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Ergonomic Immobilization Frame for Radiotherapy

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Ergonomic Immobilization Frame for Radiotherapy

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Background
➢ Every year cancer patients are treated using radiotherapy.
➢ During radiotherapy the patient must be as still as possible and the radiation must be applied evenly and in a consistent area.
➢ Currently there is no system in place which is used for general torso immobilization when applying radiotherapy in those areas.

Materials:
➢ Any areas in the system which would come into contact with radiation had to be built using radiographic safe materials.
➢ Therefore nonmetallic materials, wood and plexiglass, were used to build the system.

Design & Fabrication
➢ A mechanical shell structure was modeled in Solidworks.
➢ The shell is the area of the system which would have pressure exerted on it from the airbags. Therefore it was important to run an analysis on the shell at 6 Psi in order to calculate the displacement of the plexiglass from the wooden frame.

Strength Analysis:
➢ Three of the four posts will be permanently fixed to the base.
➢ The person will stand in the middle of the base. The removable post will be placed and the patient will have the airbag shells on both sides of them.
➢ The airbags are then inflated on both sides immobilizing the patient.

Device Operation:
➢ Three of the four posts will be permanently fixed to the base.
➢ The person will stand in the middle of the base. The removable post will be placed and the patient will have the airbag shells on both sides of them.
➢ The airbags are then inflated on both sides immobilizing the patient.

Objectives
➢ Our objective is to demonstrate that a patient can be safely immobilized using air in order to have radiotherapy administered to them.
➢ We aim to develop a prototype which will use an air medium to immobilize patients while standing.
➢ The system will be used to treat tumors and immobilize in the general torso area, namely to treat tumors in the lung and liver.

Air Immobilization: Air was chosen for immobilization because radiation can easily flow through air and it allows so there are no physical interferences while the radiation is being applied.

Fabrication:
➢ Each component was cut using a jigsaw this incudes any part with a curve in it.
➢ A frame was developed with a deep groove inside to insert the plexiglass in order to hold it in its desired curved position.
➢ As a replacement for screws in order to join parts together a series of dowels were used.

Future Plan
➢ The system will need to be integrated with current clinical hardware.
➢ Smart electronic inflation and deflation systems need to be added.
➢ Custom airbags which will perfectly fit the semi-circular shells will need to be developed.
➢ There needs to be further development in making the shell adjustable to accommodate patients with different heights.

Conclusion
➢ We successfully fabricated a radiotherapy-compatible system which can be used to immobilize the torso region of a patient using air pressure during radiotherapy.

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