Females Are Not Proportionally Smaller Males: Relationships Between Radius Anthropometrics and Their Sex Differences

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Abstract

Background: Distal radius fracture reduction by internal fixation is most commonly achieved using volar locking plates (VLPs). Many standard VLP designs make little point contact with radius anatomy, and most postsurgical complications following fixation are attributed to poor implant fit. Sex differences may require consideration in implant design, as females more commonly require VLP removal. Therefore, the purpose of this research was to determine whether the relationships between measures of radius shape are proportional between the sexes. **Methods:** Three-dimensional radius bone geometries were created from 40 male and 34 female (mean age = 72.04 years) forearm computed tomographic scans in Mimics (Materialise NV, Leuven, Belgium). Eleven measures of radius shape were collected from each scan. Principal components analysis was performed on these measures to determine which shape variables account for the greatest differences in radius shape among individuals and between the sexes. **Results:** Principal component scores representing isometric radius size separated the sexes. Six anthropometric measures significantly correlated with isometric radius size for all specimens, whereas 3 and 1 measures significantly correlated with isometric radius size in males and females, respectively. **Conclusions:** Anthropometrics of male and female radii vary by different proportions. Using anthropometrics from both sexes to create a single implant system may not result in optimal patient fit for either sex.

Keywords: anthropometrics, implant, principal components analysis

Introduction

Distal radius fractures account for 18% of all fractures in individuals older than 65 years, making them among the most common upper extremity fractures in this population.¹ This is partially attributed to longer life expectancies and older adults living more active lifestyles, which has also resulted in a greater demand for improved functional outcomes following treatment.² It is well regarded that stable fixation of bone fragments, and subsequent healing following fracture, depends on achieving anatomic union between fracture fragments.³ Volar locking plate fixation has become the most common internal fixation method for patients with distal radius fracture,^{4,5} as it allows for early wrist mobilization and high stability of fracture fragments.⁶ Although its use has doubled in the past decade,⁴ there remain significant surgical complications associated with the procedure, including incomplete reduction/loss of internal fixation (3%-7%), loss of joint/body segment movement (<1%), and issues related to overlying nerves and

tendons (eg, carpal tunnel syndrome, generalized pain; 7.5%-14%).^{4,7,8} Most complications related to implant systems have been attributed to inadequate fit of the implant to the patient's anatomy.⁹ Buzzell et al¹⁰ found that many popular volar locking plate designs produced less than 6% point contact with the underlying radius after placement at its site of best fit. This may partially explain the 18% of cases where complications arise following distal radius reduction using volar locking plates.⁸

Orthopedic implant design has traditionally relied on a small number of anatomic measurements to design scaled versions of the average implant.¹¹ However, it has been

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Table 1. Descriptions of the Anthropometric Measurements and the Process Followed in the Mimics Software.

Measurement	Definition
Distal radius height	Distance between the radial styloid and a point in the sagittal plane that intersects a plane 90° to the long axis of the distal radius (at superior limit of the sigmoid notch)
Radial inclination	Distance between the radial styloid and 2 points, at the medial and lateral radius, along a plane 90° to the long axis of the distal radius (at superior limit of the sigmoid notch)
Volar/palmar inclination	Distance between the tallest point on the dorsal lip, volar lip, and from a plane 90° to the long axis of the distal radius (at superior limit of the sigmoid notch)
Radius length	Distance between the center of the radial head to the radial styloid
Distal breadth	Distance between the sigmoid notch to the lateral-most edge of radial styloid
Volar lip height	Distance between the tallest point on the volar lip of the distal radius from a point in the same sagittal plane that intersects a plane 90° to the long axis of the distal radius (at superior limit of the sigmoid notch)
Dorsal lip height	Distance between the tallest point on the dorsal lip of the distal radius from a point in the same sagittal plane that intersects a plane 90° to the long axis of the distal radius (at superior limit of the sigmoid notch)
Radius head diameter	Measured using 3 points that encompass the proximal head of the radius at the elbow joint
Sigmoid notch radius of curvature	The radius of a sphere fit to 4 points of the radial aspect of the sigmoid notch
A-P radiolunate articular breadth	Distance between the A-P ridges of the fossa created by the lunate in the articular surface of the radius (A-P breadth taken along the medial-lateral center of fossa)
A-P radioscapoid articular breadth	Distance between the A-P ridges of the fossa created by the scaphoid in the articular surface of the radius (A-P breadth taken along the medial-lateral center of fossa)

Note. A-P = anterior-posterior.

noted that individuals should not be considered as proportionally scaled versions of one another.¹² For example, in total knee arthroplasty (TKA) patients, it was found that the prosthetic sizes chosen by orthopedic surgeons were undersized for patients considered smaller than the 50th percentile and oversized for those considered larger than the 50th percentile.⁹ Hitt et al⁹ and Engelborghs and Kaimal¹¹ also compared the dimensions of 6 different TKA systems with the anthropometrics of patients and concluded that TKA component dimensions were not congruent with patient anatomy. In addition, they indicated that incongruence existed at different anatomic locations for each sex, even after controlling for joint size.

Furthermore, it has been well established that sex differences exist for various anatomic dimensions of the radius, and these have been used to reliably determine sex from unidentified skeletal remains.¹³⁻¹⁵ Despite these sex-related anatomic differences, females are commonly treated as proportionally smaller males during implant surgery, and this may contribute to females making up approximately 61% of the patients who report complications associated with distal radius fixation.¹⁶ To the author's knowledge, no studies have previously examined radius anatomic differences between sexes using clinically relevant anthropometric measures.

Therefore, the purpose of this study was to determine the anthropometric traits that best describe changes in radius morphology and to determine whether these traits are the same in males and females.

Materials and Methods

Three-Dimensional Bone Geometry Development and Evaluation

Seventy-four age-matched (between sexes; 37 males) cadaveric forearms (49 left and 25 right) were imaged using computed tomography (CT) (GE LightSpeed VCT; General Electric Healthcare, Chalfont St Giles, UK; 120 kVp, 100 mA, slice thickness of 0.625 mm). Image data were imported into Mimics Medical imaging software (V19.0; Materialise NV, Leuven, Belgium) and were initially assessed to ensure that none of the specimens presented with any bone-affecting disorders.

The scans were automatically thresholded (Hounsfield unit = 250-3000) to segment the cortical bone from the surrounding tissue, followed by a manual process in which the mask developed from the initial thresholding was edited to separate any voxels adjoining the radius with the scaphoid, lunate, or ulna. Polylines were created for each respective bone mask and were filled to create the final bone geometries; no smoothing algorithms were used. Each 3-dimensional bone geometry was resliced along a line representing the long axis of the radius using the "reslice project" function. This line was used to create a plane perpendicular to the long axis of the radius,¹⁷ thus allowing the creation of a 3-dimensional representation of previously 2-dimensional radiographic angle measurements.

Once the reslicing was completed, 11 anatomic measurements (7 lengths, 2 angles, and 2 diameters) were taken using the measurement tools within Mimics (Table 1). Three

measurements (distal radius height, radial inclination, and palmar inclination) are clinically relevant dimensions commonly used to predict functional outcomes following distal radius fractures.^{17,18} Six measurements (radius length, distal breadth, volar lip height, dorsal lip height, radius head diameter, sigmoid notch radius of curvature) were selected from anthropology studies focusing on sexing human remains using the radius and ulna.^{13,15} Finally, the anterior-posterior (A-P) breadth of the radioscaphoid and radiolunate articular fossae was included as these are important structures in wrist biomechanics. All measurements were taken by the same investigator, and a subsample of 10 randomly selected specimens was remeasured to assess the within-measurer repeatability. A second investigator measured the 10-specimen subsample, allowing assessment of the between-measurer reliability.

Statistical Analysis

Between- and within-measurer reliability of the anthropometric measurements was assessed using intraclass correlation coefficients (ICCs). A 2-way random, absolute agreement, single-measure model was used to determine the degree of reliability according to the following scale: less than 0.40 = poor, between 0.40 and 0.59 = fair, between 0.60 and 0.74 = good, and above 0.75 = excellent.¹⁹ Furthermore, an independent samples *t* test was performed to determine whether there was a significant sex effect on each of the 11 anthropometric variables.

A log transformation was performed on the measurements to reduce the influence of outliers (determined by SPSS) on the analysis,^{20,21} and to standardize unit variance for the different variables measured.²² To examine the relationships between the anthropometric variables of the radius, a principal components analysis (PCA) was performed for all specimens (PCA_{all}) that included all radius lengths (7), angles (2), and diameters (2). A scree plot (Figure 1), created from the eigenvalues from each resulting principal component (PC), was generated to determine the number of PCs that would be further analyzed.²³ The PCs to the left of the point of inflection (ie, where the negative slope of the line between plot points visually begins to approach zero) were included in the analysis.²⁴ A PC factor score was also calculated for each individual specimen, and scatterplots were developed comparing PC1 and PC2 to examine whether the sexes are differentiated by these PCs.

The steps described above were then repeated on data sets that included only the male (PCA_{male}) and only the female (PCA_{female}) measurements to assess whether the same shape variables from each sex significantly correlated with each PC. A Pearson correlation was performed to determine the relationship between variables that were identified as significant contributors to each of the PCA analyses (PCA_{all}, PCA_{male}, PCA_{female}), with 0.70 used as a criterion to signify a

Figure 1. Scree plots for log-transformed variables of (a) all specimens, (b) only male specimens, and (c) only female specimens.

strong relationship. Finally, a Mantel test was conducted to determine the correlation between the male and female correlation matrices (including all variables). The Mantel test quantifies the relationship of anthropometric traits between males and females and whether these change proportionally in relation to radius size. All statistics were performed using SPSS 22.0 (IBM SPSS statistics; IBM Corporation, Somers, New York), and α was set at 0.05.

Results

The specimens had a mean (SD) age, weight, and height of 72.04 (14.18) years, 65.78 (22.34) kg, and 1.69 (0.11) m,

Table 2. Comparison of the Mean (SD) Anthropometric Measurements Between Males and Females, and the Between-Measurer and Within-Measurer ICCs.

Measurement	Mean		95% CI	ICC	
	Male	Female		Within	Between
Radius length, mm	254.01 (15.99)	223.34 (11.98)*	24.76 to 38.46	0.999	0.999
Distal breadth, mm	33.88 (1.65)	28.95 (1.60)*	3.80 to 5.51	0.984	0.907
Distal radius height, mm	12.94 (1.46)	11.00 (1.35)*	1.38 to 2.82	0.925	0.994
Radial inclination, deg	24.31 (2.20)	23.65 (2.74)	−0.51 to 2.25	0.882	0.949
Volar lip height, mm	3.90 (0.87)	3.32 (1.07)*	0.14 to 1.04	0.851	0.974
Dorsal lip height, mm	7.13 (1.18)	6.31 (1.08)*	0.33 to 1.40	0.856	0.863
Palmar inclination, deg	8.83 (2.77)	10.95 (3.39)	−3.18 to 0.10	0.658	0.908
Sigmoid notch curvature, mm	17.51 (5.75)	18.91 (6.44)*	−3.94 to 1.79	0.695	0.672
Radius head diameter, mm	25.02 (1.62)	21.01 (1.08)*	3.43 to 4.76	0.961	0.990
Lunate A-P breadth, mm	17.48 (1.62)	14.65 (1.30)*	1.99 to 3.43	0.944	0.949
Scaphoid A-P breadth, mm	13.92 (1.29)	11.65 (1.24)*	1.49 to 2.76	0.921	0.946

Note. ICC = intraclass correlation coefficient; CI = confidence interval; A-P = anterior-posterior direction.

*Statistically significant difference between males and females; $P < .05$.

respectively, with no significant difference between ages ($P = .163$), heights ($P = .729$), and weights ($P = .978$) between the right and the left specimens. There was no significant differences between the sexes for age ($P = .177$); however, height ($P < .001$) and weight ($P < .001$) did differ significantly between males and females. All measurements exhibited good (2 variables) to excellent (9 variables) within-measurer reliability and good (1 variable) to excellent (10 variables) between-measurer reliability (Table 2). The variables with the highest and lowest within-measurer reliability were radius length (ICC = 0.99) and palmar inclination (ICC = 0.66), respectively (Table 2). The variable with the highest between-measurer reliability was also radius length (ICC = 0.99), and the variable with the lowest between-measurer reliability was radius of curvature for the sigmoid notch (ICC = 0.67) (Table 2).

There was a statistically significant effect of sex ($P < .05$) across all measurements, with the exception of radial ($P = .212$) and palmar inclination ($P = .104$) (Table 1). The smallest difference between males and females was for the mean (SD) values of radial inclination— 24.31° (2.20°) and 23.65° (2.74°), respectively; $P = .21$ —whereas the largest statistical difference found between males and females— 254.01 (15.99) mm and 223.34 (11.08) mm, respectively; $P < .001$ —was for the mean (SD) values of radius length (Table 2).

The PCA_{all} resulted in 3 PCs being extracted from the data set, as determined by the scree plot (Figure 1a). Principal components 1 (PC1), 2 (PC2), and 3 (PC3) accounted for 48.8%, 18.3%, and 9.3% of the sample variance, respectively. The only significant correlations with PC1 were radius length (0.86), distal breadth (0.86), distal radius height (0.84), radius head diameter (0.88), and both lunate (0.86) and scaphoid A-P articular breadth (0.82) (Table 3).

A qualitative analysis of the PC scatterplots showed that PC1 was the only component that differentiated the sexes; the PC1 versus PC2 scatterplot shows that the PC scores for each sex were separated by PC1 (Figure 2), but not by PC2.

The PCA_{male} resulted in the extraction of 3 PCs (Figure 1b), while the PCA_{female} resulted in 4 significant PCs (Figure 1c). The 3 PCs (PC1, PC2, and PC3) for the PCA_{male} accounted for 43.9%, 17.2%, and 10.3% of male sample variance, respectively, whereas the 4 PCs (PC1, PC2, PC3, and PC4) for PCA_{female} accounted for 29.6%, 21.2%, 13.5%, and 10.7%, respectively. Principal component 1 for the male data set was significantly correlated with distal radius height (0.82), dorsal lip height (0.90), and lunate A-P breadth (0.76) (Table 3), whereas PC1 for females was only significantly correlated with distal radius height (0.88) (Table 3).

For PCA_{all}, the 6 radius measurements that were significantly correlated with PC1 were also positively (significantly) correlated with each other. However, only 5 of these correlations were categorized as strong (Table 4). With respect to the PCA_{male}, although all 3 variables were significantly and positively correlated with PC1, only the correlation between distal radius height and dorsal lip height was categorized as strong ($r = 0.72$) (Table 5). As only one variable from the PCA_{female} was found to be significantly correlated with PC1, no further analysis was performed. Finally, the Mantel test indicated a moderate positive (significant) relationship between the male and female correlation matrices ($r = 0.52$; $P < .001$).

Discussion

The purpose of this study was to determine the anthropometric variables that contribute to significant alterations in

Figure 2. Scatterplot of principal component scores for the first and second principal components determined from a principal components analysis of 11 anthropometric traits of the radius.

Note. Males and females are clearly separated along the first principal component, indicating that variation in size of these radius traits may account for shape differences between sexes.

Table 3. Component Matrix for the Log-Transformed Variables Across All Specimens (PCA_{all}) and for Males (PCA_{male}) and Females (PCA_{female}) Separately.

Measurement	PCA_{all}			PCA_{male}			PCA_{female}			
	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC4
Radius length	0.858*	-0.149	0.121	0.714	0.199	-0.347	0.532	0.277	0.527	0.024
Distal breadth	0.857*	-0.355	0.153	0.611	0.543	0.138	0.435	0.747*	0.019	-0.271
Distal radius height	0.854*	0.398	-0.141	0.820*	-0.375	-0.201	0.882*	-0.217	-0.139	0.326
Radial inclination	0.431	0.689	-0.355	0.585	-0.593	-0.380	0.677	-0.433	-0.159	0.535
Volar lip height	0.524	-0.430	-0.482	0.682	0.507	-0.236	0.046	0.650	-0.293	0.536
Dorsal lip height	0.660	0.486	0.159	0.898*	-0.220	0.228	0.562	-0.449	-0.123	-0.350
Palmar inclination	0.033	0.857*	0.225	0.311	-0.753*	0.475	0.537	-0.623	0.070	-0.151
Sigmoid notch ROC	-0.300	-0.059	0.674	-0.312	0.280	0.498	-0.119	-0.253	0.800*	0.198
Radius head diameter	0.877*	-0.151	0.217	0.715	0.220	0.175	0.578	0.231	0.329	-0.333
Lunate A-P breadth	0.865*	-0.216	0.136	0.755*	0.260	0.169	0.507	0.518	0.308	0.194
Scaphoid A-P breadth	0.818*	-0.032	0.090	0.628	0.000	0.416	0.575	0.249	-0.406	-0.302

Note. PCA = principal components analysis; PC = principal component; A-P = anterior-posterior direction; ROC = radius of curvature.

*Significant correlation above 0.722.

distal radius morphology and to determine whether these variables are the same in males and females. The results presented here suggest that radius length, distal radius height, dorsal lip height, and lunate A-P breadth account for the most variation in the size of the radius. In addition, the PCA and the correlation analysis indicated that radius anthropometrics do not change in a coordinated way between males and females, as the overall size of the radius increases or decreases.

The ICCs indicated that all the measurements had good to excellent within- and between-measurer reliability, while the validity of the measurements was highlighted by the agreement with previously established ranges. For instance, male (12.94 mm) and female (11.00 mm) distal radius heights fell within the 10- to 13-mm range reported by Mann et al.¹⁸ Mann et al also found that radial inclination ranged from 21° to 25°, consistent with those presented here (24.31° for males and 23.65° for females). While most of the dimen-

Table 4. Correlation Matrices Showing the Relationships Between the Variables Found to Be Significantly Correlated With PC1 for the PCA_{all} Analysis.

	Radius length	Distal breadth	Distal radius height	Radius head diameter	Lunate A-P breadth	Scaphoid A-P breadth
Radius length	I	0.726*	0.685*	0.768*	0.691**	0.525*
Distal breadth		I	0.528*	0.819*	0.769*	0.681*
Distal radius height			I	0.633*	0.488*	0.461*
Radius head diameter				I	0.763*	0.633*
Lunate A-P breadth					I	0.688*
Scaphoid A-P breadth						I

Note. Shaded values represent strong correlations. PC1 = principal component 1; PCA = principal components analysis; A-P = anterior-posterior direction.

*Significant correlation at $P < .05$.

Table 5. Correlation Matrices Showing the Relationships Between the Variables Found to Be Significantly Correlated With PC1 for the PCA_{male} Analysis.

	Distal radius height	Dorsal lip height	Lunate A-P breadth
Distal radius height	I	0.721*	0.418*
Dorsal lip height		I	0.611*
Lunate A-P breadth			I

Note. Shaded values represent strong correlation. PC1 = principal component 1; PCA = principal components analysis; A-P = anterior-posterior direction.

*Significant correlation at $P < .05$.

sions corresponded well to previously reported data, female palmar tilt was lower than the proposed range of 11.3° to 13.5°.¹⁸ However, it should be noted that the female specimens had a greater palmar inclination than male specimens, which is consistent with the report by Mann et al who found that the palmar tilt in females was approximately 1° to 5° greater than males. Furthermore, a recent study by Obert et al²⁵ suggested that normal palmar inclinations actually range from 2° to 20°, thus confirming the current findings. It is possible that technological advancements in imaging and image reconstruction over the past decade can partially explain the differences seen between the work presented by Mann et al and Obert et al,²⁵ as well as the current work.

Males were found to have significantly larger length (eg, radius length, distal radius breadth) and diameter (eg, radial head diameter) dimensions compared with females. These findings agree well with previous forensic anthropometric studies that use sex differences to identify unknown human remains.^{13,15} In contrast, females were found to have a significantly larger sigmoid notch radius of curvature compared with age-matched male specimens. Although the overall magnitudes agree well with previous work,²⁶ this is the first study, to the authors' knowledge, to reveal differences in the sigmoid notch radius of curvature between males and females. Although this was not the main focus of the current investigation, this highlights the importance of

considering sex differences when treating the injured sigmoid notch.

To make meaningful interpretations of the component matrices resulting from each PCA, it was important to identify the variables with which each PC is correlated. The first component in an anthropometric-focused PCA (ie, one that includes measurements of length, width, and height) approximates the isometric size component of shape.²¹ This is especially true when variation in size within a sample set is large; this assumption was satisfied here (eg, PC1_{all} differentiates males and females and represents 48.8% of sample variation, and significant differences are seen between sexes for measures of size such as height and weight). Therefore, given that all length and diameter variables, across all of the 3 PCAs (PCA_{all}, PCA_{male}, PCA_{female}), were positively correlated with PC1, it can be concluded that the first PC is a representation of radius size variation. Comparing the PC scores of males and females for PC1, this conclusion is further supported, as males have larger PC scores than females, and males were significantly larger than females for all anthropometric measures that correlated with PC1.

That comparison of the anthropometric traits correlated with PC1 among the different PCAs (PCA_{all}, PCA_{male}, and PCA_{female}) indicates that the traits that differentiate size changes between males and females are not identical to traits that differentiate large and small males or large and small females. For example, dorsal lip height was significantly and strongly correlated with PC1 for the male data set but was not significantly correlated with PC1 for the full data set or the female data set. Thus, while dorsal lip height does not significantly contribute to the large size variation between sexes, it is an important contributor to size differences in males. This discrepancy is potentially problematic in the clinic, as an implant system that is designed using average anthropometric measurements from both sexes may therefore not properly fit the bony anatomy of either sex individually.

Although PCA_{all} indicated that 6 different variables were significantly and positively correlated with PC1, distal radius height, dorsal lip height, and lunate A-P breadth were

the only variables that significantly and positively correlated with PC1 in males, and only distal radius height was significantly and positively correlated with PC1 in females. With this in mind, if an implant was designed for the radius using PCA_{all} data (ie, a sample containing both male and female radii), the implant size chosen for a male or a female patient with a large radius relative to their sex would likely be oversized, and vice versa. This result agrees with findings presented from a previous study on knee arthroplasty systems, where the femoral component of 6 prosthetic systems was found to be too large for female patients.⁹

Principal component 1 accounted for a greater percentage of variation in the PCA_{all} than either the PCA_{male} or the PCA_{female}. Therefore, examining the sexes together in a population analysis may overestimate the variation within each sex that can be accounted for by adjusting all length/width/diameter dimensions of a radius implant simultaneously. By examining the sexes in separate PCAs, individual changes in anatomic shape as a function of size can be better recognized.¹¹ Furthermore, given that only 3 male variables and 1 female variable were significantly correlated with PC1, a continued effort to determine the feasibility of the individualization of implant design,²⁷ and whether this should occur on a patient-specific or sex-specific level, is warranted.

The results of this study have important implications for distal radius fracture fixation, implant design, and modeling. During force transmission across the wrist, approximately 55% of the load is transmitted through the radioscaphoid joint and 35% is transmitted through the radiolunate joint.²⁸ The A-P breadth of the lunate fossa was significantly correlated with PC1 in males, but neither scaphoid nor lunate A-P breadths were significantly correlated with PC1 in females. This highlights the importance of ensuring both sexes are accounted for in research aimed at quantifying distal radius load transfer. Furthermore, it is also important to ensure that efforts are made to include both males and females when modeling the distal radius to account for the nonproportional differences in geometry between the sexes that could have a significant impact on force transmission modeling outcomes.²⁹

The limitations of this study include limited ethnic representation, an older sample population, and a small sample size for a study using PCA. Sixty-eight (92%) of the scanned radius specimens came from Caucasian patients, and therefore, the current results may not be generalizable to other ethnicities. Previous research found that a femoral component in a total knee prosthesis system was better fit to a Korean population, from which the design was based, than a Caucasian population.³⁰ In addition, as the average age of our study population was more than 70 years, these results may not be consistent with bone morphology patterns seen in younger age groups. However, this age demographic is consistent with those at the highest risk of distal radius fracture. Finally, our study sample size ($n = 74$) bordered on

what is required to accurately perform a PCA. Field (2013) suggests that a sample size of 50 is the minimum required to appropriately classify a correlation above 0.722 within a component matrix as significant.²⁴

The current study has described a novel, reliable, and accurate methodology for recording and analyzing a variety of anthropometric measurements of the radius. The proposed methodology has highlighted sex differences in the radius and suggests that sex-specific implant design for both radius prosthetics and fracture fixation systems may improve patient outcomes. Future work should be focused on generalizing the aforementioned conclusions by expanding the anthropometric database to include a greater sample size and representation from other ethnicities and age groups than those investigated in the current study.

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Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained when necessary.

Declaration of Conflicting Interests

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