CHIEF SCIENTIST OFFICE

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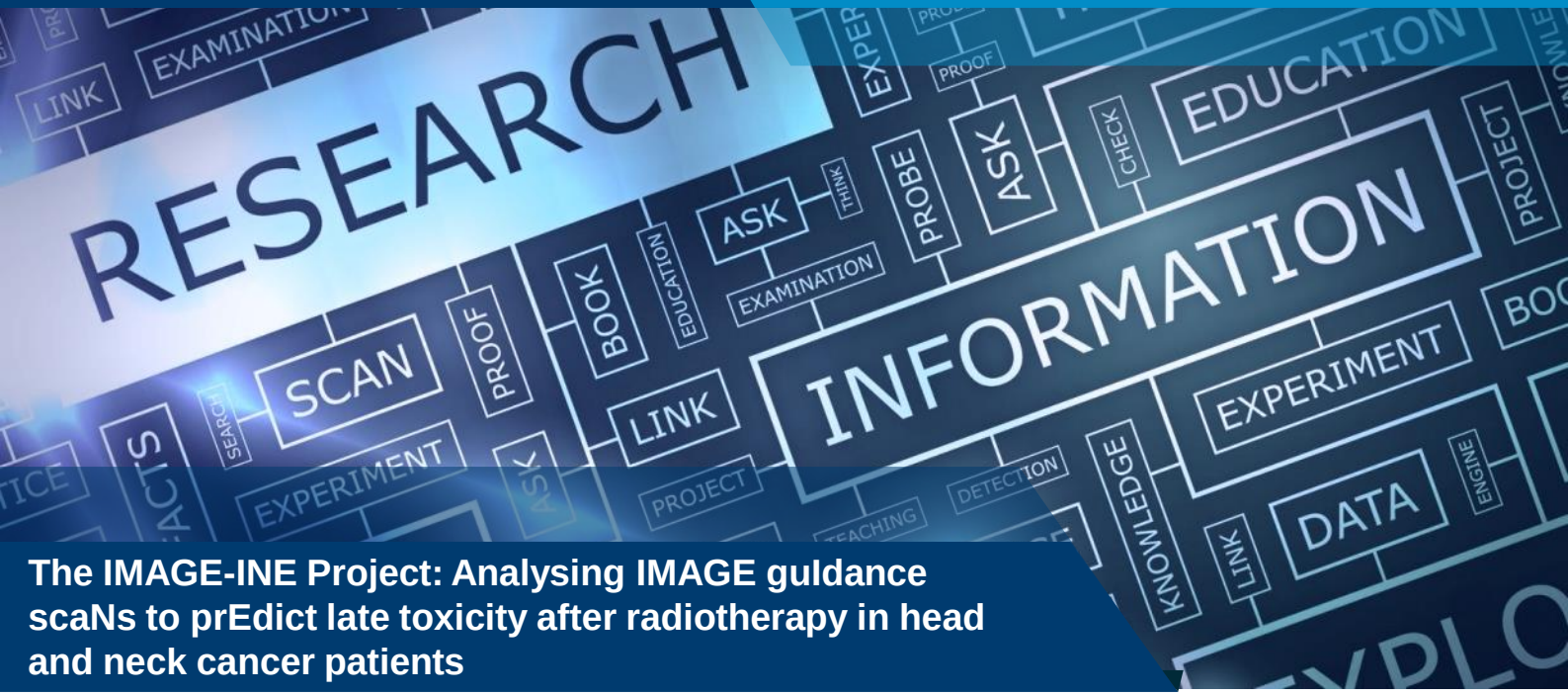
RESEARCH PROJECT BRIEFING



The IMAGE-INE Project: Analysing IMAGE guIdance scaNs to prEdict late toxicity after radiotherapy in head and neck cancer patients

AIMS

Cancers of the head and neck are increasing. Advanced radiotherapy techniques cure most patients but permanent side effects are common and can be severe. The aim of the IMAGE-INE project was to:

1) use image analysis, or radiomics techniques, to identify image features not visible to the eye and use these to predict the likelihood of head and neck cancer patients experiencing adverse side effects from radiotherapy.

2) to identify head and neck cancer patients who would benefit from adaptation of their treatment in order to reduce the likelihood of adverse effects from occurring after radiotherapy.

KEY FINDINGS

- Radiomics features calculated on images from the first half of a radiotherapy course improve the prediction of moderate-to-severe xerostomia, otherwise known as dry mouth, compared to prediction approaches that use radiation dose information.

- On images acquired at the same time as radiotherapy, radiomics features calculated on sub-regions of the parotid glands, which produce saliva, lead to earlier and improved prediction of xerostomia compared to analysis of radiomics features calculated on the whole parotid gland.

WHAT DID THE STUDY INVOLVE?

The IMAGE-INE team was made up of four different groups:

1) the Cambridge group who provided comprehensive data from over 300 head and neck cancer patients recruited to the CRUK supported VoxTox clinical trial. In this trial each patient received radiotherapy, was imaged on a daily basis, and was asked to report any toxicity from their treatment at regular intervals;

2) the Edinburgh Cancer Centre team who provided image analysis software for finding radiomics features on the VoxTox images and the resources for building prediction models;

3) the Edinburgh Parallel Computing Centre (EPCC) played an important role in IMAGE-INE because of their expertise in developing very fast and efficient software solutions. In this project they created a new software tool for analysis of large-scale cancer imaging data.

4) the Glasgow team who provided additional imaging data from a separate head and neck clinical trial called MERINO as well as expertise and scientific guidance at all stages.

The study received significant input and engagement from patient representatives in Cambridge who helped shape the final study submission. Their response was very positive highlighting the importance of maximising the use of data already gathered in VoxTox, via this multi-institutional collaboration, to improve the lives of cancer patients in the future.

WHAT WERE THE RESULTS AND WHAT DO THEY MEAN?

- The best performing tool developed for predicting xerostomia could be used either before or at the mid-point of a patient's treatment thereby allowing time for treatment adjustment to limit side-effects.

- When radiomics features, which analyse fine detail within images, were calculated on the whole parotid gland they were found to be better at predicting xerostomia than more traditional methods that use the dose of radiation to the parotid gland.

- When the same approach was applied to sub-regions within the parotid gland, radiomics features were found to be better than standard approaches based on dose. Additionally, analysis of these sub-regions was found to be better than analysis of the whole parotid gland for predicting xerostomia.

These results mean that the information generated from radiomics analysis has the potential to be used to individualise, or personalise, radiotherapy and ultimately lead to a reduction in radiation toxicity for head and neck cancer patients.

WHAT IMPACT COULD THE FINDINGS HAVE?

- **For the field**: Preliminary results indicating that there may well be a best time within a course of radiotherapy to adapt a patient's treatment and reduce toxicity.
- **For patients**: The results demonstrate that radiomics features calculated on daily images have the potential to be used to predict the likelihood of a patient experiencing toxicity.
- **For policy**: Additional evidence indicating that to move these techniques from the research domain to the clinical domain external validation on data from other patient groups is required.

HOW WILL THE OUTCOMES BE DISSEMINATED?

Key findings from the project have been presented at the European Society for Radiotherapy and Oncology (ESTRO) congresses in 2020, 2021 and 2022. The aim of the ESTRO organisation is to promote innovation, research, and the dissemination of science relating to Radiation Oncology. Key findings of the work have also been published in prominent journals in Radiation Oncology.

1. Whole parotid gland analysis - https://doi.org/10.1016/j.phro.2022.10.004
2. Parotid gland sub region analysis - https://doi.org/10.1080/0284186X.2023.2179895
3. Assessing the generalisability of radiomics - https://doi.org/10.1016/j.phro.2022.12.001

The IMAGE-INE team is keen to continue this project with IMAGE-INE2 and will meet in the coming months to explore how to do this and in doing so will continue to raise awareness of the potential of techniques based on radiomics to help patients.

CONCLUSION

The key message from this study is that radiomics, or image analysis, can identify head and neck cancer patients at risk of radiation toxicity. Furthermore, it is possible to identify at risk patients earlier and adapt their treatment accordingly. However, more research work is required to fully validate the findings before this approach can be considered for clinical use.

RESEARCH TEAM & CONTACT

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