

# RADIOMIC: PREDICTION OF ACOUSTIC NEUROMA RESPONSE TO THE CYBERKNIFE TREATMENT

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## Frontiers of Radiosurgery

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# ACOUSTIC NEUROMA

Primitive, benign tumor of the Schwann cells of the eighth cranial nerve

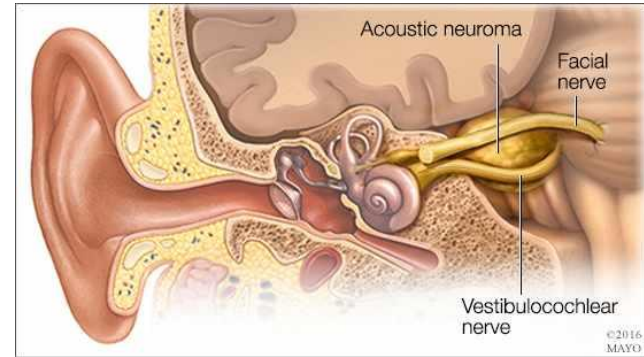
Rare and slow growing (1-2mm / year)

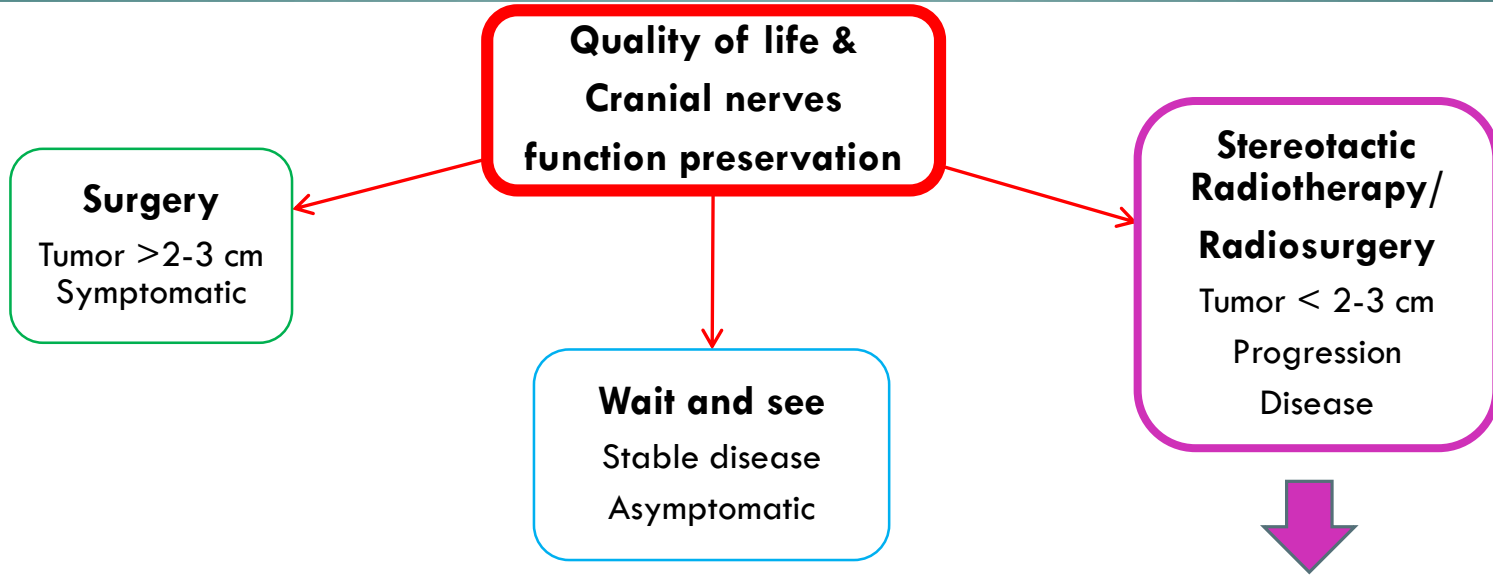
Overall incidence 1/100000 in the United States

Symptoms (depending on the tumor size)

Early and common : unilateral hearing loss, tinnitus, and unsteadiness

Late: Trigeminal or Facial nerve dysfunction, brainstem compression





Excellent long-term local control (92 - 100%), high rate of preservation of trigeminal (92 - 100%) and facial (94 - 100%) functions.

MRI follow-up with contrast enhancement

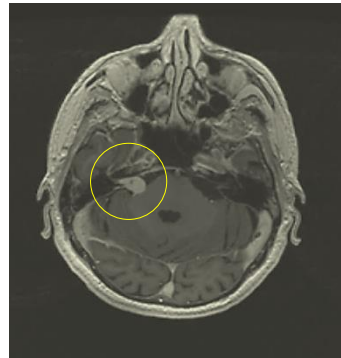


**THE AIM OF THE STUDY IS TO USE A RADIOMIC APPROACH TO EVALUATE THE POSSIBILITY OF PREDICTING THE RESPONSE OF AN ACOUSTIC NEUROMA TO CYBERKNIFE® RADIOTHERAPY ANALYZING PRE TREATMENT MRI IMAGES**

Responder



Non responder



# STUDY POPULATION

## Inclusion

Monolateral

Follow-up of at least 10 months

Follow-up MRI with c. enhancement

## Exclusion

Previous Treatments

Neuroma on other cranial nerves

Neurofibromatosis



- Axial T1w 3D MRI with contrast enhancement acquired before Cyberknife
- Slice thickness 1 mm
- 2 Different Scanner (Philips Achieva 1.5T, GE Signa 1.5T)



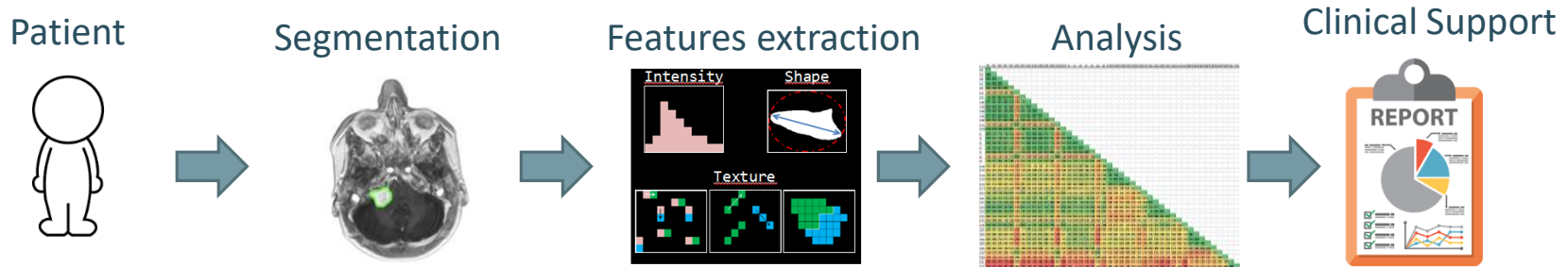
# STUDY POPULATION

- 38 Patients (2004 – 2016)  
25 volumetric reduction, 10 stable disease,  
3 volumetric increase at last follow-up.
- Mean follow-up: 52 months (range: 10-105)
- Mean age: 61 years (30-87 years)
- Mean Dose: 18 Gy / 3 fractions
- Mean volume 2.7 cm<sup>3</sup> (0.25 – 11.8)

Study population				
Characteristic	Total population	reduction	stable	increase
Total Number of Patients	38	25	10	3
Gender				
M	18	11	5	2
F	20	14	5	1
Age (at treatment)				
<50	10	5	4	1
50-70	14	10	3	1
70-90	14	10	3	1
Mean Age	61.2	63	58.3	56.3
Length of Follow-up (months)				
<36	13	6	4	3
36-60	10	7	3	0
>60	15	12	3	0
mean follow up length(months)	52.7	57.6	49.8	21



**"Radiomics" refers to the extraction and analysis of large amounts of quantitative imaging biomarkers (QIB aka features) from standard medical images, such as CT, PET or MRI, to identify a signature (a group of QIBs) with diagnostic, prognostic or predictive value.**



**Radiomics workflow**



# SEGMENTATION AND FEATURES EXTRACTION

## Volumetric Segmentation

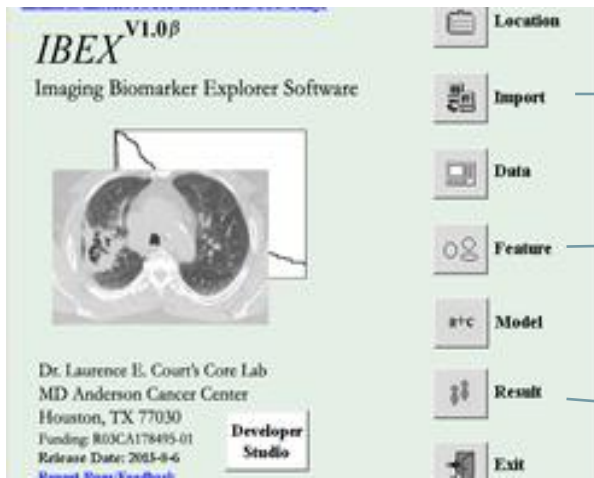
3D SLICER ([https://www.slicer.org/wiki/Modules:Editor-Documentation#Level\\_Tracing](https://www.slicer.org/wiki/Modules:Editor-Documentation#Level_Tracing))

Method: semi-automatic segmentation

## Resampling of isotropic voxel images to harmonize the 2 scanners

IBEX<sup>1</sup>: An Open Software Infrastructure Platform

<sup>1</sup> Med Phys. 2015 Mar; 42(3): 1341–1353



Importing Images

Features Selection

Features Computation

GradientOrientHistogram

GrayLevelCooccurrenceMatrix3

IntensityDirect

IntensityHistogram

IntensityHistogramGaussFit

NeighborIntensityDifference3

Shape

1135 Features

Shape based

Intensity based

Texture based



# FEATURES SELECTION AND ANALISYS

1135 Features  
 Shape based  
 Intensity based  
 Texture based

TWIST-KNN

37 features

TWIST<sup>1</sup> system based on KNN algorithm

<sup>1</sup>Semeion  
 Research Centre

- distributes the original sample into training and test set
- selects the most significant features (37)

The 2-layers feed forward back propagation algorithm was used twice inverting the training/testing set.

The final results were a mean sensitivity of 77.38 %, a mean specificity of 94.12 % and a mean global accuracy of 85.75% in distinguishing patients with Volume Reduction from the others.

	Recs	Volumetric Reduction	Stability/ Volumetric increase	SE	SP	Global accuracy	AUC
FF_Bp 4 abAUTO(1)	15	8	7	71.43	100	85.71	0.929
FF_Bp 4 baAUTO(4)	23	17	6	83.33	88.24	85.78	0.877
Mean				77.38	94.12	85.75	0.88



# CONCLUSIONS

**GOOD POTENTIAL OF MACHINE LEARNING COUPLED WITH RADIOMICS IN DISTINGUISH, BEFORE RADIOSURGERY, PATIENTS WITH VOLUME REDUCTION FROM PATIENTS WITHOUT.**

## LIMITS:

Uneven and short follow-up

Possible overfitting

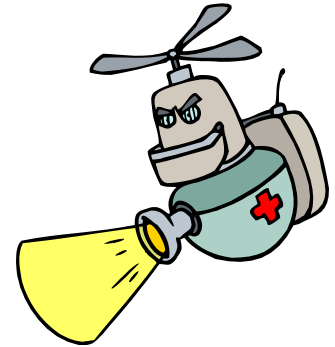
Only one classifier was used

## FUTURE DEVELOPMENTS:

In order to expand our dataset we have started collaboration with other Hospital

Possibility to consider other boundary variables and the role of Dosiomic

Possibility to predict the role of Pseudoprogression



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## THANK YOU FOR YOUR INTEREST!

For questions or comments please contact:

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