REPRODUCIBILITY OF ABDOMINAL AORTIC ANEURYSM DIAMETER MEASUREMENT AND GROWTH EVALUATION ON AXIAL AND MULTIPLANAR COMPUTED TOMOGRAPHY REFORMATIONS

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ABSTRACT

Purpose: Compare different methods measuring abdominal aortic aneurysm (AAA) maximal diameter (Dmax) and its progression on multi-detector computed tomography scan (MDCT).

Materials and Methods: Forty AAA patients with 2 MDCT acquired at different time (baseline and follow-up) were included. Three observers measured AAA diameters by 7 different methods: on axial images (antero-posterior, transverse, maximal and short axis) and on multi-planar reformation (MPR) images (coronal, sagittal and orthogonal). Diameter measurement and progression were compared over time for the 7 methods. Reproducibility of measurement methods was assessed by intraclass correlation coefficient (ICC) and Bland-Altman analysis.

Results: Dmax measured on axial slices at baseline and follow-up (FU) MDCTs was larger than that measured with use of orthogonal method ($p=0.00001$), whereas Dmax with the orthogonal method was larger than for all other measurement methods ($p\leq0.0001$). The highest inter-observer ICCs were obtained for the orthogonal and transverse method (0.972) at baseline and for orthogonal and sagittal MPR at FU (0.973 and 0.977). Inter-observer ICC of the orthogonal method to document AAA progression was higher (ICC=0.833) than measurements taken on axial images (ICC=0.662-0.780) and single plane MPRs (0.772-0.817).

Conclusion: AAA Dmax measured on MDCT axial slices overestimates aneurysm size. Diameter measured by the orthogonal method is more reproducible, especially to document AAA progression.

Keywords: Abdominal aortic aneurysm, CT, Diameter measurement, Inter-observer reproducibility, Multiplanar reformation

INTRODUCTION

Current indications to intervene in patients with abdominal aortic aneurysm (AAA), either by the surgical or endovascular approaches, are mostly based on its maximal diameter (Dmax) [1-4]. AAA follow-up, pre- and post-intervention, also relies on Dmax measurements, as treatments are based on its progression [2, 5-8]. Although reports on AAA volumetric analysis are emerging [9-17], Dmax remains the most widely-accepted criterion for AAA evaluation and therapeutic management.

Previous studies have advocated different ways of measuring Dmax and its evolution by multi-detector computed tomography (MDCT). While some authors have suggested Dmax assessment on axial slices (axialDmax) [3, 18], others have proposed the measurement of the diameter perpendicular to axialDmax (shortaxisD) [19-22], antero-posterior diameter (APD) [23-25], transverse diameter (transD) [24] and diameter perpendicular to the estimated central line on axial slices [26]. Finally, several researchers have recommended the measurement of diameter perpendicular to the aneurysm's central line (orthogonal) on multi-planar reformation (MPR) (orthoD) [6, 16, 27, 28]. Investigations reporting on orthoD have used single plane reformation [24], specialized software [16, 27] or did not precisely describe the method of plane selection [6, 19]. Moreover, debates based on reproducibility concerns persist [26, 28]. The two main issues involved in selecting the best measurement method are its reproducibility and theoretical "truthfulness" in the absence of a gold standard [29].

It has been recognized and supported by ultrasound data [18, 27, 30] that axialDmax tends to overestimate real diameters, especially in the presence of tortuous aorta, since the axial plane is one perpendicular to the patient's craniocaudal axis, but not necessarily perpendicular to the long axis of the aorta [29-33]. This explains why ultrasound shows better correlation with orthoD measurements on MDCT when they are taken perpendicular to the central line [27]. However, ultrasound can be less reproducible, especially for patient follow-up [29-32].

With widely available MPRs on MDCT workstations, a double-oblique plane perpendicular to the central axis of the aneurysm can be easily generated to calculate orthoD. However, since this method involves more manipulations, reproducibility may be reduced [24].

According to the Society of Vascular Surgery guidelines [28], the aneurysm diameter should be measured perpendicular to the centerline of the aneurysm, or as a second best, if multiplanar reconstruction is not available, perpendicular to the maximum ellipse on axial CT. However, despite variable approaches recommended in the literature, no study has specifically evaluated the reproducibility of all these different approaches of diameter measurement to estimate AAA progression.

The purpose of the present investigation is to assess and compare the intra- and inter-observer reproducibility of all approaches reported previously for AAA Dmax measurement on MDCT axial slices and on single and double oblique MPR images. The secondary objective is to evaluate the reproducibility of these different methods in the assessment of diameter progression over time.

MATERIALS AND METHODS

Study design and patient selection

We performed a retrospective study of 40 patients with AAA examined by MDCT. Patients were selected from the radiological information system, if they had an untreated (endovascular or surgical) AAA with a diameter greater than 3.5 cm and at least 2 MDCT examinations available on local Picture Archiving and Communication System (PACS) with a minimum 6-month interval between the 2 examinations. These patients were then contacted by a research nurse. Approval of radiological imaging was obtained through written patient consent. The Institutional Review Board approved this Health Insurance Portability and Accountability Act-compliant research project. If a patient had more than 2 MDCT examinations, the most remote and most recent pre-treatment examinations were selected. Totally, 80 MDCT examinations were analyzed.

MDCT protocols

All 80 examinations were undertaken on 4 different MDCTs (Somatom Sensation 4, 16, 64, Siemens, Erlangen, Germany; Lightspeed 16, GE, Milwaukee, WI, USA). The scanning parameters were the following: pitch 1-1.5, slice thickness 1-2 mm, collimation 0.75-1.5, and field of view ranging from 240 to 320. Intravenous contrast was injected at 3-5 ml/s, for a total of 80-120 ml. Bolus tracking technique was used for all examinations.

Measurement methods

Three observers (1 senior resident and 2 vascular interventional radiologists with more than 10 year experience), blinded to previous radiological reports, independently measured aneurysm Dmax on each of the 80 examinations by 7 different methods. All diameters were measured from the aneurysms' outside to outside wall, using electronic callipers, with zooming function liberally performed, when judged to be pertinent, on the same workstation (Impax, version 5.2; Agfa, Mortsel, Belgium).

The first 4 diameters were measured on original axial slices. By scrolling through the axial images, each observer selected the slice on which he thought the largest diameter was present, as would be done clinically. After slice selection, the following diameters were measured: 1) from anterior to posterior wall (APD), 2) from right to left lateral wall (transD), 3) maximal diameter in any direction (axialDmax) and 4) perpendicular to axialDmax (shortaxisD) (Figure 1).

Afterwards, MPRs (reconstructed with a slice thickness of 1-3 mm) were processed from axial images with workstation MPR software (Impax, version 5.2). Dmax perpendicular to the long axis of the aneurysm was measured on two single plane MPRs: coronal (CoroMPRD) and sagittal planes (SagMPRD), as illustrated in Figure 2.

Finally, the last diameter was measured on a double oblique reformation by establishing a plane perpendicular to the largest portion of the aneurysm, first on sagittal MPR, then on coronal MPR, creating a "modified axial" plane perpendicular to the long axis of the aneurysm in 2 orthogonal planes (double oblique). Aneurysm max diameter (in any axis) of that orthogonal plane was then measured (Figure 3), constituting orthoD.

To obtain intra-observer reproducibility, 2 of the 3 observers (1 junior and 1 senior), blinded to the radiological report and to their first set of measurements, independently took every diameter (7 different methods on 80 examinations) a second time, with a minimal 4-week interval, according to the same protocol described previously.

The time required to measure orthoD was recorded on that second set of values. The calculated time include the time needed to create the double oblique reformation from the axial source images, measure Dmax and store it in the PACS system.

Data analysis

Patient demographics and aneurysm characteristics − Descriptive statistics of patient baseline demographics, the interval between the 2 MDCTs and mean AAA diameters (averaging all values; 40 examinations, 3 observers and 7 different methods) at baseline and follow-up, were calculated with standard deviations (SD). For each type of method, the measurements of the 1st reading from the 3 observers were averaged for each patient. A one-factor (type of method) repeated measure analysis model using PROC MIXED was then used to assess differences among the methods. The p-values from the SAS procedure are adjusted using the Bonferroni method to correct for multiple comparisons. This was done separately for both the baseline and follow-up examinations. For each observer, the measurements of the 1st reading from all the seven methods were averaged for each patient. Again, a one-factor (observer) repeated measure analysis model using PROC MIXED was used to assess differences among the 3 observers for both the baseline and follow-up examination separately. In addition, for the 1st reading, to assess discordant differences of less than 5 mm among the seven methods for both the baseline & follow-up scans combined (80 scans) was determined using the McNemar test. All analyses were done with SAS version 9.2 (SAS Institute Inc., Cary, North Carolina). A P value <0.05 was considered statistically significant.

Intra-observer and inter-observer reproducibility − Inter-observer (3 readers) and intra-observer (2 readers) reproducibility was assessed by intra-class coefficient (ICC) for all 7 methods. The ICC between the 3 observers in the evaluation of aneurysm diameter progression (between baseline and follow-up MDCTs) was also measured for all 7 methods.

Inter-observer discordance by measurement method and by threshold of measurement discordance for all examinations

Inter-observer reproducibility was also assessed by looking at absolute differences between measurements, as performed previously in other studies [18, 19, 25, 27, 32, 33]. Absolute differences, recorded as being <5 mm or ≥5 mm and <10 mm or ≥10 mm, were calculated by taking into account all 3 observers. That is, to be recorded as <5 mm, differences between maximal and minimal values out of the 3 values available for the 3 observers for a particular examination and a single method (3 observers) had to be <5 mm. This concept was applied for all 7 methods, computing all 80 examinations (baseline and follow-up) by method.

Finally, Bland-Altman analysis was undertaken to assess mean errors for the different methods of diameter measurement (all observers together) in comparison to the orthoD approach to estimate aneurysm progression between baseline and follow-up. Range of agreement was defined as bias ± 2 SD, where SD was the corrected SD of differences between the 2 methods.

RESULTS

Patient demographics and aneurysm characteristics

Forty patients (33 men and 7 women) with a mean age of 72 years (range 49-86 years) were studied. The average interval between baseline and follow-up MDCTs was 16 ± 8 months (range 8-42 months). Considering all measurement methods and observers, average diameter was 49.2 ± 6.9 mm (range 31.6-74.1 mm) at baseline and 53.2±8.4 mm (31.3-77.4) at follow-up ($p<10^{-6}$).

Descriptive analysis of the different measurement methods

Average measurements (40 patients) taken during the first reading session are detailed in Table 1 by observer and measurement method for baseline and follow-up. The means of all diameters measured (40 patients and 7 diameter measurement methods) at baseline and follow-up were respectively 49.4±7.0 and 53.4±8.5 mm for observer 1, 49.0±6.8 and 53.2±8.5 mm for observer 2, and 49.1±6.8 and 53.1±8.2 mm for observer 3. The means of all diameters generated by observer 1 were significantly larger than by observers 2 ($p<0.00001$) and 3 ($p=0.0014$) at baseline and observer 3 at follow-up ($p=0.009$).

For all observers, the largest diameter evaluation was obtained with axialDmax, followed by orthoD. AxialDmax yielded diameters significantly larger than orthoD for baseline and follow-up ($p=0.00001$), whereas orthoD was significantly larger than all other measurements at baseline and follow-up ($p\leq0.0001$).

Inter-observer reproducibility of baseline and follow-up examinations

The ICCs on inter-observer agreement for baseline and follow-up examinations are listed by measurement method in Table 2. The inter-observer ICC was high for all methods, ranging from 0.924 to 0.977. The highest inter-observer ICC was obtained with orthoD and transD (0.972) at baseline, and orthoD and sagMPRD at follow-up (0.973 and 0.977).

Intra-observer reproducibility of baseline and follow-up examinations

Intra-observer reproducibility was assessed for every method with the ICCs reported in Table 3. All methods showed high intra-observer reproducibility (p>0.95). The intra-observer ICC of orthoD measurements was consistently in the upper range (0.979-0.985) except for the baseline measurements of observer 3 with values that were in the mid-range (0.969).

Inter-observer discordance by measurement method and by threshold of measurement discordance for all examinations (baseline and follow-up)

Inter-observer discordance (absolute difference between the highest and lowest AAA measurements of the 3 observers for a particular examination and a single method) is detailed by threshold of measurement discordance in Table 4. Discordance between the 3 observers never exceeded 10 mm for any of the methods using MPRs (coroMPRD, sagMPRD, orthoD). The smallest discordance with this model was obtained with orthoD, with differences between the 3 observers being less than 5 mm in 96.25% of exams, and 5 to 10 mm in 3.75%. In comparison, the proportion of discordant measurements exceeding 5 mm for the 6 other methods ranged from 5 to 12.5%. The difference in proportion of discordance of more than 5 mm was significant only between the orthoD and shortaxisD methods (p=0.035).

Inter-observer reproducibility of AAA progression between baseline and follow-up examinations

As shown in Table 5, lower values of inter-observer ICCs were observed for all measurement methods to document AAA progression as compared to baseline or follow-up diameter measurements. The highest ICC was obtained with orthoD (ICC=0.833). Lower values were recorded for all measurements taken on axial images (range 0.662-0.780), whereas CoroMPRD and SagMPRD ranged between 0.772 and 0.817.

Bland-Altman analysis comparing DODmax and other measurement methods to evaluate AAA progression

Bland-Altman analysis of the comparison between orthoD and other measurement methods of assessing AAA progression between baseline and follow-up is detailed in Table 6. When compared with orthoD, slightly lower AAA progression was observed with APD, transD and shortaxisD measurements and higher progression with axialDmax, sagMPRD and coroMPRD measurements, the latter showing the largest increase in size. However, on Bland-Altman analysis, the 95% confidence interval (95% CI) of mean error for all observers between orthoD and the other methods of documenting AAA progression was always below 4 mm**.**

Time required

The average time to measure orthoD was 1 min and 40 s (range 1 to 3 min).

DISCUSSION

As reported previously, we noted that axialDmax leads to larger diameter values when compared to orthoD [6, 27]. OrthoD was also significantly higher than all other remaining diameter measurement methods. In the absence of an absolute gold standard, orthoD measured in a plane perpendicular to the central axis of the aneurysm, is the measure closest to reality because it is independent of the angle of the aneurysm axis relative to the MDCT axial slice.

Since orthoD measurement involves more manipulations, it has been discouraged by Abada et al. [24]. In their study, they observed slightly better reproducibility of APD and transD measurements when compared with CoroD and SagD [24].

The measurements technique of the 7 methods under evaluation in our study was well standardized, resulting in high inter-observer agreement for all of them at baseline and follow-up (ICC>0.92). Standardization of measurement techniques on the workstation has been shown to be an important factor for improvement of reproducibility [20, 26].

In our investigation, however, orthoD measurement was among the methods demonstrating the highest inter- and intra-observer reproducibility for baseline study and among the highest for follow-up study. It presented the lowest proportion of discordance of more than 5 mm (3.75%) between observers whereas this proportion was significantly higher at 12.5% when using the shortaxisD method that has been proposed by several authors [19-21].

Dillavou et al. reported high inter-observer reproducibility of orthoD (ICC=0.95) which was superior to manual measurement with shortaxisD (ICC=0.90). However, their method of determining orthoD was not clearly defined [19].

Other authors have measured orthoD by manually constructing a median centerline through the lumen and assessing transverse aortic diameter in a plane perpendicular to it [6, 34]. With this approach, Wever et al. [34] obtained a good inter-observer repeatability coefficient (3.9 mm) and acceptable mean error (1.61 ± 2 mm) with this method.

Advanced post-processing software can now easily and automatically generate the central line from the enhanced aortic lumen [16]. However, this central line can be different from the real AAA central line, especially if the thrombus is asymmetrical. Basically, all commercially available software conceived to generate reformation from luminal central line were validated to calculate lumen vessel stenosis and not the maximal diameter of an aneurysm surrounded by a thrombus. To automatically generate a true AAA central line calculated from the aneurysm wall, segmentation of the thrombus and the external wall of the AAA is necessary. Since surrounding structures (psoas, inferior vena cava and duodenum) display the same density as the aortic thrombus and wall, this is not an easy task [35]. We have recently validated semi-automatic software allowing aortic segmentation of the different AAA components with an average time of 3 min [36] (blinded reference). Using the same database, orthoD measured by this software presented a very good correlation with the manual orthoD method with a mean absolute difference of 1.1±0.9 mm and error always under 5 mm [36] (blinded reference), confirming that manual measurement of orthoD using the double oblique method is very close to true orthogonal diameter computed with a validated software.

In our study, the reproducibility of all methods to assess Dmax progression during follow-up was lower than baseline and follow-up measurements. Since Dmax assessment computes the difference between two measurements, the combined variability of the baseline and follow-up diameter measurement explains its higher variability. Hence, the reproducibility of Dmax progression is important in clinical practice because diameter progression is a criteria for therapeutic management before surgical or endovascular aortic aneurysm repair (EVAR) and after EVAR. In this setting, the orthoD method presented the best inter-observer reproducibility in assessing Dmax progression. It is interesting that estimation of AAA progression based on axial slice measurements was less reproducible than measurements taken on MPR or double oblique images. It is probably easier to perform consecutive measurements at baseline and follow-up examinations in the same portion of the AAA on MPRs in a longitudinal aneurysm axis. SagMPRD showed high reproducibility, being the second most reproducible method to assess AAA growth. However, since it doesn't reflect exactly the growth of the true maximum diameter, it's not advisable to rely on this method.

Finally, when comparing Dmax progression, assessed by orthoD and the 6 other methods by Bland-Altman analysis, small differences were seen, except for CoroMPRD which tended to give slightly larger AAA growth. The best agreement for orthoD was obtained with AxialDmax (Table 6 and Figure 4).

OrthoD can be easily processed on any standard PACS workstation with an average required time of 1 min 40 s in our hands (range 1 to 3 min). Hence, it is easy to integrate into clinical workflow.

The main limitation of our study is the absence of an absolute gold standard. That being said, measurement reproducibility is the main concern, especially when endovascular specialists need to assess diameter variation between 2 consecutive examinations.

CONCLUSION

AAA diameter should not be measured as Dmax on the axial plane, because this measurement depends on the angle of aneurysm axis relative to the axial CT slice, often resulting in aneurysm size overestimation. Measurements should be taken on a plane orthogonal to the aneurysm's central axis. The orthoD method, based on a modified axial plane perpendicular to orthogonal, coronal and sagittal MPRs on a standard PACS workstation, yields measurements that are highly reproducible for evaluating AAA diameter and its growth over time.

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FIGURE LEGENDS

Figure 1: CT-scan acquisition in a 77-year old-male with an AAA. After selection of the axial slice displaying the largest diameter, the radiologist measured the following diameters: A: Antero-posterior (APD), B: Transverse (TransD), C: maximum in any axis (AxialDmax), D: Short axis perpendicular to C (ShortaxisD).

Figure 2: Same patient shown in Figure 1. Measurement of Dmax on single plane MPRs.
a: Dmax measured on the coronal plane perpendicular to the long axis of the AAA (CoroMPRD)
b: Dmax measured on the sagittal plane perpendicular to the long axis of the AAA (SagMPRD)

Figure 3: Same patient shown in Figure 1. Creation of double-oblique MPR (orthogonal plane) and measurement of orthoD.
a. First, a plane perpendicular to the long axis of the largest portion of the AAA is created on sagittal MPR.

b. Then, a plane perpendicular to the long axis of the largest portion of the AAA is created on coronal MPR.

c. Finally, Dmax is measured on the orthogonal plane created from the 2 previous steps (orthoD).

Figure 4: Bland-Altman analysis plotting differences in Dmax between the orthoD and 6 other methods of documenting AAA progression between baseline and follow-up

examinations.

a: The best agreement was observed between orthoD and AxialDmax

b: The worst agreement was observed between orthoD and CoroMPRD

TABLE 1: Mean diameters by measurement method and by observers (40 patients, baseline and follow-up examinations, first reading session)

Measurement method (mm)	APD	TransD	AxialDmax	ShortaxisD	CoroMPRD	SagMPRD	OrthoD
Observer 1 Baseline exam	48.5±6.4	50.1±7.0	52.4±7.0	46.8±6.3	49.3±7.0	48.0±6.6	51.2±7.4
Observer 1 Follow-up exam	52.4±8.4	53.8±8.4	56.4±8.4	50.3±7.9	53.4±8.4	52.5±8.4	55.2±8.4
Observer 2 Baseline exam	48.4±6.4	49.3±6.9	51.0±6.9	47.0±6.2	48.8±6.5	48.4±6.8	50.1±7.4
Observer 2 Follow-up exam	52.8±8.9	53.3±8.5	55.4±8.5	51.2±8.5	53.1±8.1	52.1±8.5	54.3±8.7
Observer 3 Baseline exam	48.5±6.6	49.3±6.6	51.6±6.8	46.7±6.0	48.6±6.5	47.8±7.0	51.2±7.5
Observer 3 Follow-up exam	52.0±8.2	53.1±7.9	55.4±8.2	51.1±7.6	53.2±8.3	51.8±8.5	54.9±8.7
Average of 3 observers Baseline exam	48.5±6.4	49.6±6.8	51.7±6.9	46.8±6.1	48.9±6.6	48.1±6.8	50.8±7.4
Average of 3 observers Follow-up exam	52.4±8.4	53.4±8.2	55.8±8.4	50.9±8	53.2±8.2	52.1±8.4	54.8±8.5

TABLE 2: Inter-observer correlation coefficient by measurement method (3 observers, 40 CT-scan examinations at baseline and follow-up, first reading session)

Measurement method	APD	TransD	AxialDmax	ShortaxisD	CoroMPRD	SagMPRD	OrthoD
ICC Baseline (95% CI)	0.961 (0.935-0.978)	0.972 (0.948-0.985)	0.962 (0.923-0.981)	0.940 (0.901-0.965)	0.950 (0.917-0.972)	0.969 (0.948-0.983)	0.972 (0.943-0.986)
ICC Follow-up (95% CI)	0.924 (0.877-0.956)	0.955 (0.925-0.974)	0.961 (0.932-0.978)	0.933 (0.890-0.961)	0.968 (0.947-0.982)	0.977 (0.961-0.987)	0.973 (0.954-0.985)

TABLE 3: Intra-observer correlation coefficient by measurement method at baseline and follow-up (2 observers, first and second reading of 40 CT-scan examinations)

Measurement method	APD	TransD	AxialDmax	ShortaxisD	CoroMPRD	SagMPRD	OrthoD
ICC Observer 1 Baseline exam (95% CI)	0.967 (0.944)	0.958 (0.929)	0.982 (0.969)	0.967 (0.945)	0.955 (0.924)	0.976 (0.960)	0.985 (0.974)
ICC Observer 1 Follow-up exam (95% CI)	0.981 (0.968)	0.989 (0.981)	0.981 (0.968)	0.983 (0.972)	0.975 (0.958)	0.966 (0.942)	0.984 (0.973)
ICC Observer 3 Baseline exam (95% CI)	0.978 (0.962)	0.975 (0.958)	0.976 (0.960)	0.953 (0.922)	0.966 (0.943)	0.960 (0.933)	0.969 (0.949)
ICC Observer 3 Follow-up exam (95% CI)	0.980 (0.966)	0.977 (0.962)	0.971 (0.952)	0.971 (0.951)	0.967 (0.945)	0.986 (0.976)	0.979 (0.965)

TABLE 4: Inter-observer discordance by measurement method and by threshold of measurement discordance (80 CT scans, 40 baseline and 40 follow-up)

Measurement method (mm)	**APD**	**TransD**	**AxialDmax**	**ShortaxisD**	**CoroMPRD**	**SagMPRD**	**OrthoD**
Inter-observer difference <5 mm	72 (90)	74 (92.5)	75 (93.75)	70 (87.5)	73 (91.25)	76 (95)	77(96.25)
Inter-observer difference = 5-9.9 mm	5 (6.25)	5 (6.25)	4 (5)	9 (11.25)	7 (8.75)	4 (5)	3 (3.75)
Inter-observer difference ≥10 mm	3 (3.75)	1 (1.25)	1 (1.25)	1 (1.25)	-	-	-

Note: Values are presented as frequencies (percentages)

TABLE 5: Intra-class inter-observer correlation coefficient by method to evaluate AAA progression (40 patients, 80 CT-scan examinations, 3 observers, first reading)

Measurement method	APD	TransD	AxialDmax	ShortaxisD	CoroMPRD	SagMPRD	OrthoD
ICC (95% CI)	0.662 (0.507-0.789)	0.773 (0.653-0.863)	0.780 (0.664-0.868)	0.738 (0.606-0.841)	0.772 (0.652-0.863)	0.817 (0.715-0.891)	0.833 (0.739-0.901)

TABLE 6: Bland-Altman analysis comparing mean error between orthoD and all other measurements methods of assessing aneurysm progression (all observers)

Measurement method	Mean error (mm)	SD (mm)	95% CI (mm)
OrthoD/APD	0.09	1.19	-2.24-2.43
OrthoD/TransD	0.13	1.82	-3.45-3.70
OrthoD/AxialDmax	-0.09	0.91	-1.88-1.70
OrthoD/ShortaxisD	0.06	1.38	-2.75-2.64
OrthoD/CoroMPRD	-0.32	1.88	-3.99-3.36
OrthoD/SagMPRD	-0.01	1.065	-2.10-2.08