



**Title** Proton Therapy  
**Agency** CEDIT, Committee for Evaluation and Diffusion of Innovative Technologies  
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**Reference** CEDIT Report (in French) No. 01.10/Ra1/01/Recommendation 01.10/Re-1/02

## Aim

AP-HP, Institut Curie, Institut Gustave Roussy, and Centre René Huguenin, are members of an interhospital body that manages the Orsay Center for Proton Therapy (CPO: Centre de Protonthérapie d'Orsay). The General Director of the AP-HP requested advice from CEDIT. The ballistic advantages of protons enable irradiation of small areas in high doses while sparing surrounding structures. Proton therapy is part of hadron therapy, as are neutron therapy and all treatments using heavy ions with good ballistic and biological properties.

CPO was created in 1989 following the sale of a synchrocyclotron from CNRS (French research institute). Today CPO has two treatment rooms with fixed beam lines. Numerous projects could help modernize this aging installation and increase patient levels. The first stage would be quicker beam alternation between the two rooms. Setting up a third room, either with a new fixed line and a robot for patient positioning, or, preferably, an isocentric gantry, would enable better adaptation of the facilities to current needs and future development.

Worldwide, about 20 centers offer proton therapy and hadron therapy with heavy ions (most offer only proton therapy). Two of these are in France (Orsay and Nice). About 20 new centers are planned, most for proton therapy. A European network has been created to oversee 6 heavy-ion hadrontherapy projects (one to be created in Lyon).

## Conclusions and results

The effectiveness of proton therapy is documented, but the rarity of indications makes it difficult to undertake systematic patient series reporting and prospective comparative randomized trials. Treatment of uveal melanomas by protons is a well-established indication (ANDEM report, 1995), particularly for posterior tumors or those astride the equator. For skull-base chordomas and chondrosarcomas, the combined use of photons and protons (protons accounting for 1/3 of the dose) provides very positive results with acceptable toxicity. Many applications attempt to benefit from the ballistic properties of protons. This benefit is particularly sought in treating tumors in children where irradiation of healthy tissue in full-growth phases can cause heavy sequelae. The modernization of CPO would cost from 0.46 M€ (quick alternation between rooms) to 7.17 M€ (a third room with an isocentric gantry). Building a new proton therapy center could cost between 25 M€ and 85 M€ depending on the type of accelerator and number of rooms involved. Treatment costs using protons are estimated to be 2 to 3 times the cost of conventional radiotherapy.

## Recommendations

CEDIT acknowledges the effectiveness of proton therapy in melanomas of the eye and skull-base chordomas and chondrosarcomas. However, the role of this new form of treatment in comparison with radio surgery remains uncertain. The proposed extension of indications needs to be validated. The excellence of the CPO is acknowledged. Its patient treatment load from France and abroad makes it the most active in Europe. To maintain performance and patient growth levels, we propose a fundamental reorganization, perhaps creating a new center for proton therapy, with its administration being more national in character.

## Methods

A literature search of 3 databases, ie, MEDLINE, EMBASE, Pascal). Nine experts were interviewed on the medical benefits of this technology.

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