5.7 US vs CT for AAA

An abdominal aortic aneurysm is a dilation of the abdominal aorta. One of the dangers of this balloon-like dilation is that the aorta can catastrophically rupture (burst).
One of the strongest predictors of rupture is the size of the aneurysm; an accepted indication for surgical repair is a maximal aneurysm diameter larger than 50 to 55 mm (5.0 to 5.5 cm; about 2 inches).

Sprouse et al[1] compared the maximal diameter (in mm) of 334 abdominal aortic aneurysms as measured by CT (CT^{max}) and as measured by ultrasound (US^{max}). Figure 2 from the paper is reprinted below.
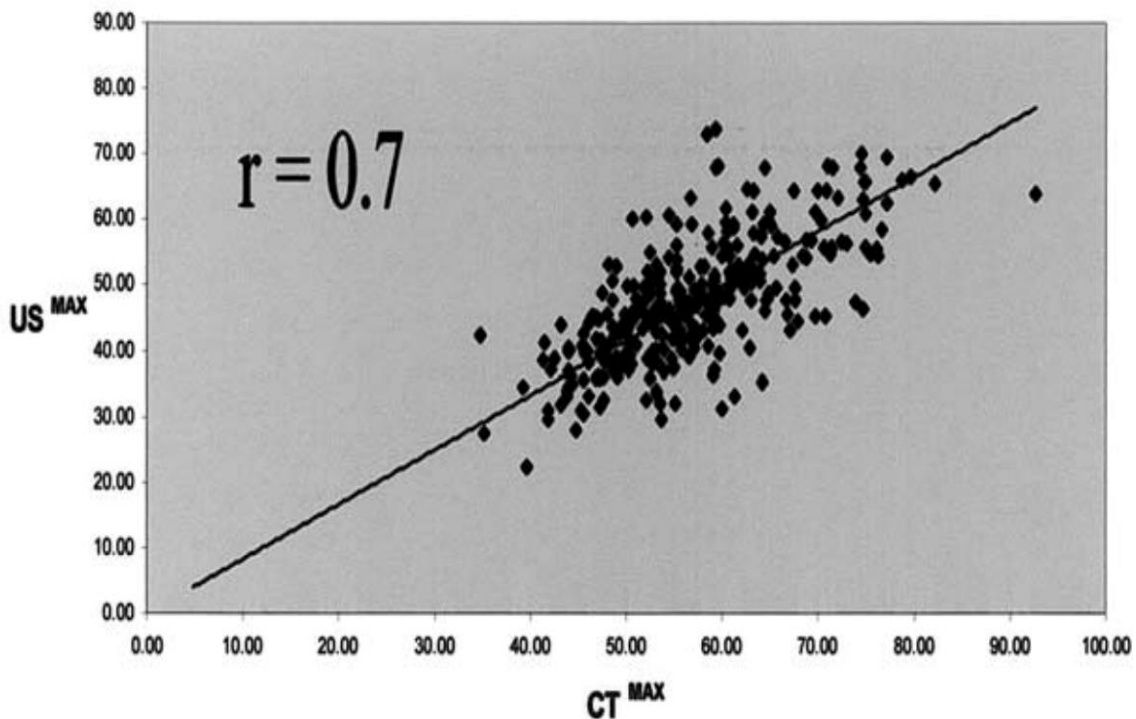

Fig 2. Correlation between CT^{max} and US^{max}. Reprinted from J Vasc Surg, 38(3):466-71, Sprouse LR, 2nd, Meier GH, 3rd, Lesar CJ, Demasi RJ, Sood J, Parent FN, et al. Comparison of abdominal aortic aneurysm diameter measurements obtained with ultrasound and computed tomography: Is there a difference? Copyright 2003, with permission from Elsevier.

a) Can you tell from this figure whether US measurements of AAA diameter tend to be higher than CT measurements, or lower?

It is hard to tell, because the line in the graph is the regression line, not the line of identity. (It looks like the line of identity partly because the scales and ranges of the X and Y axes are different.) If you draw the line of identity from (0,0) to (90,90) you will see that most of the points are below the line, meaning that CT gives the higher measurement:
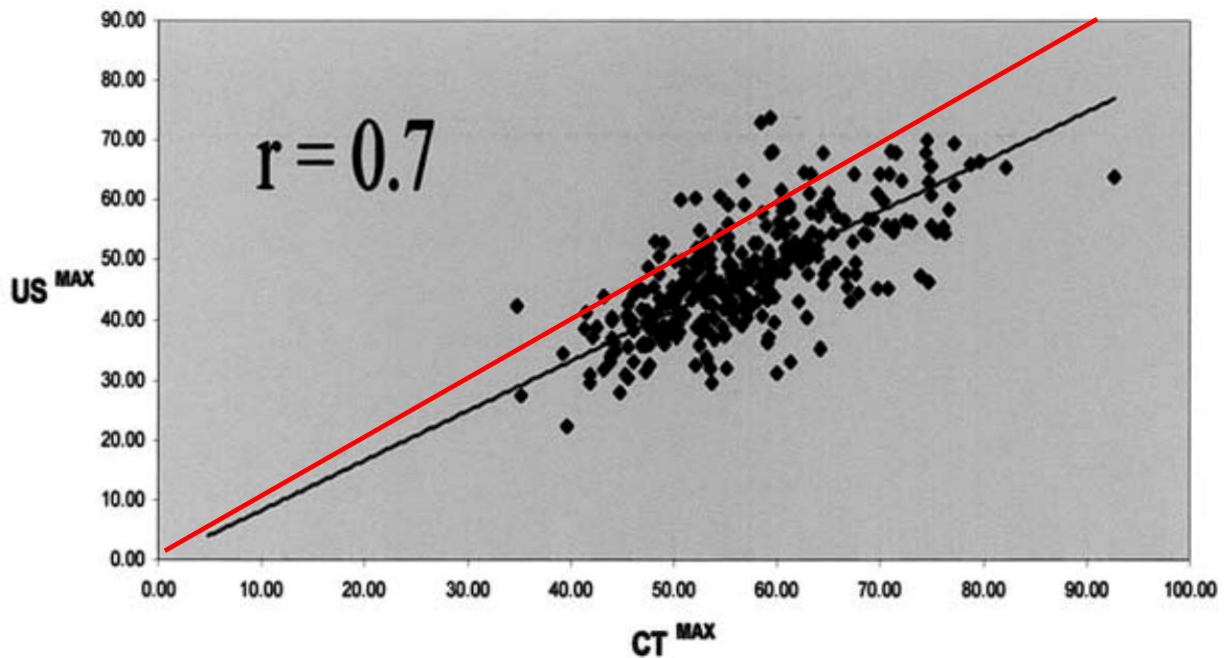
Fig 2. Correlation between CT^{max} and US^{max} with added line of identity. Original Figure 2 reprinted from J Vasc Surg, 38(3):466-71, Sprouse LR, 2nd, Meier GH, 3rd, Lesar CJ, Demasi RJ, Sood J, Parent FN, et al. Comparison of abdominal aortic aneurysm diameter measurements obtained with ultrasound and computed tomography: Is there a difference? Copyright 2003, with permission from Elsevier.

b) In the discussion of the results, the authors write:

"Although the difference between CT^{max} and US^{max} was statistically significant, the correlation (Fig 2) between CT^{max} and US^{max} in all groups was good (correlation coefficient, 0.705)."

If the goal is to determine whether clinicians can use CT^{max} and US^{max} interchangeably in the management of patients with AAA, is a "good" correlation sufficient? (Answer this part before doing the next part.)

No, as noted in Chapter 5, the correlation coefficient is not a good choice for method comparison. And as you can see in part C, this coefficient (0.7) really is not very good. But even if it were 0.99, the CT^{max} could still be consistently 20 mm higher or lower than US^{max}, differences that would be of considerable clinical significance.
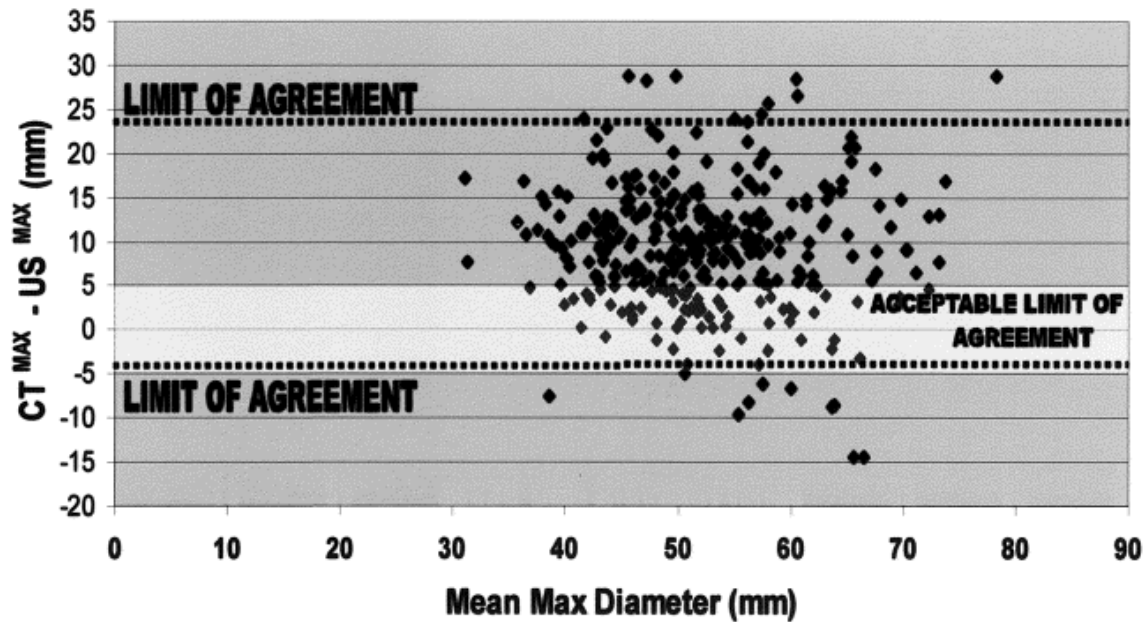
c) Here is Figure 3 from the article:

Fig 3. Limits of agreement (broken lines) between CTmax and USmax (−4.5-23.6 mm) compared with clinically acceptable limits of agreement (highlighted area) between CTmax and USmax (−5.0-5.0 mm). Reprinted from J Vasc Surg, 38(3):466-71, Sprouse LR, 2nd, Meier GH, 3rd, Lesar CJ, Demasi RJ, Sood J, Parent FN, et al. Comparison of abdominal aortic aneurysm diameter measurements obtained with ultrasound and computed tomography: Is there a difference? Copyright 2003, with permission from Elsevier.

What is the name of this type of graph?

A Bland-Altman Plot.

d.) Based on Figure 3, does Ultrasound or CT tend to give higher AAA diameter measurements?

Now it should be clear that CT gives higher diameter measurements. The average diameter according to CT was 9.4 mm (almost 1 cm) greater than by US.

e) Can CT and US assessment of AAA be used interchangeably for purposes of deciding on operative intervention?

The authors concluded no, and we agree.

REFERENCE

1.   Sprouse LR, 2nd, Meier GH, 3rd, Lesar CJ, Demasi RJ, Sood J, Parent FN, et al. Comparison of abdominal aortic aneurysm diameter measurements obtained with ultrasound and computed tomography: Is there a difference? J Vasc Surg. 2003;38(3):466-71; discussion 71-2.