ATLAS-BASED SEGMENTATION IN PROSTATE IMRT: TIME-SAVINGS IN THE CLINICAL WORKFLOW

A. Lin[1], G. Kubicek[1], J.W. Piper[2,3], A.S. Nelson[2], A.P. Dicker[1], R.K. Valicenti[1]

[1]Department of Radiation Oncology, Thomas Jefferson University, Philadelphia, PA

[2]MIMvista Corp., Cleveland, OH • [3]Department of Computer Science, Wake Forest University, Winston-Salem, NC

Purpose

Manual contouring for prostate IMRT can be tedious and time consuming. The purpose of this study is to demonstrate the time-savings experienced by integrating atlas-based segmentation for initial contour generation in our normal clinical workflow.

Methods

A commercially available package was used for atlas creation and automatic contour generation (MIMvista Corp, Cleveland, OH). An atlas was created from 98 previously contoured IMRT patients treated at our institution. Bladder and urethral contrast was used in 38 patients. Ten of the most recent patients were randomly selected for analysis, five with contrast and five without. Prior to contour generation, the patient to be contoured was removed from the atlas. The atlas was stratified by bladder size (<100mL, 100-200mL, 200-400mL, and >400mL), and only the subjects matching the patient's estimated bladder size and contrast usage were considered. The most similar atlas subject was automatically selected and contours were automatically deformed onto the patient's CT scan. The time to manually contour the patient by a resident (GK) and subsequently edit by an attending physician (AL) was recorded per contour for the prostate (CTV), bladder, rectum, and both femurs. (Figure 1 and 2) Contouring time was similarly recorded with the atlas contours used as a starting point. Contouring times were then compared and analyzed between the atlas and non-atlas contours.

Results

The time required to contour and edit a patient was reduced by 45.8% from 25.4 to 13.8 minutes on average. Contour generation time by the resident physician was reduced by 47.4%, while editing time by the attending physician was reduced by 36.0%. The average timesavings for each contour was 54.1% for the femurs, 46.2% for the prostate, 45.0% for the bladder, and 34.9% for the rectum (Figure 3 and 4). The reduction in time was statistically significant ($p < 0.0005$) for all structures. The use of contrast resulted in slightly greater timesavings for the bladder despite having fewer atlas subjects with contrast. Timesavings for rectal contouring were greater for patients without contrast.

Figure 1
Coronal View of Structures

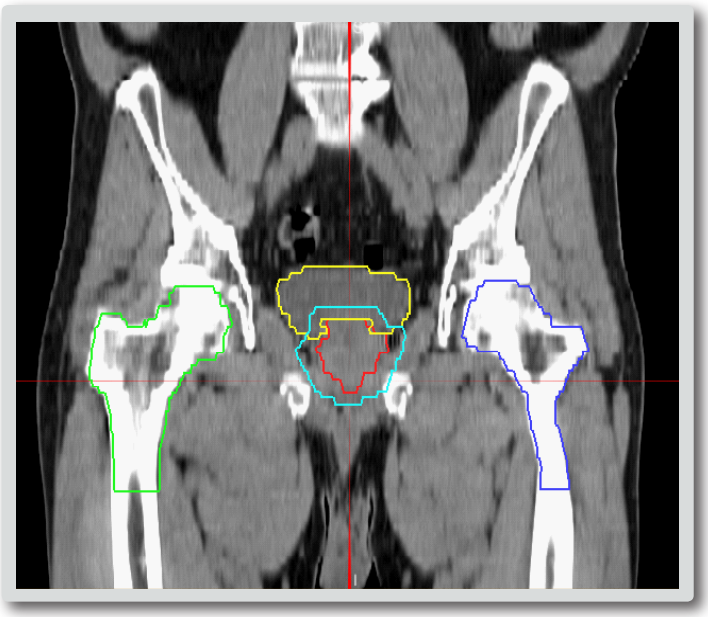
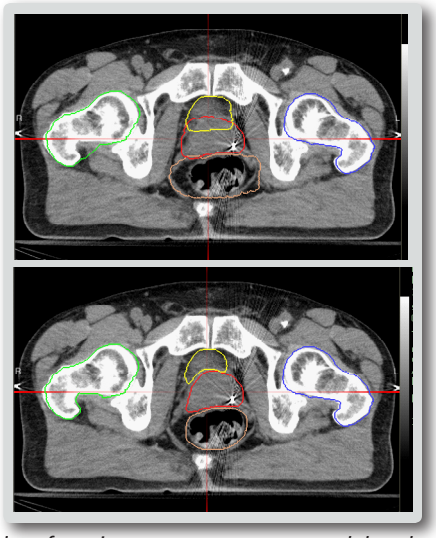


Figure 2
Example of Atlas Patient



Example of patient contours generated by the atlas before (top) and after (bottom) corrections.

Figure 3
Contouring Times

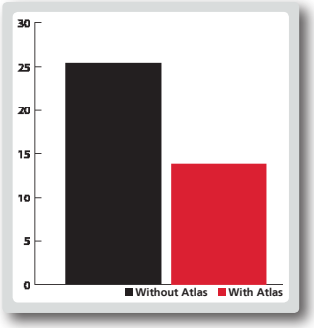
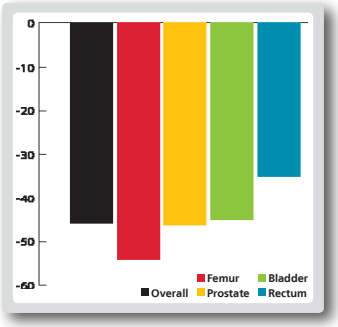


Figure 4
Time Reduction with Atlas by Structure



Discussion/Conclusion

Atlas-based segmentation significantly reduces contouring time required for prostate IMRT. We expect greater time-savings for future segmentations as more subjects are added to the atlas. Such contour-generation methods may be especially important in an era of ever-increasing treatment complexity and adaptive re-planning. In high-volume centers use of the atlas is likely to result in significant monetary savings (Table 1).

Table 1
Time Savings

Number of Patients	Time Savings with Atlas (hours)
10	1.9
25	4.8
50	9.7
100	19.3
500	96.6

For more information please contact:
Alexander Lin- alexander.lin@jeffersonhospital.org
Greg Kubicek- greg.kubicek@jeffersonhospital.org

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