PLANS FOR PARTICLE THERAPY IN SWEDEN

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Abstract

A national project for a Swedish Proton Therapy Centre (SPTC) supported by the Swedish university hospitals was formed in 2003. The aim of the SPTC project was to build a national proton therapy centre focused on combining patient treatment and clinical research. The centre was to be operated under the principle of shared governance and distributed competence meaning that the preparations before radiotherapy were to be performed at the collaborating university hospitals.

In 2006 the political majorities in all Swedish counties with university hospitals decided to form a common body, the "Joint Authority of County Councils for Advanced Radiation Therapy" with the aim of building a national particle therapy facility. In early 2007 it was decided to build a proton facility with land reserved for a possible future expansion to light ions. The facility will be operated under the shared governance – distributed competence principle and it will be located in close proximity to the University Hospital in Uppsala. The facility has been named the Skandion Clinic.

At the moment the project is in the process of procuring a complete proton therapy facility under a turnkey contract and a call for tenders has recently been submitted. The intention is to sign a contract in 2008. The plan is to start patient treatments in 2011.

THE SWEDISH PROTON THERAPY EXPERIENCE

Proton beam radiotherapy has a long tradition in Sweden. The proton beam of the synchrocyclotron at the Gustaf Werner Institute in Uppsala was used for patient treatments between 1957 and 1973. After a long period of accelerator and laboratory reconstruction, patient treatments were resumed in 1989 at the T Svedberg Laboratory (TSL). To date close to 800 patients have been treated, where the main target localisations are intracranial lesions and prostate cancer.

Until 2005 the number of treatment weeks available for radiotherapy was limited to one week per month. From 2006 the number of treatment weeks has increased to 35 per year. Although the beam time availability is good the limitations of the treatment unit at TSL have gradually become more hampering. The treatment unit has one fixed horizontal beam line, the maximum proton range is 20 cm in water and the limited field size attainable with passive scattering severely restricts the number of possible target locations.

THE DEDICATED NATIONAL PARTICLE THERAPY CENTRE

The SPTC project

The medical, technical and financial prerequisites for an advanced radiotherapy centre in Sweden were informally discussed among Swedish radiation oncologists and medical physicists during the first years of the present decade. This lead to the formation of a national project for a Swedish Proton Therapy Centre (SPTC), which was supported by a majority of the Swedish university hospitals. Important for the further development of the project were the Swedish Cancer Society Radiation Research Investigation [1] and the systematic overview of radiotherapy for cancer by the Swedish Council on Technology Assessment in Health Care (SBU) [2], where the need for advanced radiotherapy was clearly stated. The SPTC project organised its work in a number of task groups dealing with medical, technical, logistical, economical and research issues. The results of the SPTC project investigation was published in 2003 [3]. The main conclusions of the investigation can be summarised as:

- Proton radiation therapy increases the probability for cure and reduces the risk for side-effects for a number of specific cancer indications compared to the most advanced modalities of conventional radiation therapy.
- For certain patient groups proton radiation therapy is clearly cost-effective in comparison with conventional radiation therapy.
- The number of cancer patients in Sweden for whom proton irradiation would be beneficial or very beneficial is large enough to justify the investment in a national proton therapy facility. The estimated number of patients per year suitable for proton therapy is 2200-2500 corresponding to 11-12% of all cancer patients treated with radiation therapy [4].
- A national proton therapy centre should be built on the principle of "shared governance – distributed competence" and should thus provide the possibility to combine a large-scale investment with decentralised development of professional radiation therapy competence.
- Uppsala is for several reasons a suitable location for a national proton therapy facility.

The report also concluded that a dilemma for the Swedish health care authorities lay in the decentralised organisation of public health care, which is the responsibility of the local counties in Sweden. None of

these counties is large enough to take on the responsibility for the total investment costs for a national facility. The SPTC project therefore suggested that Sweden had to find new ways for cooperation and financing of such a large scale national investment.

The Joint Authority of County Councils for Advanced Radiation Therapy

In parallel with the SPTC project another Swedish particle therapy project was initiated at the Karolinska Institute in Stockholm [5]. This project was strongly focused on the potential benefits of light ions [6].

Discussions with politicians from the counties with university hospitals clearly indicated that disagreement within the professional community would impede political decisions regarding a national facility. In November 2005 professional agreement was reached on the following points:

- If possible a facility combining proton and light ion beams shall be built.
- If a combination facility cannot be realized, a proton facility prepared for a future light ion extension shall be built.
- The facility shall be built on the principle of "shared governance – distributed competence".
- The facility shall be located in Uppsala.

In July 2006 the councils of the seven counties with university hospitals decided to form a "Joint Authority of County Councils for Advanced Radiation Therapy" with the aim of building a national particle therapy facility according to the agreement of November 2005.

Distributed particle radiation therapy

The distributed model for operation of the particle therapy centre involves all the eight Swedish university hospitals – the "home clinics" [7]. The centre in Uppsala will be a pure treatment facility and all the preparations before treatment will be performed at the home clinics. This means that patients cannot be referred directly to the Uppsala facility. Instead they have to be referred to one of the home clinics. The leading idea is the distributed competence in radiation oncology and medical physics in all the collaborating home clinics supported by advanced information technology and telemedicine technology. The logistics of the treatment process from diagnostics, preparations to radiotherapy and follow-up is illustrated in Figure 1.

An efficient and optimal work flow within the facility itself is of utmost importance. The plan is to equip every treatment room with two preparation rooms, where the patient can be immobilised and positioned prior to treatment. The patient is then transported on a treatment couch top which is docked to the couch in the treatment room, where the position is verified before irradiation. This would minimise the time spent by each patient in the treatment room and thus increase the patient throughput.

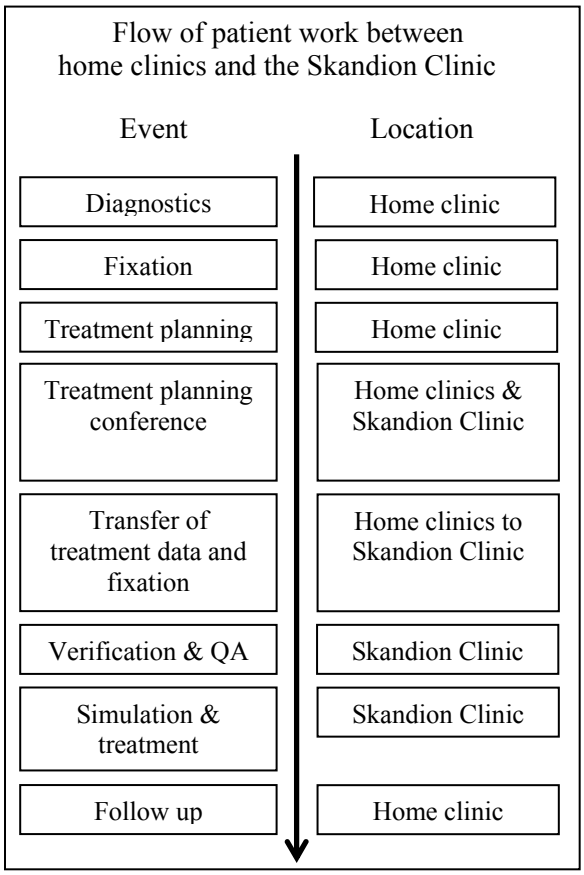

Figure 1. Schematic representation of distributed work flow between home clinics and the Skandion Clinic.

Prequalification tender process

In 2006 the Joint Authority published an invitation to tender for a particle therapy facility. The idea was to obtain a basis for a decision to build either a proton-light-ion combination facility or a proton facility. The tenders were evaluated and the board of directors of the Joint Authority decided to go for a proton facility but with land area reserved for a future expansion to light ions.

THE SKANDION CLINIC

The particle facility was named the Skandion Clinic (Skandionkliniken in Swedish) and a land area adjacent to the University Hospital was chosen for the centre. The Skandion Clinic will be built with culvert connection to the University Hospital so that bed confined patients can be transported directly from their wards to the proton facility.

The land lot for the facility is owned by Uppsala University and the University real-estate administration is planning for the building. At present four different architect firms are working in a parallel commission with design and configuration of the building in the cityscape.

Specifications for the turnkey proton facility

In 2007 a new invitation to tender for a proton facility was submitted. Key points of the technical specification were:

- A turnkey facility with high uptime (>95%).
- The facility shall meet all national and international safety standards including CE-marking
- Active scanning with intensity modulated proton therapy (IMPT) is required in every treatment room.
- Isocentric gantries.
- Proton range and field sizes enabling treatment of all target locations.
- A minimum treatment capacity per year of 1000 patients corresponding to 15000 fractions. Possibility to increase the treatment capacity to 2500 patients or 37500 fractions by increased working hours.
- Treatment planning and oncology information systems with a common data base accessible from all home clinics and the Skandion Clinic. Open communication between these systems and the corresponding systems at the home clinics.
- Treatment planning system with capability of planning both for intensity modulated proton and photon beams as well as 3D conformal radiotherapy with photons and electrons.

STATUS AND PLAN FOR THE PROJECT

The plan for the Skandion Clinic is to evaluate the tenders and negotiate a contract for a complete turnkey proton facility during 2008. The construction work for the building will begin before the end of 2008. The building work and the installation and commissioning of the equipment are scheduled to be completed within three years. If this plan holds the first patient will be treated by the end of 2011.

The Skandion Clinic will have a permanent staff of oncology nurses, medical physicists and engineers for patient treatments, quality assurance and technical maintenance. In addition, radiation oncologists, medical physicists and oncology nurses from the collaborating home clinics will work at the Skandion Clinic on a rotation schedule in order to maintain expert knowledge in the collaborating home clinics.

CONCLUSIONS

A national particle therapy centre will be built in Sweden. It will be operated under shared governance by the seven counties with university hospitals. This is the first time in Sweden that a large scale investment is managed in collaboration between all the university hospitals.

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