Cancer Therapy & Oncology
International Journal
ISSN: 2473-554X

Juniper Publishers
key to the Researchers

Research Article
Volume 26 Issue 5 - May 2024
DOI: 10.19080/CTOIJ.2024.25.556198

Cancer Ther Oncol Int J

Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases

Omer Sager*, Ferrat Dincoglan, Selcuk Demiral and Murat Beyzadeoglu

Department of Radiation Oncology; University of Health Sciences, Gulhane Medical Faculty, Ankara, Turkey

Submission: April 07, 2024; **Published:** May 10, 2024

Corresponding author: Omer Sager, Department of Radiation Oncology; University of Health Sciences, Gulhane Medical Faculty, Ankara, Turkey, Email: omersager@gmail.com

Abstract

Objective: Adrenal gland constitutes a common site of metastasis from several cancers, and management of oligometastatic disease with sophisticated irradiation strategies such as Stereotactic Body Radiation Therapy (SBRT) has gained utmost attraction in recently. SBRT may serve as an excellent tool for management of oligometastatic adrenal disease. High doses of irradiation may be excellently focused on well-defined targets by use of SBRT under stereotactic localization, immobilization and image guidance. The dose is focused on the target and surrounding critical structures may be spared with SBRT owing to steep dose gradients around the target volume. In this study, we evaluated treatment volume determination for SBRT of adrenal metastases with comparative analysis of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI).

Materials and methods: For this study, the ultimate endpoint was treatment volume determination for SBRT of adrenal metastases by comparative analysis of CT and MRI.

Results: In this study, we found that CT and MRI defined treatment volume determination resulted in differences. Considering this, we made use of fused CT and MRI for ground truth treatment volume determination for SBRT of adrenal metastases.

Conclusion: Results of this study may have implications for increased adoption of multimodality imaging for treatment volume determination for SBRT of adrenal metastases, however, future studies may be required to shed light on this issue.

Keywords: Adrenal metastases; Stereotactic Body Radiation Therapy; Treatment volume determination; Immobilization; Stereotactic localization

Abbreviations: SBRT: Stereotactic Body Radiation Therapy; IGRT: Image Guided RT; ART: Adaptive RT; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; LINAC: Linear Accelerator; AAPM: American Association of Physicists in Medicine; ICRU: International Commission on Radiation Units and Measurements

Introduction

Adrenal gland constitutes a common site of metastasis from several cancers, and management of oligometastatic disease with sophisticated irradiation strategies such as Stereotactic Body Radiation Therapy (SBRT) has gained utmost attraction in recently [1-7]. As a matter of fact, recent years have witnessed unprecedented advances in technology. Automatic segmentation techniques, molecular imaging methods, Image Guided RT (IGRT), Intensity Modulated RT (IMRT), stereotactic RT, and adaptive RT (ART) have been introduced for improved radiotherapeutic management of patients [8-49]. SBRT may serve as an excellent tool for management of oligometastatic adrenal disease as addressed in several studies [1-7]. High doses of irradiation may be excellently focused on well-defined targets by use of SBRT under stereotactic localization, immobilization and image guidance. The dose is focused on the target and surrounding critical structures may be spared with SBRT owing to steep dose gradients around the target volume. In this study, we evaluated treatment volume determination for SBRT of adrenal metastases with comparative analysis of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI).

Materials and Methods

We have been treating a high patient population from several places from Turkey and abroad for decades at our Department of Radiation Oncology at University of Health Sciences. With administration of state-of-the-art radiotherapy techniques, several benign and malignant tumors are irradiated. For this study, the ultimate endpoint was treatment volume determination for SBRT of adrenal metastases by comparative analysis of CT and MRI. All included patients have been referred to Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for SBRT of adrenal metastases. We have performed a comparative analysis of treatment volume determination by CT simulation images for SBRT planning and with MRI. CT simulations of the patients have been performed at CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) available at our department. Also, MRI of patients have been acquired and used for comparative assessment.

A Linear Accelerator (LINAC) with the capability of sophisticated IGRT techniques was used for SBRT. After rigid patient immobilization, planning CT images have been acquired at CT-simulator for SBRT planning. Afterwards, acquired SBRT planning images were sent to the contouring workstation via the network. Treatment volumes and critical structures were outlined on these images and structure sets have been generated. Also, treatment volume determination was also performed on MRI for comparison purposes. All patients underwent SBRT at Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences.

Results

Our study has selectively focused on assessment of treatment volume determination for SBRT of adrenal metastases with comparative analysis of CT and MRI. Stereotactic irradiation procedures were carried out at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Before SBRT, all included patients were individually assessed by a multidisciplinary team of experts from surgical oncology, radiation oncology, and medical oncology.

We considered the reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU) for optimal SBRT planning. Radiation physicists took part in generation of SBRT treatment plans by considering relevant normal tissue dose constraints. Tissue heterogeneity, electron density, CT number and HU values in CT images have also been considered by radiation physicists for precise SBRT planning. Main goal of SBRT planning was to achieve optimal treatment volume coverage without violation of normal tissue dose constraints. IGRT techniques including kilovoltage cone beam CT has been utilized, and SBRT was delivered by Synergy (Elekta, UK) LINAC. We found that CT and MRI defined target volume definition resulted in differences as an important result of this current study. Considering this, we made use of fused CT and MRI for ground truth treatment volume determination for SBRT of adrenal metastases.

Discussion

Adrenal gland constitutes a common site of metastasis from several cancers, and management of oligometastatic disease with sophisticated irradiation strategies such as SBRT has gained utmost attraction in recently [1-7]. As a matter of fact, recent years have witnessed unprecedented advances in technology. Automatic segmentation techniques, molecular imaging methods, IGRT, IMRT, stereotactic RT, ART have been introduced for improved radiotherapeutic management of patients [8-49]. SBRT may serve as an excellent tool for management of oligometastatic adrenal disease as addressed in several studies [1-7]. High doses of irradiation may be excellently focused on well-defined targets by use of SBRT under stereotactic localization, immobilization and image guidance. The dose is focused on the target and surrounding critical structures may be spared with SBRT owing to steep dose gradients around the target volume. In this study, we evaluated treatment volume determination for SBRT of adrenal metastases with comparative analysis of CT and MRI.

We have been treating a high patient population from several places from Turkey and abroad for decades at our Department of Radiation Oncology at University of Health Sciences. With administration of state of the art radiotherapy techniques, several benign and malignant tumors are irradiated. For this study, the ultimate endpoint was treatment volume determination for SBRT of adrenal metastases by comparative analysis of CT and MRI. All included patients have been referred to Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences for SBRT of adrenal metastases. We have performed a comparative analysis of treatment volume determination by CT simulation images for SBRT planning and with MRI. CT simulations of the patients have been performed at CT-simulator (GE Lightspeed RT, GE Healthcare, Chalfont St. Giles, UK) available at our department. Also, MRI of patients have been acquired and used for comparative assessment.

A Linear Accelerator (LINAC) with the capability of sophisticated IGRT techniques was used for SBRT. After rigid patient immobilization, planning CT images have been acquired at CT-simulator for SBRT planning. Afterwards, acquired SBRT planning images were sent to the contouring workstation via the network. Treatment volumes and critical structures were outlined on these images and structure sets have been generated. Also, treatment volume determination was also performed on MRI for comparison purposes. All patients underwent SBRT at Department of Radiation Oncology at Gulhane Medical Faculty, University of Health Sciences.

How to cite this article: Omer S, Ferrat D, Selcuk D, Murat B. Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases. Canc Therapy & Oncol Int J. 2024; 26(5): 556198. DOI: 10.19080/CTOIJ.2024.25.556198

Our study has selectively focused on assessment of treatment volume determination for SBRT of adrenal metastases with comparative analysis of CT and MRI. Stereotactic irradiation procedures were carried out at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Before SBRT, all included patients were individually assessed by a multidisciplinary team of experts from surgical oncology, radiation oncology, and medical oncology.

We considered the reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU) for optimal SBRT planning. Radiation physicists took part in generation of SBRT treatment plans by considering relevant normal tissue dose constraints. Tissue heterogeneity, electron density, CT number and HU values in CT images have also been considered by radiation physicists for precise SBRT planning. Main goal of SBRT planning was to achieve optimal treatment volume coverage without violation of normal tissue dose constraints. IGRT techniques including kilovoltage cone beam CT has been utilized, and SBRT was delivered by Synergy (Elekta, UK) LINAC. We found that CT and MRI defined target volume definition resulted in differences as an important result of this current study. Considering this, we made use of fused CT and MRI for ground truth treatment volume determination for SBRT of adrenal metastases.

From the perspective of radiation oncology, optimal treatment volume determination and normal tissue sparing may be considered among the pertinent aspects of improved stereotactic irradiation. While definition of larger target volumes may result in un-towards toxicity, definition of smaller than actual target volumes may lead to consequent treatment failures. Adaptive RT strategies and multimodality imaging-based target determination has been suggested for addressing this critical issue [50-106].

In this study, we found that CT and MRI defined treatment volume determination resulted in differences. Considering this, we made use of fused CT and MRI for ground truth treatment volume determination for SBRT of adrenal metastases. Results of this study may have implications for increased adoption of multimodality imaging for treatment volume determination for SBRT of adrenal metastases, however, future studies may be required to shed light on this issue.

References

1. van Overeem Felter M, Møller PK, Josipovic M, Bekke SN, Bernchou U, et al. (2024) MR-guided stereotactic radiotherapy of infra-diaphragmatic oligometastases: Evaluation of toxicity and dosimetric parameters. Radiother Oncol 192: 110090.
2. Yuste C, Passerat V, Calais G, Schipman B, Vaugier L, et al. (2023) Stereotactic body radiation therapy for adrenal gland metastases: A multi-institutional outcome analysis. Clin Transl Radiat Oncol 45: 100708.
3. Ehret F, Kaul D, Kufeld M, Endt CV, Budach V, et al. (2023) Robotic stereotactic body radiotherapy for the management of adrenal gland metastases: a bi-institutional analysis. J Cancer Res Clin Oncol 149(3): 1095-1101.
4. Franzese C, Stefanini S, Scorsetti M (2023) Radiation Therapy in the Management of Adrenal Metastases. Semin Radiat Oncol 33(2): 193-202.
5. Chen WC, Baal JD, Baal U, Pai J, Gottschalk A, et al. (2020) Stereotactic Body Radiation Therapy of Adrenal Metastases: A Pooled Meta-Analysis and Systematic Review of 39 Studies with 1006 Patients. Int J Radiat Oncol Biol Phys 107(1): 48-61.
6. Voglhuber T, Kessel KA, Oechsner M, Vogel MME, Gschwend JE, et al. (2020) Single-institutional outcome-analysis of low-dose stereotactic body radiation therapy (SBRT) of adrenal gland metastases. BMC Cancer 20(1): 536.
7. Scouarnec C, Pasquier D, Luu J, le Tinier F, Lebellec L, et al. (2019) Usefulness of Stereotactic Body Radiation Therapy for Treatment of Adrenal Gland Metastases. Front Oncol 9: 732.
8. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2023) Adaptive radiation therapy (art) for patients with limited-stage small cell lung cancer (LS-SCLC): A dosimetric evaluation. Indian J Cancer 60(1):140-147.
9. Gamsiz H, Sager O, Uysal B, Dincoglan F, Demiral S, et al. (2023) Outcomes of Sterotactic Body Radiotherapy (SBRT) for pelvic lymph node recurrences after adjuvant or primary radiotherapy for prostate cancer. J Cancer Res Ther 19(Suppl 2): S851-S856.
10. Gamsiz H, Sager O, Uysal B, Dincoglan F, Demiral S, et al. (2022) Active breathing control guided stereotactic body ablative radiotherapy for management of liver metastases from colorectal cancer. Acta Gastroenterol Belg 85(3): 469-475.
11. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2022) Concise review of radiosurgery for contemporary management of pilocytic astrocytomas in children and adults. World J Exp Med 12(3): 36-43.
12. Sager O, Dincoglan F, Demiral S, Gamsiz H, Uysal B, et al. (2022) Optimal timing of thoracic irradiation for limited stage small cell lung cancer: Current evidence and future prospects. World J Clin Oncol 13(2): 116-124.
13. Demiral S, Sager O, Dincoglan F, Uysal B, Gamsiz H, et al. (2021) Evaluation of breathing-adapted radiation therapy for right-sided early-stage breast cancer patients. Indian J Cancer 58(2): 195-200.
14. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2021) Omission of Radiation Therapy (RT) for Metaplastic Breast Cancer (MBC): A Review Article. International Journal of Research Studies in Medical and Health Sciences 6: 10-15.
15. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2021) Concise review of stereotactic irradiation for pediatric glial neoplasms: Current concepts and future directions. World J Methodol 11(3): 61-74.
16. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2020) Adaptive radiation therapy of breast cancer by repeated imaging during irradiation. World J Radiol 12(5): 68-75.
17. Sager O, Beyzadeoglu M, Dincoglan F, Demiral S, Gamsiz H, et al. (2020) Multimodality management of cavernous sinus meningiomas with less extensive surgery followed by subsequent irradiation: Implications for an improved toxicity profile. J Surg Surgical Res 6: 56-61.
18. Beyzadeoglu M, Sager O, Dincoglan F, Demiral S, Uysal B, et al. (2020) Single Fraction Stereotactic Radiosurgery (SRS) versus Fractionated Stereotactic Radiotherapy (FSRT) for Vestibular Schwannoma (VS). J Surg Surgical Res 6: 62-66.

How to cite this article: Omer S, Ferrat D, Selcuk D, Murat B. Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases. Canc Therapy & Oncol Int J. 2024; 26(5): 556198. DOI: 10.19080/CTOIJ.2024.25.556198

19. Dincoglan F, Beyzadeoglu M, Sager O, Demiral S, Uysal B, et al. (2020) A Concise Review of Irradiation for Temporal Bone Chemodectomas (TBC). Arch Otolaryngol Rhinol 6: 16-20.

20. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2019) Utility of Molecular Imaging with 2-Deoxy-2-[Fluorine-18] Fluoro-DGlucose Positron Emission Tomography (18F-FDG PET) for Small Cell Lung Cancer (SCLC): A Radiation Oncology Perspective. Curr Radiopharm 12(1): 4-10.

21. Dincoglan F, Sager O, Demiral S, Gamsiz H, Uysal B, et al. (2019) Fractionated stereotactic radiosurgery for locally recurrent brain metastases after failed stereotactic radiosurgery. Indian J Cancer 56(2): 151-156.

22. Sager O, Dincoglan F, Demiral S, Uysal B, Gamsiz H, et al. (2019) Breathing adapted radiation therapy for leukemia relapse in the breast: A case report. World J Clin Oncol 10(11): 369-374.

23. Dincoglan F, Sager O, Uysal B, Demiral S, Gamsiz H, et al. (2019) Evaluation of hypofractionated stereotactic radiotherapy (HFSRT) to the resection cavity after surgical resection of brain metastases: A single center experience. Indian J Cancer 56(3): 202-206.

24. Sager O, Dincoglan F, Uysal B, Demiral S, Gamsiz H, et al. (2018) Evaluation of adaptive radiotherapy (ART) by use of replanning the tumor bed boost with repeated computed tomography (CT) simulation after whole breast irradiation (WBI) for breast cancer patients having clinically evident seroma. Jpn J Radiol 36(6): 401-406.

25. Demiral S, Dincoglan F, Sager O, Uysal B, Gamsiz H, et al. (2018) Contemporary Management of Meningiomas with Radiosurgery. Int J Radiol Imaging Technol 80: 187-190.

26. Sager O, Dincoglan F, Uysal B, Demiral S, Gamsiz H, et al. (2017) Splenic Irradiation: A Concise Review of the Literature. J App Hem Bl Tran 1: 101.

27. Dincoglan F, Sager O, Demiral S, Uysal B, Gamsiz H, et al. (2017) Radiosurgery for recurrent glioblastoma: A review article. Neurol Disord Therap 1: 1-5.

28. Demiral S, Dincoglan F, Sager O, Gamsiz H, Uysal B, et al. (2016) Hypofractionated stereotactic radiotherapy (HFSRT) for who grade I anterior clinoid meningiomas (ACM). Jpn J Radiol 34(11): 730-737.

29. Dincoglan F, Beyzadeoglu M, Sager O, Demiral S, Gamsiz H, et al. (2015) Management of patients with recurrent glioblastoma using hypofractionated stereotactic radiotherapy. Tumori 101(2): 179-184.

30. Gamsiz H, Beyzadeoglu M, Sager O, Demiral S, Dincoglan F, et al. (2015) Evaluation of stereotactic body radiation therapy in the management of adrenal metastases from non-small cell lung cancer. Tumori 101(1): 98-103.

31. Sager O, Beyzadeoglu M, Dincoglan F, Demiral S, Uysal B, et al. (2015) Adaptive splenic radiotherapy for symptomatic splenomegaly management in myeloproliferative disorders. Tumori 101(1): 84-90.

32. Sager O, Dincoglan F, Beyzadeoglu M (2015) Stereotactic radiosurgery of glomus jugulare tumors: Current concepts, recent advances and future perspectives. CNS Oncol 4(2): 105-114.

33. Sager O, Beyzadeoglu M, Dincoglan F, Uysal B, Gamsiz H, et al. (2014) Evaluation of linear accelerator (LINAC)-based stereotactic radiosurgery (SRS) for cerebral cavernous malformations: A 15-year single-center experience. Ann Saudi Med 34(1): 54-58.

34. Demiral S, Beyzadeoglu M, Sager O, Dincoglan F, Gamsiz H, et al. (2014) Evaluation of Linear Accelerator (Linac)-Based Stereotactic Radiosurgery (Srs) for the Treatment of Craniopharyngiomas. UHOD-Uluslararasi Hematoloji Onkoloji Dergisi 24(2): 123-129.

35. Sager O, Beyzadeoglu M, Dincoglan F, Gamsiz H, Demiral S, et al. (2014) Evaluation of linear accelerator-based stereotactic radiosurgery in the management of glomus jugulare tumors. Tumori 100(2): 184-188.

36. Ozsavaş EE, Telatar Z, Dirican B, Sager O, Beyzadeoğlu M (2014) Automatic segmentation of anatomical structures from CT scans of thorax for RTP. Comput Math Methods Med 2014: 472890.

37. Demiral S, Beyzadeoglu M, Sager O, Dincoglan F, Gamsiz H, et al. (2014) Evaluation of linear accelerator (linac)-based stereotactic radiosurgery (srs) for the treatment of craniopharyngiomas. UHOD - Uluslararasi Hematoloji-Onkoloji Dergisi 24: 123-129.

38. Gamsiz H, Beyzadeoglu M, Sager O, Dincoglan F, Demiral S, et al. (2014) Management of pulmonary oligometastases by stereotactic body radiotherapy. Tumori 100(2): 179-183.

39. Dincoglan F, Sager O, Gamsiz H, Uysal B, Demiral S, et al. (2014) Management of patients with ≥ 4 brain metastases using stereotactic radiosurgery boost after whole brain irradiation. Tumori 100(3): 302-306.

40. Sager O, Beyzadeoglu M, Dincoglan F, Demiral S, Uysal B, et al. (2013) Management of vestibular schwannomas with linear accelerator-based stereotactic radiosurgery: a single center experience. Tumori 99(5): 617-622.

41. Dincoglan F, Beyzadeoglu M, Sager O, Uysal B, Demiral S, et al. (2013) Evaluation of linear accelerator-based stereotactic radiosurgery in the management of meningiomas: A single center experience. J BUON 18(3): 717-722.

42. Dincoglan F, Beyzadeoglu M, Sager O, Oysul K, Kahya YE, et al. (2013) Dosimetric evaluation of critical organs at risk in mastectomized left-sided breast cancer radiotherapy using breath-hold technique. Tumori 99(1): 76-82.

43. Demiral S, Beyzadeoglu M, Uysal B, Oysul K, Kahya YE, et al. (2013) Evaluation of stereotactic body radiotherapy (SBRT) boost in the management of endometrial cancer. Neoplasma 60(3): 322-327.

44. Sager O, Beyzadeoglu M, Dincoglan F, Oysul K, Kahya YE, et al. (2012) Evaluation of active breathing control-moderate deep inspiration breath-hold in definitive non-small cell lung cancer radiotherapy. Neoplasma 59(3): 333-340.

45. Sağer Ö, Dinçoğlan F, Gamsiz H, Demiral S, Uysal B, et al. (2012) Evaluation of the impact of integrated [18f]-fluoro-2-deoxy-D-glucose positron emission tomography/computed tomography imaging on staging and radiotherapy treatment volume definition of nonsmall cell lung cancer. Gulhane Med J 54: 220-227.

46. Sager O, Beyzadeoglu M, Dincoglan F, Oysul K, Kahya YE, et al. (2012) The Role of Active Breathing Control-Moderate Deep Inspiration Breath-Hold (ABC-mDIBH) Usage in non-Mastectomized Left-sided Breast Cancer Radiotherapy: A Dosimetric Evaluation UHOD - Uluslararasi Hematoloji-Onkoloji Dergisi 22: 147-155.

47. Dincoglan F, Sager O, Gamsiz H, Uysal B, Demiral S, et al. (2012) Stereotactic radiosurgery for intracranial tumors: A single center experience. Gulhane Med J 54: 190-198.

48. Dincoglan F, Beyzadeoglu M, Sager O, Oysul K, Sirin S et al. (2012) Image-guided positioning in intracranial non-invasive stereotactic radiosurgery for the treatment of brain metastasis. Tumori 98(5): 630-635.

49. Sirin S, Oysul K, Surenkok S, Sager O, Dincoglan F, et al. (2011) Linear accelerator-based stereotactic radiosurgery in recurrent glioblastoma: A single center experience. Vojnosanit Pregl 68(11): 961-966.

50. Demiral S, Sager O, Dincoglan F, Uysal B, Gamsiz H, et al. (2018) Evaluation of Target Volume Determination for Single Session Stereotactic Radiosurgery (SRS) of Brain Metastases. Canc Therapy & Oncol Int J 12(5): 555848.

51. Beyzadeoglu M, Sager O, Dincoglan F, Demiral S (2019) Evaluation of Target Definition for Stereotactic Reirradiation of Recurrent Glioblastoma. Arch Can Res 7(1): 3.

52. Sager O, Dincoglan F, Demiral S, Gamsiz H, Uysal B, et al. (2019) Evaluation of the Impact of Magnetic Resonance Imaging (MRI) on Gross Tumor Volume (GTV) Definition for Radiation Treatment Planning (RTP) of Inoperable High-Grade Gliomas (HGGs). Concepts in Magnetic Resonance Part A.

53. Sager O, Dincoglan F, Demiral S, Gamsiz H, Uysal B, et al. (2019) Utility of Magnetic Resonance Imaging (Imaging) in Target Volume Definition for Radiosurgery of Acoustic Neuromas. Int J Cancer Clin Res 6: 119.

54. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2019) Assessment of Computed Tomography (CT) And Magnetic Resonance Imaging (MRI) Based Radiosurgery Treatment Planning for Pituitary Adenomas. Canc Therapy & Oncol Int J 13(2): 555857.

55. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2019) Multimodality Imaging for Radiosurgical Management of Arteriovenous Malformations. Asian J Pharm Nurs Med Sci 7(1): 7-12.

56. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2019) Evaluation of Radiosurgery Target Volume Determination for Meningiomas Based on Computed Tomography (CT) And Magnetic Resonance Imaging (MRI). Cancer Sci Res Open Access 5: 1-4.

57. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2019) Assessment of target definition based on Multimodality imaging for radiosurgical Management of glomus jugulare tumors (GJTs). Canc Therapy & Oncol Int J 15(2): 555909.

58. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2019) Incorporation of Multimodality Imaging in Radiosurgery Planning for Craniopharyngiomas: An Original Article. SAJ Cancer Sci 6: 103.

59. Beyzadeoglu M, Dincoglan F, Demiral S, Sager O (2020) Target Volume Determination for Precise Radiation Therapy (RT) of Central Neurocytoma: An Original Article. Int J Res Stud Med Health Sci 5(3): 29-34.

60. Dincoglan F, Demiral S, Sager O, Beyzadeoglu M (2020) Utility of Multimodality Imaging Based Target Volume Definition for Radiosurgery of Trigeminal Neuralgia: An Original Article. Biomed J Sci & Tech Res 26: 19728-19732.

61. Demiral S, Beyzadeoglu M, Dincoglan F, Sager O (2020) Assessment of Target Volume Definition for Radiosurgery of Atypical Meningiomas with Multimodality Imaging. J Hematol Oncol Res 3(4): 14-21.

62. Dincoglan F, Beyzadeoglu M, Demiral S, Sager O (2020) Assessment of Treatment Volume Definition for Irradiation of Spinal Ependymomas: an Original Article. ARC J Cancer Sci 6: 1-6.

63. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M (2020) Target Volume Definition for Stereotactic Radiosurgery (SRS) Of Cerebral Cavernous Malformations (CCMs). Canc Therapy & Oncol Int J 15(4): 555917.

64. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Treatment Volume Determination for Irradiation of Recurrent Nasopharyngeal Carcinoma with Multimodality Imaging: An Original Article. ARC J Cancer Sci 6: 18-23.

65. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Assessment of Target Volume Definition for Irradiation of Hemangiopericytomas: An Original Article. Canc Therapy & Oncol Int J 17(2): 555959.

66. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Evaluation of Treatment Volume Determination for Irradiation of chordoma: an Original Article. International Journal of Research Studies in Medical and Health Sciences 5(10): 3-8

67. Demiral S, Dincoglan F, Sager O, Beyzadeoglu M (2020) Multimodality Imaging Based Target Definition of Cervical Lymph Nodes in Precise Limited Field Radiation Therapy (Lfrt) for Nodular Lymphocyte Predominant Hodgkin Lymphoma (Nlphl). ARC J Cancer Sci 6: 6-11.

68. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Radiosurgery Treatment Volume Determination for Brain Lymphomas with and without Incorporation of Multimodality Imaging. J Med Pharm Allied Sci 9: 2398-2404.

69. Beyzadeoglu M, Dincoglan F, Sager O, Demiral S (2020) Determination of Radiosurgery Treatment Volume for Intracranial Germ Cell Tumors (GCTS). Asian J Pharm Nurs Med Sci 8(3): 18-23.

70. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2020) Target Definition of orbital Embryonal Rhabdomyosarcoma (Rms) by Multimodality Imaging: An Original Article. ARC J Cancer Sci 6(2): 12-17.

71. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Evaluation of Target Volume Determination for Irradiatıon of Pilocytic Astrocytomas: An Original Article. ARC J Cancer Sci 6: 1-5.

72. Demiral S, Beyzadeoglu M, Dincoglan F, Sager O (2020) Evaluation of Radiosurgery Target Volume Definition for Tectal Gliomas with Incorporation of Magnetic Resonance Imaging (MRI): An Original Article. Biomed J Sci & Techn Res (BJSTR) 27: 20543-20547.

73. Demiral S, Dincoglan F, Sager O, Beyzadeoglu M (2021) Assessment of Multimodality Imaging for Target Definition of Intracranial Chondrosarcomas. Canc Therapy Oncol Int J 18(2): 1-5.

74. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2021) Impact of Multimodality Imaging to Improve Radiation Therapy (RT) Target Volume Definition for Malignant Peripheral Nerve Sheath Tumor (MPNST). Biomed J Sci Tech Res 34: 26734-26738.

75. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M (2021) Multimodality Imaging Based Treatment Volume Definition for Reirradiation of Recurrent Small Cell Lung Cancer (SCLC). Arch Can Res 9(1): 1-5.

76. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2021) Radiation Therapy (RT) Target Volume Definition for Peripheral Primitive Neuroectodermal Tumor (PPNET) by Use of Multimodality Imaging: An Original Article. Biomed J Sci & Tech Res 34: 26970-26974.

77. Dincoglan F, Demiral S, Sager O, Beyzadeoglu M (2021) Evaluation of Target Definition for Management of Myxoid Liposarcoma (MLS) with Neoadjuvant Radiation Therapy (RT). Biomed J Sci Tech Res 33: 26171-26174.

78. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2021) Radiation Therapy (RT) target determination for irradiation of bone metastases with soft tissue component: Impact of multimodality imaging. J Surg Surgical Res 7: 42-46.

79. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2021) Evaluation of Changes in Tumor Volume Following Upfront Chemotherapy for Locally Advanced Non-Small Cell Lung Cancer (NSCLC). Glob J Cancer Ther 7: 31-34.

80. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M (2021) Assessment of posterior fossa target definition by multimodality imaging for patients with medulloblastoma. J Surg Surgical Res 7: 37-41.

81. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2021) Assessment of the role of multimodality imaging for treatment volume definition of intracranial ependymal tumors: An original article. Glob J Cancer Ther 7: 43-45.

82. Beyzadeoglu M, Demiral S, Dincoglan F, Sager O (2022) Assessment of Target Definition for Extramedullary Soft Tissue Plasmacytoma: Use of Multımodalıty Imaging for Improved Targetıng Accuracy. Canc Therapy & Oncol Int J 22(4): 556095.

How to cite this article: Omer S, Ferrat D, Selcuk D, Murat B. Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases. Canc Therapy & Oncol Int J. 2024; 26(5): 556198. DOI: 10.19080/CTOIJ.2024.25.556198

83. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2022) Target Volume Determination for Recurrent Uterine Carcinosarcoma: An Original Research Article Revisiting the Utility of Multimodality Imaging. Canc Therapy & Oncol Int J 22(3): 556090.

84. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2022) Reappraisal of Computed Tomography (CT) And Magnetic Resonance Imaging (MRI) Based Target Definition for Radiotherapeutic Management of Recurrent Anal Squamous Cell Carcinoma (ASCC): An Original Article. Canc Therapy & Oncol Int J 22(2): 556085.

85. Demiral S, Dincoglan F, Sager O, Beyzadeoglu M (2022) An Original Article for Assessment of Multimodality Imaging Based Precise Radiation Therapy (Rt) in the Management of Recurrent Pancreatic Cancers. Canc Therapy & Oncol Int J 22(1): 556078.

86. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M (2022) Assessment of Target Volume Definition for Precise Radiotherapeutic Management of Locally Recurrent Biliary Tract Cancers: An Original Research Article. Biomed J Sci & Tech Res 46(1): 37054-37059.

87. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M. (2022) Radiation Therapy (RT) Target Volume Determination for Locally Advanced Pyriform Sinus Carcinoma: An Original Research Article Revisiting the Role of Multimodality Imaging. Biomed J Sci & Tech Res 45(1): 36155-36160.

88. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2022) Improved Target Volume Definition for Radiotherapeutic Management of Parotid Gland Cancers by use of Multimodality Imaging: An Original Article. Canc Therapy & Oncol Int J 21(3): 556062.

89. Beyzadeoglu M, Sager O, Demiral S, Dincoglan F (2022) Reappraisal of multimodality imaging for improved Radiation Therapy (RT) target volume determination of recurrent Oral Squamous Cell Carcinoma (OSCC): An original article. J Surg Surgical Res 8: 4-8.

90. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2022) Multimodality imaging-based treatment volume definition for recurrent Rhabdomyosarcomas of the head and neck region: An original article. J Surg Surgical Res 8(2): 13-18.

91. Dincoglan F, Demiral S, Sager O, Beyzadeoglu M (2022) Appraisal of Target Definition for Management of Paraspinal Ewing Tumors with Modern Radiation Therapy (RT): An Original Article. Biomed J Sci & Tech Res 44(4): 35691-35696.

92. Beyzadeoglu M, Sager O, Demiral S, Dincoglan F (2022) Assessment of Target Volume Definition for Contemporary Radiotherapeutic Management of Retroperitoneal Sarcoma: An Original Article. Biomed J Sci & Tech Res 44(5): 35883-35887.

93. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2023) Appraisal of Target Definition for Anaplastic Thyroid Carcinoma (ATC): An Original Article Addressing the Utility of Multimodality Imaging. Canc Therapy & Oncol Int J 24(4): 556143.

94. Demiral S, Dincoglan F, Sager O, Beyzadeoglu M (2023) Reappraisal of Treatment Volume Determination for Parametrial Boosting in Patients with Locally Advanced Cervical Cancer. Canc Therapy & Oncol Int J 24(5): 556148.

95. Demiral S, Sager O, Dincoglan F, Beyzadeoglu M (2023) Tumor Size Changes after Neoadjuvant Systemic Therapy for Advanced Oropharyngeal Squamous Cell Carcinoma. Canc Therapy & Oncol Int J 24(5): 556147.

96. Demiral S, Dincoglan F, Sager O, Beyzadeoglu M (2023) Assessment of Changes in Tumor Volume Following Chemotherapy for Nodular Sclerosıng Hodgkin Lymphoma (NSHL). Canc Therapy & Oncol Int J 24(5): 556146.

97. Sager O, Demiral S, Dincoglan F, Beyzadeoglu M (2023) Evaluation of Volumetric Changes in Transglottic Laryngeal Cancers After Induction Chemotherapy. Biomed J Sci & Tech Res 51(4): 43026-43031.

98. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2023) An Original Research Article for Evaluation of Changes in Tumor Size After Neoadjuvant Chemotherapy in Borderline Resectable Pancreatic Ductal Adenocarcinoma. Biomed J Sci & Tech Res 52(1): 43253-43255.

99. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2023) Assessment of Tumor Size Changes After Neoadjuvant Chemotherapy in Locally Advanced Esophageal Cancer: An Original Article. Biomed J Sci & Tech Res 52(2): 43491-43493.

100. Beyzadeoglu M, Demiral S, Dincoglan F, Sager O (2023) Evaluation of Target Definition for Radiotherapeutic Management of Recurrent Merkel Cell Carcinoma (MCC). Canc Therapy & Oncol Int J 24(2): 556133.

101. Dincoglan F, Demiral S, Sager O, Beyzadeoglu M (2023) Reappraisal of Treatment Volume Determination for Recurrent Gastroesophageal Junction Carcinoma (GJC). Biomed J Sci & Tech Res 50(5): 42061-42066.

102. Beyzadeoglu M, Dincoglan F, Demiral S, Sager O (2023) An Original Article Revisiting the Utility of Multimodality Imagıng for Refıned Target Volume Determinatıon Of Recurrent Kidney Carcinoma. Canc Therapy & Oncol Int J 23(5): 556122.

103. Beyzadeoglu M, Demiral S, Dincoglan F, Sager O (2023) Appraisal of Target Definition for Recurrent Cancers of the Supralottic Larynx. Biomed J Sci & Tech Res 50 (5): 42131-42136.

104. Beyzadeoglu M, Demiral S, Dincoglan F, Sager O (2024) Reappraisal of Target Definition for Sacrococcygeal Chordoma: Comparative Assessment with Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). Biomed J Sci & Tech Res 55(1): 46686-46692.

105. Dincoglan F, Demiral S, Sager O, Beyzadeoglu M (2024) Assessment of Changes in Tumor Size After Induction Systemic Therapy for Locally Advanced Cervical Squamous Cell Carcinoma Running title: Tumor size changes in cervical carcinoma. Cancer Ther Oncol Int J 26(1): 1-7.

106. Dincoglan F, Beyzadeoglu M, Demiral S, Sager O (2024) Appraisal of Changes in Tumor Volume After Neoadjuvant Systemic Therapy for Hepatocellular Carcinoma (HCC). Cancer Ther Oncol Int J 26(2): 1-4.

How to cite this article: Omer S, Ferrat D, Selcuk D, Murat B. Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases. Canc Therapy & Oncol Int J. 2024; 26(5): 556198. DOI: 10.19080/CTOIJ.2024.25.556198

DOI: 10.19080/CTOIJ.2024.25.556198

How to cite this article: Omer S, Ferrat D, Selcuk D, Murat B. Assessment of Multimodality Imaging Based Treatment Volume Determination for Stereotactic Body Radiation Therapy (SBRT) of Adrenal Metastases. Canc Therapy & Oncol Int J. 2024; 26(5): 556198. DOI: 10.19080/CTOIJ.2024.25.556198