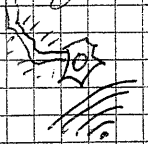
ROBOTICS FOR MINIMALLY INVASIVE THERAPY
ARIANNA MENCIASSI

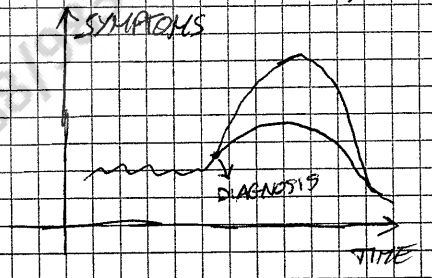
INTRODUCTION TO THE COURSE

Robotic surgery has three main objectives:

- to reach with flexibility remote body areas; traditional technologies are painful and dangerous (digestive system is the only one that is open, so it is the most reachable and doesn't need sterilization);
- to add dexterity, flexibility and adaptability to surgical systems
- to combine the CAS with ultra-sound therapy; surgery is not only a matter of cutting, but also of energy deposition;
- to help medics and surgeons in training, through hardware simulator;
- to treat chronical diseases and replace lost functionalities



In robotic surgery, MASS screening and early diagnosis ~~has~~ will have a major impact on type and invasiveness of surgical operations. Moreover, early diagnosis stops increasing of symptoms.



A useful index in this topic is the following

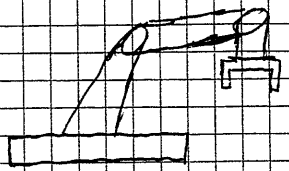
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TYPES OF PLATFORMS

There are two kinds of platforms:

A sphere platform is composed by a series of joints with a final end effector. A parallel platform:




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instead, is composed of a platform, movable through combination of different actuators. In platform there are five important concepts:



- workspace, largest operative area;
- footprint, space occupied by platform.

In a sphere platform, control is flexible, but not so highly precise, and forces are lower. Parallel ones, on the contrary, are more stable and precise. However, forces ~~exercited~~ exerted are higher and workspace is smaller. It avoids large incisions and allows precise tasks.

SURGERY IN HISTORY

First surgery was discovered during prehistory and it involved the brain. Egyptians, instead, invented the first catheter.

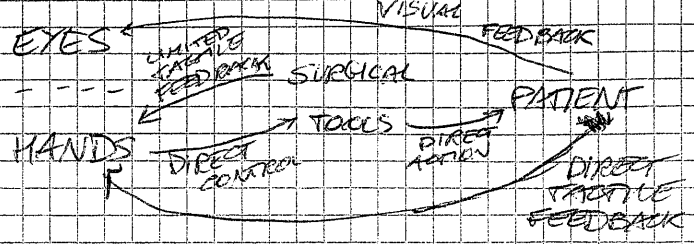
Hippocrates was the first medic to talk about non invasive surgery.

Middle age, instead, knew a regression, most people died because of post-operative infections. Until now, antibiotics, pain therapy and imaging were totally missing. Infections were known, but ~~not~~ their origin. ~~Pasteur~~ war. This is why anesteria initially worsened the problem.

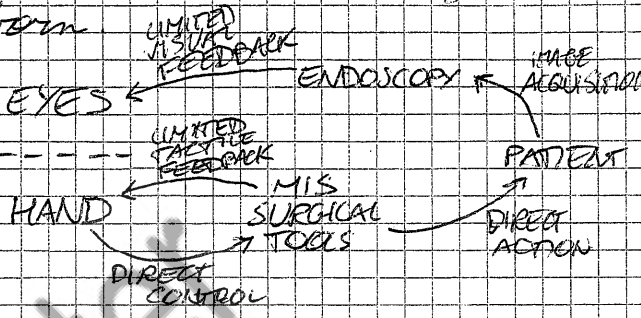
Then, matching of infections with bacteria and penicillins were discovered. ~~and~~ So, the ~~traditional~~ modern surgery born by combination of

- anesthetics;
- antiseptics;
- anticoagulants;
- antibiotics;
- analgesics

This is the scheme of a traditional surgical operation. Most used system for feedback was the eye.



With endoscopic instruments, minimally invasive surgery was born. Insufflation is used to move endoscopes inside. However, they are limited sensors w.r.t. human eye, but allows to perceive unseen things.



TRADITIONAL LAPAROSCOPY

In traditional laparoscopy, there are 5 drawbacks:

- hand-eye coordination: it is lost, because of the endoscope visor and coordination with other surgeons;
- fulcrum effect, due inversion of movements due to operating techniques;
- DoFs reduction: only external movements are allowed;
- 2-D vision: no perception of depth, unless through touch;
- inversion and scaling of movements, due to the level of insertion

TAXONOMY OF ABDOMINAL SURGERY TECHNIQUES

MANIPULATION \ OBSERVATION	DIRECT	INDIRECT (LAPAROSCOPE)
DIRECT	OPEN SURGERY	HAND-ASSISTED LAPAROSCOPIC SURGERY
INDIRECT (INSTRUMENTS)	SMALL INCISION SURGERY	LAPAROSCOPIC SURGERY

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In open surgery you perform a large incision and manipulate tissues through hands and simple instruments. Here, eye-hand coordination is not disturbed. In mini-incision surgery, you can still see, yet not to have a physical contact with organs.
Laparoscopic surgery, of course, deals with tiny incision through ~~and~~ which several time instruments are made to pass ~~through~~. Vision is performed through a camera. They can be performed through a single port, too. However, this worsens dexterity of surgeons.
Hand-assisted version makes possible for only one hand to enter the cavity through a plastic sleeve.
Laparoscopic surgeries are much less risky ~~and less~~ than open ones, but require lots of preliminary analysis and more effort from the surgeon.

LAPAROSCOPIC OPERATION STEPS-CONCEPTS
First part is pneumoperitoneum. One of main problems is fat, especially that one internal to tissues; it all has to be removed. Then, you perform the mechanical exposure, ~~by~~ through abdominal wall lifting. It is performed through ~~to~~ the insufflation of cavity.
Here, an insufflator device is mandatorily needed, because:
- you have to maintain pneumoperitoneum;
- maintain gas pressure;
- renew the gas

Usually, internal pressure is 0÷30 mmHg and 0÷30 l/min of CO_2 flow, using a 0,3 μm filter. It is also responsible ~~to~~ handle heating camera, in order to maintain organs to their normal conditions.
Secondly, you have to insert trocars. They are surgical tools, used for introducing other tools and laparoscope inside ~~the~~ the cavity. Most important one is primary trocar, since it is used for ~~the~~ introduction