Comparison of 2D and 3D Views for Evaluation of Flat Lesions in CT Colonography

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Rationale and Objectives: Flat lesions in the colon may result in false-negative computed tomography colonography interpretations. It is unknown whether flat lesions are better measured on two-dimensional (2D) or three-dimensional (3D) images and which settings are optimal for enhanced reproducibility and decreased variability. We evaluated these factors to determine whether 2D or 3D is best for flat lesion measurements.

Methods and Materials: Eighty-eight lesions in 66 patients from a previously published clinical trial were analyzed. Lesions were viewed with four methods including 2D at three window/level settings and 3D endoluminal view. Lesions in either supine or prone were counted as one dataset. Long axis and height were measured. Criteria of "height" (≤3 mm high) or "ratio" (height ≤half the long axis) were applied. A subset of lesions was subject to inter- and intra-observer variability analysis.

Results: With the "height" criterion, more datasets were classified as flat in 2D flat (n = 76), 2D soft tissue (n = 82), and 3D (n = 73) views than in the 2D lung (n = 49) view. If long axis is used as the key metric, endoluminal 3D (12.1%) views significantly showed the least inter-observer variability compared to lung (18.9%) or soft tissue (20.2%) views. Intra-observer variability was low overall for all methods.

Conclusion: When characterizing lesions as flat, a consistent viewing method should be used. To minimize inter-observer variability (such as when following a patient over time), it is best to use the ratio criterion for flat lesion definition incorporating the single longest dimension on 3D views as the key metric.

Key Words: CT colonography; colon; screening; computed tomography; virtual colonoscopy.

Flat lesions of the colon are a potentially important source of false negative computed tomography colonography (CTC) interpretations (1,2). Several different definitions of flat lesions have been proposed (3–9) including height <3 mm, a definition recommended in a consensus opinion (10) and a height less than one-half the width (as seen on two-dimensional [2D] views, or long axis as seen on three-dimensional [3D] views). In many CTC investigations and clinical reports, endoscopists and radiologists may classify a lesion as "flat" based on subjective visual impression without defining the term in their methods or without measuring the lesion (11).

There are no clinical data to indicate whether flat lesions are better measured on 2D views or the 3D endoluminal views. On 2D views, the optimal window and level settings to visualize or to measure a flat lesion have not been determined.

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We undertook this study to determine the incidence of flat lesions in a large clinical trial based on objective CTC measurements. We comparatively evaluated 2D and 3D visualization methods to determine which is best for flat lesion measurement and to assess the reproducibility of flat lesion measurements. The reproducibility of lesion measurement is particularly important for patients with small colonic lesions (<10 mm) because a small increase in size of a 6–9 mm lesions might prompt a decision for immediate optical colonoscopy rather than continued follow-up CTC.

MATERIALS AND METHODS

Study Population

Cases were selected from a previously published multicenter clinical trial (12). The anonymized CT and reconciliation data on 152 patients with 228 colonoscopically verified lesions ≥6 mm were available. The endoscopists visually measured the lesions during optical colonoscopy in comparison to open biopsy forceps that were 7 mm in diameter. Of these lesions, 9 were cancers, 138 were adenomas, 53 were hyperplastic, 10 were normal, 13 were labeled other histology, and 5 histologies were not available. Lesions from the entire dataset were evaluated. Included were those classified as sessile or flat on

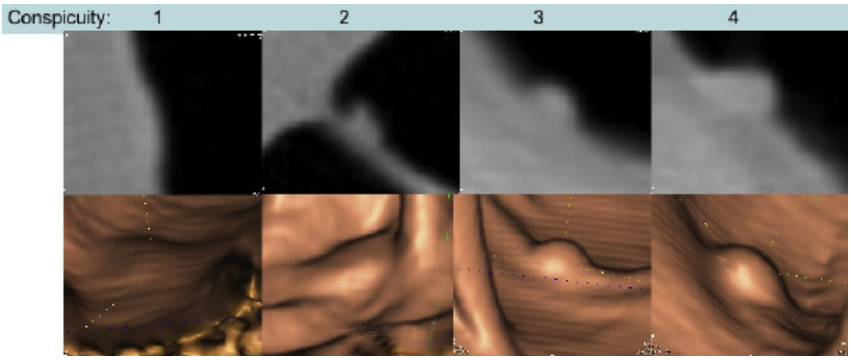

Figure 1. Conspicuity scale demonstrating eight different lesions in the four views. The top row is two dimensional in lung (W = 1500, L = -200) and in three-dimensional in the bottom row. In each case, the same scale applies as follows: 0 = lesion was not visible at all and could not be measured; 1 = lesion was barely visible and it was hard to visualize its borders; 2 = lesion was somewhat visible and paging through the slices on computed tomography or rotating the viewing angle may have helped in visualizing the lesions' borders, especially if the lesion was located on a fold; 3 = lesion was relatively visible, but had a few minor limitations; 4 = lesion was highly visible with very discrete borders.

visualization by a radiologist at CTC. Lesions that were labeled pedunculated (31) or not visible (103) on at least one CTC view (supine or prone) were excluded, leaving 73 patients with 94 sessile or flat lesions for analysis. Of these lesions, 68 were adenomas, 22 were hyperplastic, 3 were labeled other histology, and 1 was normal. Eighty were called sessile, 4 sessile/flat, 5 flat, and 5 not available by the radiologist. Lesions called sessile were also included because they were classified as such by visualization alone and had the potential to fit a particular definition of a flat lesion. Lesions missed by the readers in the original trial (false-negative cases) were nevertheless included in this analysis if they were visible in retrospect on at least one CTC view (13). Lesion localization was based on the original trial reconciliation data. The CTC exams were performed with 2.5 mm slice thickness and 1 mm reconstruction intervals and table speeds of 7.5–15.0 mm/second. All exams included in this article were performed under institutional review board approval and informed consent was obtained.

Observers

A radiologist with more than 500 CTC case experience trained observers #1 and #2 in the use of the software and in the measurement of lesions and use of the 2D and 3D five-point conspicuity scales detailed in the following section using cases that were not part of the experiment. Observers #1 and #2 were both fourth-year medical students. When the observers' measurements were consistently correct, the experiment commenced.

Lesion Assessment

Each lesion was viewed interactively (paging in 2D or manipulating in 3D) and rated on each dataset (supine and prone views). Observers were given the CT slice number on supine or prone views and location of the lesion within the intestinal tract for lesion localization. Lesions were reviewed retrospectively and polyps were measured to determine if they were flat. Four ratings were obtained: one for the 3D endoluminal view and 2D images as viewed on each of the three window and level settings. Conspicuity of the 3D images was assessed from a view directed to the polyp. Conspicuity (Fig. 1) was defined as follows: 0 = lesion was not visible at all and could not be measured; 1 = lesion was barely visible and it was hard to visualize its borders; 2 = lesion was somewhat visible and paging through the slices on CT or rotating the viewing angle may have helped in visualizing the lesions' borders, especially if the lesion was located on a fold; 3 = lesion was relatively visible, but had a few minor limitations; 4 = lesion was highly visible with very discrete borders.

Lesion Conspicuity and Measurement

Observer #1 determined lesion conspicuity and measurements on a Vital Images workstation using Vitrea 2 software (Vital Images, version 3.9, Minnetonka, MN). Default settings of the colon CTC software were used (direct light and transparent CT colon surface with color was set to "fat-muscle-bone" setting). 2D images were viewed with three tailored window/level settings: "lung" (W = 1500, L = −200), "flat" (W = 970, L = 87), and "soft tissue" (W = 400, L = 10) in a stable room lighting environment and fixed monitor settings. Some experts have advocated each of these window/level settings as ideal for visualizing flat lesions (1,14). In 2D, magnified axial, coronal, sagittal planes, and oblique views were simultaneously analyzed to perform a point-to-point correlation with the epicenter of the polyp before measuring polyp height. Point-to-point correlation was also made between the 2D and 3D views, which ensured that polyp height would not be overestimated. We used the standard multiplanar views to make our measurements because these views are likely to be used in general clinical practice. The longest axis and maximal height of the lesion as seen on each dataset (supine and prone) was then recorded. On a close-angle 3D endoluminal view, the lesion was viewed from various angles to first decide its borders. Longest axis and maximal height were measured on each dataset. Comparison of 2D and 3D images before making measurements were permitted to assess lesion shape and borders in the

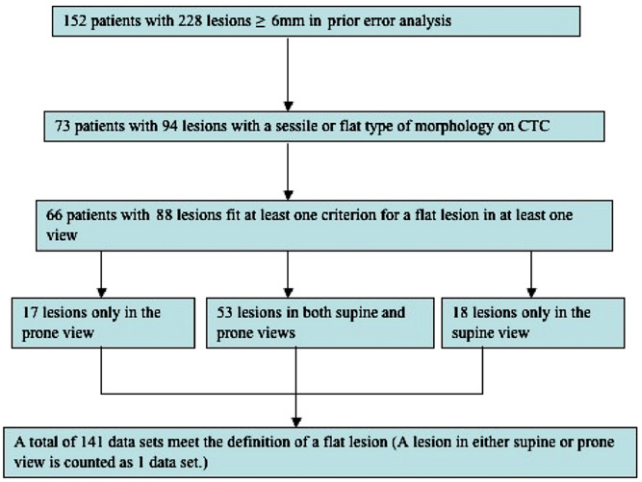

Figure 2. Flow chart of lesion analysis. Of the 88 lesions in 36 patients that met one of the two criteria for flat lesions in at least one viewing methods, 65 were adenomas, 19 were hyperplastic polyps, 3 were other histology, and 1 was normal mucosa.

TABLE 1. OC, Long Axis, and Height Measurements in the Two-dimensional Lung View Comparing 68 Adenomas (121 Datasets) versus 26 Non-adenomas (39 Datasets)

	Adenoma (n = 68)		Non-adenoma (n = 26)	
	Mean (mm)	Standard Deviation	Mean (mm)	Standard Deviation
OC	8.83	3.08	7.48	1.78
Long axis	9.09	2.93	8.26	2.46
Height	3.81	1.32	3.28	0.65

OC, optical colonoscopy; CTC, computed tomography colonography.

One dataset was not visualized in the two-dimensional lung view. Ninety-four lesions (161 datasets) in 73 patients seen on CTC had flat or sessile type morphologies that were measured to determine if they fit a proposed flat lesion definition. Non-adenomas included those classified as normal, hyperplastic, or other. A lesion in either supine or prone view is counted as one dataset. OC measurements ranged from 6–18 mm in size.

same session, because this approach corresponds to the method that would be used in clinical practice when measuring lesions. The perspective and the cutting plane of the cube view were manually adjusted to find the epicenter of the lesion in 3D and simultaneously compare it to the 2D views. To determine the height in 3D, the true lesion's epicenter and perspective at right angle to its maximal dimension was found. Scatter plots of adenomas versus non-adenomas showing lesion height and long axis measurements were constructed.

Statistical Experimental Design

Data from the 3D endoluminal view and the 2D view in each of the three window/level settings was analyzed to determine which measurements fit the definitions of "flat" lesions as defined by a "height" ≤3 mm or a "ratio" of height ≤half of the long axis. A chi-square test was applied to the data to evaluate if statistically significant differences existed among the four viewing methods with respect to how many datasets fit a particular definition as compared to expected. Analysis of variance (ANOVA) analysis was applied to the data to determine if there was a difference among the four viewing methods within a particular flat lesion definition. Post-hoc two-tailed t-test was used to determine if there was a difference between two viewing methods (eg, 2D "lung" window vs. 3D) for datasets defined as flat by each of the respective definitions previously presented.

Intra-observer Variability

Thirty-five datasets containing flat lesions were selected to evaluate intra-observer variability of the 2D and 3D measurements by Observer #1. The datasets were grouped into those ranging in size from 6–9 mm and those ≥10 mm (based on optical colonoscopy). Within each size group, the datasets were chosen randomly such that about half were from each group. Intra-observer data using each of the four viewing methods was analyzed by first calculating the absolute percent difference between the two measurements of each lesion. Absolute percent difference equaled ([Measurement #1−Measurement #2]/Measurement #1)*100. ANOVA analysis was used to compare the average percent difference for each of the four viewing methods to determine if a difference existed among the different viewing methods. The data were also analyzed using a post-hoc two-tailed t-test to determine if there is a difference between two viewing methods (eg, 2D lung vs. 3D).

Inter-observer Variability

Inter-observer variability on the Vital Images software was evaluated on 33 randomly selected datasets. Measurements from Observer #1 were compared to those from Observer #2 for all measurements in 2D and 3D. Observer #2, who underwent the same training, only measured lesions in the soft tissue and lung window/level settings and 3D endoluminal view. The data were statistically analyzed using ANOVA and post-hoc two-tailed t-test in the same manner as the intra-observer data. The goal was to determine if there was any difference in measurement when the two window/level settings in 2D and the 3D view were compared. Bland-Altman plots with 95% limits of agreement of the difference between polyp long axis or height measurements of Observer #1 and Observer #2 versus mean long axis or height measurements in the 2D lung, 2D soft tissue, and 3D endoluminal views were also constructed.

RESULTS

Definition

Figure 2 shows a flow chart for the study cohort. Table 1 summarizes the optical colonoscopy, long axis, and height

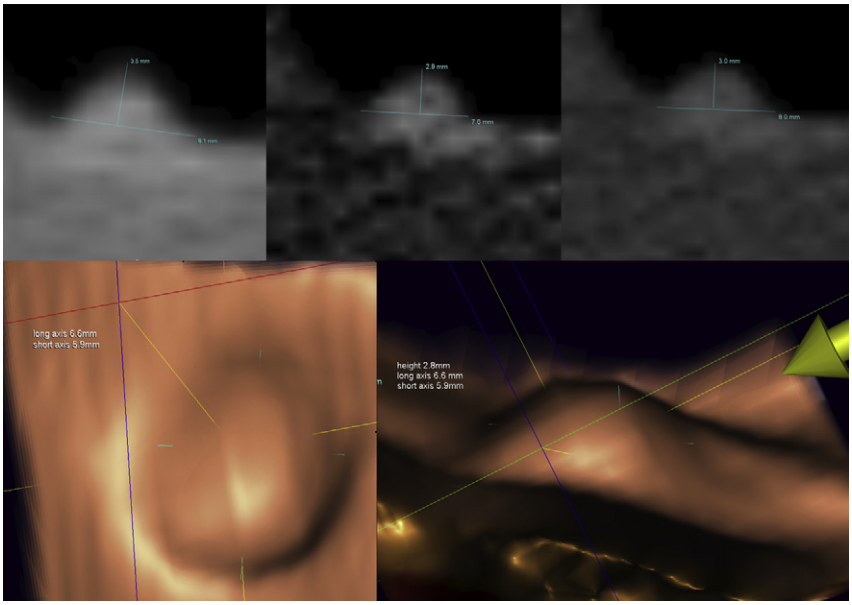

Figure 3. Illustrations of the measurements of height and long axis of the lesions. The first row shows three flat lesions in two-dimensional lung tissue, soft tissue, and flat views measured on an axial plane (from left to right). The second row shows flat lesions in the three-dimensional (3D) endoluminal view. After optimizing the magnification and cutting plane, manual rotation of the 3D image was used to determine the proper perspective to measure maximal height. In difficult cases, trial and error was used to find the maximal height.

TABLE 2. The Number of Datasets that Fit Two Different Definitions of a Flat Lesion

	2D Lung	2D Soft Tissue	2D Flat	3D
	n = 141	*n* = 134	*n* = 135	*n* = 141
Fits less than or equal to 3 mm height definition (% of total)	49 (34.8%)	82 (61.2%)	76 (56.3%)	73 (51.8%)
Fits height less than half the longest axis definition (% of total)	116 (82.3%)	110 (82.1%)	121 (89.6%)	119 (84.4%)

2D, two-dimensional; 3D, three-dimensional.
Seven and six datasets could not be visualized in the 2D soft tissue and flat views, respectively.

measurements in the 2D lung view of adenomas versus non-adenomas in the 94 lesions in 73 patients seen on CTC that had a sessile or flat type of morphology. The 2D lung view was used as just one example and similarly seen in the other three viewing methods of how measurements of adenomas versus non-adenomas fell within similar ranges. After measurement, a total of 141 datasets met the definition for a flat lesion in at least one viewing method. A lesion in either the supine or prone position was counted as one dataset. Of the 94 lesions measured by Observer #1, 88 lesions in 66 patients (65 adenomas, 19 hyperplastic polyps, 3 other histology, and 1 normal mucosa) met one of the two criteria for flat lesions in at least one viewing method. From the 228 colonoscopically verified lesions ≥6 mm in 152 patients available, 68 (29.8%) lesions in 53 (34.9%) patients met the definition using the "height" criterion and 85 (37.2%) lesions in 64 (42.1%) patients met the definition using the "ratio" criterion in at least one viewing method. The definition was met in both supine and prone for 53 lesions, the supine view only for 18, and the prone view only for 17 lesions. Factors limiting measurement of a lesion in only supine or prone included fluid, stool, or poor distension of the colonic segment. Figure 3 demonstrates how some of the lesions were measured.

Table 2 summarizes the number of datasets meeting the definition of flat in all four viewing methods. In the 2D soft tissue and 2D flat viewing methods, seven and six datasets, respectively, could not be visualized and were not measured. Using the flat lesion definition of height ≤ 3 mm, significantly fewer datasets were defined as flat using the 2D lung (n = 49 of 141) view compared to 2D soft tissue (n = 82 of 134), 2D flat (n = 76 of 135), and 3D viewing methods (n = 73 of 141) for which datasets fit the definition (chi-square test, $P < .0001$). With the ratio definition, there was no statistically significant difference among all viewing methods (2D lung [n = 116], 2D soft tissue (n = 110), 2D flat (n = 121), and 3D (n = 119) for the number of datasets fitting the definition ($P = .28$).

Conspicuity

With lesions fitting either the "height" or "ratio" definition, there was a statistically significant difference among the four viewing methods and average conspicuity (ANOVA, $P = .0005$). A post-hoc two-tailed t-test showed lesions were significantly more conspicuous in the 3D endoluminal view (2.9) when compared to 2D lung (2.5; $P = .003$), 2D soft tissue (2.4; $P < .0001$), or 2D flat (2.5; $P = .0029$) views.

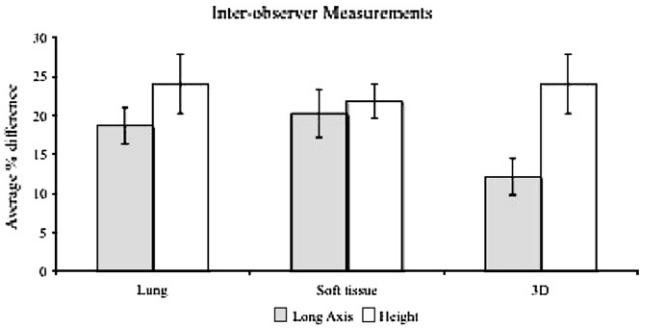

Figure 4. Inter-observer long axis and height measurement average % differences versus view. In the long axis measurement, a post-hoc two-tailed *t*-test showed a statistically significant difference between the 3D endoluminal view (12%) compared to the 2D lung (19%; $P = .016$) or to 2D soft tissue (20%; $P = .0099$) viewing methods.

There was no statistically significant difference among the three 2D window/level settings.

Comparison of Viewing Methods

Figure 4 shows the results for the inter-observer measurements. Regarding comparison of Observers #1 and #2, there was no statistically significant difference among the three different viewing methods (3D, 2D lung, 2D soft tissue) or the average percent difference in inter-observer long axis measurements ($P = .07$). However, a post-hoc two-tailed *t*-test showed there was a significantly less average percent difference in inter-observer long-axis measurements when viewed on the 3D endoluminal view (12.1%) compared to the 2D lung (18.9%; $P = .016$) or to 2D soft tissue (20.2%; $P = .0099$) viewing methods. The 2D viewing methods were not statistically different among each other (two-tailed t-test, $P = .56$). There was no statistically significant difference among the average percent difference in inter-observer height measurements in the 2D lung (24.1%), 2D soft tissue (21.8%), and 3D endoluminal (24.1%) viewing methods ($P = .86$). Tables 3 and 4 summarize the mean percentage differences, mean differences, and the 95% Bland-Altman limits of agreement of inter-observer measurements. Figure 5 shows a Bland-Altman plot of the difference between polyp long axis measurements of Observer #1 and Observer #2 versus mean long axis measurement of lesions in the 3D endoluminal view. There is general agreement in measurements between observers. Appendix 1 shows additional Bland-Altman plots for long axis or height measurements in the 2D lung, 2D soft tissue, and 3D endoluminal views.

Lesion Measurements

Figure 6 shows the results for the intra-observer measurements. There was no statistically significant difference in the average percent difference in intra-observer long axis measurements among the 2D lung (5.8%), 2D soft tissue (6.1%), 2D flat (5.7%), and 3D endoluminal (7.5%) viewing methods ($P = .63$). The average percent difference was significantly greater in intra-observer height measurements in the 3D endoluminal (18.6%) view as compared to the 2D lung (8.9%), 2D soft tissue (11.5%), and 2D flat (12.4%) viewing methods ($P = .02$). A post-hoc two-tailed *t*-test showed a significant difference between the 2D lung and 3D endoluminal viewing methods ($P = .025$).

DISCUSSION

Definition

Varied definitions of flat lesions are used throughout the literature. Sawada et al (3) reported that, macroscopically, flat adenomas were defined as mucosal elevations with a flat or slightly rounded surface and a height of less than half the diameter of the lesion. Using the term "diameter" portrays this lesion as a concentric circle, but flat lesions can be varying in shape. Kudo et al (4) classified the gross appearance of small flat adenomas as level or minimally elevated lesions usually no more than 10 mm in diameter. They classified large flat adenomas otherwise known as laterally spreading tumors as those that extend circumferentially along the colon wall but are short in height compared with the large diameter of more than 10 mm. The Paris classification defines flat lesions as those protruding below the level of closed jaws of biopsy forceps (2.5 mm) (5). Histologically, flat lesions have been described as those in which the thickness of the lesion is less than twice of the adjacent normal mucosa (6). Pickhardt et al (7) defined a flat lesion on CTC as a lesion with a height of less than a half of its width, and except for some larger lesions, they were generally 3 mm or less in height. Because the size of the lesion is regarded as the most important factor in determining lesion detectability at CTC, it is important to use a consistent method to measure lesions (15). By using the endoscopic definition of "height $\leq$ a half of the longest axis" implies that lesions can be of varying sizes and shapes, but only the longest axis is compared with the maximal height.

Comparison of Viewing Methods

We found that when using the flat lesion definition of height $\leq$ 3 mm, more lesions were classified as "flat lesions" in the 2D flat, 2D soft tissue, and 3D viewing methods than in the 2D lung viewing method. A smaller number of polyps met criteria using 2D lung windows for the height definition showing that lesions were on average larger using the lung window. These data suggest that the lung window is more accurate and should be the window setting used to report the 2D size. Also, these data suggest that whoever is using a method for a measurement; he or she must use the same viewing method consistently because the lesions fitting the definition may change. For example, if one used the height criterion for flat lesions, and measured a lesion in the 2D lung viewing method, but then switched to the 2D flat viewing method, you may not call the same lesion a flat lesion in the different viewing methods. Our data is consistent with

TABLE 3. Statistical Analysis of Height Measurements Taken by Observer #1 Compared to Observer #2 in the 2D Lung, 2D Soft Tissue, and 3D Endoluminal Views

Measurement Parameter	Mean Percentage Difference (%)*	Mean Difference (mm) †	Standard Deviation of Difference	95% Bland-Altman Limits of Agreement‡
2D Lung	24.1	0.26	1.07	-1.84, 2.36
2D soft tissue	21.8	0.26	0.84	-1.39, 1.91
3D	24.1	0.47	1.36	-2.21, 3.14

2D, two-dimensional; 3D, three-dimensional.
*Average value of the absolute percent differences, ((Observer #1-Observer #2)/Observer #1) ×100.
†Observer #1-Observer #2.
‡Mean difference ± 1.96 times standard deviation of differences.

TABLE 4. Statistical Analysis of Long Axis Measurements Taken by Observer #1 Compared to Observer #2 in the 2D Lung, 2D Soft Tissue, and 3D Endoluminal Views

Measurement Parameter	Mean Percentage Difference (%)*	Mean Difference (mm) †	Standard Deviation of Difference	95% Bland-Altman Limits of Agreement‡
2D Lung	18.9	0.94	2.32	-3.61,5.48
2D soft tissue	20.2	0.92	2.22	-3.43, 5.28
3D	12.1	0.46	2.11	-3.67, 4.59

2D, two-dimensional; 3D, three-dimensional.
*Average value of the absolute percent differences, ((Observer #1-Observer #2)/Observer #1) ×100.
†Observer #1-Observer #2.
‡Mean difference ± 1.96 times the standard deviation of differences.

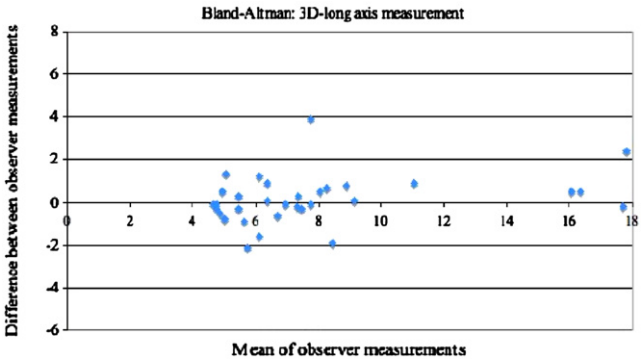

Figure 5. Bland-Altman plot of the difference between polyp long axis measurements of Observer #1 and Observer #2 versus mean long axis measurement of lesions in the 3D endoluminal view.

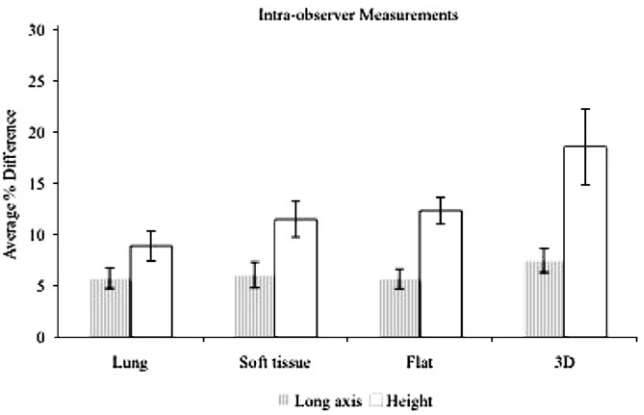

Figure 6. Intra-observer measurement average % differences versus view. There was a statistically significant difference (analysis of variance, P = .02) in the average percent difference in intra-observer height measurements among the two-dimensional (2D) lung (8.9%), 2D soft tissue (11.5%), 2D flat (12.4%), and three-dimensional (3D) endoluminal (18.6%) viewing methods. A post-hoc two-tailed t-test showed a significant difference between the 2D lung and 3D endoluminal viewing methods (P = .025).

data obtained in a study of polyp measurement in a phantom model by Young et al (16), in which they found significant differences among measurements obtained at various viewing methods (2D lung and soft-tissue window/level settings and 3D cube view). Overall, the number of patients in the analyzed cohort fitting any one criterion of a flat lesion was relatively small. Comparisons of adenomatous versus non-adenomatous lesions showed similar size ranges.

Conspicuity and Measurement

A consensus opinion has recommended polyps to be evaluated in multiplanar and 3D views, and for measurements to be performed at a window/level setting of 1500/−200 HU with additional soft-tissue display settings for more accurately characterizing flat lesions (10). However, optimal viewing methods for visualization and measurement of flat lesions have not been established. Studies have shown that flat lesions tend to be less conspicuous. In a study by Summers et al, lesion height correlated with conspicuity. Less conspicuous polyps

tended to be flatter (lower in height) (17). Pickhardt et al also found that flat lesions were more conspicuous on the 3D endoluminal view (7). Fidler et al recommended that both lung (width = 2000 HU, level = −600 HU) and soft tissue (width = 400 HU, level = 20 HU) settings be used because a lesion was more conspicuous on the soft-tissue setting (1). Lesions were on average significantly more conspicuous in the 3D endoluminal view as compared to the 2D views. Because we did not do full CTC blinded interpretation, we cannot extend this conclusion to the detection of lesions. Summers et al also demonstrated that readers tended to prefer the 3D endoluminal images or a combination of the 3D endoluminal and 2D axial images for conspicuity assessment (17).

Lesion Follow-up

Differences in measurements between observers or within observers are important if the size of the lesion is being followed over time. There is no guarantee that the same person is going to read the same case. Therefore, inter-observer variability is more important. The long axis measurement in the 3D endoluminal view had the lowest inter-observer variability. There was low variability in long axis measurements in all views when performed by the same observer. The 3D endoluminal view intra-observer height variability was high most likely due to the limitation of the Vital Images software in taking the height measurements. At times, it was difficult to take a measurement of the height in the proper cutting plane. In these cases, trial and error was used to find the optimal height.

Source of Variability

The source of variability in measurements between observers and between measurements from the same observer included the lesion being very flat, falling on or between folds, and partly in fluid or stool, all which caused difficulty in defining the true borders of the lesion. While taking measurements, the observers noted difficulties in measurements of such lesions. Also, smaller lesions may not have had a numerically large difference in measurements, but because the measurement was small to begin with, the overall percent difference between measurements may have been large.

To minimize inter-observer variability (such as when following a patient over time), we propose that it is best to use the single longest dimension as seen on 3D views as the key metric. Young et al (16) also reported that when using the Vitrea software, the 3D cube view was the best way to measure the polyps.

This study has several limitations, including small sample size, use of archived data from a previously reported study (not done with current CT scanner systems), only two observers, and absence of phantom test objects. Small sample size may attributed to the number of available lesions in the original trial which had a by-lesion CTC sensitivity of 49% for lesions ≥6 mm, however we included lesions visible in retrospect, even if missed in the original trial. Despite these limitations, we were able to show robust differences between viewing methods and suggest the best measurement technique for flat lesions. This fills an important gap in the CTC literature and suggests the need for further investigation with future prospective studies that may include flat lesion assessment as a secondary objective.

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APPENDIX 1

Bland-Altman plots of the difference between polyp long axis or height measurements of Observer #1 and Observer #2 versus mean long axis or height measurement of lesions in the two-dimensional (2D) lung, 2D soft tissue, and 3D endoluminal views.

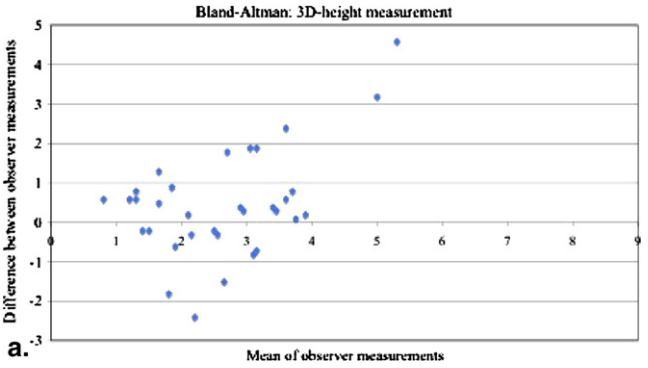

Figure 1A. Bland-Altman plot of the difference between polyp height measurements of Observer #1 and Observer #2 versus mean height measurement of lesions in the three-dimensional endoluminal view.

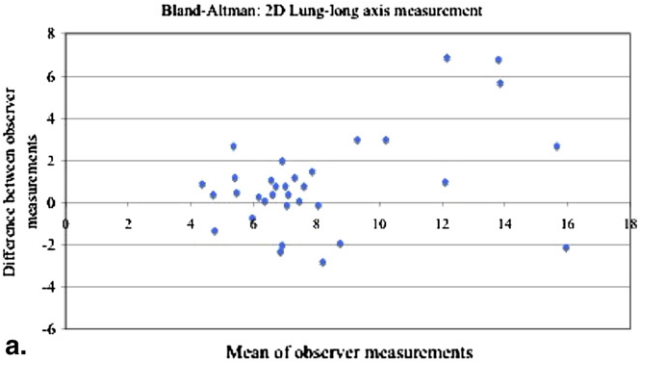

Figure 2A. Bland-Altman plot of the difference between polyp long axis measurements of Observer #1 and Observer #2 versus mean long axis measurement of lesions in the two-dimensional lung view.

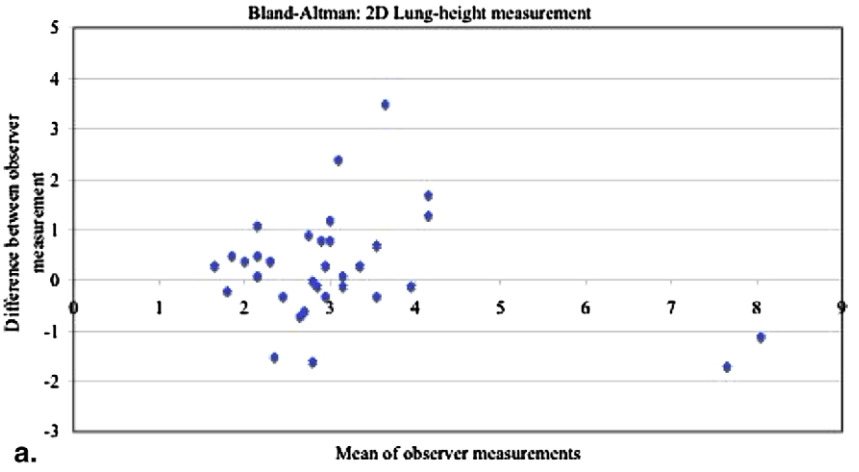

Figure 3A. Bland-Altman plot of the difference between polyp height measurements of Observer #1 and Observer #2 versus mean height measurement of lesions in the two-dimensional lung view.

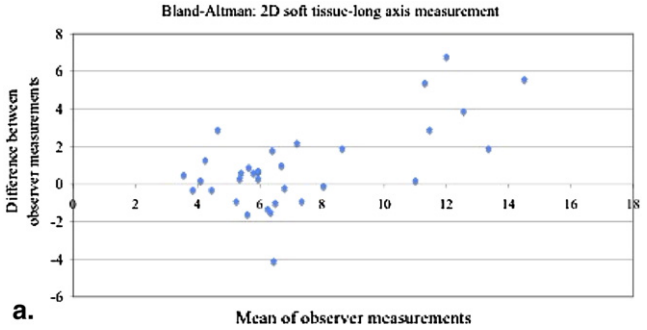

Figure 4A. Bland-Altman plot of the difference between polyp long axis measurements of Observer #1 and Observer #2 versus mean long axis measurement of lesions in the two-dimensional soft tissue view.

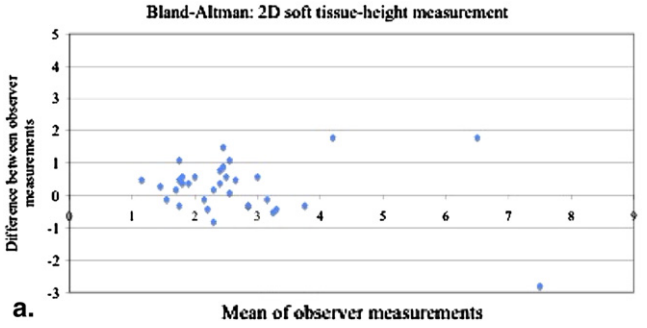

Figure 5A. Bland-Altman plot of the difference between polyp height measurements of Observer #1 and Observer #2 versus mean height measurement of lesions in the two-dimensional soft tissue view.