Bone & Joint Research

Supplementary Material

10.1302/2046-3758.142.BJR-2024-0172.R2

STROBE Statement—Checklist of items that should be included in reports of case-control studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5

Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	5
		(*b*) For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how matching of cases and controls was addressed	

		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	Tables 2-4
Outcome data	15*	Report numbers in each exposure category, or summary measures of exposure	Tables 2-4
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	7-8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7-8
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title Page

*Give information separately for cases and controls.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Measurement protocol

Landmark annotation

In standard weightbearing position only

An axial view parallel to the ground was used to locate: 1) the malleolar mortise (CM), using a slice passing through the middle of the tibiotalar gap; 2) the centre of the large calcaneal tuberosity, using a slice passing through the lowest point of the calcaneum (Calca); and 3) the lowest point of the head of the fifth metatarsal (M5), using a slice passing through the lowest point of the M5.

In both positions

Proximal and distal points of M1 and the second and third metatarsals (M2 and M3) were positioned in the sagittal plane, along the axis of each metatarsal, and in the axial plane. A line was drawn across the midline of each metatarsal, connecting the centre of the head to the centre of the base. Two equidistant lines were drawn perpendicularly to the previous line, separating the metatarsals in three equal sections. The intersection between the midline and the most proximal and most distal perpendicular lines were respectively identified as the proximal and distal points of each metatarsal. The points were placed equidistantly from the dorsal and plantar borders, and equidistantly from the medial and lateral borders (M1P, M1D, M2P, M2D, M3P, M3D).

A coronal slice of the M1 head, perpendicular to the M1 axis, and 1 cm from the proximal end of M1 was used to place the dorsal (MIPD) and plantar (M1PP) points of the M1 head. The two points were placed on the lateral side of the M1 head visible on the selected slice.

Proximal and distal points for the first phalanx (P1) were identified on an axial view, passing by the most distal point of P1, perpendicular to the P1 axis, and with a correction of P1 pronation. The pronation was corrected by first placing the medial (P1M) and lateral (P1L) points of the phalanx gutter in a coronal plane, perpendicular to the P1 axis, passing by the lowest point of the gutter. The axial slice was then positioned parallel to the line connecting the medial and lateral points of the gutter. Finally, the proximal (P1P) and distal (P1D) points of P1 could be placed.

A coronal slice, perpendicular to the axis of M3, and passing just below the talonavicular cup was used to position the most lateral point of the navicular bone (NavL), followed by the most medial point of the navicular bone (NavM), which was placed the furthest possible from the lateral point.

A vertical coronal slice, perpendicular to the axis of M3, and passing the centre of the medial sesamoid was used to position: 1) the inferomedial and inferolateral points of the M1 head (IM, IL); 2) the superolateral and superomedial points of the M1 head (SL, SM); 3) the most distal points of the lateral and medial sesamoids (SesL, SesM); 4) the middle of the inter-sesamoid gap (CS); 5) the most protruding point of the sesamoid ridge (Crete); and 6) the centre of M2 (M2).

Four points were placed on the first cuneiform bone (C1). In an axial view of C1, parallel to the distal edge of C1, the distal and proximal points of the medial edge C1 were placed (C1MedD, C1MedP). In a coronal view of C1, perpendicular to the medial edge of C1, the distal and proximal points of the lateral edge of C1 were placed (C1D, C1P).

Angle measurements

For each CT scan, the Cartesian coordinates of the digitized points were exported as comma-separated variables (CSV) files, which were then imported into a spreadsheet using Excel (Microsoft, USA), and represented as an array for each foot, in each position.

The foot and ankle offset (FAO) was measured using the method described by Bernasconi et al,[1] in the standard weightbearing position only. All remaining angles were measured for each patient in both standard weightbearing and sesamoid view positions. Depending on the specific angle of interest, we then implemented a projection of coordinates onto distinct planes. The M3 axis, which corresponds to the line between the points M3D and M3P, was used as a reference in measurements performed in sagittal and coronal planes. Angle calculations between two points and the ground were performed by either setting the inferosuperior coordinates to 0, or the lowest value of the two projected points.

A sagittal plane positioned along the M3 axis was used to calculate the metatarsophalangeal (MTP) dorsiflexion. The proximal and distal points of M1 (M1P, M1D) and P1 (PIP, PID) were projected onto the plane, and the angle between the M1 and P1 was calculated (Figure a).

Fig a. Metatarsophalangeal dorsiflexion. a) M1D/M1P placement. b) PID/PIP placement.

A vertical coronal plane, perpendicular to the sagittal plane along the axis of M3, was used to calculate: 1) the sesamoid rotation angle (SRA), by measuring the angle between the line connecting SesM and SesL, and the ground (Figure b); 2) the Saltzman angle or the M1 head pronation, by measuring the angle between the line connecting IM and IL (inferomedial and inferolateral points of the M1 head), and the ground (Figure c); 3) metatarsosesamoid rotation angle (MSRA), by measuring the angle between the line connecting IM and IL, and the line connecting SesM and SesL (Figure d); and 4) the M1 base pronation, by measuring the angle between the line connecting M1PD and M1PP (dorsal and plantar points of the proximal end of the M1 head), and the ground (Figure e).

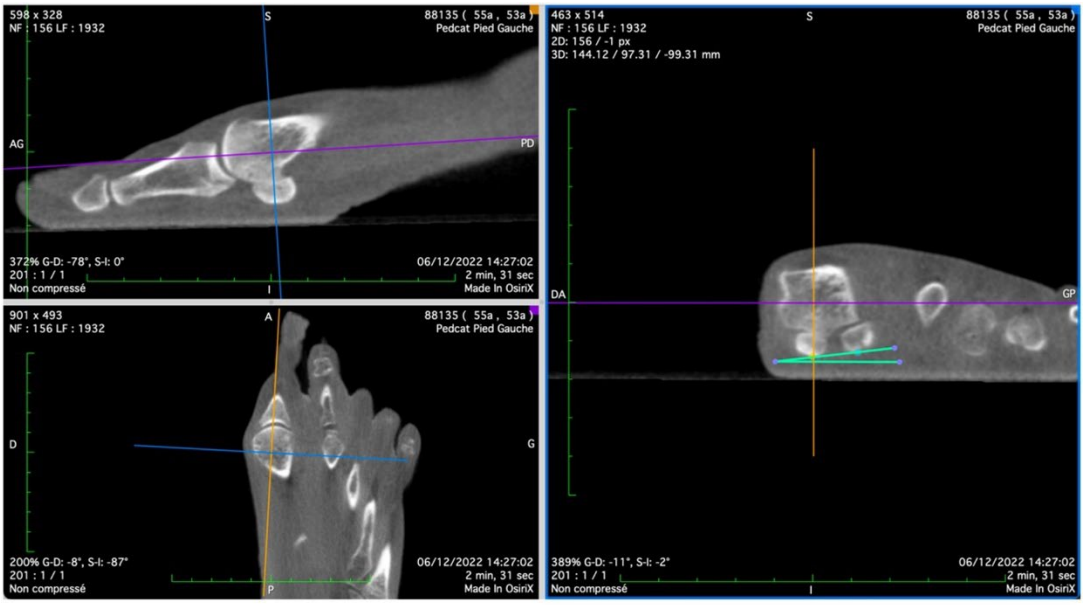

Fig b. Sesamoid rotation angle.

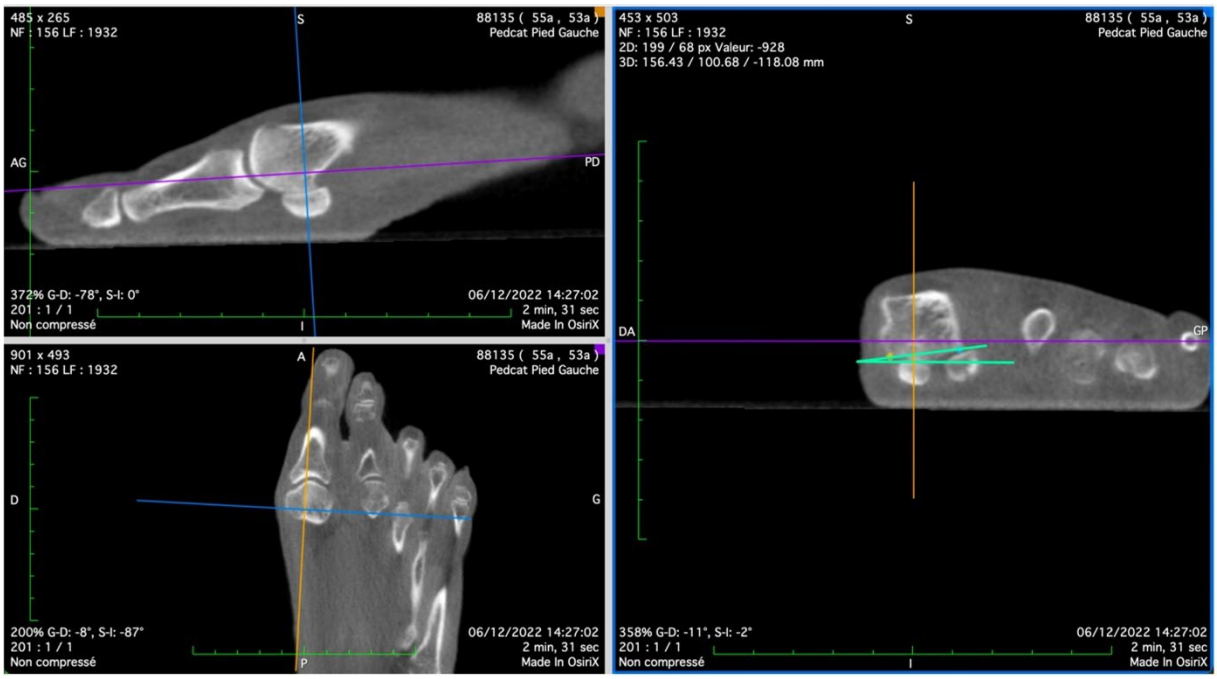

Fig c. Saltzman angle.

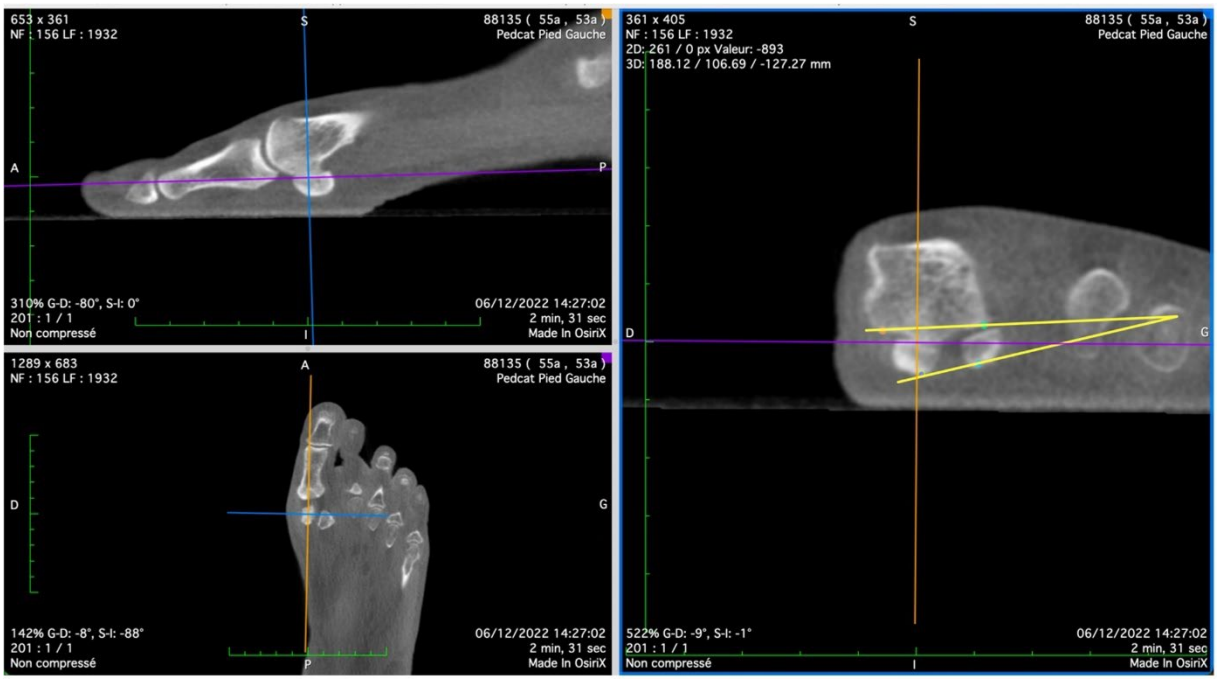

Fig d. Metatarsosesamoid rotation angle.

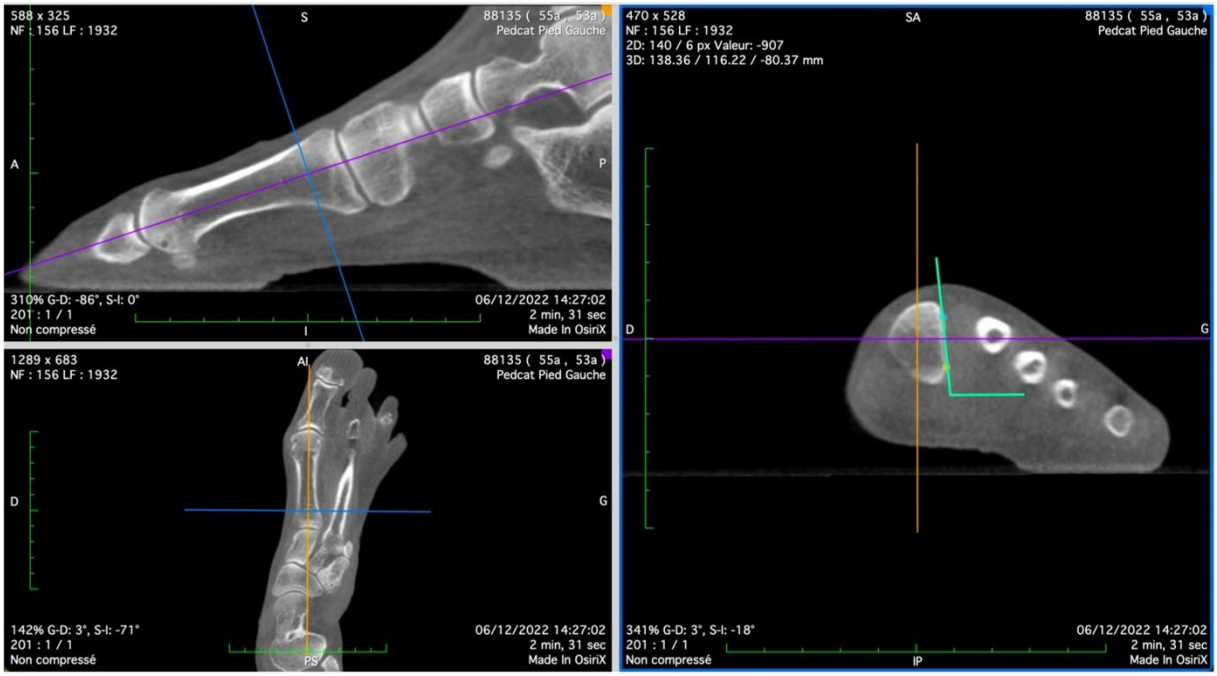

Fig e. M1 base pronation angle.

A coronal plane, perpendicular to the axis of M3, was used to calculate the navicular pronation angle, by measuring the angle between the line connecting NavM and NavL, and the ground (Figure f).

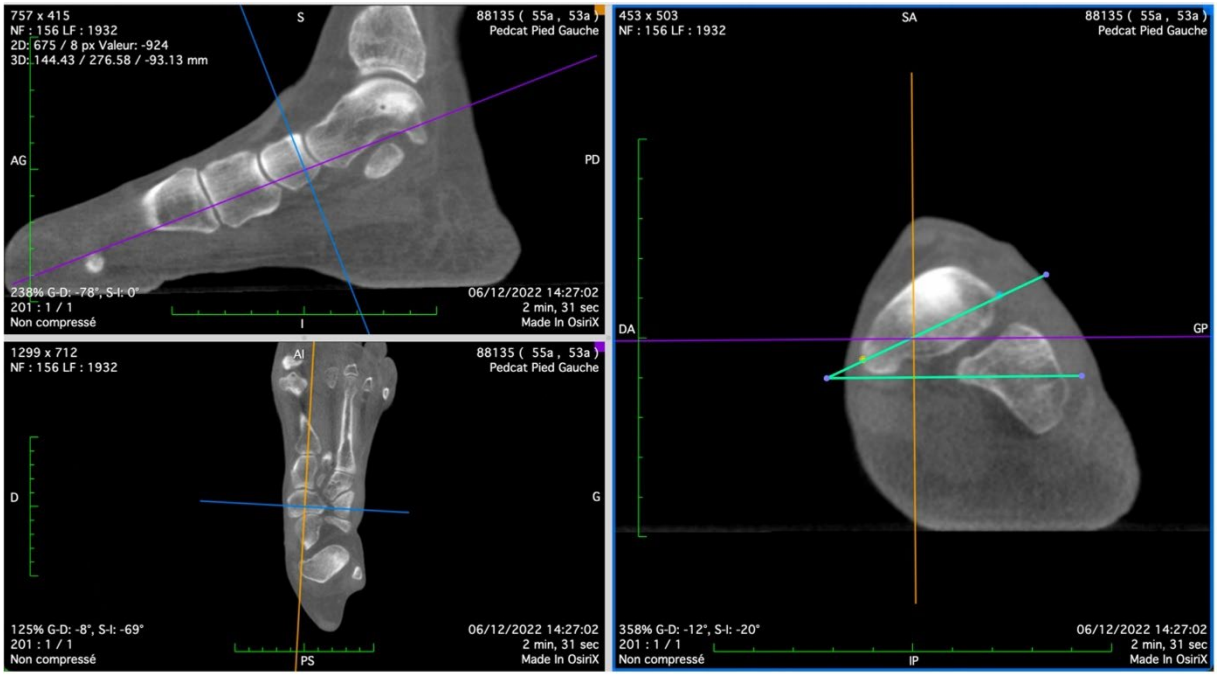

Fig f. Navicular pronation angle.

An axial plane with a 15° inclination along the mediolateral axis was used to calculate: 1) the inter-metatarsal angle (IMA), by measuring the angle between the line connecting M1P and M1D, and the line connecting M2P and M2D (Figure g); and 2) the hallux valgus angle (HVA), by measuring the angle between the line connecting M1P and M1D, and the line connecting P1P and P1D (Figure h).

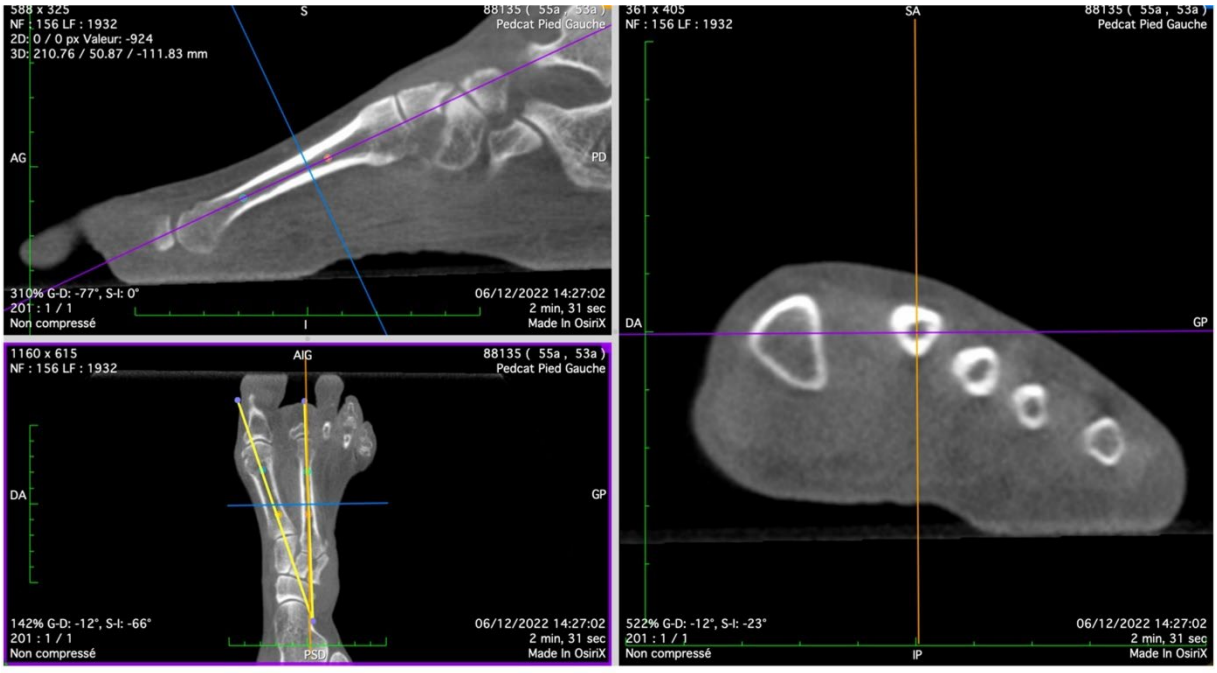

Fig g. Intermetatarsal angle.

Fig h. Hallux valgus angle.

Finally, raw measurements with no projection were used to calculate: 1) the pronation of P1, by measuring the angle between the line connecting PIM and PIL, and the ground; and 2) the sesamoid subluxation, by measuring the absolute distance between Crete and CS (Figure i).

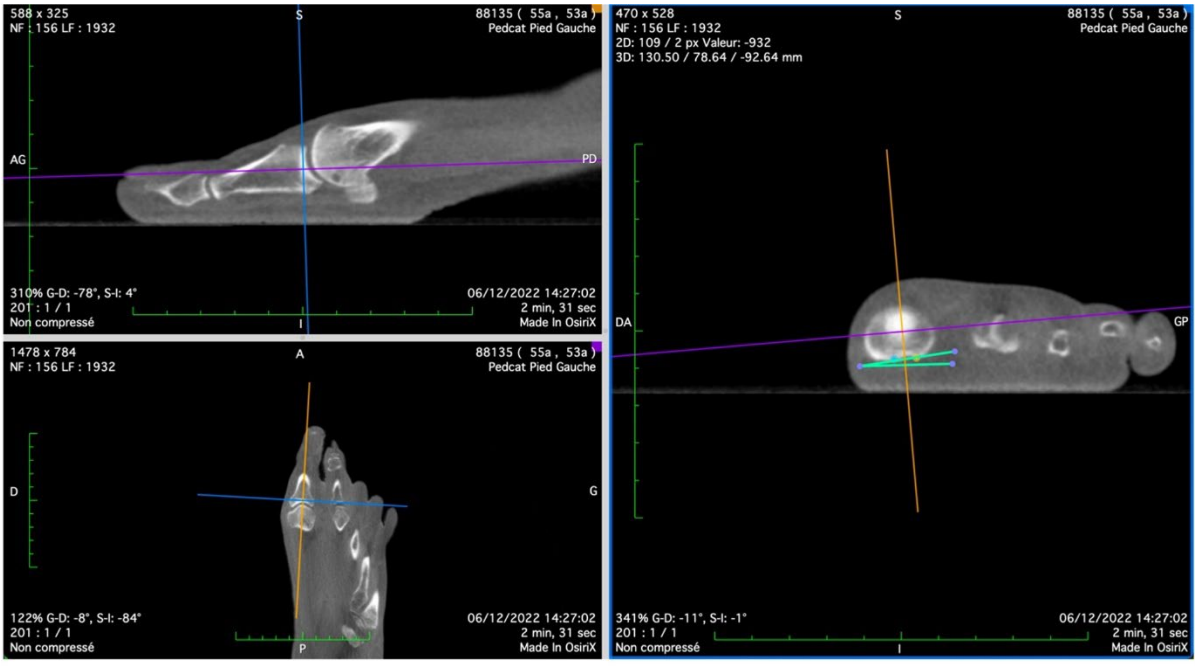

Fig i. Phalangeal pronation angle.

References

1. **Bernasconi A, Cooper L, Lyle S, et al.** Intraobserver and interobserver reliability of cone beam weightbearing semi-automatic three-dimensional measurements in symptomatic pes cavovarus. *Foot Ankle Surg*. 2020;26(5):564–572.