

Comparison of Pseudoprogression in Glioma Patients Following Proton vs Photon Therapy

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BACKGROUND

- Following radiation for glioma, the presence of new enhancements on follow-up MRI present a challenge in differentiating recurrent tumor and radiation-induced lesions, termed pseudoprogression (Ps).
- Criteria have been outlined to diagnose Ps after photon radiation by the Radiologic Assessment in Neuro-Oncology (RANO) group based on time and location of occurrence.
- Some patients receiving proton radiation seem to manifest changes that look subjectively different in appearance, location and timing from photon Ps, and would be identified as recurrent tumor.
- We review post-treatment MRI changes of proton patients and compare the Ps seen after photon radiation. We propose a criterion to characterize proton pseudoprogression (ProPs) distinct from photon.

METHODS

- Patients treated at the University of Washington for gliomas with proton or photon radiation were retrospectively reviewed.
- 76 proton patients were reviewed for the presence of ProPs, and then 64 photon patients were reviewed for any matching imaging changes.
- T1 post-contrast MRI imaging from the time of radiation therapy to the present for each patient was examined.
- Data collected included the location, timing, and morphology of the imaging change, tumor grade, molecular subtyping, chemotherapy received, and clinical symptoms.

RESULTS

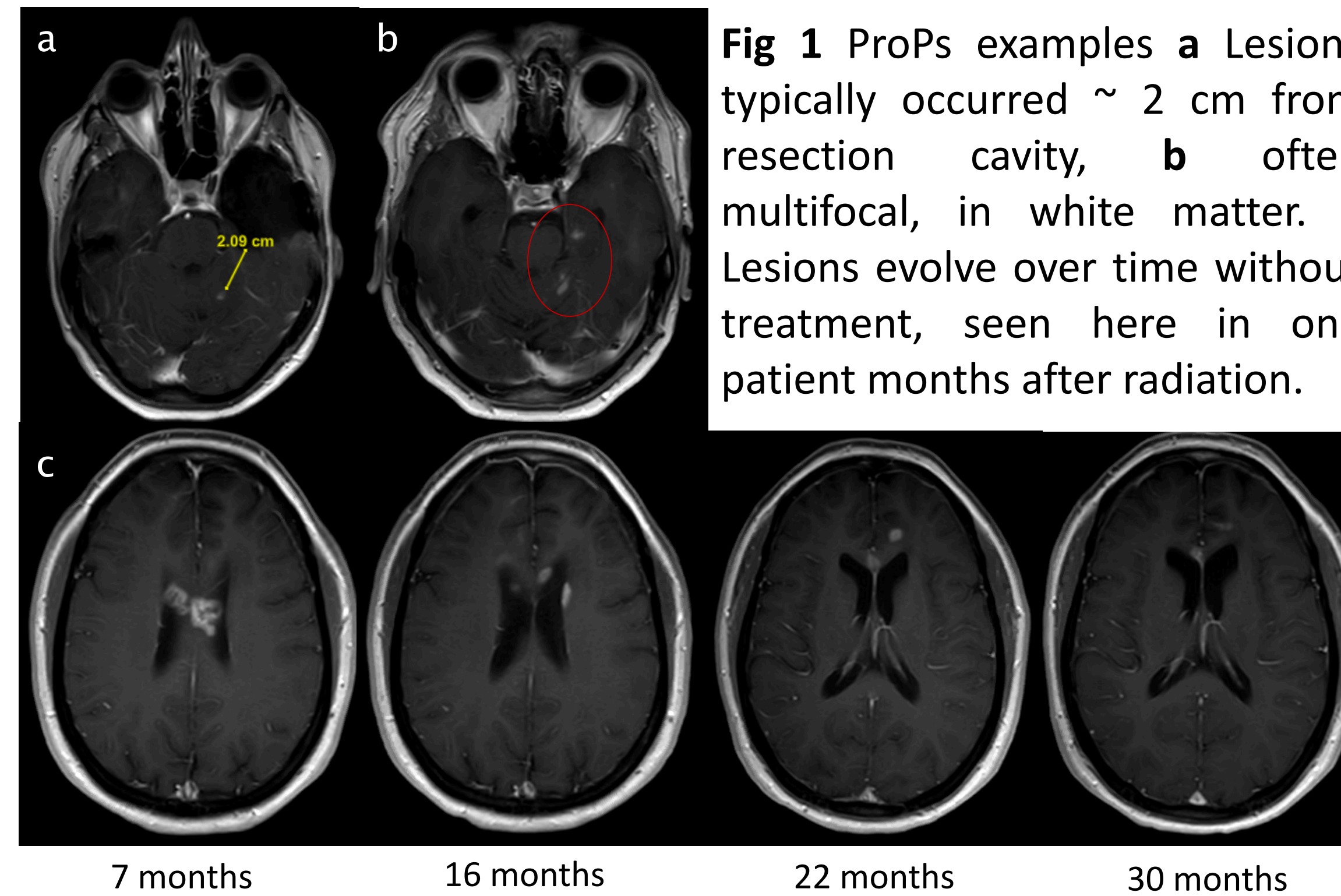


Fig 2 Histogram of timing of ProPs from the time of completion of radiation therapy to the first MRI when lesions were seen.

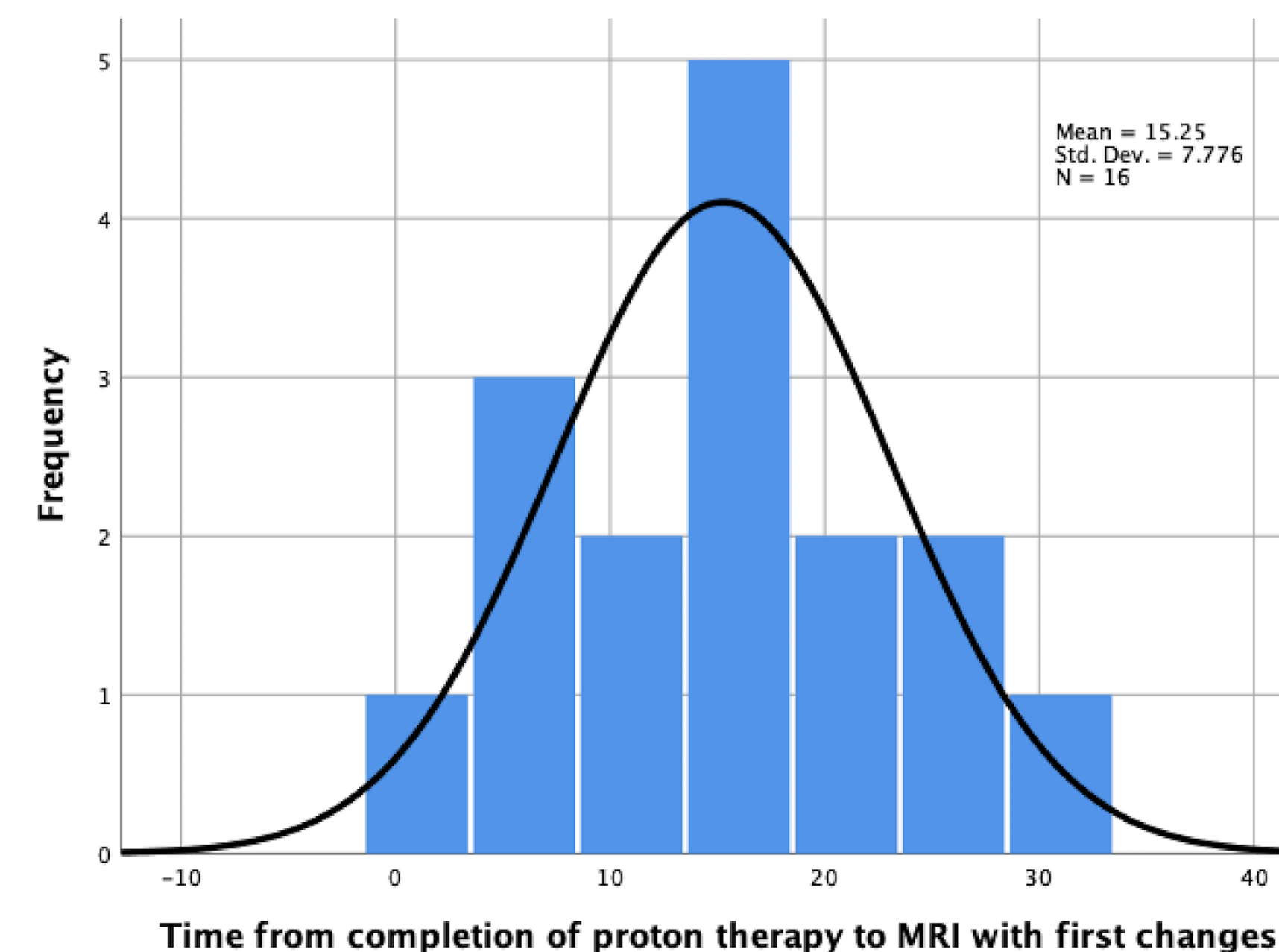
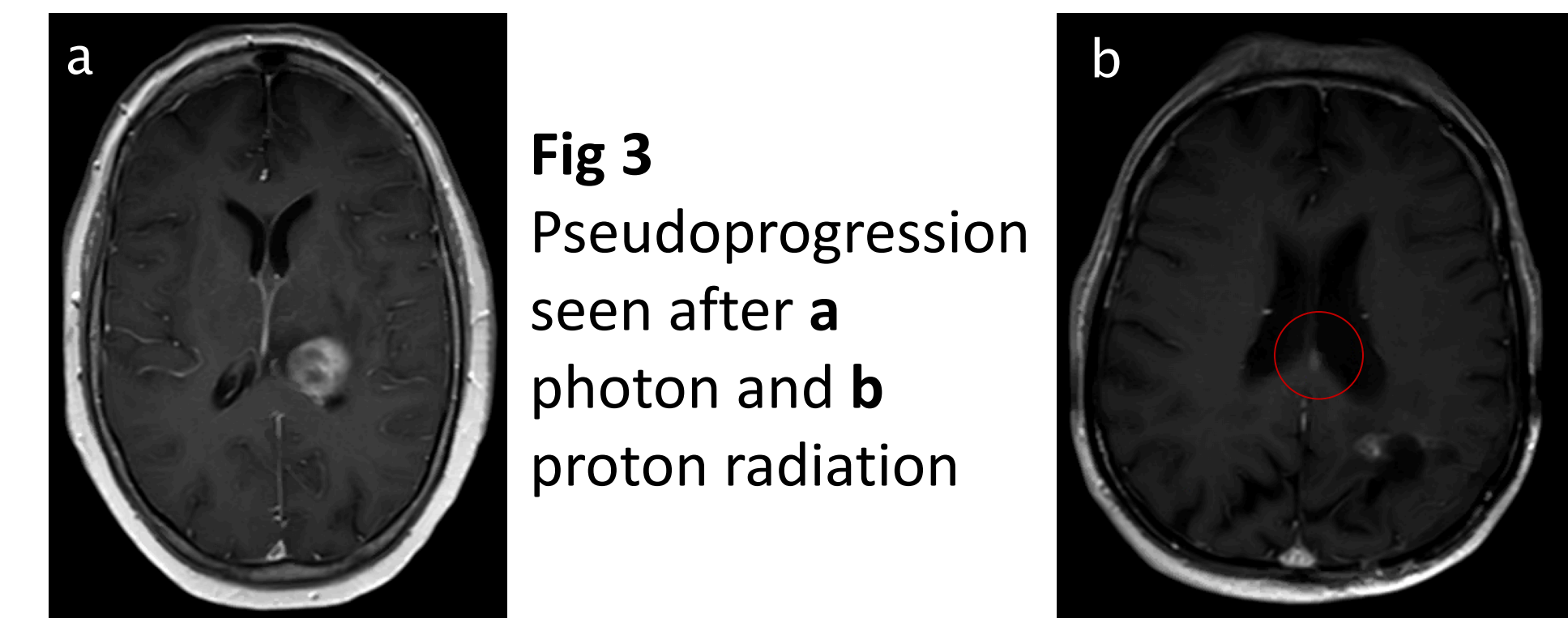


Table 1 Comparison of ProPs by radiation treatment received

Treatment	Presence of ProPs	p-value
Proton (n=76)	16 (21%)	0.001
Photon (n=64)	0 (0%)	

DISCUSSION

- Criterion to characterize ProPs
 - Located not immediately in or adjacent to the resection cavity or residual tumor
 - ~ 2cm opposite from target proton beam entry
 - resolves without treatment or with bevacizumab
 - combination of subjectively multifocal, patchy, small (<1cm)
- ProPs occurs later than Ps, which RANO criteria defines as seen up to 3 months after radiation.
- ProPs can possibly be explained by the increased Relative Biological Effectiveness (RBE) of protons and beam angle selection.
- Future steps include reviewing the radiation plan for proton patients to examine how the dose distribution contributes to the presence of ProPs.



CONCLUSIONS

Patients who receive protons are subject to a unique subtype of Ps which appears differently and occurs later than typical Ps. Current RANO guidelines would inaccurately characterize ProPs as tumor progression. Using the radiation oncology treatment plan can help confirm the nature of the enhancement and prevent unnecessary treatment for mistaken tumor progression.