performed using either Tomotherapy [4-6] or conventional linear accelerators with VMAT and IMRT technologies support [1, 7, 8].

Currently, there are no protocols for contouring and dosimetric planning of whole-body irradiation using volumetric modulated arc therapy (VMAT) in the Republic of Belarus. Our goal was to try to conduct end-to-end preparation for TBI of real patients based on world experience and using the instruments available in our clinic.

Based on the literature information [2, 3, 9], the radiation dose is mainly in the range of 12 to 15 Gy. For test plans creation, the authors selected a dose of 12 Gy as the most often mentioned.

Test plans were created on computed tomography scans (CTs) of real patients, who were full-body scanned for diagnostic purposes in our clinic previously. In addition, for the first plan CT images of inhomogeneous, anatomically accurate Alderson phantom (torso+head) was used. All treatment planning activities were carried out using the Eclipse Treatment Planning System (Varian MS, Palo Alto) for Unique linac (Varian MS) with 6 MV photon beams.

The fields arrangement was as follows: 10 full arcs with different collimator rotation were applied to the up part of the patient body (or whole Alderson phantom) in head-first supine position. Another 6 arcs were planning on down part of patient body in feet-first supine position.

Clinical volume coverage was evaluated in accordance with international standards and recommendations [10]. OARs constraints were taken from literary description of other clinics experience [1, 4-8].

For Alderson phantom and two whole-body real patient CTs test plans were created. All constraints of clinical volume coverage and organs at risk tolerance dose were achieved. The authors have proposed the sequence of actions for dosimetric evaluation of the dose delivery accuracy, but now this issue needs further study.

**BIBLIOGRAPHY**


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**ANALYSIS OF SECONDARY RAW MATERIAL EXTRUCTION IN THE US, THE RUSSIAN FEDERATION AND THE REPUBLIC OF BELARUS**

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We have analyzed the modern technologies of secondary raw material extraction regarding municipal solid waste (MSW) in the Federal Republic of Germany, the Russian Federation and the Republic of Belarus.

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Keywords: secondary raw material (SRM), municipal solid waste (MSW), waste management.

According to the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in 2017, there were 68 waste incineration plants operating in Germany with a capacity of around 20 million tons. About 55% of total mixed waste was burned annually. In 2017, 45 mechanical-biological treatment plants treated 5 million tons of solid waste, recovering 4.5 million tons of secondary raw materials, while only around 0.5 million tons ended up in landfills. At the same time, only 7 percent of total mixed municipal solid waste of commercial origin that accounts for 6 million tons was recycled into secondary raw materials.

In their environmental policies most European countries including Germany and Belarus follow the waste management hierarchy listed below from the most to the least preferable options: avoidance; reduction of wastes; reuse; recycle; energy recovery; and treatment and disposal. The countries give the top priority to the most environmentally friendly strategies.

The morphological composition of municipal solid waste is seen to be constantly changing. This is due to the world’s common tendency for MSW generation to dramatically increase from 0.485 kg per capita per day to 1.7–2.0 kg per capita per day. The significant growth in non-biodegradable fractions in the MSW composition such as plastics; packaging glass; rubber products; and mercury-containing wastes like mercury-containing light bulbs, temperature and pressure gauges is occurring.

The rate of processing of non-biodegradable materials in Germany, such as glass, steel, aluminium, paper and plastic has increased; the percentage of processing of some materials out of the total volume being near 80%. The waste recycling industry of Belarus is dynamically developing. For example, there are already about 200 plastic processingenterprises in the Registry of waste management facilities.

Comparing the Republic of Belarus and the Russian Federation, we can see that there are the same problems associated with great workload on landfills; however the projects to help reduce this workload exist in both countries. Moreover, according to the law each country has its own waste management priority principle.

In particular, the following waste management principles are applied in the Russia: introduction of low-waste and non-waste technologies, waste reduction; foreground recycling; minimizing landfilling; decreasing the toxicity of waste dumped in landfills. Waste reduction is the target of the highest priority both in Russia and in the EU. This is due to the fact that by the beginning of 2018 only 4-5% of total wastes were recycled while almost all municipal solid waste was dumped in landfills in Russia, according to the Federal Service for Supervision of Natural Resource Usage.

The Law of the Republic of Belarus “On Waste Management” defines the use of waste as a priority principle of waste management. Only the waste that cannot be used is subjected to disposal. The requirements of environmental legal system and economic efficiency must be taken into account. Thus, we can say that the strategy for secondary raw materials of Belarus in some aspects differs from the strategies of European countries, but have their own equiva-lent.

According to the National Strategy for the Management of Municipal Solid Waste and Secondary Material Re-sources in the Republic of Belarus for the period up to 2035, the real volume of MSW generation in Belarus accounts for 3 to 3.65 million tons per year, taking into consideration secondary raw material, which is 15–20% lower than existing official estimates.

In the countries analyzed in this paper there are some problems of SRM extraction from MSW, which include: the lack of space for MSW disposal, uneven pace of waste generation, and the environmental impact of waste. Thus, in the EU countries (in Germany in particular), Russia and Belarus, there are common problems associated with the waste management, which don't depend on the degree of the country development or legislative norms.

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