Research Organization Document

Section 1

The purpose of this document is to organize your ideas and keep in mind the key research components as you begin working through your research. Please refer to this document often so that you remember the key questions you are answering and to update the research components as you research them.

First, you will outline the 3 key components to selecting a research topic: a problem that needs to be solved, evidence of gap in the literature (a summary of different journal articles that support a similar topic or a journal article that says further research should be conducted on the topic you are interested in researching), an active “references” page that you update continuously to keep track of your research information.

For the “problem that needs to be solved section,” you need to decide what the problem is for your research. This includes addressing a set of 5-7 questions that you need to refer to often in your research to make sure that you are staying on topic. Key questions should be your active research questions. When you have finished writing your research paper, your reader should be able to address and answer these questions easily.

For the “evidence of gap in the literature section,” you should include a paragraph written in your own words with referenced superscripts to the references page so that the instructor can look at the article you are using to support your research.

The “references to support your research section” should include all of the references you have used for your research in AMA formatting. Use this as a place to keep track of your articles and update this often as you get into your research. This shouldn’t necessarily include all of the references that you sent to the instructor for the conference call. Since your topic was likely tweaked during the conference call, only include the references that pertain directly to your topic. This is important because there is a limit to the number of references you can have depending on the type of paper you decide to write.

Finally, you will indicate the title of your official research topic. This may change as you begin your research so it is important that you keep your topic updated so that the instructor may track your progress through the research paper progression.

For most groups, this information was decided in the conference call with the instructor so it should be easy to answer these questions.
Problem that needs to be solved:
Photon beam attenuation occurs any time a material with density enters the path of the beam. When delivering radiation therapy treatments to target volumes, objects that impede the effects of the radiation could alter dose distributions and decrease target coverage. There is no standard practice currently established accounting for these devices in contouring or in dose calculations.¹ Many institutions have implemented couch models to incorporate obstruction to the beam path when treating with posterior beam angles; however, often times immobilization devices remain unaccounted for in dose calculations.

Key Questions that need to be answered:
- What is the dosimetric impact of head and neck immobilization devices on the planning target volume (PTV) and organ at risk (OAR) structures?
- How does the dosimetric impact of head and neck immobilization devices differ using the Eclipse TPS with Anisotropic Analytical Algorithm (AAA), Eclipse TPS with Acuros XB, and Pinnacle TPS using Collapsed Cone Convolution (CCC)?

Evidence of a gap in the literature:
Immobilization devices are a staple in radiation therapy aiding in setup reproducibility and limiting intrafractional movement of the patient. One particular area that is highly dependent on the use of immobilization is the treatment of head and neck cancers. Common devices used for treatment include head holders, thermoplastics, and table top extensions/overlays. Previous studies have shown that immobilization devices attenuate a portion of the beam²-⁴ and various studies have reported that immobilization devices decrease skin sparing.⁴-⁶

While most current literature regarding immobilization devices involves intensity modulated radiation therapy (IMRT) and 3D-based planning, one study reported by Olsen et al⁷ shows a statistically significant impact on planning target volume (PTV) coverage due to head and neck immobilization devices using volumetric modulated arc therapy (VMAT). However, limitations to this study exist in that it was carried out using a single calculation algorithm in the treatment planning system (TPS) Eclipse, and organ at risk (OAR) structures were not considered. Thus, a retrospective study will be conducted to determine the dosimetric impact of head and neck immobilization devices on the PTV, in addition to OAR’s using the Eclipse TPS with Anisotropic Analytical Algorithm (AAA) and Acuros XB, along with Pinnacle TPS using Collapsed Cone Convolution (CCC).
References to support your research:


Research Topic:
Assessing the dosimetric impact of head and neck immobilization devices on PTV and OAR’s using the Eclipse TPS with Anisotropic Analytical Algorithm (AAA) and Acuros XB, and Pinnacle TPS Collapsed Cone Convolution (CCC).
Research approach

Section 2

The next section of your research organization document contains your research template to follow as you begin your data collection. This section will change often but it will help you to follow your goals closely as you progress and for the instructor to track your progress.

Study Details:
Retrospective study

Do any group members need to obtain additional IRB approval?

- Julie- Yes (should not take long to get, email sent to research)
- Jackie- Yes (should not take long to get, email sent to research)
- Nick- Yes (currently working on getting approval)
- Savannah- No

Number of patients: 15-20

Type of study: Research paper, possibly a retrospective case study analysis

Roles of each group member (some members may have multiple roles)

Group Leader (someone who will keep the group on track, make sure group members are adhering to deadlines, be the direct point of contact for the instructor with overall questions, update the research organization document throughout the course of research)

→ Nick

Data Collector(s) (someone who will be doing the data collection and data reporting in excel; maintaining journal entries)

→ Jackie
→ Nick
→ Savannah

Data analysis (someone who will be responsible for analyzing the raw data, running any statistical tests and providing conclusive data for the writer)

→ Savannah
→ Jackie
→ Nick
Writer (someone who is responsible for writing the outline (later in the course) and the paper; usually the best writer of the group takes this role)

→ Julie (with assistance from the group)

Editor (someone who is responsible for checking each draft for errors and providing feedback and corrections to writer)

→ Nick  
→ Savannah  
→ Jackie

Data Collection Approach:
Indicate here what data you are looking to collect and your approach to collection:

Number of clinical sites for data collection- 3
- Georgia Radiation Oncology Augusta University-Augusta, GA
- Beaumont Health Systems - Royal Oak, MI and Troy, MI
- Lahey Hospital and Medical Center - Burlington, MA

What information are you interested in (if a planning study, list structures for evaluation; if a study survey, list your study questions)

- Skin 3mm
  - Max Dose in 0.03cc
- Parotids
  - Max Dose
  - Mean Dose
- Spinal Canal
  - Max Dose
  - Mean Dose
- Brainstem
  - Max Dose
  - Mean Dose
- Mandible
  - Max Dose
  - Mean Dose
- PTV (Possibly if our results show any form of variance from the previous study)
  - V95
  - D100
Are you interested in completing a statistical analysis on this data? If so, what parameters will you be analyzing? (p-value, mean, t-test etc.).

- Evaluation of the percent difference for the dose values that we plan to examine for the PTV and organs at risk.
- Determine the statistical significance of the percent differences.
- An evaluation of the direct difference may be performed if values are sufficiently small as to produce large percent difference.

What resources (in addition to the literature search) are available for you to use?

<table>
<thead>
<tr>
<th>Manufacture Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immobilization Device</strong></td>
</tr>
<tr>
<td>QFix Curve Board</td>
</tr>
</tbody>
</table>

Previous research study that will be used for data analysis (ex: RTOG study constraints):

**RTOG 1016: Constraints for Organs at Risk**

<table>
<thead>
<tr>
<th>Organ At Risk</th>
<th>Dose Constraint (Gy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parotids</td>
<td>Mean &lt; 26</td>
</tr>
<tr>
<td>Brainstem</td>
<td>$D_{0.03cc} &lt; 55$</td>
</tr>
<tr>
<td>Cord</td>
<td>$D_{\text{max}} &lt; 45$</td>
</tr>
<tr>
<td>Mandible</td>
<td>$D_{1cc} &lt; 75$</td>
</tr>
</tbody>
</table>

Description of your data collection approach (Please provide the instructor with the details you intend to use in your research and use the example to be your guide).

Example: We will be analyzing how dose conformity changes comparing 3DCRT to IMRT. We will look at pancreatic cases with tumor sizes between 200 and 500 cc to limit variability. All plan comparisons will receive a total dose of 50 Gy in 25 fractions at 200cGy/day. We will analyze dose coverage to the PTV, CTV and GTV structures including maximum dose, minimum dose and the parameter of 100% of prescription dose covering 95% of the PTV, a constraint listed in the RTOG 1234 trial. We will also analyze the following OR constraints: stomach: V10<70%; V50<30%; small bowel: maximum dose of 50Gy, 0.03cc<47 Gy; total kidney: V20<40%, V10<60%.

Additional details:
We will be analyzing how head and neck immobilization devices impact PTV coverage and organ at risk doses using 3 different treatment planning algorithms including: Anisotropic Analytical Algorithm (AAA), Acuros XB (AxB), and Collapsed Cone Convolution (CCC). We will look at 15-20 oropharyngeal head and neck cases planned using a VMAT technique. The criterion for patient cases chosen excludes cases in which volumes involve treatment of the skin surface such as those requiring bolus. Also, cases in which the primary gross tumor volume invades locally into surrounding organs at risk may be excluded. An example that might remain included is in the case where one parotid gland is targeted but the other is intended to be spared. The plans chosen can display multiple dose levels with the highest in the range of 60 Gy to 70 Gy. Only the PTV receiving the highest prescribed dose will be evaluated. All plans chosen will be clinically delivered plans. We will leave the delivered plan intact as our baseline and calculate the dose a second time, either with the inclusion of an immobilization device(s) or the exclusion of a device(s), depending on the original plan and TPS. The secondary plans will be set equal to the original treated plan in all other regards, to include: normalization, modulation, geometry, MU, etc. Using DVH analysis, the volume of the PTV receiving 95% of the prescription dose (V95), and the dose covering 100% of the PTV (D100) will be assessed. We will then compare the percent difference of normal tissue mean and maximum doses for the following structures in each plan: brainstem, cord, mandible, parotids, and skin.