus comprised of concentric layers of intertwined annular bands. The annulus fibrosus is arranged in a specific pattern to balance the various forces acting on the spine while maintaining the

flexibility. The strength and mobility of the disc is related to the proteoglycan and fluid content of the disc.

Most often than not, disc prolapsed is precipitated by a trauma or on imbalance in the forces and pressure exerted by various factors on the spine. Pre-existing degeneration in the form of Degenerative Disc Disease (DDD) is a major contributor for Disc prolapse. Disc degeneration due to mechanical stresses most commonly affects the L4-5 and L5-S1 regions. The degenerated discs undergo herniation even from lower pressures than normal discs.^[14] The symptoms occur as a direct result of impingement of sciatic nerve by either herniation of nucleus pulposus through a mechanically weak annulus fibrosis or rupture of the annulus fibrosis itself. The degree of disease in the lumbar spine is characterized by the location of abnormal portion of the disc. Often the prolapsed nucleus pulposus induces an inflammatory response which leads to other symptoms in the area such as redness swelling etc.

Acharyas describe *Gridhrasi* as a *Vatavyadhi* which may result gradually from *Vata Prakopa* by *Vata* vitiating *Ahara* and *Vihara* or through an *Agantu* cause like *Abhogata*, *Prapatana* or *Prapedana* to the low back region. *Vata Prakopa* in the form of *Pakwasaya Gata Vata* and *Guda Gata Vata* gradually cause *Dhatukshaya* in the *Asthi* and *Sandhi* of *Kati Desha*, afflicting the *Kandara* that passes along the *Parshni* to *Pada Anguli* leads to the manifestation of specific symptomatology of *Gridhrasi*. *Marmabhogata* or *abhogata* to *Kati Desha* may directly cause affliction of the same *Kandara* but without the prior *Vata Prakopa*. Depending upon the *Dosha* involved in the pathogenesis, the symptoms may vary.

Purvarupa or prodrome is usually said as *Avyakta* in *Vatavyadhi* which would mean the prodromal symptoms would be non-specific or vague. However, it may be assumed that symptoms of *Pakwasaya Gata Vata Kopa* or *Gudagata Vata Lakshana* might be seen as the disease initially manifests with *Vata Kopa* in its primary abode, i.e, *Pakwasaya*.

The vague symptoms may range from mild back ache to pain during movements of spine.

Symptomatology of sciatica of IVDP origin and *Gridhrasi*

The typical clinical picture of disc herniation includes initial lumbalgia that may evolve to lumbar sciatica (generally after one week) and may finally persist as pure sciatica.^[15]

- Pain: sharp, burning, stabbing pain radiating down the posterior or lateral aspect of the leg, to below the knee or along the course of the sciatic nerve, which may be unilateral or bilateral.
- Aggravation of leg pain with straining, coughing, and sneezing
- Numbness with or without tingling sensation in the legs, along the nerve.
- Pain with flexion, rotation, or prolonged sitting or standing and relieved in recumbent position. (Pain during lumbar flexion points to discogenic pain)
- Weakness in the leg and/or foot
- Bladder or bowel control may be affected in certain cases.
- Motor deficit with diminished reflexes may occur.
- Sensory deficits may manifest

On the basis of *Dosha* predominance, *Gridhrasi* may be classified as *Vataja* or *Vata-Kaphaja* and the symptomatologies are given below (Table 2).

Table 2: Description of symptomatologies of *Vataja* and *Vata-Kaphaja* *Gridhrasi*.

<i>Vataja Gridhrasi</i>	<i>Vata-Kaphaja Gridhrasi</i>
<i>Ruk</i> (pain)	Symptomatology of <i>Vataja Gridhrasi</i> +
<i>Toda</i> (pricking pain)	<i>Tandra</i> (Lassitude)
<i>Stambha</i> (rigidity or stiffness)	<i>Gourava</i> (Heaviness of the body)
<i>Spandana</i> (Pulsatile Sensation)	<i>Arochaka</i> (Tastelessness)
<i>Dehasya Pravakrata</i> (exaggerated curvature of spine)	<i>Staimitya</i> (feeling as if wrapped in wet cloth, here, it would indicate stiffness of spine)
<i>Chimichimayana</i> (Tingling sensation)	<i>Vahni Mardava</i> (impaired digestion)
<i>Gridhravat Gati</i> (Gait like vulture, which here would mean antalgic gait)	<i>Bhaktadvasha</i> (anorexia)
	<i>Mukha Praseka</i> (salivation)

The diseases sciatica has similarities to *Gridhrasi* in aetiological and symptomatological aspects and hence is described in detail. Understanding a disease (*roga pariksha*) will not be complete without examining the facets of *Upashaya* and *Anupasaya*. *Puranashali*, *Godhuma*, *Masha*, *Taila*, *Ghrita*, *Kshira* etc which does not produce *Vata Kopa* in *Pakwasaya* produces relief to *gridhrasi*, just like any other *vata Vyadhi*. *Abhyanga*, *Swedana*, *Atapa Sevana*, *Guru Pravarana*, *Basti* etc are effective in producing *Vata Samana* and will be beneficial to counter *Dosha Dushti* in *Gridhrasi*.

DISCUSSION

In human body locomotion is a much initiated and well coordinated activity under the control of nervous system. In Ayurveda activity of locomotion in all aspects is imparted by *Vata*, the unique *Dosa* which is the creator, conductor and enactor of all neurological commands. *Koshtha* is the primary abode of all *Dosas* and *Pakwasaya* is said to be the *Sthana* of *Vata*. Among the *Pancha Vata*, *Vyana Vata* is responsible for *Gati*, *Prasarana*, *Akunjana*, *Utkshepana* etc.

Among the *Vatas*, *Apana* is the regulator of activities related with the autonomic regulation of voluntary motor system, sympathetic and parasympathetic divisions of visceral motor system, through the lower motor neurons that originate from lumbar and sacral segments of spinal cord and invested with the functions of defecation, micturition, expulsion of foetus etc. Acharyas has opined that in the condition of *vata Kopa* in *Pakwasaya*, a range of conditions varying from mild *Sula*, *Anaha*, *Antrakujana*, *Malarodha* to diseases such as *Vridhi*, *Arshas*, *Asmari* and various other diseases of *Adhakaya* are mentioned. "*Trika- Prishta- Kateegraha*" is the musculoskeletal symptomatology associated with *Vata*

Kopa in its primary abode. This indicates that *Vata Kopa* at *Pakwasaya* has a direct relation with spinal diseases.

It can be seen that a synergistic relation exist between *Kati* and *Pakwasaya Vata*. When one is afflicted, other also get afflicted. When *Vataprakopa* occurs at *Pakwasaya*, *Kateegraha* manifests and it might get relieved with normalising *Pakwasaya Vata*. The *Nija Samprapthi* of an intervertebral disc prolapse begins at *Pakwasaya*, which gradually cause disc dehydration, weakness of *Snayu*, *Kandara* and *Asthi* at spine, specifically lumbosacral region resulting in qualitative, quantitative, structural and functional changes, resulting in further *Vata Kopa* and *Sleshaka Kapha Ksaya*. This leads to *Slathangathva* and instability in the lumbar spine, making it prone to a *Nimitta Karana* in the form of even slight trauma (*Agantuja*).

In the case of *Agantuja Nidana* in the form of a fall or trauma hitting the spine, result in injury to the spine secondary to instant structural instability and protrusion of nucleus pulposes. Here, the *dosha dushti* is secondary to *Abhigata* (*Kati Marma Abhigata/Upatapa*).

Role of Kapha in the spine and intervertebral joints

The type of *Kapha* vested with the action of keeping *Sandhi*'s well lubricated and stable is *Sleshaka Kapha*. The *Sleshaka Kapha* has two aspects; the aspect which contributes to the integrity of bony joints and their smooth functioning and the second aspect is that allows smooth movement through a range of physiological states and nourishes, lubricates and protects the *Sandhi* against injury and *Sandhichyuti* (misalignment).

In *Nija* diseases of disc, the qualitative change in the *Ap Mahabhuta*, due to *Vata Kopa*, brings about *Rookshata*

and *Ksaya* to *Sleshaka Kapha* which render the disc unable to work across usual weight bearing mechanisms and make it prone to prolapse. In certain conditions, the *Kapha* formed from *Sama Rasadhātu* will be *Sama* in nature and there will be the generation of *Ama* in the *Sandhi*. The *Sama Kapha* might cause *Srotorodha* to *Vyana Vata* activity and may produce *Sthamba*, *Gourava*, *Sotha* and *Soola* in joints. It is said that *Vata*, when localised in the *sakthi* in an extremely vitiated state, it afflicts the *Kandaras* extending from *Sroni* to *Nakha Praroha* and produces symptoms of *Khanja* or *Pangu*. These two conditions can be considered as the result of a complicated intervertebral disc herniation of lower limbs resulting in a lower motor lesion within a peripheral nerve producing decreased muscle tone,

decreased reflexes in the affected area, atrophy and fasciculation.

IVDP as a disease is not mentioned in Ayurveda. Acharyas had designed chapter based on the symptomatology and not on the basis of *nidanas* or *samprapthi*. Diseases with neuromuscular and skeletal symptomatology are considered under the chapter *vata vyadhi*, since *vata* is the *dosha*, which is concerned with initiation and execution of *karmas* related to locomotor system and nervous system. Disease in which movement become impaired or abolished comes under the spectrum of *vata vyadhi*. The similarities between sciatica and *Gridhrasi* is given in table 3.

Table 3: Similarities between Sciatica and Gridhrasi.

Sciatica of IVDP origin	Gridhrasi
Aetiological similarities	
Trauma	<i>Marmabhogata, prapatana, prapeedana</i>
Degenerative Disc Disease	<i>Dhatukshaya</i>
Symptomatology	
Sharp, burning, stabbing pain radiating along the pathway of sciatic nerve.	<i>Ruk</i> along <i>Sphik, Kati, Prishtha, Uru, Janu, Jangha</i> and <i>Pada</i> , which is the course of sciatic nerve.
Stiffness in the lumbar region	<i>Sthamba</i>
Cardinal feature is positive SLR test	<i>Sakthiutkshepa Nigraha</i>
Pulsations or fasciculation in muscles supplied	<i>Muhu Spandana</i>
Sciatic scoliosis	<i>Dehasya Pravaktrata</i>
Paraesthesia along the course of nerve root	<i>Supthi, Chimichimayana,</i>

Samprapthi ghataka of Sciatica of IVDP origin

- *Dosha – Vata (Vyana, Apana), Kapha (Sleshaka)*
- *Dushya: Asthi, Majja and Kandara(Upadhātu)*
- *Rogamarga: Madhyama Rogamarga*
- *Srotas – Rasavaha, Ashthivaha, Majjavaha*
- *Sroto Dusti Prakara – Sanga, Margavarodha*
- *Udbhava – Pakvashaya, Kati*
- *Vyaktasthana- Kati, Adhahkaya(Parshnim Kandara)*
- *Rogavastha: can have Samavastha(with redness, acute pain, swelling, heaviness of body, stiffness, impaired activity of Vata), and Niramavastha(with sensory, motor deficits, pain and paraesthesia).*

Although the disease *Gridhrasi* is caused by the morbidity of *Vata Dosha (Vyana and Apana)* with secondary involvement of *Kapha Dosha, Vataja Gridhrasi Lakshana* will be seen predominantly and the management of the diseases should be aimed at improving *Dhatu Bala* and regulating *Vata*. In *Gridhrasi* with *Kapha* predominance, *Deepana, Pachana* procedures should be done, prior to addressing *Vata*, to remove *Margavarodha*.

Almost all signs and symptoms of *Gridhrasi* resemble with *Sciatica* as described in contemporary medicine. Hence, *Sciatica* may be addressed and evaluated in the same way as *Gridhrasi*.

Inflammatory and degenerative pathologies have been addressed by various researchers and clinicians in *Sciatica* and likewise depending upon the presentation, *Vyadhyavastha* may vary in *Gridhrasi* also. If its thought along the lines of *Sciatica*, an acute *Samavastha* may be seen during the initial phase following a disc prolapse and will be characterised by severe pain(*Ruk*), redness(*Raga*), swelling(*Sotha*) etc which is not directly mentioned in Ayurveda classics. In chronic cases, where pure degeneration of disc co-exist, symptoms of pure *Vata*, as seen in *Vataja Gridhrasi* might be seen.

CONCLUSION

Sciatica has emerged as a common disease in the current era, owing to the various levels of stress and strain produced in the spine due to altered lifestyle such as regular travelling in vehicles for long, abnormal postures, indulging in *Vata Prakopa Kara Ahara* etc. *Sciatica* is symptomatologically similar to *Gridhrasi* and hence the management may be done in the lines of *Vatasamana(Sneha, Sweda, Vasti)* in *Sciatica* secondary to Degenerative Disc Disease (*Dhatukshaya Janya Gridhrasi*) and *Ruksha Purva Vatasamana Chikitsa* in *Sciatica* without evidence of degeneration(*Gridhrasi* due to *Margavarodha*).

REFERENCES

1. Frymoyer J. Backpain and sciatica. *N. Eng. j. Med.*, 1988; 318: 291-8.
2. Evans FG, Lissner HR. Strength of intervertebral discs. *J Bone Joint surg*, 1954; 36: 185.
3. R.Prasad, M Hoda, M Dhakal, K.Singh, A.Srivastava, V.Sharma. *Epidemiological Characteristics Of Lumbar Disc Prolapse In A Tertiary Hospital*. The Internet Journal of Neurosurgery, 2005; 3: 1.
4. Raja Radha kant Deva, Shabdakalpadruma, vol.4, edition 1967, Chaukhamba Sanskrit series, Varanasi, page-348.
5. Hippocrates (460-370 BC), The Genuine works of Hippocrates, 1849 London, Sydenham Society Translation –Adams F.
6. Delaney TJ, Rowlingson JC, Carron H, Butler A. Epidural Steroid effect in nerves and meninges, *Anaesth Analog*, 1980; 59: 610-4.
7. Agnivesha, Charaka Samhita with Ayurveda Deepika commentary, chikitsasthana, vatavyadhi, edited by Vaidya yadavji trikamji Acharya, Chaukhambha Surbharti Prakashana, Varanasi, 2009; 28/56-57.
8. Madhavakara, Madhava Nidanam with Madhukosha Vyakhya, Pratham Khanda, Vatavyadhinidanam, 22/55-56, Edited by Prof. Yadunandana upadhyaya, Chaukhamba prakashana, Varanasi, 2011; 108.
9. Sushruta Samhita with Dalhana commentary, Nidanasthana, vatavyadhinuidana, edited by Yadavji Trikamji Acharya, Chaukhamba prakashana, Varanasi, 2010; 1/74, 268.
10. Sarngdharacharya, Sarngdhara Samhita, purvakhanda, Rogabheda paricharya, 7/108, Edited by dr Brahmanand Tripathy, Chaukhambha Surbharti Prakashana, Varanasi, 2011; 108.
11. Agnivesha, Charaka Samhita with Ayurveda Deepika commentary, chikitsasthana, vatavyadhi, edited by Vaidya yadavji trikamji Acharya, Chaukhambha Surbharti Prakashana, Varanasi, 2009; 28/56-57.
12. Vagbata, Astanga hridaya, Vatavyadhi nidana, Nidanasthana, edited by pandit hari sadashiv Shastri paradakara, chaukhamba prakashana, Varanasi, 2011; 535.
13. Sunderland S (1951) A classification of peripheral nerve injuries producing loss of function. *Brain*, 1951; 74: 491–516.
14. Mimura M, Panjabi MM, Oxland TR, et al: Disc Degeneration affects the multidirectional flexibility of the lumbar spine. *Spine*, 1994; 19: 1371-1380.
15. Vialle LR, Vialle EN, Suárez Henao JE, Giraldo G. LUMBAR DISC HERNIATION. *Rev Bras Ortop.*, 2015; 45(1): 17-22. Published 2015 Nov 16. doi:10.1016/S2255-4971(15)30211-1.