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Original Article

A new method for measuring hindfoot alignment: Reliability and temporal stability

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Abstract

Objective: To evaluate the interobserver reliability and temporal stability of an adapted Van Dijk-Asaumi method for measuring coronal hindfoot alignment.

Methods: A cross-sectional, analytical, and prospective study including 42 adults without clinically apparent foot deformities. Weight-bearing radiographs were obtained in the anteroposterior, profile, and long axial views of the calcaneus. Hindfoot alignment was measured using a novel adapted method by Van Dijk-Asaumi and assessed by four evaluators with different levels of experience. Interobserver reliability and test-retest reliability were assessed using the intraclass correlation coefficient (ICC). The standard error of measurement (SEM) and the minimal detectable change (MDC) were also calculated. Additionally, Bland-Altman analysis was performed, and Lin's concordance correlation coefficient was determined.

Results: Interobserver reliability was moderate, with ICC values ranging from 0.54 to 0.61. Test-retest reliability demonstrated adequate temporal stability, with ICC values between 0.57 and 0.61. The SEM was low (0.12°-0.14°), with an MDC below 0.4°. Bland-Altman analysis revealed negligible systematic bias and narrow limits of agreement. Lin's concordance correlation coefficient indicated near-perfect agreement (0.996-0.997). The adapted method demonstrated low measurement error and adequate temporal stability, though only moderate interobserver reliability (ICC 0.54-0.61).

Conclusions: The novel method demonstrated low measurement error, adequate temporal stability, and moderate overall interobserver agreement, establishing itself as a practical, objective, and reliable alternative for the quantitative assessment of hindfoot alignment in clinical practice.

Level of evidence III; Methodological, Cross-sectional, Analytical, and Prospective Study.

Keywords: Talus; Calcaneus; Foot deformities; Observer variation; Reference values.

Introduction

The posterior region of the foot, formed by the talus and calcaneus bones, is known as the hindfoot. It is delimited by the tibiotalar joint and the transverse tarsal joint distally[1]. It stands out as an important region for weight-bearing distribution and alignment between the ankle and forefoot, contributing to impact absorption and gait biomechanics[2].

To compare ankle deformities in patients with significant orthopedic complaints, it is paramount to understand what constitutes a healthy, function-preserved foot. Therefore, the alignment of a healthy foot presents an aligned calcaneus, with no significant deviation in valgus or varus, allowing the line of the leg axis to be aligned with the center of the calcaneus and the medial longitudinal arch to maintain the proper height, providing adequate functionality with good impact absorption and adequate weight distribution[3-5].

Deformities in valgus and varus present high morbidity, thus interfering with the patient's quality of life. The valgus hindfoot has the calcaneus deviated medially, with support

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from the medial edge of the foot, and is often associated with conditions such as flatfoot[3]. This contributes to the appearance of hyperpronation gait and medial arch collapse, often clinically, with important pain syndrome, in addition to causing tendinitis of the posterior tibialis, while in the varus hindfoot, the calcaneus is laterally deviated, with the support on the lateral edge of the foot, thus associated with the existence of the cavus foot[3]. It presents with a rigid gait with less impact absorption, predisposing to sprain.

In this context, changes in the hindfoot interfere with the entire kinetic chain of movement, affecting joints such as the knee and hip that are part of the lower limbs' movement; the final route of these deformities is degeneration, loss of function, and pain[6]. Thus, it is understandable that there is concern among orthopedists, especially foot and ankle specialists, about determining these deformities not only qualitatively through clinical examination but also quantitatively to achieve a more objective and grounded management approach.

In the radiographic evaluation, changes in angular parameters objectively indicate hindfoot deformities, providing greater safety in evaluation and clinical decision-making. Studies have shown the superiority of radiographic measurements regarding the use of the goniometer in clinical examination[7-9] (Figure 1).

It is important to note that weight-bearing anteroposterior (AP) and profile (P) radiographs of the ankle are not applicable due to the overlapping of bones[10], there are other views to measure these deformities, but they are not routinely used in clinical practice due to the technical requirements for their execution. In this context, a long view of the calcaneus relates the calcaneus to the leg and prioritizes visualization of the subtalar joint, making it an excellent view for the analysis and surgical planning of patients with angular hindfoot deformities[11].

Figure 1. Hindfoot ectoscopy.

Although the Van Dijk method is validated and widely cited, its practical application is limited because it requires identifying two specific anatomical points on the calcaneus (at 30 mm and 7 mm from the distal surface), which can introduce variability among observers and hinder its adoption in clinical practice. The proposed adaptation, called the Van Dijk-Asaumi method, aims to reduce this variability by replacing the first point with the crossing of the tibial axis with the subtalar joint, thereby simplifying the process while maintaining technical rigor.

Given the above, this study has as its primary objective to evaluate the interobserver reliability and temporal stability of an adaptation of the Van Dijk method (called Van Dijk-Asaumi) to measure the hindfoot coronal alignment. As a secondary objective, to correlate the measurements obtained by this adapted method with conventional radiographic parameters of the foot (Kite, Meary, and calcaneal pitch angles) to characterize the studied sample.

Methods

A cross-sectional, analytical, and prospective study was conducted in the orthopedics outpatient clinic of a tertiary hospital in São Bernardo do Campo, SP, Brazil, after approval by the Institutional Review Board. Data were collected after signing the Informed Consent Form and obtained from the institutional electronic medical record, as authorized by the institution.

Individuals aged 18 years or older, without apparent clinical deformities in the foot and ankle and without musculoskeletal comorbidities that could interfere with the hindfoot alignment, were included. Patients unable to maintain weight-bearing support, non-ambulators, or those who did not agree to participate in the study were excluded.

The sample size was defined based on reliability studies using the intraclass correlation coefficient (ICC). Considering an expected ICC of 0.60, 80% power, a 5% significance level, and two measurements per individual, the calculation indicated the inclusion of at least 40 participants. To compensate for possible losses, 42 individuals were recruited.

Weight-bearing radiographs were obtained in the AP, P, and long axial views of the calcaneus. In Van Dijk's method[12], an existing method for visualizing hindfoot alignment, a cassette box with a Plexiglas surface was used, with a radiation source configuration of 4 mAs and 50 kV, a focal length of 100 cm, and the beam directed at the ankle joint.

To record the long axial view, the film cassette was laid on the floor. The volunteers stood on the cassette and were asked to maintain a dorsal ankle flexion of 10°, which was verified with a goniometer. The beam configurations were the same as the hindfoot alignment view, but the beam inclination angle was 45° to the ground (Figure 2).

Both feet were positioned in internal rotation so that they were parallel, and images were taken in bilateral posture, with the feet positioned 80mm apart and the medial edges of the feet parallel.

For radiographic measurements (Figure 3), according to Van Dijk, the mid-diaphyseal tibial axis is traced by dividing the tibia into two mid-diaphyseal points 30 mm apart and extending the line distally.

The calcaneal axis is traced by connecting:

a) First: The midpoint of a horizontal line 30mm proximal to the most distal part of the calcaneus.
b) Second: At 7 mm from the most distal part of the calcaneus, a horizontal line is drawn and divided in a 40%/60% ratio, with the 40% length measured from the lateral face.

For the proposed adapted method (Van Dijk-Asaumi), the mid-diaphyseal tibial axis is traced as originally described. For the calcaneal axis, the first anatomical point is defined as the intersection of the axis line of the distally extended tibia and the subtalar joint, radiographically identified as the articular space between the talus and the calcaneus. The second point is defined 7 mm from the most distal surface of the calcaneus, on a horizontal line. From the lateral face, a 40%/60% ratio is traced, and the resulting point is connected to the first point to form the calcaneal axis. The backfoot angle is formed by the intersection of the two axes (Figure 4).

In addition to this method, conventional radiographic parameters of the foot were measured, including talocalcaneal angle (Kite) in AP and P views, Meary's angle in AP and P views, and calcaneal pitch in both feet.

The images were independently assessed by four evaluators with different levels of experience in foot and ankle, including a foot and ankle specialist with ten years of experience, a foot and ankle specialist with five years of experience, a fellow orthopedist (Resident level 4) in foot and ankle surgery, and a first-year resident in orthopedics and traumatology. Each evaluator performed all measurements without access to the others' results. For radiographic sample characterization, the Kite, Meary, and calcaneal pitch angles were initially obtained separately for each evaluator and each foot. Then, the mean of the four evaluations was calculated for each parameter, and these values were used to describe the sample data. The results were expressed as the mean and standard deviation, separately for the right and left feet.

The reliability of the Van Dijk-Asaumi method was assessed from the individual measures of each evaluator. Interobserver reliability was estimated using the intraclass correlation coefficient (ICC) with the two-way random, absolute agreement, single-measure (ICC2) model. The test-retest reliability was evaluated by repeating the measurements after one month, with recalculation of the ICC2 to assess the method's temporal stability. The standard error of measurement (SEM) was calculated from the ICC, and the minimum detectable error (MDC) was estimated as $MDC = 1.96 \times \sqrt{2} \times SEM$. The agreement between the measures was also evaluated using Bland-Altman charts, which are used to

Figure 2. Long axis of the calcaneus, according to Reilingh et al.[1].

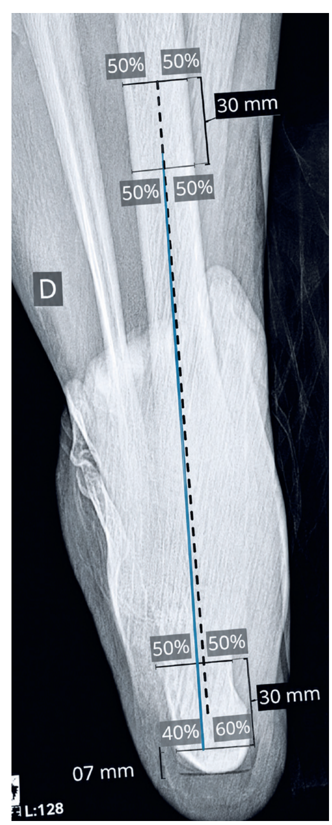

Figure 3. Original Van Dijk method.

identify possible systematic biases between the evaluators and the limits of agreement between the measurements. All statistical analyses were performed using Jamovi software version 2.6.44.0.

Results

Forty-two individuals were included, with a mean age of 48.3 ± 15.1 years and a mean body mass index of 27.2 ± 5.1 kg/m^2. The sample had a balanced sex distribution, with 21 men (50.0%) and 21 women (50.0%). Regarding skin color, 18 participants (42.9%) were classified as white and 24 (57.1%) as non-white (Table 1).

The radiographic characterization of the sample is detailed in Table 2, where mean values compatible with structurally normal feet are observed, including Kite, Meary, and calcaneal pitch angles within the reference ranges described in the literature. Thus, these results confirm that the sample consisted of feet radiographically within normal standards.

The reliability of the Van Dijk-Asaumi method is presented in Table 3. The interobserver reliability, assessed using the ICC2, was 0.54 (95% CI, 0.15-0.76) for the right foot and 0.61 (95% CI, 0.22-0.80) for the left foot, indicating moderate interrater agreement. The test-retest reliability was also moderate, with ICC2 values of 0.57 (95% CI, 0.16-0.78) in the right foot and 0.61 (95% CI, 0.20-0.80) in the left foot. The SEM was low for both sides, with values of 0.14° for the right foot and 0.12° for the left, corresponding to MDCs of 0.40° and 0.34°, respectively. These results indicate that variations of less than approximately 0.4° can be attributed to the measurement error of the method. The values of the backfoot angle obtained by the Van Dijk-Asaumi method were, in the right foot, a mean of 2.3° ± 1.1° (amplitude: -0.5° to 4.8°) and, in the left foot, a mean of 2.4° ± 1.0° (amplitude: -0.3° to 4.9°). These values represent the normal range in a population without apparent deformities and serve as a preliminary reference for future studies (Table 3).

The concordance analysis by the Bland-Altman method confirmed the high temporal stability of the method (Figure 5). For the right foot, the mean bias between test and retest

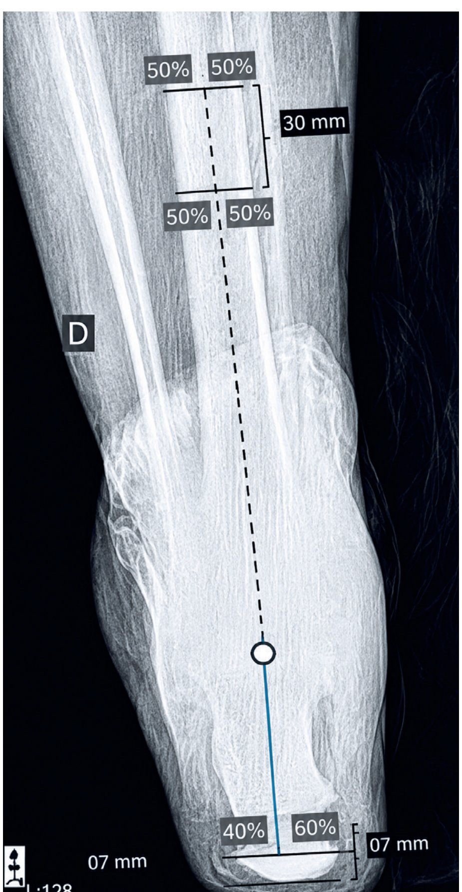

Figure 4. Proposed Van Dijk-Asaumi method.

Table 1. Sociodemographic and clinical characteristics of the sample (n = 42)

Variable	n (%) or mean ± SD	Min-Max
Age (years)	48.3 ± 15.1	22-75
BMI (kg/m^2)	27.2 ± 5.13	18.7-37.2
Sex		
Female	21 (50.0)	-
Male	21 (50.0)	-
Skin color		
White	18 (42.9)	-
Non-white	24 (57.1)	-

SD: Standard deviation; BMI: Body mass index

Table 2. Radiographic characterization of the feet (n = 42)

Parameter	Right foot	Left foot
Anteroposterior talocalcaneal angle (Kite) (°)	33.0 ± 1.5	32.9 ± 1.6
Profile talocalcaneal angle (Kite) (°)	25.5 ± 1.9	25.5 ± 1.8
Anteroposterior Meary angle (°)	0.54 ± 0.79	0.57 ± 0.80
Profile Meary angle (°)	0.52 ± 0.85	0.51 ± 0.80
Calcaneal pitch angle (°)	22.9 ± 1.4	22.9 ± 1.4

Values expressed as mean ± standard deviation.

Table 3. Reliability of the Van Dijk-Asaumi method

Analysis	Right foot	Left foot
Interobserver (ICC2)	0.54 (0.15-0.76)	0.61 (0.22-0.80)
Test-retest (ICC2)	0.57 (0.16-0.78)	0.61 (0.20-0.80)
SEM (°)	0.14	0.12
MDC (°)	0.40	0.34

Note: Values presented as ICC (95% CI), SEM: Standard error of measurement; MDC: Minimum detectable change.

was +0.006°, with limits of agreement from -0.08° to +0.10°, demonstrating the absence of systematic bias and low dispersion of differences. For the left foot, the mean bias was -0.010°, with limits of agreement from -0.09° to +0.07°, with a similar pattern. On both sides, the points showed a homogeneous distribution around the zero line, with no proportional tendency or heteroscedasticity.

In addition, Lin's concordance correlation coefficient was 0.996 for the right foot and 0.997 for the left foot, indicating almost perfect agreement between the test and retest measurements. Altogether, these findings demonstrate that the Van Dijk-Asaumi method presents high temporal stability, low measurement error, and excellent overall agreement, even when applied by evaluators with different levels of experience (Figure 5).

Discussion

The present study evaluated the reliability and temporal stability of the adapted Van Dijk-Asaumi method to measure the hindfoot coronal alignment. The results showed that the method has low measurement error, excellent temporal stability, and near-perfect test-retest agreement, even when applied by evaluators with different levels of experience. These findings reinforce the potential of the method as a reproducible and clinically useful tool, corroborating the search for simplified and reliable radiographic techniques for hindfoot evaluation, as explored in the literature[13].

In recent years, weight-bearing computed tomography (WBCT) has been considered the gold standard for three-dimensional assessment of hindfoot alignment. However, its high cost, limited availability, and greater radiation exposure limit its use as a first-line exam. The simple radiographic method proposed here supports relevant clinical analysis, especially in resource-limited services, as a screening examination and for longitudinal follow-up.

The radiographic characterization of the sample, which included measures such as Kite and Meary angles, confirmed that the individuals studied had feet structurally within normal parameters[13]. Establishing this baseline in a population without major deformities is very important, as it minimizes the influence of extreme anatomical variations, allowing to test the accuracy of the measurement method under more controlled and clinically relevant conditions.

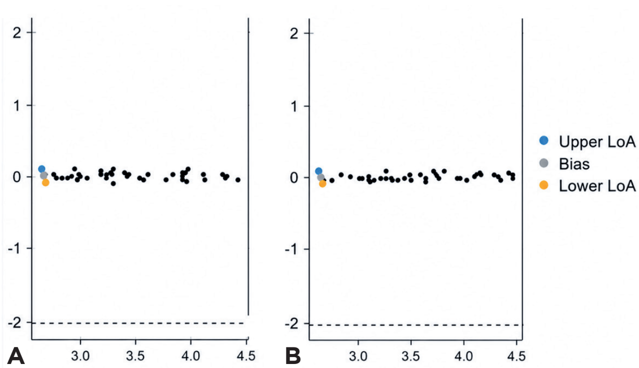

Figure 5. Bland-Altman plots showing agreement between test and retest for the Van Dijk-Asaumi method on the right (A) and left (B) feet.

The interobserver reliability of the method presented moderate values that, although not reaching the range considered excellent according to some criteria[14], are compatible with the performance observed in other radiographic methods of hindfoot alignment that depend on the manual identification of anatomical points[1,15]. Although we have not made a direct comparison between the Van Dijk-Asaumi method and established radiographic methods (original Van Dijk, Saltzman hindfoot alignment view) or with WBCT, it is possible to contextualize our findings with the literature. Reilingh et al.[1] reported ICCs of 0.61-0.77 for the long axial view of the calcaneus, while Saltzman and El-Khoury[8] found ICCs of 0.58-0.68 for the hindfoot alignment view. The main justification for the proposed adaptation lies in simplifying the identification of anatomical points. While Van Dijk's original method requires the demarcation of 30 mm from the distal surface of the calcaneus, a technically challenging and error-prone procedure, especially in bones with irregular morphology, our adaptation uses the crossing of the tibial axis with the subtalar joint. This anatomical point is consistently visualized in the long axial view of the calcaneus, and its identification requires less geometric inference from the evaluator. Although the interrater reliability of the adapted method (ICC 0.54-0.61) was only moderate and did not exceed the values reported for the original method, we believe that simplifying the process can facilitate training new raters and reduce variability in clinical settings with varying levels of experience. Future studies with a direct comparison design between the two methods are needed to test this hypothesis.

In practice, small variations between observers are common, especially when they involve professionals at different stages of training[15]. Therefore, moderate reliability reflects more the inherent variability of image interpretation than an intrinsic limitation of the proposed protocol.

On the other hand, the high temporal stability of the method, as measured by the Bland-Altman analysis[16], showed practically no bias and narrow limits of agreement, with values much lower than the estimated MDC. Lin's concordance correlation coefficient close to 1 reinforces this observation, indicating almost perfect agreement between measurements taken at different times. These findings suggest that when the technique is repeated under the same conditions, the method produces highly consistent results, a key attribute for serial clinical monitoring of patients.

From a clinical point of view, the low magnitude of the measurement error is particularly relevant. An MDC of less than 0.4° indicates that small angular variations, but greater than this threshold, observed in serial examinations, have a high probability of representing real changes in hindfoot alignment, and not method fluctuations[16]. This suggests that the method could be sensitive to angular changes greater than 0.4°, although this hypothesis has yet to be confirmed in studies with patients with progressive deformities. This potential is clinically relevant both for the evolutionary follow-up of deformities and for the evaluation of response to therapeutic interventions, filling a need pointed out in studies that compare clinical and imaging evaluations[17].

An apparent discrepancy between the moderate ICC (0.54-0.61) and the near-perfect Lin coefficient (0.996-0.997) can be explained by the distinct nature of these indices. The ICC is sensitive to systematic variability among raters, as present in our intentionally heterogeneous sample (residents and specialists). The Lin coefficient and the Bland-Altman analysis evaluated the pairwise agreement and temporal stability, which were adequate under standardized conditions. Therefore, the results are not contradictory, but complementary.

Another important aspect is that the analysis included raters with different levels of experience. The fact that excellent temporal stability was maintained regardless of the evaluator reinforces the method's applicability across heterogeneous teaching and clinical practice environments. In the literature, reliability studies in foot and ankle radiology often highlight the evaluator's experience as a critical factor for reproducibility[18]. In this context, our results are promising, suggesting that with a well-defined protocol and standardized basic training, the adapted Van Dijk-Asaumi method can be safely incorporated into clinical routine and resident training, mitigating the variability traditionally associated with the learning curve and facilitating its wider adoption.

In summary, the adapted Van Dijk-Asaumi method proved to be a radiographic technique with excellent temporal stability, low measurement error, and high test-retest agreement. Its simplicity and robust performance, even among evaluators with different experience, make it a practical and promising alternative for the quantitative evaluation of hindfoot coronal alignment in clinical practice and future research.

We recognize as main limitations of this study the exclusive inclusion of individuals without apparent clinical or radiographic deformities, which limits the clinical validity of the method in populations with deformities; the modest sample size and sample homogeneity, which restrict the generalization of the findings; the only moderate interobserver reliability, which, although compatible with other radiographic methods, indicates that the method is not exempt from interrater variability; the absence of direct comparison with established methods (Van Dijk original, Saltzman, WBCT) in the same study, which prevents a definitive conclusion on superiority or equivalence; the impossibility of affirming, based on current data, sensitivity to detect subtle clinical changes over time, once progressive. Future studies with clinical samples, including patients with varus and valgus deformities, are needed to validate the method under these conditions and determine its diagnostic accuracy.

Conclusion

The adapted Van Dijk-Asaumi method demonstrated adequate temporal stability and low measurement error, but only moderate interobserver reliability. Although the results are promising, clinical validation in populations with deformities is still required before recommendation for widespread clinical use. The method is currently configured as a technical alternative for future studies and for use in resource-limited contexts, provided that its limitations are recognized.

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References

1. Reilingh ML, Beimers L, Tuijthof GJM, Stufkens SAS, Maas M, van Dijk CN. Measuring hindfoot alignment radiographically: the long axial view is more reliable than the hindfoot alignment view. Skeletal Radiol. 2010;39(11):1103-8.
2. Smitaman EE, Davis M. Fractures of the hindfoot: injury patterns and relevant imaging findings. Radiographics. 2022;42(3):661-82.
3. DuBois KS, Cates NK, O'Hara NN, Lamm BM, Wynes J. Coronal hindfoot alignment in midfoot Charcot neuroarthropathy. J Foot Ankle Surg. 2022;61(5):1039-45.
4. Kiener AJ, Hanna TN, Shuaib W, Datir A, Khosa F. Osseous injuries of the foot: an imaging review. Part 3: the hindfoot. Emerg Med J. 2017;34(5):337-43.
5. Lin YC, Kwon JY, Ghorbanhoseini M, Wu S. The hindfoot arch: what role does the imager play? Radiol Clin North Am. 2016;54(5):951-68.
6. Pavani C, Belvedere C, Ortolani M, Girolami M, Durante S, Berti L, et al. 3D measurement techniques for the hindfoot alignment angle from weight-bearing CT in a clinical population. Sci Rep. 2022;12(1):16900.

7. Elveru RA, Rothstein JM, Lamb RL. Goniometric reliability in a clinical setting: subtalar and ankle joint measurements. Phys Ther. 1988;68(5):672-7.
8. Saltzman CL, El-Khoury GY. The hindfoot alignment view. Foot Ankle Intern. 1995;16(9):572-6.
9. Ozaki Y, Hara R, Okamura K, Kurokawa H, Inagaki Y, Ogawa M, et al. Correlation between varus-type knee osteoarthritis severity and hindfoot alignment: analysis of radiographs in the long-leg weight-bearing anteroposterior view. PloS One. 2025;20(6): e0324974.
10. Weseley MS, Koval R, Kleiger B. Roentgen measurement of ankle flexion-extension motion. Clin Orthop Relat Res. 1969;65:167-74.
11. Johnson JE, Lasmdan R, Granberry WF, Harris GF, Carrera GF. Hindfoot coronal alignment: a modified radiographic method. Foot Ankle Int. 1999;20(12):818-25.
12. Kleiger B, Mankin HJ. A roentgenographic study of the development of the calcaneus by means of the posterior tangential view. J Bone Joint Surg. 1961;43(7):961-9.
13. Benevides PC, Nery CA de S, Godoy-Santos AL, Marion Alloza JF, Prado MP. Study of the radiographic parameters of normal ankles: literature review and technical recommendations. J Foot Ankle. 2020;14(1):84-8.
14. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med. 2016;15(2):155-63.
15. Robinson I, Dyson R, Halson-Brown S. Reliability of clinical and radiographic measurement of rearfoot alignment in a patient population. The Foot. 2001;11(1):2-9.
16. Cao X, Bai Z, Sun C, Wen J, Lin X, Sun W. Bland-Altman analysis of different radiographic measurements of the hallux valgus angle and the intermetatarsal angle after distal osteotomy. Orthop Surg. 2020;12(6):1621-6.
17. Papineni VRK, Mariathas M, Sidhu SS, Chari B. Imaging modalities for non-acute pathologies of the foot and ankle. J Clin Orthop Trauma. 2024;48:102329.
18. Carula BC, Giostri GS, Bebber F, Batista MFS, Silva FB, Novak EM. Evaluation of intra- and interobserver reproducibility of the new AO/OTA classification for distal radius fractures compared with the Fernandez classification. Rev Bras Ortop. 2022:57(6):917-23.