

# The Influence of Hallux Valgus Severity on postural stability and risk of fall: Narrative Review

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## Abstract:

**Background:** Hallux valgus (abductovalgus), an irreversible foot deformity, is defined in the International Classification of Disease (ICD) as an acquired deformity of toes (big toe). It is characterized by lateral deviation of the hallux and medial deviation of the first metatarsal. Another term, Bunion, which is often used to describe the same condition, more precisely describes the enlargement and chronic swollen of the medial projected eminence. Almost hallux valgus deformity leads to progressive kinematic impairments, balance dysfunction, and increasing the risk of falls that has become a growing concern worldwide. Hallux valgus influences on foot kinematics, and musculoskeletal articulations` axis has been described in some detail, its effect on the hallux valgus remains poorly understood. Severity of hallux valgus, and extend of its progression fortunately influences static and dynamic balance, postural stability in addition positively associated with extra painful complains those accompanied with excess dysfunctional deficits, aggravated falling incidences.. Therefore, comprehensive understood of both kinetics and kinematics of hallux valgus and its severity correlation with both static and dynamic balance, and postural stability permits caregivers valuable chances to conduct the most proper rehabilitation programs.

**Keywords:** Dynamic balance, Hallux valgus severity, Postural stability, Risk of fall, Static balance.

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## Introduction:

Hallux valgus (HV) that recognized as the great toe results in apparent static and dynamic balance deficits those contributes to raised falling risk incidence. Limited published papers have examined hallux valgus influences in relation to healthy population. The term HV often known as lateral hallux deviation of 1<sup>st</sup> big toe, in addition osteo-metatarsal medially deviated from midline beyond fifteen degrees<sup>(1,2)</sup>. In addition, the reported prevalence ranged 13-25% among males, and it is higher 30-58% among females, as well HV represents one-third among elders. HV represents nearby 28.4% among young adults, and 74% among older adults<sup>(3)</sup>.

Typically, HV pathophysiological is accompanied with an exostosis that addresses osseous overgrowth, in addition developing dorsomedial 1<sup>st</sup> metatarsal head eminence<sup>(4)</sup>. Clinical HV was classified as a congenital big toe bent articulation deformity, the worldwide stated reduction of transverse arch height, in addition to typically deformed big toe flexors, and extensor tendons. As well, increased forefoot width within HV subject resulted in altered pressure distribution benth metatarsal heads<sup>(5)</sup>.

Fortunately, various negative impacts resulted from HV on suffers life quality mainly old adults and overweighted individuals e.g., adverse feet posture, regressed balance, and less functioning gait cycles, and raised falling incidences<sup>(6,7)</sup>. In addition, related published articles show that HV has a progressive course that often associated with painful discomfort, long-term dysfunction, and restricts sufferers` daily activities. Up to date, advanced aged population have a pathological gait pattern alterations those negatively influences their quality of life that rise HV

classification to a real medical isolated deformity that aggravated into an actual functional failure which requires in-depth clinical management <sup>(8)</sup>.

Fortunately, HV still responsible for quite disability due to functional loss of capability to perform prior activities of daily living that negatively manifested reduced overall stability, as well elevated risk of falling <sup>(7)</sup>.

Evidence shows that severity of HV almost diagnosed via 1st metatarsophalangeal inclination angle, plus radiographic often measures that addresses HV angle at < 15 degrees as a normal value, where <sup>(9)</sup> had classified HV deformities into normal (<15°), mild (15°-20°), moderate (21°-39°), and severe (≥40°) in terms of HV severity. Earlier published clinical trials had ensured the positive correlation of HV severity and associated painful complains, progressive HV course that aggravates well-known negative impacts on HV individuals <sup>(10)</sup>. Therefore, current published article was conducted to reveal the actual influences of HV severity of pain, static and dynamic balance in line to enhance orthopedists, physical therapists, orthotic specialists...etc. to build up the most suitable rehabilitation approach that based on actual comprehension of HV impacts on both static and dynamic balance, and postural stability.

### Hallux valgus and balance:

Kinetic analysis of HV individuals stated that 1<sup>st</sup> metatarsal articulation of the big toe is the prime transferring weight key through the late stance gait cycle phase. Therefore, HV almost suffers from gradual meta-tarso-phalangeal articulation subluxation that has a direct impact on HV person balance via potential interfering with toe-off step, which additionally resulted in altered plantar pressure distribution and in turn accelerates their genu osteoarthritis, feet painful complains, and reduces their overall quality of life <sup>(11,5)</sup>.

Recently, the correlation between hallux valgus and dynamic balance still a challenged either in single or double leg support postures <sup>(2)</sup>. Within healthy individuals the accelerated gait speed, obvious increase of angular momentum at sagittal plane resulted in balance improvement. In the same line, hallux valgus persons at controlled gait speed reveals some deficits, unless at higher speeds still unevaluated with apparent deficits in term of advanced sensitive outcome measures i.e., stability indexes, and medial body center of mass- center of pressure, as well inclination angle <sup>(12)</sup>.

Improper postural alignment of HV individuals leads to their balance degradation in terms of static or dynamic types. On the other hand, an earlier clinical trial conducted by Kavlak. had neglected any correlation in-between severity of HV and both subtypes of balance either static or dynamic. Kavlak had randomly recruited 106 feet of fifty-three participants their mean age was 73.79 ±7.08 years old with their mean HV angle value was 17.32±11.29° for right foot, and 16.45±10.65° for left one. <sup>(13)</sup>.

### Hallux valgus and postural stability:

Almost hallux valgus exhibits restricted capacity in balance maintenance throughout dynamic tasks, such reduced dynamic balance capabilities duplicate their falling risk incidence, mainly among advancing age. Approximately HV individuals suffer from remarkable decline of their big toe's flexors strength by 27-36%, mainly among old adults, and elders that directly influences their walking safety <sup>(14,2)</sup>.

Recent clinical trial conducted on forty-eight women of double age decades (20-30 years old, and 50-60 years old), had underwent calibrated biomechanical examination at an ideal gait speed. Hallux valgus actual impact at young participants angular acceleration was significantly differed in all ankle planes, sagittal knee plane, and hip horizontal and frontal planes <sup>(15)</sup>. As well, hallux valgus actual impact at older participants revealed significant differs in ankle, and knee sagittal planes, and both hip sagittal and frontal planes <sup>(16)</sup>.

Known near-fall scenario in line to maintain balance among older adults with HV, declined ankle dorsiflexion at terminal stance phase overloads big toe flexors in line to ensure postural stability and reduce falling risks that overload associated HV deficits i.e., additional over-compressed forefoot <sup>(17)</sup>, by external foot rotation, and negatively influence their quality of life <sup>(15)</sup>. Noting that HV severity influences in a noteworthy approach with reduced hallux plantarflexion strength in a dose-dependent maneuver <sup>(14)</sup>, as well the degrees of HV have a direct correlation with pelvic retroversion degrees <sup>(18,19)</sup>.

No doubt that double support period within walking is not a sufficient measure across gait cycle, as it neglects correlation in-between whole-body center of mass and its base of support. While across single support stage, support base within foot area differs greatly of the double support gait cycle phase, in addition to theoretical inclusion of inclining angle and ground reaction force items those respected in term of postural stability evaluation <sup>(20,19)</sup>.

Clinically, HV individual consumes additional duration through stance gait cycle where their accelerated angular inclination at swing phase exhibits a sudden enhancement of inversion angulation prior heel contact in a compensatory maneuver among HV population that exhibits greater tendency to body weight transfer laterally <sup>(21)</sup>. HV manifested kinematically by shorter distance from heel strike to the one of center of mass projection, also smaller differences between the minimal and maximal center of mass than healthy individuals <sup>(8)</sup>.

The HV severity correlation with the magnitude of negative influences on postural stability at sway phase still an inconclusive issue. Up on that Omae and his colleagues had conducted recently a clinical trial on 169 older adult's healthy individuals in line to reveal the association of HV deficits with postural sway utilizing a force plate. Omae and his team had classified their participants' HV severity positive if the angle was ≥ 20°. They stated that positive correlation of HV severity with antero-posterior postural sway magnitude as they revealed the positive differs in terms of antero-posterior postural sway magnitude and photographic HV angle, as well the decline in lower

extremity musculoskeletal mass that fortunately aggravates falling incidences among more severe HV individuals<sup>(22)</sup>.

In a 2021 clinical trial, Kim investigated thirty-four adults (14 males and 20 females) with a hallux valgus deformity and found that the extent of abnormal plantar pressure translation is related to the severity of the deformity<sup>(23)</sup>. Therefore, the pressure force under the first metatarsophalangeal joint is reduced significantly with increasing severity of the HV deformity. Up on that could state that a more aggressive early evaluation and treatment will be needed in clinical practice to prevent and manage HV deformities.

Furthermore, HV individuals have no aggravated momentum of force of plantar flexors throughout acceleration, and subjects with HV have a half-smaller increase neural activities even in case of accelerated speed of gait beyond healthy population<sup>(24)</sup>. In addition, HV individuals have aggravated ground reaction forces along the lateral foot side along the stance gait cycle phase that overloading in case of uneven surfaces<sup>(25)</sup>.

### **Hallux valgus and pain complains:**

Recent guidelines highlight the importance of visualizing HV kinematic alterations to facilitates their rehabilitation planning into the therapeutic management protocols. Older adults with HV represents significant tendency throughout 31-41% of their gait cycle at horizontal plan, which classified as an apparent deviation from healthy individuals, also by the terminal stance phase the HV individuals experience a near-zero acceleration of toe-in posture angular acceleration that immediately reduced<sup>(2,16)</sup>.

On the other hand, the pathogenesis of hallux valgus (HV) involves an enlarged first metatarsal head eminence, commonly referred to as a bunion, which is characterized by pain, swelling, and a progressive course with an unclear etiology<sup>(4)</sup>. Meanwhile, clinical commentary suggests an exercise-based approach aimed at slowing the progression of the deformity by optimizing the length-tension relationship of the muscles. This perspective supports a preventive strategy rather than delaying intervention until impairments worsen and surgery becomes necessary<sup>(26)</sup>.

Associated raised planter pressure, hallux planter flexion strength, and tactile sense that addressed as proprioception sense those all declined in case of progressive HV, as well its severity that often lower among who reported painful complains thus seek for the proper management and slow down HV progressive course<sup>(27)</sup>.

An earlier clinical trial has ensured that HV can offset the effects i.e., aggravated negative correlation between feet, and hip/pelvic rotation in the transverse plane<sup>(28)</sup>. As well, HV results in excessive 1<sup>st</sup> metatarsophalangeal joint pronation that associated with more pelvic tilt that maximize associated low back, and knee osteoarthritis painful complains<sup>(29,25)</sup>.

The popular Orthopaedic feet complain regarding HV directly correlates with its severity and its progressive course, even after surgical management it has a recurrence rate is high nearby 15%<sup>(10)</sup>. Where painful complains arise from altered kinetic that aggravated planter pressure that serves as a prime indicator for feet and ankle functioning throughout daily activities, as well painful complains arise from negative adaptations for altered kinematics across gait cycle that massively influence progressive HV maneuver<sup>(27)</sup>. A recent systematic review with meta-analysis recommends to verify the suitable orthotic modality to realignment the anatomical HA angle in line to relieve foot painful complains<sup>(30)</sup>.

### **Conclusion:**

The progressive hallux valgus almost often leads to functional dependency that worsening quality of life. Up to date on current knowledge, hallux valgus has remarkable negative influences on overall and postural stability those directly correlated with its severity in terms of regression of individual's functional capabilities, and aggravating incidence of falling.

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### **Conflict of Interest:**

The authors declare no conflicts of interest. None of the authors have any other financial or personal relationships that could inappropriately influence or bias the content of the current article.

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