Biomechanics of lower extremities and the bike handlebar reach.

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ABSTRACT

The cyclist's position on the bicycle is essential to prevent injury and improve performance. A well-known example is saddle adjustment where a backward saddle position results in reduced hip angle, accompanied by increased activation of the hamstrings and ankle plantar flexors, and increased resistance to tibiofemoral shear. Conversely, a forward chair position results in increased hip and knee angle, decreased hamstring activation, and increased quadriceps strength, which can lead to patello-femoral pain. However, other modifications of the adjustment, such as the adjustment of the reach handlebar, have been less studied. we think adjusting the handlebar reach can have similar or opposite effects to the horizontal adjustment of the saddle. Here we quantify the consequences of adjusting the handlebar reach on the muscular activation and kinematics of a group of amateur cyclists.

PURPOSE: To relate the variations of muscular activity and the joint range of the lower extremities in the pedaling cycle with the reach distance change of the handlebar, by variating the stem length of the handlebar for non-professional cyclists.

METHODOLOGY: Electromyography of the surface, bilateral joint angles in 3D and the adjustment of their bicycles were measured on eight male cyclists with right predominance. Two stress tests were carried out: one on maximum power incremental load and the other on steady load to the 57% of the maximum power at 90 rpm at three different handlebar reach lengths: 1. Preferred. 2. Forward (preferred + 3 centimeters) and 3. Backward (preferred – 3 centimeters). Data about the biceps femoral muscle, lateral gastrocnemius, vastus lateralis and medialis, as well as the angles of the sagittal plane in the hip, knee and ankle bilateral joints was registered for 30 seconds. **RESULTS:** An analysis of variance (ANOVA) was carried out to compare the muscle activation means with the lower extremity joint angles according to the handlebar reach length. Significant differences were found in the left hip angle at 120° and 150° of the pedaling cycle, in the forward position against the backward position (89.4° vs 94.2° and 96.6° vs 101.2° respectively, p= 0.05, Tukey test). **DISCUSSION:** The variation in the handlebar reach of the bicycle from the forward position to the backward position produces an increment of the left hip angle. This modification is observed at 120° and 150° of the pedaling cycling in the transition from maximum power to inferior death point and a non- significative reduction of the lateral left and right gastrocnemius muscle activation. **CONCLUSION:** Modifications related to the handlebar reach of the bicycle increase the left hip angle and reduce the lateral gastrocnemius activation in the non-dominant leg at backward position, and in the dominant leg in the forward position.

Key words: Electromyography, joint angles, lower extremity, cycling, bike handlebar reach

		Mean ± DS	IC 95%
CYCLISTS	Age	41,75 ± 10,08	33,32 - 50,18
	Weight (Kg)	72,56 ± 5,53	67,94 - 77,18
	Size (cm)	174,81 ± 5.55	170,17 - 179,46
	Watts maximum	306,79 ± 30,03	281,68 -331,89
	Relative watts	4,26 ± 0,63	3,74 - 4,79
	Weekly training (km)	238,75 ± 85,43	167,33 - 310,17
	Watts trial at 57%	174,04 ± 15,83	160,80 - 187,28
	Relative Watts 57% test	2,42 ± 0,34	2,13 - 2,70
	Pedal RPM to 57%	88,08 ± 1,88	86,52 - 89,65
	Heart rate to 57%	121.77 ± 6.42	113,79 - 129,74
BICYCLES	Reach of the handlebar (cm)	58,51 ± 1,81	57,00 - 60,02
	Handlebar stem length (cm)	10,75 ± 1,39	9,59 - 11,91
	Handlebar height (cm)	6,29 ± 2,08	4,55 - 8,03
	Handlebar width (cm)	42,25 ± 0,71	41,66 - 42,84
	Seat backrest 7 cm (cm)	21,23 ± 3,50	18,30 - 24,15
	Point saddle delay (cm)	6,49 ± 3,20	3,81 - 9,16
	Connecting rod length (cm)	17,16 ± 0,19	17,00 - 17,31

Table 1 Characteristics of cyclists and bicycles (Average ± DS, 95% Confidence Index).

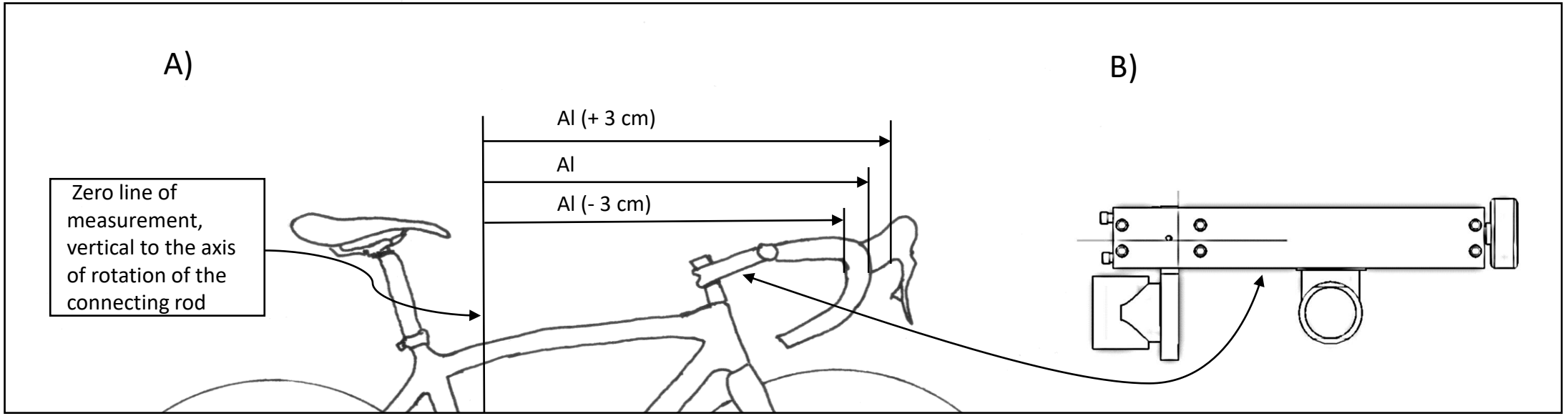

Figure 1. A) Bicycle handlebar reach positions. Preferred Position (Al); Backward Position (Al. (-3)) and forward Position (Al. (+3)). B) Special handlebar stem that allows you to change the length of the reach and the angle of inclination of the handlebar.
Source: self made.

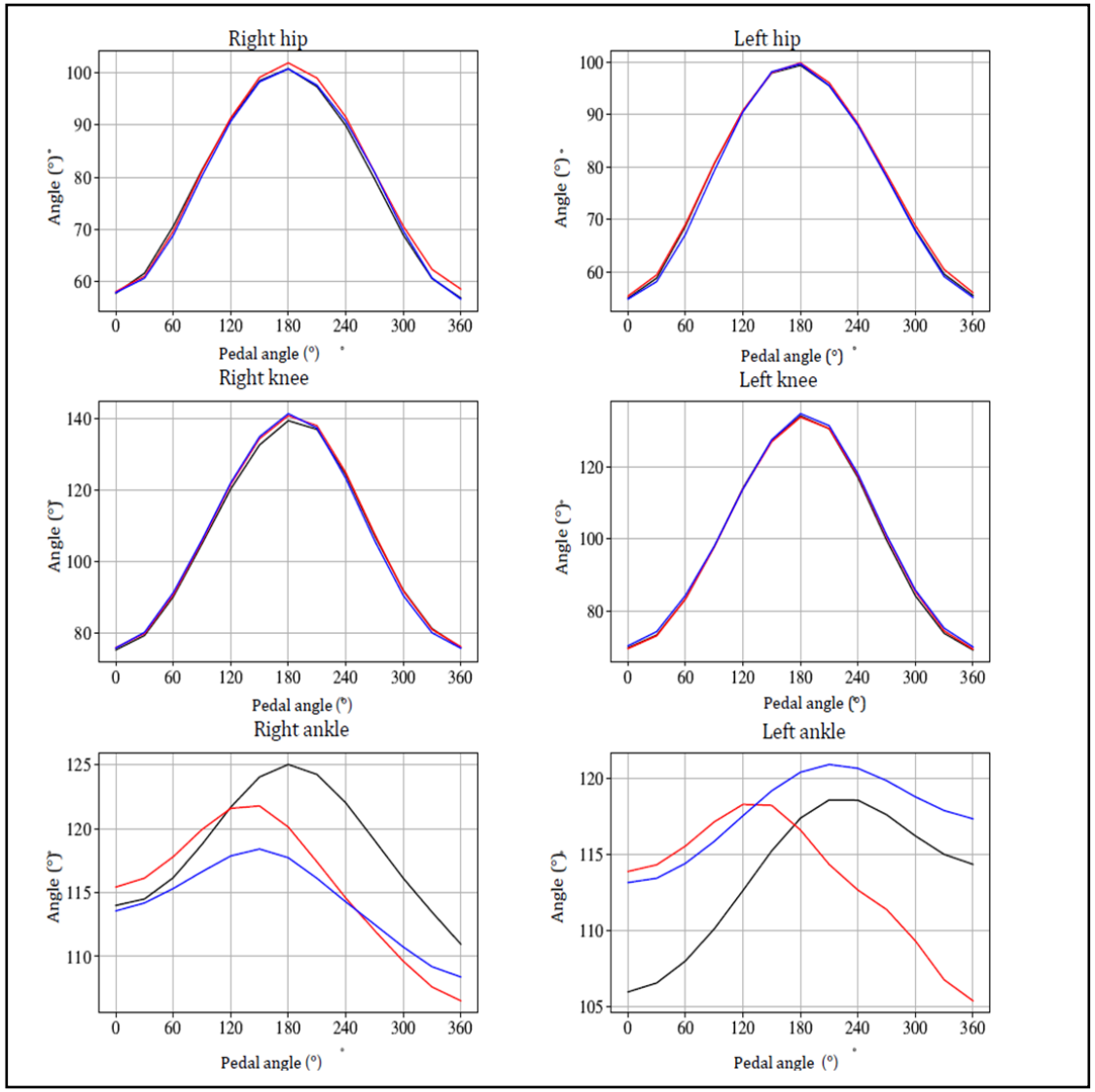

Figure 2. Joint angles of a representative cyclist of Hip, Knee and Ankle, right and left. At each of the handlebar reach positions: Backward (red), Preferred (blue) and Forward (black).
Source: self made.

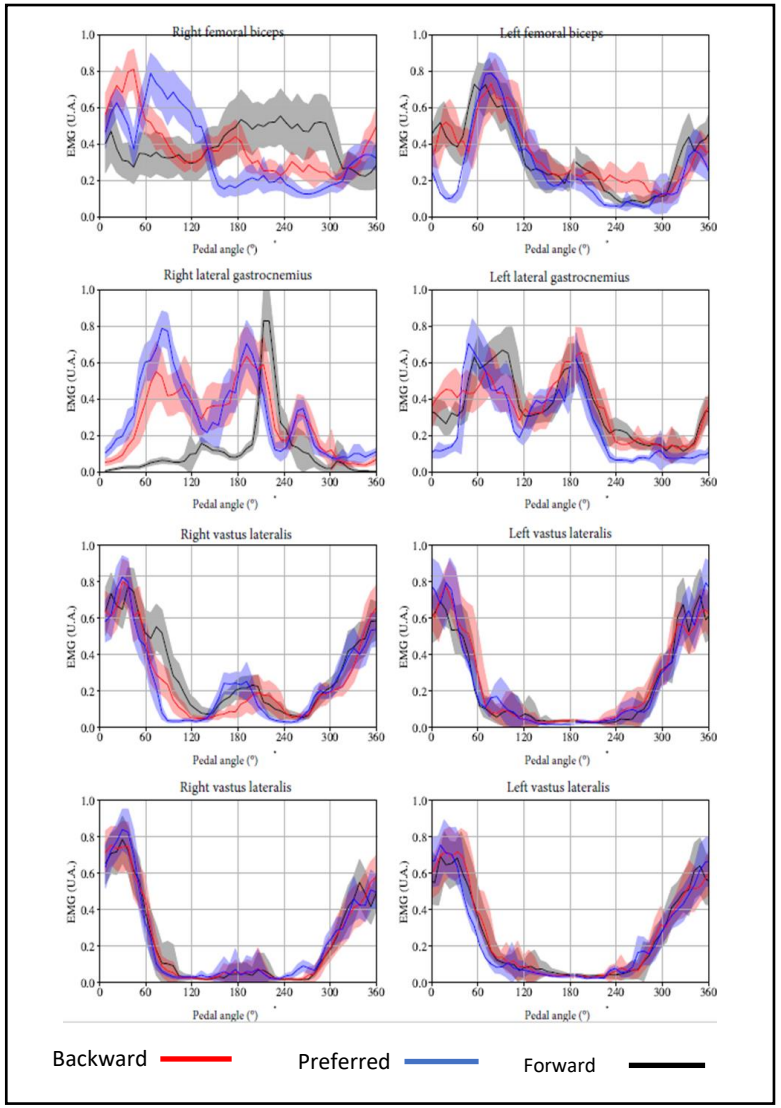

Figure 3. Muscle activity of a representative cyclist. Mean amplitude (enveloping line) and standard deviation (shaded area according to color) of the EMG of the muscles Vastus lateralis, Vastus medialis, Biceps femoris and gastrocnemius lateralis, right and left during the pedaling cycle at 90 RPM. In each of the handlebar reach positions.
Source: self made.

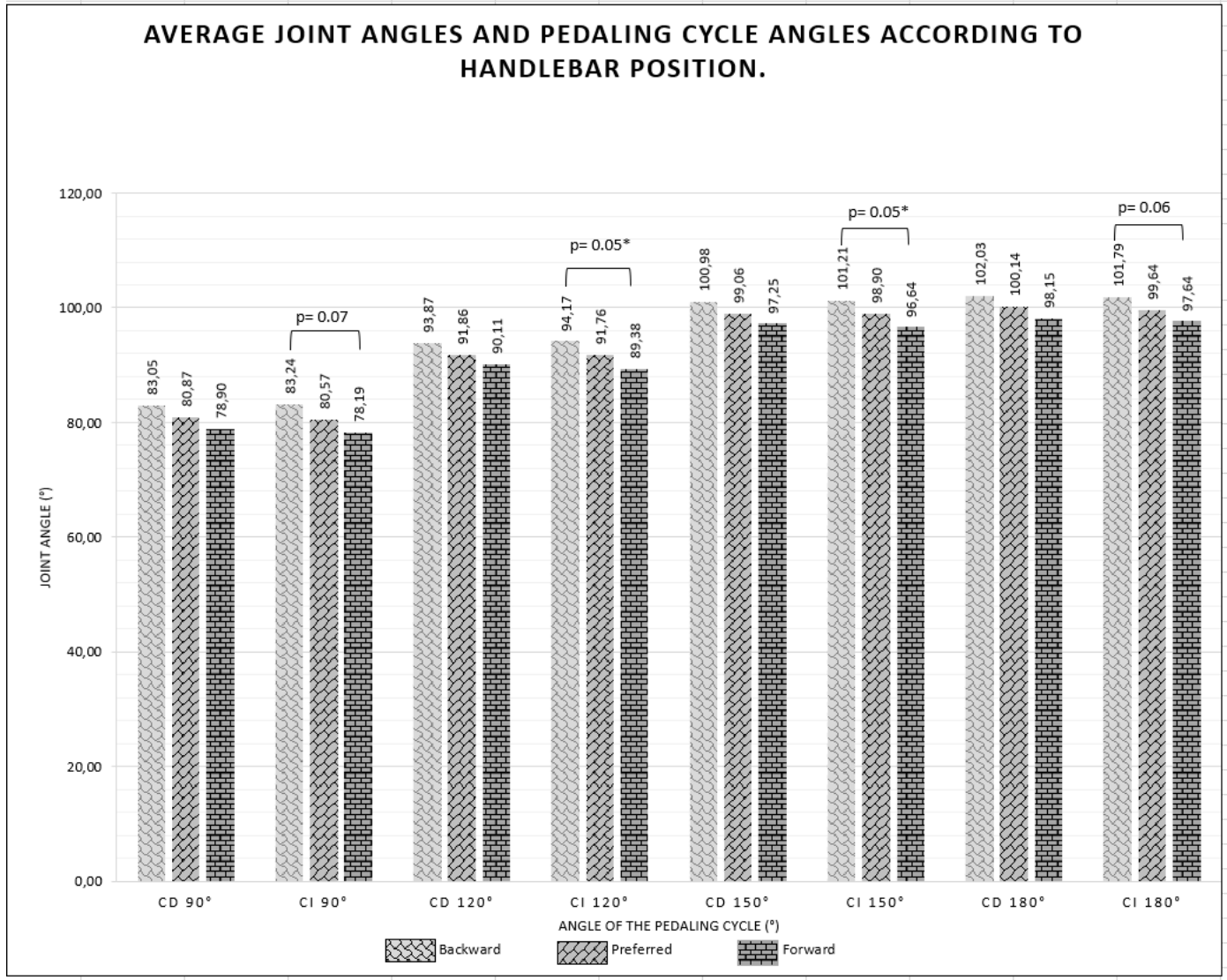

Table 2. Results. Mean values in degrees of the Right Hip (CD) and Left (CI) angles according to the angle of the pedaling cycle (90 °, 120 °, 150 ° and 180 °) in each position of the handlebar reach (backward , preferred and forward). Significant values (p≤0.05) of the Tukey multiple comparison.
(*) Significant difference between positions.
Source: self made.

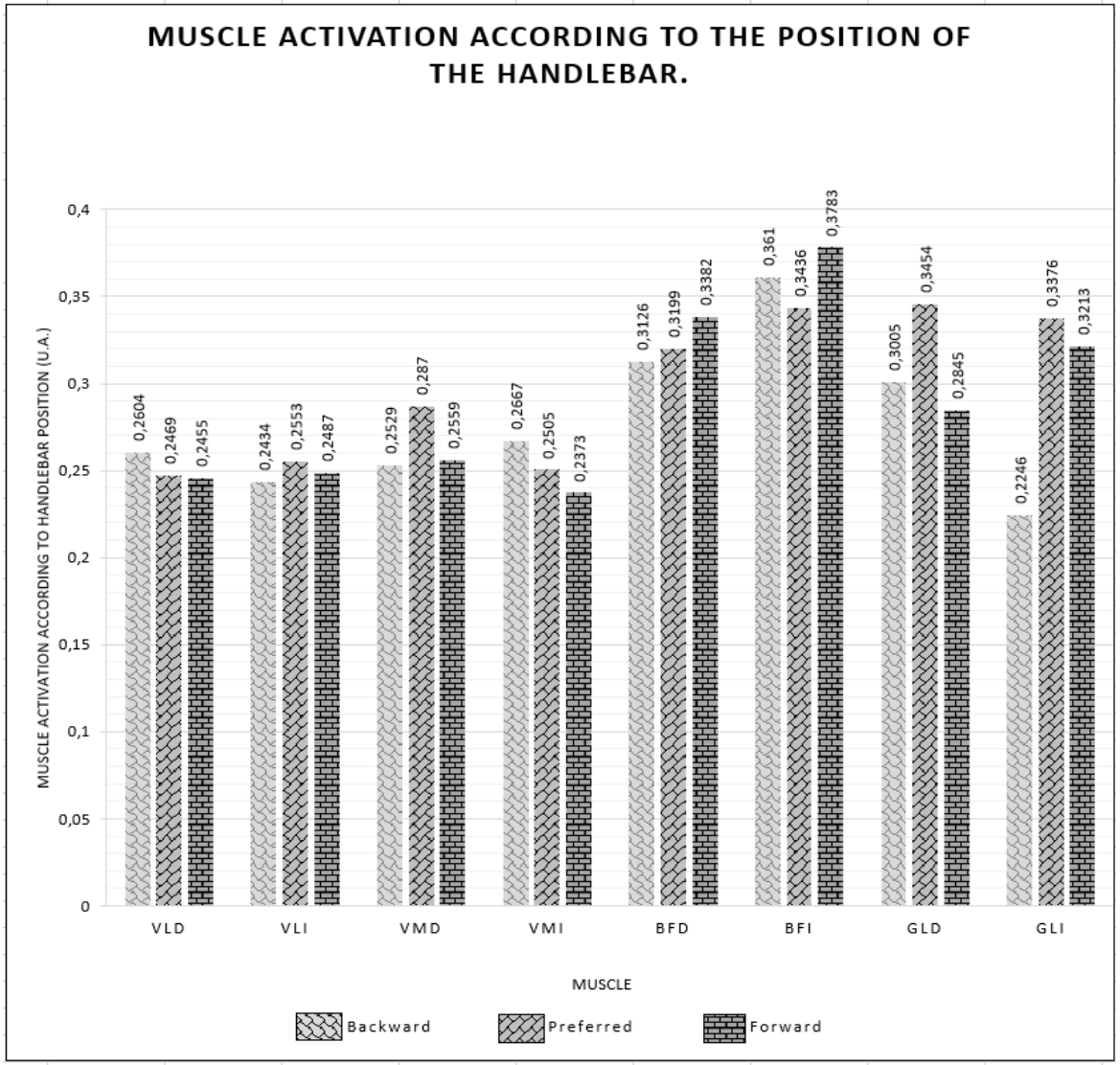

Table 3. Results. Mean values in Arbitrary Units (UA) of the Muscle Activation of each muscle Vastus Lateral (VL), Vastus Medialis (VM), Biceps Femoris (BF) and Gastrocnemius Lateral (GL) bilateral, Right (D) and Left (I) in the handlebar reach positions (backward, preferred, and forward).
Significant values ($p \leq 0.05$) of the Tukey multiple comparison.
Source: self made.