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Comparative study between Volumetric Modulated Arc therapy plans using FF and FFF beam in case of head and neck cancer

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Abstract:

This study aims to evaluate the dosimetric and biological differences in Radiotherapy protocol at 6MV photon from flattened and flattening filter free (FFF) using Volumetric Modulated Arc therapy (VMAT) beam in patient diagnosed with Head and Neck cancer. To establish this aim ten patients with squamous cell carcinoma were subjected to 20 VMAT plans using Monaco 5.51.10 treatment planning system (TPS) at 6MV FF and 6MV FFF . The quality of plan and efficiency were evaluated using radiobiolgical parameters (NTCP) normal tissue complication probability and (TCP) tumor control probability. The results showed that there is difference between 6FF and 6FFF in TCP values, while the target coverage and sparing of the OARs for FFF VMAT were similar to those for FF VMAT. Also, there was no observable differences in homogeneity or conformity index for both modes plans. Conclusively, all treatment protocols met the planning objectives and 6 MV FFF-VMAT plan is a highly efficient and feasible option for the treatment of head and neck cancer .

Keywords: Flattening filter-free beam, Volumetric Modulated Arc therapy, head and neck cancer treatment planning.

1. Introduction

Volumetric modulated arc therapy (VMAT) is an emerging radiation technique which delivers a high dose to the target volume while prevents the normal adjacent tissues, all in short time less than 3 minutes. Accuracy of the treatment is done using inverse optimized treatment planning [3]. The goal of VMAT is to give optimized treatment plans with high dose conformity in an efficiency and accuracy way. VMAT allows beam-on during afull gantry rotation of 0° to

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360° with simultaneous modulation of the multileaf collimator (MLC) and avariation of gantry rotation speed as well as dose rate. It can be used for treating vary types of cancer and for example the most efficient radiotherapy for brain, head and neck cancer, delivering high quality treatments in the least amount of time (Minna Ahlstrom, 2015) [4]. Recently, the use of biological models based TPS for plan optimization and evaluation has generated a growing interest [5-11].

In external radiotherapy, the use of (FFF) radiation beams increasing, and the advantage of clinical use are the subject of research. A new treatment techniques have increased and the interest in clinial operation of LINACS in FFF mode. To creat a beam with characteristics of a non-uniform dose distribution must be remove FF and The differences of the optained beams should be compared to the beams with an uniform dose distribution which used as a standard were examined. These differences were compared in the treatment plans of patients who have different (PTVs). Though the use of FFF radiation beams obtained by lifting (FF) in standard LINAC linear accelerators is increasing in RT, the advantages of clinical use are researched. A LINAC linear accelerator with the FF removed produces an irregular dose profile beam [12, 13] . In a previous astudy [14] LINAC accelerator that does not include aFF. FFF beams provide amore intense X-ray beam at the center,forward peak than conventional FF photon rays. The high dose rate provided by the FFF, beams reduces beam duration and increases clinical efficiency [15, 16]. The reduction of head leakage in FFF mode lead to the radiation attenuation effect is decreased. At greater distances, the out-of-field dose was decrease (17). Advanced treatment techniques VMAT have increased interest in the operation ofLINAC linear accelerators in FFF mode. characteristics of FFF rays have an affect on treatment delivery, patient comfort, beam matching [18,19]. Studied the superficial dose of conventional FF beam and FFF beam using the Monte Carlo method. As a result, the Monte Carlo simulation illustrated the surface dose was higher compared to the F beam due to low average energy in the FFF beam [20] . VMAT in previous studies already used in the treatment of various tumors, as Brain NPC, pelvis, prostate cases and so on [21–23]. Several researchers have studied the roles of VMAT compared with other techniques as static gantry IMRT for which had been elucidated the shorten treatment beam on times (BOT) [24].

With more widespread in recent years and large application of VERSA HD LINACLinear accelerator (ELEKTA MedicalSystems) in external radiotherapy, clinicals applications of (FFF) beams have increasingly needs. FFF beams potentially high dose rates thus decrease treatment delivery time, out-of-field dose and lower peripheral dose clearly true its unique characteristic [25,26]. Further more comparison was evaluated for FFF beams and FB for several authors, and the results showed that FFF beams resulted in dose distributions similar to flattened beams [27,28].

Goal of this study is to evaluate the effect of the flattening filter free (FFF) mode of aLINAC linear accelerator for VMAT in patients with squamous cell carcinoma. The comparison between the FFF plan and FB plan by [physical parameters (DVH, , Max dose , Min dose ,dose distributions, Mean dose, HI , CI) and radiobiological parameters (TCP, NTCP , EUD)].

2. Materials and Methods:

A total of ten patients with Squamous cell carcinoma (head and neck) previously treated underwent replanning with VMAT technique using 6MV FFF and 6MV FF , performed with ELEKTA MONACO 5.51.10 Treatment Planning System (TPS). A total of 20 plans generated for ten patients, radiobiological model have been used to calculate the out come of treatment plans based on dose-volume histogram(DVH), Niemierko's EUD-based NTCP and TCP mathematical model and MATLAB was chosen to implement the models and obtain MATLAB program code, MATLAB is a high level technical computing language and interactive environment .it a language that is easy to learn , Is available for Microsoft windows and Macintosh operating system. Physical parameters for plan evaluation (DVH dose volume histogram , dose distribution , Maximum dose, Minimum dose , Mean dose , CI conformity index and HI homogeneity index) , radiobiological parameters for plan evaluation (TCP tumor control probability , NTCP normal tissue complication probability and EUD equivalent uniform dose)

<u>Treatment planning</u>: plans, done by using (2) photon beams of VERSA HD LINAC equipped with AGILITY head with MLC 5mm (160 leaves) with 6MV FF and 10MV FF and have Beam Quallity for HD (D10 Vlaues for the FFF energies) is Same as flattened energies, Effective leaf speed is 6.5cm/s which is important for FFF and dynamic treatments. Ten patients were planned with VMAT (ELEKTA MedicalSystems) technique in the Monaco 5.51.10 with The Monte Carlo (MC) algorithm is potentially the most accurate method for the calculation of dose distributions in treatment planning with Mosaiq 2.82 fully integrated treatment planning system permissible the optimizer to use the maximum DR of 500 MU/min for energy 6MV FF and 1400

MU/min for 6MV FFF beams. Prescribed dose was (70Gy / 35 Fraction) 2Gy per fraction. For all plans, the constraints of normal tissue and objectives for PTV were kept constant to avoid bias. Normalization of dose adjusted at 95% of PTV received 100% of the prescribtion dose and to minimize the PTV volume receiving >110% of the dose. For the OARs, the maximum dose of Brainstem less than 54Gy were received ,Optic.Nerve <55Gy, Optic.chiasm <55Gy, Spianl.cord <50Gy and the mean dose of Parotid<25Gy, Larynx<50Gy, esophagus<34Gy ,eye <35Gy. The radiobiological parameters for target is TCD_{50}=63.8 Gy , α/β=10Gy, a=-13, γ_{50}=3.2 [1,2]

3. Results and Discussion :

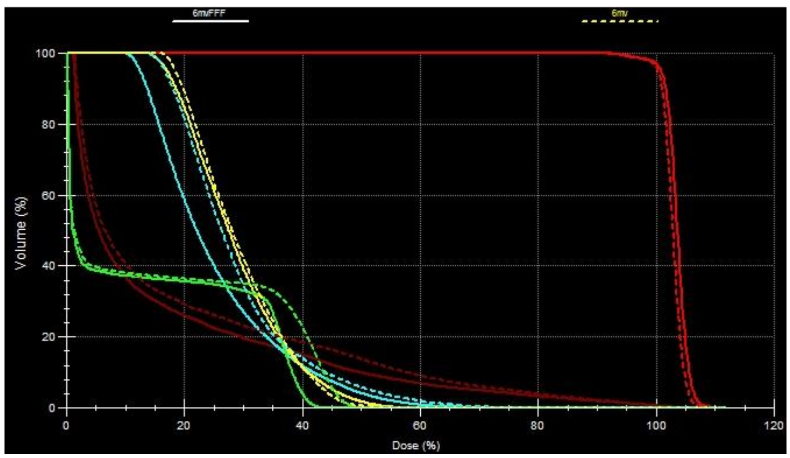
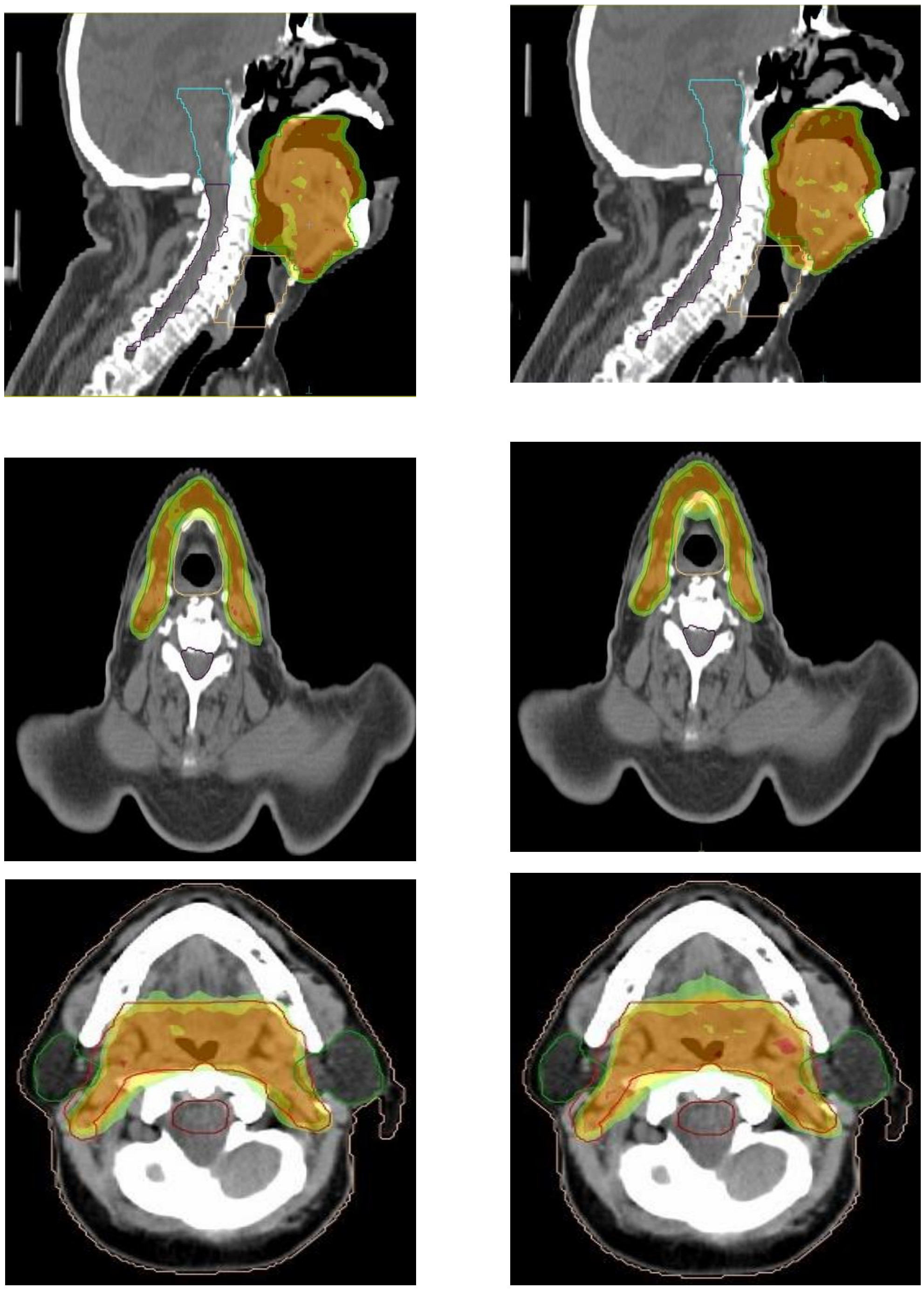


Fig (1): Dose volume histogram (DVH)



(a) FFF **(b) FF**

Fig (2): The difference in Dose distribution between FFF plan Fig(a) and FF plan Fig(b)

Physical parameters and biological parameters for OARs cases:-

		Flattened Beam				FFF Beam			
n	**ORS**	**Max Dose (CGy)**	**Mean Dose (CGy)**	**EUD (Gy)**	**NTCP**	**Max Dose (CGy)**	**Mean Dose (CGy)**	**EUD (Gy)**	**NTCP**
n=1	**Esophagus**	7129.1	1798.3	61.45	16.51	7130.7	1755	60.48	14.45
	Larynx	7071.9	4458.2	56.6	0.39	6986.6	4451.8	55.45	0.28
	Optic.Nerve	5281.7	1981.8	37.4	0.13	5213.5	2124.7	36.05	0.08
	Brainstem	4399	2326.2	21.23	0.00016	3927	2315.6	20.1	.000012
	Cord	5034.2	2996.3	33.60	0.17	4856.9	2853.8	31.1	0.049
n=2	**Optic.Nerve**	4900.6	1730.9	33.2	0.031	4861.4	1700.4	33.01	0.029
	Eye	4529.4	693.0	32.7	0.0017	4048	652	29.3	0.0003
	Parotid	3172.5	1067.3	6.8	0.005	3227.4	961.3	5.7	0.001
	Brainstem	4493.7	2691.3	23.96	0.00063	4363.1	2597.5	23.9	0.0006
n=3	**Esophagus**	3881.7	1522.8	27.1	0.00004	3542.3	1124.3	23.73	0.0000049
	Larynx	7588.7	4530.1	60.6	1.16	6987	4177.8	35.8	0.00026
	Parotid	6287.1	1987.9	15.1	0.000002	6827	1922.1	14.54	0.00000099
	Brainstem	4186.6	1734.2	21.43	0.000165	4086.8	1784.8	20.46	0.000095
	Cord	3847.7	2585.2	22.42	0.0002661	3834.6	2388.3	22.1	0.00021
n=4	**Esophagus**	6149.8	1610.2	47.14	0.28	6038.3	1503.7	46.2	0.20
	Rt.Carotid	6927.7	3108.8	53.21	0.14	6836.5	3059.4	52.14	0.11
	Lt.Carotid	7125.7	3862.5	54.72	0.23	6918.9	3843.4	53.52	0.16
	Cord	3686.1	1841.9	21.58	0.00015	3619.8	1785.6	21.2	0.0001
n=5	**Esophagus**	7397.0	2806.1	62.94	22.48	7310	2770	61.7	17.0
	Rt.Carotid	6768.7	3820.5	52.6	0.12	6723.6	3604.9	52.03	0.1
	Lt.Carotid	7008.7	3905.2	54.9	0.24	7064.7	3757.2	52.57	0.11
	Cord	3993.4	1790	23.44	0.00054	4000	1703.6	22.23	0.00023
n=6	**Rt.Parotid**	3968.8	2043.3	16.1	0.0000051	4159.3	1994.1	15.76	0.0000032
	Lt.Parotid	5396.7	2014.5	15.7	0.0000034	5142	1759.7	13.37	0.00000026
	Larynx	7347.3	1143.5	56.1	0.3372	7257.13	1317	56.06	0.3368
	Cord	3515.7	1087.3	21.62	0.00015	3089.1	952.9	18.46	0.000012
n=7	**Brainstem**	5294.7	2948.1	30.414	0.011	4758	2740.3	26.11	0.00176
	Eye	4740.5	1529.5	35.03	0.00505	4478.4	1316	33.41	0.00237
	Cord	4847.8	2251.7	27.355	0.00644	39641	1841	21.67	0.000155
n=8	**Optic.Nerve**	5892	3451.5	44.424	1.028	5647	3450.7	41.7003	0.4837
	Parotid	6526.2	1821.1	13.77	0.00000042	6641.2	743.5	4.2	0.00000002
	Eye	4671.7	1699.6	35.3839	0.005946	4539.2	1358.2	33.97	0.0030979
n=9	**Optic.Chiasma**	5596.1	3789.4	43.1425	0.725	5214.8	3534.2	39.464	0.25029
	Parotid	6356.1	2081.3	16.2384	0.0000057	6001	1068.2	6.3	0.00000012
	Optic.Nerve	5636.1	4174.1	43.4526	0.790	5175.5	3815.8	38.66	0.1959
n=10	**Brainstem**	4423	2789.4	22.25	0.0009	4214.8	2534.2	20.24	0.00007
	Parotid	6256.1	2089.8	15.884	0.0000058	6362	1868.2	14.1	0.0000012

	Optic.Nerve	5736.1	4174.1	44.2576	0.94	5375.5	3916.3	39.48	0.265

Table(1)

Physical parameters and biological parameters for Target (PTV) cases:-

n	6MV	CI	HI	Min.D	Max.D	Mean.D	TCP	EUD
n=1	**FF**	0.79	1.03	6464.0	7600.2	7127.7	81.1	71.51
	FFF	0.76	1.04	6509.4	7670.6	7183.5	82.75	72.13
n=2	**FF**	0.82	1.06	6198.2	7765.6	7192.4	82.62	72.1
	FFF	0.79	1.05	6271.2	7767.8	7242.2	84.22	72.72
n=3	**FF**	0.77	1.1	4779.5	7854.3	7070	77.154	70.16
	FFF	0.88	1.08	4970.5	7910.4	7260.3	83.354	72.363
n=4	**FF**	0.62	1.05	5710	7640.2	7096.2	79.52	70.93
	FFF	0.61	1.05	5746.2	7668.4	7168.9	82.10	71.79
n=5	**FF**	0.51	1.05	4592.1	7832.7	7146.8	80.2	71.2
	FFF	0.52	1.05	4820.2	7866.5	7178.9	81.7	71.7
n=6	**FF**	0.93	1.05	5613.8	7802.6	7189.1	82.53	72.029
	FFF	0.92	1.05	5574.5	7819.4	7241.8	83.876	72.573
n=7	**FF**	0.86	1.05	6108.7	7736.2	7174.6	82.197	71.899
	FFF	0.89	1.06	6158.2	7868.1	7273.7	84.749	72.95
n=8	**FF**	0.85	1.04	6101.6	7736.2	7164.6	82.1569	71.895
	FFF	0.88	1.05	6147.2	7868.1	7288.7	84.949	72.99
n=9	**FF**	0.86	1.05	6001.1	7736.2	7164.6	82.1569	71.895
	FFF	0.88	1.05	6147.2	7898.1	7401.7	85.949	73.99
n=10	**FF**	0.84	1.04	6105.4	7645.3	7155.3	82.126	71.64
	FFF	0.82	1.04	6177.9	7733.6	7368.5	85.3	73.27

Table(2)

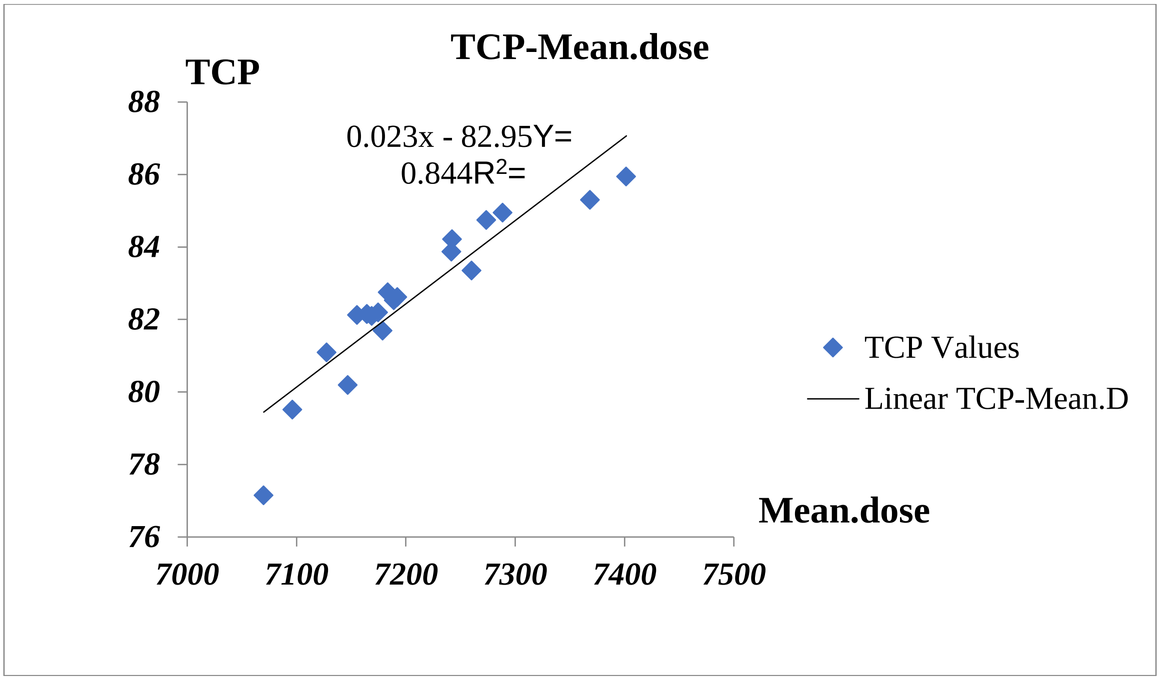


Fig (3): The correlation between Mean dose and TCP

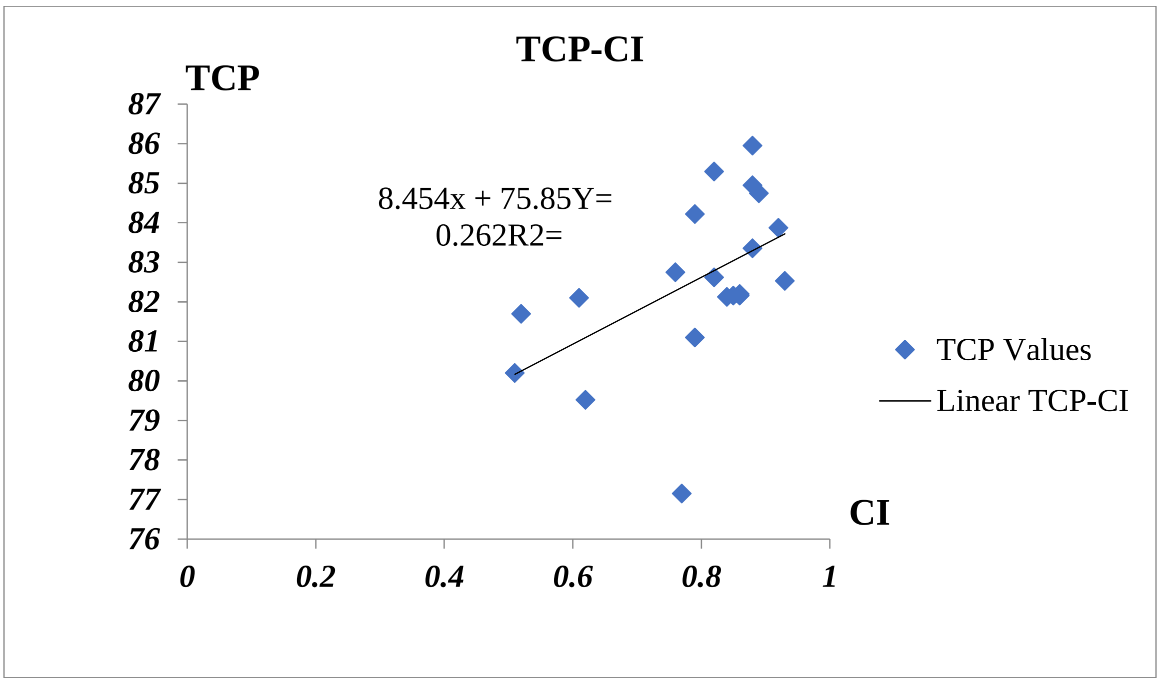


Fig (4): The correlation between CI and TCP

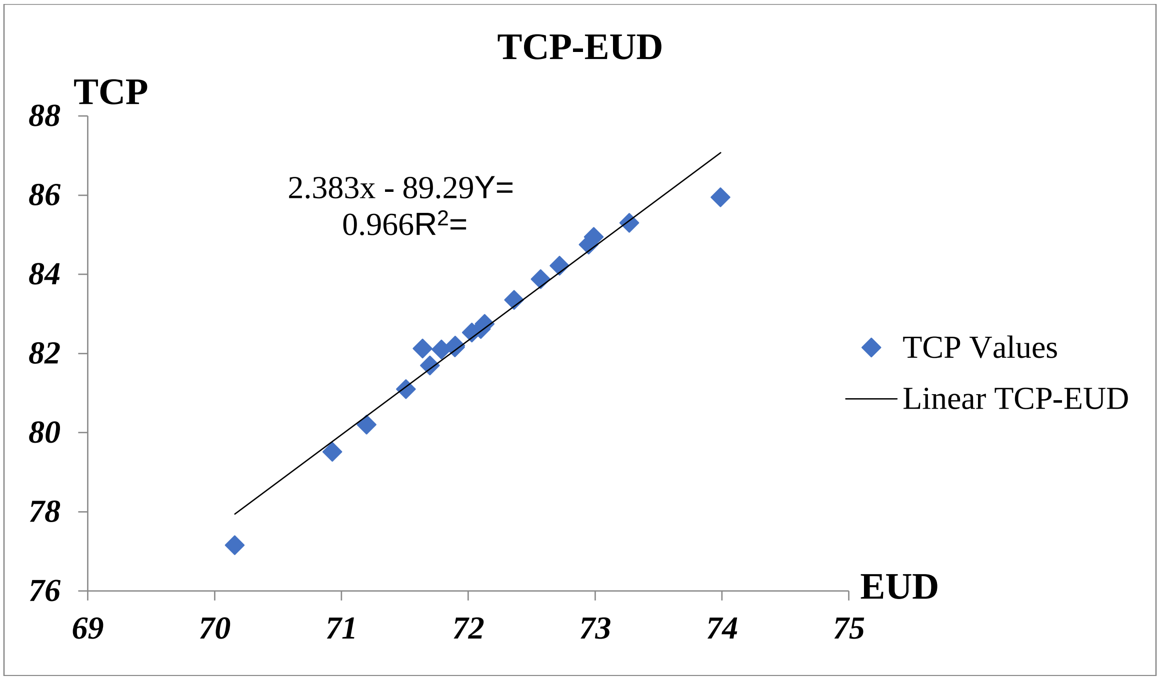


Fig (5): The correlation between EUD and TCP

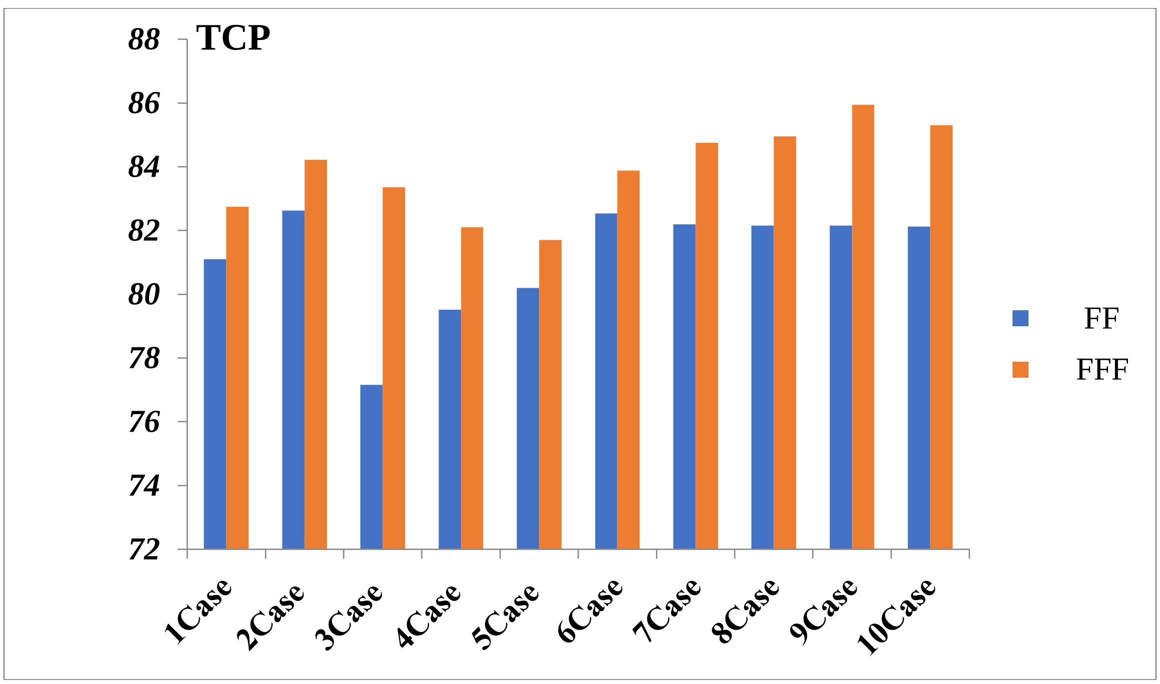


Diagram (1): The difference in TCP Values between FF and FFF for all cases

Figure (1) shows that Dose Volume histogram (DVH) of atypical case drawn PTV and OAR curves for comparison between FF and FFF mode. The results showed no major differences between the two modes , where DVH are similarly, but if we translate into radiobiological parameters we found that there is difference in NTCP and TCP values as illustrated in tables(1,2) . Coverage of target volume was obtained for the ten cases evaluated in VMAT plan on using FF and FFF modes. Dose distribution of the two plans for atypical case are shown in Fig(2). It shows that both FF and FFF mode can achieve a comparable dose distribution in target.

According to table(1) It's clear that in the dosimetric (physical) parameters, there is dose reduction of Mean dose for parallel organs as Parotid as in case(8) , Larynx as in case(3) , Esophagus as in case(3) and Eye as case(8). Also dose reduction of Max dose for serial organs as Spinal cord as in case(7) , Optic Nerve as in case(9) and BrainStem as in case(7) using (6MV FFF) beam plans compared to (6MV FF), this reduction is also found in radiobiological parameter (NTCP) values of critical organs using (6MV FFF) beam plans which is lower than 6MV Flattened beams.

Results of physical and biological parameters of Target for all cases under study are given in Table(2) , the target dose coverage are compared, and the results show that there is difference between 6FF and 6FFF in TCP values. The results Show that there is no differences observed in homogeneity or conformity index for both modes plans (HI ranged between 1.03 to 1.1) and (CI ranged between 0.51 to .93). Also the Mean dose of PTV for 6MV FFF mode shows slight increase compared to FF, this difference seem to be slight and not effective but in true when we translate and convert it to radiobiological parameters we found that there is interested increase in TCP values for all cases. Also we found that The Maximum dose for PTV in FFF mode was more than FF mode but still under tolerance ($V_{>110}$ <10%). According to Diagram(1) and Table(2) For target (PTV) which required maximize tumor control probability, there's increase in TCP values for all cases using (6MV FFF) compared to 6MV Flattened beam for example case(n=3), shows difference in TCP values up to 6% .

Figure (3) illustrates the correlation between Mean dose and TCP values for all cases, which positive correlation between mean dose as a physical parameter and TCP as a radiobiological parameter (corr.coeff of 84.45%) this mean that the high TCP value should required the high mean dose so we can depend on mean dose (physical parameters) for target (PTV) for physical evaluation of treatment plans when we use VMAT Technique.

Figure (4) illustrates the correlation between CI and TCP values for all cases (correlation coefficient of 26.23%) means that There's no correlation between (CI) as physical parameter and (TCP) as radiobiological parameter. These results mean that the high TCP shouldn't require the high CI so we cannot depend on CI for physical evaluation of treatment plans when we use VMAT technique.

Figure (5) illustrate the correlation between EUD and TCP values for all cases, There's positive high correlation between EUD and TCP as a radiobiological parameters (corr.coeff of 96.66%) this mean that the high TCP should require the high EUD.

4. Conclusions:

Multileaf collimator (MLC) segments, Gantry speed , and dose rate are dynamically varied during rotation of the gantry when we use VMAT , yielding a fast and highly conformal treatment delivery . the main advantage of VMAT include a large reduction in treatment time ,required to deliver a given fraction size. Head and neck cancers are challenging due to the involvement of multiple critical organs (OAR_S),it appears to be the ideal technique to be used with adaptive radiotherapy. VMAT plans using FFF beams has several advantage ,such as increased dose rate , reduced head leakage and reduced out of field doses to the patient. From the present study its shown that using treatment plans with 6MV FFF can improve dose sparing to OARs , increase mean dose and TCP for target (PTV), which can improve the deliver of a therapeutic dose to target. Also our results show that we can depend on Mean dose as aphysical parameter to evaluate the VMAT plan, on the other hand CI is not adequate parameter for physical evaluation of VMAT plan .

References:-

[1] Rekha Reddy Buchapudi, Ravikumar Manickam1, Anil Kumar, Tanvir Pasha, Varatharaj Chandraraj, Anil Pyakuryal, Ganesh Narayanasamy,Physical and Radiobiological Evaluation of Accelerated Intensity Modulated Radiotherapy for Locally Advanced Head and Neck Cancer and Comparison with Short-Term Clinical Outcomes, Asian Pacific Journal of Cancer Prevention 20:(2019) 2463-2470

[2] Joe H. Chang, Christopher Gehrke, Ramachandran Prabhakar, Suki Gill, MorikatsuWada, Daryl Lim Joon, Vincent Khoo, A simpl program for utilising biological modelling in radiotherapy plan evaluation, *Physica Medica 32: (2016) 248–254*

[3] PALMA. D. A, VERBAKEL. W. F, OTTO. K , SENAN. S, “ New developments in arc radiation therapy”, Cancer Treat Rev 36: (2010) 393-399, https://doi.org/10.1016/j.ctrv.2010.01.004

[4] Minna Ahlstrom 2015 PHD Thesis (Lund University)

[5] X. Sharon Qi, Vladimir A. Semenenko, and X. Allen Li , Improved critical structure sparing with biologically based IMRT optimization, MEDICAL PHYSICS 36:(2009) 1790-1799

[6] Wu, D. Djajaputra, Y. Wu, J. Zhou, H. H. Liu, and R. Mohan, Intensity-modulated radiotherapy optimization with gEUD-guided dosevolume objectives, Phys Med Biol 48: (2003) 279–91

[7] Thieke, T. Bortfeld, A. Niemierko, and S. Nill, From physical dose constraints to equivalent uniform dose constraints in inverse radiotherapy planning, Med Phys 30: (2003) 2332–2339

[8] N. Plowman, K. Cooke, and N. Walsh, Indications for tomotherapy intensity-modulated radiation therapy in pediatric radiotherapy,Extracranial disease, Br. J. Radiol 81: (2008) 872–880

[9] Bichay, D. Cao, and C. G. Orton, Point/counterpoint. Helical tomotherapy will ultimately replace linear accelerator based IMRT as the best way to deliver conformal radiotherapy, Med. Phys 35: (2008) 1625–1628

[10] F. Lee, F. M. Fang, P. J. Chao, T. J. Su, L. K. Wang, and S. W. Leung, Dosimetric comparisons of helical tomotherapy and step-and-shoot intensity modulated radiotherapy in nasopharyngeal carcinoma, Radiother.Oncol 89: (2008) 89–96

[11] K. Lee, I. I. Rosen, J. P. Gibbons, R. S. Fields, and K. R. Hogstrom , Helical tomotherapy for parotid gland tumors, Biol. Physics 70: (2008) 651-968

[12] Dang. T. M, Peters. M. J, Hickey. B , Semciw. A, Efficacy of flattening-filter-free beam in stereotactic body radiation therapy planning and treatment, A systematic review with meta-analysis. J.Med. Imaging Radiat. Oncol. 61: (2017) 379–387

[13] Cashmore.J, The characterization of unflattening photon beams from a 6 MV linear Accelerator, Phys. Med. Biol. 53: (2008) 1933–1946

[14] Vassiliev. O. N. et al, Dosimetric properties of photon beams from a flattening filter free clinical accelerator, Phys. Med. Biol.51: (2006) 1907–1917

[15] Kragl. G. et al, Dosimetric characteristics of 6 and 10 MV unflattening photon beams, Radiat. Oncol 93: (2009) 141–146

[16] Prendergast. B. M. et al, Flattening filter-free linacs improves treatmen delivery efficiency in stereotactic body radiation therapy, Med. Phys 14: (2013) 64–71

[17] Kry. S. F., Vassiliev. O. N. , Mohan. R, Out-of-field photon dose following removal of the flattening filter from a medical accelerator, Phys. Med. Biol 55: (2010) 2155–2166

[18] Georg. D, KnOOs. T , McClean, B, Current status and futureperspective of flattening filter free photon beams, Med. Phys 38: (2011) 1280– 1293

[19] Javedan . K , Javedan . K. , Monte Carlo comparison of superficial dose between flattening filter free and flattening beams, Phys. Med 30: (2014) 503–508

[20] Arslan. A, Sengul. B, Comparison of radiotherapy techniques with flattening filter and flattening filter-free in lung radiotherapy according to the treatment volume size, Sci Rep 10, 8983 (2020), https://doi.org/10.1038/s41598-020-66079-6

[21] Lu S-H, Cheng JC-H, Kuo S-H, Lee JJ-S, Chen L-H, Volumetric modulated arc therapy for nasopharyngeal carcinoma: A dosimetric comparison with TomoTherapy and step-and-shoot IMRT, Radiotherapy and oncology 104(3): (2012) 324– 330

[22] Yang R, Wang J, Xu S, Li H, SmartArc-based volumetric modulated arc therapy for endometrial cancer: a dosimetric comparison with helical tomotherapy and intensity- modulated radiation therapy. BMC Cancer 13: (2013)

[23] Hall WA, Fox TH, Jiang X, Prabhu RS, Rossi PJ, Treatment Efficiency of Volumetric Modulated Arc Therapy in Comparison With Intensity-Modulated Radiotherapy in the Treatment of Prostate Cancer, J Am Coll Radiol. 10(2): (2013) 128–134

[24] Ong CL, Verbakel WFAR, Cuijpers JP, Slotman BJ, Lagerwaard FJ, Stereotactic radiotherapy for peripheral lung tumors: A comparison of volumetric modulated arc therapy with 3 other delivery techniques, Radiother Oncol. 97(3): (2010) 437–442

[25] Hrbacek J, Lang S, Kloeck S , Commissioning of photon beams of a flattening filter-free linear accelerator and the accuracy of beam modeling using an anisotropic analytical algorithm, Int J Radiat Oncol Biol Phys 80(4): (2011) 1228–1237

[26] Lang S, Shrestha B, Graydon S, Cavelaars F, Linsenmeier C, Clinical application of flattening filter free beams for extracranial stereotactic radiotherapy, Radiother Oncol. 106(2): (2013) 255–259

[27] Zwahlen DR, Lang S, Hrbacek J, Glanzmann C, Kloeck S, The Use of Photon Beams of a Flattening Filter-free Linear Accelerator for Hypofractionated Volumetric Modulated Arc Therapy in Localized Prostate Cancer. Int J Radiat Oncol Biol Phys 83(5): (2012) 1655–1660

[28] Spruijt KH, Dahele M, Cuijpers JP, Jeulink M, Rietveld D, Flattening Filter Free vs Flattened Beams for Breast Irradiation, Int J Radiat Oncol Biol Phys 85(2): (2013) 506–513

الملخص العربي

دراسه شامله لخطط العلاج الإشعاعى بإستخدام تقنيه العلاج القوسى متغير الشده فى حاله وجود المرشح المسطح لشعاع الفوتون وبدون وجود المرشح فى علاج أورام الرأس والرقبه

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اهتمت هذه الدراســه بتقييم الفروق فى القياســات الفيزيائيه والإختلافات البيولوجيه بين خطط العلاج الإشــعاعى بواسطه أشعه الفوتون ذات طاقه (6MV) مع طريقه الفلتر المسطح للشعاع وبدون الفلتر باستخدام التقنيه الحديثه (VMAT) فى حالات أورام الرأس والرقبه.

تم خلال الدراســه البحثيه عمل 20 خطه علاجيه لعدد 10 حالات اورام لها تشــخيص squamous cell carcinoma بإستخدام نظام تخطيط علاج اشعاعى يسمى Monaco إصدار(5.51.10) باستخدام اشعه فوتونات ذات طاقه 6MV مع الفلتر المســطح وبدون الفلتر. جوده الخطه العلاجيه وكفاءتها تم تقييمها لكل الخطط العلاجيه فى كل الحالات وتم عمل ربط بين ال NTCP وال TCP لكل خطه علاجيه.

أظهرت النتائج ان هناك فروق واختلافات بين الخطه العلاجيه بواســطه ال 6MV FF والخطه العلاجيه بواســطه ال 6MV FFF فى قيم ال TCP الخاصه بالورم الهدف بينما لايوجد فروق فى التغطيه الاشعاعيه للورم ايضا لا يوجد اختلاف بين الخطط الاشعاعيه المختلفه فى قيم الجرعات الخاصه بالأعضاء السليمه NTCP وايضا لا يوجد فروق ملحوظه فى بعض المتغيرات الفيزيائيه للخطط العلاجيه المختلفه مثل HI و CI. فى النهايه نجد ان كل الخطط الاشــعاعيه المختلفه حققت كل الشروط المطلوبه لكل خطه وأن الخطه العلاجيه 6MV FFF بواسطه تقنيه ال VMAT هى أفضل واكفأ خطه يتم وضعها لعلاج حالات أورام الرأس والرقبه حيث تكون الأعلى قيمه TCP بالإضــافه الى الفوائد العديده المعروفه لدى الاشــعه بدون مرشح تسطيح.