Evaluation of prostate edema and seed migration via seed position change from consequent post-implant CT scan in prostate brachytherapy

We developed a method utilizing seed coordinates in subsequent CTs that can be used to evaluate prostate edema change and seed migration. On each CT slice, the seeds constructed a convex polygon (Fig. 1) that could be assumed as the boundary of the edema in that slice. The area of the polygon is given:

\[
A_i = \frac{1}{2} \sum_{1}^{n-1} (x_i y_{i+1} - x_{i+1} y_i)
\]

Where \(x_i\) and \(y_i\) are the coordinates of \(i\)th seed on the apex of the polygon.

Distances from prostate center to each seed for the consequent CTs (Fig. 2) show a drift toward to the center. The weighted distance (Fig. 3) is a ratio of number of seeds in a certain distance to the prostate center. From Fig. 3, the center of the peak from day-30 is about 2 mm less than that from day-0. This could be an index for edema shrinkage and seed migration.

Comparison of the \(V_i\)s (Fig. 4) show a large shrinkage of the edema at day-30. The average \(V_i\) (table 1) are 1.34 and 0.80 cm\(^3\) and the total volume are 18.77 and 11.66 cm\(^3\) for day-0 and day-30, respectively. The edema shrank by a factor of 1.7 in this case.

![Area defined by the out-most seeds constructed a convex polygon on each slice.](image)

Table 1. average \(V_i\) and average total edema volume.

<table>
<thead>
<tr>
<th>Vol(cm(^3))</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg (V_i)</td>
<td>1.34</td>
<td>0.80</td>
</tr>
<tr>
<td>Total</td>
<td>18.77</td>
<td>11.16</td>
</tr>
</tbody>
</table>

1. [http://www.mathwords.com/a/area_convex_polygon.htm](http://www.mathwords.com/a/area_convex_polygon.htm)
Fig. 2 Distances from prostate center to each seed

Fig. 3 Weighted distance each seed to the prostate center

Fig. 4 Volumes between adjacent slices