

Comparison of dose accuracy between electron Monte Carlo and pencil beam algorithms in phantom with bolus

Introduction

Pencil beam (PB) and Monte Carlo (MC) are two available algorithms now. They have both advantages and disadvantages when applying on different situations such as different mediums, interface and field sizes.

In recent years, several have been conducted to compare the differences between PC and MC. But these comparisons are limited in different anatomy regions or different machines. There is no research focus on comparing the dose accuracy between MC and PB with and without bolus. Since bolus is frequently used in daily treatments. The purpose of this research is to compare the dose accuracy between PB and MC algorithms in phantom with bolus.

Methods

Output measurements were performed for 6MeV, 9MeV and 12MeV electron beams in 40x40cm² solid water phantom at 100cm SSD, using the electrometer, ion chamber.

For the PB group, the actual MU number of 6MeV with bolus, 6MeV without bolus, 9MeV with bolus, 9MeV without bolus, 12MeV with bolus, 12MeV without bolus were measured on the Varian ClinacIX-953. The MU number in the TPS is calculated by eclipse version11.

For the eMC group, the actual MU number of 6MeV with bolus, 6MeV without bolus, 9MeV with bolus, 9MeV without bolus, 12MeV with bolus, 12MeV without bolus were measured on the Varian RapidArc. The MU number in the TPS is calculated by eclipse version15.

The dose accuracy were compared between the PB group and the eMC group.

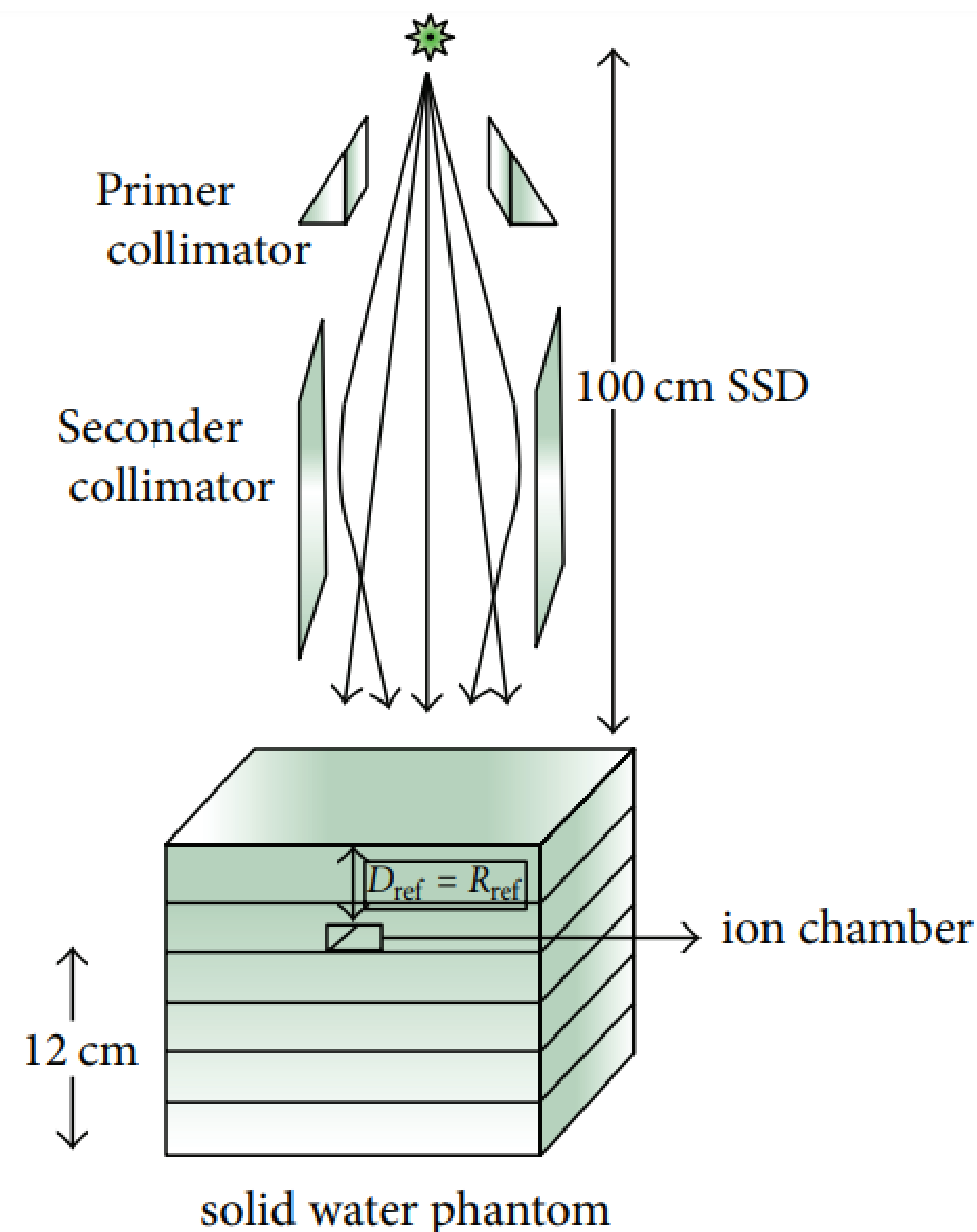


Figure 1 : Output factor measurements obtained with solid water phantoms which were aligned perpendicular to the electron beam

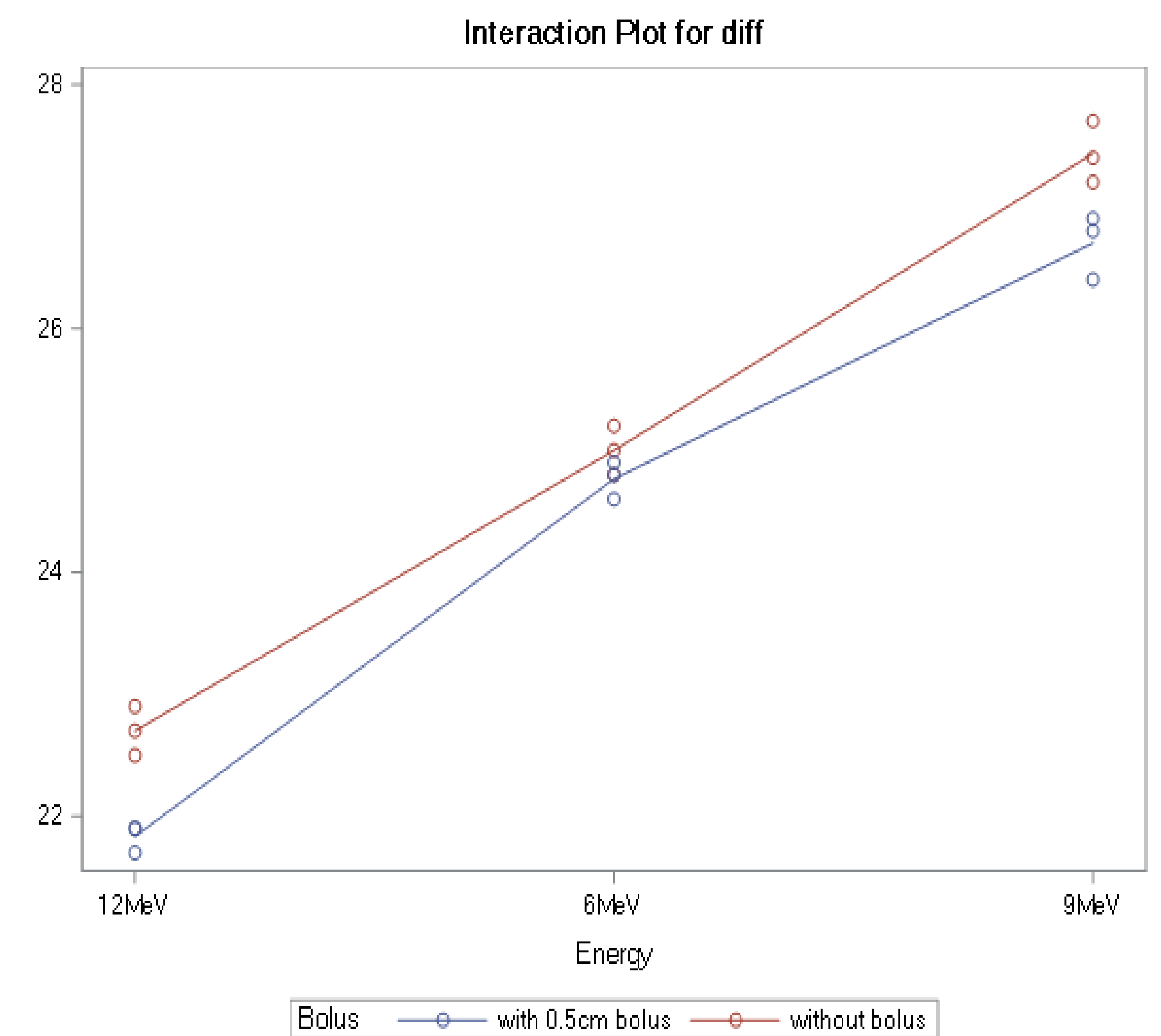


Figure3: two way ANOVA: energy and bolus effect for PB algorithm

Results

Type of Algorithm	mean	95% CL Mean	Std Dev	95% CL Std Dev
PB	27.7389	23.7167	2.0554	1.5424
eMC	18.2222	14.2114	8.0654	6.0521
MU difference	6.5167	2.5298	10.5035	4.7605

Figure 2: independent Samples T-Test Comparing the Absolute Difference of the eMC and PB algorithm

Conclusion

- ◆ The dose accuracy between electron Monte Carlo and pencil beam differ significantly. Electron Monte Carlo is more accuracy than pencil beam.
- ◆ The 0.5cm bolus effect is not statistically significant different for PB algorithm (6MeV) and PB algorithm (9MeV). While the 0.5cm bolus effect is statistically significant difference with PB (12MeV)
- ◆ The 0.5cm bolus effect is not statistically significant different for eMC algorithm.