RADIOMIC: PREDICTION OF ACOUSTIC NEUROMA RESPONSE TO THE CYBERKNIFE TREATMENT

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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 disfunction, brainstem compression
**MANAGEMENT**

**Quality of life & Cranial nerves function preservation**

**Surgery**
- Tumor >2-3 cm
- Symptomatic

**Wait and see**
- Stable disease
- Asymptomatic

**Stereotactic Radiotherapy/Radiosurgery**
- Tumor < 2-3 cm
- Progression Disease

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

- 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)

**Inclusion**
- Monolateral
- Follow-up of at least 10 months
- Follow-up MRI with contrast enhancement

**Exclusion**
- Previous Treatments
- Neuroma on other cranial nerves
- Neurofibromatosis
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 cm³ (0.25 – 11.8)

<table>
<thead>
<tr>
<th>Study population</th>
<th>Total population</th>
<th>reduction</th>
<th>stable</th>
<th>increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Patients</td>
<td>38</td>
<td>25</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Gender</td>
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<tr>
<td>M</td>
<td>18</td>
<td>11</td>
<td>5</td>
<td>2</td>
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<tr>
<td>F</td>
<td>20</td>
<td>14</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Age (at treatment)</td>
<td></td>
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<tr>
<td>&lt;50</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>1</td>
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<tr>
<td>50-70</td>
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<td>70-90</td>
<td>14</td>
<td>10</td>
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<tr>
<td>Mean Age</td>
<td>61.2</td>
<td>63</td>
<td>58.3</td>
<td>56.3</td>
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<tr>
<td>Length of Follow-up (months)</td>
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<td>&lt;36</td>
<td>13</td>
<td>6</td>
<td>4</td>
<td>3</td>
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<tr>
<td>&gt;60</td>
<td>15</td>
<td>12</td>
<td>3</td>
<td>0</td>
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<tr>
<td>mean follow up length(months)</td>
<td>52.7</td>
<td>57.6</td>
<td>49.8</td>
<td>21</td>
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</table>
"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.
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**: An Open Software Infrastructure Platform

1 Med Phys. 2015 Mar; 42(3): 1341–1353

**Features Computation**

- GradientOrientHistogram
- GrayLevelCooccurrenceMatrix
- IntensityDirect
- IntensityHistogram
- IntensityHistogramGaussFit
- NeighborIntensityDifference
- Shape

**Features Selection**

**Importing Images**

1135 Features
- Shape based
- Intensity based
- Texture based
TWIST\textsuperscript{1} system based on KNN algorithm

- 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.

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<th>FF_Bp 4 baAUTO(4)</th>
<th>Mean</th>
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<tr>
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\textsuperscript{1}Semeion Research Centre
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 classificator 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 Pseudoprogession
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THANK YOU FOR YOUR INTEREST!

For questions or comments please contact:

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