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Quad Shot Radiotherapy Volume Determination in Head and Neck Cancer Patients

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Abstract

Objective: The dose determination of quad shot was evaluated in head and neck cancer radiotherapy.

Materials and methods: Head and neck area is the most commonly cancer site of unknown primary worldwide. Radiotherapy and or chemotherapy is a crucial treatment modality for patients with head and neck cancer. The development of different dose schemes in head and neck cancer patients undergoing radiotherapy has led to the exploration of various strategies. Primary goal of this study has been to evaluate pacemaker dose determination for breast cancer. We have carried out a comparative analysis of treatment volume determination by CT simulation images only or by integration of PET. While we primarily focused on evaluation of incorporated multimodality imaging for treatment volume determination, we also assessed critical organ contouring along with interobserver and intra observer variations. Ground truth target volume has been utilized for comparative analysis, and it was determined by board certified radiation oncologists after detailed evaluation of all imaging and relevant data with thorough colleague peer review and consensus.

Results: Ground truth target volume was used as the reference for comparative evaluation, and our results revealed that use of fused PET-CT based treatment volume determination was identical with ground truth target definition in our selected group in head and neck cancer patients.

Conclusion: This article aims to review the association between the use of quad shot radiotherapy in head and neck cancer patients, focusing on the materials and methods employed, results obtained, and the subsequent discussions surrounding the topic.

Keywords: Quad shot; Head and Neck Cancer; Radiotherapy; Surgical Oncology; Medical Oncology and Radiation Oncology

Abbreviations: IMRT: Intensity-Modulated Radiotherapy; SBRT: Stereotactic Body Radiation Therapy; LINAC: Linear Accelerator; AAPM: American Association of Physicists in Medicine; ICRU: International Commission on Radiation Units and Measurements; RT: Radiation Therapy

Introduction

Quad Shot radiotherapy is a regimen designed for palliation in advanced head and neck cancer patients, characterized by delivering a higher fraction of radiation over a shorter period. The volume determination for Quad Shot radiotherapy is typically guided by the same principles as conventional radiotherapy, where a radiation oncologist delineates the target volumes on planning images, such as a computed tomography scan.

Despite advances in the treatment of head and neck cancer, 15 to 50 percent of patients will develop recurrent disease. Survivors also are at risk to develop second primary tumors, the incidence of which is estimated at 8 to 22 percent, with approximately one-third occurring in the head and neck. Therapeutic options are limited for patients who present with locally recurrent disease or a second primary tumor in a previously irradiated field. Surgical salvage with a curative-intent resection is the preferred option for those with limited-volume disease. Reirradiation is an alternative for patients who are not candidates for surgical salvage.

Reirradiation with or without the addition of chemotherapy may hold promise for long-term survival for appropriately selected patients. Indications for reirradiation may include: Patients who undergo surgical salvage but are found to have high-risk features or who are medically suitable for curative-intent interventions but are not amenable to curative-intent resection and or who are not candidates for curative-intent interventions but may benefit from palliative treatment.

A thorough analysis of the initial treatment volumes and dose distributions relative to the location of the locoregional recurrence or second primary tumor should be made when reirradiation is considered. Determination of the dose received at the site of recurrence may demonstrate geographic tumor miss and is necessary for treatment planning since a geographic or marginal miss may not represent the same radioresistant disease as a true in-field recurrence, even with a disease-free interval of less than a year.

Reirradiation treatment volumes for patients treated with IMRT (typically with concurrent chemotherapy) are usually limited to a 1 to 2 cm margin around the gross tumor or the surgical site, with even smaller margins when tumors are near critical structures such as the skull base/brainstem, spinal cord, optic nerve, or optic chiasm. This approach was validated in a retrospective review of 66 re-irradiated patients, which demonstrated that 96 percent of locoregional recurrences following reirradiation occurred within the gross tumor volume and only 4 percent occurred in untreated regional sites. The cumulative dose to the spinal cord from all courses of treatment is usually limited to 50 Gy, with the reirradiation dose to the spinal cord restricted to 10 percent of the prescribed reirradiation dose. Treatment volumes for patients re-irradiated with stereotactic body radiation therapy (SBRT) are often limited to small deposits of gross disease and a <1 cm margin for patient setup uncertainty [1-15].

Materials and Methods

Conventionally, such patients are prescribed a dose of 30 Gy/2 weeks/10 fractions for palliation of symptoms. Squamous cell carcinoma of the head and neck region constitute approximately 20% of the total cancer patient population treated different centers worldwide, and about 40% of these patients are treated with only palliative intent. However, recent trials have suggested alternative hypo-fractionated schedules for palliation where the overall treatment duration is further reduced.

Primary goal of this study has been to evaluate treatment volume determination for head and neck cancer based on PET and CT fusion. We have carried out a comparative analysis of treatment volume determination by CT simulation images only or by integration of PET. While we primarily focused on evaluation of incorporated multimodality imaging for treatment volume determination, we also assessed critical organ contouring along with interobserver and intra observer variations. Decision making procedure for individualized patient management has involved multidisciplinary input from experts on surgical oncology, radiation oncology, medical oncology. Patient, disease, and treatment related factors were all considered. Patient age, previous treatments, symptomatology, lesion size, performance status, lesion localization and association with normal tissues, contemplated outcomes of alternative treatment alternatives, patient preferences and logistical issues have also been taken into account. A Linear Accelerator (LINAC) furnished with sophisticated IGRT techniques has been utilized for RT. Following robust patient immobilization, planning CT images were obtained at CT simulator for radiation treatment planning. Then, acquired RT planning images have been transferred to the delineation workstation via the network.

The process includes defining the gross tumor volume, which contains the visible tumor, and the clinical target volume, which includes the GTV plus a margin to cover any microscopic disease spread. Additionally, a margin is added to the CTV to create the planning target volume, which accounts for patient movement and variations in treatment setup and delivery. Treatment volumes and normal tissues have been outlined on these images and structure sets have been generated. Either CT simulation images only or fused CT-MR images have been used for assessment and comparative data analysis.

Results

The results from several studies have demonstrated that quad shot radiotherapy administered concurrently or sequentially with chemotherapy can decrease the pain in head and neck cancer patients. We designated this original research article to assess the utility of multimodality imaging with incorporation of PET-CT fusion for treatment volume determination in a selected group of patients with head and neck cancer. Irradiation of patients was performed at our Radiation Oncology Department of Gulhane Medical Faculty at University of Health Sciences, Ankara. Before irradiation, patients were individually evaluated by multidisciplinary collaboration of surgical oncology, medical oncology and radiation oncology disciplines. We executed a comparative analysis based on either CT only imaging or by fused PET-CT to evaluate the use of this sophisticated strategy. Optimal RT planning procedure included consideration of lesion sizes, localization, and association with nearby critical structures. Radiation physicists were included in RT planning process with consideration of reports by American Association of Physicists in Medicine (AAPM) and International Commission on Radiation Units and Measurements (ICRU). Precise RT planning process included consideration of electron density, tissue heterogeneity, CT number and HU values in CT images. Primary objective of RT planning has been to achieve optimal coverage of treatment volumes along with minimized exposure of surrounding critical structures. Truth target volume was used as the reference for comparative evaluation, and our results revealed that use of fused PET-CT based treatment volume determination was identical with ground truth target definition in our selected group of patients with head and neck cancer.

Discussion

The Quad Shot regimen specifically involves delivering four fractions on two consecutive days, for a total of four cycles, which can repeat every 4 weeks. Each fraction is generally a higher

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dose than in standard fractionation, targeting a rapid palliative response while still trying to minimize side effects. Because this method is palliative, the volumes may be somewhat smaller and focused compared to those used in curative treatments, with the aim of alleviating symptoms and maintaining the quality of life. However, the exact delineation of volumes would depend on individual patient anatomy, the extent of the disease, and the clinical judgment of the treating radiation oncologist.

Corry et al described the 'Quad Shot' radiation dose schedule was 14 Gy/2 days/ 4 fractions as by. The patients were treated in Cobalt60 teletherapy units and the gross tumor volume (including the primary tumor and involved nodes) with 2 cm margin was irradiated. Two fractions of radiation were given every day with a minimum 6-hour gap between the two fractions. The Biologically Equivalent Dose for one Quad Shot was 18.9 Gy10 and 30.38 Gy3 for tumor and late reacting tissues (LQED2 15.75 Gy10 and 18.19 Gy3), respectively. Patients were reviewed 3 weeks later for response and toxicities.

IMRT is being used to deliver a radical radiation dose to the primary tumor and high-risk nodal volumes only (PTV1), with a simultaneous integrated boost to the gross nodal disease to a higher dose with or without a sequential boost to the primary tumor (PTV2). This will help determine the feasibility of a complex dose-dense IMRT regimen, along with gathering early evidence of high rates of loco-regional control in poor prognosis head and neck cancer sub-sites with acceptable toxicity. This is a rare and difficult to treat cancer which has a high probability of being cured with radiation alone, or in combination with surgery [16-35].

The use of intensity-modulated radiotherapy (IMRT) is widespread in the treatment of head and neck cancers. It has been shown to consistently achieve a higher degree of target conformity and normal tissue sparing. Given these potential gains, the aims of this study were to investigate the feasibility of a new form of high-precision radiation treatment, dynamic IMRT, and to determine the potential gains in target coverage and normal tissue sparing achievable compared with conventional IMRT. Carcinomas of the head and neck account for 5% of all tumors. Radiation alone, or in combination with surgery or chemotherapy, has been the accepted method of treatment for many years. This is based on the results of randomized trials which have shown equivalent survival rates and organ preservation with radiation compared to surgery, along with the improvement in loco-regional control and quality of life compared to palliative care. Step and shoot IMRT has been shown to facilitate the delivery of altered fractionation regimes compared with 3D conformal radiotherapy and has thus been widely adopted as the method of choice for definitive or adjuvant radiation treatment of head and neck cancers in many centers An optimal radiation therapy regimen in terms of fractionation and dose has yet to be determined, although altered fractionation regimes have shown promise in terms of improving loco-regional control and survival at the expense of increased acute and late toxicities [36-65].

Although data are limited, palliative irradiation is an option for patients whose tumor is significantly impacting quality of life and who are not candidates for an aggressive course of reirradiation. In general, tumor shrinkage with palliative reirradiation is expected to be greater than the response to chemotherapy. Lower doses and larger fraction sizes are delivered to patients receiving palliative reirradiation. The lower dose should result in a lower risk of acute toxicity, and the increased risk of late complications with larger fraction sizes is generally not relevant.

The "Quad Shot" approach to palliative radiation therapy (RT) delivers short, cyclical courses to maximize clinical response and minimize toxicity. Each cycle consists of twice-daily hypo-fractionated RT administered over two days in four-week intervals for a total of two or more cycles depending on treatment response. This approach allows mucosal stem cells to repopulate before the next cycle. While the best data regarding the Quad Shot approach come from an uncontrolled perspective trial in patients without prior RT exposure, this approach is offered to the patients with prior RT exposure who are not candidates for more aggressive treatment, as the limited observational data in the setting of reirradiation are promising.

In two retrospective studies including a total of 101 patients with incurable recurrent or metastatic head and neck cancer treated with the Quad Shot approach, responses were seen in 70 percent, and there was a low rate of grade ≥3 toxicities [66-99]. As a conclusion, detailed protocols for Quad Shot radiotherapy volume determination might not be universally standardized and therefore should be individualized based on the patient's specific clinical scenario and the treating institution's guidelines.

Conflict of Interest

No.

References

1. Rebecca L Siegel, Kimberly D Miller, Nikita Sandeep Wagle, Ahmedin Jemal (2023) Cancer statistics, 2023. CA Cancer J Clin 73(1): 17-48.
2. Jamora KE, Patricia A Canal J (2022) Factors predictive of parametrial boost in patients with cervical cancer treated with definitive chemoradiation. Gynecol Oncol Rep 39: 100919.
3. Mohamed S, Kallehauge J, Fokdal L, Lindegaard JC, Tanderup K (2015) Parametrial boosting in locally advanced cervical cancer: combined intracavitary/interstitial brachytherapy vs. intracavitary brachytherapy plus external beam radiotherapy. Brachytherapy 14(1): 23-28.
4. Postema S, Pattynama PM, van Rijswijk CS, van Erkel A, Tjin A Ton ER (1998) MR imaging of uterine cervical carcinoma: comparison between fast spin-echo MRI and GRASE. Eur Radiol 8(1): 45-49.
5. Carvajal F, Carvajal C, Merino T, Lopez V, Retamales J, et al. (2021) Radiotherapy for cervical cancer: Chilean consensus of the Society of Radiation Oncology. Rep Pract Oncol Radiother 26(2): 291-302.

How to cite this article: Bora U, Hakan G. Quad Shot Radiotherapy Volume Determination in Head and Neck Cancer Patients. Canc Therapy & Oncol Int J. 2024; 26(5): 556197. DOI: 10.19080/CTOIJ.2024.25.556197

6. Felici F, Benkreira M, Lambaudie E, Fau P, Mailleux H, et al. (2022) Adaptive Magnetic Resonance-Guided External Beam Radiation Therapy for Consolidation in Recurrent Cervical Cancer. Adv Radiat Oncol 7(6): 100999.

7. Fields EC, Weiss E (2016) A practical review of magnetic resonance imaging for the evaluation and management of cervical cancer. Radiat Oncol 11: 15.

8. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2022) Potential Utility of Radiopharmaceuticals in the Battle Against SARSCov- 2 and COVID-19 Pandemic. Curr Radiopharm 15(2): 93-95.

9. Oktay EA, Zerener T, Dirican B, Yildiz S, Sager O, et al. (2022) Dosimetric evaluation of the effect of dental restorative materials in head and neck radiotherapy. Indian J Cancer 59(3): 402-407.

10. 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.

11. 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.

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. Int J Res Stud Med and Health Sci 6(1): 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.

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(2): 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-D Glucose 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(2): 187-190.

26. Sager O, Dincoglan F, Uysal B, Demiral S, Gamsiz H, et al. (2017) Splenic Irradiation: A Concise Review of 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. Ozsavas EE, Telatar Z, Dirican B, Sager O, Beyzadeoglu 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.

How to cite this article: Bora U, Hakan G. Quad Shot Radiotherapy Volume Determination in Head and Neck Cancer Patients. Canc Thearpy & Oncol Int J. 2024; 26(5): 556197. DOI: 10.19080/CTOIJ.2024.25.556197

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. Sager O, Dincoglan 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(3): 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. 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.

51. 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.

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

53. 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.

54. 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.

55. 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.

56. 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.

57. 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.

58. 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.

59. 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.

60. 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.

61. 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(1): 4-8.

62. 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.

63. 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.

64. 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.

65. 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): 555981.

66. 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.

67. 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: 1-5.

68. 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(4): 26970-26974.

69. 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(5): 26171-26174.

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70. 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(1): 42-46.

71. 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(1): 31-34.

72. 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(1): 37-41.

73. 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(1): 43-45.

74. 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.

75. 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.

76. 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.

77. 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): 1-6.

78. 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.

79. 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(2): 18-23.

80. 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.

81. 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.

82. 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(2): 6-11.

83. Sager O, Dincoglan F, Demiral S, Beyzadeoglu M (2020) Radiosurgery Treatment Volume Determination for Brain Lymphomas with and without Incorporation of Multimodality Imaging. Journal of Medical Pharmaceutical and Allied Sciences 9(1): 2398-2404.

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

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

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

87. 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 Scient & Tech Res (BJSTR) 27(2): 20543-20547.

88. 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.

89. 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 2019: 4282754.

90. 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.

91. 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.

92. Dincoglan F, Sager O, Demiral S, Beyzadeoglu M (2019) Multimodality Imaging for Radiosurgical Management of Arteriovenous Malformations. Asian Journal of Pharmacy, Nursing and Medical Sciences 7(1): 7-12.

93. 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.

94. 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: 555909.

95. 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.

96. 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.

97. Barillot I, Reynaud-Bougnoux A (2006) The use of MRI in planning radiotherapy for gynaecological tumours. Cancer Imaging 6(1): 100-106.

98. Dolezel M, Odrazka K, Zizka J, Vanasek J, Kohlova T, et al. (2012) MRI-based preplanning using CT and MRI data fusion in patients with cervical cancer treated with 3D-based brachytherapy: feasibility and accuracy study. Int J Radiat Oncol Biol 84(1): 146-152.

99. Corriher TJ, Dutta SW, Alonso CE, Libby B, Romano KD, et al. (2020) Comparison of initial computed tomography-based target delineation and subsequent magnetic resonance imaging-based target delineation for cervical cancer brachytherapy. J Contemp Brachytherapy 12(3): 279-282.

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