classified according to the International Paralympic Committee (IPC), on the following functional classes: S6 (n = 1), S8 (n = 1), S9 (n = 4). Standardized mean difference (SMD) and 95% confidence intervals (CI) were used. Magnitude thresholds for difference in a mean were described using the following scale: 0-0.2 trivial, > 0.2-0.6 small, > 0.6-1.2 moderate, > 1.2-2.0 large, and > 2.0 very large (Hopkins, 2010). Table 1 shows the kinematical parameters in the laps 100 m and 175 m for each steps from crawl incremental protocol.

Table 1.
Means (±standard deviation) of kinematical parameters in the laps 100 m and 175 m for each steps, standardized mean difference and 95% CI, and effect size from comparisons between the 100 m and 175 m for each step of kinematical parameters.

Variables	Incremental protocol (N x 200 m)	100 m (M±SD)	175 m (M±SD)	100 m x 175 m SMD (IC)	Effect size
SL	Step 1	1.76±0.27	2.00±0.25	0.68 (-0.38, 1.74)	Moderate
SL	Step 2	1.68±0.28	1.84±0.25	0.43 (-0.60, 1.46)	Small
SL	Step 3	1.62±0.33	1.76±0.23	0.33 (-0.63, 1.29)	Small
SL	Step 4	1.60±0.34	1.78±0.24	0.39 (-0.56, 1.35)	Small
SL	Step 5	1.56±0.35	1.66±0.32	0.23 (-0.83, 1.29)	Small
SL	Step 6	1.48±0.36	1.57±0.29	0.19 (-0.81, 1.19)	Trivial
SF	Step 1	0.47±0.11	0.47±0.06	0.02 (-0.90, 0.95)	Trivial
SF	Step 2	0.51±0.09	0.51±0.08	0.00 (-1.03, 1.03)	Trivial
SF	Step 3	0.54±0.10	0.53±0.10	0.00 (-1.11, 1.11)	Trivial
SF	Step 4	0.58±0.08	0.60±0.05	0.18 (-0.74, 1.11)	Trivial
SF	Step 5	0.61±0.09	0.63±0.04	0.17 (-0.75, 1.09)	Trivial
SF	Step 6	0.65±0.10	0.72±0.06	0.47 (-0.46, 1.40)	Small
IVV	Step 1	0.37±0.37	0.40±0.53	0.06 (-1.34, 1.45)	Trivial
IVV	Step 2	0.35±0.41	0.40±0.36	0.08 (-0.95, 1.11)	Trivial
IVV	Step 3	0.26±0.17	0.42±0.60	0.71 (-2.47, 3.89)	Moderate
IVV	Step 4	0.27±0.22	0.35±0.48	0.31 (-1.72, 2.34)	Small
IVV	Step 5	0.22±0.15	0.32±0.44	0.52 (-2.08, 3.13)	Small
IVV	Step 6	0.21±0.08	0.22±0.17	0.14 (-1.73, 2.00)	Trivial

General swimming kinematical parameters (SL and SF) and efficiency estimators (IVV) remained stable in the 100 and 175 m laps independently of intensity changes. These indicators can be useful to a coach planning and monitoring training sets. Further experiments on the topic are encouraged, particularly to characterize the underlying mechanisms regarding 3D-kinematic data in other classes of physical-motor disabilities.

References:

Figueiredo, P., Nazario, R., Sousa, M., Pelarigo, J. G., Vilas-Boas, J. P., & Fernandes, R. (2014). Kinematical analysis along maximal lactate steady state swimming intensity. *Journal of Sports Science and Medicine, 13*(3), 610-615.

Hopkins, W. (2010). Linear models and effect magnitudes for research, clinical and practical applications. *Sport science, 14*, 49-58.

Effects of changes in handlebar height and bicycle frame length in muscular activity during cycling

Ana Conceição[1,2,3], Vítor Milheiro[1], Pedro Sobreiro[1], Hugo Louro[1,2]

1. Sport Sciences School of Rio Maior, Rio Maior, Portugal; conceicao.ana@gmail.com; 2. Research Center in Sports Sciences, Health and Human Development, CIDESD, Vila Real, Portugal; 3. CIEQV- Life Quality Research Center, Santarém, Portugal

Bicycling is a common mode of transportation adopted by many people around the world. So most of the adjustments in the bicycle are done to obtain a comfortable riding position and proper range of motion in lower extremities (Baino, 2011). Geometric factos like handlebar height and bicycle frame lenght are generaly adjusted to optimize the biking seating position. The aim of this study was to analyze the effects of muscular activity of different handlebar height and bicycle frame length during cycling. Nine male recreational cyclists (21.6±1.9 years; 75.3±5.8 kg; 1.8±0.1 m; crotch height: 9.5±26.1 m; seat height: 0.7±0.0 m; saddle distance from the handlebar_ long: 0.6±0.0 m; saddle distance from the handlebar short: 0.5±0.0 m) took part in this study. Each subject performed: i) five minutes warm-up; ii) 30 seconds at maximal intensity; iii) 1 minute at 150 watts intensity; iv) 1 minute at 250 watts of intensity, and in a specifics conditions: a) handlebar height (high and low) and in a b) specific bicycle frame length(long and short), according the previous measures of each subjects. Using a wireless signal acquisition system (bioPlux research, Portugal), surface EMG was collected in 4 muscles *deltoid anterior* (DA), *trapezius descendens* (upper) (TD), *gluteus maximus* (GM) and *latissimus dorsi* (LD). EMG analysis were conducted with a MATLAB routine. Starting from the raw signal, DC components were removed and thereafter filtered with a fifth-order Butterworth band pass filter where the lower and upper cut-off frequencies were set to 10 and 500Hz. The average amplitude of EMG of each active phase was estimated using the average rectified value (ARV) and plotted as a function of time. The results showed differences with a $p<0.05$ in short and long bicycle frame length in 4 muscles TD ($t=5.982$), LD (t=3.264), GM (t=4.077) and DA (t=4.844). The 2 handled bar height positions with a short size frame showed differences ($p<0.05$) in GM (t=4.6) and DA (t=2.56). TD (t=1.78) and LD (t=0.586) revealed no significant differences. The handled with a long size frame presented differences ($p<0.05$) in TD (t=2.98) and GM (t=3.11), and no differences in LD (t= 1.486) and DA (t=1.47). This study revealed that consecutive changes handlebar height and bicycle frame length over time lead to increase in discomfort during cycling.

References:

Baino, F. (2011). Evaluation of the relationship between the body positioning and the postural comfort of non-professional cyclists: a new approach. *The Journal of Sports Medicine and Physical Fitness*, *51*(1):59–65.

Muscle activation levels during the push-up exercise on stable and unstable surfaces

Carolina Vila-Chã[1,2], Luís Ribeiro[1], Nuno Serra[1], Mário Costa[1,2], Filipe Conceição[3], José António De Paz[4]

1. Polytechnic Institute of Guarda, Guarda, Portugal; cvilacha@ipg.pt; 2. Research Center in Sports Sciences, Health and Human Development, CIDESD, Vila Real, Portugal; 3. LABIOMEP – Universidade do Porto; 4. Institute of Biomedicine, Universidad de León

The push-up (PU) is one of the most common exercises used in the strength training programs for the upper body. Since it is limited to the body weight, fitness trainers use several exercise types (e.g. unstable surfaces) in order to increase the activity of the involved muscles (Freeman et al., 2006). This study aimed to analyze the changes in muscle activity pattern induced by either performing PU exercise on a stable surface (ground) or an unstable surface (BOSU®). Eleven voluntary male subjects (age, mean ± SD: 21.9 ± 4.2 yrs.), familiarized with the push-up's exercises, have been recruited for this study. Subjects performed 5 repetitions of each push-up exercise (stable vs. unstable surfaces. Electromyographic activity (EMG) from the agonist muscles (clavicular, sternal and chondral portion of pectoral major, triceps brachii and anterior deltoid), antagonist muscles (latissimus dorsi and biceps brachii) and the stabilizer muscles (serratus anterior, superior trapezius, external oblique and erector spinae) has been collected with 11 wireless surface electrodes. The results showed that, from the agonist group, only the magnitude of activation of the triceps brachii has been affected by the exercise type ($p < 0.001$). In the unstable PU the triceps brachii showed higher activation levels than in stable surface (70.13 ± 29.03% and 58.62 ± 25.31%, respectively). Regarding the antagonist group, the unstable PU exercise induced a higher activity of the brachial biceps and of the latissimus dorsi compared to the stable PU exercise ($p <0.05$ for both muscles). In addition, for stabilizer muscles, it was observed that the upper trapezius activation was, on average, 37.79% higher than in the stable exercise ($p <0.01$) during unstable PU. Instead, for the serratus anterior, the activation level was, on averaged, significantly higher in the unstable PU exercise than in the stable PU (+ 14.71%, $p = 0.01$). For the external oblique there were no differences between exercise types ($p = 0.23$). However, the activity of the erector spinae was significantly higher in unstable PU ($p = 0.01$). These results indicate that the push up exercise performed on an unstable surface (BOSU®) changes the pattern of activation of antagonist muscles, shoulder stabilizer muscles and agonist muscles, particularly the brachial triceps activation.

References:

Freeman, S., Karpowicz, A., Gray, J., & McGill, S. (2006). Quantifying muscle patterns and spine load during various forms of the push-up. *Medicine and Science in Sports and Exercise, 38*(3), 570–577.

EMG of trunk muscles compared with the pedaling power of and cyclist position: A case of study

Vítor Milheiro[1], Ana Conceição[1,2,3], Hugo Louro[1,2], Marco Branco[1], Brito, João[1,2]

1. Sport Sciences School of Rio Maior, Rio Maior, Portugal; conceicao.ana@gmail.com; 2. Research Center in Sports Sciences, Health and Human Development, CIDESD, Vila Real, Portugal; 3. CIEQV-Life Quality Research Center, Santarém, Portugal.

Over the past decades, have been published numerous biomechanical studies to optimize the performance and the prevention of cyclists' injury. Many of these studies have used electromyography (EMG) to analyze the effects of the cyclist position and bike geometry on kinematics, kinetics, muscle activation and energy expenditure. Most EMG studies in cycling has analyzed the lower limb (Hug, 2009), with few analyzing trunk and upper limbs EMG activity. The aim of this study was to analyze trunk muscles involvement in a recreational cyclist, as a result of bike fit and pedaling power.,The sample consisted of one male recreational cyclist, 20 years old, 1.82m and 76kg, which was shot while riding a bicycle supported on a roller equipped with a PowerTap potentiometer and allowed two handlebar positions and two frame lengths. Using a wireless signal acquisition system (bioPlux research, Portugal), surface electromyogram was collected in four muscles: deltoid anterior (DA), trapezius descendens (upper) (TD), gluteus maximus (GM) and latissimus dorsi (LD).