

Problems with Designing of Medical Equipment for Young Patients

Malgorzata John-Banach¹, Antoni John^{2,*}

¹Mechanical Engineering Faculty, Silesian University of Technology, Gliwice, Poland
e-mail: Malgorzata.John-Banach@polsl.pl

²Mechanical Engineering Faculty, Silesian University of Technology, Gliwice, Poland
e-mail: Antoni.John@polsl.pl

KEYWORDS: *Rehabilitation equipment, Young patients, Small-scale production, Additively manufactured components, Mass-produced components.*

Recently, there has been a growing demand for rehabilitation equipment for children. This is due to road accidents, disabilities, and, above all, armed conflicts, in which civilians, including children are the victims. In its 2022 report [1], UNICEF summarizes that over 104,100 children were killed or injured between 2005 and 2020. However, the organization emphasizes that these figures are underreported. This is due to limited access to victims, lack of safety, and the shame, pain, and fear experienced by victims, which often hinder the reporting, documentation, and verification of serious violations of children's rights in situations of armed conflict. Since 2020, further conflicts have emerged around the world, resulting in an increase in these statistics. Long-term use of equipment requires adapting it to the developing body. Responding to such changes should be relatively quick to avoid interruptions in rehabilitation or to keep it as short as possible. Discontinuing exercise can result in a reversal of previously achieved results and progress. An important aspect is the ability to relatively quickly produce small-scale components. Solutions that can be applied to a variety of patients are a good direction. While this is possible in some cases, it is not always possible. There are patients who require personalized device adaptation. It is then necessary to use technology that allows for relatively easy changes and relatively rapid production. The possibility of rehabilitation in a center located as close to the patient as possible reduces the material and psychological costs incurred by the patient and their family. Aspects that have been marginalized for some time in the design process include aesthetic values and the possibility of external personalization dictated by the patient. Prolonged, repeated repetitions of, for example, an exercise can lead to fatigue and withdrawal. In rehabilitation, the patient's consistency and determination are often crucial. The ability to choose options provides a sense of agency. We are more likely to use devices we have chosen ourselves or have had an influence on their appearance. Allowing a child to choose the color or texture can enhance the experience of using the equipment.

The problems presented above were observed when designing personalized medical equipment for a young patient. Two cases will be discussed in more detail. The aim was to propose a solution that would be adapted to the developing organism. It combines readily available, mass-produced components with additively manufactured components, which are relatively well-suited for small-scale production. Such components offer the potential for aesthetic personalization. Another project addressed the issue of a prosthesis designed for soccer. This approach was aimed at activating individuals after limb amputation. This is an important aspect – improving quality of life. As in the previous case, the proposed solution utilizes both mass-produced and additively manufactured components. In summary, the most important problems related to the design of rehabilitation equipment for young patients will be presented, along with possible solutions using available resources.

[1] 25 years of children and armed conflict: taking action to protect children in war, ©United Nations Children's Fund (UNICEF) June 2022;