



An Insight into the Biomechanics and Other Details of Vrikshāsana, One of the Standing Yoga Āsanās

D. Mohan Kishore^a and Jintu Kurian^{a++*}

^a Division of Yoga and Lifesciences, Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Jigani, Bengaluru, Karnataka, India.

Authors' contributions

This work was carried out by both the authors. Also, both authors have read and approved the content of the manuscript.

Article Information

DOI: 10.9734/AJARR/2022/v16i12452

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/94260>

Review Article

Received: 11/10/2022

Accepted: 15/12/2022

Published: 21/12/2022

ABSTRACT

Aim: Adopting a perfect final pose of specific yoga āsanā and obtaining maximum benefits is possible by learning the major to minor details of the āsanā including the preparations, steps and parts of the body involved, benefits, contra-indications, final pose and much more. However, understanding the specific body parts involved and how muscles, bones and joints work together to create movements and shape is through the study of Biomechanics. Anatomically, human body adapts to a specific posture of Yoga āsanā with proper sync of Bones, muscles, and joints. Studies on biomechanics of selected yoga āsanās are found sparsely any in Scientific interfaces. Therefore, with this article, we intended to give an insight on one of the standing poses named as Vrikshāsana, known as Tree pose. For which, related information was obtained from scientific and non-scientific sources and to postulate the details of practice of Vrikshāsana, citing the biomechanics.

Methodology: Manuscripts related to Vrikshāsana and its details including Biomechanics were identified from scientific interfaces like PubMed and Google Scholar. Books on Anatomy of Human

**Research Officer;

*Corresponding author: Email: jintukurian@gmail.com, jintukurian@svyasa.edu.in;

body and Scriptures describing the steps of adopting the final pose and benefits were referred to extract details specific to the correct position of hip, muscles, and ankle joint for reaching at appropriate posture of *Vrikshāsana*. The search was conducted between the month of February and September 2022.

Conclusion: This review emphasizes on the importance of practice of *Vrikshāsana* on enhancing the wellness of body and brain. But the benefits are obtained only when the practitioner is well aware of the right posture, higher benefits and Biomechanics of the *āsana*.

Keywords: *Vrikshāsana*; biomechanics; anatomy; appropriate posture; standing *āsana*s.

1. INTRODUCTION

Healthy body is essential for every individual to achieve their life goals [1]. The western world has adopted more of physical components of *Yoga* such as physical postures. Therefore, the classical approach of *Yoga* is being compromised. Hence compilation of this form is needed to bring the traditional knowledge base to people for a proper understanding [2] about the practice of *Yoga āsana* [3].

Yoga, derived from medieval *Hatha Yoga* period [4], is known to public since the mid of 20th century [5]. *Yoga* constitutes physical postures called *āsana*. Interestingly, adopting of which involves almost all the parts of the human body with specific stretch and impact on particular body parts[6]. During the practice, understanding the parts involved is inevitable in order for the practitioner to be mindful during the practice which can help adapt proper posture thereby attaining maximum benefit of the practice [7].

While the interest and awareness about *Yoga* among public is increasing over the last 7-8 decades, scarcity of skilled and experienced teachers result in adapting wrong postures. Furthermore, unguided inappropriate ways of practice results in either obtaining lesser benefit or adverse effects like knee pain and cramps to the practitioner [8]. However, along with the rising demand and interest of people across the globe in *Yoga*, the interested go in search for experts in the field for getting well acquainted. The search in this direction took the researchers to develop interest in Biomechanics and Kinesiology of particular *āsana* [9]. Not just learning but adopting such robust methods, help individuals to understand the need and ways for practice, capability and extend to which they can try attaining the final pose of each *āsana*, obtaining maximum benefits. Glancing at the recent trend and curiosity of people paying attention on minor details of each *yoga āsana*, the authors of the present study understood the scope of exploring and compiling the information

on specific *yoga* postures under one umbrella. On search, as we found few *yoga āsana*s being studied in depth, but, such studies on particulars of balancing *yoga āsana*s are hardly any. In search we found two articles in total on *Vrikshāsana*. Hence we taken up *Vrikshāsana*, which is known as Tree pose. And, in this context, the present review exhibits the variations, preparatory practices, steps involved and Biomechanics of *Vrikshāsana*. However, more of attention of this work is laid on the higher benefits of practice, emphasizing the Biomechanics.

1.1 Preparations Required before the Practice

As *Vrikshāsana* is a balancing *āsana*, the practitioner should make sure about the strength of the bones, muscles, joints, ligaments, cartilages and tendons of both the legs. Following which the practitioner must try adopting the posture, by taking wall support or by using props to see for the strength of the legs. Adding on, as known, avoiding solid food at least one hour before the practice and strenuous physical activities will help attain and maintain the final pose with no extra efforts [10].

1.2 Steps of Practice

After being ensured about the balancing, the practitioner can make a try of reaching at the final pose, adopting for few seconds in the first try and gradually can try increasing the time of maintenance. The steps are: stand in *Tādāsana*, slowly being on one leg, bend the other leg so that the foot rests on the inner thigh, by toes pointing downwards. By balancing on one leg, join the palms and raise the palms straight over the head. Breathing deeply, stay for a few seconds in the final pose, lower the arms and separate the palms, straighten the leg and return back to *Tādāsana*. Repeat the practice standing on the opposite leg following the same steps [11]. Note that the practitioner should not place his sole on the knee. Because this might lead to strain, resulting in knee pain.

1.3 Variations of *Vrikshāsana*

There are a few variations of this asana. One among which is performed with hands extended against the chest in a prayer pose. Moreover, the variation is also known to create a higher center of gravity and therefore, is a more challenging pose to attain [12].

1.4 Breath

Because of the stabilizing action of the muscles that keep the arms overhead, the thoracic movement and resultant breathing pattern might encounter more resistance in this position. In addition, the higher center of gravity tends to produce a stronger stabilizing action of the abdominal muscles. Taken together, these factors combine to reduce the overall excursion of the diaphragm. In all, the breathing should be slow and steady for higher benefits.

1.5 Biomechanics

Biomechanics is the study about the structure, sync and movement of the body during each locomotion. Moreover, it is all about identifying the mechanical laws to the human body while adopting particular postures. A conventional approach towards modern *Yoga* is well understood though the study of Biomechanics of each *yoga* postures [13]. The understanding about Biomechanics includes stretching and relaxation properties involving each of the organs and organ systems, entailing a safe and effective practice of the *āsana*. The Skeletal and muscular joints biomechanics of *Vrikshāsana* is as described below [14].

1.6 Bones Involved and the Role Played

1.6.1 Upper limb

- Spine: retain proper link of upper and lower limb, helping keep head, chest, pelvis, shoulder, arms and legs in one line. During the practice of *Vrikshāsana*, the spine is however Neutral.
- Humerus, Radius and Ulna: enable proper hold of the hand in *Namaskara mudra*, also helping in shoulder flexion and adduction; elbow flexion; forearm pronation, wrist, hand, and finger extension.

1.6.2 Lower limbs

- Femur, tibia, fibula: help with the rotation, abduction, flexion and extension of the leg, knee, hip and toes.

1.7 Muscles

1.7.1 Upper limb

- Biceps brachialis: even though not the most powerful flexor of forearm, this muscle definitely helps in flexion and supination of the forearm.
- Erector Spinae and longissimus: the muscle that lie in each side of the vertebral column works with longissimus muscle to help keeping the spine erect in standing postures and help in side to side rotation of the spine if required during balancing.
- Spinalis: Spinalis muscle is a part of Erector Spinae that helps in extension of the spine to feel the full stretch at the final posture. This muscle also supports in backward and side bend and rotation of the spine, when the practitioners puts effort to adapt the final pose.
- Iliocostalis: bilaterally extends and laterally flexes the vertebral column, but, only if required during the efforts to balance the posture.

1.7.2 Lower limb

- Gluteus medius and minimus: allow a lateral shift of pelvis over standing foot for balance and to keep pelvis level and help open it to side and help through concentric contractions
- Piriformis: rotates the femur during the hip extension and abducts the femur during hip flexion
- Obturator internus: helps in lateral rotation of femur with hip extension and femur abduction with hip flexion. It steadies the femoral head in the acetabulum helping in adapting a steady posture and balancing of the body.
- Gemellus inferior and superior: help to steady the femoral head in the acetabulum and help in lateral rotation and extension of thigh and abduct the flexed thigh at the hip assisting the internal obturator.
- Quadriceps femoris: a group of muscles of front thigh, helping in any movement involving the thigh.
- Hamstring: helps is flexion and extension of the leg.
- Intrinsic muscles of foot: Movement of toes during the practice of *Vrikshāsana*.
- Extrinsic muscles of foot: keep the knee in neutral extension and balance on a single leg and help to go through a concentric

contraction. Also help in dorsiflexion, plantar flexion and evert the foot.

- Tensor Fasciae Latae: stabilize the hip and the knee and assist in locomotion. This muscle works with gluteus medius and minimus. Help in internal rotation and abduction of the hip.
- Rectus Abdominis: this muscle of the abdomen supports in steadying the middle part of the body while adopting physical postures, by helping hold the abdominal organs in place thus keeping the body stable.
- Psoas major: Connects the upper body to the lower, inside out and front to back. To flex hip and to externally rotate the leg: contracts concentrically. During the practice of *Vrikshāsana*, the Psoas major combines with the iliopsoas muscle and contributes to the flexion of the hip joint.
- Adductor magnus: links to the deltoid muscle and helps in flexion of thigh and works as a medial and lateral rotator. Further, it helps extending and adducting the thigh.
- Adductor minimus (adductor femoris minimus): is a thigh muscle that adducts and laterally rotates the femur.
- Pectineus, adductor longus, and adductor brevis, adductor magnus and gracilis muscle: all these five large muscles of medial thigh which act as hip adductor. These muscles help in adapting like steady postures and movements involving the lower extremities.
- Calf: supports to stand steady and flex the foot and locks the knee [15].

1.7.3 Whole body

- Trapezius: help with the upper body's stretch to the fullest maintaining alignment of the head, neck and spine, to a major extend enabling activation of the nerves linking the brain and the body.

1.8 Joints

The joints involved and their role are:

1.8.1 Upper limb

- Glenohumeral joint of the shoulder: supports the muscles like biceps brachii and tendons helping perform movement, rotation and balancing of hands, neck and head.

- Elbow: bending, straightening and rotation of hand and arms.

1.8.2 Lower limb

- Ankle: ankle joint is bent backward and contracted and even if this joint is more helpful in ambulation, during the standing poses, this joint support the muscles of lower limb in flexion and extension to certain extend and also in weight bearing.
- Hip: hip joint is outward and opened during the practice and plays a major role in weight bearing during the practice of standing poses.
- Knee: connects the bones of upper and lower leg, enabling the bend of one knee and placing foot on the opposite legs thigh.
- Sacroiliac joint of the pelvis: distributes the load of force from the lower extremities.

1.9 Positioning of the Body

While adopting *Vrikshāsana*, the basic joint positions are such where the Ankle is dorsiflexed, Hip is flexed externally rotated and abducted, Knee is fixed and the Spine is neutral, Pelvis in level, shoulder is slightly flexed and adducted. In the pose of *Vrikshāsana*, the entire body weight is on one leg thus the practice of this asana improves the balance of the body and concentration.

1.9.1 Key elements of tree pose

Proper weight distribution and strong legs to provide stability to the groin, pelvis, hips and thighs. The practice of tree pose will strengthen the core and therefore even help improve the metabolism and digestion. As we know, balancing of the total body weight on one leg requires a strong core with active engagement, which in turn help gaining strength in the body.

1.10 Benefits of the Practice

As known, during the practice of *Vrikshāsana* the practitioner gets to feel the stretch at legs, arms, hands, arms, fingers, back and entire body [16] thereby improving the body balance. Adding on, the practice of *Vrikshāsana* is known to impart enormous benefits beyond just musculoskeletal. Moreover, the practice improves overall body balance, flexion and extension of the limbs, better posture, tones up leg muscles, strengthens hip and pelvic region, improves digestion, improves blood circulation, regulates

heartbeat and heart rate, calms down the body and mind, relieves constipation and flatulence issues, acidity by increasing blood flow to the stomach, flexibility of whole body and alignment, balance and equilibrium to body and mind, opens the hips and also improves strength of the musculoskeletal system [17]. Though, the higher level benefits are neurological, with the involvement of brain as reflected through an improved concentration and attention among the practitioners, in short, postulating the involvement of central nervous system [18].

2. METHODOLOGY

The aim of this observational study was to study in detail the biomechanics, steps for the practice, indicating the multiple benefits a practitioner would gain with the practice of *Vrikshāsana*. However, objectives of this study were to highlight the biomechanics referring to texts on Anatomy and Physiology of Human body, enabling guidance to the readers through steps of adopting the posture rightly using a set of images and to bring awareness about the neuro and musculoskeletal benefits of the practice.

For obtaining information relevant to meet the objectives of this study, manuscripts were found from scientific platforms like PubMed and Google scholar. Non-scientific sources referred are Yoga texts including *Haṭha Yoga Pradīpikā*, *Gheraṇḍa sāmhitā*, *Sivasāmhitā*, *Patañjali Yoga Sūtra*, *Bhagavad Gītā*, as well as selected contemporary texts written by great masters of *Haṭha Yoga* during 19th and 20th centuries were examined to understand: Preparations needed to start the practice, Steps involved, Variations, Breathing, proper final pose and Biomechanics of *Vrikshāsana*. The search was conducted between the month of February and September 2022. The key terms used during the search are “*Vrikshāsana*”, “*Vrikshāsana* biomechanics”, “*Vrikshāsana* biomechanics human body parts involved”, “*Vrikshāsana* anatomy and physiology”, “*Vrikshāsana* benefits”, “*Vrikshāsana* steps of practice”, “*Vrikshāsana* steps of practice”, “*Vrikshāsana* limitations”, “*Vrikshāsana* final pose”. Published Yoga based experimental studies with *Vrikshāsana* as one of the component were excluded from the review.

3. DISCUSSION

Vrikshāsana is one of the standing *āsana*s linking the whole body starting from foot to the

nervous system. To have the best of the benefits gained, the practitioner must feel as steady as a tree while balancing on one leg. To achieve and obtain the expected benefit out of this *asana*, it would be better if the individual imagines rooted like a tree. As mentioned in the main content of this manuscript, scriptures also advise the individuals to take wall support in the beginning stage when the practitioner finds it difficult to attain the balance.

In Ancient period, sages used to recommend the disciples to practice *Vrikshāsana* as a preparatory practice to reach into the state of Meditation. In addition, certain scriptures also describe *Vrikshāsana* as activating *Mooladhara chakra* [19], which indeed boosts energy flow, calm down the mind, or at time of need stimulates confidence of the practitioner. In addition to these known benefits like improved concentration, attention and focus, which the practice of *Vrikshāsana* can impart, praiseworthy benefit is musculoskeletal health and mind-body balance, which not many *yoga āsanās* are found granting [20].

Adding on, the expected benefits are attained when the instructor is instructing properly, the instructor makes sure that the practitioner is following the instructions to the fullest in addition to the interest and dedication of the performer to follow the instructions after learn the benefits, contraindications [21]. Adding on, the practitioner should be thorough about the pre preparatory practices and the parts of the body involved and getting benefitted along with the overall wellness at both mind and body level, as described in this article.

Although, there might be many inferences based on the extent of interest that a subject transmits during practice of *Vrikshāsana*, like ensuring alignment and strategy of hip, knee and ankle joint with which the stability can be attained. But, having a better understanding about the need of the practice is inevitable. However, maintaining, attaining and regaining stability of the posture is dependent equally on certain aspects of acceleration related to the joints and muscles related to hip, knee and ankle. Say for example, if acceleration of ankle is higher than knee, this indicates that the ankle has greater contribution in regaining stability, likewise, about the hip joint. Moreover, these acceleration is of course related to the passion of the practitioner.

On a wider view, the practice of *Vrikshāsana* is not only about the balance and control of the body but also about the stability at the mind level, which also involves attention and concentration. However, people who have undergone neurological and nephrological disorders, knee replacement surgeries, injuries at knee, high or ankle joints, ligaments and muscles, those who have body balancing problems, issues with temporal lobe should avoid the practice. Ultimately, the insight on biomechanics provides a better way for the instructor and the practitioner to know more about the *āsana* helping them get a quality teaching-learning experience. The outcome of this article is that the readers can get to know the minor to major details of *Vrikshāsana*, which a practitioner must and should know.

4. CONCLUSION

This article emphasizes on the importance of practice of *Vrikshāsana* on enhancing the wellness at body and mind, also declaring that the benefits are undoubtedly obtained only when the practitioner is well aware of the right posture maintained though an understanding of Biomechanics. In addition, the authors of this work promote the practitioners to look further into the details of each of the yoga *āsana*s besides adopting right pose appropriately by the practitioner.

COMPETING INTERESTS

Authors declared that they do not have any competing interest.

REFERENCES

1. Mutrie N. Healthy body, healthy mind? The Psychologist. 2002;15(8):412-13.
2. Ross Alyson ST. The health benefits of yoga and exercise are view of comparison studies. The Journal of Alternative and Complementary Medicine. 2010;16(1):3-12.
3. Singleton M, Byrne J. The classical reveries of modern yoga: Patanjali and constructive orientalism. In Yoga in the Modern World. 2008:89-111.
4. Mishra S, Dash SC. An overview of hatha yogic practices in hathayoga pradipika, gheranda samhita and shiva samhita. Research Journal of Humanities and Social Sciences. 2017;8(3):354–66.
5. Ivtzan I, Jegatheeswaran S. The yoga boom in western society: Practitioners' spiritual vs. physical intentions and their impact on psychological wellbeing. Journal of Yoga & Physical Therapy. 2015;5(03).
6. Yadav SK, Singh A, Gupta A, Raheja JL. Real-time yoga recognition using deep learning. Neural Computing and Applications. 2019;31(12):9349-61.
7. Taneja DK. Yoga and health. Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine. 2014; 39(2):68.
8. Cramer H, Quinker D, Schumann D, Wardle J, Dobos G, Lauche R. Adverse effects of yoga: A national cross-sectional survey. BMC Complementary and Alternative Medicine. 2019;19(1):1-10.
9. Mullerpatan RP, Agarwal BM, Shetty T, Nehete GR, Narasipura OS. Kinematics of suryanamaskar using three-dimensional motion capture. International Journal of Yoga. 2019;12(2):124.
10. Greendale GA, Kazadi L, Mazdyasni S, Ramirez E, Wang MY, Yu SS, Salem G. Yoga empowers seniors Study (YesS): Design and asana series. Journal of Yoga & Physical Therapy. 2012;2(1).
11. Yelluru SN, Shanbhag RR, Omkar SN. Understanding vrikshasana using body mounted sensors: A statistical approach. International Journal of Yoga. 2016;9(1):4.
12. Iyengar BKS. Light on the yoga sutras of patanjali. Aquarian/Thorsons.1993:384.
13. Kishore DM, Bindu S, Manjunath NK. Estimation of yoga postures using machine learning techniques. International Journal of Yoga. 2022;15(2):137.
14. Sahu KK, Yadav JS. An experimental study on shooting ability of male archers: With reference to specific yoga exercises; 2020.
15. Kaminoff L, Matthews AT. Joga: anatomija; 2010.
16. Kaminoff L, Matthews A. Yoga: anatomi. Tukan Förlag; 2018.
17. Kumari K, Mishra VB, Ojha S. Comparative study on foot pressure distribution of vrikshasana between visual and non-visual yogic practice. Indian Journal of Physical Education, Sports Medicine & Exercise Science. 2018;18(2):11-14.
18. Joshi S, Deole YS, Vyas GH, Dash SC. Management of overweight and obesity through specific yogic procedures. AYU (Int QJ Res Ayurveda). 2019;30(4):425.

19. Sahu P, Singh BK, Nirala N. Effect of various standing poses of yoga on the musculoskeletal system using EMG. *Computer-aided Design and Diagnosis Methods for Biomedical Applications*. 2021:89-112.
20. Kumawat J, Sharma RK, Sharma GP. Anatomical exploration on various postures of "Suryanamaskara"; 2021.
21. Zago M, Kleiner AFR, Federolf PA. Machine learning approaches to human movement analysis. *Frontiers in Bioengineering and Biotechnology*. 2021:1573.

© 2022 Kishore and Kurian; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/94260>