

# The effect of wheel diameter on vertical and horizontal mountain bike position

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## Abstract

**Background:** Mountain bike wheel dimensions have evolved to larger diameters in recent years. While numerous claims can be found for performance advantages of larger diameter wheels, systematic comparisons of mechanical characteristics are not available.

**Purpose:** Compare the change in velocity and the variability of vertical position between 26 and 29 inch diameter mountain bike wheels while rolling across a straight 10 m long bumpy track over a range of velocities.

**Methods:** Horizontal and vertical bike position data were collected across a straight wooden track (10 m) with an assortment of 21 randomly spaced wooden bumps ranging in size from 1.75 to 7.5 cm. Position data were recorded at 200 Hz using a 10 camera Vicon System with a reflective marker attached to the stem. Two front wheels (Stan's NoTubes ZTR Crest, Maxxis Ardent tire, 26 psi inflation, tubeless) were matched in all characteristics except diameter and mass. Mass differed by about 100 g (7%). A carbon, hardtail frame (Niner Air 9) was used throughout with 29 inch rear wheel; 26 and 29 inch front wheels were exchanged between conditions. Rigid (White Brothers Rocksolid) and suspension (Rockshox Reba) front forks were tested with each wheel condition. For each wheel/fork combination 10 trials were ridden with increasing speeds that ranged from 3 to 8 m/s. Conditions were randomized with the rider (male, 30 yrs) riding passively without lifting or pedaling during each trial. Analysis of covariance was used to compare conditions with speed as the covariate. Linear regression was used to assess the relationship of the change in velocity to incoming velocity and the variability of vertical position to incoming velocity.

**Results:** There was no significant difference for all wheel/fork conditions with the change in velocity (suspension;  $p = 0.4523$ , rigid;  $p = 0.4164$ ). The variability of vertical position with a rigid fork and 29 inch wheel was significantly greater ( $p = 0.0004$ ) than with the 26 inch wheel. With the suspension fork, there was a small but significant difference ( $p = 0.0006$ ) with the 29 inch wheel over the 26 inch wheel.

**Discussion:** Wheel diameter had no significant influence on the change in velocity of the bike. However, for both fork conditions, the variability of vertical position was significant between the 29 and 26 inch wheels. The larger wheel experienced a greater vertical motion due to the mechanics of the wheel. The larger diameter of the 29 inch wheel translated to more contact time with each bump causing more vertical motion. This difference was seen in both fork conditions, albeit much smaller with the suspension fork. For each wheel/fork condition, the change in velocity decreased as the incoming velocity increase. For both wheel diameters with the suspension fork, the vertical motion decreased as incoming velocity increased, whereas with the rigid fork, vertical motion increased with an increase in incoming velocity.

**Conclusion:** Wheel diameter has a significant influence on the vertical motion of a mountain bike; however, changes of velocity were not affected by wheel size. Wheel diameter on a mountain bike with a rigid front fork has a significant influence on vertical motion while a bike travels along a bumpy track. The larger wheel diameter produced greater vertical motion.

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