

Belinson S, Ledford K, Wulan N, Rasool N, Wang C, Rollins A, Rong X, Zhang W, Mohr M, Zhu YS, Tresser N, Wu RF, Belinson JL.

(1) Feinberg School of Medicine, Northwestern University, Department of Preventive Medicine, Chicago, United States; (2) University of Toledo, Department of Bioengineering, Toledo, United States (3); Peking University Shenzhen Hospital, Department of OB/GYN, Shenzhen, China (4) The Cleveland Clinic, Section of Gynecologic Oncology, Cleveland, United States (5) Case Western Reserve University, Department of Biomedical Engineering, Cleveland, Ohio. (6) Imalux Corporation, Clinical, Cleveland, United States

ABSTRACT  
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## ABSTRACT

**Objectives:** Analyze the differences in the brightness of the cervical epithelium on Optical Coherence Tomography (OCT) images as a potential distinguishing characteristic of normal, low-grade, high-grade, and cancer histologies.

**Methods:** Three hundred women who participated in a real-time study of OCT as a diagnostic adjunct to colposcopy and 183 women who participated in a real-time study of OCT as a diagnostic adjunct to VIA were combined to compare the relationship between the brightness of the OCT images to corresponding histology. All patients undergoing colposcopy or Unaided Visual Inspection (VIA) were evaluated by cervical quadrant. Areas were likewise evaluated by OCT. All women had biopsies obtained from any abnormal areas in any quadrant. In normal quadrants biopsies matching the OCT sites were taken at 2,4,8, or 10 o'clock at the squamo-columnar junction depending on the quadrant. Brightness of the epithelium was measured at 3 and 12 o'clock and averaged together to create a normal brightness reading for each patient. Abnormal lesions were then measured for brightness; normal images were then subtracted from the abnormal image to create a difference from normal. All brightness measures were a log scale. Mean difference from normal was used to compare brightness levels by histological grade. Two sample T-tests were used to look at differences in brightness between histological grades.

**Results:** Histologic diagnoses were as follows 6 squamous metaplasia, 52 CIN II, 64 CIN III, and 22 cancer. Mean brightness was 0.16, 1.57, 3.34, and 4.60 for squamous metaplasia, CIN II, CIN III, and cancer respectively. Mean brightness differed significantly between each histological grade (p-values 0.000) for the comparisons of CIN II to CIN III, CIN II to cancer, and squamous metaplasia to cancer. For the comparison of mean brightness for CIN III to cancer p=.008.

**Conclusions:** We conclude that epithelial brightness is an important component to include in the development of mathematical algorithms to use for the diagnostic interpretation of OCT generated images of the uterine cervix.

## BACKGROUND

- OCT uses near-infrared light, similar to ultrasound
- Has an optimal
- OCT creates a cross-sectional image of the tissue microstructure.
- Niris™ Imaging System, Imalux, Cleveland, Ohio, USA
- ImageJ is a public domain, java image processing program.
- Formally known as NIH Image
- ImageJ has the ability to open raw OCT images and gather information.

## Objective

- Analyze the brightness of cervical epithelium on Optical Coherence Tomography images as a potential distinguishing characteristic of histological grades.

## METHODS

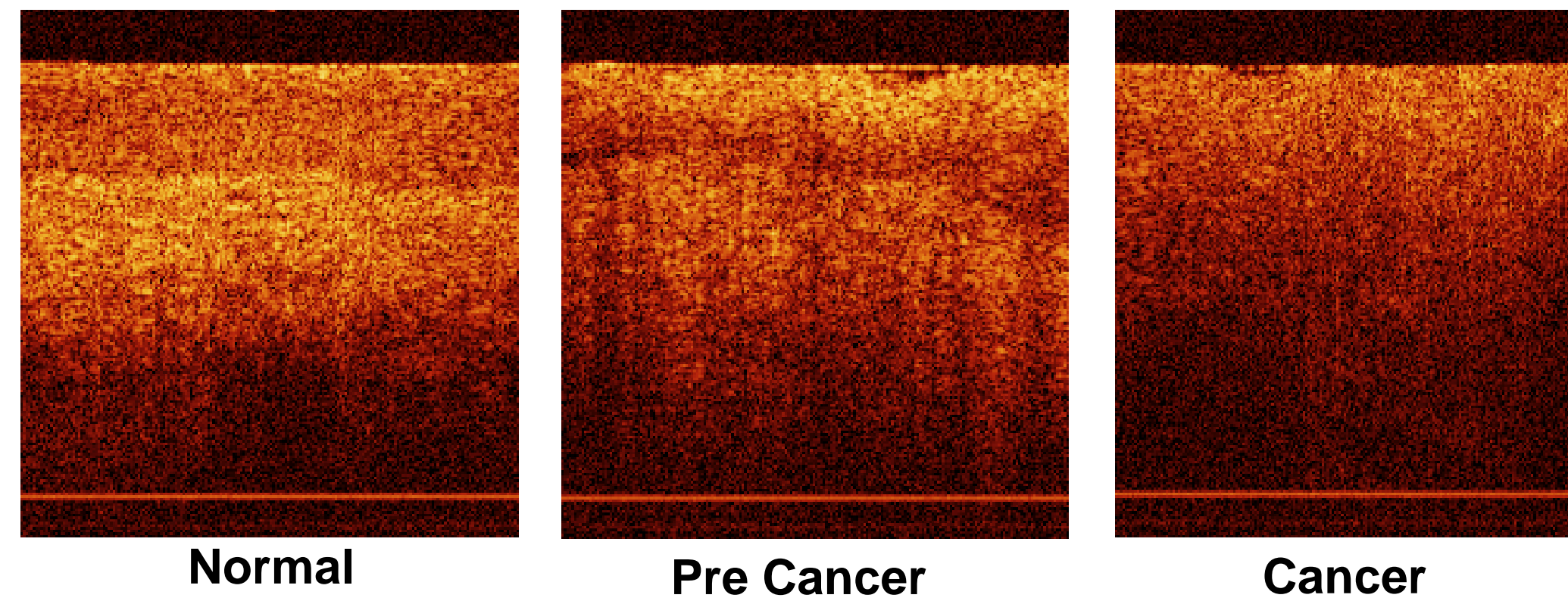
- Data from 300 women who participated in a real-time study of OCT as a diagnostic adjunct to colposcopy (PUSH-OCT) and 183 women who participated in a real-time study of OCT as a diagnostic adjunct to VIA (GUPOCT) were combined to compare epithelial brightness to corresponding histology.
- All patients were evaluated by cervical quadrant: Quadrant I (12:00 – 3:00), Quadrant II (3:00 – 6:00), Quadrant III (6:00 – 9:00), and Quadrant IV (9:00 – 12:00)
- Baseline OCT images were obtained at 12 and 3 o'clock in the transformation zone to provide individual baseline images of the cervical thickness.
- Biopsies were obtained for all abnormal areas in any quadrant.
- In normal quadrants, biopsies were obtained from 2, 4, 8, or 10 o'clock at the squamo-columnar junction, with matching OCT readings.
- Epithelium brightness was analyzed using ImageJ.
- An area of interest (area with no artifacts) was selected and the areas mean brightness was recorded.

- Brightness of the epithelium was measured at 3 and 12 o'clock, and averaged together to create a normal brightness reading for each patient.
- Epithelium brightness was measured for all abnormal lesions.
- The normal brightness reading was subtracted from the abnormal reading, to create a change in brightness.
- Mean difference from the patients normal was used to compare brightness levels by histological grade.
- All original data was in logarithmic values and had to be converted to decibels by multiplying by 0.049.
- Two sample T-tests were used to look at differences in the brightness between histological grades.

## RESULTS

- Histological Diagnoses included: 6 squamous metaplasia, 52 CIN II, 64 CIN III, and 22 cancer.
- Data included a total of 82 women, 57 from PUSH-OCT and 25 from GUPOCT.
- The overall normal brightness was 56.49 db.
- The mean brightness was: 0.16, 1.57, 3.34, and 4.60 for squamous metaplasia, CIN II, CIN III, and cancer respectively.

- Mean brightness differed significantly between each histological grade (p-values 0.000) for the comparisons of CIN II to CIN III, CIN II to cancer, and squamous metaplasia to cancer.
- The comparison of mean brightness from CIN III to cancer, p= 0.008.



- Images from a normal cervix display a clear distinction between the epithelium and stroma.
- With increasing grade of dysplasia the distinction between the two layers becomes harder to differentiate.
- Eventually distinction between the two layers is not possible.

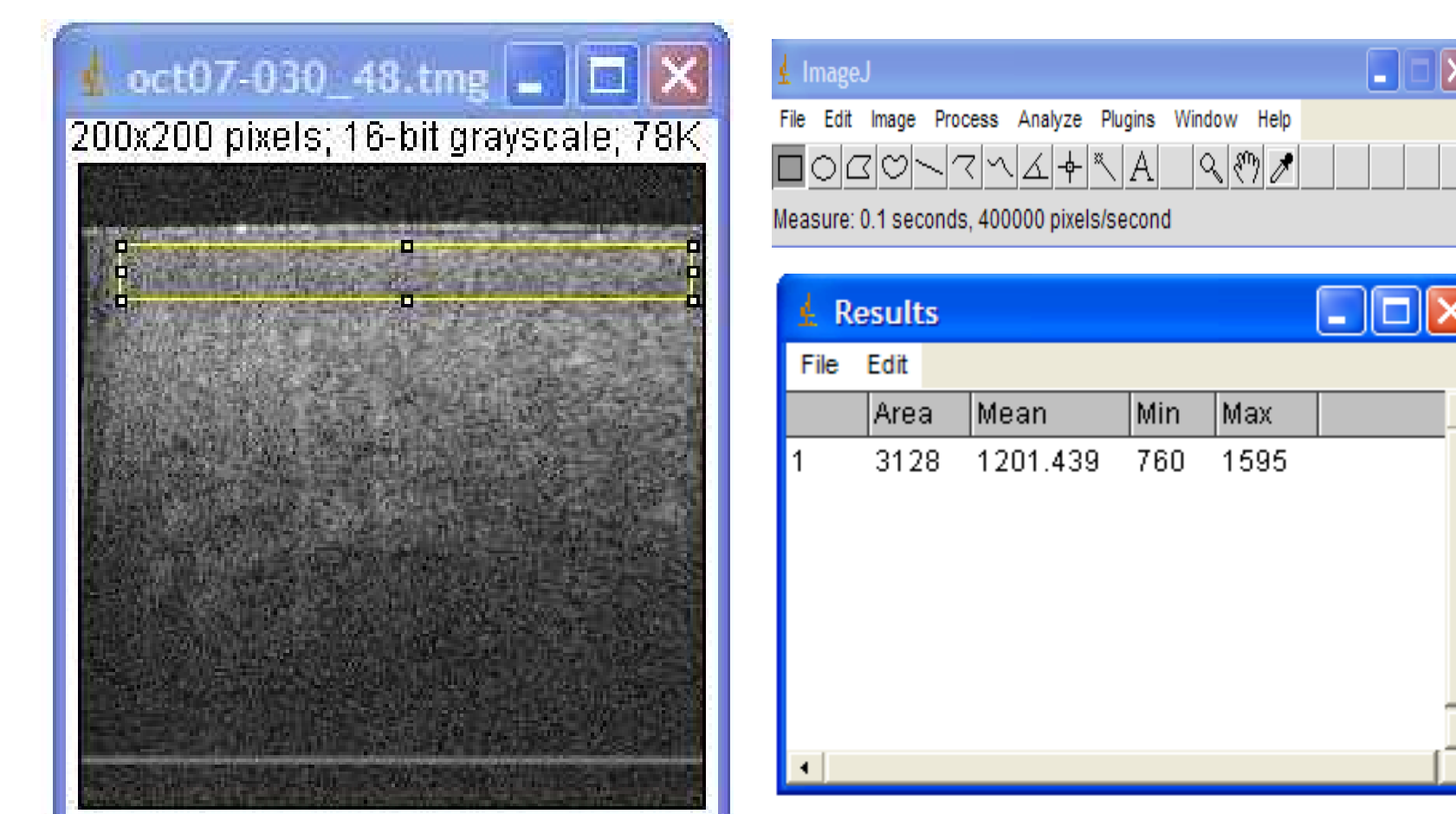
Table 1: Mean epithelial brightness measured by Image J software from optical coherence tomography images by histological grade among 82 women enrolled in the PUSH-OCT and GUPOCT trials.

Histological Grade(N)	Difference in Mean Brightness (95% CI)	Standard Deviation	Change from Previous grade	T-Test P-Value*
Normal (91)	-.839 (-1.29, -.384)	2.18	-	-
CIN I (115)	-.221 (-.610, .168)	2.11	+ .618	0.02
CIN II (52)	1.57 (1.03, 2.10)	1.91	+ 1.79	0.000
CIN III (64)	3.34 (2.82-3.87)	2.09	+ 1.77	0.000
Cancer (22)	4.60 (3.66-5.54)	2.11	+ 1.26	0.018

\*P-value for CIN II vs. CIN III  
\*\* P-value for CIN III vs. Cancer.

Table 2: Demographic characteristics of 82 women with at least one biopsy of ≥ CIN II from the PUSH-OCT and GUPOCT trial

Characteristic	PUSH-OCT N=57 women	GUPOCT N=25 women	Fishers Exact P-Value
Median Age (range)	37 (19-64)	41 (30-50)	.149
Median Number of Live Births (range)	1 (0-9)	2 (1-4)	.230
Median Number of Pregnancies (range)	3 (0-9)	3 (1-5)	.231
Menopausal (%)			
Yes	7 (12)	1 (4)	.424
No	50 (87)	24 (96)	
Married (%)			
Yes	48 (84)	22 (88)	.748
No	9 (16)	3(12)	
≥ CIN II (%)			
Yes	53 (93)	25 (100)	.308
No	4 (7)	0 (0)	
≥ CIN III(%)			
Yes	27 (47)	14 (56)	.632
No	30 (53)	11 (44)	



## SUMMARY AND CONCLUSIONS

- Epithelial brightness is an important component to include in the development of mathematical algorithms for the diagnostic interpretation of OCT images of the uterine cervix.