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Evaluation of anatomic and dosimetric parameters to determine the optimal time for adaptive VMAT radiation therapy for oropharyngeal cancer

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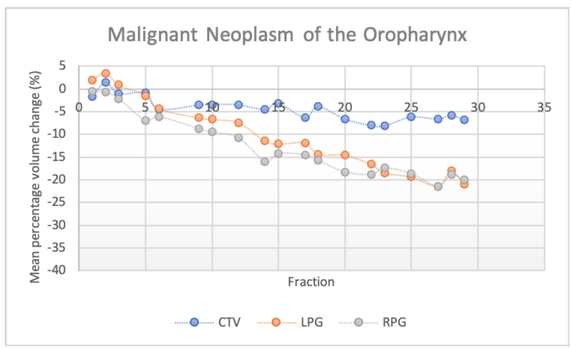
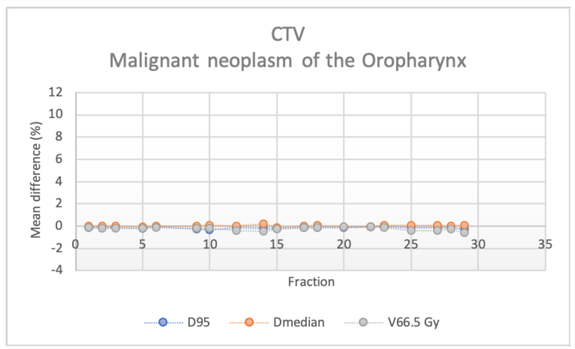
Background: Anatomic and dosimetric variations are prevalent in Head and Neck Cancer (HNC) patients undergoing radiation therapy. This study aimed to monitor the optimal time frame for Adaptive Radiation Therapy (ART) in HNC patients using Image-Guided Radiation Therapy and Deformable Image Registration (DIR).

Materials & Methods: Anatomic and dosimetric variations in the clinical target volume (CTV) and parotid glands (PGs) of 11 patients with oropharyngeal cancer were analyzed retrospectively. DIR was utilized for automated contour delineation. The Dice similarity coefficient (DSC) was employed to assess geometric variations. Anatomic variations were investigated by comparing volume changes between the original and deformed structures. Dosimetric variations were evaluated by re-calculating dose-volume histogram (DVH) metrics for the deformed structures and comparing them to baseline metrics.

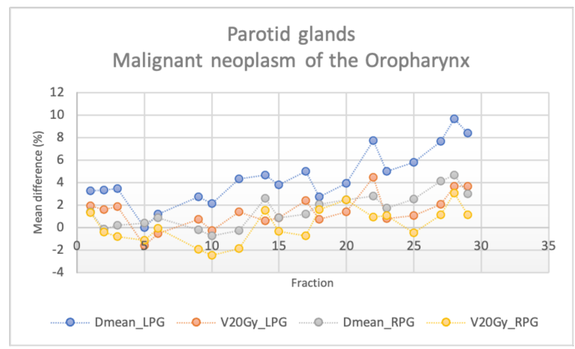
Results: The mean DSC values for the CTV indicated clinically acceptable results, whereas for the PGs exhibited a decreasing trend. The CTV showed robustness to anatomic and dosimetric variations. The PGs underwent a greater volume change compared to the CTV. These volume changes in the PGs led to significant dosimetric changes. A replan was proposed at the end of the 1st week or at the beginning of the 2nd week of treatment in order to spare the PGs.



(a)



(b)



(c)

Fig. 1: (a) Mean percentage volume change (%) for the CTV and parotid glands over the course of treatment. (b) Mean percentage difference of D95%, Dmedian and V66.5Gy for the CTV . (c) Mean percentage difference of Dmean and V20Gy for parotid glands.

Conclusion: Regular monitoring of the PGs could indicate the need for re-planning, mitigating the risk of toxicities. Identifying the optimal time frame for re-planning in specific HNC categories could streamline the ART workflow, offering significant clinical benefits compared to the current resource-intensive and time-consuming approach.

References

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