Noninvasive Canine Stereotactic Frame

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BME 200/300

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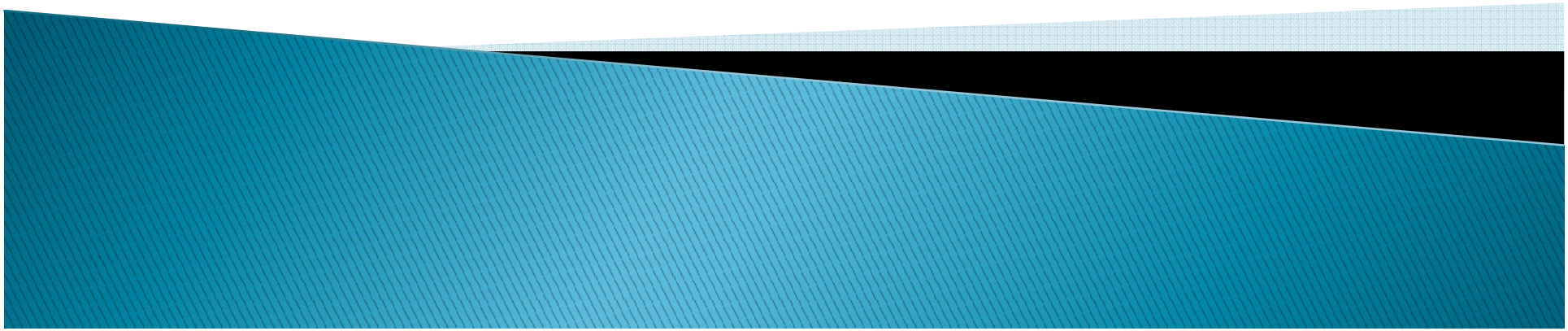
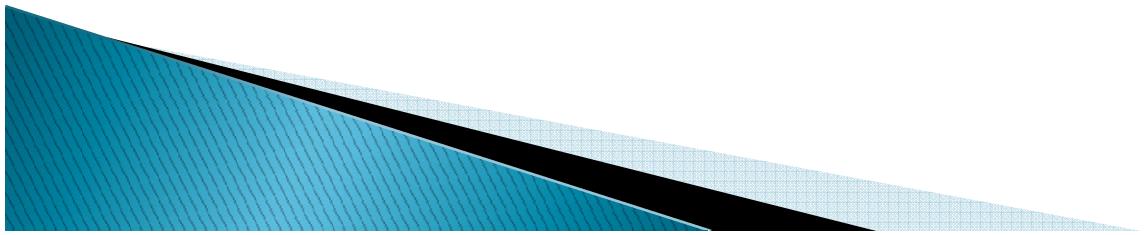


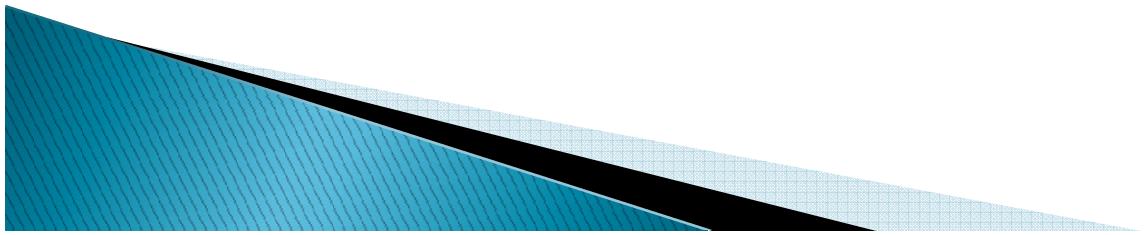
- Client: Michael Deveau
  Dept. of Surgical Sciences
  School of Veterinary Medicine

- Advisor: John Webster
  Dept. of Biomedical Engineering



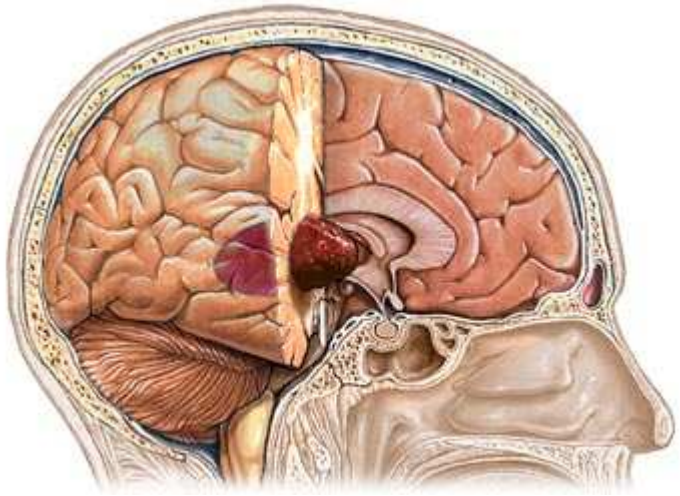
Overview

- Radiation/IMRT Therapy
- Noninvasive Stereotactic Frame
- Client requirements
- Possible prototype designs
- Future work
- Acknowledgments & References



Radiation Therapy

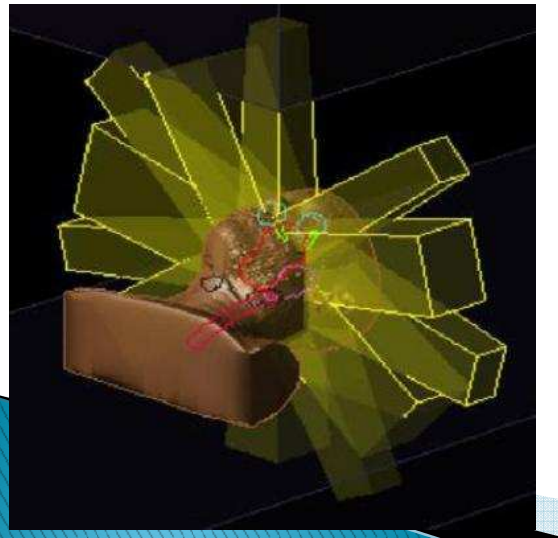
- Treatment for cancerous tumors
- Ionizing radiation kills cancerous cells
- Has been successful
- Intensity of radiation is limited
- Too much radiation to healthy tissue



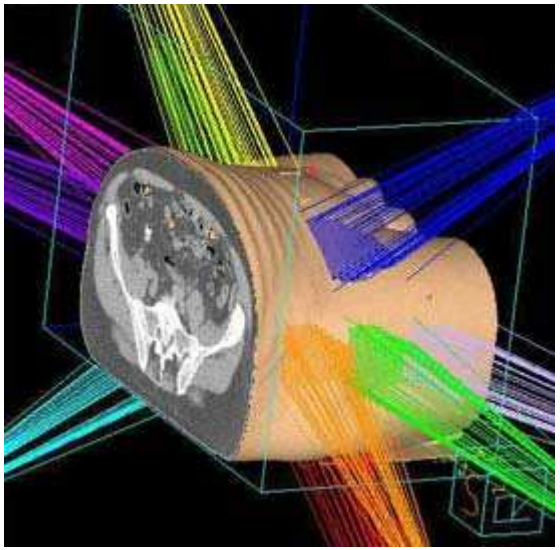
http://www.nlm.nih.gov/medlineplus/ency/imagepages/19851.htm

IMRT

- Intensity-Modulated Radiation Therapy
- High dose to tumor
- Low dose to healthy organs
- Uses a medical linear accelerator
- Changes beam path to hit target



http://www.nd.edu/~hliu/schoolpage/medical.ht

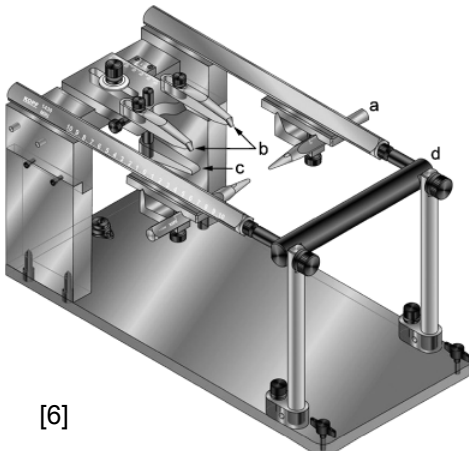


http://www.mayoclinic.org/imrt/howitworks.html

Determining Treatment

- Computed Tomography (CT) scan
- Computer program designs treatment.
- Tomotherapy machine gives radiation.
- Canine must be
  in same position.

Current Positioning Systems

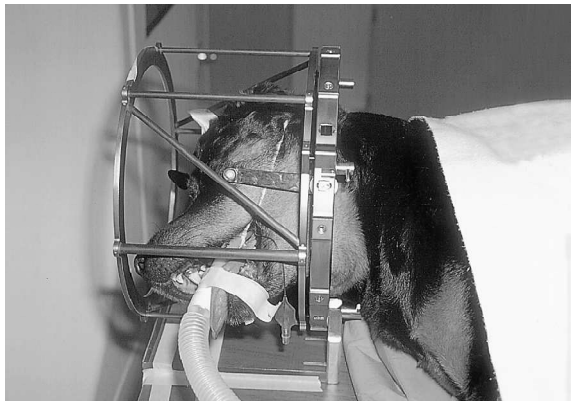


[6]

- Pro: Probes in dog's ears position accurately
- Con: Invasive

Pro: Rigid

Cons: Invasive, nonadjustable, incompatible with smaller dogs



[3]

Design Proposal

- Design a noninvasive stereotactic frame for canines during radiation therapy
  - Accurate to 0.5°
  - Adjustable for different size dogs
  - Reusable

http://www.wisebuy.co.uk/images/content/dogs%20copy%20copy.JPG

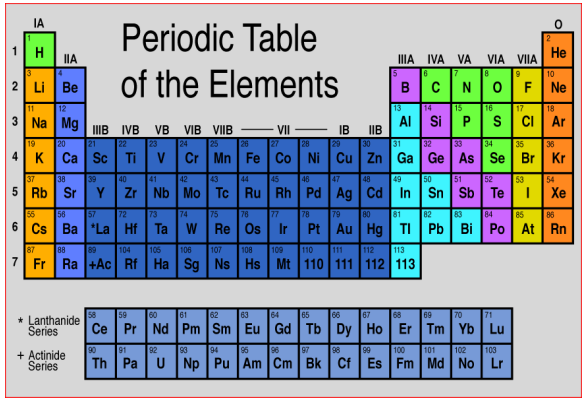
Client Specifications

- Noninvasive frame
- Mouth stabilized using bite block
- Adjustable 10° in pitch an yaw
- Frame should allow different sized endotracheal tubes down mouth

http://farm3.static.flickr.com/2044/1526994732_a2869b420b.jpg

Material Constraint

- Frame
  - Low atomic number
  - Light weight
  - Not porous
  - Reusable (up to 10 times a day)
- Tomotherapy machine diameter is 0.84 m
- CT diameter is 0.51 m
- Cost efficient



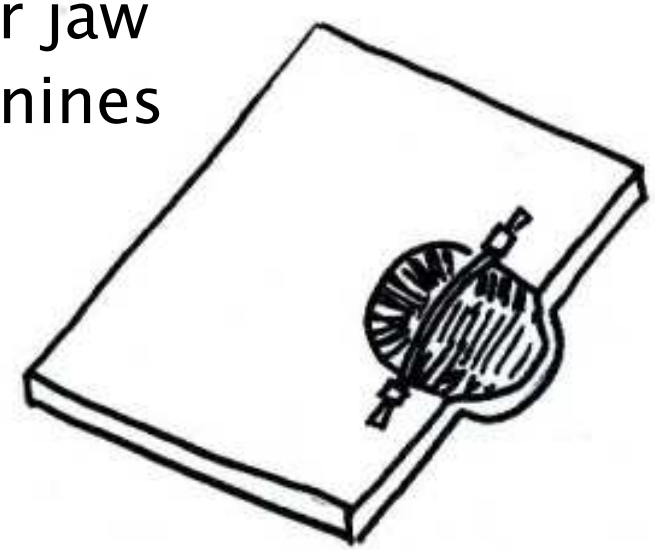
http://facstaff.gpc.edu/~pgore/PhysicalScience/periodic-table.gif

Dental Mold

- Disposable
- Made out of putty that hardens in about 3 minutes
- Canine teeth lock it in place
- Holds shape for up to 2 weeks

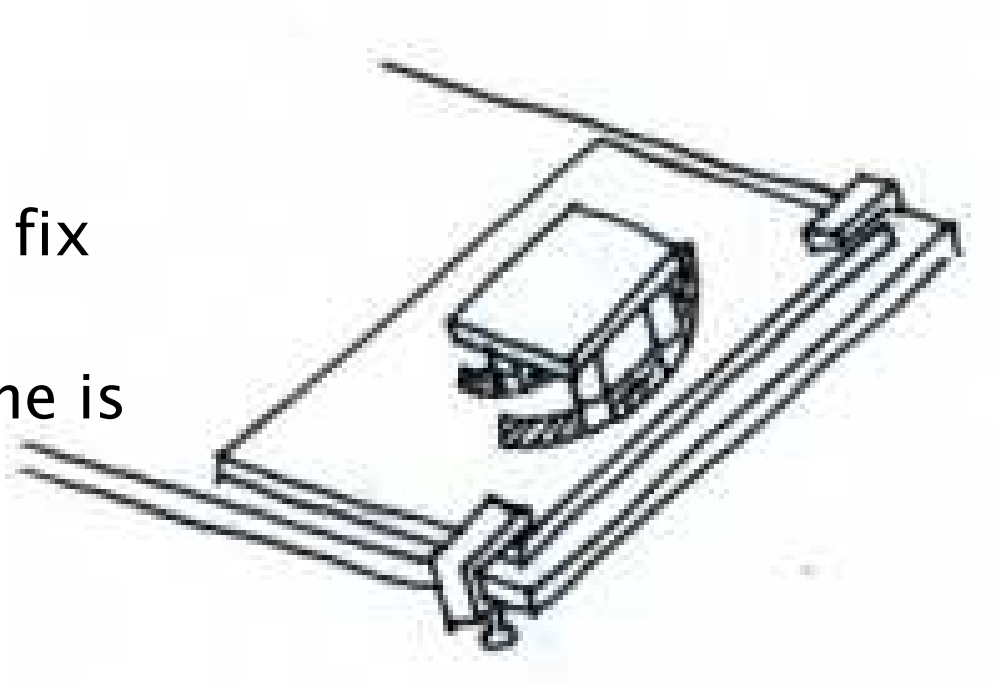
Design Option 1

- Upper jaw placed in valley with bite block underneath
- Straps secure upper jaw to sheet
- Pros
  - Lower jaw doesn't hinder radiation
  - Easy to maneuver around lower jaw
  - Compatible with all sizes of canines
- Cons
  - Upper jaw in fixed position
  - Difficult to adjust



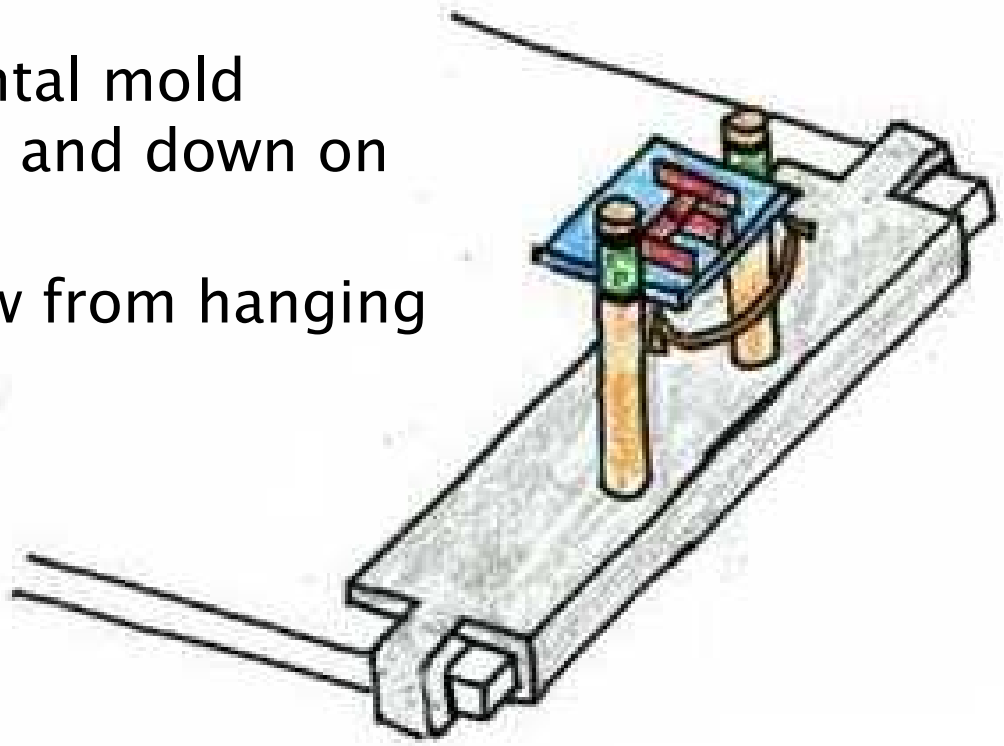
Design Option 2

- Pros
  - Movable in yaw and pitch
  - Will fit to any size canine
- Cons
  - Easy to adjust but hard to fix
  - Not fixed tightly to table
  - Accuracy decreases if frame is removed from table



Design Option 3

- Pros
  - Adjustable in pitch and yaw
  - Bite block adjusts to fit different sized dental molds
  - Whole bite block/dental mold mechanism slides up and down on numbered axis
  - Strap keeps lower jaw from hanging freely
- Cons
  - Difficult to construct



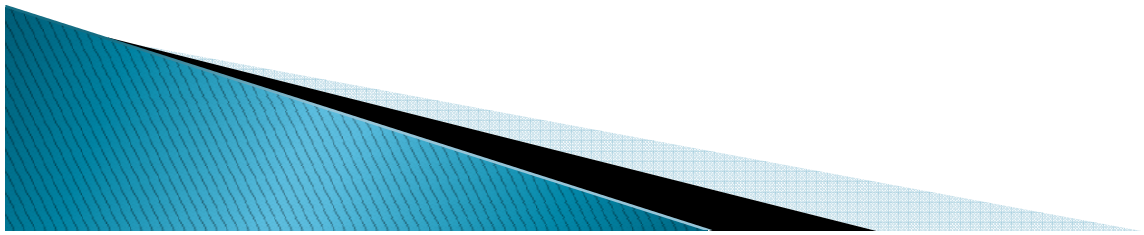
Design Matrix

Design Criteria	Option 1	Option 2	Option 3
Prototype Cost	9	7	4
Mass Production Cost	9	7	6
Ability to move in yaw	1	9	9
Ability to move in pitch	1	3	9
Feasibility of development	7	2	3
User Friendliness	3	5	8
Rigidity	2	3	9
Total	32	36	48

Scale: 1 – 10 (1 poor, 10 excellent)

Future Works

- Order parts
- Assemble prototype
- Test fit of device in hospital environment
- Test accuracy with real dog
- Finalize prototype



Acknowledgements

- Michael Deveau
- Department of Surgical Sciences
- School of Veterinary Medicine
- Dentistry and Oral Surgery Department

References

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Got any dog-gone good questions?