Tetrapodium PW - new quality in daily life of the disabled

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1. Introduction

In the recent years, knowledge about the benefits of regular reception of standing position has spread among people with disabilities. This happened, among other things, through the campaign which was held during the launch Parapodium PW - Dynamic orthosis developed in the 90s in our Institute. Everyone should spend in the standing position least 2-3 hours everyday. Otherwise, all their internal organs will be subject to degeneration to a smaller or larger degree. Tilting tables are very seldom used in everyday’s life*. Not everyone is able to assume an erect position in existing orthosis. These are devices powered by the upper limbs. A person who has weak arms will not be able to walk in them. Therefore, the team of Parapodium designers created a new, fully electrified apparatus- Tetrapodium PW. This device not only gives its users the opportunity to assume a standing position, Z

2. Description of the apparatus

The equipment enabling mobility for the disabled consists primarily of wheelchairs that allow moving in the sitting position and orthosis that allow moving in the erect position (provided that its users retains full aptitude of upper limbs). However, there is no equipment which would allow the disabled, for instance, to work in the seating position and to move in the erect position. The standing-up wheelchairs with the almost never allow for movement in an upright position. This is due to the high risk of losing the balance and falling. In turn, shifting from the wheelchair to the orthosis takes much time (least with the use of Parapodium PW, but still it is minimum 20 seconds) and requires large expenditure of energy. For this reason, users of orthosis avoid frequent transition from wheelchair to orthosis and back. To help them regain the natural rhythm of life in which the majority of activities are performed in the sitting position and moving in the apartment is in the erect position, a new type of mobile electric orthosis - Tetrapodium PW (Fig.1) has been developed.

In the construction of this apparatus the designers took advantage of the expertise gained at the Parapodium PW project. Particularly important were the conditions that must be satisfied to provide balance while moving in an upright position. At the same time it was necessary to build the drive that allows the move on any trajectory, which is essential in a cramped apartment space.

Two independently driven wheels mounted on the sides of the axis of transverse symmetry in the Tetrapodium PW allow moving around the trajectory with radius from 0 to ∞. Since the wheels are located on control arms, they do not lose contact with the ground even in case on unevenness. Four self-adjusting wheels at the corners of the base of the apparatus provide stability. The original engine control system ensures virtually silent movement. The biggest problem the designers were facing was to ensure safety of the user in both extreme positions - sitting and standing - and in all intermediate positions taken when standing up and sitting down. When standing up, the centre of body mass moves forward about 35 cm (Fig. 2). This is half the length of the field base of the apparatus. So, if in the sitting position, the projection of the centre of mass were in the axis of the power wheels, in the standing position it would be on the edge of the bearing field of the apparatus. And it would risk falling every time the user moves. The solution is a unique kinematic structure that makes the user’s centre of mass move vertically with an accuracy of 30mm (when changing the position from sitting to standing and vice versa) (Fig. 3). So at any time the user has a large reserve of stability of Tetrapodium PW on the ground.
3. **Summary**

There has been created a device enabling paralysed people (even Tetraplegics) frequent switching from the standing to the sitting position and back, free movement in these positions and performing any movements of hands. In the study evaluating the attractiveness of the solution, conducted on a group of 22 persons with disabilities, 95% of the group gave very positive rating. In the summary of the study there has been written "It was emphasized that no other device allows for such a trouble-free assuming the erect position with the possibility to spend time so actively and versatile. (which among other things, is the cause of a lack of sufficient standing time of the disabled). Summarizing, the device fills the market gap - the respondents were not aware of any other device distinguished by similar features and functionality."