

Project 3 | 27.04.2017

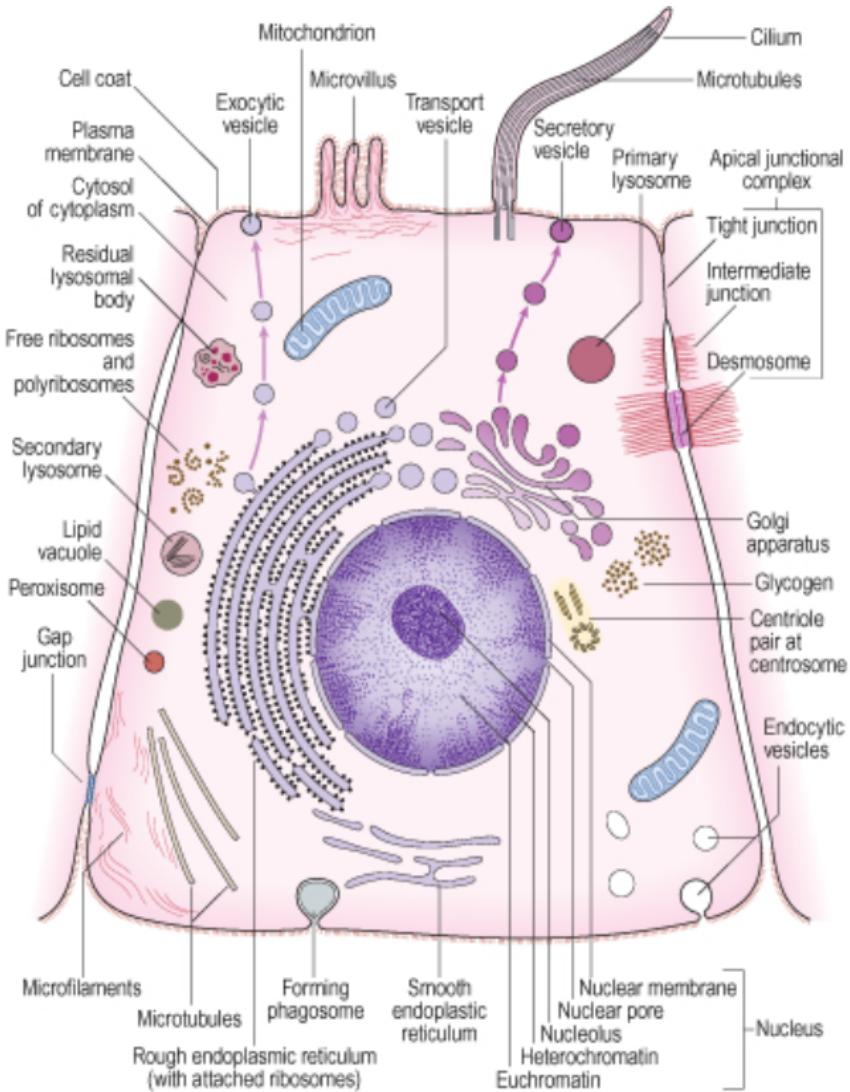
Pooja B. Kulkarni | 156130008

Guide: Prof. Purba Joshi Co Guide: Prof. Milind Atrey, Prof. V. P. Bapat

Breast cancer is the most common type of cancer in women.

And the second most common type of cancer over all

SO, WHAT EXACTLY
IS CANCER?

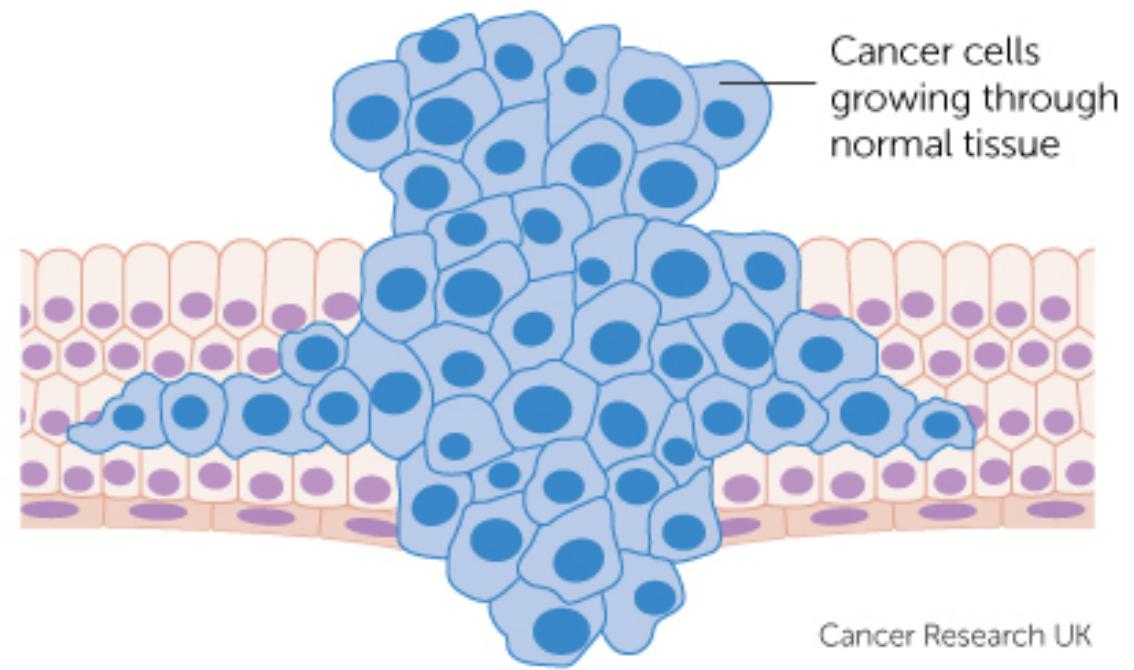


CELL

Smallest structural and functional unit of a living body or an organism

CANCER

Some cells change their nucleic structure and grow uncontrollably



Cancer Research UK

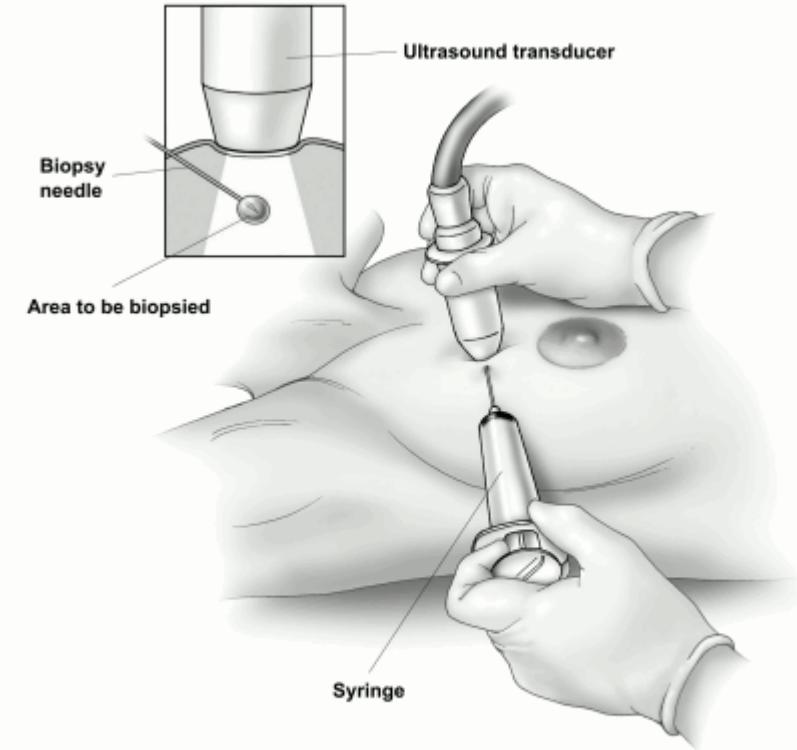
CANCER SCREENING

Generally a mammogram is taken to detect the tumor location and size

X Rays (Mammography)

Ultrasound

Biopsy



Fine needle aspiration using ultrasound

HOW TO KILL THE CANCER CELLS?

1.

NECROSIS

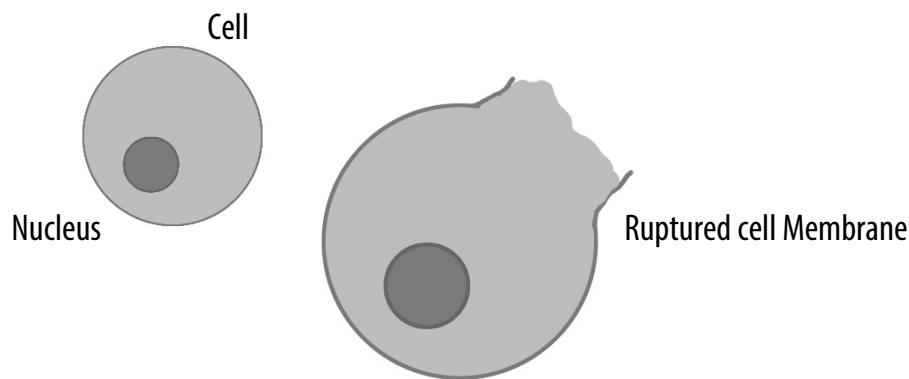
2.

APOPTOSIS

Cell death due to rupturing of the
CELL MEMBRANE

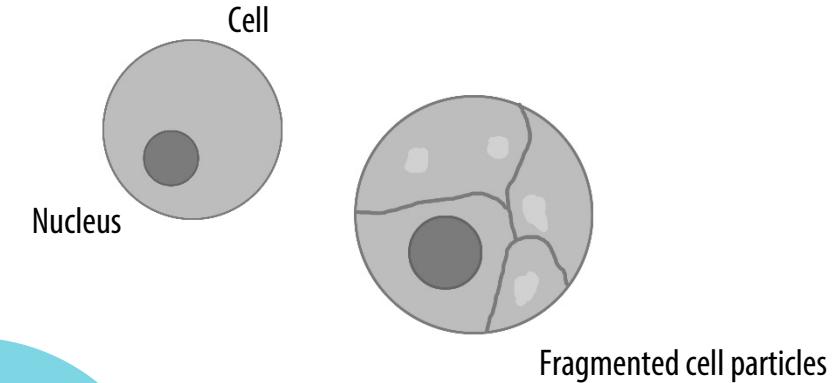
1.
NECROSIS

2.
APOPTOSIS



1. NECROSIS

2. APOPTOSIS



Cell death due to fragmentation of the Cells
into membrane bound particles

CURRENT TECHNIQUES TO CURE BREAST CANCER

Radiotherapy

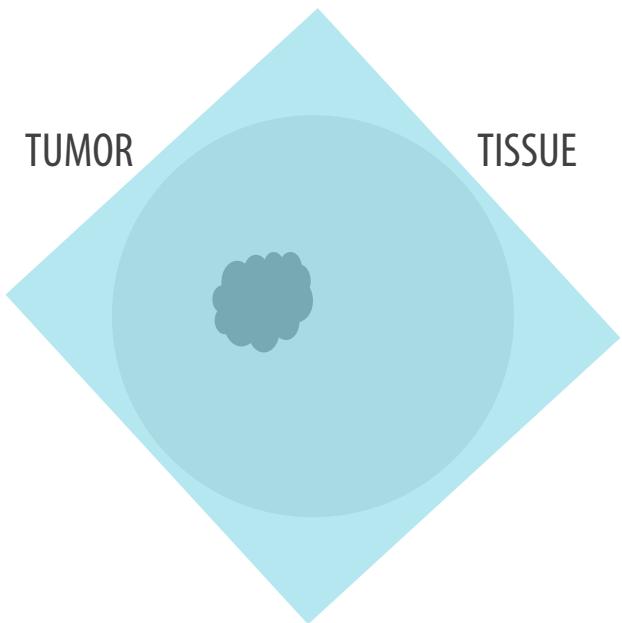
Chemotherapy

Hormone therapy

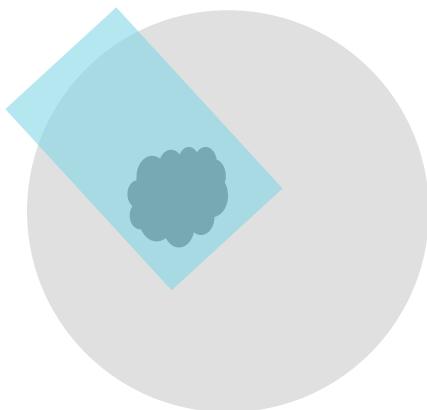
Biological therapy

Surgery

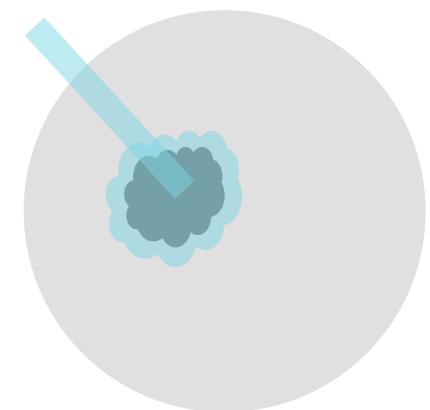
SURGICAL TREATMENT



MASTECTOMY



LUMPECTOMY



MINIMALLY INVASIVE

MINIMALLY INVASIVE SURGERY

Radio frequency Ablation
Microwave Ablation
Laser Ablation

Ethanol Ablation
Chemoembolization

Cryoablation

HEATING

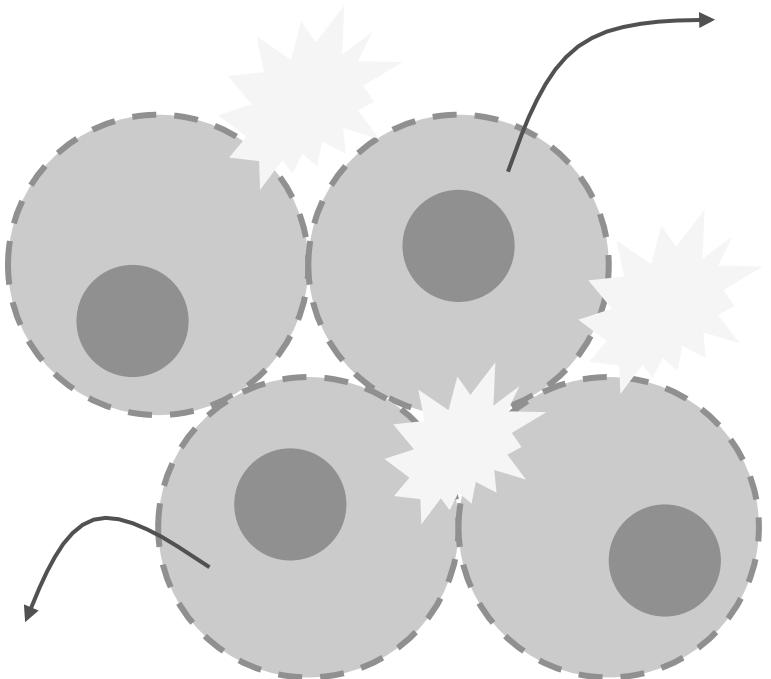
CHEMICAL

FREEZING

CRYOABLATION

CRYO: Icy cold | ABLATION: Surgical removal of tissue

Treatment to kill cancer cells with extreme cold

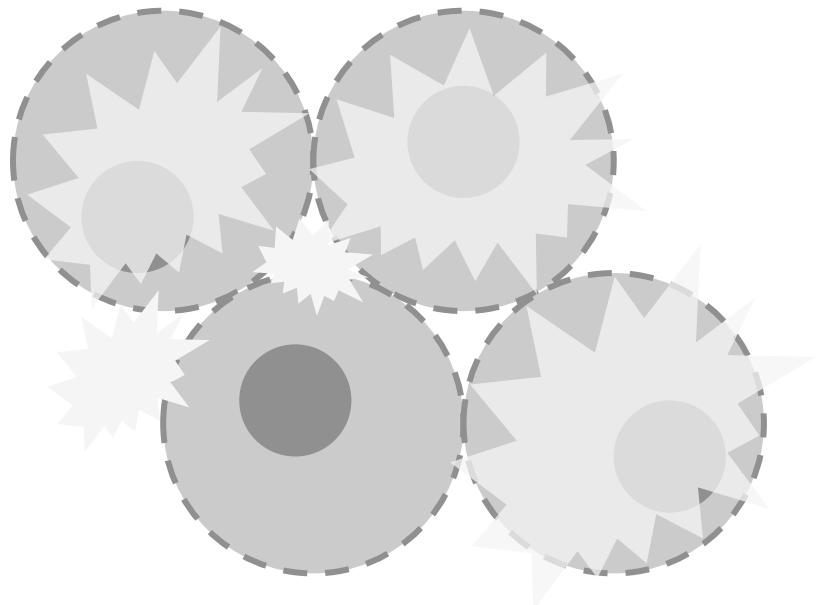


EXTRACELLULAR ICE FORMATION

Extracellular ice crystals form at -20 deg C

Water is drawn out due to osmotic pressure

Death due to 'Solution Effect'



INTRACELLULAR ICE FORMATION

Intracellular Ice Formation (IIF)
Extracellular ice may enter the cell through micro-pores
Formed IIF kills the cells with most certainty

LITERATURE REVIEW

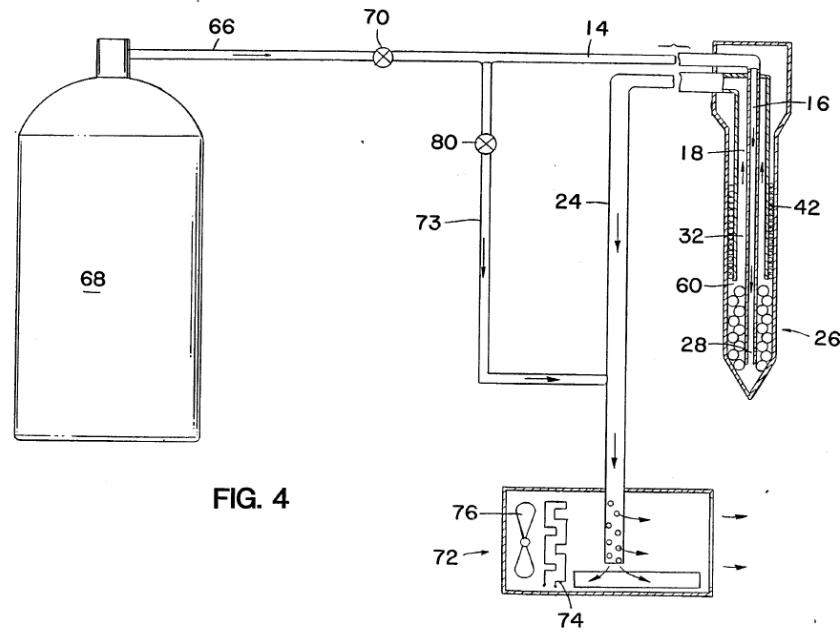


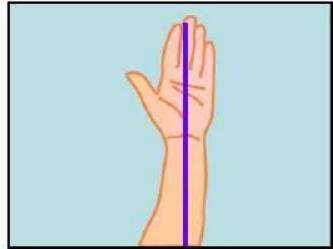
FIG. 4

No.	Patent No.	Name	Relevance	Source
1.	US5899897	Method and apparatus for heating during Cryosurgery	Heating device	United States Patent
2.	US5674218	Cryosurgical Instrument and System and Method of Cryosurgery	Process understanding	United States Patent
3.	US4946460	Apparatus for Cryosurgery	Setup	United States Patent

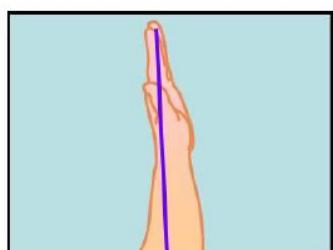
ERGONOMIC STUDY

Neutral Posture

View#1
(minimal radial/ulnar deviation)

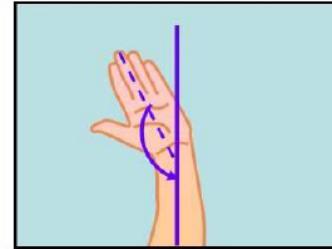


View#2
(minimal flexion/extension)

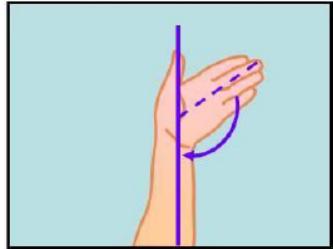


Awkward Postures

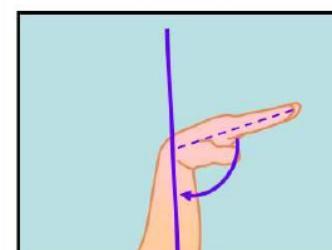
Radial Deviation



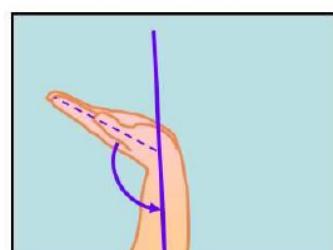
Ulnar Deviation



Flexion



Extension



TASK ANALYSIS

IAP 12 mmHg

gasF:O₂ 0 l/min

Speed: 2.5x

TASK ANALYSIS

PRE OPERATIVE

- Patient Preparation
- OT Setup
- Device Preparation
- Mammogram

OPERATIVE

- Tentative location of the tumor is mapped on the contours of the breast
- Visualization of tumor is carried out by using a Ultrasound device
- Incision is made
- Probe is inserted
- Freezing and thawing cycle
- Monitoring the ice ball growth
- Freezing and thawing cycle is repeated
- Removal of Probe

POST OPERATIVE

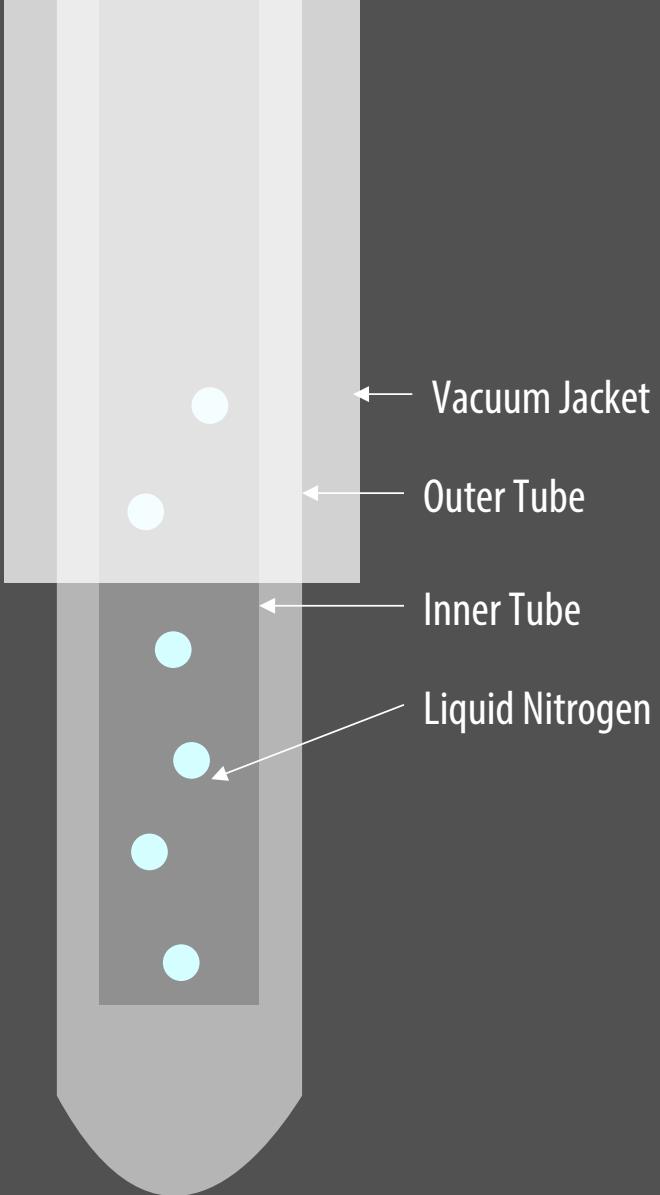
- A suture is used to close the incision if required

FOLLOW UP

- The tumor site is monitored to check for relapse and infection

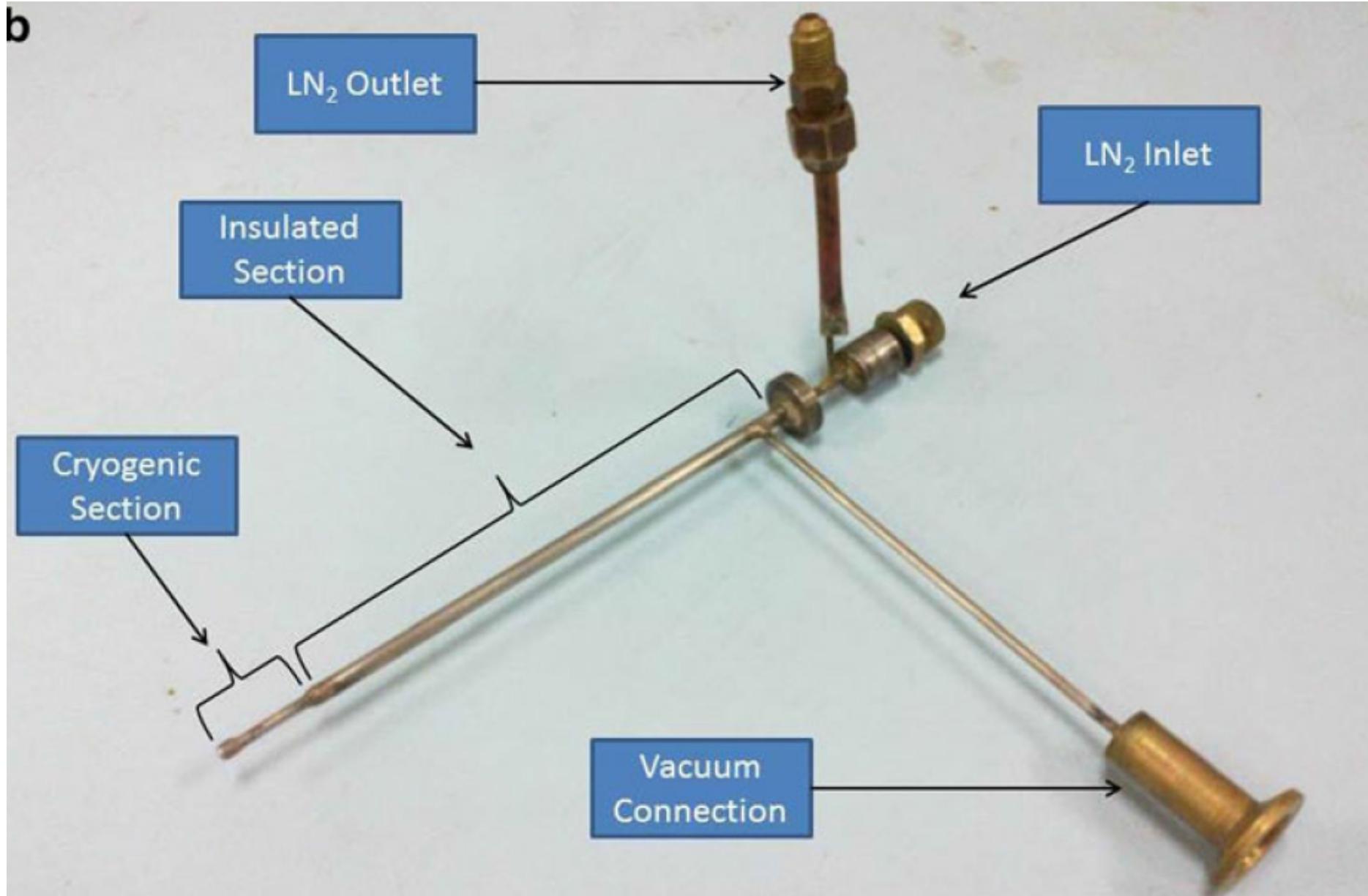
PROBLEMS

- Monitoring the ice growth accurately
- Incision size
- Need for multiple incisions
- Holding the probe through the freeze thaw cycle

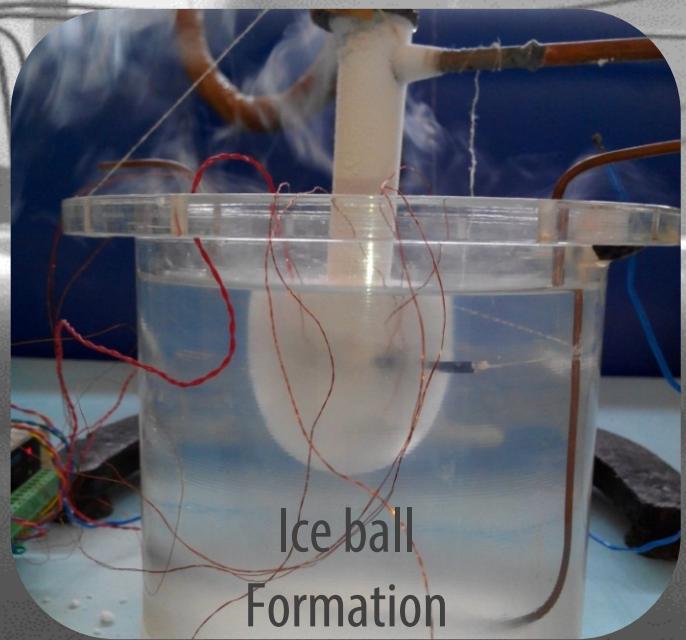


NEW GENERATION CRYOPROBE

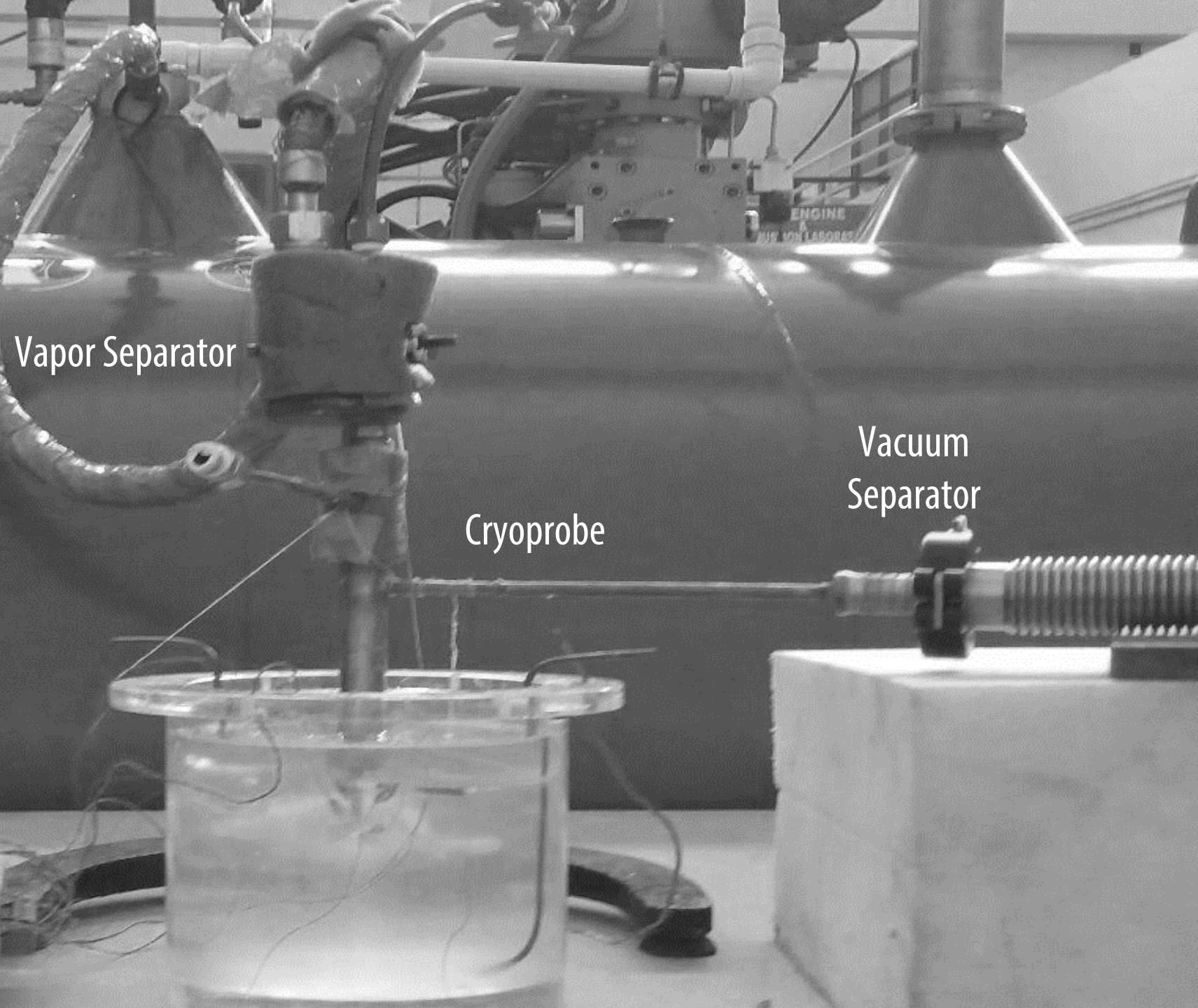
Designed by:Abdul Mateen A.G. Shaikh, Atul Shrivastava and Prof. MD Atrey

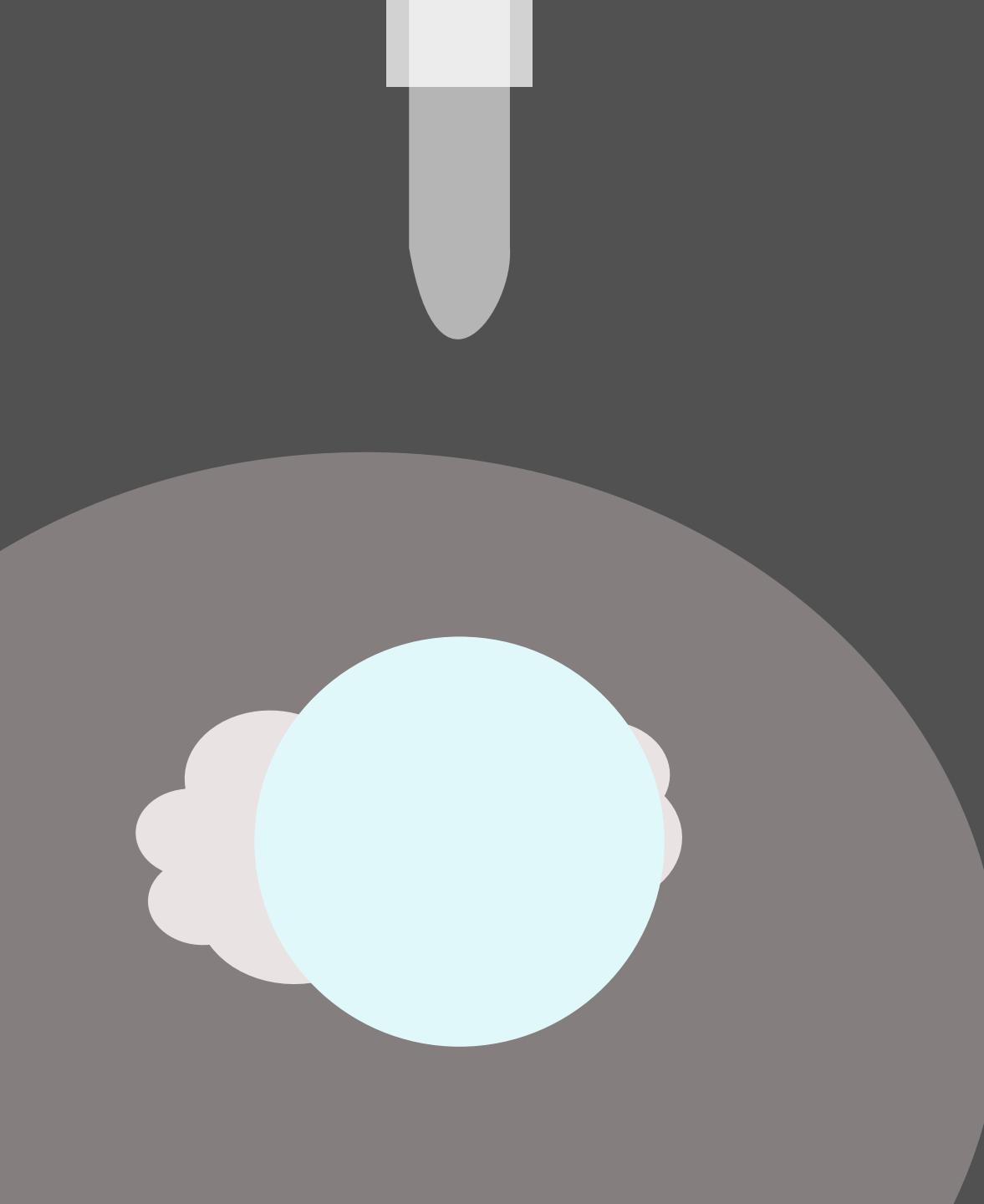


Designed by: Abdul Mateen A.G. Shaikh, Atul Shrivastava and Prof. MD Atrey



Data Acquisition
System





PROBLEMS

- Incision size is 5 mm
- No control over ice growth
- Healthy tissue is damaged
- Prior incision has to be made to insert the probe
- Cooling and thawing cycle
- Device Setup
- Monitoring

NEW GENERATION CRYOPROBE

Designed by:Abdul Mateen A.G. Shaikh, Atul Shrivastava and Prof. MD Atrey

USER STUDY

Dr. Bhansali
Senior Laparoscopic
surgeon

Dr. Hrishikesh
Kulkarni
Internal Medicine
Specialist

Dr. Rakesh
Neve
Oncosurgeon

Dr. Utkrant
Kurlekar
Oncosurgeon

INSIGHTS

- Breast Cancer scenario in India
- Lumpectomy is the most widely used surgical alternative
- High costs for cryosurgical setups
- Used for external applications with visible tissue

BRIEF

To design a probe for Cryoablation of tumors in breast tissue with system and process proposition

SYSTEM

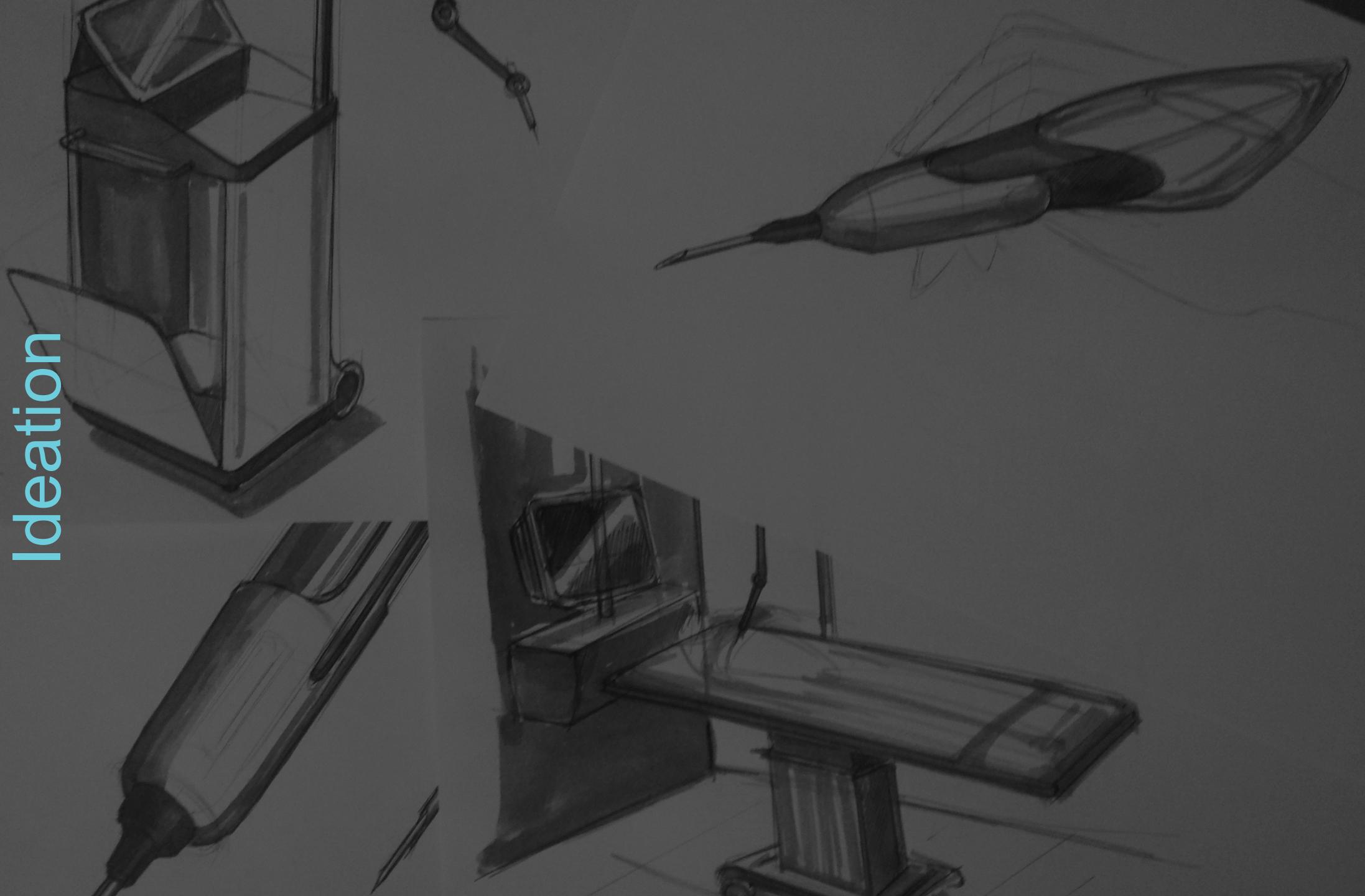
- All integrated system
- Easy to access and use
- Probe stabilization
 - Mobility

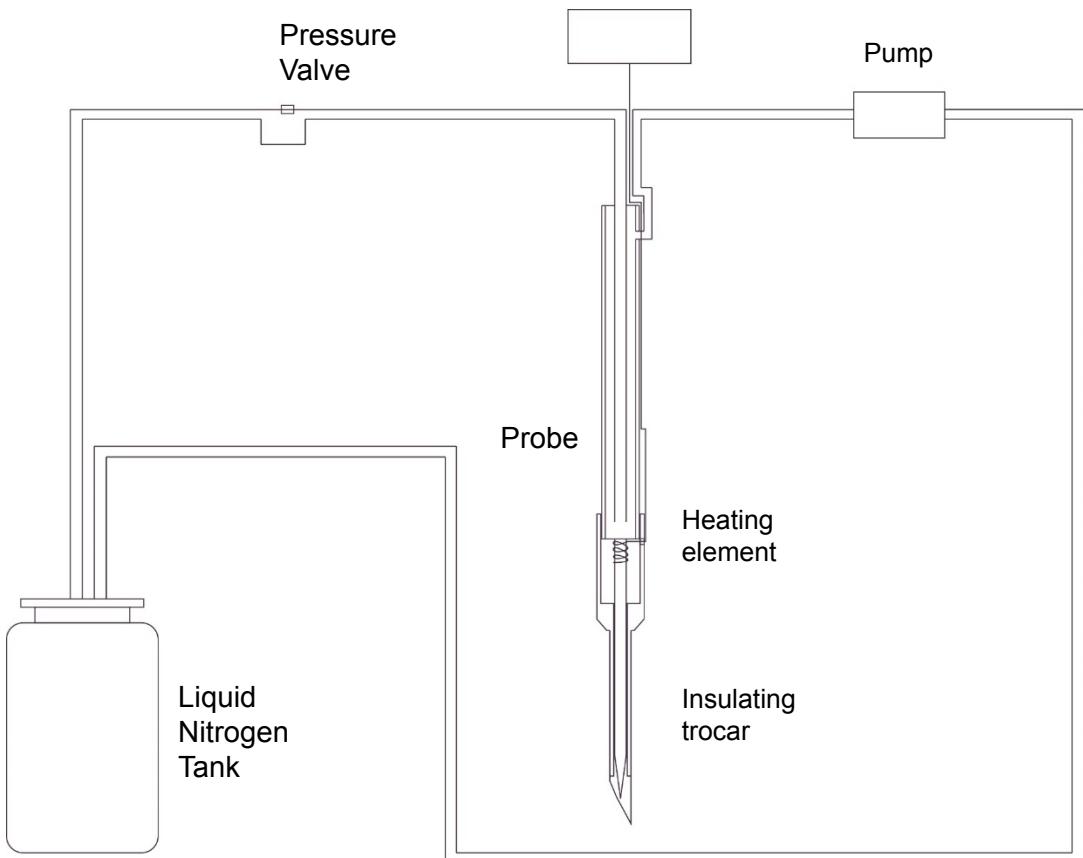
PROBE

- Minimum damage to the healthy tissue
 - Ergonomic handle
 - Holding time
 - Biocompatible materials
 - Sterilization procedures
 - Easy to setup and use
 - Lesser number of steps
- Minimize the frosting on the probe

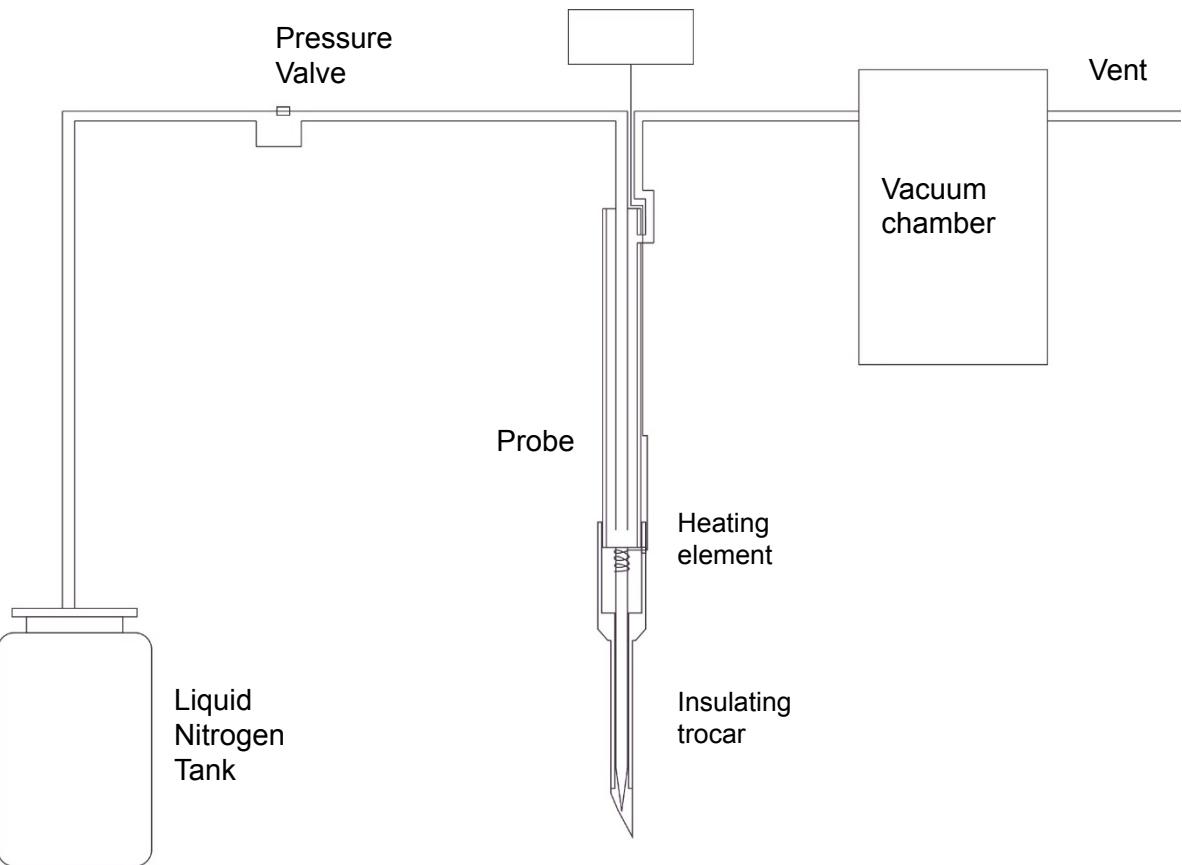
SYSTEM

Ideation





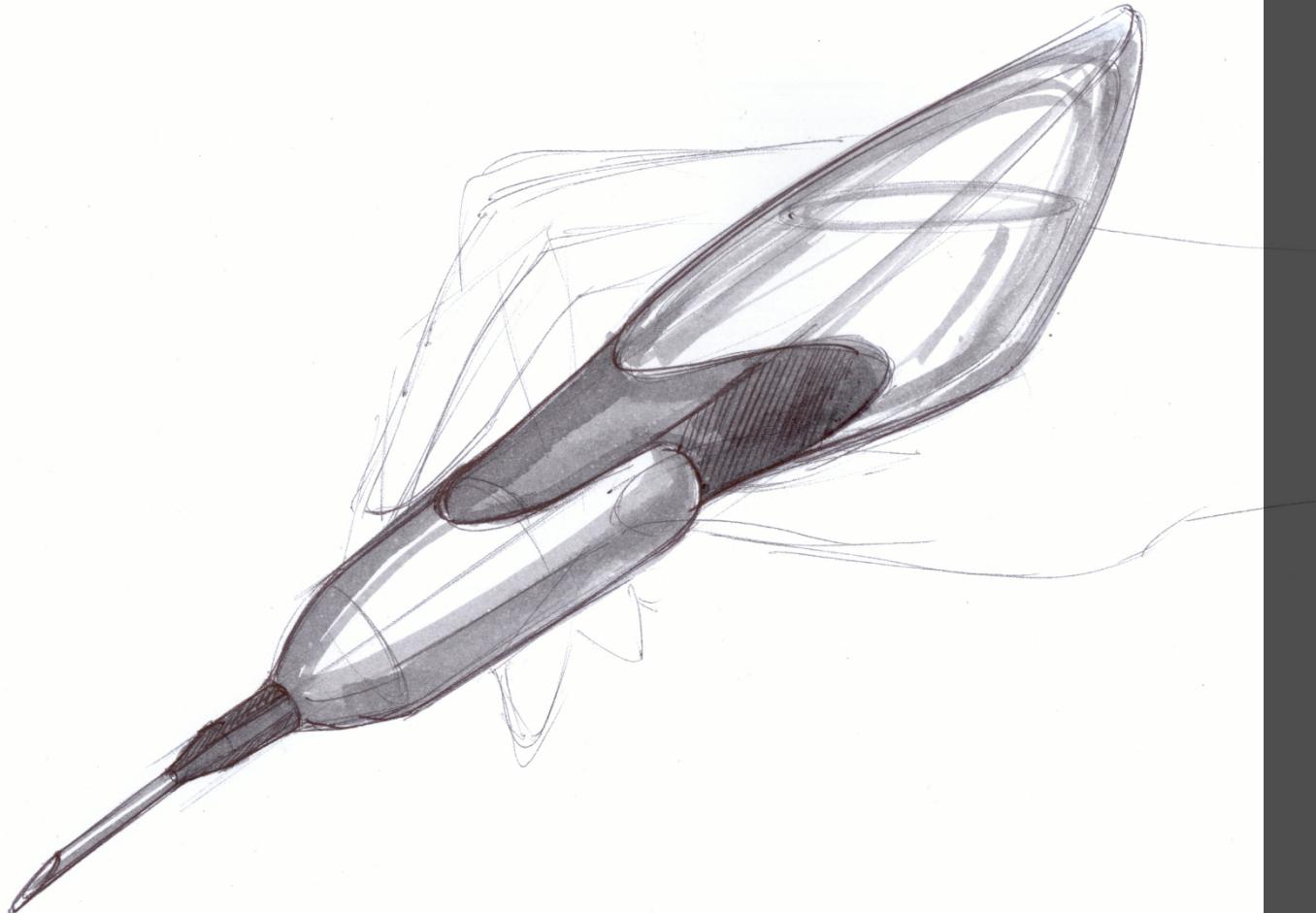
CLOSED SYSTEM



OPEN SYSTEM

MONITORING





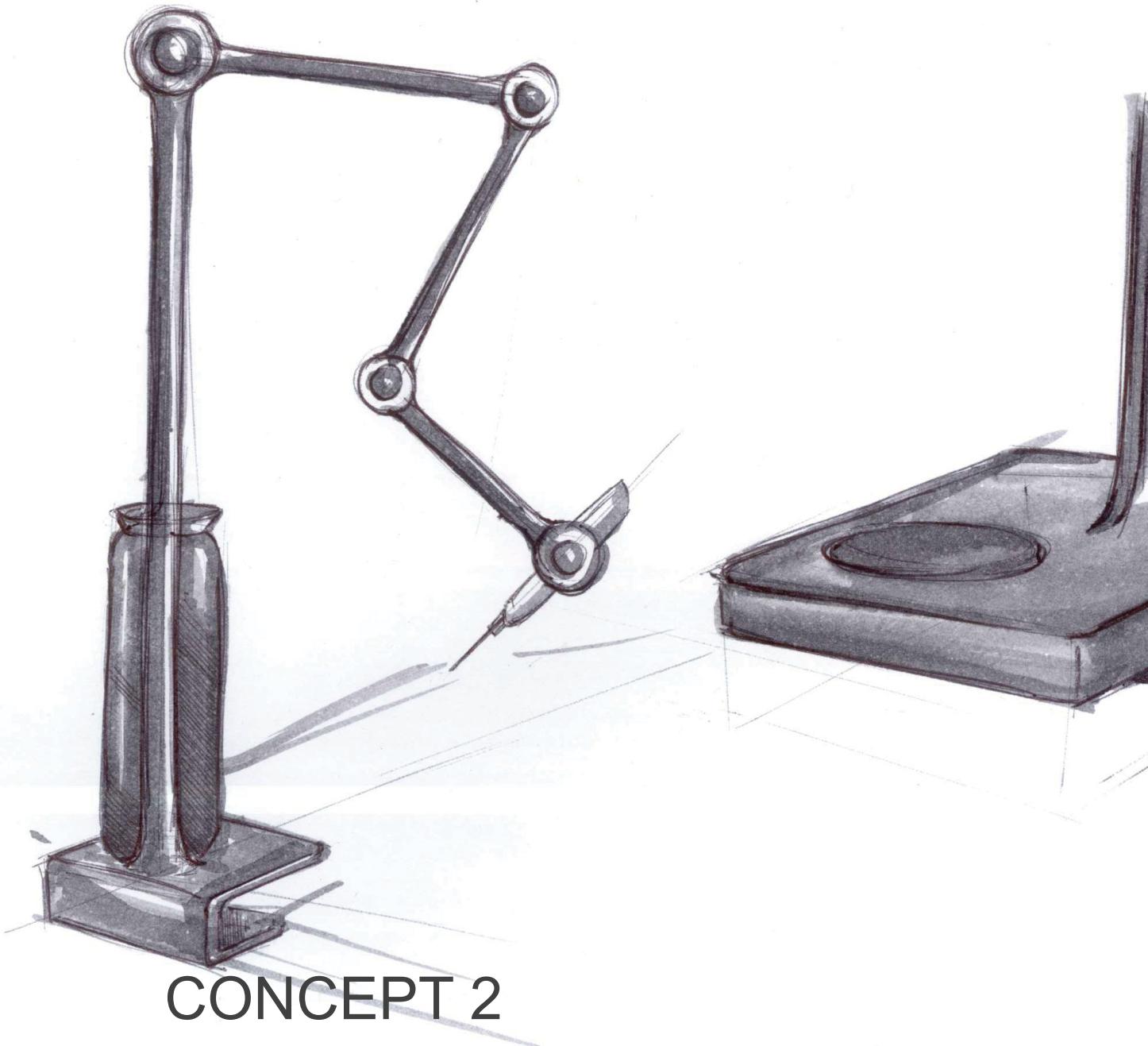
CONCEPT 1

MERITS:

- Small Compact device
- Portable
- Less wastage
- Easy to adapt

DEMERITS:

- Higher component costs
- Complicated setup
- Amount of LN2 required for surgery



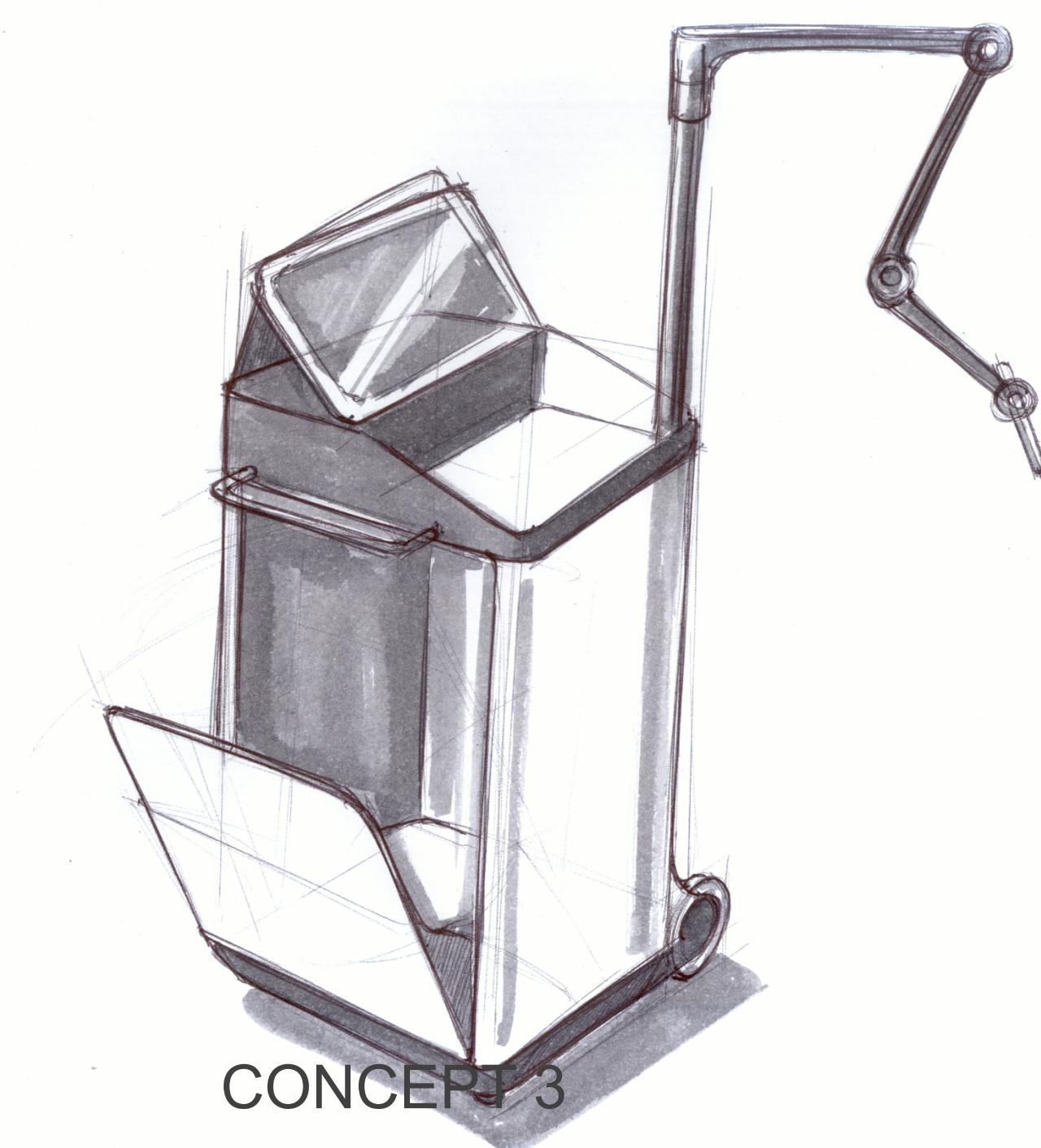
CONCEPT 2

MERITS:

- Probe support
- Smaller initial investment costs

DEMERITS:

- Not an integrated system
- Amount of LN2 required for surgery
- Complicated setup
- Higher component cost



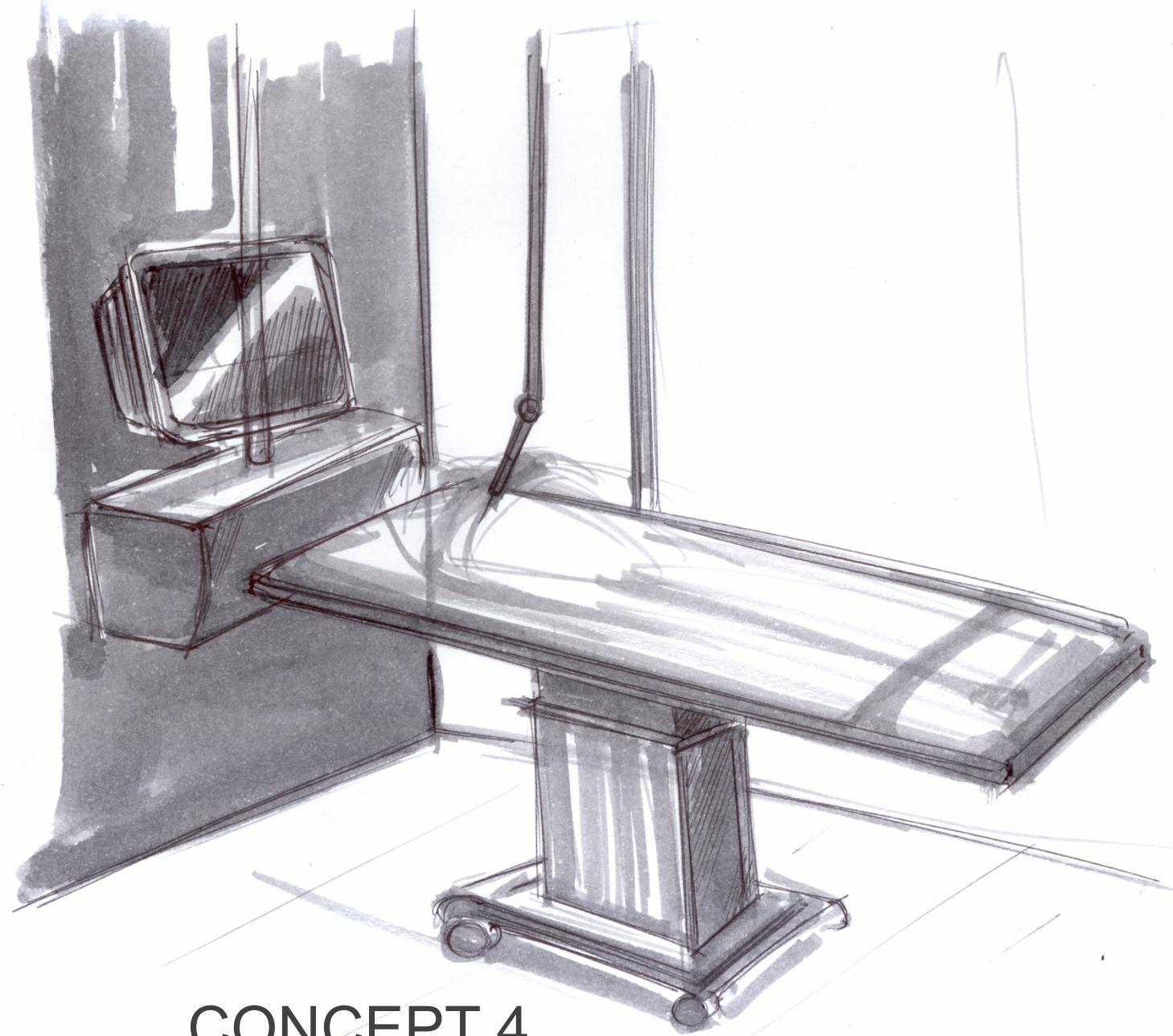
CONCEPT 3

MERITS:

- Mobile setup
- Integrated design
- Probe support

DEMERITS:

- Larger size



CONCEPT 4

MERITS:

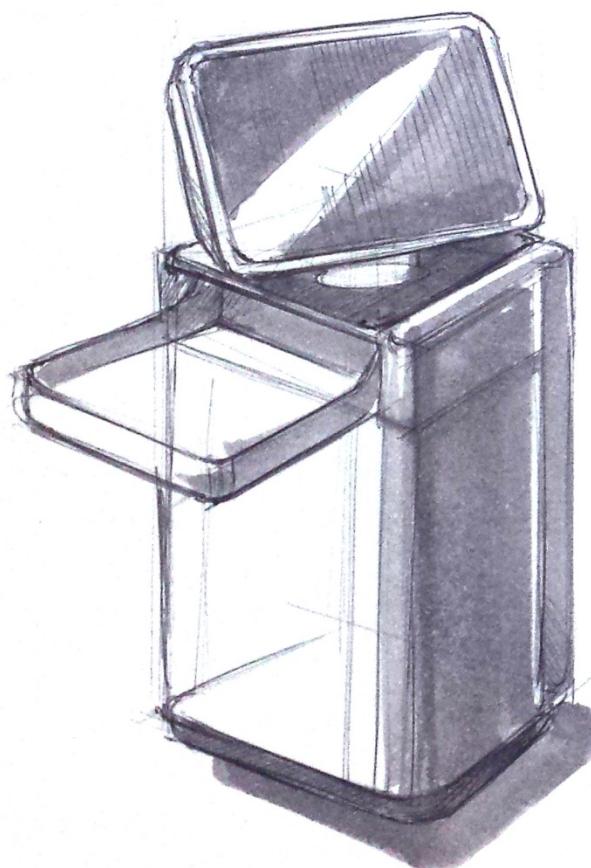
- Cheaper in the long run
- Specialized Operation theatres
- No dependency on external agency

DEMERITS:

- Higher initial investment costs
- Time required to modify OT

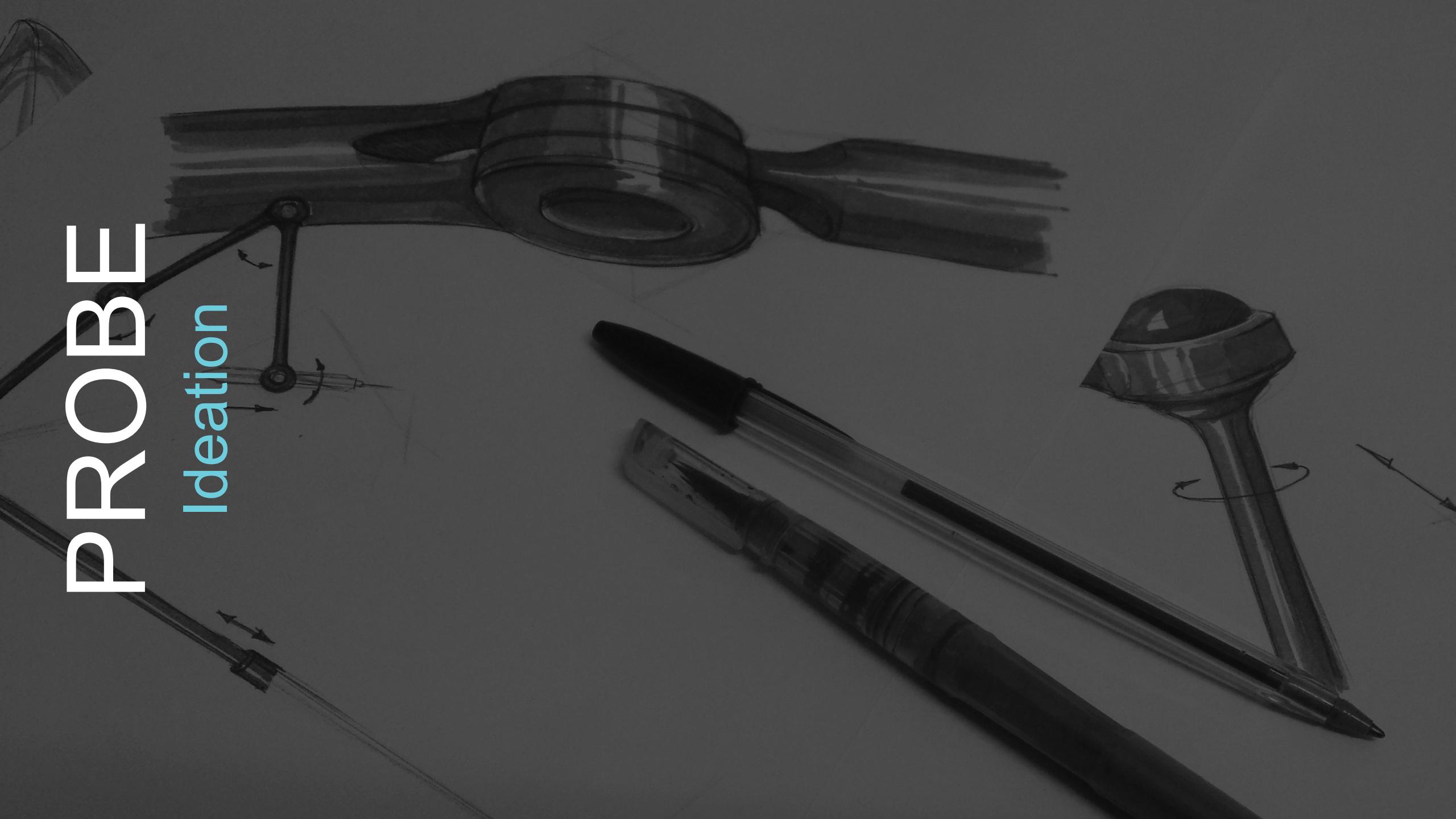
	Concept 1: Hand held device	Concept 2: Table top device	Concept 3: Mobile compact setup	Concept 4: Inbuilt setup for OT
Advantages	<p>Small Compact device</p> <p>Portable</p> <p>Less wastage</p> <p>Easy to adapt</p>	<p>Probe support</p> <p>Smaller initial investment costs</p>	<p>Mobile setup</p> <p>Integrated design</p> <p>Probe support</p>	<p>Cheaper in the long run</p> <p>Specialized Operation theatres</p> <p>No dependency on external agency</p>
Disadvantages	<p>Higher component costs</p> <p>Complicated setup</p> <p>Amount of LN2 required for surgery</p>	<p>Not an integrated system</p> <p>Amount of LN2 required for surgery</p> <p>Complicated setup</p> <p>Higher component cost</p>	<p>Larger size</p>	<p>Higher initial investment costs</p> <p>Time required to modify OT</p>

SYSTEM PROPOSITION



PROBE

Ideation

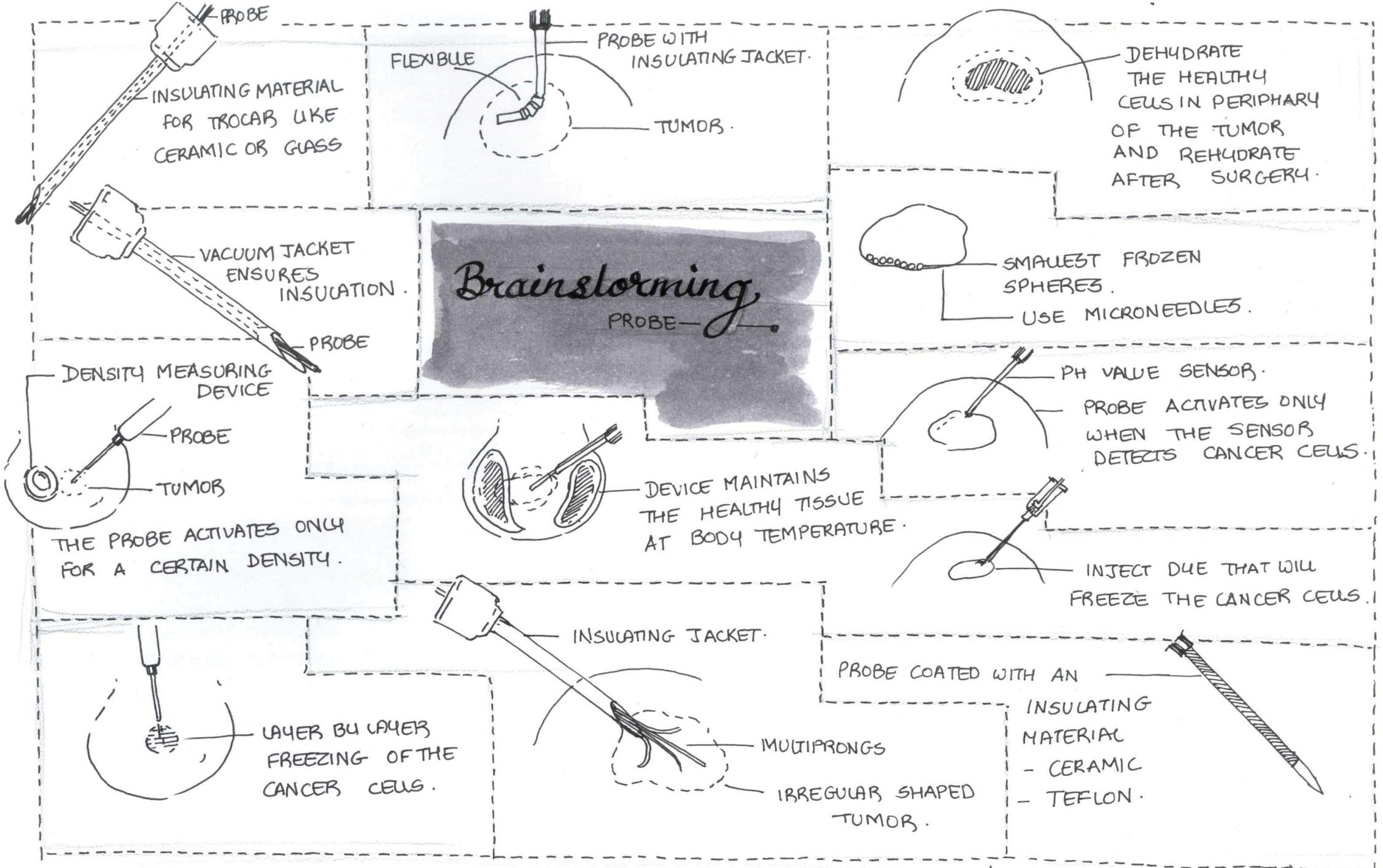


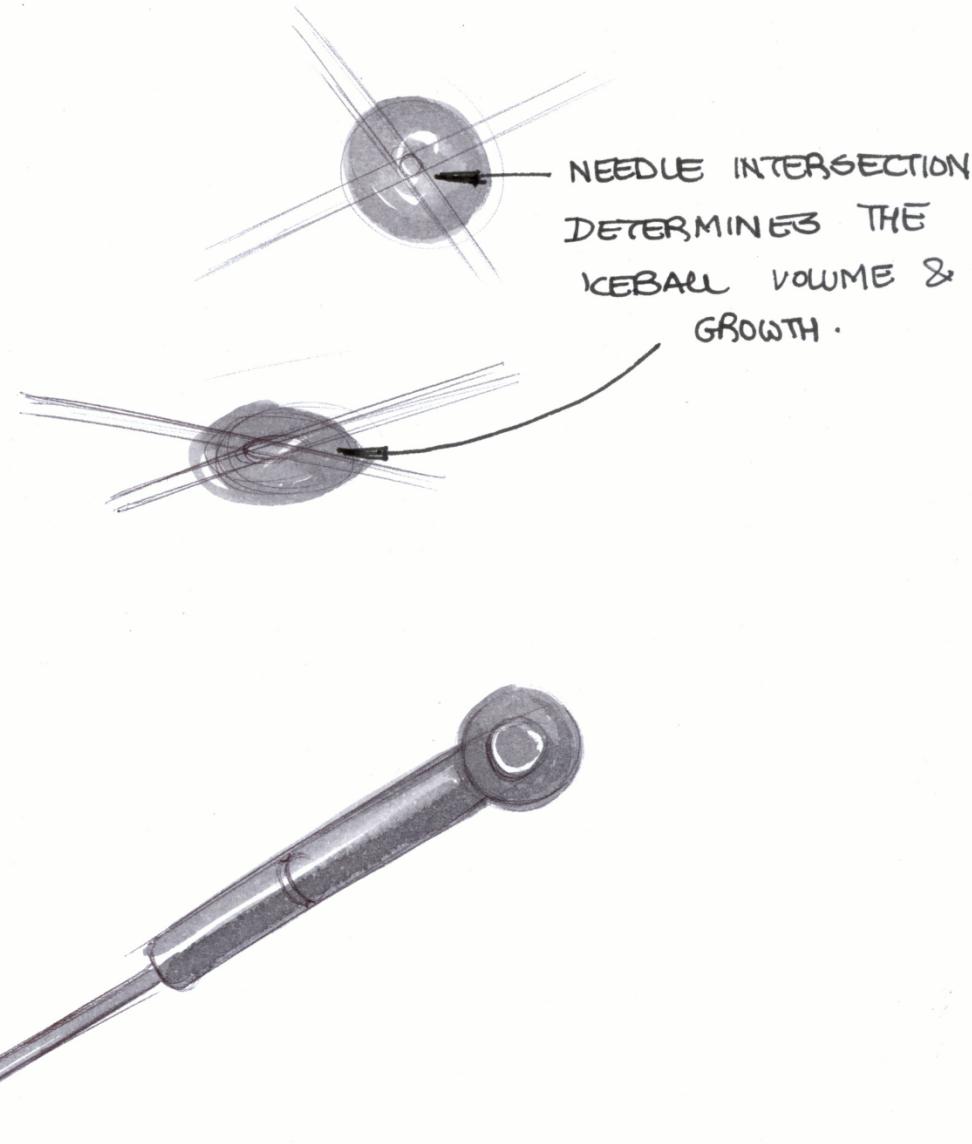
Brainstorming

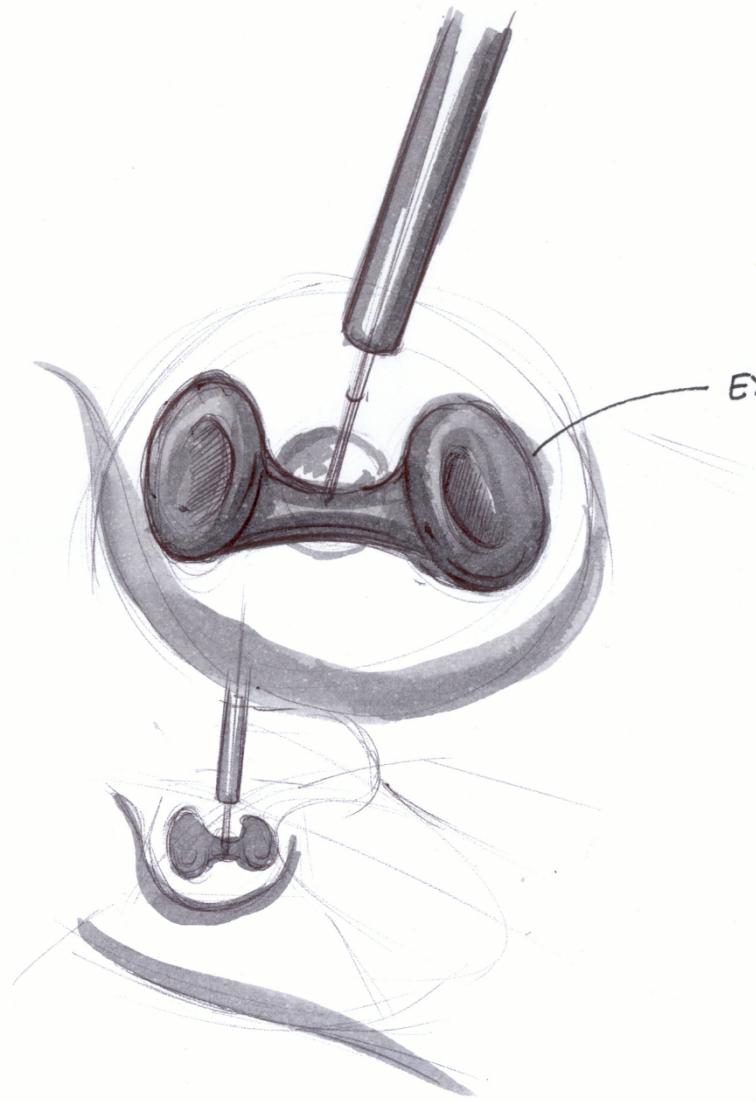
How to minimize healthy tissue damage?

CONSTRUCTION OF TISSUE
MONITOR TISSUE DENSITY
TRANSITION, NEW
COOLED (62 CELSIUS)
ASPIRIN TEST
RTPDPR

- PH VALUE
- COOLING
- COLOR GAS
- TEMP. DIST
- IR BASED
- ELECTRICAL PROPERTIES
BET, PROBE SURFACE
- VOLTAGE OR
RESISTANCE INFLAMMATION
- LAPAROSCOPE
- SLOW MOTION
- STIFFNESS TEST
- MEDITATION, HOT & COLD TEST
- PALPATION, RADAR
- NEUTON'S LAW OF COOLING → PROBE
TEMPERATURE DESSIPITATE FIRE
- SOUND
- SHARP IT - TUMOR
- INTRAVENOUS & EXTRAVENOUS
FORCE SENSING ON PROBE
POKE IT.
- THERMATE, IMAGING
- SENSOR
- COLOR SPECTRUM
- X RAY
- ULTRASOUND
- TOUCH - STIFFNESS
- DIP IN WATER - BIOPSY
- WT. OF TUMOR

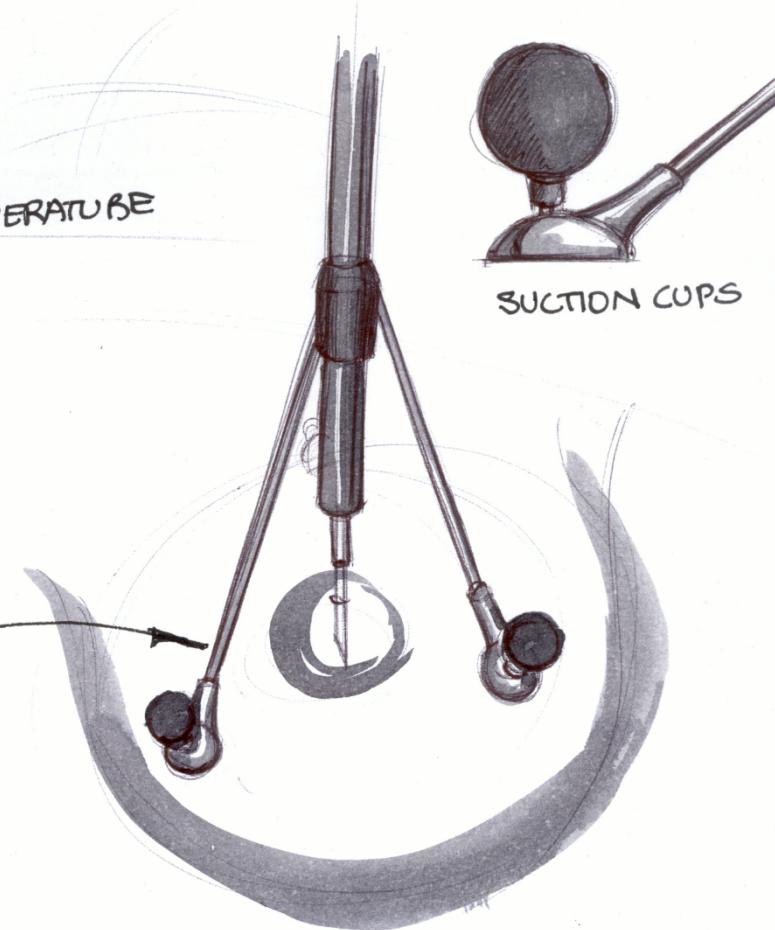




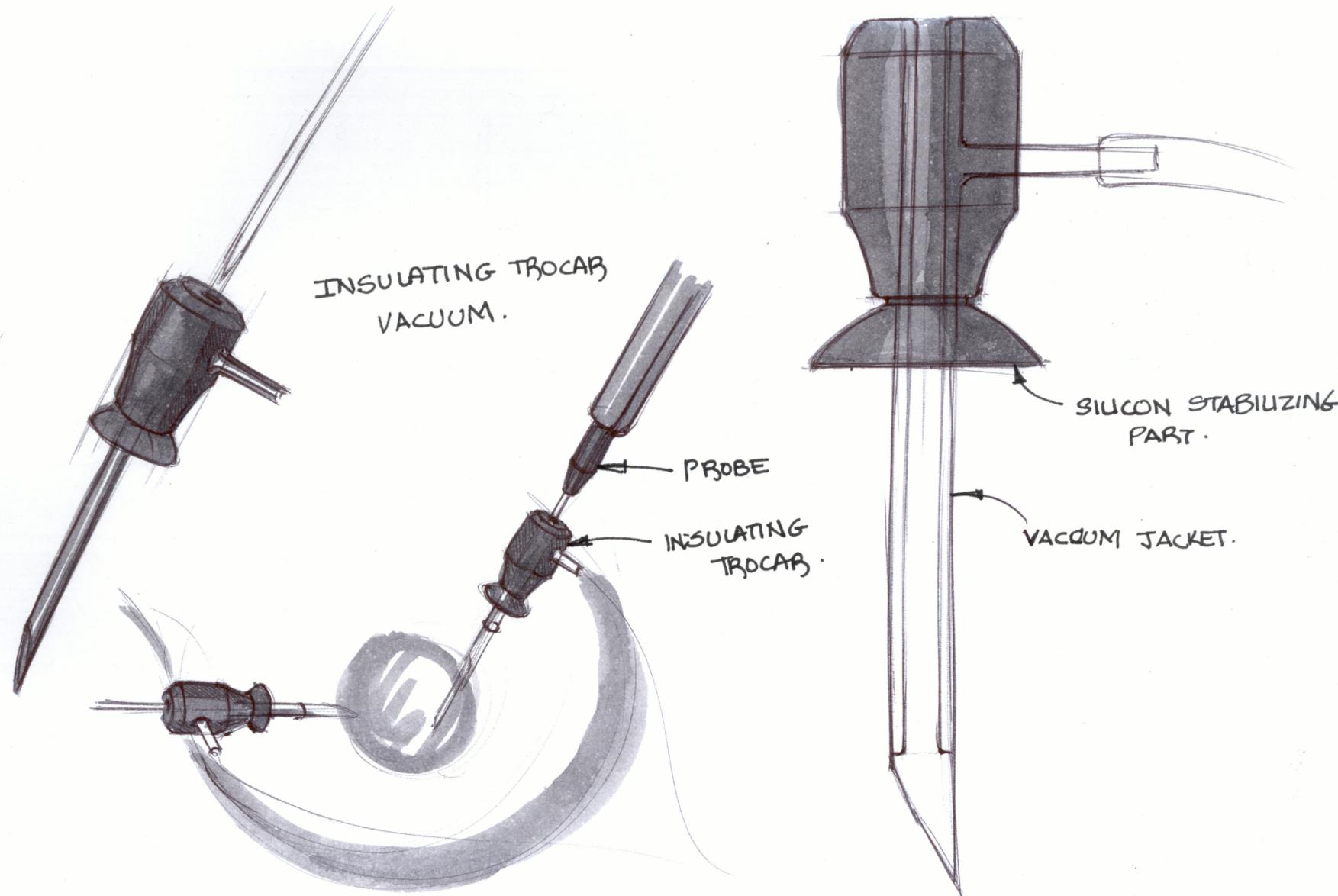


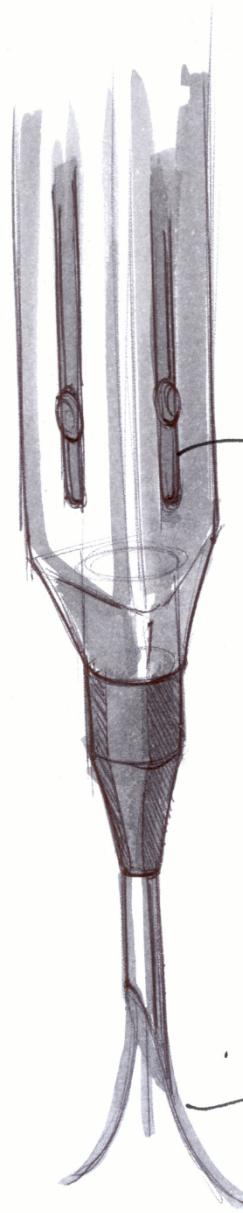
EXTERNAL TEMPERATURE
GUIDE

STABILIZATION
STAND



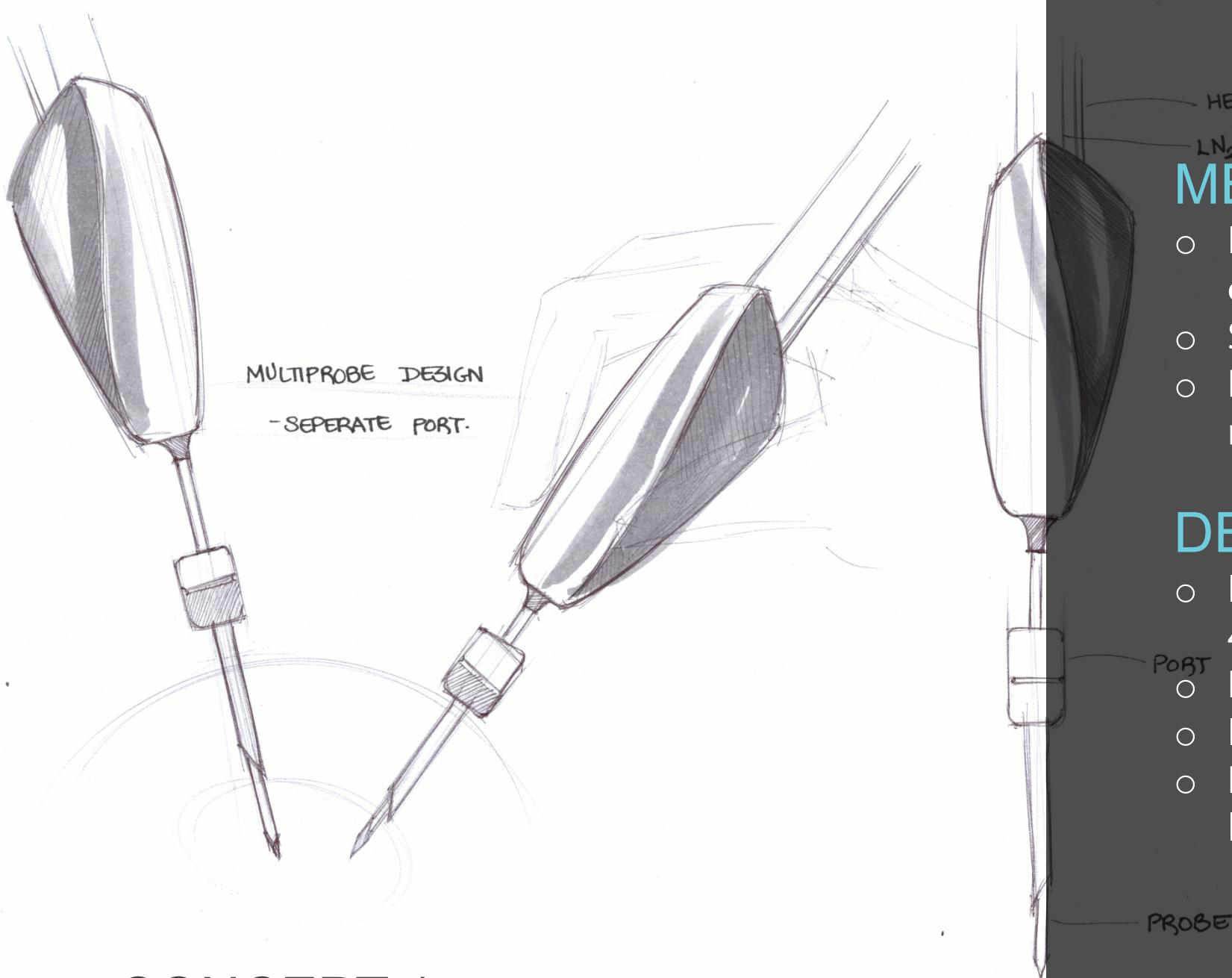
SUCTION CUPS





INDIVIDUAL
CONTROLS FOR
PRONGS .

MULTIPLE PRONGS
CONNECTED TO PROBE .



CONCEPT 1

MERITS:

- Insulating material like ceramic or glass used
- Separate trocars
- No separate incision required

DEMERITS:

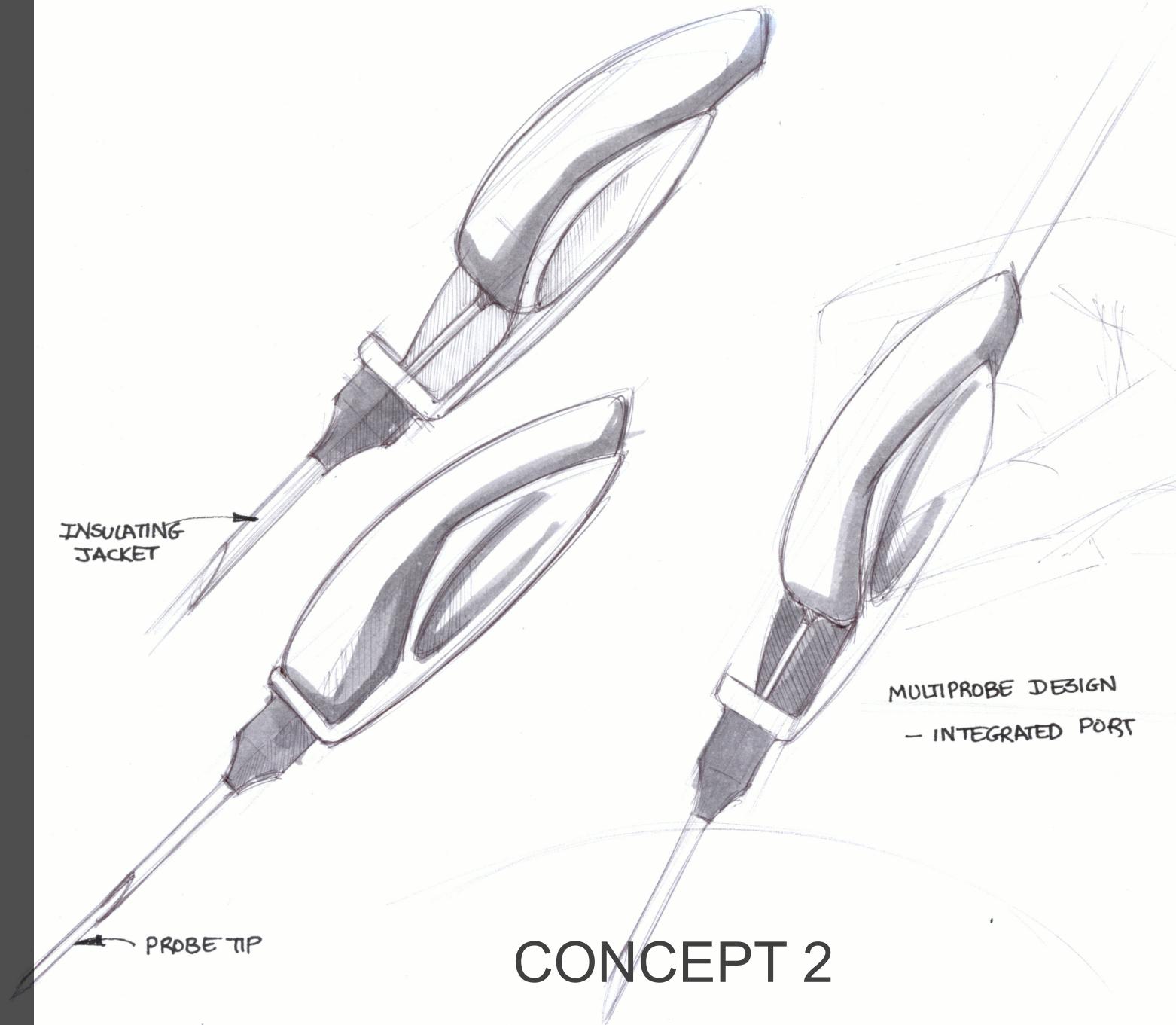
- Incision width above 4mm
- Brittle materials
- Insulating capacity
- Possibility of damage or loss of trocars

MERITS:

- Integrated design
- Easy and quick to use
- Precision grip for accuracy

DEMERITS:

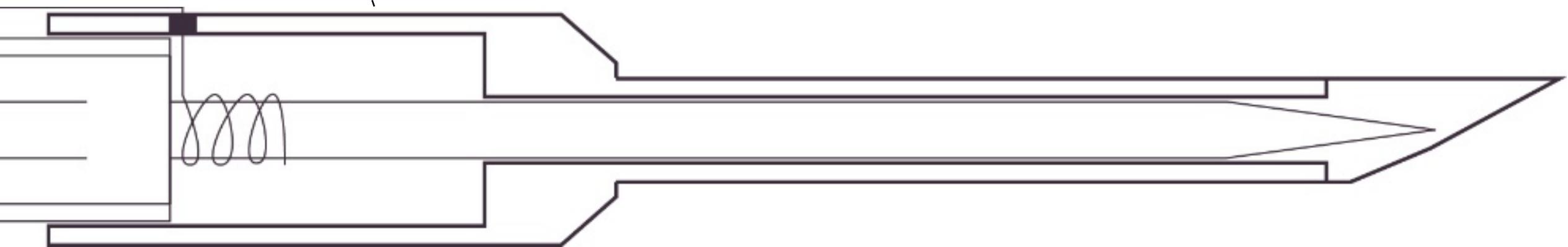
- Sterilization
- Frosting

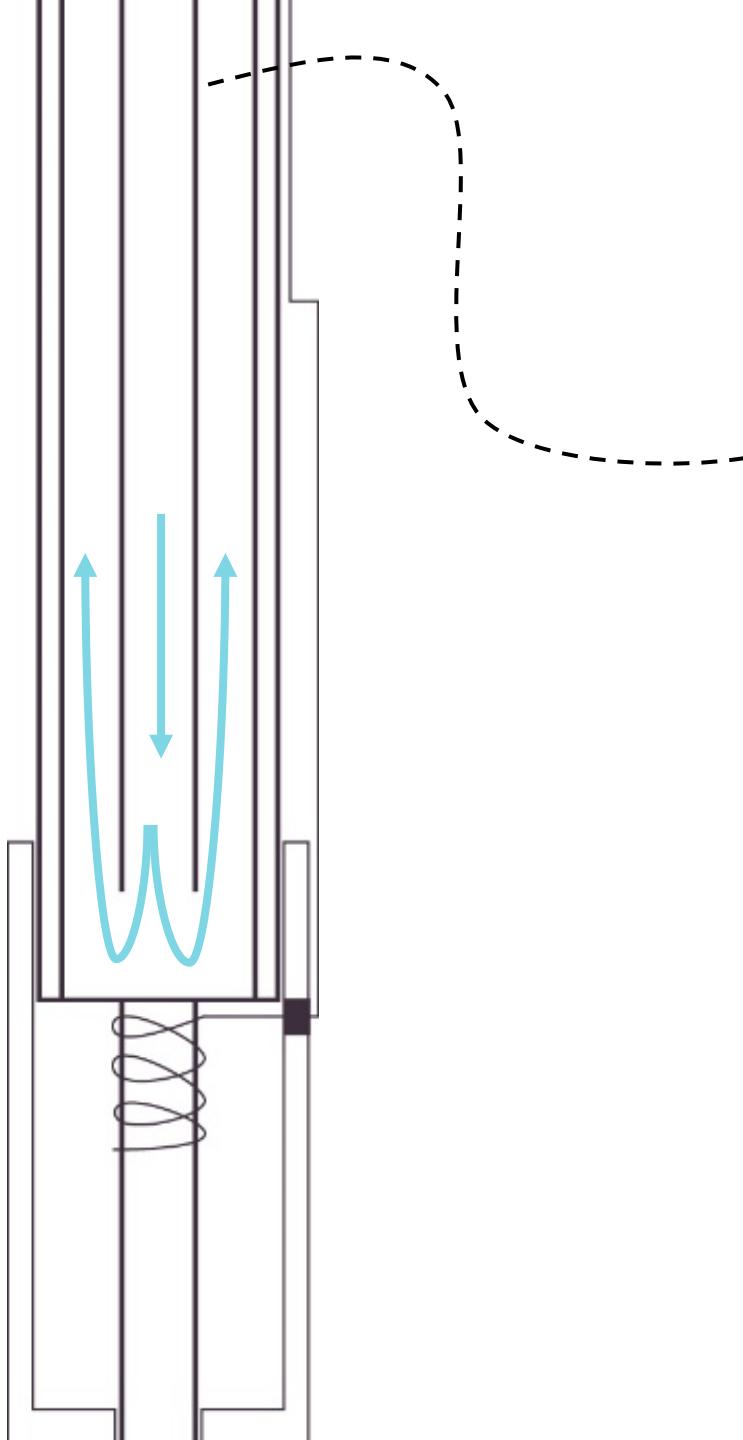


INSULATING TROCAR

Concentric tubes with vacuum in the cavity between them.

Teflon coating in the inner wall





PROBE

Concentric tubes with vacuum jacket

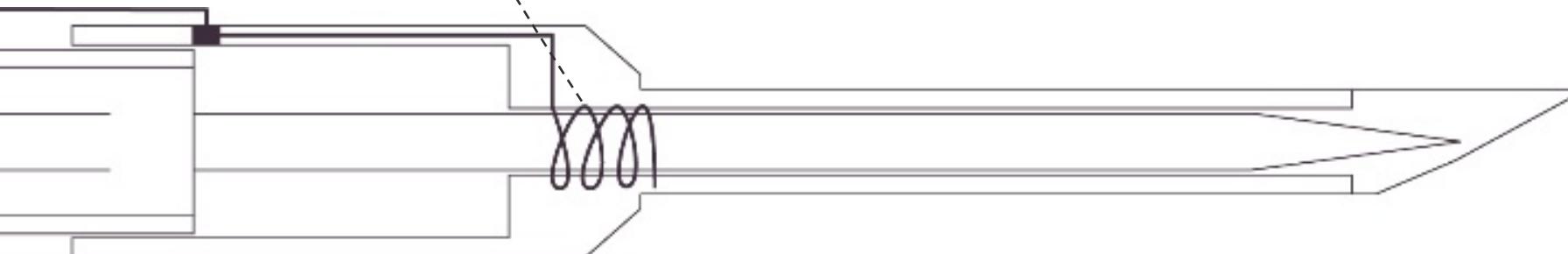
A provision for attachment of the needle

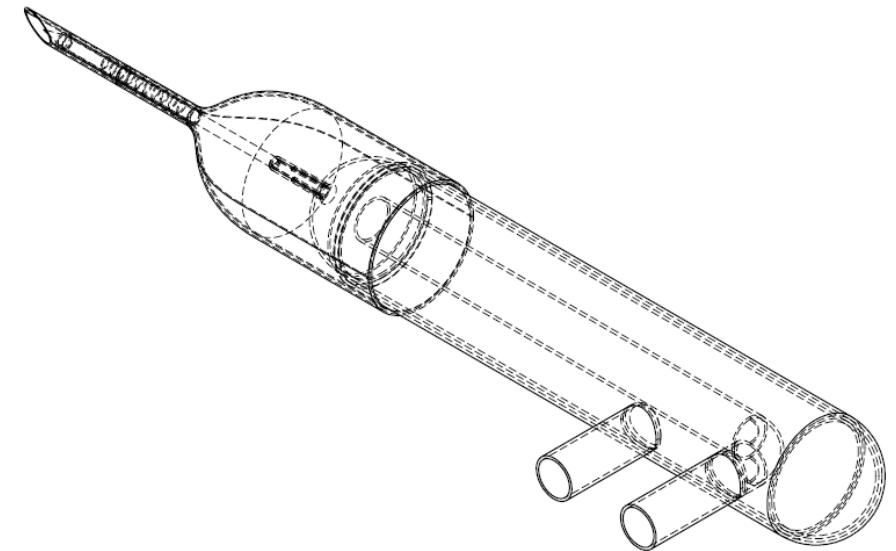
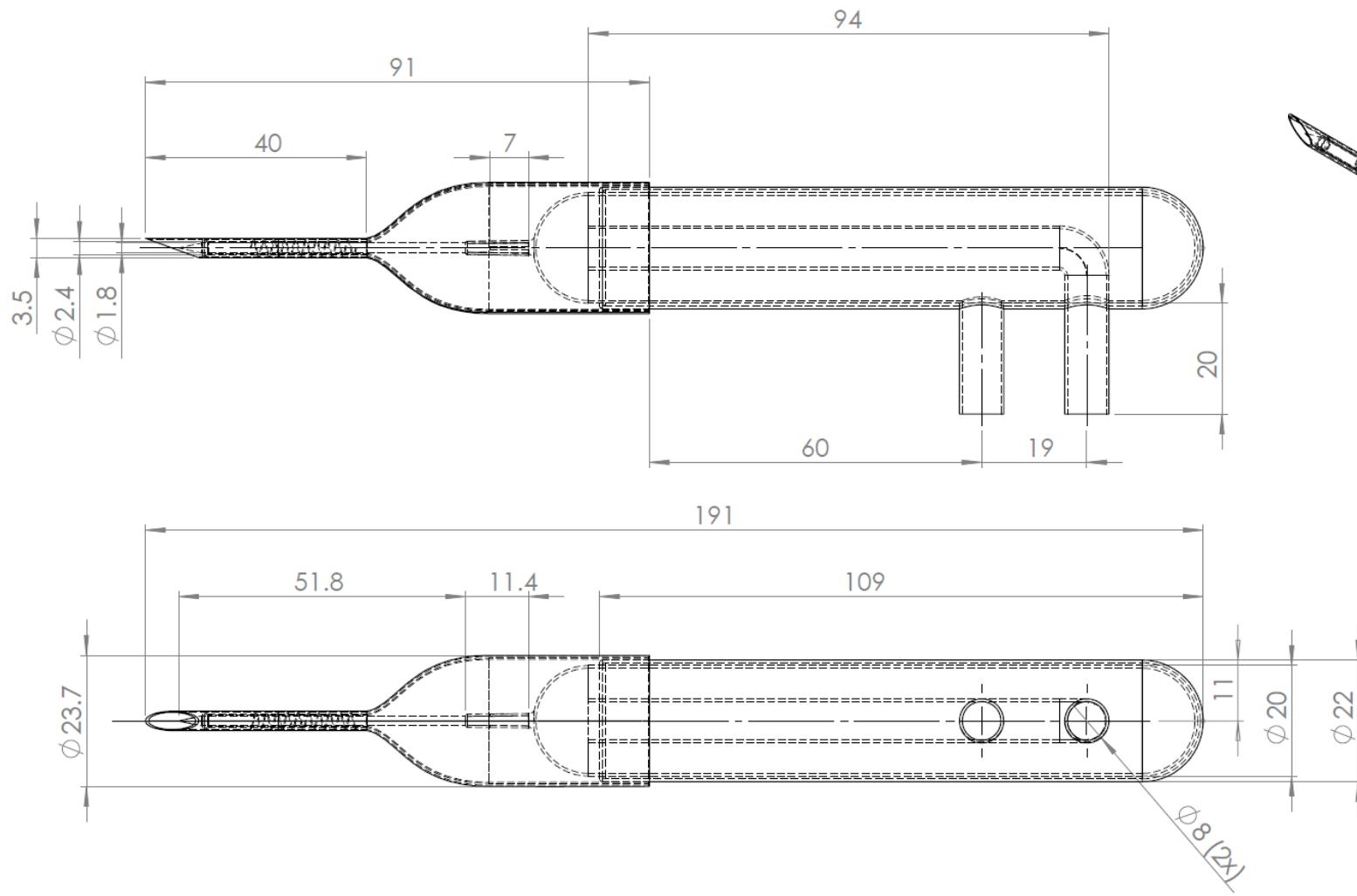
Teflon coating on the outer surface for added insulation and to reduce friction

THAWING SETUP

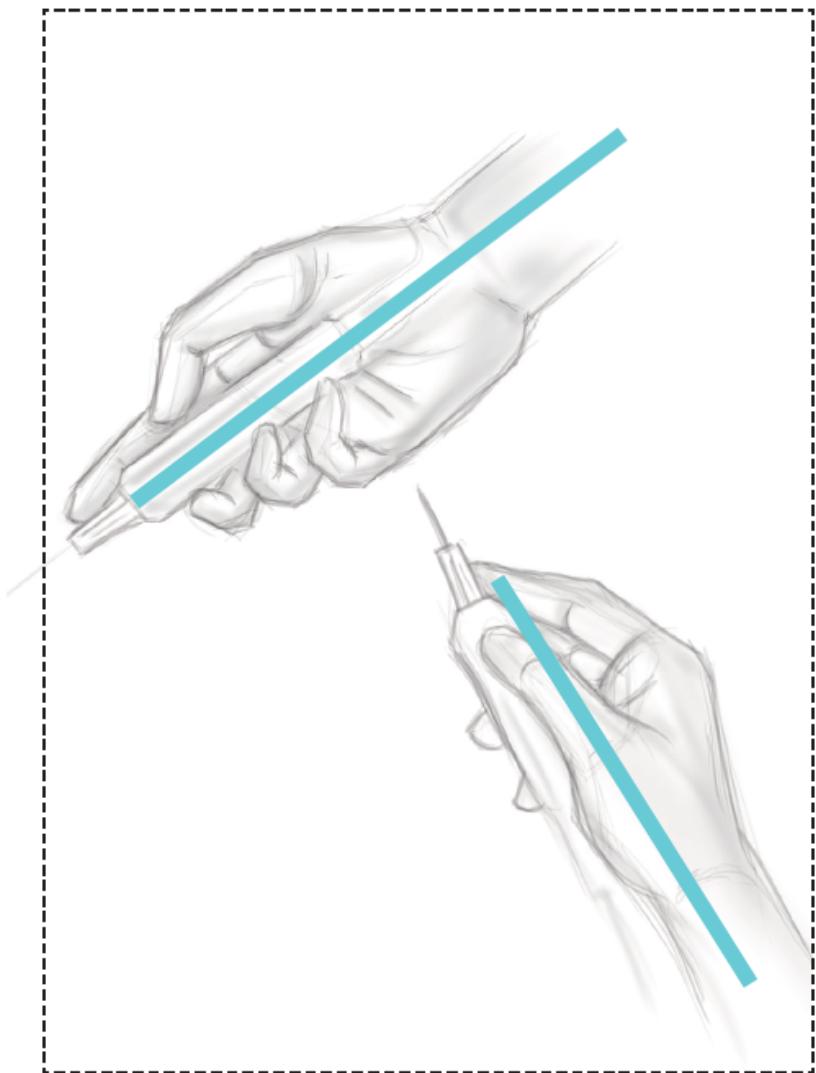
A heating element is inside the insulating trocar

Wound over the inner steel tube

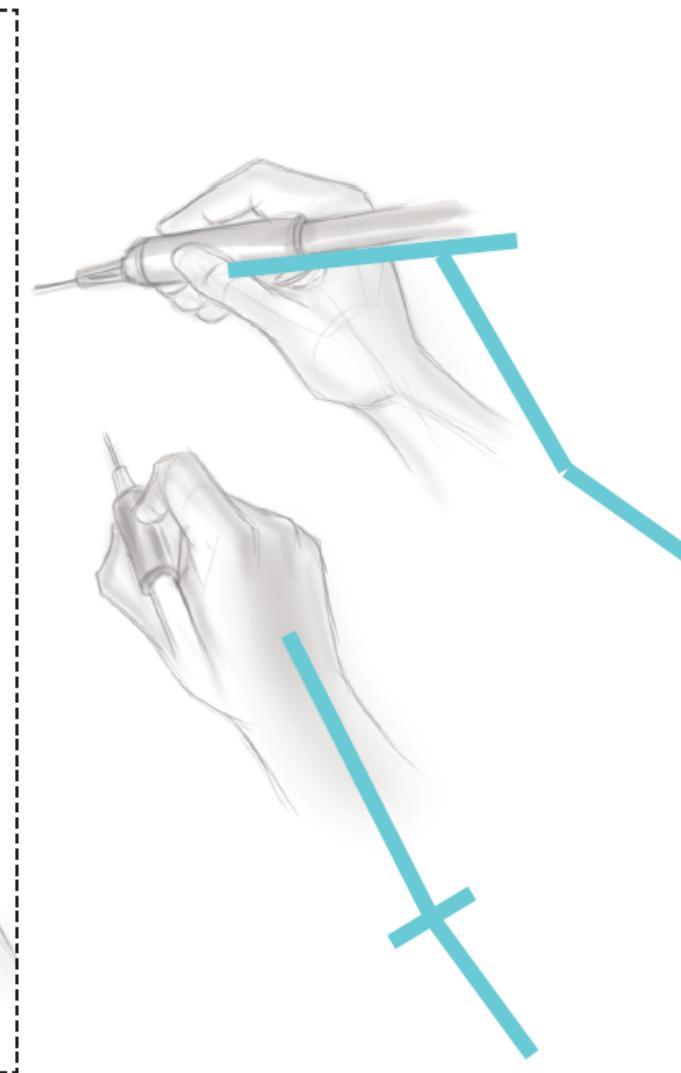




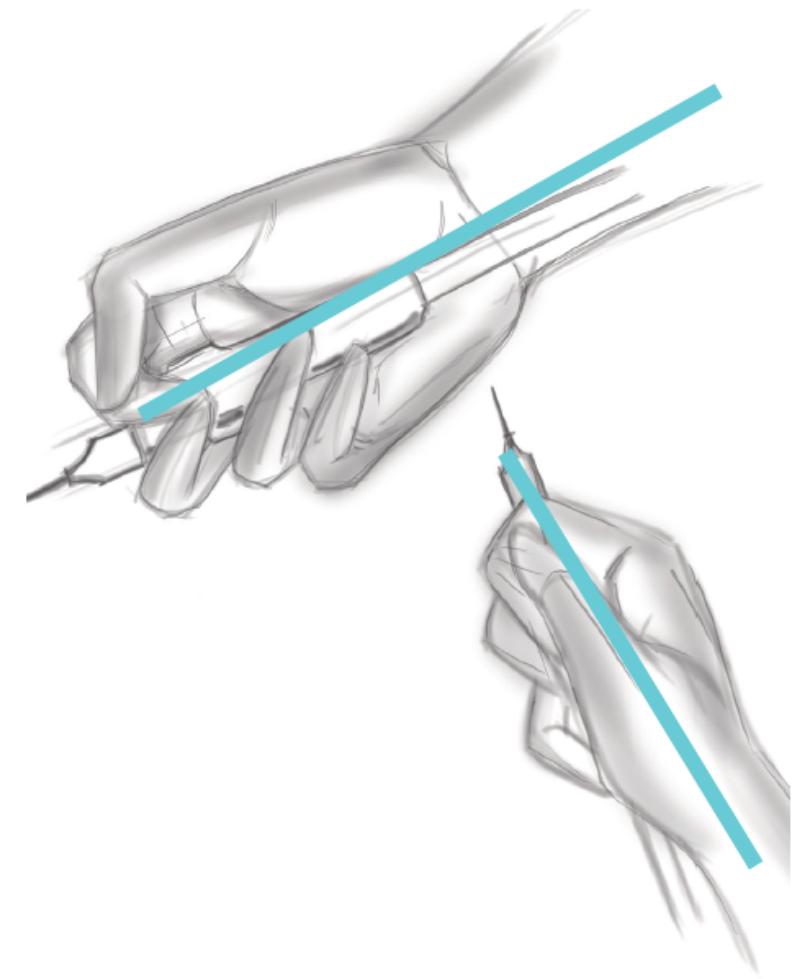
DIMENSIONS



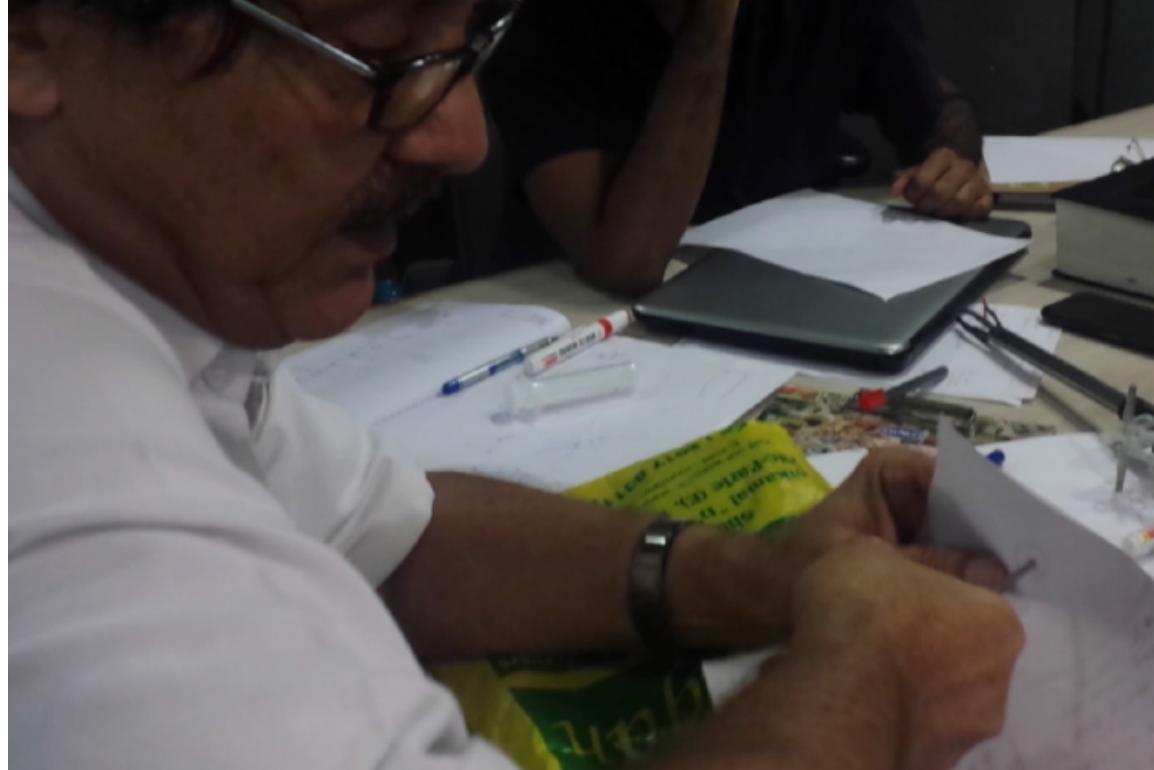
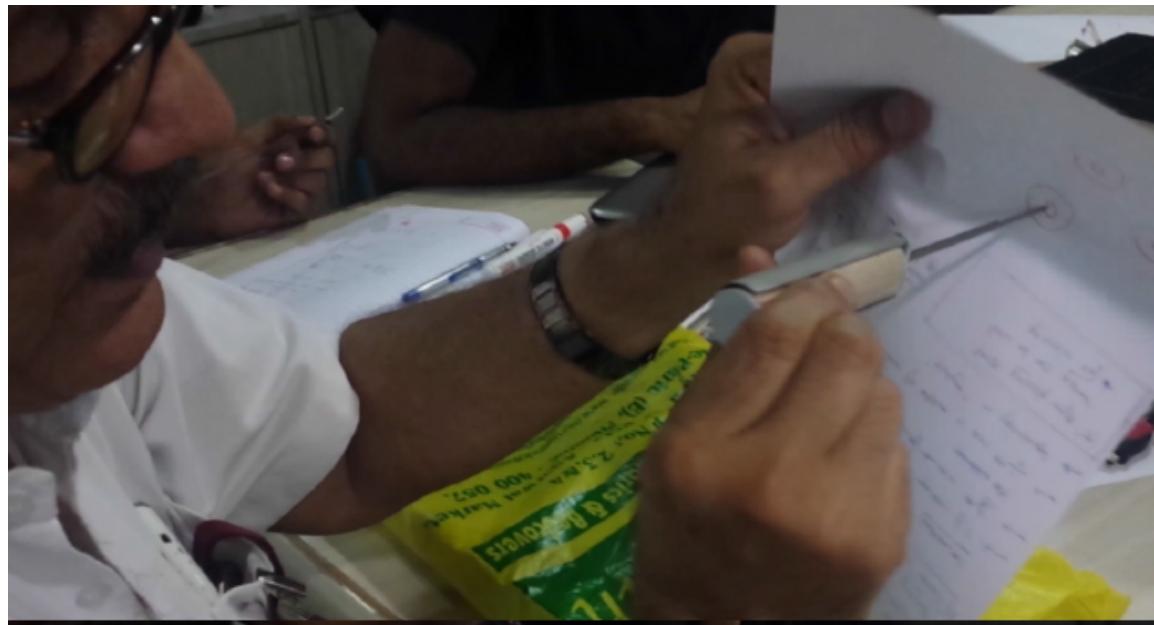
Grip 1



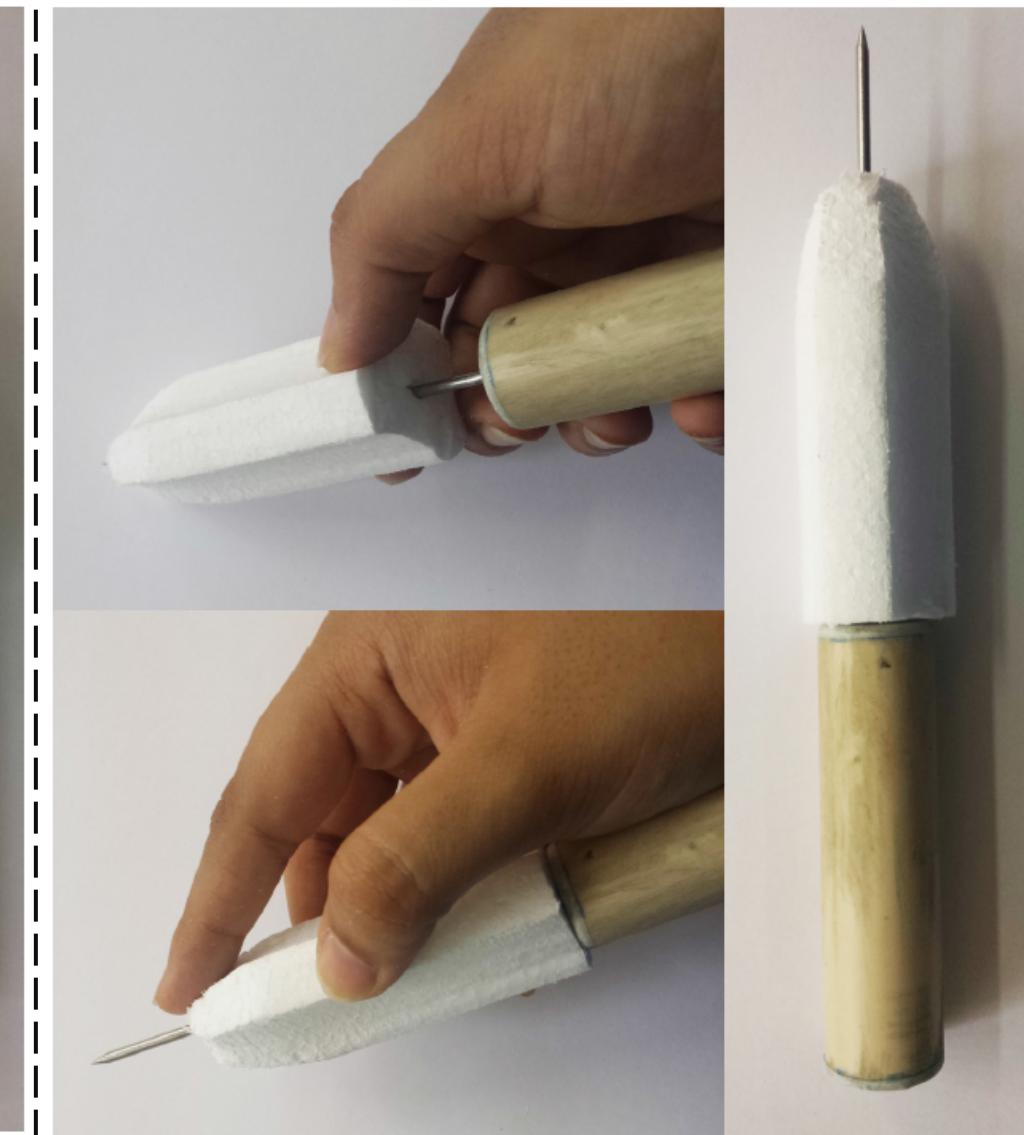
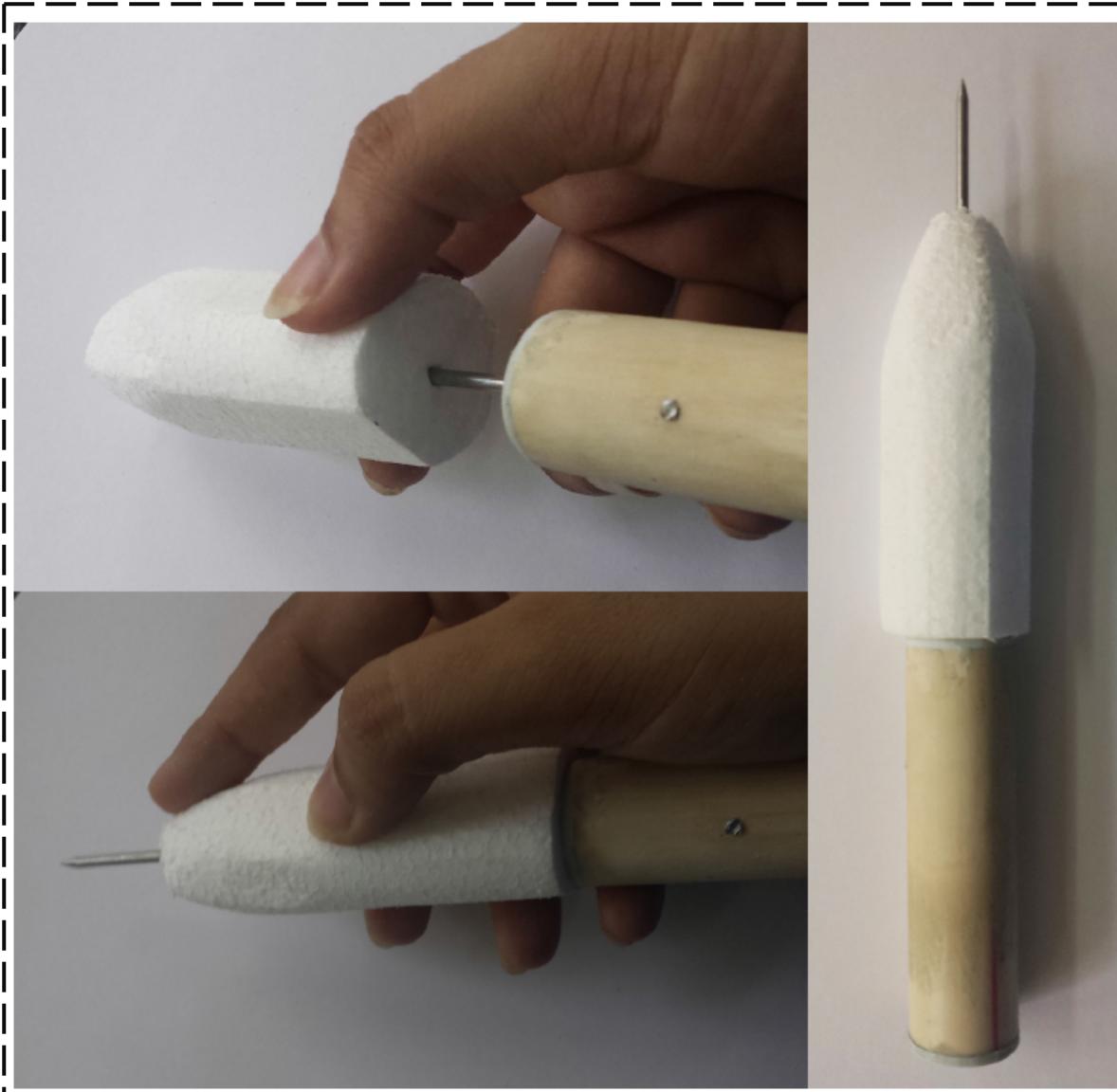
Grip 2



Grip 3



GRIP VALIDATION



FORMAL ASPECT



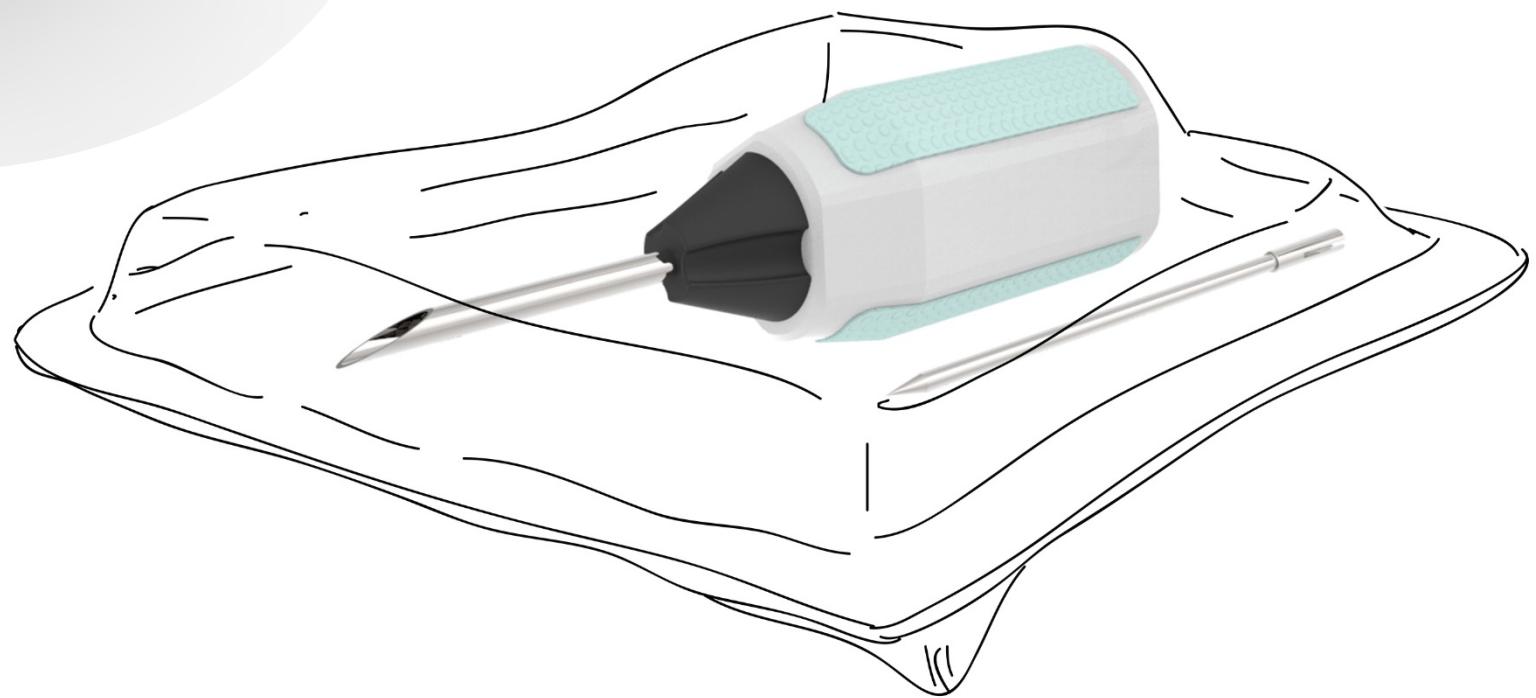
FORMAL ASPECT

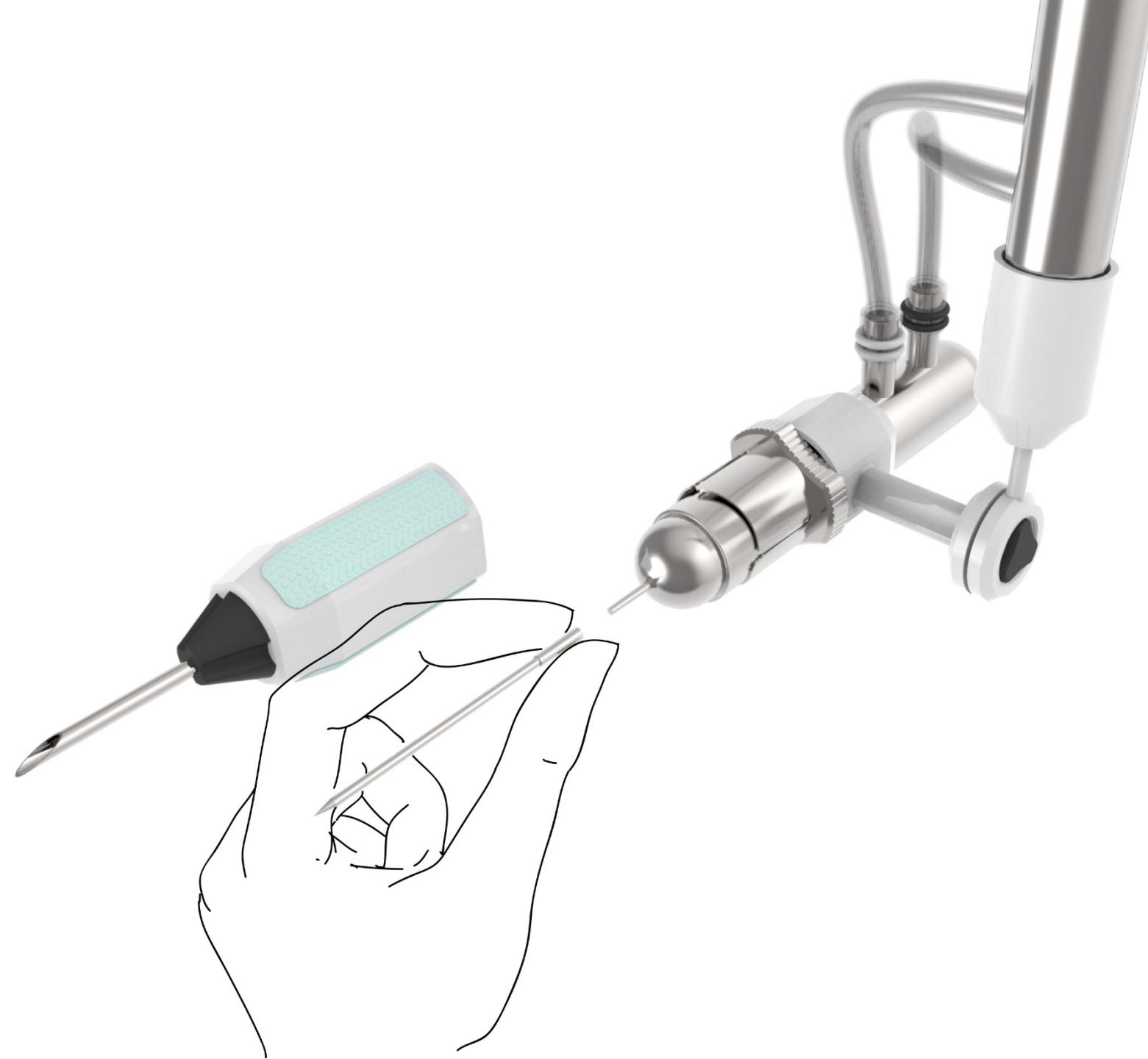


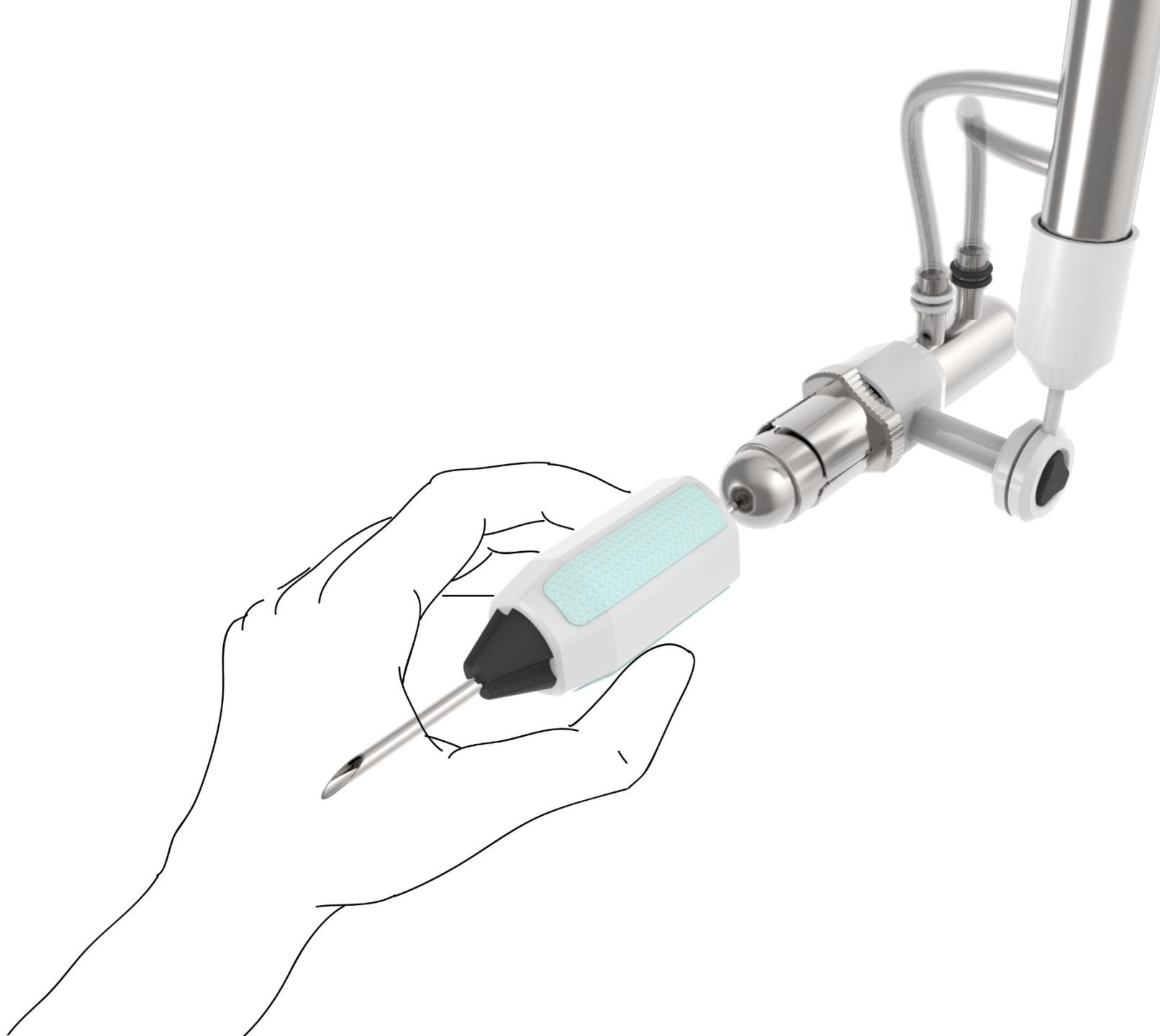
INSPIRATION BOARD



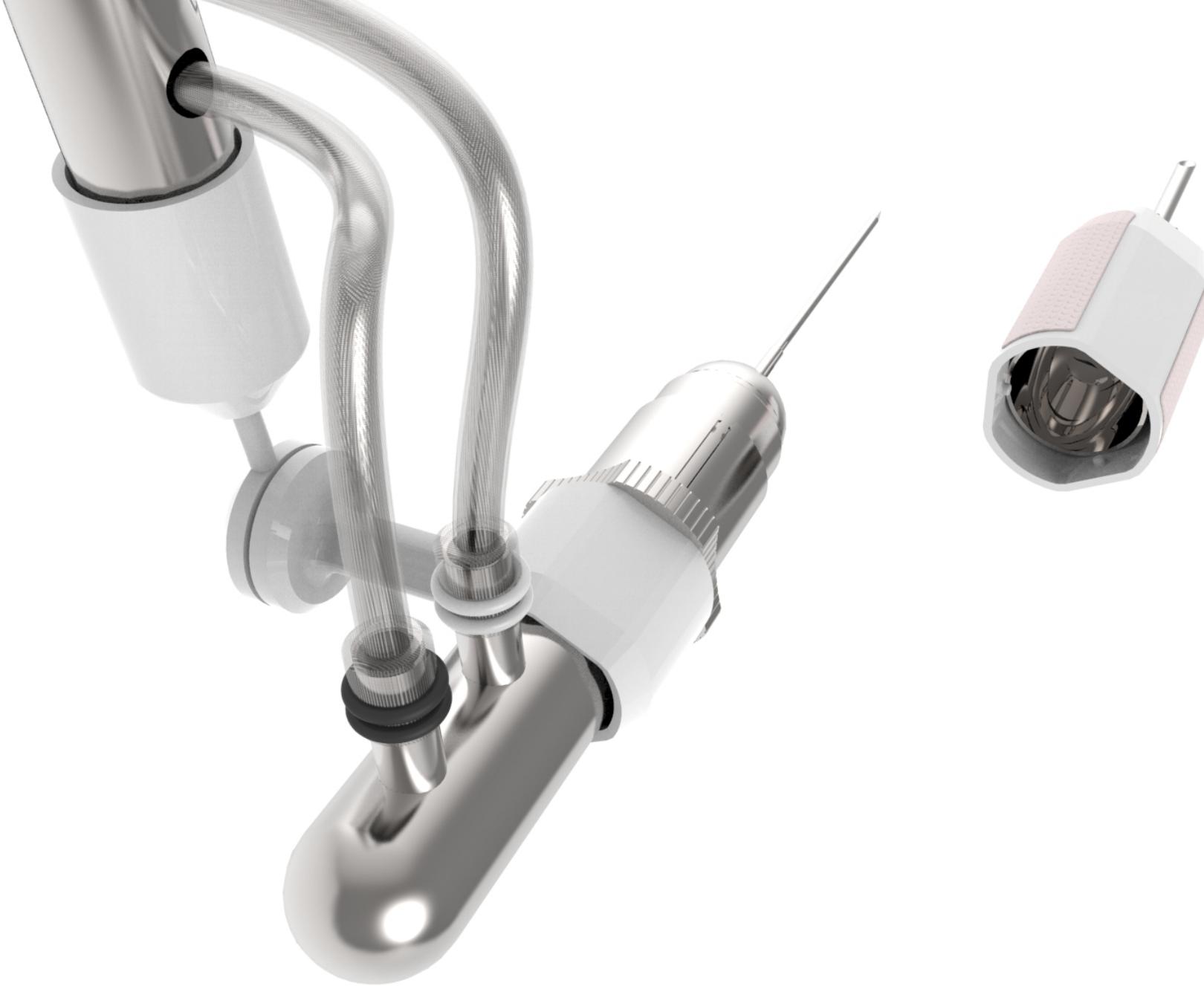












CRYO⁺FFACE.

FUTURE SCOPE

System design and detailing

Testing and trials

Number	Title	Author	Year of publication	Page no
1	Taber's Cyclopedic Medical Dictionary		Edition 21st	395
2	Gray's Anatomy	Elsevier, Churchill and Livingstone	Edition 39th	6
3	Breast Cancer facts and Figures 2015-2016	https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2015-2016.pdf	2016	1
4	Cancer Research UK	http://www.cancerresearchuk.org/about-cancer/what-is-cancer	11.02.2017 11.34PM	
5	Breast Anatomy	http://www.webmd.com/women/picture-of-the-breasts#1	12.02.2017 4.11PM	
6	Minimally Invasive Treatment of malignant Hepatic Tumors: Gerald D. Dodd III, Michael C. Soulen, MD, Robert A. Kane, MD, Tito Livraghi, MD, William R. Lees, MB BS, FRCR, Yasuyuki Yamashita, MD, Alison R. Gillams, MBChB, MRCP, FRCR, Okkes I. Karahan, MD, Hyunchul Rhim, MD, PhD		2000	
7	Minimally invasive surgery:Laparoscopy	https://www.glenaeagles.com.sg/specialties/advanced-procedures/minimally-invasive-cardiac-surgery	17.02.2017 9.37AM	
8	Minimally invasive surgery:Laparoscopy	http://wecareindia.com/spinal-fusion-surgery/	17.02.2017 9.40AM	
9	Magnetic Resonance Imaging	https://www.scienceabc.com/humans/why-must-you-remove-all-metal-objects-before-an-mri-scan.html	17.02.2017 9.45AM	
10	Ultrasound biopsy	http://blog.universalmedicalinc.com/why-ultrasound-guided-procedures-are-common-in-medical-settings/	17.02.2017 9.48AM	
11	Cryosurgery for breast cancer	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115688/	17.02.2017 1.35PM	
12	Basics of Cryosurgery	Nikolai N. Korpan (ed.)		
13	Cryoablation	http://www.mdmag.com/medical-news/cryoablation-successful-for-atrial-fibrillation	18.02.2017 11.13AM	
14	National Cancer Institute	https://www.cancer.gov/about-cancer/treatment/clinical-trials/search	18.02.2017 11.53AM	
15	Next Generation Design Development and Evaluation of Cryoprobes for Minimally Invasive Surgery and Solid Cancer Therapeutics In Silico and Computational Studies	Abdul Mateen A. G. Shaikh, Atul Shrivastava and Milind Atrey	2015	
16	MSDS for Liquid Nitrogen	http://www.afrox.co.za/internet.global.corp.zaf/en/images/Liquid%20Nitrogen266_92254.pdf?v=.	25/03/2017 4.04 PM	
17	FDA website for device classification	https://www.fda.gov/default.htm	25/03/2017 4.06 PM	
18	CDSCO website for device classification	http://www.cdsco.nic.in/forms/Default.aspx	25/03/2017 4.08 PM	
19	Cryosurgery for renal fibroid	https://www.youtube.com/watch?v=YpDkQ30FHV4&oref=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DYpDkQ30FHV4&has_verified=1	30/01/2017 5.59 PM	
20	Lumpectomy	https://www.cedars-sinai.edu/Patients/Health-Conditions/Images/Breast/Lumpectomy-Surgery-Horizontal.jpg	01/04/2017 5.25 PM	
21	Practical demonstrations of Ergonomic Principles	Department of Health and Human services, Centers for Disease control and Prevention and National Institute of Occupational Safety and Health	July 2011	
22	Guidelines for Disinfection and Sterilization in healthcare facilities	Centers for Disease control and Prevention	2008	

Name	Link	Relevance	Date	Time
Cryopen Video	https://www.youtube.com/watch?v=TDZpkoM5Aas	Product	13/01/2017	4.10 PM
Cryosurgery	https://www.youtube.com/watch?v=TDZpkoM5Aas	Technique	13/01/2017	4.11 PM
Cryosurgery	https://www.youtube.com/watch?v=Riwzl1SNaRc&t=93s	Technique	13/01/2017	4.14 PM
Cryosurgery	https://www.youtube.com/watch?v=KDsKKiMtAKE	Technique	13/01/2017	4.18 PM
Cryosurgery	https://www.youtube.com/watch?v=Bh4qPwPf-ug	Technique	13/01/2017	4.27 PM
Cryoprobe	https://www.youtube.com/watch?v=qY5tQmKzzD4	Product	13/01/2017	4.31 PM
Lumpectomy	https://www.youtube.com/watch?v=fNKcXBdJXpo	Parallel technique	30/01/2017	5.28 PM
Cryo for Cervix	https://www.youtube.com/watch?v=yJgRiHUwNl8&oref=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DyJgRiHUwNl8&has_verified=1	Technique	30/01/2017	5.32 PM
Radio frequency ablation	https://www.youtube.com/watch?v=95G0E7t-cnc	Technique	30/01/2017	5.36 PM
Radio frequency ablation	https://www.youtube.com/watch?v=PMpIb-7Fjo0	Technique	30/01/2017	5.39 PM
Radio frequency ablation	https://www.youtube.com/watch?v=eDEKSVGdRcE	Technique	30/01/2017	5.44 PM
Cryosurgery	https://www.youtube.com/watch?v=_sTAp6hqXeE	Technique	30/01/2017	5.48 PM
Cryosurgery for renal fibroid	https://www.youtube.com/watch?v=YpDkQ30FHV4&oref=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DYpDkQ30FHV4&has_verified=1	Technique	30/01/2017	5.59 PM
Cryosurgery for renal fibroid	https://www.youtube.com/watch?v=YrHePivoAkg	Technique	30/01/2017	6.02 PM
Ultrasound	https://www.youtube.com/watch?v=s23_d-qeEn4	Principle	09/02/2017	12.06 AM
Ultrasound	https://www.youtube.com/watch?v=JqVGgq5bE-Y	Principle	09/02/2017	12.14 AM
For Atrey sir, comparision about liq N2 and argon	https://www.ncbi.nlm.nih.gov/pubmed/9425653 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1472868/			
Cryosurgery	https://www.google.co.in/search?q=cryoablation&source=lnms&tbm=isch https://www.google.co.in/search?q=cryoablation&source=lnms&tbm=isch&h&sa=X&ved=0ahUKEwjR9KnK95jSAhXGvI8KHZ30BagQ_AUICSGC&biw=1536&bih=710#imgrc=6VhrgvqKDtv3hM:		18/02/2017	12.27 PM
Biocompatible materials	http://www.uni-sz.bg/tsj/vol8,Suppl.2,2010/D.Mihov.pdf	Materials	30/03/2017	4.11 PM