

EFFECT OF TACTILE PAVING ON GAIT PARAMETERS IN OLDER ADULTS

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INTRODUCTION

Fall-related injuries in older people are associated with loss of independence [1], morbidity [2] and death [3], and walking on uneven ground has been reported as a leading activity in which fallers were engaged at the time of a fall [4]. A number of studies have identified relationships between biomechanical variables (speed, gait variability) measured during walking on smooth and irregular surfaces and fear of falling and fall risk [5-7].

Tactile blister paving has been developed in order to provide warning and guidance for blind and visually impaired people and is used at critical points such as pedestrian crossings. Each 40x40 cm paving slab contains blisters ("domes") protruding 5mm above the surrounding pavement. These slabs are laid over a distance of up to 2.4m up to the curb of the street [8]. Such paving may be considered manmade uneven ground, yet despite the known effects of uneven surfaces on gait and balance a search with Web of Science resulted in only one study on healthy young subjects that investigated the effects of tactile pavement on the biomechanics of gait [9] and no reports of the effects on older people.

It was our objective to design a laboratory platform resembling a pedestrian crossing and to investigate gait parameters in older adults walking on smooth and tactile paving. We hypothesized that tactile pavement, as compared to smooth pavement, would result in increased gait variability and decreased speed in older adults.

METHODS

Test platform: in this study the test platform was configured according to the UK's Department for Transport guidelines [8]. The length of the pavement area was 2.4m and the slope leading to the curb of the street was 1:12. A pedestrian traffic



Figure 1: Controlled pedestrian crossing: real world (top) and laboratory set up (bottom).

light and three pairs of timing gates were integrated with a motion analysis system so that the state changes of the light could be synchronized with the marker data.

Test Protocol: 20 older adults (10 with a history of falling) were randomly allocated into either group A or B. Group A began with walking trials on tactile

paving, followed by trials on smooth paving; group B proceeded through the study in the reverse order. Participants then carried out, in a randomized order, a series of walks at self-selected speed along the walkway for both paving types. The 30 walking trials, half of them on tactile paving, comprised i) continuous walking, in which the participant proceeds along the walkway uninterrupted; ii) walking & stopping at curb after an early trigger of the traffic light; iii) walking & stopping at curb after a late trigger of the light. Their presentation was random. This paper only discusses the results for condition (i).

Data collection & analysis: reflective markers were placed on both shoes and on a rigid plate attached to a waist belt. Heel and toe markers were used to first calculate heel strike and toe-off [10] and subsequently to obtain step time and step width & length during dual support (Figure 2). A waist marker was used to obtain speed. Parameter variability was characterized by the standard deviation and paired t-tests were used for comparison of the two paving conditions.

RESULTS AND DISCUSSION

This is the first study to report on gait parameters obtained for a scenario that closely resembles crossing of the street. Ten steps per subject per pavement condition were recorded. No changes in step width and step length variability or speed were obtained. However, step time variability significantly increased from the smooth to the tactile paving condition ($p=0.01$) indicating that subjects exhibited a less rhythmic gait pattern when walking on tactile paving. This has been associated with an elevated falls risk [5-7]. Given the “domes” of blister pavement we will next determine the minimum toe-clearance on both surfaces and evaluate the probability of tripping [11]. Moreover, we will evaluate the effect of pavement type on successful stopping for conditions ii & iii and will analyze data of fallers and non-fallers separately.

CONCLUSIONS

Safe ambulation in the community is crucial to older adults’ independence & quality of life and gait analysis may support good urban design: our results show less regular gait on tactile than on smooth paving and this may reflect an increase in falls risk. Further analysis is required to confirm our findings.

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ACKNOWLEDGEMENTS

UK Engineering & Physical Science Research Council.

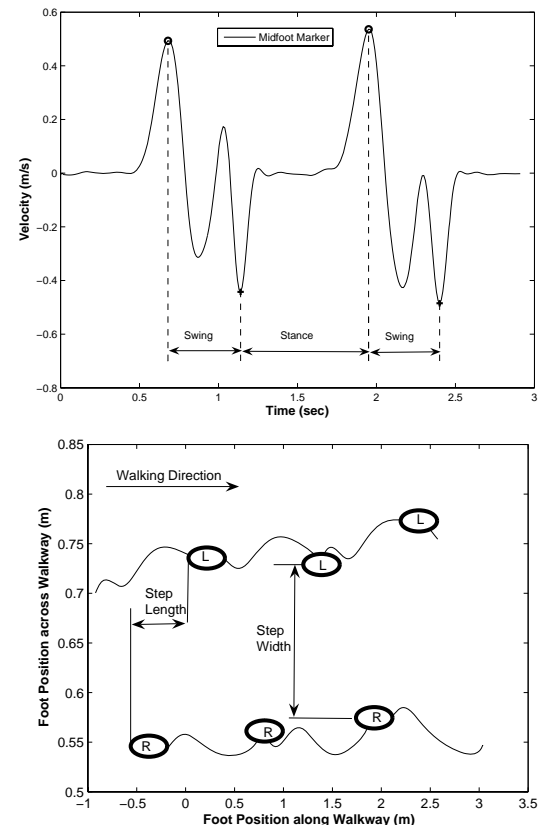


Figure 2: Kinematic data of heel strike, ‘+’, and toe-off, ‘o’, (top) and definition of step width & length (bottom).