

# The virtual slide and conventional microscope - a direct comparison of their diagnostic efficiency

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# Summary

- Simple experiment to test the efficiency of virtual slides
- Found that virtual slides less efficient than the conventional microscope, taking over 60% longer to perform the same tasks
- This knowledge can be used to improve the virtual slide

# Background

- Virtual slides are very large computer images produced by scanning entire glass slides at high resolution
- They are viewed using computer software with standard PC, mouse and keyboard
- Anecdotally, pathologists report that they are more difficult to use, and less efficient than the microscope
- This would have implications for the widespread adoption of virtual slides in diagnostic practice

# Previous studies of the efficiency of virtual slides

- Leong et al (2002) reported a dynamic (robotic) telepathology system to be 10 times slower
- Renal EQA virtual slide examination reported by participants to take 3.9x as long (Furness (2007))
- Few formal studies of efficiency of virtual slides

# Methods

- Within-subject comparison of efficiency of conventional microscope and virtual slide
- 4 subjects
- Timed while performing 7 diagnostic tasks chosen to represent a spectrum of work
- Recorded time taken
- Diagnostic accuracy was not tested
- User feedback on preferred method obtained

# Microscope vs. virtual slide



- Leica DMRB
- 2.5x, 5x, 10x, 20x and 40x objectives



- Standard NHS PC (Pentium 4, 512MB RAM)
- liyama Vision Master Pro 410 CRT monitor (17", 1024 x 768 pixels, 850 X 710 viewable area of slide)
- Virtual slides scanned at 0.23 microns per pixel with Aperio virtual slide scanner
- **Slides stored on PC hard drive to avoid bias due to network latency**
- Custom-made slide viewing software

Slide tracker: 10578

1. Start here

Start

Report a  
problem

2. Look at the slide

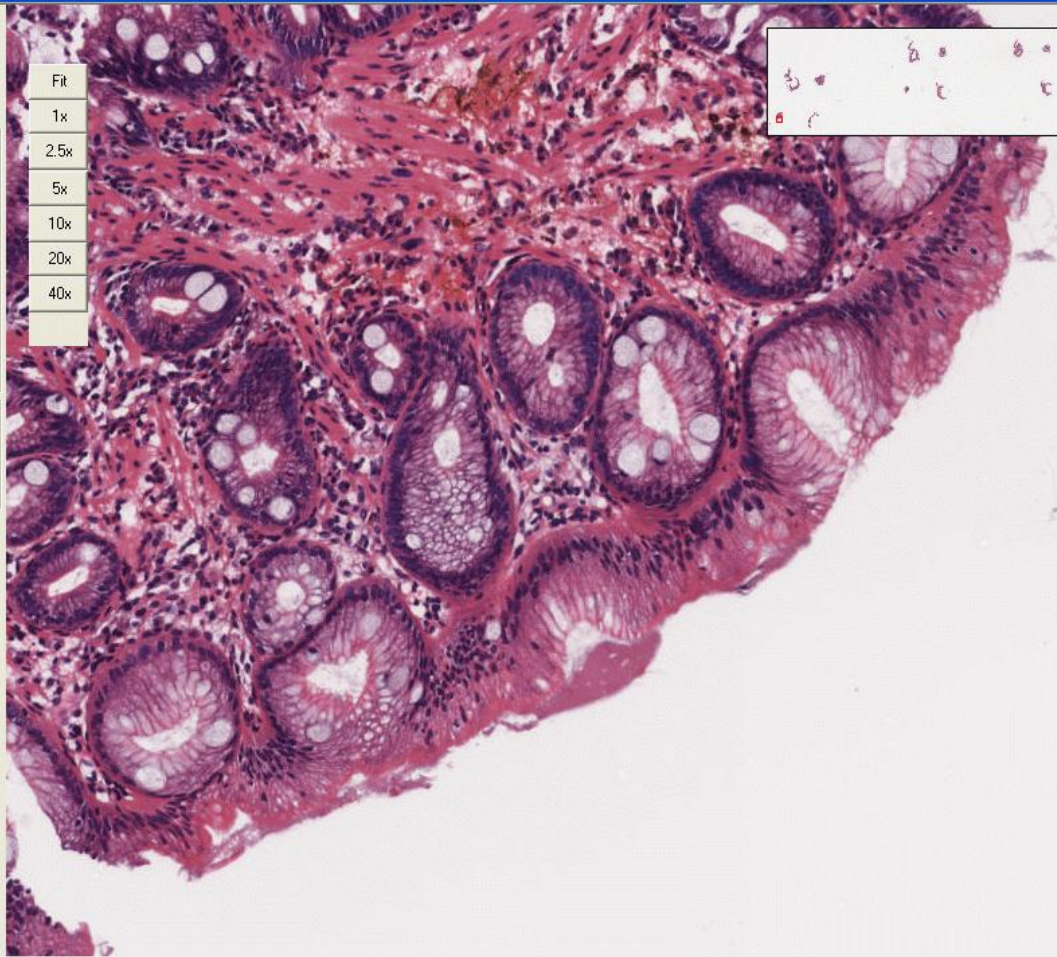


Pause

Quit

3. Mark diagnostic areas

Mark



Fit

1x

2.5x

5x

10x

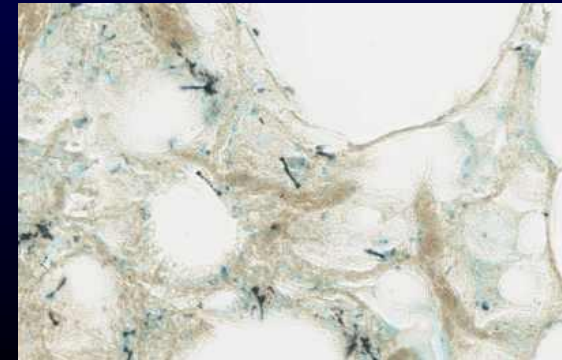
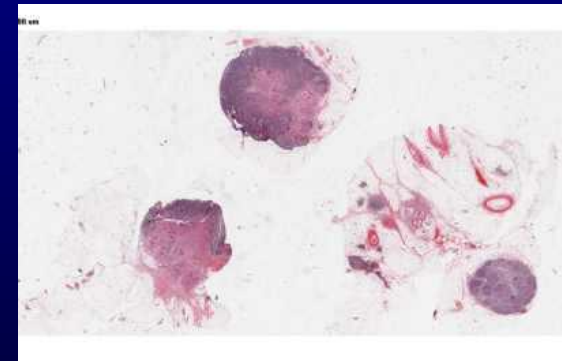
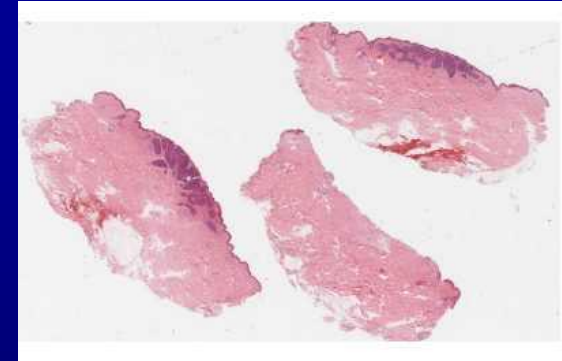
20x

40x

# Experimental design

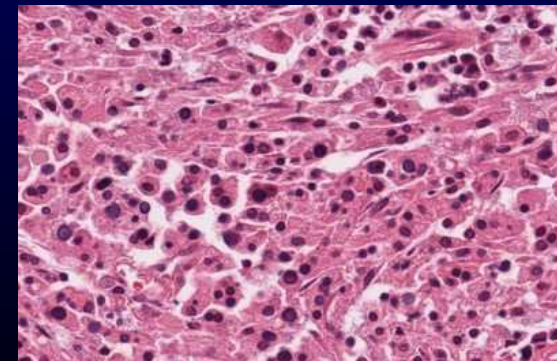
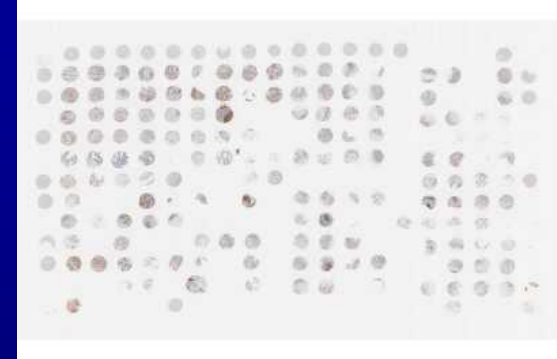
Short (5 minutes) practice session, then  
7 tasks:

1. Make a simple diagnosis
2. Make a decision about a lymph node
3. Make a measurement
4. Find a needle in a haystack



# Experimental design

5. Score a tissue microarray
6. Navigate to a specific point on a slide
7. Attempt a very difficult diagnosis



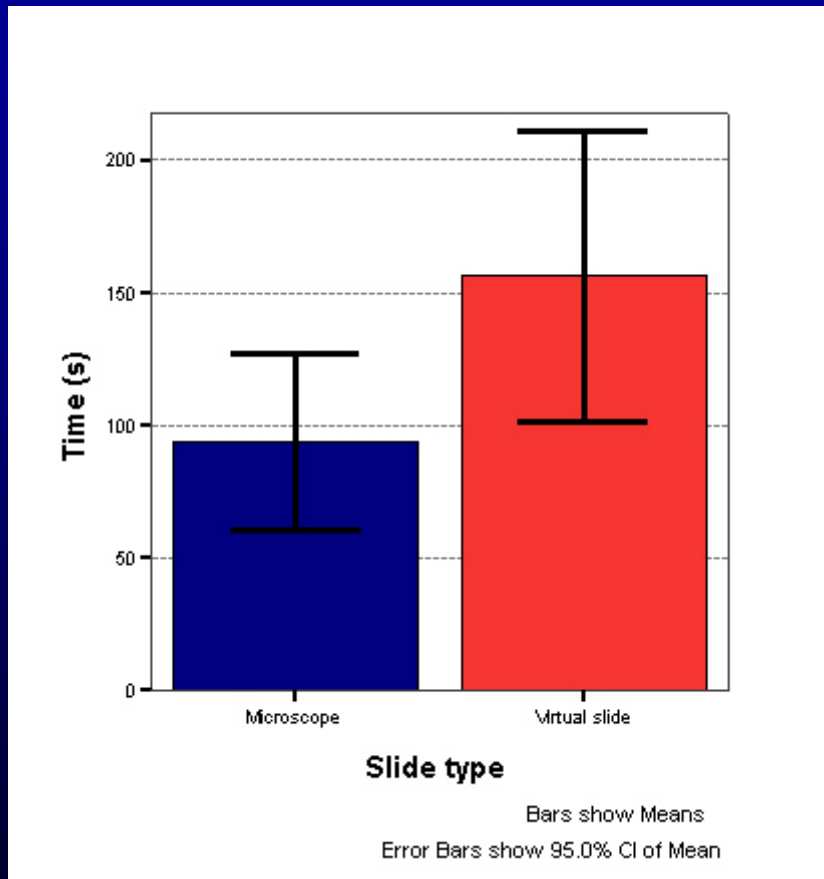
# Cross over design

	Experiment 1	Experiment 2
A	Virtual slide	Conventional microscope
B	Conventional microscope	Virtual slide
C	Virtual slide	Conventional microscope
D	Virtual slide	Conventional microscope

# Subjects

	A	B	C	D
Age (approximate)	50	32	50	35
Years of experience in histopathology	12	5	6	5
Qualifications	PhD, MRCPPath part 1	MRCPPath part 1	MRCPPath	MRCPPath
Years of experience of using computers	10	10	26	23
Level of knowledge of computers (self assessed, out of 10)	5	5	5	4
<b>Number of virtual slides seen before (approximately)</b>	<b>25</b>	<b>10 approx.</b>	<b>100</b>	<b>10</b>

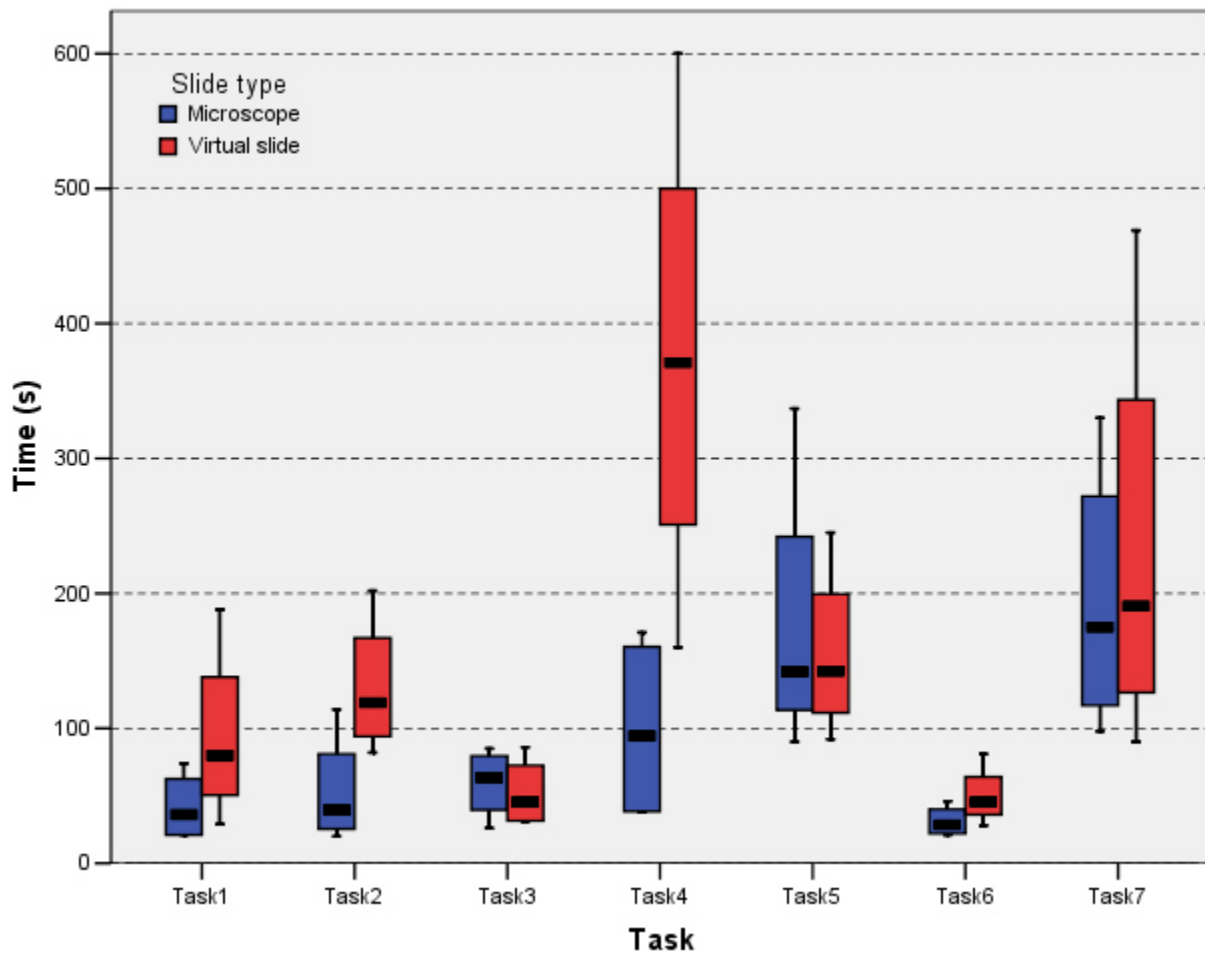
# Average time taken per task



93s vs. 156s  
(67% longer  
with the  
virtual slide)

$P = 0.03$

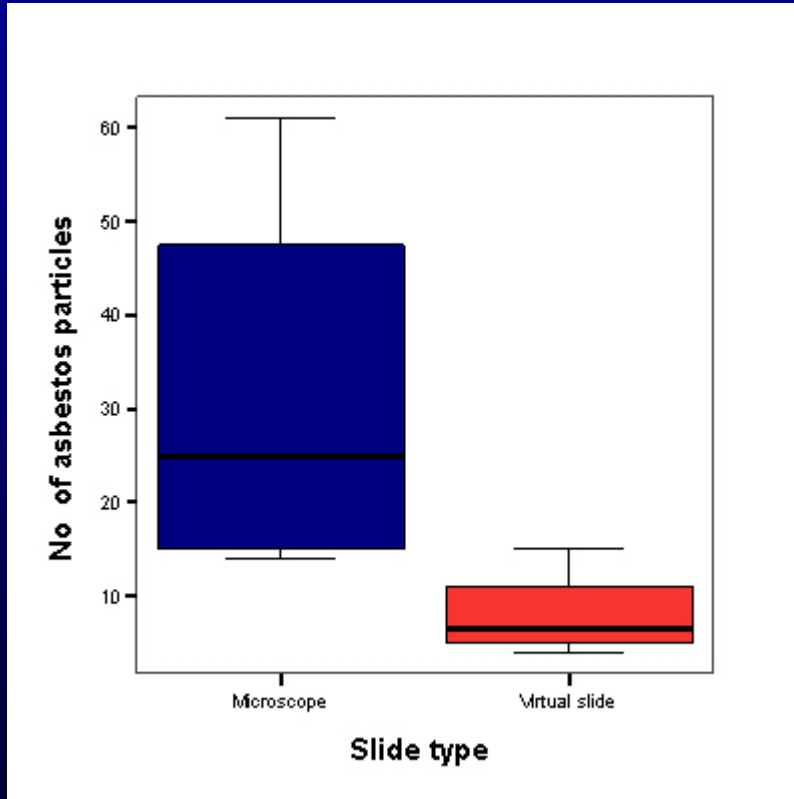
# Task by task breakdown



## Tasks

1. Make a simple diagnosis
2. Make a decision about a lymph node
3. Make a measurement
4. Find a needle in a haystack
5. Score a tissue microarray
6. Navigate to a specific point on a slide
7. Attempt a very difficult diagnosis

# Number of asbestos particles found



Median 25 vs. 7 particles  
 $P = 0.06$

# User-preferred method for performing the tasks

1. Make a simple diagnosis		B	A
2. Make a decision about a lymph node	A	B	
3. Make a measurement	B		A
4. Find a needle in a haystack			BA
5. Score a tissue microarray	B		A
6. A very difficult case			BA
	Virtual slide	No difference	Microscope

# Interpretation

	Mean time to perform all 7 tasks (S.E.)	
Microscope	657 sec (91)	10 min 57 sec
Virtual slide	1092 sec (213)	18 min 12 sec

# Summary

- Tasks took 67% more time with the virtual slide than the conventional microscope ( $P < 0.05$ )
- Virtual slide particularly less efficient at
  - Screening slides for small objects (Task 4)
  - Complex navigation tasks (Task 2)
- Pathologists preferred the microscope !
- *This is knowledge which can be used as a baseline for developing improved user interfaces*

# Acknowledgements

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