Medical Imaging
Bringing the Invisible to Light

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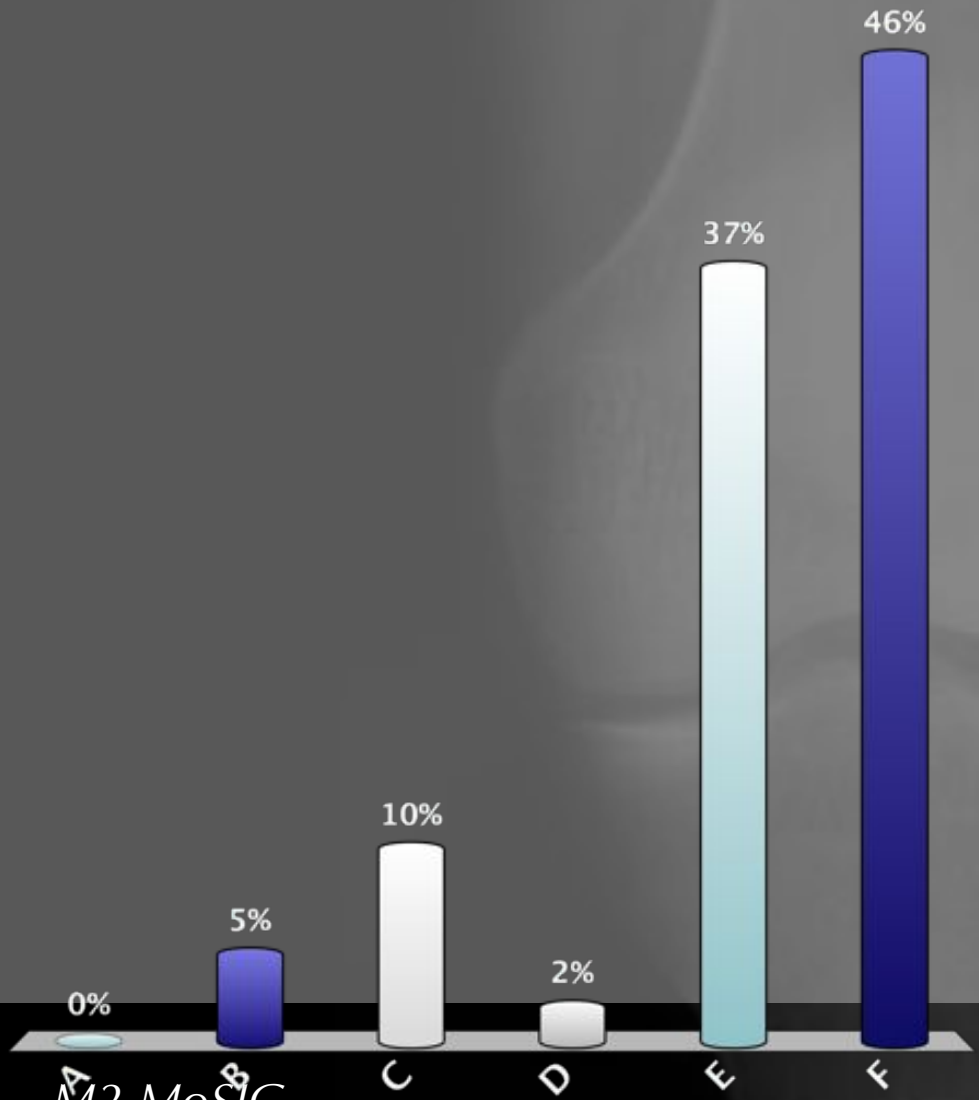
Goals of this lecture

- Learning the most common medical imaging modalities
- Learning how they work and what are their basis
  - To process/analyse/use medical imaging, one has to understand what they are made of …
- Seeing some medical applications using these modalities
- Guessing the future of these modalities…

Medical Imaging implies

- ✓ A. Physics
- ✓ B. Mathematics
- ✓ C. Signal Processing
- ✓ D. Chemistry
- ✓ E. Medicine
- ✓ F. Computer Science



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Medical Imaging Simulation & Robotics

Overview

- Introduction
- Light & Endoscopy
- X-Rays
- Magnetic Resonance Imaging
- Nuclear imaging
- Ultrasound imaging

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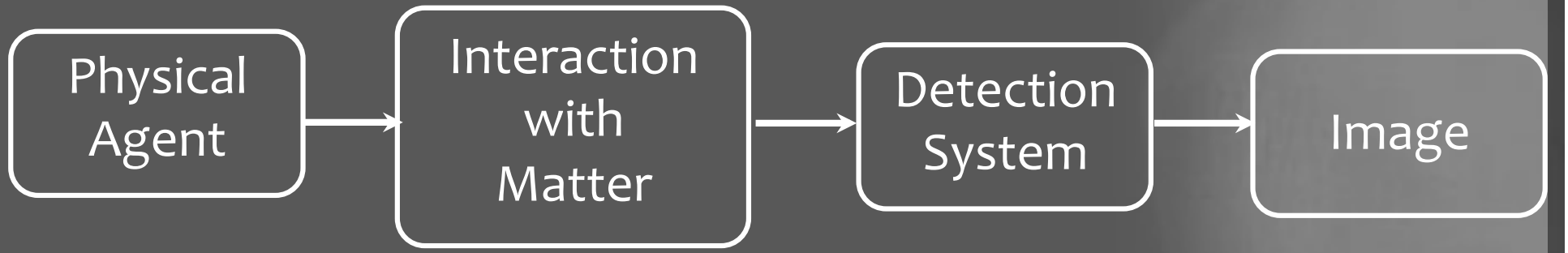
Introduction

- Purpose of Medical Images
  - Diagnosis
  - Preoperative planning (surgery, radiotherapy)
  - Follow-up care for patients
  - Guided surgery: real time imagery
  - Teaching/Formation

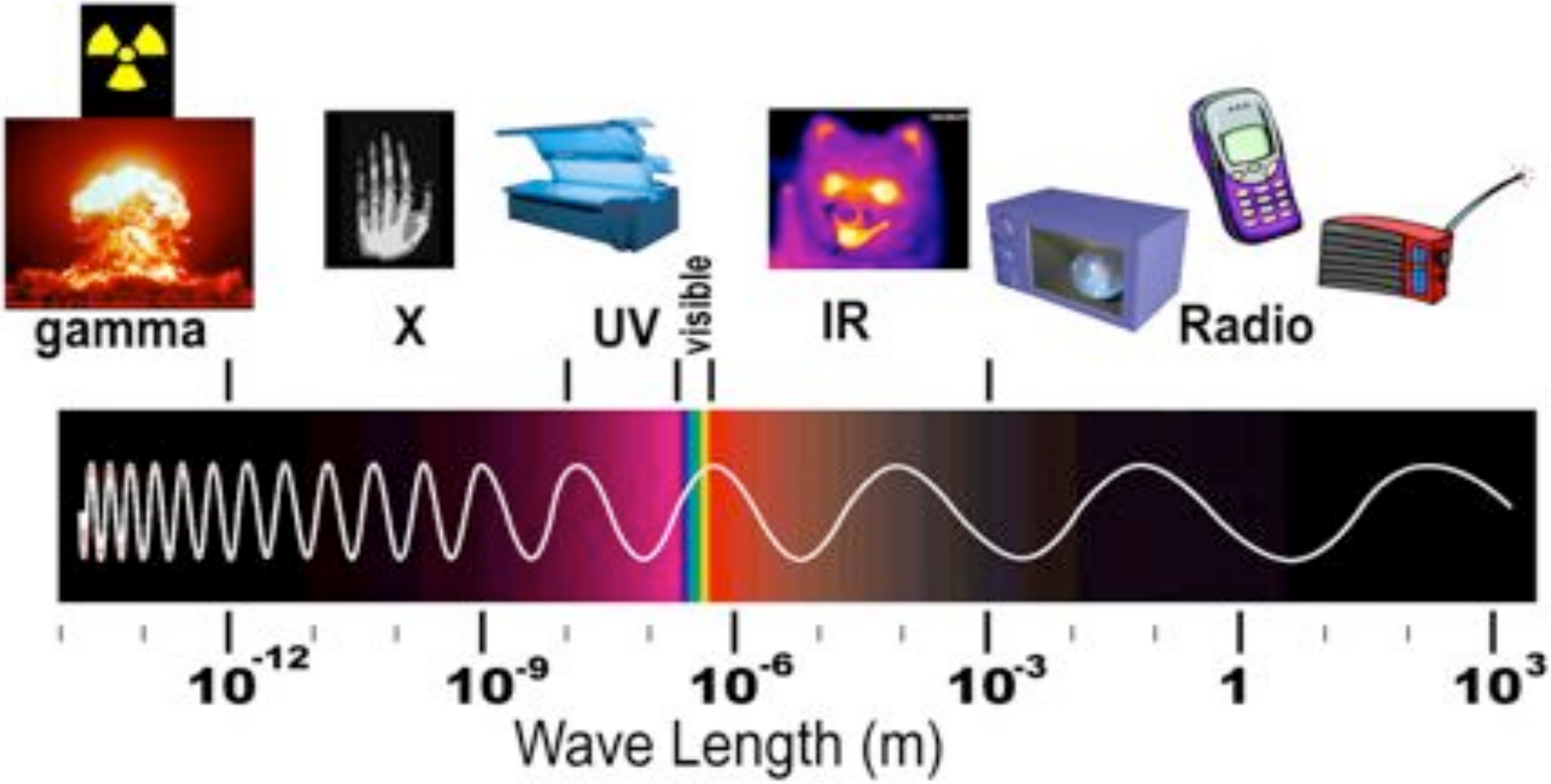
Introduction

- Imaging Science: Bringing the Invisible to Light
  - Anatomy (bones, soft tissues, etc.)
  - Movements (hart, lungs, etc.)
  - Physiological measures (blood flow, muscles elasitcity, etc.)
  - Metabolism (biochemistry: use of radioactive markers)

Introduction

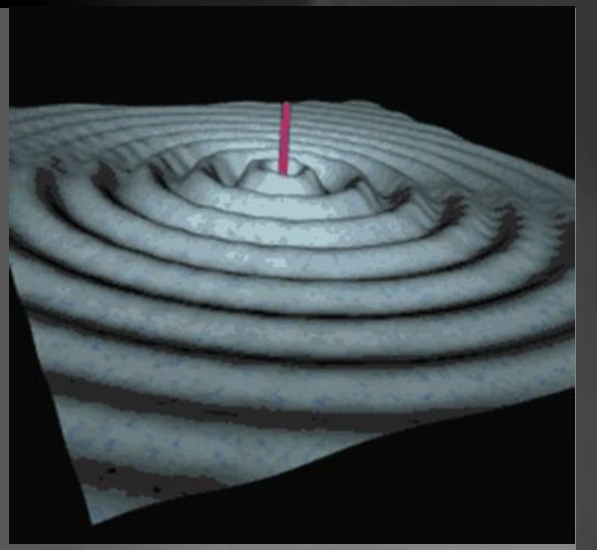


Physical Agent



Physical Agent

- Physical Agent = Mechanical Wave
- propagate through the matter
  - compressions
  - relaxations



Agent	Techniques	Abbreviation
Ultra-Sound	Ultrasound Imaging (echography) Doppler Imaging Elastography High Intensity Focused Ultrasound	US -- -- HIFU

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Light and Endoscopy

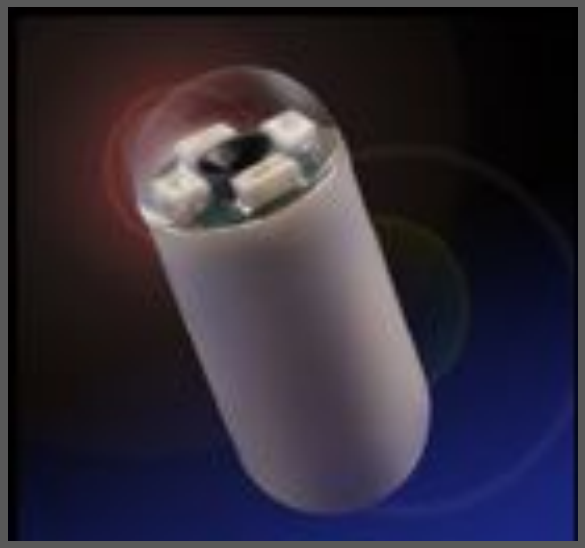
- Endoscopy
  - Endo: within
  - Scopy: examination of
  - Endoscopy = looking inside
    - A minimally invasive way to *look inside*

Light and Endoscopy

- Short History :
  - -600 Speculum
  - 1806 First endoscope: LichtLighter
  - 1853 First endoscope with optic and light source (Desormeaux)
  - 1878 Miniaturization of electrical light bulbs
  - 1881 First Bronchoscopy with rigid endoscope

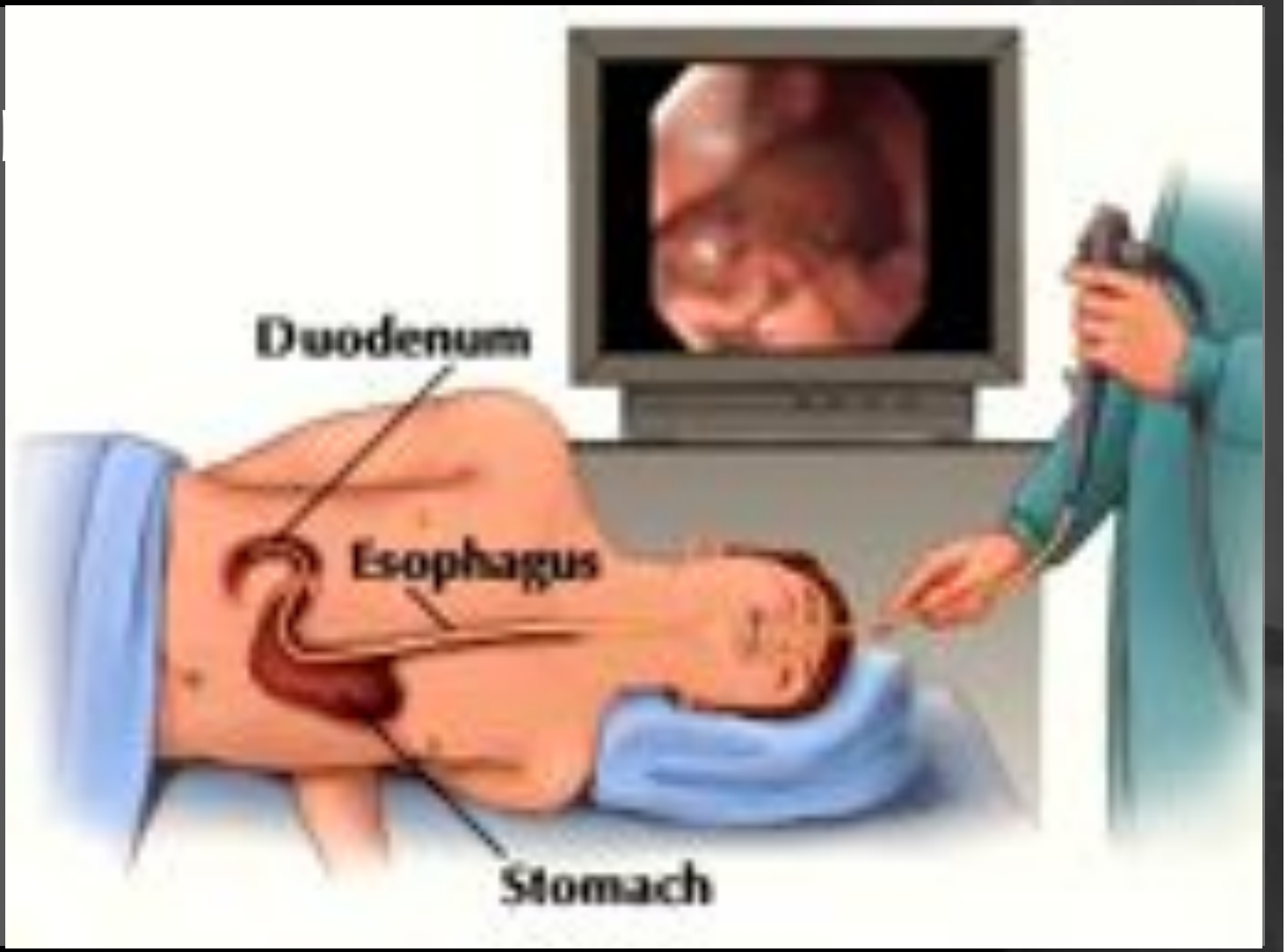
Light and Endoscopy

- Short History :
  - -1917 Semi-rigid endoscope
  - 1956 Fibroscope
  - 2009 Capsules



Light and Endoscopy

oesophageal-gastrointestinal endoscopy with fibrescope





Light and Endoscopy

- Artroscopy

Light and Endoscopy

- Laparoscopy

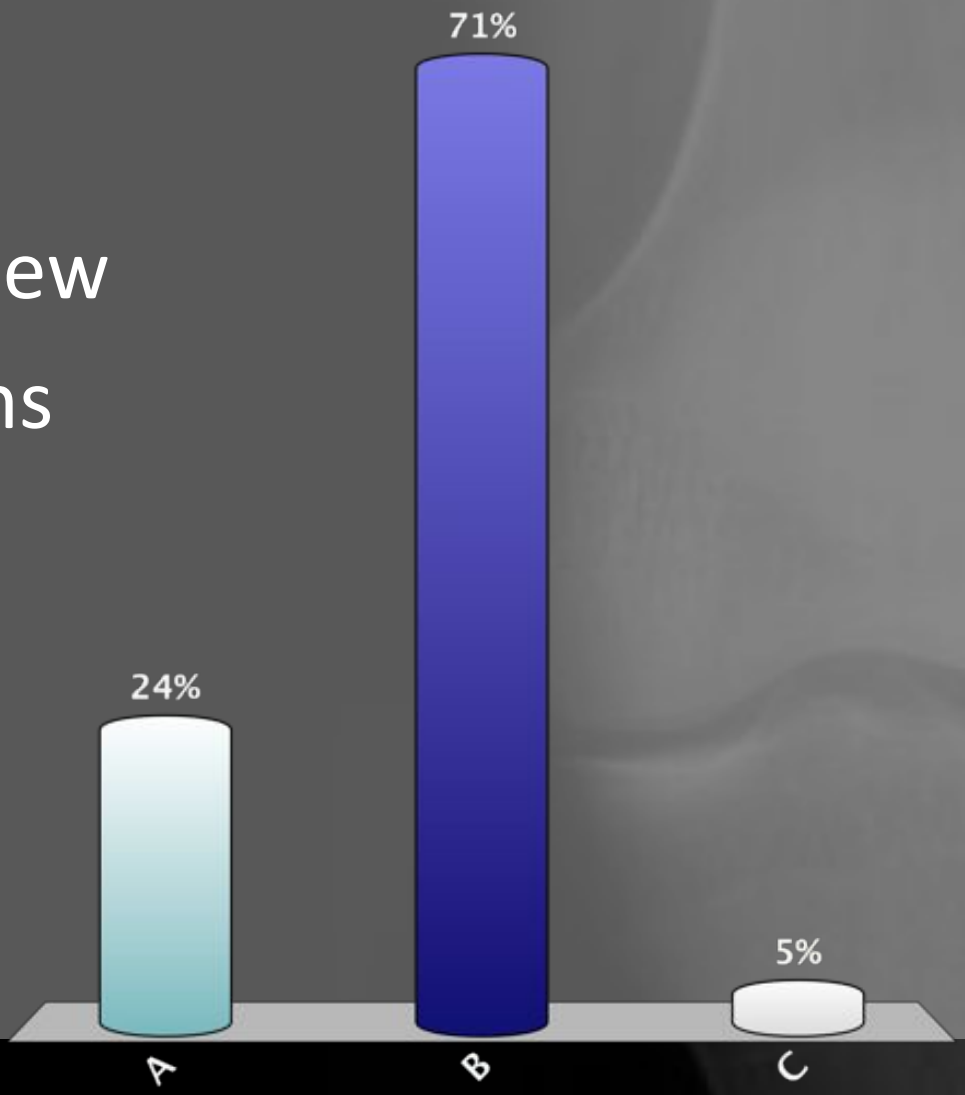
Light and Endoscopy

- Laparoscopy

C	Surgeon
A	Assistant
1	Endoscope
2	Endoscopic Video Camera
3	Endoscopic Image
4	Surgical Instruments
5	Trocart

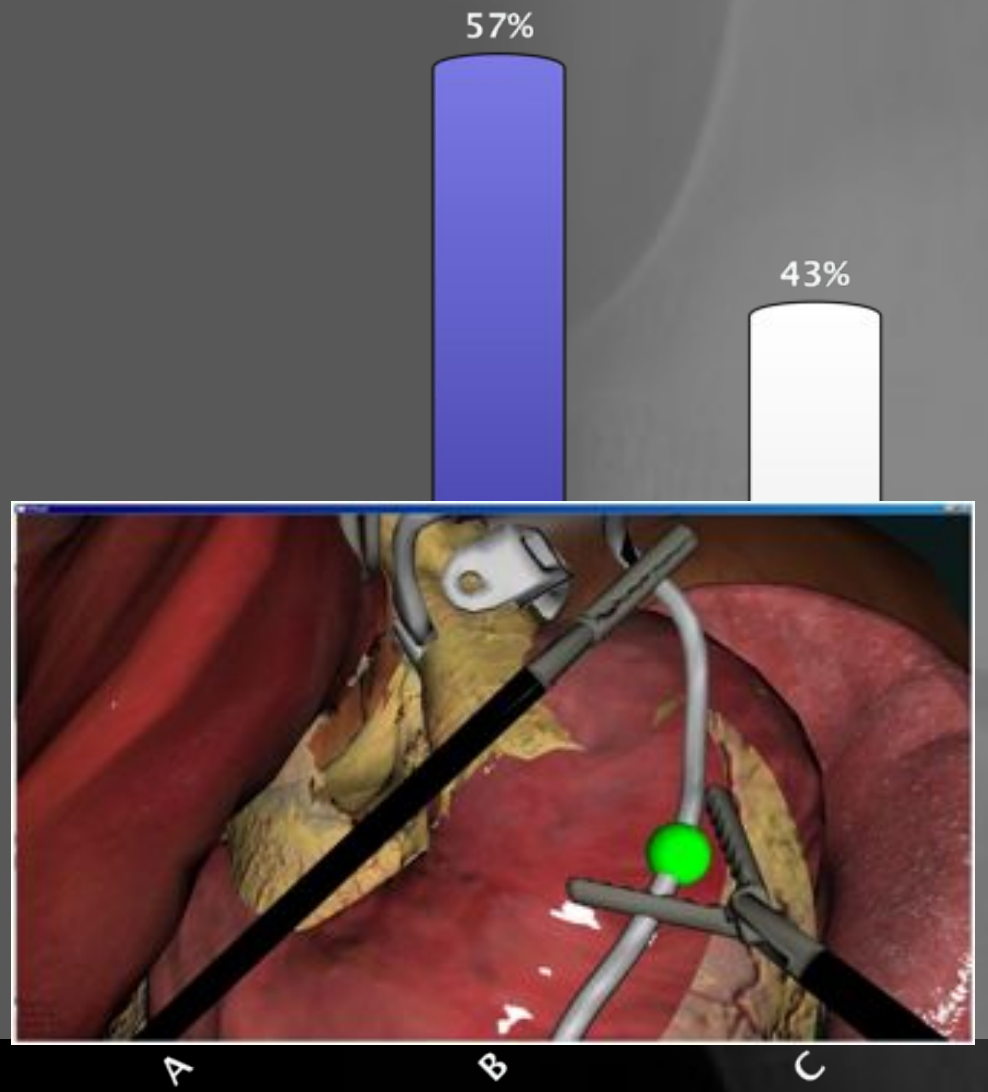
During Endoscopy, the abdominal cavity is filled with gaz to

A. Have a glowing illumination
B. Enhance the field of view
C. Avoid image distortions



Why don't we see the shadows of the surgical instruments

A. Because there is no light
B. ✓ Because the light is spherical
C. Because the light is diffuse



Why do you have to move the instrument toward left to make it move toward right during laparoscopy ?

A. Becaus
image

B. Becaus
trocca

C. Becaus
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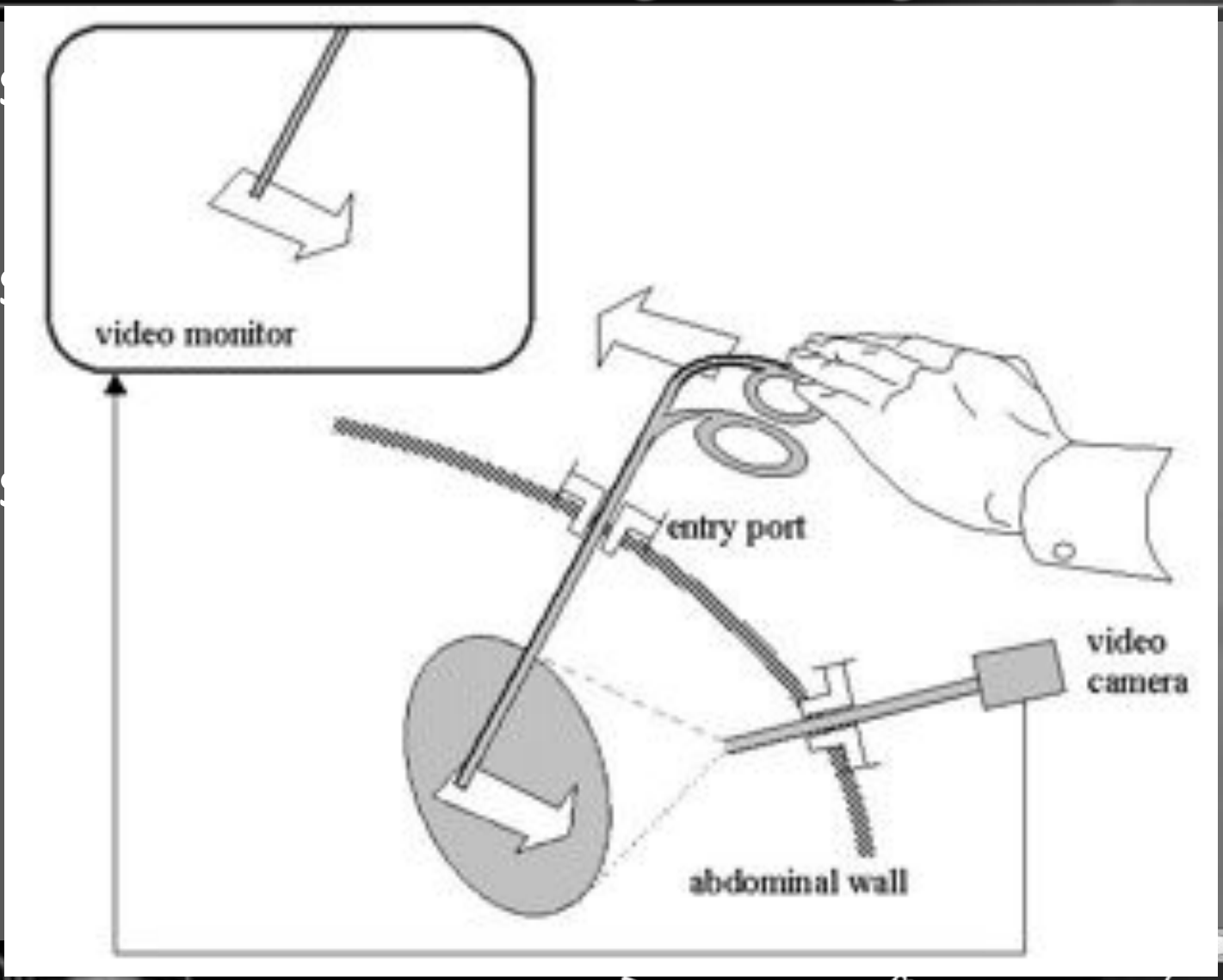
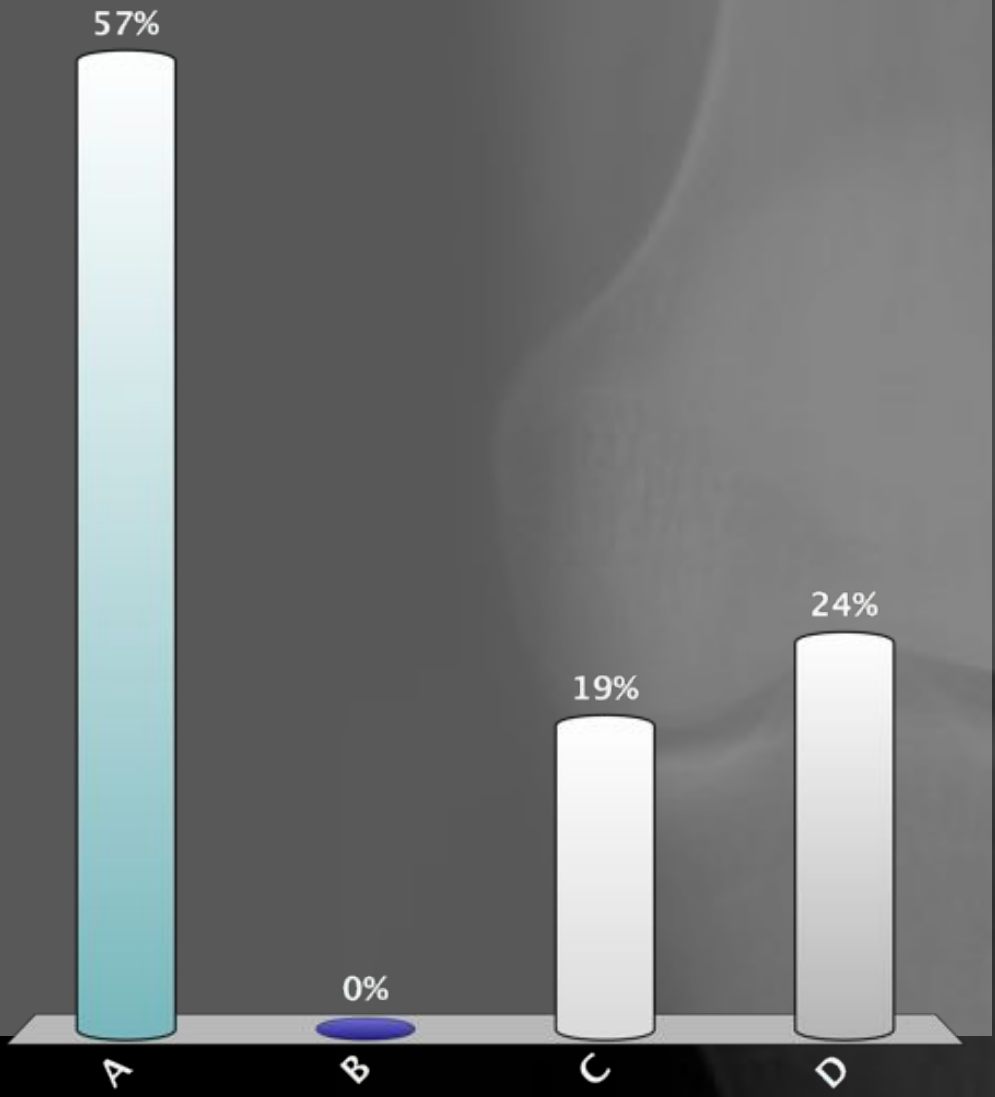


What makes Navigation interesting for endoscopy?

- ✓ A. Small field of view
- B. Lack of luminosity
- C. Loss of 3D
- D. Loss of touch



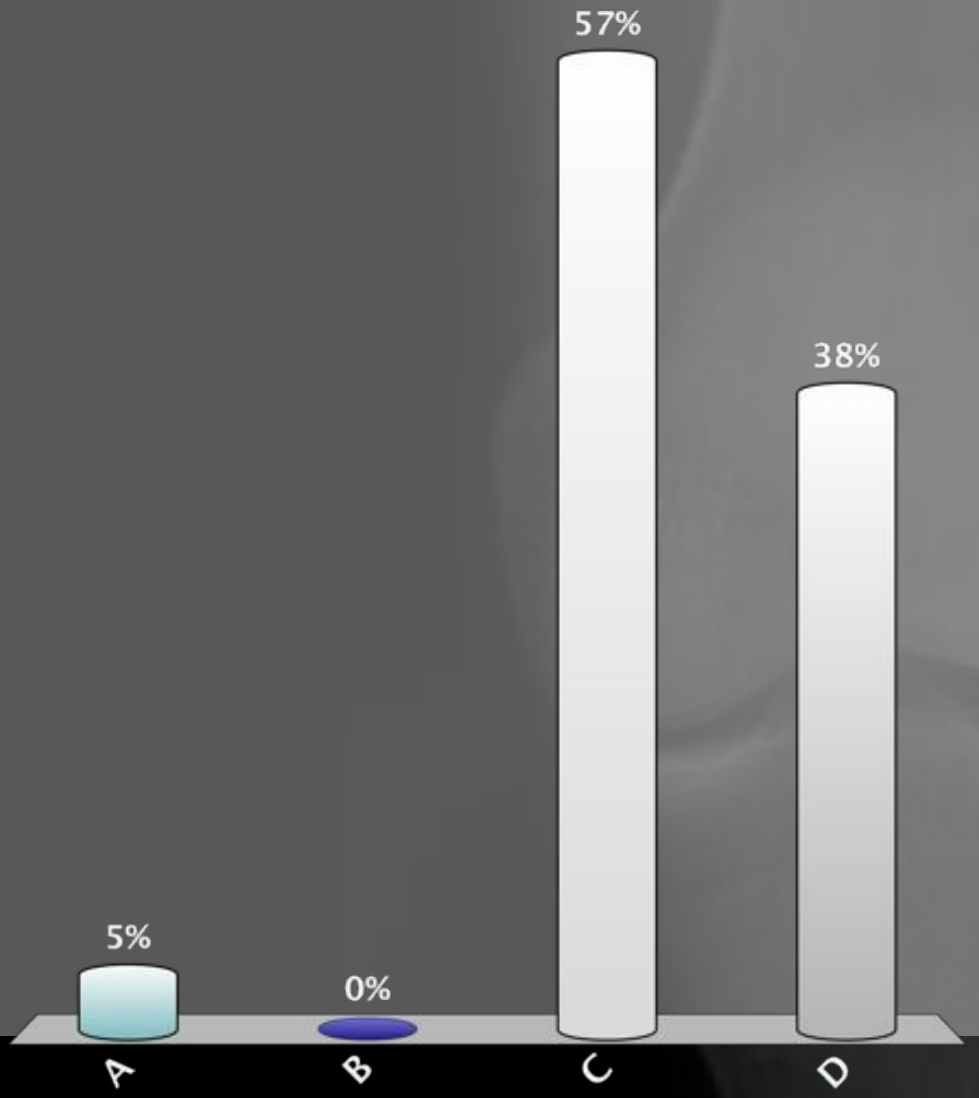
What makes Virtual Reality interesting for endoscopy?

A. Small field of view

B. Lack of luminosity

✓C. Loss of 3D

D. Loss of touch



Light and Endoscopy

- Advantages
  - Minimally invasive,
  - Allows local anesthesia
  - Quick healing / Less reinfeciton.
- Drawbacks
  - Very partial view,
  - Need of an assistant to manipulate the endoscope,
  - Loss of touch sensitivity,
  - 2D views.

Light and Endoscopy

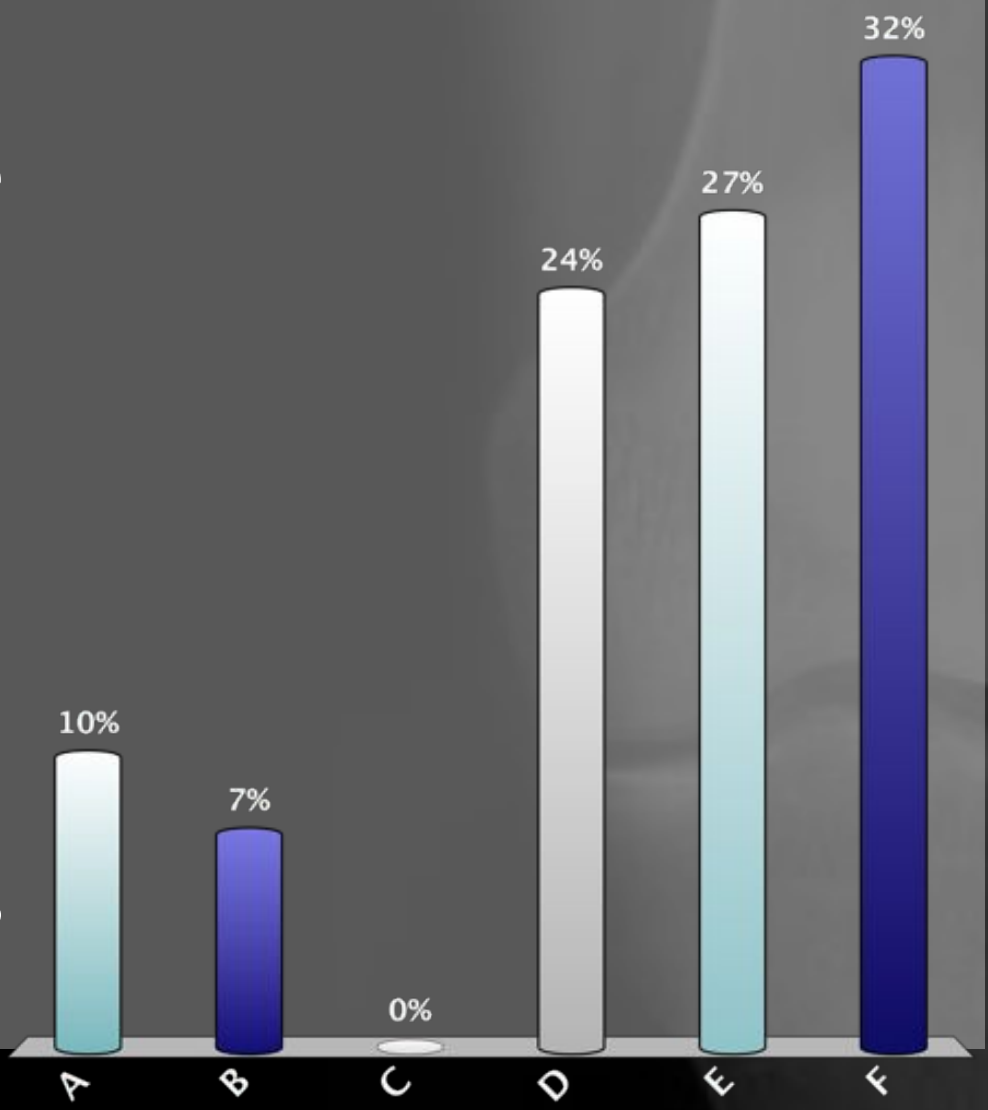
Da Vinci robot (©Intuitive)

Light and Endoscopy

Da Vinci robot (©Intuitive)

The Da Vinci Robot allows surgeons

- ✓ A. To see organs in 3D
- B. To better diagnose the patient
- C. To recover touch
- ✓ D. To make more precise movements
- E. To go home earlier
- F. To need less assistants



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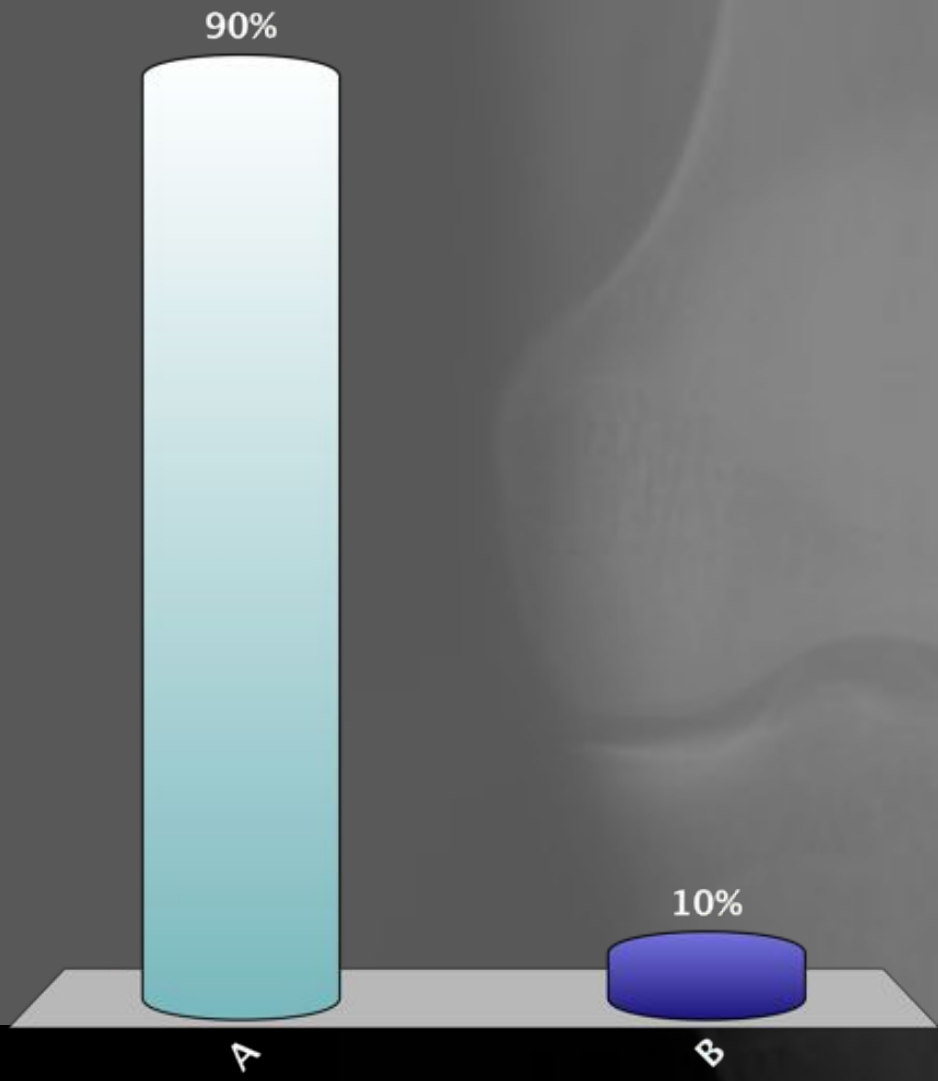
Operation with Da Vinci Robot is better for the patient than Open Surgery

✓A. True

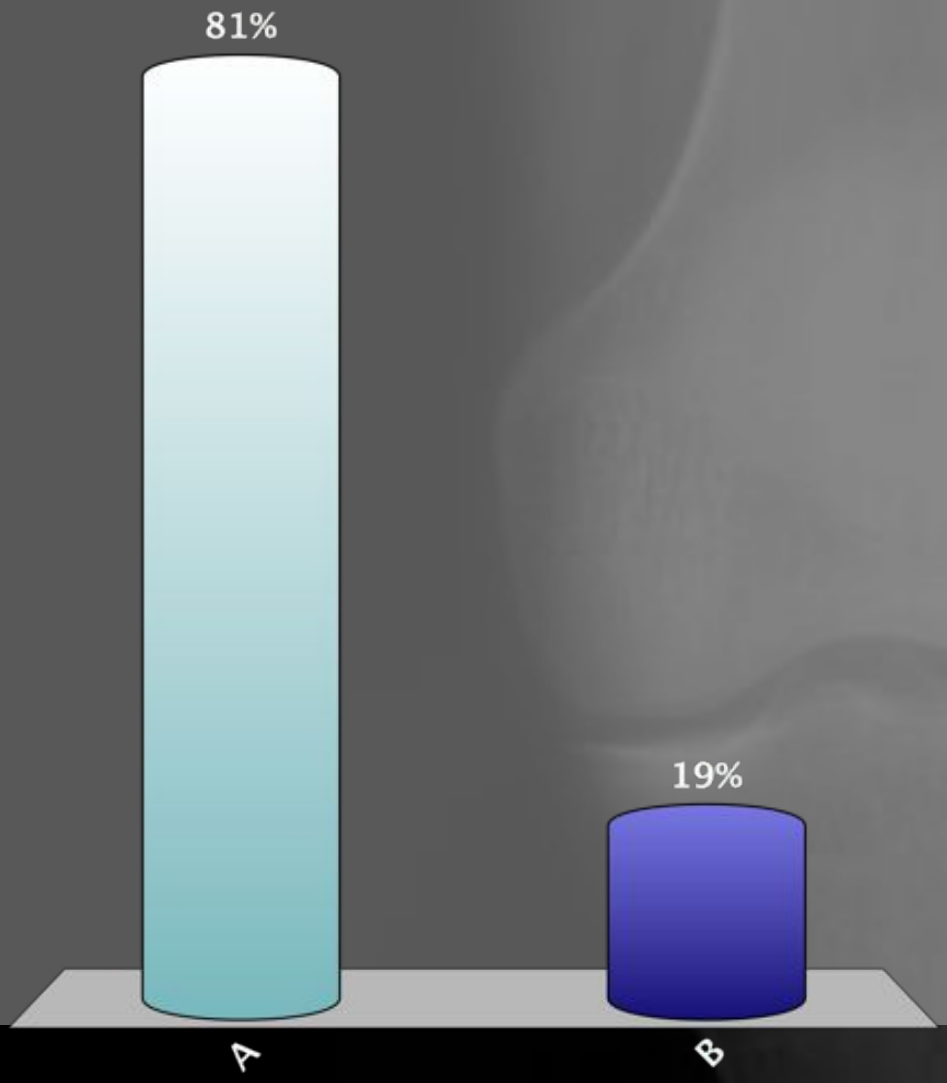
B. False



Operation with Da Vinci Robot is better for the patient than standard laparoscopy

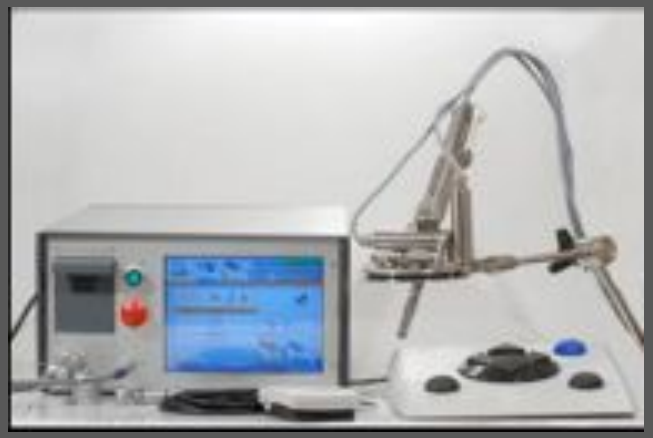
A. True

B. False



Light and Endoscopy

ViKY robot, Endocontrol (Grenoble)



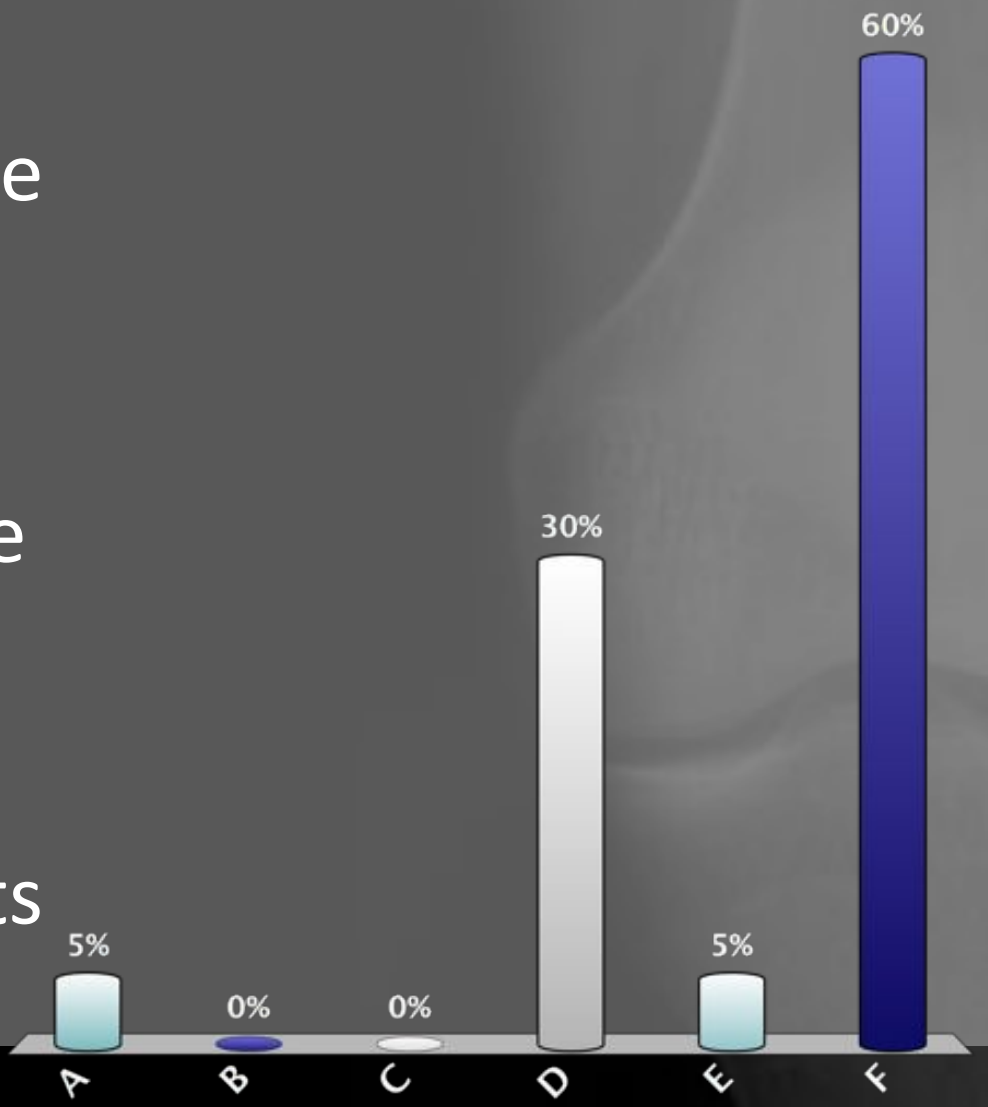
Light and Endoscopy

ViKY robot, Endocontrol (Grenoble)

Tracking of single surgical instrument

The Vicky Robot allows the surgeon

A. To see organs in 3D
B. To better diagnose the patient
C. To recover touch
D. To make more precise movements
✓ E. To go home earlier
✓ F. To need less assistants



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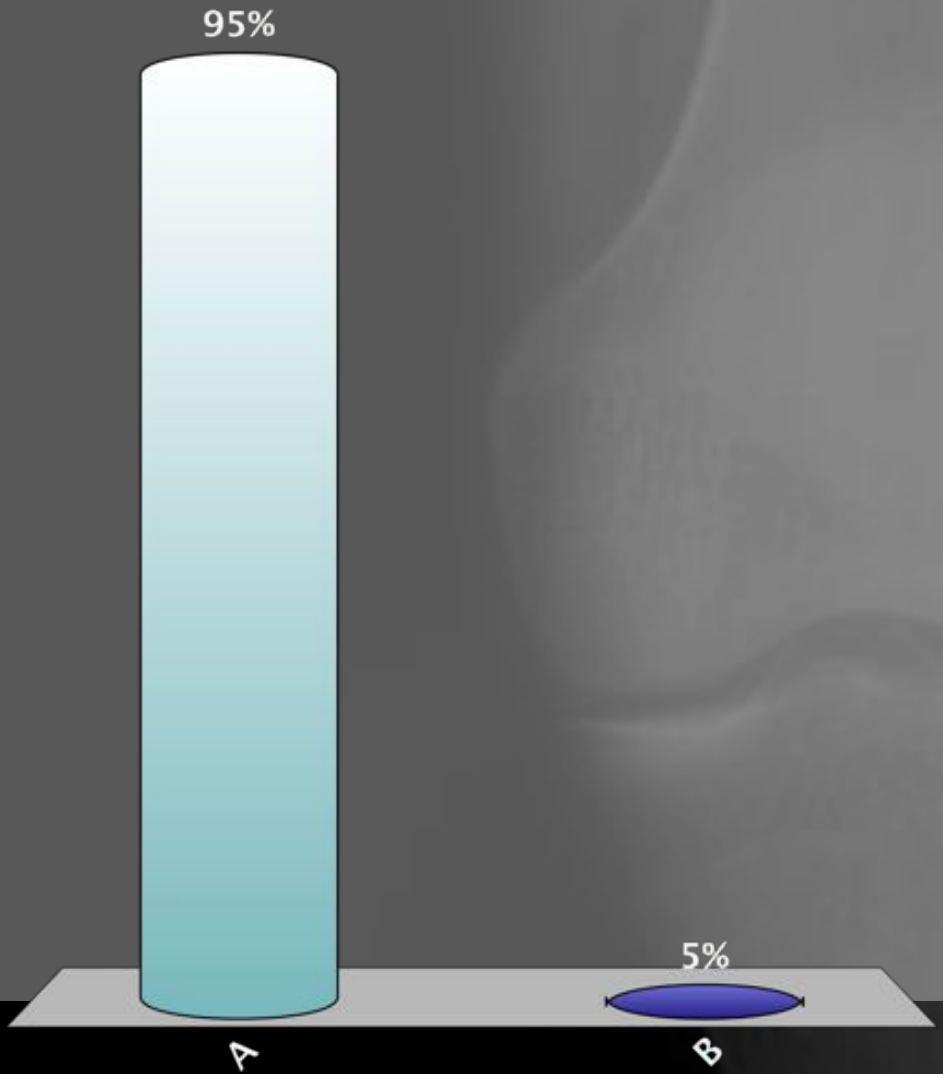
Operation with VickyRobot is better for the patient than Open Surgery

A. True

B. False



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