High precision radiation therapy, called stereotactic therapy, is already frequently applied for small intracranial lesions in the Oncology Centre of Limburg (Limburgs Oncologisch Centrum, LOC, Belgium) since 2004. This technique is performed in cooperation with the departments neurosurgery of both the Jessa Hospital and the Hospital Oost-Limburg. The LOC has built up considerable expertise and is experienced in the follow-up of treated patients on the long term. Since 2014, the LOC is equipped with a new machine which allows for the application of this technique in a less invasive way while maintaining high precision.

10 years ago, as one of the first in Belgium, the Oncology Centre of Limburg (Limburgs Oncologisch Centrum, LOC, Belgium) founded a centre for Stereotactic Radiation Surgery in cooperation with the departments neurosurgery of both the Jessa Hospital and the Hospital Oost-Limburg (ZOL). Stereotactic Radiation Surgery (SRS) is a technique in which a high dose of radiation is applied with high precision (stereotaxy) on small intracranial injuries (maximum diameter of 3 cm). Thanks to the high precision of delivery, the radiation dose can be increased which results in a significantly better outcome. This technique can also be applied with bigger lesions. However, the radiation dose is spread over multiple fractions (days) while maintaining the same precision as with single fraction SRS.

Every year, approximately 50 patients are treated using this technique. The LOC has therefore built up considerable expertise and is experienced in the follow-up of treated patients on the long term. “We already apply this technique since 2004” says Dr. Annelies Maes, radiotherapist-oncologist at the LOC.

An invasive frame is replaced by a stereotactic mask

“Until recently, an invasive stereotactic frame was used for the immobilisation of patients and the localisation of the tumour. On the day of the treatment, the neurosurgeon secured this frame to the head of the patient using 4 pins while the patient was anesthetized”, says Dr. Eric Put, neurosurgeon at the Jessa Hospital. “Since January 2015, we started at the LOC with stereotactic radiosurgery without using this frame (frameless SRS). Instead of the frame, a stereotactic mask is used. This mask consists of a thermoplastic material. After heating, a nurse places the mask over the face of the patient so a personalized radiation mask is created. Thanks to this mask, we can immobilize the head of the patient with the same precision compared to a frame.”

“After making the mask, a planning CT-scan is performed”, says dr. Yves Staelens, radiotherapist-oncologist at the LOC. “These images are fused with the NMR images. While the neurosurgeon and the radiotherapist mark the lesion and determine the dose together, the radiation physicist
develops the planning. Afterwards, a few quality checks are performed to be sure all parameters are set properly. Only if this quality check is successful, the treatment is performed. After the treatment the patient can go back home”.

**New radiation machine**

“To allow treatments using this mask, the LOC invested in a new state of the art radiation machine, the Truebeam STX. This device is equipped with a real-time imaging system and a 6D treatment couch. The imaging system allows making pictures of the radiation isocentre during treatment and subsequent correlation with the treatment plan. In this way possible minor deviations in positioning may be detected and adjusted immediately”, says Dr. Maes.

“The 6D treatment couch can be moved full-automatically in 6 directions (vertical, lateral, longitudinal and rotations in 3 planes) to adjust for minor deviations in positioning”, says Dr. Staelens. “Another benefit of the new machine is the possibility of controlling the movement of the patient inside the mask during treatment. In this way corrections can still be made during the treatment itself.”

“Measurements by the team of the radiation physicists of the LOC show that these movements inside the mask are minimal when using a mask which was carefully molded. The nurses working at the simulator are utmost experienced in making masks which are as precisely fitting. Consequently adaptations during treatment almost never have to be performed,” continues dr. Staelens.

**Minimal stress for patients**

“This technique offers a lot of advantages”, says Dr. Koen Engelborghs, neurosurgeon at ZOL. “The first major advantage for the patient is that frameless SRS can be performed without experiencing pain. We use a normal mask instead of an invasive frame which has to be screwed into the skull of the patient under local anaesthesia. In this way the use of painkillers becomes redundant. Sometimes anxiolytics are used with patients suffering from claustrophobia. However, this phenomenon rarely occurs. A second important advantage is better planning of the radiation itself. The mask can be made in advance where after the physicists may perform all calculations. The radiation itself can take place a few days later upon appointment. In this way the costs for the patient are brought down since a hospital admission for one day becomes unnecessary.”

Dr. Put: “Frameless SRS is minimally stressful for the patient. This allows for an adequate treatment of patients in a poor general condition as well. Another advantage lays in the fact that when relapse (i.e. metastases) occurs, the patient can be treated again in a much easier way. While a frame has to be secured again, the mask is already customized and can easily be reused.”
Good results

“Research points out that this new technique is very efficient and precise for treatments of smaller and non-operable intracranial benign and malign lesions. Moreover, the technique is as accurate as the technique which makes use of the frame”, concludes Dr. Maes.

“In general, the results of SRS are good. A growth stop of benign injuries like meningioma occurs in 90-95% of the patients and sometimes the diameter of the injury is diminished as well. By using this technique, we can prevent the growth of the meningioma which would otherwise result in a serious neurological deficit.” says Dr. Put. “In patients having (a limited number of) brain metastases, the volume of the metastases is usually diminished or even disappeared after approximately 3 months. With this technique we are capable of controlling the brain metastases and prevent neurological deficit which will ultimately result in an improved quality of life.”

Dr. Engelborghs: “For the correct indications, the results of this minimally invasive technique are even comparable to a surgical intervention. Moreover, the risks of this technique are smaller than those experienced with a surgical intervention, which is particularly an asset for older and weakened patients.”

Which are the most important indications for SRS?

Benign lesions
• Non-operable meningioma, e.g. some base of skull meningioma
• Schwannomas, e.g. nervus acousticus (vestibularis)
• Arteriovenous malformations (AVM) for which embolization cannot or only partially be used (in this case the invasive frame still has to be fixed)

Malign lesion
• Non-operable solitary brain metastases.
• Postoperative tumour bed, e.g. after resection of brain metastases
• Multiple brain metastases (1-3)
• Recurrent gliomas

The technique is currently used for extra cranial injuries as well. In this case it is called stereotactic body radiation therapy or ‘SBRT’ (e.g. pulmonary coin lesion).