Gait and Balance Comparison Between Young and Elderly Adults: Minimizing Fall Risk

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ABSTRACT

IMUs (Inertial Measurement Units) are commonly used to monitor several patients who are prone to fall. With the help of these devices, the research team will simultaneously collect data on both old and younger adults and establish the baseline for fall risk modeling; detecting fall risk in its early stages, preventing it, and providing an effective intervention program (exercises) to reduce this risk with the support of the mhealth paradigm (i.e., mobile phone application). Future work will involve the application of the findings at this stage to advance on the intervention aspects of the project.

INTRODUCTION

Falls are among the most common cause of injury and independence in older adults. Approximately 30% of adults over 65 fall each year, and almost 50% will likely fall more than ones. The direct-cost of fall-related injuries and fatalities in 2015 was close to $50 billion in the United States alone [1]. This is directly related to the lack of postural stability appearing as humans grow older and bodies become atrophied.

Nevertheless, fall prevention does not need from biological breakthrough findings, or even new elements found in nature, to be improved. Individualized analysis including the right measurements, such as local dynamic stability and non-linear gait analysis can properly assess fall risk and therefore prevent it on fallers [2]. Focusing on the key parameters from these analysis can also decrease these alarming numbers greatly, resulting in a better quality of life for prone-to-fall adults. This would not only be applicable to U.S. residents, but it has proven to work in different cultures [3].

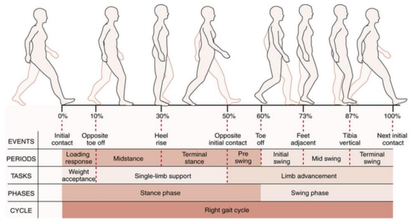

Figure 1. Gait phases breakdown

METHODS

Research process was started by collecting data on the different subjects. These will be elderly patients (11), which are the target group of choice for the project, as well as younger healthy subjects (4) serving as control data.

Collecting was done by means of IMUs. In this case, iPhones were used. They were added onto a belt worn by the analyzed subject. The LMOrtho app from the Locomotion Laboratory recorded the relative motion parameters on a variety of tests: 3-meter walk, 2-minute normal walk, standing balance (eyes open/eyes closed), and Timed Up and Go (TUG) - stand up from a sitting position, walk 3 meters, turn around, come back, and end up at the starting position. There was a background check also included to get an estimate on the ABC score of thr subjects.

The app itself has an implemented result acquisition for parameters such as gait speed, balance sway area, and time used for each stage of TUG. These can be utilized to run different tests on MATLAB pre-coded script as well as statistics software (JMP Pro in this case) where data values arise that are significatively different between both groups. These are sign of key parameters to look for when assessing fall risk and postural stability in elderly patients.

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	Media	Standard Deviation	Media	Standard Deviation
Age	81,91	3,45	22,00	2,00
Height(cm)	163,05	7,79	184,25	5,97
Weight (Kg)	65,27	16,16	90,50	9,47
BMI	33,15	7,28	26,70	3,59
ABC score	81,36	20,68	100,00	0,00

Figure 2. Analyzed subject data references

RESULTS

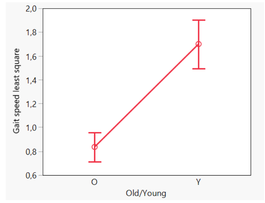
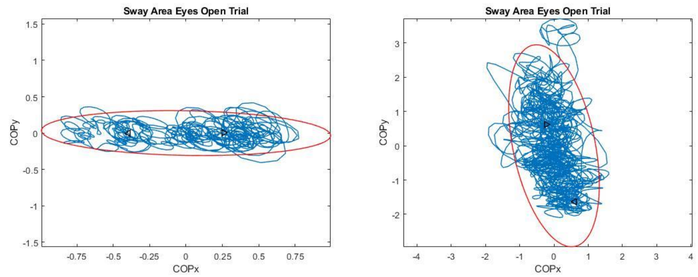


Figure 3. Least square analysis on gait speed data

Gait speed is an important parameter to highlight, remaking how it is significally different between both subject groups, as inferred from Fig. 3 and the p-value (<0.0001).

RESULTS



Figures 4 and 5. Sway area on young (left) and elderly (right) patients

Center of pressure (COP) in sway area for balance analysis is completely different in young and elderly patients. Control group leans to stabilize along the frontal (x) axis while target group stabilizes along the sagittal (y) axis. Deviation along these axis is also much more pronounced on the older group, reporting an average sway area about 10 times as extense as the younger group. When running the statistical comparison, p-value equals 0.0453, making the two data groups significally different.

CONCLUSION

Significally different statistical data groups shows how there is an extensive difference in the parameters recorded. Whenever this is encountered, values are to be analyzed as key parameters to detect fall risk. Postural stability also plays a very important factor in all this, and, as this is supposed to get worse with age, specific data such as sway area and gait speed is affected and consequently deteriorated. Whenever a decrease in these values under 1.5 mph (gait speed) and 2 (COP on each axis) is to be seen on patients, they should be assessed as fall-prone and work on their gait and balance to decrease as much as possible this risk.

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REFERENCES

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