# DEVELOPMENT OF INDEPENDENT WALKING IN TODDLERS: WHEN AND HOW DIFFERENT STRATEGIES CONVERGE TO PENDULUM MECHANISM?

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## Introduction

Many studies have been observing infants at the onset of walking in order to evaluate the development of different strategies and coordination [Yvanenko, 2005, Looper 2012]. These studies regard most of the times small groups (<10) and only few studies observed longitudinally the evolution of independent walking (on 2 or 5 subjects) [Bril, 1992, Yvanenko, 2004, Looper 2012]). Given the small numbers of subjects, different strategies were only described qualitatively [McCollum 1995] and the quantifications made for describing the development of gait were representative of the whole group analysed at a specific developmental stage. The aim of the present study is to observe longitudinally a large group of infants (>20) using inertial sensors over a 6-months period after onset of independent walking. These data will allow evaluating the changes in gait temporal parameters and coordination at the beginning of independent walking. Moreover they will permit to evaluate quantitatively differences in strategies at the very beginning of walking [McCollum 1995] and to eventually correlate these differences with children characteristics.

## Methods

Twenty healthy infants (77±3cm, 10±2kg, 13±2months) were included in the study. All of the infants were full-term at birth and had no known developmental delays. Tests on the infants were scheduled once a month after the onset of independent walking for three months and one after six months. When possible, a test during the very first week of independent walking was performed. Three tri-axial wireless inertial sensors (OPALS, Apdm, USA) were mounted respectively on the lower back and on the two legs. The participants were asked to freely walk in the room. For all the participants 10 consecutive strides were analyzed. Right heel strike (HS) and toe off (TO) instants were estimated from the angular velocity of the lower limb [Aminian, 2001]. Stride (strT), swing (swT) and stance (stanceT) times were calculated. Step and stride regularity (stepR and strR) were evaluated using trunk vertical acceleration [Moe-Niellsen 2004].

## Results

StrT generally decreased with months of experience even if the height of the children increased. SwT (%strT) increased and stanceT (%strT) decreased. StepR and strR did not show a general trend for all the children.

## Discussion

The decrease of StrT corresponds to an increase in cadence with months of experience: this is in contrast to what found by Looper [2012] on a group of 8 children. An analysis of different children characteristics (e.g. age at the first test) could be interesting for explaining these different results. The low swT at the very beginning of walking evidences children fear of falling. StepR and strR did not show a general trend among the whole group: future works will focus on evaluating if there are two or more typical trends in the whole group or if regularity is not a significant descriptive index for toddlers. Future works will also evaluate the possibility of identifying the strategies descripted by McCollum [1995] by sensor data and to describe quantitatively how these strategies develop towards the pendulum mechanism with experience.

## References

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