# Mosquito Bite Needle Endoscopy (MBNE)

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## Toronto is one of the top world Life Science clusters

Toronto's <u>Discovery District</u>, a 2.5km<sup>2</sup> downtown research park and health innovation hub, is comprised of 7 million square feet of facilities representing **Canada's largest concentration of hospitals, research institutes, business incubators, and venture capital organizations**, along with the University of Toronto. Within a 15-minute walk, 10 different clinical trial sites can be reached. The Discovery District invests over \$1 billion annually into public and private medical research.

We represent Ryerson University and Princess Margaret Cancer Centre (UHN)





## Current practice: Diagnosis of Breast Cancer

Breast Cancer presentation: Palpable lump or screening mammogram

Diagnosis: Lesion seen on mammogram, call back for ultrasound +/- tissue biopsy

To date problems: invasive, painful, bleeding, tissue destruction, relatively slow leading to patient anxiety: waiting for callback appointment and results of tissue biopsy









## Diagnostic Imaging in Breast Cancer

Ontario Breast Screening Program Annual Report 2011

The PROBLEM: Breast Imaging and Reporting System (BI-RADS score)

Category	Meaning	% cancer	Action	USA (2017) Ontario 11.6% Canada (2011) 7.8%
BI-RADS 0	Need more tests			
BI-RADS I	Nothing seen	0	Repeat mammo 1-2 yrs	Ontario: 12.85 million pop 467,531 screened 1.1% had biopsies
BI-RADS II	Benign lesion	0	Repeat mammo 1-2 yrs	
BI-RADS III	Probably benign	> 0 but < 2%	Repeat mammo 6 months or biopsy	5420 women had biopsies
BI-RADS IV	Suspicious for cancers	>2 and < 95%	Tissue biopsy	
BI-RADS V	Likely a cancer	> 95%	Tissue biopsy	Population of Netherlands:
BI-RADS VI	Biopsy proven cancer	100%	Refer to a surgeon	17.18 ml resulting in 7263 biopsies/year



Lehman et al National Performance Benchmarks for Modern Screening Digital Mammography: update from the Breast Cancer Surveillance Consortium Radiology Vol 283(1). April 2017

Solution: small invasive interstitial endoscopy aka acupuncture: no pain, no bleeding, tissue/cell self repair. Allows a small invasive examination at the time of consultation and early diagnostics





Modified from Ioannis V. Yannas: "Synthesis of organs: In vitro or in vivo?, PNAS August 15, 2000 97 (17) 9354-9356



Conditional Name for the technology: Mosquito Bite Needle Endoscopy (MBNE) (patent pending)

This is the 3rd generation of the microendoscope developed by our group (since 2005)

MBNE will facilitate:



## MBNE facilitates: 1. Color Imaging





Normal breast tissue

## **Cancerous breast tissue** (3.5cm invasive ductal carcinoma (AJCC T2N1M0))

Images are taken from our 1<sup>st</sup> and 2<sup>nd</sup> generations of the microendoscope results



## MBNE facilitates: 2. Autofluorescence Imaging





Normal breast tissue

**Cancerous breast tissue** (3.5cm invasive ductal carcinoma (AJCC T2N1M0))

Images are taken from our 1<sup>st</sup> and 2<sup>nd</sup> generations of the microendoscope results



## MBNE facilitates: 3. Raman Spectroscopy



PhotochemCAD by Scott Prahl, http://omlc.org/spectra/PhotochemCAD/index.html

#### Advantage of Raman Spectroscopy: rich signature



#### Schematics of combined Multispectral-Fluorescence-Raman confocal microscope





Miniaturized detection/light source head with the capabilities of performing combined white light/fluorescence and Raman sensing coupled to MBNE



RYERSON UNIVERSITY

The microneedle of 45 mm long, 195 micron outer diameter (comparable with an acupuncture needle), 100 micron internal diameter





## Microendoscope

Protecting/storage - cylinder



straight port (this port provides a full connection with the Miniaturized detection/light source head or in case of its failure is a back up connector to a RGB camera

90 degrees port (at normal mode is not used, and in case of the Miniaturized detection/light source head failure is a back up connector to a broad band light source)



## Distal end of the microendoscope





# Rinsing and suction facilities coupled with the Microendoscope



#### Suction facility collects biopsy tissues and cells



## MBNE applications: Breast biopsy





## MBNE applications: Thyroid biopsy



Modified from https://www.cancer.gov/types/thyroid/patient/thyroid-treatment-pdq



## MBNE applications: Prostate biopsy



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Adapted from https://www.mayoclinic.org/diseases-conditions/prostate-cancer/symptoms-causes/syc-20353087



# MBNE applications: Ascites differentiation (transudate from exudate



Modified from https://www.aagyarthayurved.com/ascites/



# Mosquito Bite Needle Endoscopy (MBNE) can be a game changer in cancer diagnosis :

- No pain, no bleeding
- Faster healing
- Potential for improved real time tissue diagnosis
  - Reduce need for biopsy in indeterminate lesions
  - Can confirm location of lesion
  - Reduce need for rebiopsy



Preliminary results with previous generation microendoscope (550 micron outer diameter, breast ex vivo): AUTOFLUORESCENCE IMAGING



	Normal	Tumor
Patient 2	0.49±0.17	1.10±0.17
Patient 3	0.21±0.16	0.89±0.45
Patient 5	0.13±0.05	0.69±0.25

Results are taken from our 1<sup>st</sup> and 2<sup>nd</sup> generations of the microendoscope



### Preliminary results with previous generation microendoscope (550) micron outer diameter, breast ex vivo): RAMAN SPECTROSCOPY





#### Results are taken from our 1<sup>st</sup> and 2<sup>nd</sup> generations of the microendoscope

**Background corrected** 

## ACKNOWLEDGEMENTS



S. Done



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iBEST

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A. Pandya



Conseil de recherches en sciences naturelles et en génie du Canada







Supriya Kulkarni

Start-Up Company: MBEndoscopy (www.mbendoscopy.com)

(Mosquito Bite Endoscopy technology : patent pending)

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#### This presentation was presented at EPIC Meeting on Photonics for Cancer Diagnostics and Treatment 2019

