Purpose: To compare and evaluate the dosimetric effect of metal implants in 3 different radiation therapy modalities, photon IMRT, Tomotherapy, and Proton Therapy.

Methods: We have constructed two sets of PMMA phantom with and without titanium alloy orthopaedic implants embedded. Combinations of the two phantom sets provide a hole in the middle for a dose measurement using ion chambers and also a space in which an EBT film can be inserted for a measurement of dose distribution in that plane. The phantoms have been CT-scanned separately and will be planned in 3 different treatment modalities (IMXT, Tomotherapy, and Proton therapy in passive scattering mode). In each plan, we make an assumption that the beam path(s) should include the metal implants so that we can compare the dosimetric effect in different modalities directly. The plan comparison between the three modalities will be made. In addition, point doses and dose distributions of the plans will be measured using ion chambers and EBT films and compared to the result of the plan study.

Results: The plan outcome of three different modalities shows different properties as expected. The uncertainty due to the presence of high-density metal is not only coming from the metal artifacts in CT numbers but also coming from the distinct physical property of the metal especially for the proton therapy. The most suitable treatment modality among the three treatment methods in various aspects will be determined.

Conclusions: The comparison result would provide a guideline for the selection of radiation therapy modalities in the presence of metal implants and help to make decisions based on quantitative supporting data. In addition, the result would be a basis for the further study to effectively avoid the undesired effects of the metal implants in radiation therapy especially for the proton therapy.