



CLINICAL EXPERIENCE FROM THE FIRST COMPACT IMPT PROTON THERAPY CENTER THE ADVANTAGES OF TREATING IN AN OPEN GANTRY ENVIRONMENT

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The Willis-Knighton Health System, headquartered in Shreveport, Louisiana, is a not-for-profit community healthcare corporation with four general acute care hospitals and affiliate relationships with several rural hospitals. The Willis-Knighton Proton Therapy Center is the first compact single-room IMPT proton therapy system that was installed in the world.

Under the leadership of Lane R. Rosen, M.D and using the open gantry Proteus®ONE solution with Philips' Ambient Experience, the clinical team has treated a multitude of malignancies such as brain, breast, lung, prostate, cervical, central nervous system, gynecological and gastrointestinal tumors.



|| *We have a strong CNS and brain tumor program and with the open gantry we are able to treat a vertex field very easily.* ||

Lane Rosen, M.D., Medical Director, Willis-Knighton Health System

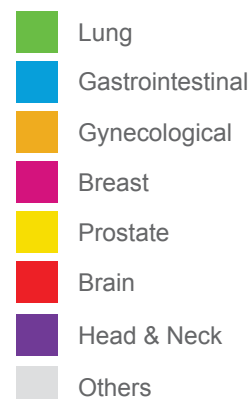
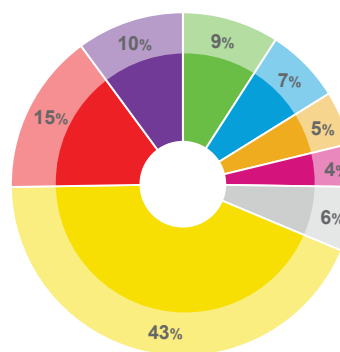
Over 40 compact single-room proton therapy solutions have been sold across all vendors. About 75% of these compact solutions have an open gantry configuration, including prestigious centers such as Willis-Knighton, Beaumont, University of Florida Proton Therapy Institute, ParTICLE / UZ Leuven and Taipei Medical University. This paper summarises the initial clinical experience of Willis-Knighton using Proteus®ONE, the only true compact image-guided single-room proton therapy solution with Pencil Beam Scanning (PBS) and Cone Beam Computed Tomography (CBCT), which has been in clinical use since 2014. Their results highlight the advantages of treating patients in an open gantry environment:

- Treatment of a large range of indications
- Treatment of non-coplanar fields
- Higher patient volume

Body sites and clinical outcomes

The patient mix analysis is based on the first 500 patients treated with proton therapy. Treatment areas include the brain (15%), head and neck (H&N) (10%), lung (9%), gastrointestinal (7%), gynecology (5%), breast and chestwall (4%), prostate (43%), and others (6%). Most cases were initial courses of proton therapy (92%) with the remaining 8% receiving re-irradiation from previous photon radiation treatments.

The clinical paper^a describing the initial experience of the first 100 patients shows promising results with respect to toxicity levels and Quality of Life (QoL). Based upon the amount of acute toxicity experienced by the patient group, it is believed that the nature of the side effects and severity of the reported toxicities are both acceptable. Furthermore, despite being



Patient mix for the first 500 patients^b

entirely rid of a malignancy, most patients did not experience a clinically significant change in QoL in comparison to their baseline score.

From the analysis of the initial sample of patients, open compact IMPT proton beam therapy was shown to be safe and efficient when delivered to a wide variety of body sites using both volumetric/CBCT and stereoscopic image-Guidance.

Advantages of the open environment for treating non-coplanar fields

With the open gantry and verification with the oblique imaging system, treating a vertex field for cases such as Brain, CNS, CSI and also Head & Neck in some configurations is easy compared to the difficulty that is required with a closed gantry. Even though treating vertex fields is possible with a closed gantry, the patient positioning, the therapist positioning and the size of the patient has a much bigger impact on the workflow. That can lead to significant time increase in the workflow or in some cases treatment becomes impossible.



Illustration of the positioning of the patient for a vertex field in an open gantry environment with Philips Ambient Experience

Higher patient volume

In the initial experience clinical paper^a, the typical proton therapy plan for the patient grouping included two to three unique beams delivering a dosage averaging a Planning Target Volume (PTV) of 360 cc.

The total time in the treatment room, including patient set up, image guidance, treatment and electronic charting, is on average 16 minutes per patient (range 12.17-22.13 minutes). 7% of the patients were treated with a gradient field matching technique and 5% of the patients received breath hold during treatment with no impact in efficiency.

Based on that timing, between 3 and 4 patients can be treated per hour in IBA's open gantry environment. For 16 hours of treatment, 5 days a week and 50 weeks a year, between 12 000 and 16 000 fractions can be administered. This represents a yearly total ranging between 480 and 640 patients [25 fractions per patient].

Mean treatment time of 16 minutes per patient

The Proteus[®]ONE open gantry's unique features contributing to a 20% increase in workflow efficiency are:

- Open environment and ambient experience

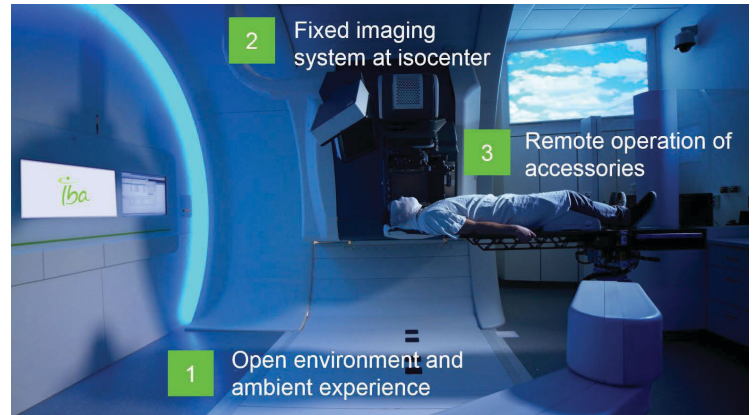
The soothing and welcoming atmosphere provided by an open environment and the Philips' Ambient Experience allows for faster patient loading and positioning. The spacious open environment drastically improves levels of access to patients. Ambient Experience is an approach to clinical environment design aimed at improving the patient and staff experience by providing positive distractions for patients as well as recommendations for effective staff workflow.

- Fixed imaging system and Cone Beam CT at isocenter

The fixed imaging system is always ready to image the patient. Because the system is set at isocenter, it eliminates the need for substantial displacement after patient alignment. Furthermore, thanks to the open environment, most of the treatment positions are available for the imaging phase, including the vertex position. CBCT is also available at isocenter to provide soft tissue detectability for more precise target localization and generate 3D images capable of treatment adaptation.

- Remote operation of accessories

As with the linear accelerator workflow, all mechanical elements and the imaging equipment can be activated from inside or outside the room. This feature eliminates the need to enter the room between fields to rotate the gantry or re-align the patients, or place the range shifter in or out of the field.



Unique features of Proteus[®]ONE open gantry solution

Conclusion

The Proteus[®]ONE has been designed to be the most advanced compact IMPT proton therapy solution. The initial clinical experience of Willis-Knighton Proton Therapy Center shows that an open gantry environment can treat a large number of clinical indications, affirms advantages when dealing with non-coplanar fields, and offers the most efficient workflow.

|| PBS-based PT can be safely and efficiently delivered to a wide variety of body sites using both volumetric/CBCT and stereoscopic image-guidance. An open-gantry compact design increases our ability to offer treatment for a large range of indications. ||

**Terry Wu, Ph.D., Chief Physicist
Willis-Knighton Health System**

Reference

- "Initial Experience with the First Community-Based Single-Vault Proton Therapy System", JB. Wilkinson et al, submitted to IJPT
- "Treatment efficiency and optimization of patient care with Proteus[®]ONE", T. Wu, IBA Meet the Experts presentation, ASTRO 2018, San Antonio, TX, US

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