National Imaging Associates, Inc. *	
Clinical guidelines: **INTENSITY-MODULATED RADIATION THERAPY (IMRT) FOR OTHER CANCERS**	**Original Date: June 2013**
CPT codes: 77385, 77386, G6015, G6016	**Last Revised Date: February 2021**
Guideline Number: NIA_CG_223	**Implementation Date: January 2022**

Most requests for radiation therapy are addressed by NIA treatment site clinical guidelines. However, there may be requests that are not. For such requests, determinations will be made on a case-by-case basis utilizing the following guidelines (when applicable) but not limited to: National Comprehensive Cancer Network (NCCN), American Society for Radiation Oncology ASTRO (i.e., Model Policies; Evidence-Based Consensus Statement), ACR Appropriateness Criteria, American Society of Clinical Oncology (ASCO) and/or peer reviewed literature.

This IMRT guideline applies to other cancers not addressed by NIA treatment site clinical guidelines.

Refer to applicable treatment site-specific guidelines for the management of primary malignancies. Applicable site-specific guidelines may include all or some of the sites below.

- Anal Cancer
- Bone Metastases
- Breast Cancer
- Cervical Cancer
- CNS Cancer
- Colon Cancer
- Rectal Cancer
- Endometrial Cancer
- Gastric Cancers
- Head and Neck Cancer
- Lung – Non-Small Cell
- Lung - Small Cell Lung Cancer
- Lymphoma - Hodgkin's Lymphoma
- Lymphoma - Non-Hodgkin's Lymphoma
- Pancreas Cancer
- Prostate Cancers

For metastasis to the brain, regardless of primary site, refer to the NIA clinical guideline for Central Nervous System (CNS).

For metastasis to bone, refer to the NIA clinical guideline for Bone Metastases.

For all other metastases, refer to the NIA clinical guideline for Metastatic disease.

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MEDICALLY NECESSARY INDICATIONS FOR INTENSITY-MODULATED RADIATION THERAPY (IMRT) (ASTRO, 2015)**:**

- Anal cancer
- Esophageal cancer
- Prostate cancer
- Trachea cancer
- Thyroid cancer
- Head and neck cancer
- CNS lesions with close proximity to the optic nerve, lens, retina, optic chiasm, cochlea or brain stem. (See NIA CNS Clinical Guidelines)
- Primary Bone and Articular Cartilage cancer of the skull and face, vertebral column, sacrum, and coccyx
- Treatment for repeat irradiation of a field that has received prior irradiation
- Vulvar cancer
- Pediatric patients less than 21 years with a radiosensitive tumor

CONDITIONS REQUIRING ADDITIONAL PHYSICIAN REVIEW

IMRT is not indicated as a standard treatment option and should not be used routinely for the delivery of radiation therapy for all other conditions including, but not limited to (ASTRO, 2015):

- Breast cancer
- Colon cancer
- Gastric cancer
- Gynecological cancer
- Lung cancer
- Lymphoma
- Pancreas cancer
- Pelvic bone cancer
- Primary or secondary liver cancer
- Rectal cancer
- Secondary bone and articular cartilage cancer
- Soft tissue sarcoma
- All other neoplasms not listed above as medically necessary

IMRT may be indicated for the above conditions if <u>ALL</u> of the following are present (ASTRO**,** 2015)**:**

IMRT is strictly defined by the utilization of inverse planning modulation techniques. IMRT may be appropriate for limited circumstances in which radiation therapy is indicated and 3D conformal radiation therapy (3D-CRT) techniques cannot adequately deliver the radiation prescription without exceeding normal tissue radiation tolerance, the delivery is anticipated to contribute to potential late toxicity or tumor volume dose heterogeneity is such that unacceptable hot or cold spots are created. If IMRT is utilized, techniques to account for respiratory motion should be performed when appropriate.

Clinical rationale and documentation for performing IMRT rather than 2D or 3D-CRT treatment planning and delivery will need to:

- Demonstrate how 3D-CRT isodose planning cannot produce a satisfactory treatment plan (as stated above) via the use of patient-specific dose volume histograms and isodose plans. 3D-CRT techniques, such as step-and-shoot or field-in-field, should be considered for the comparison.
- Confirm the IMRT requested will be inversely planned (forward plans or 'field-in-field' plans are not considered IMRT).
- Provide tissue constraints for both the target and affected critical structures.

BACKGROUND

Intensity-Modulated Radiation Therapy (IMRT) is a computer-based method of planning for and delivery of, generally narrow, patient-specific, spatially, and often temporally modulated beams of radiation to solid tumors within a patient. IMRT planning and delivery uses an approach for obtaining the highly conformal dose distributions needed to irradiate complex targets positioned near, or invaginated by, sensitive normal tissues, thus improving the therapeutic ratios. IMRT delivers a more precise radiation dose to the tumor while sparing the surrounding normal tissues by using non-uniform radiation beam intensities that are determined by various computer-based optimization techniques. The computer-based optimization process is referred to as “inverse planning.” Inverse planning develops a dose distribution based on the input of specific dose constraints for the Planned Treatment Volume (PTV) and nearby clinical structures and is the beginning of the IMRT treatment planning process. The Gross Tumor Volume (GTV), the PTV and surrounding normal tissues must be identified by a contouring procedure and the optimization must sample the dose with a grid spacing of 1 cm or less. Traditional “field-in-field technique,” which is neither MLC nor compensator-based, is not considered IMRT but rather external beam therapy.

The decision process for using IMRT requires an understanding of accepted practices that take into account the risks and benefits of such therapy compared to conventional treatment techniques. While IMRT technology may empirically offer advances over conventional or 3-D conformal radiation, a comprehensive understanding of all consequences is required before applying this technology. IMRT is not a replacement therapy for conventional radiation therapy methods.

POLICY HISTORY

Date	Summary
February 2021	No changes
February 2020	Updated references
February 2019	Added and updated references

REFERENCES

American College of Radiology (ACR). ACR Practice Parameter for Intensity Modulated Radiation Therapy (IMRT). https://www.acr.org/~/media/eabb986bc4ff4a78b53b001a059f27b3.pdf. Published 2016. Accessed May 15, 2017.

American Society for Radiation Oncology (ASTRO) Model Policy. Intensity Modulated Radiation Therapy (IMRT). https://www.astro.org/uploadedFiles/_MAIN_SITE/Daily_Practice/Reimbursement/Model_Policies/Content_Pieces/IMRTMP.pdf. Published December 9, 2015. Accessed May 15, 2017.

Bentzen SM, Constine LS, Deasy JO, et al. Quantitative analyses of normal tissue effects in the clinic QUANTEC: An introduction to the scientific issues. Introductory paper. *Int J Radiat Oncol Biol Phys*. 2010; 76(3):S3-S9.

Beriwal S, Coon D, Heron DE, et al. Preoperative intensity-modulated radiotherapy and chemotherapy for locally advanced vulvar carcinoma. *Gynecol Oncol.* May 2008; 109(2):291-5. doi: 10.1016/j.ygyno.2007.10.026.

Beriwal S, Heron DE, Kim H, et al. Intensity-modulated radiotherapy for the treatment of vulvar carcinoma: a comparative dosimetric study with early clinical outcome. *Int J Radiat Oncol Biol Phys.* April 2006; 64(5):1395-1400. doi:10.1016/j.ijrobp.2005.11.007.

Braam PM, Terhaard CH, Roesink JM, et al. Intensity-modulated radiotherapy significantly reduces xerostomia compared with conventional radiotherapy. *Int J Radiat Oncol Biol Phys.* November 2006; 66(4):975-980. doi:10.1016/j.ijrobp.2006.06.045.

Chen AM, Daly ME, Bucci MK, et al. Carcinomas of the paranasal sinuses and nasal cavity treated with radiotherapy at a single institution over five decades: are we making improvement? *Int J Radiat Oncol Biol Phys.* 2007; 69(1):141-147. doi:10.1016/j.ijrobp.2007.02.031.

Chen MF, Tseng CJ, Tseng CC, et al. Clinical outcome in posthysterectomy cervical cancer patients treated with concurrent Cisplatin and intensity-modulated pelvic radiotherapy: comparison with conventional radiotherapy. *Int J Radiat Oncol Biol Phys.* 2007; 67(5):1438-1444. doi:10.1016/j.ijrobp.2006.11.005.

Chen YJ, Liu A, Han C, et al. Helical tomotherapy for radiotherapy in esophageal cancer: a preferred plan with better conformal target coverage and more homogeneous dose distribution. *Med Dosim.* 2007; 32(3):166-171. doi:10.1016/j.meddos.2006.12.003.

Clark EE, Thielke A, Kriz H, et al. Intensity modulated radiation therapy. Final Evidence Report. Prepared by the Oregon Health & Science University, Center for Evidence-based Policy for the Washington State Health Care Authority, Health Technology Assessment Program. Olympia, WA: Washington State

Health Care Authority, Health Technology Assessment Program. http://www.hca.wa.gov/hta/Pages/intensity_radiation.aspx. Published August 20, 2012.

Cozzi L, Clivio A, Bauman G, et al. Comparison of advanced irradiation techniques with photons for benign intracranial tumours. *Radiother Oncol.* August 2006; 80(2):268-273. doi:10.1016/j.radonc.2006.07.012.

Daly ME, Le QT, Maxim PG, et al. Intensity-modulated radiotherapy in the treatment of oropharyngeal cancer: clinical outcomes and patterns of failure. *Int J Radiat Oncol Biol Phys.* 2010; 76(5):1339-1346. doi: 10.1016/j.ijrobp.2009.04.006.

Ding M, Newman F, Raben D. New radiation therapy techniques for the treatment of head and neck cancer. *Otolaryngol Clin North Am.* 2005; 38(2):371-395. http://dx.doi.org/10.1016/j.otc.2004.10.009.

Eccles CL, Bissonnette JP, Craig T, et al. Treatment planning study to determine potential benefit of intensity modulated radiotherapy versus conformal radiotherapy for unresectable hepatic malignancies. *Int J Radiat Oncol Biol Phys.* 2008; 72(2):582-588. doi: 10.1016/j.ijrobp.2008.06.1496.

Fang FM, Chien CY, Tsai WL, et al. Quality of life and survival outcome for patients with nasopharyngeal carcinoma receiving three-dimensional conformal radiotherapy vs. intensity-modulated radiotherapy. A longitudinal study. *Int J Radiat Oncol Biol Phys.* 2008; 72(2):356-364. doi: 10.1016/j.ijrobp.2007.12.054.

Floyd NS, Woo SY, Teh BS, et al. Hypofractionated intensity-modulated radiotherapy for primary glioblastoma multiforme. *Int J Radiat Oncol Biol Phys.* 2004; 58(3):721-726. doi:10.1016/S0360-3016(03)01623-7.

Fuller CD, Choi M, Forthuber B, et al. Standard fractionation intensity modulated radiation therapy (IMRT) of primary and recurrent glioblastoma multiforme. *Radiat Oncol.* 2007; 2:26. doi: 10.1186/1748-717X-2-26.

Gierga DP, Chen GT, Kung JH, et al. Quantification of respiratory-induced abdominal tumor motion and its impact on IMRT dose distributions. *Int J Radiat Oncol Bio Phys.* 2004; 58(5):1584-1595. doi:10.1016/j.ijrobp.2003.09.077.

Goodman KA, Toner S, Hunt M, et al. Intensity-modulated radiotherapy for lymphoma involving the mediastinum. *Int J Radiat Oncol Biol Phys.* May 2005; 62(1):198-206. doi:10.1016/j.ijrobp.2004.08.048.

Hall EJ. Intensity-modulated radiation therapy, protons, and the risk of second cancers. *Int J Radiat Oncol Bio Phys.* 2006; 65(1):1-7. doi:10.1016/j.ijrobp.2006.01.027.

Hartford AC, Palisca MG, Eichler TJ, et al. American Society for Therapeutic Radiology and Oncology, American College of Radiology. American Society for Therapeutic Radiology and Oncology (ASTRO) and

American College of Radiology (ACR) Practice Guidelines for Intensity-Modulated Radiation Therapy (IMRT). *Int J Radiat Oncol Biol Phys*. 2009; 73(1):9-14.
Hodge CW, Bentzen SM, Wong G, et al. Are we influencing outcome in oropharynx cancer with intensity-modulated radiotherapy? An inter-era comparison. *Int J Radiat Oncol Biol Phys.* 2007; 69(4):1032-1041. doi:10.1016/j.ijrobp.2007.05.017.
http://www.nccn.org/professionals/physician_gls/f_guidelines.asp#site.

IMRT Documentation Working Group, Holmes T, Das R, et al. American Society of Radiation Oncology recommendations for documenting intensity-modulated radiation therapy treatments. *Int J Radiat Oncol Biol Phys.* August 2009; 74(5):1311-1318. doi: 10.1016/j.ijrobp.2009.04.037.

Jackson A, Marks LB, Bentzen SM, et al. The lessons of QUANTEC: Recommendations for reporting and gathering data on dose-volume dependencies of treatment outcome. *Int J Radiat Oncol Biol Phys*. 2010; 76(3):S155-S160.

Jang JW, Kay CS, You CR, et al. Simultaneous multitarget irradiation using helical tomotherapy for advanced hepatocellular carcinoma with multiple extrahepatic metastases. *Int J Radiat Oncol Biol Phys.* 2009; 74(2):412-418. doi: 10.1016/j.ijrobp.2008.08.034.

Jin JY, Chen Q, Jin R, et al. Technical and clinical experience with spine radiosurgery: a new technology for management of localized spine metastases. *Technol Cancer Res Treat.* 2007; 6(2):127-133. http://www.ncbi.nlm.nih.gov/pubmed/17375975.

Kavanagh BD, Pan CC, Dawson LA, et al. Radiation dose-volume effects in the stomach and small bowel. QUANTEC: organ-specific paper. *Int J Radiat Oncol Biol Phys.* 2010; 76(3 Suppl):S101-S107.

Kavanagh BD, Pan CC, Dawson LA, et al. QUANTEC: Organ-specific paper: Radiation dose-volume effects in the stomach and small bowel. *Int J Radiat Oncol Biol Phys.* 2010; 76(3):S101–S107.

Kirkpatrick JP, Van der Kogel AJ, Schultheiss TE. Radiation dose-volume effects in the spinal cord. QUANTEC organ-specific paper. *Int J Radiat Oncol Biol Phys*. 2010; 76(3):S42-S49.

Lee CT, Bilton SD, Famiglietti RM, et al. Treatment planning with protons for pediatric retinoblastoma, medulloblastoma, and pelvic sarcoma: how do protons compare with other conformal techniques? *Int J Radiat Oncol Biol Phys.* October 2005; 63(2):362-372. doi:10.1016/j.ijrobp.2005.01.060.

Lee NY, De Arruda FF, Puri DR, et al. A comparison of intensity-modulated radiation therapy and concomitant boost radiotherapy in the setting of concurrent chemotherapy for locally advanced oropharyngeal carcinoma. *Int J Radiat Oncol Biol Phys.* November 2006; 66(4):966-974. doi:10.1016/j.ijrobp.2006.06.040.

Levegrün S, Hof H, Essig M, et al. Radiation-induced changes of brain tissue after radiosurgery in patients with arteriovenous malformations: correlation with dose distribution parameters. *Int J Radiat Oncol Biol Phys.* 2004; 59(3):796-808. doi:10.1016/j.ijrobp.2003.11.033.

Luchi T, Hatano K, Narita Y, et al. Hypofractionated high-dose irradiation for the treatment of malignant astrocytomas using simultaneous integrated boost technique by IMRT. *Int J Radiat Oncol Biol Phys.* 2006; 64(5):1317-1324. doi:10.1016/j.ijrobp.2005.12.005

Luchi T, Hatano K, Yuichiro N, et al. Hypofractionated high-dose irradiation for the treatment of malignant astrocytomas using simultaneous integrated boost technique by IMRT. *Int J Radiat Oncol Biol Phys.* 2006; 64(5):1317-1324. doi:10.1016/j.ijrobp.2005.12.005.

Mackley HB, Reddy CA, Lee SY, et al. Intensity-modulated radiotherapy for pituitary adenomas: the preliminary report of the Cleveland Clinic experience. *Int J Radiat Oncol Biol Phy.* January 2007; 67(1)232-239. doi:10.1016/j.ijrobp.2006.08.039.

Marks LB, Bentzen SM, Deasy JO, et al. Radiation dose-volume effects in the lung. QUANTEC: Organ specific paper. *Int J Radiat Oncol Biol Phys.* 2010; 76(3):S70-S76. doi: 10.1016/j.ijrobp.2009.06.091.

Marks LB, Yorke ED, Jackson A, et al. Use of normal tissue complication probability models in the clinic. *Int J Radiat Oncol Biol Phys.* 2010; 76(3):S10-S19. doi: 10.1016/j.ijrobp.2009.07.1754.

Marks LB, Bentzen SM, Deasy JO, et al. Radiation dose-volume effects in the lung. QUANTEC: Organ specific paper. *Int J Radiat Oncol Biol Phys*. 2010; 76(3):S70-S76.

Matzinger O, Heimsoth I, Poortmans P, et al. Toxicity at three years with and without irradiation of the internal mammary and medial supraclavicular lymph node chain in stage I to III breast cancer (EORTC trial 22922/10925). *Acta Oncologica.* 2010; 49:24-34. doi: 10.3109/02841860903352959.

McDonald MW, Godette KD, Whitaker DJ, et al. Three-year outcomes of breast intensity-modulated radiation therapy with simultaneous integrated boost. *Int J Radiat Oncol Biol Phys.* 2010; 77(2):523-530. doi: 10.1016/j.ijrobp.2009.05.042.

McIntosh A, Hagspiel KD, Al-Osaimi AM, et al. Accelerated treatment using intensity-modulated radiation therapy plus concurrent capecitabine for unresectable hepatocellular carcinoma. *Cancer.* 2009; 115(21):5117-5125. doi: 10.1002/cncr.24552.

Menkarios C, Azria D, Lalibert B, et al. Optimal organ-sparing intensity-modulated radiation therapy (IMRT) regimen for the treatment of locally advanced anal canal carcinoma: a comparison of conventional and IMRT plans. *Radiat Oncol.* November 2007; 2:41. doi: 10.1186/1748-717X-2-41.

Milker-Zabel S, Zabel-du Bois A, Huber P, et al. Intensity-modulated radiotherapy for complex-shaped meningioma of the skull base: long-term experience of a single institution. *Int J Radiat Oncol Biol Phys.* July 2007; 68(3):858-863. doi:10.1016/j.ijrobp.2006.12.073.

Munter MW, Hoffner S, Hof H, et al. Changes in salivary gland function after radiotherapy of head and neck tumors measured by quantitative scintigraphy: Comparison of intensity modulated radiotherapy and conventional radiation therapy with and without amifostine. *Int J Radiat Oncol Biol Phys.* 2007; 67(3):651-659. doi:10.1016/j.ijrobp.2006.09.035.

Narayana A, Chang J, Yenice K, et al. Hypofractionated stereotactic radiotherapy using intensity modulated radiotherapy in patients with one or two brain metastases. *Stereotact Funct Neurosurg.* 2007; 85(2-3):82-87. doi: 10.1159/000097923.

Narayana A, Yamada J, Berry S, et al. Intensity-modulated radiotherapy in high-grade gliomas: clinical and dosimetric results. *Int J Radiat Oncol Biol Phys.* 2006; 64(3):892-897. doi:10.1016/j.ijrobp.2005.05.067.

National Cancer Institute (NCI). National Cancer Institute Guidelines for the Use of Intensity-Modulated Radiation Therapy in Clinical Trials. Bethesda, MD: NCI. http://atc.wustl.edu/home/NCI/IMRT_NCI_Guidelines_v4.0.pdf. Published January 2005.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Bone cancer. Version 2.2018. https://www.nccn.org/professionals/physician_gls/pdf/bone.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Central nervous system cancers. Version 1:2018. https://www.nccn.org/professionals/physician_gls/pdf/cns.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Esophageal and esophagogastric junction cancers. Version 1:2018. https://www.nccn.org/professionals/physician_gls/pdf/esophageal.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Malignant pleural mesothelioma. Version 2.2018. https://www.nccn.org/professionals/physician_gls/pdf/mpm.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Pancreatic adenocarcinoma. Version 1:2018. https://www.nccn.org/professionals/physician_gls/pdf/pancreatic.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Soft tissue sarcoma. Version 2.2018. https://www.nccn.org/professionals/physician_gls/pdf/sarcoma.pdf. Accessed May 1, 2018.

National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Thymomas and thymic carcinomas. Version 2.2018. https://www.nccn.org/professionals/physician_gls/pdf/sarcoma.pdf. Accessed on May 1, 2018.

National Comprehensive Cancer Network (NCCN). Clinical Practice Guidelines in Oncology. Hepatobiliary Cancers. 1:2018. https://www.nccn.org/professionals/physician_gls/pdf/hepatobiliary.pdf. Accessed May 1, 2018.

Pacholke HD, Amdur RJ, Morris CG, et al. Late xerostomia after intensity-modulated radiation therapy versus conventional radiotherapy. *Am J Clin Oncol.* 2005; 28(4):351-358. https://www.ncbi.nlm.nih.gov/pubmed/16062076.

Pai Panandiker A, Ning H, Likhacheva A, et al. Craniospinal irradiation with spinal IMRT to improve target homogeneity. *Int J Radiat Oncol Biol Phys.* August 2007; 68(5):1402-1409. doi: 10.1016/j.ijrobp.2007.02.037.

Penagaricano JA, Papanikolaou N, Yan Y, et al. Application of intensity-modulated radiation therapy for pediatric malignancies. *Med Dosim.* 2004; 29(4):247-253. http://www.ncbi.nlm.nih.gov/pubmed/15528065.

Pepek JM, Willett CG, Wu QJ, et al. Intensity-modulated radiation therapy for anal malignancies: A preliminary toxicity and disease outcomes analysis. *Int J Radiat Oncol Biol Phys.* 2010; 78(5):1413-1419. doi: 10.1016/j.ijrobp.2009.09.046.

Pow EH, Kwong DL, McMillan AS, et al. Xerostomia and quality of life after intensity-modulated radiotherapy vs. conventional radiotherapy for early-stage nasopharyngeal carcinoma: initial report on a randomized controlled clinical trial. *Int J Radiat Oncol Biol Phys.* November 2006; 66(4):981-991. doi:10.1016/j.ijrobp.2006.06.013.

Qi XS, Schultz CJ, Li XA. Possible fractionated regimens for image-guided intensity-modulated radiation therapy of large arteriovenous malformations. *Phys Med Biol.* 2007; 52(18):5667-5682. doi:10.1088/0031-9155/52/18/013.

Rades D, Fehlauer F, Wroblesky J, et al. Prognostic factors in head-and-neck cancer patients treated with surgery followed by intensity-modulated radiotherapy (IMRT), 3D-conformal radiotherapy, or conventional radiotherapy. *Oral Oncol.* 2007; 43(6):535-543. doi:10.1016/j.oraloncology.2006.05.006.

Radiological Society of North America, Inc. (RSNA). Intensity-modulated radiotherapy IMRT. http://www.radiologyinfo.org/pdf/imrt.pdf. Last reviewed 2013.

Rose J, Rodrigues G, Yaremko B, et al. Systematic review of dose-volume parameters in the prediction of esophagitis in thoracic radiotherapy. *Radiother Oncol.* 2009; 91(3):282-287. doi: 10.1016/j.radonc.2008.09.010.

Rusthoven KE, Carter DL, Howell K, et al. Accelerated partial-breast intensity-modulated radiotherapy results in improved dose distribution when compared with three-dimensional treatment-planning techniques. *Int J Radiat Oncol Biol Phys.* January 2008; 70(1):296-302. doi:10.1016/j.ijrobp.2007.08.047.

Sajja R, Barnett GH, Lee SY, et al. Intensity-modulated radiation therapy (IMRT) for newly diagnosed and recurrent intracranial meningiomas: Preliminary results. *Technol Cancer Res Treat.* 2005; 4(6):675-82. https://www.ncbi.nlm.nih.gov/pubmed/16292888.

Samson, D.J., Ratko, T.A., Rothenberg, B.M., et al. Comparative effectiveness and safety of radiotherapy treatments for head and neck cancer. Comparative Effectiveness Review No. 20. (Prepared by Blue Cross and Blue Shield Association Technology Evaluation Center) Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK45242. Published May 2010.

Selvaraj RN, Beriwal S, Pourarian RJ, et al. Clinical implementation of tangential field intensity modulated radiation therapy (IMRT) using sliding window technique and dosimetric comparison with 3D conformal therapy (3DCRT) in breast cancer. *Med Dosim.* 2007; 32(4):299-304. https://www.ncbi.nlm.nih.gov/m/pubmed/17980832/?i=2&from=/16143787/related.

Studer G, Luetolf UM, Glanzmann C. Locoregional failure analysis in head-and-neck cancer patients treated with IMRT. *Strahlenther Onkol.* August 2007; 8:417-423; discussion 424-5. doi: 10.1007/s00066-007-1663-8.

Staremi M, Ringash J, Dawson LA. Upper abdominal malignancies: Intensity-modulated radiation therapy. *Front Radiat Ther Oncol.* 2007; 40:272-288. doi:10.1159/000106041.

Varlotto JM, Gerszten K, Heron DE, et al. The potential nephrotoxic effects of intensity-modulated radiotherapy delivered to the para-aortic area of women with gynecologic malignancies: Preliminary results. *Am J Clin Oncol.* June 2006; 29(3):281-289. https://www.ncbi.nlm.nih.gov/pubmed/16755182.

Veldeman L, Madani I, Hulstaert F, et al. Evidence behind use of intensity-modulated radiotherapy: a systematic review of comparative clinical studies. *Lancet Oncol.* April 2008; 9(4):367-75. doi: 10.1016/S1470-2045(08)70098-6.

Wang SJ, Choi M, Fuller CD, et al. Intensity-modulated Radiosurgery for patients with brain metastases: A mature outcomes analysis. *Technol Cancer Res Treat.* June 2007; 6(3):161-168. https://www.ncbi.nlm.nih.gov/pubmed/17535023.

Wang W, Purdie TG, Rahman M, et al. Rapid automated treatment planning process to select breast cancer patients for active breathing control to achieve cardiac dose reduction. *Int J Radiat Oncol Biol Phys*. 2010; 1-8. doi: 10.1016/j.ijrobp.2010.09.026.

Weber DC, Peguret N, Dipasquale G, et al. Involved-node and involved-field volumetric modulated arc vs. fixed beam intensity-modulated radiotherapy for female patients with early-stage supra-diaphragmatic Hodgkin lymphoma: A comparative planning study. *Int J Radiat Oncol Biol Phys.* 2009; 75(5):1578-1586. doi: 10.1016/j.ijrobp.2009.05.012.

Yovino S, Poppe M, Jabbour S, et al. Intensity-modulated radiation therapy significantly improves acute gastrointestinal toxicity in pancreatic and ampullary cancers. *Int J Radiat Oncol Biol Phys.* January 2011; 79(1):158-162. doi: 10.1016/j.ijrobp.2009.10.043.

Zagar TM, Marks LB. Breast cancer radiotherapy and coronary artery stenosis: location, location, location. *J Clin Oncol.* February 2012; *30*(4):350-352.doi: 10.1200/JCO.2011.38.9304.

Reviewed / Approved by NIA Clinical Guideline Committee

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.