

Project 002: Effect of novel pedal design (Vista) on power output and joint loading

In this project we investigate the effect of a novel pedal design, characterised by the downward (Y) and forward (X) shift of the cleat fixing platform relative to the pedal axle.



www.vista-bikes.com

By means of our biomechanical model the novel Vista pedal was compared with a conventional pedal according to 2 criteria.

Results calculated by the biomechanical model:

Vista Pedal Original: X = 18 mm; Y = 20 mm

Knee peak power at same crank power (criterion 1): Vista pedal versus conventional pedal: + 4.3 %, which is unfavourable.

Crank power at same instantaneous joint moments (criterion 2): Vista pedal versus conventional pedal: +2.7 %, which is favourable

Our test result (+ 2.7 % Crank Power at 90 rpm) is completely in line with and is confirmed in the publication issued by

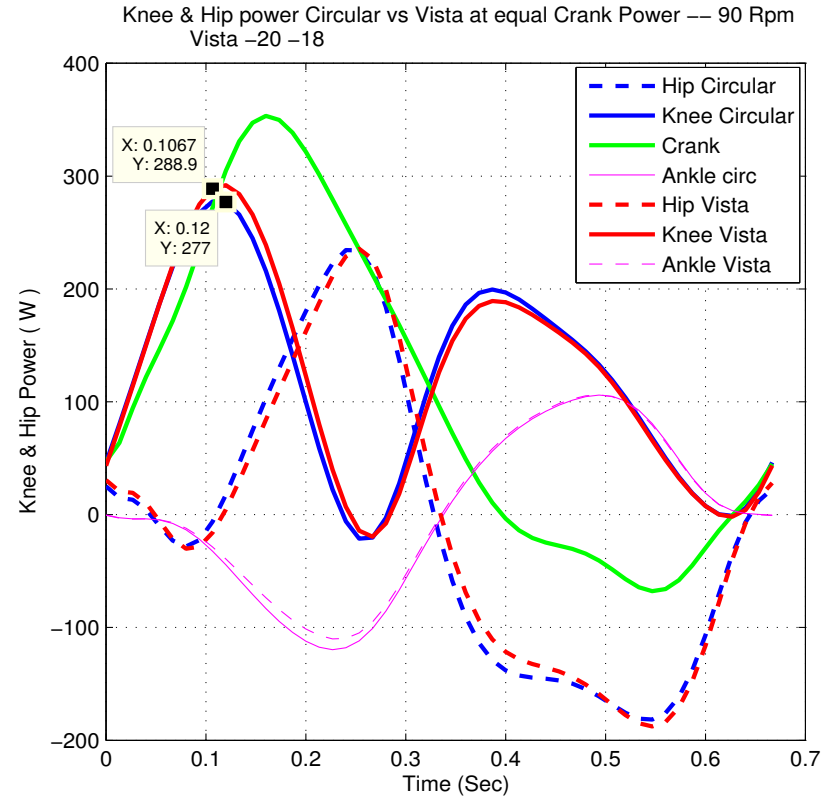
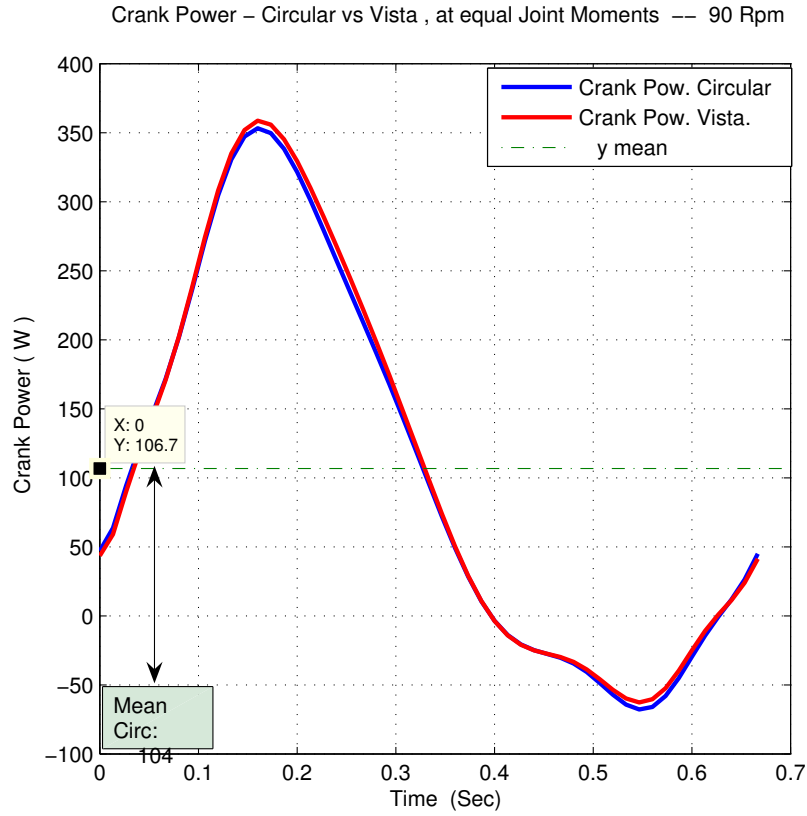
KONINCKX, E., VAN LEEMPUTTE, M., and HESPEL, P., Effect of a novel pedal design on maximal power output and mechanical efficiency in well-trained cyclists. *Journal of Sports Sciences*, Volume 26, Issue 10 Aug 2008, pages 1015-1023

namely +2.5% $s_x = 0.6 \%$, at 80 rpm

+1.8% $s_x = 0.7 \%$, at 100 rpm

Graphs

Vista Original X = 18 mm; Y = 20 mm

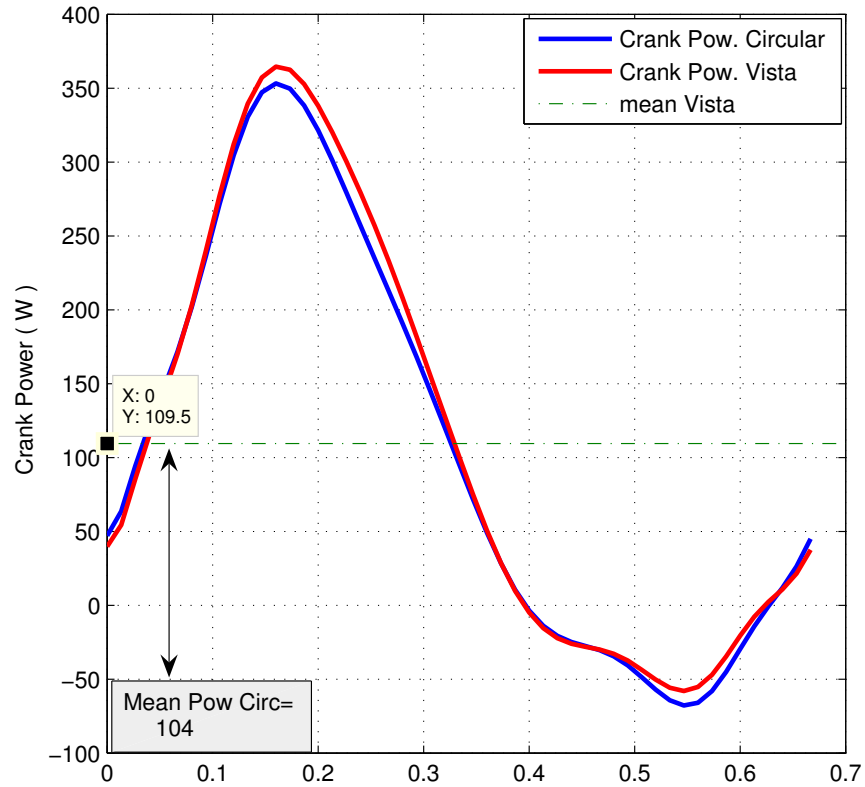


Vista X = 38 mm; Y = 40 mm

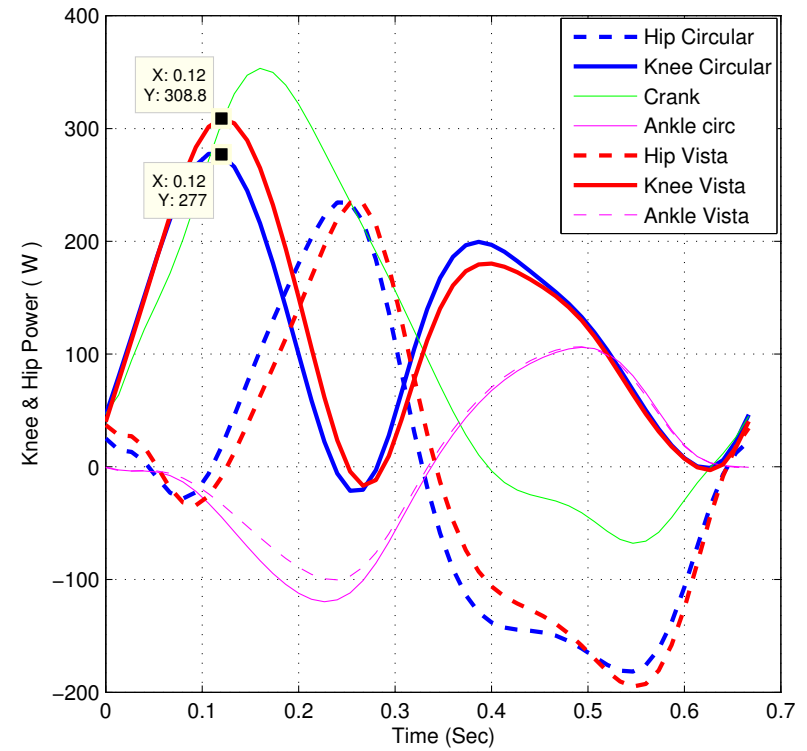
Crank power gain: +5.3 %

Knee peak load: + 11.5%

Crank Power – Circular vs Vista X–0.038 Y–0.040 at equal Joint Moments -- 90 Rpn

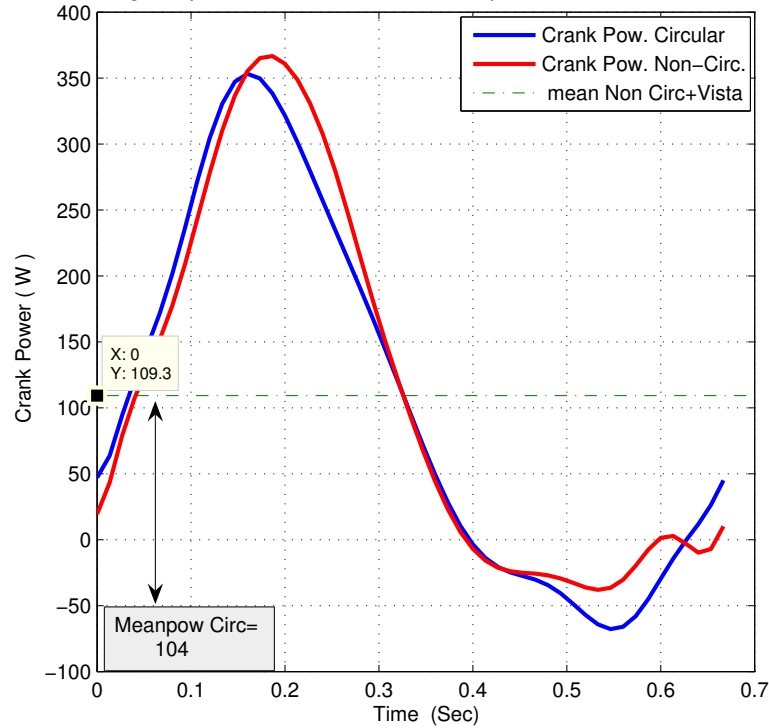


Knee & Hip power Circular vs Vista X–0.038 Y–0.040 at equal Crank Power -- 90 Rpn



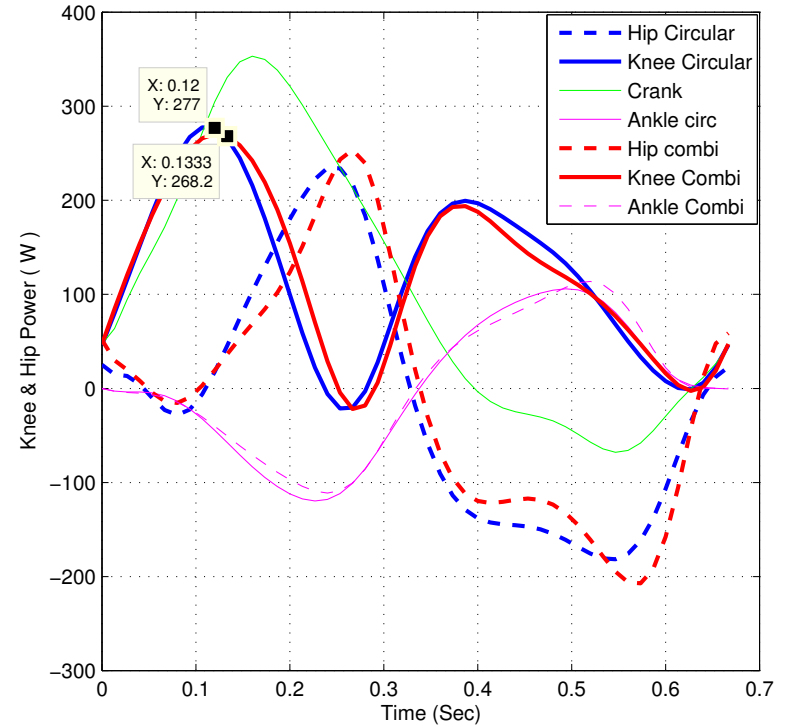
Combi Vista orig. + Osy +5t Crankpower +5.1% vs Circular chainring

Power – Circular vs Osymmetric +5T rotated +Vista X-0.018 Y-0.020, at equal Joint Moments
 Angle Major axis vs Crank : 117° --- Ovality : 1.215



Combi Vista Orig + Osy+5t Knee peak load: -3.2% vs Circular chainring

Knee & Hip power Circular vs combi at equal Crank Power --- 90 Rpm
 Vista X-0.018 Y-0.020 OSY+5t



Simulations Vista Pedal

Knee peak power at same crank power

Circular = 277 W (conventional pedal)

Vista X (m)
Y (m)

	-0.010	-0.018	-0.028	-0.038	-0.048
-0.010	302.10	293.70	303.80		
-0.020	302.10	288.90	302.10		
-0.030	282.10	290.30	300.50		
-0.040				308.80	

Crank power at same instantaneous joint moment

Circular = 104 W (conventional pedal)

Vista X (m)
Y (m)

	-0.010	-0.018	-0.028	-0.038	-0.048
-0.010	105.40	106.30			
-0.020	106.30	106.70	107.20		
-0.030	107.20	107.6	108.10		
-0.040				109.50	
-0.050					110.90

Discussion and conclusions:

1. The original Vista pedal ($X = 18$ mm; $Y = 20$ mm) shows an attractive crank power efficiency gain compared to a conventional pedal.
2. Knee peak power at equal crank power of the original Vista pedal is significantly higher compared to a conventional pedal, which is a negative aspect and completely the opposite of what we see when studying non-circular chainrings.
3. By increasing the offset (X and Y), crank power is increasing but also the peak power load in the knee joint.
4. The offset change is limited by physical constraints and by UCI regulations.
5. Opposed to what Vista is claiming, it can be demonstrated that the crank length is not increasing during the downstroke. Thus a possible powergain is not resulting from the assumed increasing crank length during down stroke. The offset of the pressure point of the foot at the upper dead point can also not be responsible for the power efficiency gain. The power efficiency gain has most probably to do with the variation of the pedal angle causing acceleration/deceleration and consequently also causing mass forces on the limbs being different from the conventional pedal. As a consequence of the pedal angle variation, the foot - particularly the action point on the pedal - describes a non-circular path, which might not be in accordance with the UCI regulations.
6. An optimization of the original Vista pedal is possible.
With $X = 10$ mm and $Y = 30$ mm, the knee peak power drops and is close to the conventional pedal value (+1.02%) whereas the power efficiency gain increases to +3.2%.
7. Combination of Vista pedal with non-circular chainring: the performance percentages are “adding up”.

Combining the Vista pedal with e.g. the Osymetric non-circular chainring, with the crank oriented in the optimal position (see “Biomechanical Study”), gives:

- knee peak power: -3.2 % compared to a circular chainring (criterion 1)
- crank power efficiency gain: +5.1 % compared to a circular chainring (criterion 2)

Vista is offering a combination-set of a non-circular chainring plus the Vista pedal. Unfortunately, the ovality of the Vista chainring is far too weak to yield additional performance gains for the system.