

Mayo Clinic Arizona

Our Experience: Five-Fraction Breast Cancer Treatment

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Technology Advances in Radiation Oncology



- Technology advancement drives the success of Hypo-fractionation and SBRT treatment:
 - Simulation, Treatment planning, and Treatment delivery
- IGRT and surface-guidance technology has led to efficient and accurate delivery for hypo-fractionated breast treatment

Timmerman et al. J Clin Oncol. 2007;25(8):947-952 Rong et al. Hypofractionation and SABR: 25 years of evolution in medical physics and a glimpse of the future. Med Phys. 2023 | slide-2

Past 20 Years of Breast Clinical Trials

- Historical clinical trials for breast:
- Planning: CyberKnife or 3D tangential fields
- IGRT: chest-wall tracking or kV/MV x-rays
- CTV-PTV Margin: 2mm with tracking or 10mm without tracking (5mm pulled from skin)
- MCA experience: CTV-PTV margin 0mm, requiring IGRT imaging and surfaceguidance for setup and monitoring

Rong Y, Ding X, Daly ME. Hypofractionation and SABR: 25 years of evolution in medical physics and a glimpse of the future. Med Phys. 2023.

Studies Disease site		Immobilization	Motion management	Target margin (mm)	Treatment planning	IGRT	Tumor tracking	
Rusthoven et al. ⁸⁴ ; Phase I/II, 2009	Lung (excluding central lesions), pt n = 38; Phase I: 36–60 Gy in 3; Phase II: 60 Gy in 3 fx	Customized external vacuum-type or synthetic body mold	Abdominal compression or ABC	4DCT, ITV to PTV: seven radial and 15 craniocaudal; Or five radial and 10 craniocaudal	Dynamic conformal arcs, or multi non- coplanar static beams	Orthogonal X-rays or on-board CT	NA	
Rusthoven et al. ⁸⁸ Phase I/II, 2009	Liver metastases, pt n = 47;	Customized external vacuum-type or synthetic body mold	Abdominal compression or ABC	4DCT, ITV to PTV: seven radial and 15 craniocaudal; Or five radial and 10 craniocaudal	Dynamic conformal arcs, or multi non- coplanar static beams	Orthogonal X-rays or on-board CT	Fluoroscopy	
Chang et al., ⁶⁶ retrospective, 2009	Pancreas, pt n = 77; SRS 25 Gy in 1 fx	Alpha Cradle immobilization	End-expiration and End- inspiration of 4DCT	GTV to PTV: 2–3 mm	CyberKnife	Three to five gold fiducials, orthogonal X-ray	Synchrony tracking on chest	
Ryu et al. ⁷⁹ Phase II, 2011	Spine, pt <i>n</i> = 39; Phase II: 16 Gy in 1 fx	Immobilization systems, that is, vacuum bag, alpha cradle, SBF with rigid pillow	NA	Radiosurgery target: 0 Beam aperture margin 0–3 mm allowed	IMRT non- coplanar non opposing beams, or arcs	IGRT: pre-tx, post shift and post-tx	NA	
Bondiau et al ⁶⁷ ; Phase I, 2013	Breast, pt n = 25; Phase I: 19.5-31.5 in 3 fx.	NA	Fiducial surface tracking	CTV to PTV: 2 mm (5 mm pulled from skin)	Cyberknife robotic SABR	Orthogonal X-rays	Synchrony tracking on chest	
Bezjak, et al. ^{/3} Phase I/II, 2019	NSCLC (central lesions), pt n = 120; Phase I/II: 40–60 Gy in	Require a fixed 3D coordinate system defined by fiducials, that is, SBF with conforming	Abdominal compression, beam gating, tumor tracking or breath-hold	If no 4DCT, GTV to PTV: five radial and 10 craniocaudal with 4DCT, ITV to PTV: five	3D CRT or IMRT	IGRT: Daily localization images; Verification CTs or portal films	NA	
Brunt et al. ⁷⁸ phase III, 2020	Breast, pt n = 4096; Phase III test arm: 26–27 in 5 fx	NA	NA	CTV to PTV: 10 mm (5 mm pulled from skin)	3D tangential fields	Electronic port films MV or kV X-rays	NA	
Tree et al,/ ⁵ Phase III, 2022	Prostate, pt n = 874; Phase III test arm: 36.25 Gy in 5 fx	NA	Three or more prostatic fiducial markers; No rectal spacing	CTV to PTV: 4–5 isometric, 3–5 posteriorly	VMAT	Daily IGRT (fiducial or CBCT), re-image if delivery > 3 min	Intra-fractional motion monitor	



Implementation: Mayo Clinical Trials

- Mayo Clinic research trial held 4/4/18-2/11/2020
- Patients with localized breast cancer managed with breast conserving surgery
- 2 Arms- Randomized to moderate hypofractionation breast RT (40Gy /15 fractions) or extreme hypofractionation (25Gy /5 fractions)
 - Optional Simultaneous Integrated Boost (SIB) for 48Gy or 30Gy
- A total of 107 patients were in the study
 - 54 patients moderate hypofractionation
 - 53 patients extreme hypofractionation.

Implementation: Mayo Clinical Trials Continued...

- Clinical trial results:
 - No significant differences in any characteristics were noted between the two arms.
 - At end of treatment, there was less itching and blistering in the 5fraction group.
 - After 3 months, same patient reported outcomes
 - After 3 years, same patient reported outcomes



Implementation: Mayo Clinical Trials Continued...

- Clinical trial results:
 - This study showed that Extreme-hypofractionation consisting of 25 Gy in 5 fractions provided a better toxicity and cosmesis profile in comparison to moderate hypofractionation 40 Gy in 15 fractions.
 - Patients receiving 25 Gy in 5 fractions had moderate or mild skin reactions compared to 15 fractions.
- <u>After this trial was completed</u>, <u>5-fraction breast treatments became common practice at Mayo</u> <u>Clinic Arizona</u>.





Implementation: Patients that can be considered

- Indications
 - Whole breast
 - Chest-wall alone
 - Reconstructed breast
- Setup
 - Supine
 - Prone
- Breast with lymph node involvement <u>cannot</u> be considered for five-fraction treatment.



Implementation: Fractionation Patterns

Breast

- 25Gy/5 fractions
- Partial Breast for lumpectomy cavities
 - 21Gy/3 fractions
 - 25Gy/5 fractions
- Breast with Simultaneous Integrated Boost (SIB)
 - 25Gy/5 fractions (breast) and 30Gy/5 fractions (SIB to PTVLumpectomy)





Workflow: Supine Simulation Process

Breast setup

- Immobilization using Orfit and upper vacloc
- Both arms up in vacloc
- No tattoos
- Partial Breast Setup
 - Same setup, but unaffected arm is down along side, due to CBCT.
- Siemens CT Scan
 - Free Breathing scan
 - All Left Breasts-Free Breathing and Deep Inspiration Breath Hold (DIBH) scan
 - No sheets or fabric in scan for VisionRT compatibility



Workflow: Prone Simulation Process

- Prone Breast setup
 - Immobilization using the CDR ProCline prone breast board and upper vacloc
 - Tattoos given at iso center. This helps with Sup/Inf positioning on the board.
- Siemens CT Scan
 - Free Breathing scan
 - No sheets or fabric in scan for VisionRT compatibility





Workflow: Treatment Supine Breast

- Treatment with Varian Truebeam
 - Setup table per simulation
 - RT Breast VisionRT/AlignRT
 - Setup using CT Sim Body
 - Use postural alignment to verify arms/chin in position
 - Final patient position using ROI
 - Roll and yaw under 1.0 degrees or as close as possible. Get pitch under 3 degrees
 - LT Breast DIBH VisionRT/AlignRT
 - Setup using CT Sim Body FB (free breathing).
 - Use postural alignment to verify arms/chin in position
 - Final patient position using ROI.
 - Next, step out of room and change to CT sim DIBH Body structure set and Image.
 - If minimal shifts continue using CT Sim Body FB for daily setups
 - If consistent shifts exceed 1.0 cm, then take a new reference capture (in free breathing and DIBH)

Workflow: Treatment Supine Breast

VisionRT/AlignRT Postural Video





Workflow: Treatment Supine Breast

VisionRT/AlignRT ROI





Workflow: Treatment Supine Breast Continued....

- Treatment with Varian Truebeam
 - Imaging
 - Physician present 1st treatment only
 - Breast
 - Imaging SOP: kV/kV, Beams Eye View imaging. One image at treatment tangent fields and one image 90 degree opposed. Match to treated chestwall and verify breast tissue. Must be within 1 cm of body contour
 - All Left Breast are DIBH kV/kV. Same matching instructions.
 - Partial Breast
 - CBCT. Match to PTV. If clips, verify they are withing PTV Lumpectomy



Right Breast, kV/kV with Beams Eye View imaging

			average	average	average	average	average	average
			Vrt	Lng	Lat	Pitch	Roll	Rtn
Type of tx	No of tx	IGRT	[cm]	[cm]	[cm]	[°]	[°]	[°]
Supine Breast	5	kV-kV 2D/3D with BEV orthogonal pair	<mark>-0.11</mark>	- <mark>0.35</mark>	<mark>-0.32</mark>	<mark>-0.3</mark> 2	- <mark>1.16</mark>	1.16



Right Breast, MV Ports Tx fields 48 deg & 225 deg



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Partial Right Breast w/clips, CBCT imaging

			average	average	average	average	average	average
			Vrt	Lng	Lat	Pitch	Roll	Rtn
Type of tx	No of tx	IGRT	[cm]	[cm]	[cm]	[°]	[°]	[°]
Partial Breast	3	CBCT	-0.11	0.22	0.17	- <mark>0.30</mark>	-0.30	2.40



Partial Right Breast w/clips, MV ports /Tx fields



- 1st Treatment with Varian Truebeam
 - Setup table per simulation
 - Use tattoos to verify sup/inf positioning on CDR prone board.
 - Turn on VisionRT/AlignRT (need photos)
 - Setup using CT Sim Body Setup
 - Start with Postural alignment to verify arms and fine tune breast in correct position
 - CT Sim Body Setup
 - Roll and yaw under 1.0 degrees or as close as possible. Get pitch under 3 degrees
 - Next make anterior shift and switch to <u>CT Sim Body ISO</u> for monitoring

• VisionRT/AlignRT Prone Breast ROI SETUP surface



• VisionRT/AlignRT ROI Treatment surface





• VisionRT/AlignRT Postural alignment & ROI Treatment surface





Workflow: Treatment Prone Breast Continued....

- Treatment with Varian Truebeam
 - Imaging
 - Physician present 1st treatment only
 - Prone Breast
 - Daily PA kV to bony anatomy, and daily medial or lateral tangent kV, Match to treated chestwall and verify breast tissue, if clips included, verify they are within the PTV Lumpectomy

Workflow: Prone Left Breast w/clips, PA and Tang KV

			average	average	average	average	average	average
			Vrt	Lng	Lat	Pitch	Roll	Rtn
Type of tx	No of tx	IGRT	[cm]	[cm]	[cm]	[°]	[°]	[°]
Prone Breast	5	kV-kV match BEV, PA	-0.06	-0.21	0.05	0.12	na	<mark>0.44</mark>



slide-25

Workflow: Prone Left Breast w/clips, MV ports Tx fields



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Benefits: Patients

- Easier for patients to come in for treatments
- Easier access to care
- Patient tolerance of radiation treatments at end of treatment are better
- After 2 weeks from treatment, there is minimal skin reaction



Benefits: Staff

- Physicists-same amount of work
- Therapy-same amount of work
- Mayo Clinic is a patient-centered practice and staff feel proud to give the patient care that is best for them.
- Help shorten wait time for centers that typically have wait lists.
- Not a benefit:
 - Physicians/department-less money is paid for the service (in United States)





Recommendations New Users

- If your practice uses a tight margin, ensure your department establishes a Standard Operating Procedure (SOP) for IGRT and for Surface Guidance technology
- Make sure to minimize the inter-fractional and intra-fractional movement with Surface Guided Technology.
- 5-fraction hypofractionation may be considered for patients with special circumstances where 15-30 fractions is not feasible or a hardship.
 - Patients out of town
 - Patients work may not be accommodating

MAYO AZ ACKNOWLEDGMENTS



THANK YOU



QUESTIONS