

An insight into the Biomechanics and other details of *Vrikshāsana*, one of the standing Yoga *āsana*s

Abstract

Aim: Adopting a perfect final pose of specific yoga *āsana* and obtaining maximum benefits is possible by learning the major to minor details of the *āsana* 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 *āsana*s are found in sparse 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 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, ankle joints for reaching at appropriate posture of *Vrikshāsana*. The search was conducted between the month of February and September 2022.

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

Key words: *Vrikshāsana*, Biomechanics, Anatomy, Appropriate posture, Standing *āsana*s

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 in *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 āsanā* [3].

Yoga, derived from medieval Haṭha *Yoga* period [4], is known to public since the mid of 20th century [5]. *Yoga* constitutes physical postures called *āsana*, and interestingly, adopting of which involves almost all the parts of the human body with specific stretch and impact on particular parts [6]. During the practice, understanding the parts involved is inevitable in order for the practitioner to be mindful during the practice which can 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 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 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 *āsanas* being studied in depth, but, such studies on particulars of balancing yoga *āsanas* are very few and there are only two articles in total on *Vrikshāsana*. Hence we taken up *Vrikshāsana*, which is known as Tree pose. 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.

Preparation 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 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].

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. 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 *Tādāsanā*. Repeat the practice standing on the opposite leg following the same steps [11]. Note that the practitioner should not place the sole on the knee. Because this might lead to strain to the knee.

***Vrikshāsanā* variation with arms elevated**

There are a few variations of this asana and 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].

Breathing

Because of the stabilizing action of the muscles that keep the arms overhead, the thoracic movements of the breath might encounter more resistance in this position. In addition, the higher center of gravity tends to produce a stronger stabilizing action in the abdominal muscles. Taken together, these factors combine to reduce the overall excursion of the diaphragm.

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 poses. 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 *āsanā*. The Skeletal and muscular joints biomechanics of *Vrikshāsanā* is as described below [14].

Skeletal parts involved and the role played:

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 Vrikshasana, 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.

Lower limbs

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

Muscles:

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.

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 in 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].

Whole body:

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

Joints:

The joints involved and their role are:

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

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 supports the muscles of lower limb in flexion and extension to certain extent 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 leg's thigh.
- Sacroiliac joint of the pelvis: distributes the load of force from the lower extremities

Positioning of the body

While adopting Vrikshasana, the basic joint positions are such where the Ankle is dorsi-flexed, 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 *Vrikshasana*, the entire body weight is on one leg thus the practice of this asana improves the balance of the body and concentration.

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 helps in gaining strength in the body.

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].

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 saṁhitā*, *Sivasāṁhitā*, *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.

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, focus, which the practice of

Vrikshāsana can impart, praiseworthy benefit is musculoskeletal health and mind-body balance, which not many *yoga āsanās* are found benefitting [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, the interest and dedication of the performer to follow the instructions, learning the benefits, contraindications [21], pre preparatory practices and the parts of the body involved and getting benefitted in addition to the overall wellness at both mind and body level, as described on this observational study.

Although, there might be many inferences based on the extent of interest that a subject imparts during the steps of practice of *Vrikshāsana*, starting with the pre-preparatory practices, ensuring alignment and strategy of hip, knee and ankle joint. With which the stability can be attained during the course of practice of *Vrikshāsana*. Although, 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.

To add on, 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. On a wider view. However, people who have undergone neurological and nephrological disorders, knee replacement surgeries, injuries at knee, hip or ankle joints, ligaments and muscles, those who have lost balance over the body, should avoid the practice. Ultimately, the insights on

biomechanics provides a better way of instruction delivery by the instructors, clinicians and therapists involved in teaching specific balancing yoga poses like *Vrikshāsana*. 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.

Conclusion

This observational work emphasizes the importance of practice of *Vrikshāsana* on enhancing the wellness at body and mind, but, the benefits are undoubtedly can be obtained only when the practitioner is well aware of the right posture maintained though an understanding on Biomechanics of *Vrikshāsana*, in addition to promoting the adopting of the pose rightly and appropriately by the practitioner.

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