**Subject: Proton Beam Therapy**

**Overview:** Proton beam therapy is a type of radiation therapy that uses streams of protons to kill tumor cells. The proton beam radiation kills tumor cells but does not damage the nearby tissues. Proton beam therapy is used to treat cancers in the head and neck and in organs such as the brain, eye, lung, spine, and prostate.

**Policy and Coverage Criteria:**

**NOTE:** Prior Authorization is NOT required

Harvard Pilgrim considers proton beam therapy medically necessary for the following conditions:
- Medulloblastomas
- Skull-based tumors (Chordomas and Chondrosarcomas), with no evidence of metastasis
- Uveal Melanomas, with no evidence of metastasis
- Prostate cancer when the following criteria are met:
  - Initial monotherapy; and
  - Cancer is localized
- Malignancies in children (under the age of 21 years)

**Exclusions:** Harvard Pilgrim does not consider proton beam therapy medically necessary for conditions other than those listed above.

**Supporting Information:**

1. Technology Assessment: Proton beam therapy (PBT) is a type of external radiation treatment in which positively charged subatomic particles (protons) are precisely targeted to a specific tissue mass by using a sophisticated stereotaxic planning and delivery system. In contrast to conventional photon irradiation, proton beam radiation may deliver a higher dose to the target tissue while minimizing exposure to surrounding healthy tissue.

2. Literature Review:
   - Medulloblastoma – Brodin et al. (2014) investigated how varying the treatment margin and applying hippocampal sparing and PBT impact the risk of neurocognitive impairment in pediatric medulloblastoma patients compared with standard 3D CRT. The largest risk reduction was seen when applying hippocampal sparing proton therapy. The estimated risk of impaired task efficiency was 92%, 81%, and 50% for 3D conformal radiotherapy, intensity-modulated radiotherapy, and proton therapy, respectively, for the smallest boost margin and 98%, 90%, and 70% if boosting the whole posterior fossa. Jimenez et al (2013) reported outcomes in children under the age of 60 months with medulloblastoma or SPNET who were treated with chemotherapy followed by 3D-CPT. The authors concluded that proton radiation after chemotherapy resulted in good disease outcomes for the small cohort. Longer follow-up and larger numbers of patients are needed to assess long-term outcomes and late toxicity. Zhang et al. (2013) evaluated the predictive risk of cardiac toxicities for a 4-year old boy receiving photon or proton irradiation CSI for medulloblastoma and concluded that PT CSI carried a lower risk of radiogenic cardiac toxicity compared to photon CSI. St Clair et al. (2004) generated three plans of a patient affected by medulloblastoma, while comparing conventional x-rays, IMRT and PT. PT resulted to be the best technique to reduce the dose to structures located beyond the vertebral body and to the cochlea, pituitary, hypothalamus, temporo-mandibular joint, parotid and pharynx.
   - Chordomas and Chondrosarcomas – Amichetti et al. (2010) conducted a systematic review of published literature on the use of proton beam therapy to treat chondrosarcoma. There were no prospective trials but nine uncontrolled single-arm studies were identified. The reviewers found that the use of proton therapy following
maximal surgical resection shows a very high probability of medium- and long-term cure with a relatively low risk of significant complications. Amichetti et al. (2009) conducted a similar review on the use of proton therapy to treat chordoma and reported that the use of protons has shown better results compared to conventional photon RT, resulting in the best long-term outcome for this tumor with relatively few significant complications considering the high doses delivered.

Uveal Melanomas – Romanowska-Dixon et al. (2012) published preliminary results for 9 patients with choroidal melanoma who were treated using proton beam therapy. The preliminary results showed the proton beam therapy is a highly precise method of uveal melanoma treatment achieving high rates of local control. Vawas et al. (2010) studied the clinical profile and prognosis of young patients with uveal melanoma treated by proton beam therapy. Seventeen patients ≤20 years with uveal melanoma were included in the study. No metastatic deaths were observed at follow up (16 years). The authors reported that the outcome was excellent regarding metastasis.

Prostate – The American Society for Therapeutic Radiology and Oncology (ASTRO; 2014) states in their medical policy that the use of proton beam therapy in the treatment of prostate cancer is evolving and efficacy is still being developed. “In order for an informed consensus on the role of PBT for prostate cancer to be reached, it is essential to collect further data, especially to understand how the effectiveness of proton therapy compares to other radiation therapy modalities such as IMRT and brachytherapy. There is a need for more well-designed registries and studies with sizable comparator cohorts to help accelerate data collection.” Mendenhall et al. (2014) reported the 5-year clinical outcomes of 3 prospective trials of image-guided proton therapy for prostate cancer. A total of 211 prostate cancer patients were treated and 5-year rates of biochemical and clinical freedom from disease progression were 99%, 99%, and 76% in low-, intermediate-, and high-risk patients. The authors concluded that the 5-year clinical outcomes with image-guided proton therapy included high efficacy, minimal physician-assessed toxicity, and excellent patient-reported outcomes, however, further follow-up and a larger patient experience are necessary to confirm the favorable outcomes. Yu et al. (2013) performed a retrospective study of 27,647 Medicare patients ≥ 66 years who received proton beam therapy (553) or IMRT (27,094) for prostate cancer. The main outcome measures were early genitourinary, gastrointestinal, and other toxicity. Patients receiving proton beam therapy were younger, healthier, and from more affluent areas than patients receiving IMRT. Although proton beam therapy was associated with a statistically significant reduction in genitourinary toxicity at 6 months compared with IMRT, at 12 months post-treatment there was no difference in genitourinary toxicity. There was no statistically significant difference in gastrointestinal or other toxicity at 6 months or 12 months post-treatment. Vargas et al. (2008) reviewed the contrast in dose distribution between proton radiotherapy and IMRT in 10 patients with prostate cancer. All rectal and rectal wall volumes treated to 10-80 GE were significantly lower with proton therapy. The rectal V(50) was reduced from 31.3% +/- 4.1% with IMRT to 14.6% +/- 3.0% with proton therapy for a relative improvement of 53.4% and an absolute benefit of 16.7%. The mean rectal dose decreased 59% with proton therapy. The bladder V(30) was reduced with proton therapy for a relative improvement of 35.3% and an absolute benefit of 15.1%. The mean bladder dose decreased 35% with proton therapy. The authors concluded that proton therapy reduced the dose to the doselimiting normal structures while maintaining excellent planning volume coverage compared with IMRT. Trofimov et al. (2007) compared proton therapy and IMRT for the treatment of early-stage prostate cancer. The authors noted that proton therapy allows for a reduction in the radiation dose to the surrounding normal pelvic tissues in the low to moderate range of 0 to 50 Gy range compared to IMRT, while maintaining similar volumes of the organs at risk which receive higher doses. Slater et al. (2004) analyzed results of conformal proton radiation therapy for localized prostate cancer in 1255 patients. The authors concluded that conformal proton radiation therapy yielded disease-free survival rates comparable with other forms of local therapy, and with limited morbidity.

**Codes:**

77520 – Proton treatment delivery; simple, without compensation
77522 – Proton treatment delivery; simple, with compensation
77523 – Proton treatment delivery; intermediate
77525 – Proton treatment delivery; complex

**References:**

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