We exist to make a difference in people’s lives through excellent patient care

The Contour Conundrum:
When Circle Cords Go Square

Annual AAMD Conference: Atlanta, GA
June 12, 2016

Lexie Smith-Raymond, MAdm, BS, CMD, RT(R)(T)
A LITTLE ABOUT ME

- Radiologic Technologist
- Radiation Therapist
- Dosimetrist

- Lead Dosimetrist
- Technical Coordinator
- Radiation Therapy Program Manager
WHY AM I HERE TODAY?

I am a Dosimetrist

The Medical Dosimetrist is a member of the radiation oncology team who has knowledge of the overall characteristics and clinical relevance of radiation oncology treatment machines and equipment, is cognizant of procedures commonly used in brachytherapy and has the education and expertise necessary to generate radiation dose distributions and dose calculations in collaboration with the medical physicist and radiation oncologist.
WHY AM I HERE TODAY?

Practice Standards for the Medical Dosimetrist
Approved June 14, 2013

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http://pubs.medicaldosimetry.org/pub/031956fa-06e9-c83a-f043-84d4419b987c?_ga=1.140545904.376661306.1465060709
FOR A DOSIMETRIST A CONTOUR IS....

Contours are our starting point
Nurses doing hydration with no IV tubing, or an architect with no building plans
Coupled with the Prescription are NECESSARY for us to work
They are a point of contention
They frequently are described with colorful adjectives when they are received late
Their importance in our field is often discounted
WHAT IS A CONTOUR?

Contour is a synonym for Outline

**Outline**: a style of drawing in which only the outer edges of an object are shown; a line that is drawn around the edges of something

**Contour**: the outline or outer edge of something; an outline especially of a curving or irregular figure
3. Treatment planning

- Entire process of treatment planning can take anywhere from 1 day to 2 weeks, depending on the complexity of the plan.
- Physicians draw on CT scan to outline tumor volumes and normal structures – outlines are called “contours.”
Origin of **contour**

French, from Italian *contorno*, from *contornare* to round off, from Medieval Latin, to turn around, from Latin *com- + tornare* to turn on a lathe — more at **turn**

Related to **contour**

Synonyms

outline, figure, silhouette

Related Words

delineation, sketch; profile, skyline; cast,
WHY IS CONTOURING SO VITAL?

• Sometimes in order to understand the present we must visit the past
• 15-16 Years Ago (in my facility):
  • CT, SBRT, Motion Management, and Contouring barely existed.
  • We did have solder wire and graph paper!!!
• As time progresses, we start trying to get fancy
• We start to use CT to our benefit, but contouring......
• 15-16 Years Ago (in my facility):
  • CT, SBRT, Motion Management, and Contouring barely existed.
  • We did have solder wire and graph paper!!!

• 10-11 Years Ago:
  • Beginning to reach consensus on whether or not lung and tissue corrections were needed for ALL patients and IMRT was still something relatively new with a difficult to manage planning systems
  • We WERE CT simming our patients
Graham, M.V., et al, Washington University Medical Center, St. Louis, MO
“Multivariate analysis revealed the V20 to be the single independent predictor of pneumonitis”
Study evaluated 99 patients, all with inoperable NSCLC

In Conclusion:
- Attaining V20 Is Not Always Easy Or Simple
- 3D Conformal Plans May Do Best To Get The Lung Doses Needed
- IMRT May Not Be Able To Deliver
- Be Prepared For Dose Requests To V5, V10, V15, and Any Other V Possible
• 15-16 Years Ago (in my facility):
  • CT, SBRT, Motion Management, and Contouring barely existed.
  • But we did have solder wire and graph paper!!!

• 10-11 Years Ago:
  • Beginning to reach consensus on whether or not lung and tissue corrections were needed for ALL patients and IMRT was still something relatively new with a difficult to manage planning systems
  • But we WERE CT simming our patients

• At about the same time:
  Not contouring every region known to man
  • BUT; there was this guy Timmerman......
  • AND; there was this SBRT thing......
• Over the last 7 or so years
  • Monumental advances in dosimetry as a field
  • Education standards have changed
  • EVERYTHING we plan has changed

• IMRT and SBRT are the go-to planning techniques
  • AP/PA is a thing of the past

• Contouring and doing it more efficiently are on everyone’s mind
  • “Golden Rule of IMRT”? No contour= No dose control
  • End up with dozens of “opti” stuctures that have to be contoured AND understood by dosimetrists

• Still so exciting.....Hello Modern Contour Age!
  • Contouring competition at the conference this year
  • The annual planning challenge
  • Development of tools like MIM and Velocity
  • Integration of deformable registration in the treatment planning systems in the near future
• Relatively common to treat Liver and Lung SBRT 12Gy X 5fx
  • Greater BED in 1/6 time of traditional planning
  • Worry about the ribs….. Oh do we worry

• We tally the Brain V12 and V20 for SRS and SRT

• We don’t even treat standard HN IMRT anymore WITHOUT that fabulous hippocampus contour

• We regularly tally doses to a 0.03cc volume of specific contours
  • Is 1/21 of a single M&M candy
    • https://www.wolframalpha.com/input/?i=0.03cc

• I am fairly certain these things were not on the minds of the inaugural CMD board exams participants……

None of these things are possible without careful, precise, accurate and well thought out contouring before the planning starts
WHO SHOULD DO THE CONTOURING?

American Association of Medical Dosimetrists Facebook
https://www.facebook.com/groups/63289007532/10154239896092533/?notif_t=group_activity&notif_id=1464921779980962
WHO SHOULD DO THE CONTOURING?

Participation in the development of optimal treatment strategies that result in attainable radiation therapy plans including localization of tumor volumes, critical structures, generation of isodose distributions, and performance of dose calculations according to the written directive.  

Section IX, Part 9
Practice Standards for the Medical Dosimetrist
Approved June 14, 2013

For the QMD, participation includes, but is not limited to the following activities, which may be performed under the supervision of a Qualified Medical Physicist and Radiation Oncologist, in accordance to each department/ institution’s policies and procedures:

- Contour clearly discernible critical normal structures.
- Ensure proper orientation of volumetric patient imaging data and the radiation therapy treatment planning (RTP) system (from computed tomography and other fused image data sets).
- Design and generate the dosimetric treatment plan under the direction of the Radiation Oncologist and the Qualified Medical Physicist as required.
- Generate all technical documentation required to implement the dosimetric treatment plan.
- Be available for the first treatment and assist with verification for subsequent treatments as necessary.

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http://pubs.medicaldosimetry.org/pub/031956fa-06e9-c83a-f043-84d4419b987c?_ga=1.140545904.376661306.1465060709
ACR-ASTRO PRACTICE PARAMETERS

C. Dosimetrists or Planning Physicists [8-9]

3D Conformal

The responsibilities of the dosimetrists or planning physicists must be clearly defined and should include the following:

1. Contour clearly discernible critical normal structures.
2. Ensure proper orientation of volumetric patient image data on the 3D RTP system.
3. Design and generate the 3D treatment plan in consultation with the radiation oncologist and physicist as required.
4. Generate all technical documentation required to implement the 3D treatment plan.
5. Transfer 3D plan parameters (including beam monitor units) and planning images to the treatment delivery unit.
6. Participate in peer review of contours, prescription, 3D treatment plans, and verification images in conjunction with other members of the team.

IMRT

The responsibilities of the medical dosimetrists or other designated treatment planner must be clearly defined and should include the following:

1. Contour clearly discernible critical normal structures.
2. Ensure proper orientation of volumetric patient image data on the IMRT RTP system (from CT and other fused image data sets).
3. Design and generate the IMRT treatment plan under the direction of the radiation oncologist and medical physicist as required.
4. Generate all technical documentation required to implement the IMRT treatment plan.
5. Be available for the first treatment and assist with verification for subsequent treatments as necessary.

http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/IMRT.pdf
ACR-ASTRO PRACTICE PARAMETERS

**3D Conformal**

The responsibilities of the radiation oncologist must be clearly defined and should include the following:

1. Plan and/or approve the immobilization/repositioning system in consultation with other members of the team.
3. Contour organs at risk (“critical normal structures”) not clearly discernible on treatment planning images, as clinically appropriate.
4. Review and approve all critical structures contoured.
5. Describe the appropriate target dose and limitations on critical normal structures, as clinically appropriate.
6. Participate in peer review of contours, prescription, 3D treatment plans, and verification images in conjunction with other members of the team.

**IMRT**

The responsibilities of the radiation oncologist must be clearly defined and should include the following:

1. Participate in and approve the immobilization/repositioning system in consultation with other members of the team.
2. Define the goals and requirements of the treatment plan, including the specific dose constraints for the target(s) and nearby critical structure(s).
3. Delineate tumor and specify and approve target volumes, preferably using appropriate methodology of the International Commission on Radiation Units and Measurements (ICRU).
4. Contour critical normal structures not clearly discernible on cross-section.
5. Review and approve all critical structures contoured.
6. Perform final evaluation and approve the final IMRT plan for implementation.
7. Participate in peer review of IMRT treatment plans in conjunction with other members of the team.
8. Continue management of the patient throughout the course of radiation therapy, including the ongoing acquisition, review, and verification of all treatment-related imaging.

### PHYSICIAN CONTOURS

<table>
<thead>
<tr>
<th>Target Volume Name</th>
<th>PTV Margin</th>
<th>Prescribed Dose (total)</th>
<th># Fx</th>
<th>Dose / Fx</th>
<th>TX Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Parietal PTV</td>
<td>5mm</td>
<td>50Gy</td>
<td>25</td>
<td>2Gy/Ex</td>
<td>Daily</td>
</tr>
</tbody>
</table>

**Notes:**

### DOSIMETRIST CONTOURS

<table>
<thead>
<tr>
<th>Avoidance Structure</th>
<th>Dose</th>
<th>Volume/Constraint</th>
<th>Completed Plan</th>
<th>Dose</th>
<th>Volume/Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Eye</td>
<td>25cc</td>
<td>point</td>
<td>X max</td>
<td>1cc</td>
<td>104Gy point x max</td>
</tr>
</tbody>
</table>

22
WHO CARES WHAT A CONTOUR IS....BESIDES THE DOSIMETRIST??

- Physicians
  - Attending
  - Resident
  - Referring
  - Concomitant Care

- Physicists
- Therapists
- Billing Staff

PATIENTS
BECAUSE THEY WATCH TV......

Have you or someone you know suffered complications after an IVC filter placement?

Free Case Review 1-877-667-4265

Attorney Advertising: Prior outcomes do not guarantee similar results.
TALCUM POWDER LAWSUITS

If you or a loved one has been diagnosed with ovarian cancer, and previously used talcum powder—such as Baby Powder and Shower to Shower—contact our lawyers for a no cost consultation.

Contact Us

and should contact an attorney for a case evaluation.
THEY ALSO WATCH THE NEWS AND READ THE NEWSPAPER.....

New York Times, 2010
http://www.nytimes.com/2010/01/24/health/24radiation.html?_r=0
### Radiation Mistakes: One State’s Tally

Even though New York State is the most stringent regulator of radioactive medical devices in the nation, many radiation mistakes go unreported there.

State records analyzed by The New York Times described 621 mistakes from January 2001 to January 2009. On average, there were about two contributing factors for each.

#### 621 Radiation Mistakes

<table>
<thead>
<tr>
<th>Cause of Mistake</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missed all or part of intended target</td>
<td>284</td>
<td>46%</td>
</tr>
<tr>
<td>Wrong dose/layer given</td>
<td>255</td>
<td>41%</td>
</tr>
<tr>
<td>Wrong patient/treatment</td>
<td>50</td>
<td>8%</td>
</tr>
<tr>
<td>Other</td>
<td>32</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Total:** 621

#### 1,264 Causes of Mistakes

<table>
<thead>
<tr>
<th>Cause of Mistake</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality assurance flawed</td>
<td>355</td>
<td></td>
</tr>
<tr>
<td>Data entry or calculation errors by personnel</td>
<td>252</td>
<td></td>
</tr>
<tr>
<td>Misidentification of patient or treatment location</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Blocks, wedges or collimators misused</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>Treatment plan flawed</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Staffing</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Patient’s physical setup wrong</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Hardware malfunction</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Computer, software or digital information transfer malfunction</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Override of computer data by personnel</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Miscommunication</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Unclear/other</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 1,264

Sources: New York State Dept. of Health; Times analysis

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New York Times, 2010

[Click for full article](http://www.nytimes.com/imagepages/2010/01/24/us/24radiation_graphic.html?version=meter+at+null&contentId=&mediaId=&referrer=https%3A%2F%2Fwww.google.com%2F&priority=true&action=click&contentCollection=Health&module=RelatedCoverage&region=EndOfArticle&pgtype=article)
THEY ARE INTERNET SAVVY

A series of articles in the New York Times in 2010 and 2011 exposed many sloppy and dangerous practices in the radiation therapy industry. We have documented many of those in our own patient safety blog. Many of these bad practices, when they cause harm to a patient, justify a medical malpractice lawsuit.

“Because radiation from linear accelerators is so intense, accuracy of the treatment is extremely important.”

“Everybody says these are isolated incidents,” said Dr. William David Bloomer, chairman of radiation medicine at Evanston Hospital in Illinois. “Until you find out that maybe they are not so isolated.”

Patrick Malone & Associates, PC
http://www.patrickmalonelaw.com/malpractice-z/radiation-overdose-injuries/
Schmidt & Clark, LLP
https://www.schmidtandclark.com/radiation-treatment-lawsuit
Radiation Side Effects:

Effects of radiation sickness vary according to the dose the patient is exposed to. In most cases, the higher the dose the sooner the effects appear — and the worse the prognosis. Symptoms include:

- Nausea / vomiting
- Spontaneous bleeding from the nose, mouth, gums and/or rectum
  - Red, blistered skin
- Hair loss
- Severe fatigue
- Ulcers in the mouth, esophagus, stomach and/or intestines
- Infections (bacterial, fungal, viral)
Negligent Cancer Treatment

If you are suing a doctor, you must prove that your physician acted with a standard of care below the standard of care a reasonable doctor would have used in treating your cancer. In other words, if your doctor was less careful than a reasonable doctor in his position would have been in, and you can prove it, you will meet this element of your case.

Cause of Damages

You also must prove that the doctor or hospitals breach of care, or negligence, actually caused your injuries. In other words, you have to show that the damage you suffered wasn't just a normal side effect of radiation or just something that happened to you during the course of your chemotherapy treatment - it must have been caused directly by the negligence or breach of care.

WE LIVE IN A LITIGIOUS SOCIETY

2015 MEDICAL MALPRACTICE PAYOUT ANALYSIS

Presented by Diederich Healthcare

Total Payout amounts increased again in 2014
$3,891,743,050 4.4%

North Dakota 762 k 82%
South Dakota 20.3 MM 196%
Indiana 95 MM 33%
Vermont 3.5 MM 85%
Rhode Island 25.6 MM 30%
Virginia 56.8 MM 29%
North Carolina 44 MM 29%
Utah 27.4 MM 80%
Tennessee 58.7 MM 73%
Alabama 47.4 MM 75%

MEDICAL MALPRACTICE PAYOUT AMOUNTS
From 2003-2014

Dietrich Healthcare
WE LIVE IN A LITIGIOUS SOCIETY

PATIENT TYPE
Total payment amount by patient type.

- BOTH (9%)
- UNKNOWN (5%)
- OUTPATIENT (40%)
- INPATIENT (46%)

PAYMENT AMOUNTS BY MALPRACTICE ALLEGATION
Percentage roundoff.

- Diagnosis 33%
- Surgery 24%
- Treatment 19%
- Obstetrics 11%
- Medication 5%
- Monitoring 3%
- Other 5%

Dietrich Healthcare
WHY WE NEED TO CARE MORE ABOUT CONTOURS

Sloppy  
Less Careful  
Inaccurate  
Negligent  
Abnormal
OR COULD THIS BE OUR TELEVISION FUTURE?

Have you or someone you loved been given Radiation Therapy Treatments in hopes of curing cancer?

Side effects:
- Skin Redness
- Blindness
- Severe Fatigue
- Permanent Hair Loss
- Decreased Salivary Production
- Tooth Decay or Loss
- Formation of Secondary Cancer
OR COULD THIS BE OUR TELEVISION FUTURE?

If you or someone you love received Radiation Therapy, you may be entitled to compensation. Call Today!
WHAT IF THE CONTOUR IS WRONG?
WHAT IF THE CONTOUR IS WRONG?
YOU'VE CAT TO BE KITTEN ME RIGHT MEOW
WHAT IF THE CONTOUR IS WRONG?

LET’S LOOK AT THIS JUST A LITTLE BIT MORE....
Summary of Decision Making Model

1. Designated act

2. Basic parameters of legal practice?
   Yes or Unsure  no → stop

3. Special education required?
   Yes  no → stop

4. Scope of practice factors consistent?
   Yes  no → stop

5. Possess knowledge?
   Yes  no → stop

6. Competent?
   Yes  no → stop

7. Reasonable and prudent?
   Yes  no → stop

8. Responsibility assumed?
   Yes  no → stop

Perform

AAMD Scope of Practice of a Medical Dosimetrist, 2012

http://pubs.medicaldosimetry.org/pub/39731f93-2354-d714-5182-a342d50fd925?_ga=1.103606466.376661306.1465060709
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Summary of Decision Making Model

1. Designated act

2. Basic parameters of legal practice? Yes or Unsure no stop
   3. Special education required? Yes no stop
   4. Scope of practice factors consistent? Yes no stop
   5. Possess knowledge? Yes no stop
   6. Competent? Yes no stop
   7. Reasonable and prudent? Yes no stop
   8. Responsibility assumed? Yes no stop

**Perform**

- YES
- YES
- YES

6. Do you personally possess current clinical competence to perform the act safely? (If you answer NO, the act is not within your scope of practice unless competence is demonstrated. If you answer YES, continue.)

7. Is the performance of the act within the accepted “standard of care” which would be provided in similar circumstances by reasonable and prudent medical dosimetrists who have the same training and experience? (If you answer NO, the act is not within your scope of practice. Performance of the act may place both medical dosimetrist and patient at risk.) (If you answer YES, continue.)

8. Are you prepared to accept the consequences of your action? (If you answer NO, the act is not within your scope of practice.) (If you answer YES, then:
   a. Perform the act - based upon valid order when necessary, and in accordance with appropriately established policies and procedures.
   b. Assume responsibility for your action(s).)

AAMD Scope of Practice of a Medical Dosimetrist, 2012

http://pubs.medicaldosimetry.org/pub/39731f93-2354-d714-5182-a342d50fd925?_ga=1.103606466.376661306.1465060709
WHAT IF THE CONTOUR IS WRONG?
WHAT IF THE AUTO CONTOUR IS WRONG?
WHAT IF THE CONTOUR IS MISSING?
AND WHAT IF IT’S A TARGET STRUCTURE?
Summary of Decision Making Model

1. Designated act

2. Basic parameters of legal practice?
   - Yes or Unsure
   - No → stop

3. Special education required?
   - Yes → no
   - No

4. Scope of practice factors consistent?
   - Yes → no
   - No → stop

5. Possess knowledge?
   - Yes → no
   - No

A. Radiation Oncologist

The responsibilities of the radiation oncologist must be clearly defined and should include the following:

1. Participate in and approve the immobilization/repositioning system in consultation with other members of the team.
2. Define the goals and requirements of the treatment plan, including the specific dose constraints for the target(s) and nearby critical structures.
3. Delineate tumor and specify and approve target volumes, preferably using appropriate methodologies of the International Commission on Radiation Units and Measurements (ICRU).
4. Contour critical normal structures not clearly discernible on cross-section.
5. Review and approve all critical structures contoured.
6. Perform final evaluation and approve the final IMRT plan for implementation.
7. Participate in peer review of IMRT treatment plans in conjunction with other members of the team.
8. Continue management of the patient throughout the course of radiation therapy, including the ongoing acquisition, review, and verification of all treatment-related imaging.
TELL THEM THE TRUTH, SHOW THEM YOUR EXPERTISE

25Gy ≠ 18Gy; need to sacrifice coverage or accept a higher cord max
AND WHAT IF THIS HAPPENS?

“I wasn’t really sure where the edges of tumor were.....”
AND WHAT IF THIS HAPPENS?

“Yeah, but I’m not too concerned about it”
“It’s a long way from where we are treating”
“Oh, I only put that contour in so we had enough structures to justify IMRT”
“Go ahead and just change whatever you think is best and I’ll just sign it....I trust you”
“Ah, the dose to that doesn’t really matter anyway”
IT MAKES ME FEEL A LITTLE BIT LIKE THIS.....
BECAUSE IT DOES MATTER!!
HOW DO WE IMPROVE CONTOURING?

• Cannot Stress Enough The Importance of **Open Communication**
  • The more open we are about what we think **PROFESSIONALLY**, the easier the dialogue will be
  • It’s OK to tell an MD what you can and **CANNOT** plan, and that contours are poor

• **TIME CONSTRAINTS:** They are hard on EVERYONE in Rad Onc
  • **When they have time to work with you; TAKE IT**

• CT anatomy book available for reference at all times
• Try my trick, if you haven’t already, make #2 contours

• Clarification of desired plan outcome or points of focus are good communication starters; consider PRE-planning check-ins

• Those with Residents; Consider an Elective Dosimetry Rotation, for BOTH Medical and Physics Residents
THE ULTIMATE CONTOUR

CATASTROPHE HALL OF FAME

Pretty sure I cannot dosimetry today
TUMORS OF TERROR
CRANIAL CRIMINALS
SPINAL CORD CONTENDERS

Smallest Cord Contour On Record
BEST ...... GTV/PTV ...... EVER
AND THEN THERE WAS ONE....
MANY THANKS

BUMCT Dosimetry Staff
- Misty Ceizyk
- Angie Locke
- Michael Carpio
- Gabby Avila

UA Physics Resident
- John Gloss

UA Rad Onc Residents
- Dr. Tina Skrepnik
- Dr. Uma Goyal
- Dr. Raj Davuluri
- Dr. Justin Suzsko
- Dr. Justin Famoso
- Dr. Steve Skolnik
- Dr. Joel Grow