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Reliability and comparability of the accelerometer and the linear position measuring device in Resistance Training

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Abstract:

The purpose of this study was to determine the inter-machine reliability attained from devices used to measure the common variables in sports performance. Repeatability conditions were established by creating a similar set of conditions under which the measurements were taken from both devices. Objectives: To demonstrate the reliability between two devices in a bench press movement: the linear position measuring device (LPM) isoinertial dynamometer (T-Force) and 2; the 3-D (Myotest) accelerometer (AC). To compare the existing correlations between maximum velocity, maximum estimated strength and peak power estimate variables in the bench press exercise. Method: 40 bench press exercise trials were analysed simultaneously, performed by three different subjects (age: 26.74 ± 1.2 years, height: 175.74 ± 4.04 cm, weight: 78.7 ± 3.35 kg) at maximum velocity (25 kg additional load). Statistical Analyses: Three simple linear regression models were developed, supplied by the linear position measuring device (LPM) on the basis of the accelerometer's (AC) data. The assumption of independence of errors was compared by means of the Durban-Watson test and partial autocorrelation coefficients were established at an overall $p < 0.05$ significance level. Results: It has not been possible to confirm the presence of a general correlation between the measurements of both devices. Regarding the assumption of independence of errors, the presence of generalised autocorrelation was confirmed. Linear regression analysis revealed an inter-machine correlation in one of the nonconclusive cases, (Peak Power) variable and subject 1, $r(10) = 0.640$, $p = 0.024$. No partial autocorrelation was found. Practical applications: The devices should not be used interchangeably as instruments to assess and monitor resistance training. The AC device revealed higher and more disperse values than the LPM device.

Title: Reliability and Comparability of the Accelerometer and the Linear Position Measuring Device in Resistance Training

Running head: Inter-machine Reliability (T-Force® y Myotest®)

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1 INTRODUCTION

2 The purpose of this technical report was to examine the measurable properties of two
3 commercially available devices routinely used in the field of sports training: it sets out
4 to compare their post-processing characteristics highlighting their differences and
5 advising specialist professionals against their interchangeable use when assessing and
6 monitoring sports performance.

7 In this instance, the reliability of measurement refers to the reproducibility of results in
8 repeated trials carried out with both devices. Clarification of this issue allows for a
9 greater understanding of the researchers' theory of reliability, which helps reduce the
10 incidence of inappropriate analyses in the literature of Sports Science (1).

11 Several studies have examined the concept of inter-machine reliability between devices
12 used in sports training aimed at analyzing variance by combining the use of an
13 accelerometer (model 3140, ICS Sensors, USA) and a cable-extension position
14 transducer (model PT5DC, Celesco, USA) in a simulated mechanical laboratory setup
15 (2). Results revealed a coefficient of variation in the repeated measures in just one of the
16 measured variables analyzed. In turn, greater data variability was revealed when
17 assessing athletes' performance (3). With the same objective in mind, the same study
18 analyzed the values obtained from three models of accelerometer (Actical, Actigraph
19 and RT3) and from the results obtained, it was recommended that future studies should
20 focus on understanding why accelerometers designed to measure the same variables
21 gave such different results. Furthermore, the need to control the parameters for
22 measurement accuracy in successive research was emphasized (5). Demonstrating that
23 data obtained from both devices commonly used in training should be the same is
24 therefore a key issue. Consequently, this aspect is examined in this report by comparing
25 two measuring devices:

26 A) The inertial dynamometer, (T-Force System Ergotech, Murcia, Spain) referred to in
27 this report as LPM , is a device routinely used in the measurement and monitoring of
28 training using additional loads and has recently been employed in several research
29 studies (4, 6, 7, 19).

30 B) The Accelerometer 3-D Myotest Sport S4P model (Myotest SA, Sion, Switzerland),
31 which here is referred to as AC. This device is also currently widely used to monitor
32 and measure diverse force values. It has recently been used for varied functions in this

1 field that have proved its worth (8, 9, and 10). Comstock et al. (11) verified the
2 concurrent validity of this device (AC) when compared to a computerized linear
3 transducer and force platform system (Celesco linear transducer of the directly
4 interfaced BMS system, Ballistic Measurement System Innervations Inc, Fitness
5 Technology force plate, Skye, South Australia, Australia) finding a strong, positive
6 correlation and concluding that when fixed on the bar in the vertical axis, the Myotest is
7 a valid field instrument for measuring force and power.

8 Assessment of the validity and reliability between the AC device and a photoelectric
9 cells measurement system (Optojump, Microgate, Bolzano, Italy) was expanded upon in
10 a study (12) and determined the need for additional analysis to prove the latter's
11 reliability. The authors concluded that AC is a valid and reliable tool for assessing
12 vertical jump height performance but advised that there should be no cross-over of data
13 from one device to the other, due to the systematic overestimation of jumping height by
14 the AC device.

15 In another study (13), tests were carried out to assess the validity and reproducibility
16 between the AC device and other linear position measuring devices for the variables of
17 maximum velocity, force and peak power in the bench press exercise. The authors of
18 this study concluded that the algorithms used by both devices could be the possible
19 source of the lack of data correlation. These three variables are used in several studies
20 concerned with training assessment (4, 5, 6, 7, 8, 11 and 19)

21 The practical questions addressed in our study therefore relate to the measurement of
22 kinematic variables using different devices, LPM (T-Force) and AC (Myotest). Do these
23 produce the same results? Can the devices be interchanged indiscriminately? How can
24 the results of each device be isolated given the existing autocorrelation of data produced
25 by each athlete?

26 Sufficient objective grounds exist to raise doubts about the measurement of the same
27 variables by these two devices, which increase when it comes to assessing athletes. For
28 this reason the following aims were established:

29 -To compare data obtained by both devices and observe their evolution, establishing
30 strategies in the test design to control the presence of autocorrelation among the output
31 variables between trials carried out by the athletes.

1 -To correlate the results obtained by both devices and establish the relevant parameters
2 to assess and monitor the training session.

3 The general hypothesis of the study was based on the theory that different
4 measurements carried out in identical conditions by the two devices should produce the
5 same results. Prediction models were defined by observable parameters, in this instance,
6 based on standard variables in resistance training when performing the bench press
7 exercise.

8 Finally, the following statistical assumptions were made:

9 1. The results obtained from both devices should allow the interreliability of both
10 devices to be demonstrated.

11 2. Autocorrelation is present in the different measurements taken from the subjects that
12 interfere with obtaining inter-machine correlation.

13 3. Statistically significant correlation is present between results obtained from both
14 devices, carried out under the research conditions outlined, between the variables of
15 maximum velocity, estimated maximum force and estimated peak power when
16 performing the bench press exercise.

18 METHODS

19 Experimental Approach to the Problem

20 The data from both tested devices were collected simultaneously. A) the linear position
21 measuring device -LPM- (Isoinertial Dynamometer (Model TF-100, T-Force System
22 Ergotech, Murcia, Spain) – a system that via a cable extension transducer translates
23 movement generated (sampled at a frequency of 1000 Hz) to the linear velocity with
24 which it is displaced by means of calibration constant $K = .4899$ (each device is factory-
25 calibrated). The related software (T-Force v.2.28) calculates the kinematic variables via
26 invariant statistical methodology obtained from the kinetic variables. B) The
27 accelerometer -AC, (3-D Myotest Sport S4P model, Myotest SA, Sion, Switzerland),
28 which calculates velocity, force and power resulting from the measurement of
29 acceleration (time variation of velocity) computing the kinetic variables (MyotestPRO
30 v.1.00.20995). The device receptor is very small (W x L x H: 54.2 x 1032.5 x 10.7mm)

1 and weighs 58 g. The rate of data acquisition is 200-500 Hz, dependent on assessment
2 requirements, connected via a USB 2.0 interface cable.

3 Subjects

4 Three different athletes took part in this study (age: 26.74 ± 1.2 years, height: $175.74 \pm$
5 4.04 cm, weight: 78.7 ± 3.35 kg) performing a total of 40 bench press exercises (subject
6 1: 12; subject 2: 12 and subject 3: 16)

7 All gave written consent for their voluntary participation in this research study. No
8 physical limitations, health problems, or musculoskeletal injuries that could affect
9 testing were found after a medical examination. The subjects had a continental breakfast
10 90 minutes before the start of the session. None of the subjects were taking drugs,
11 medications, or dietary supplements known to influence physical performance. All
12 subjects in the study were in the pre-competition phase of their training, performing an
13 average of 2 weight-training sessions per week. The study met the ethical standards of
14 this Journal and was approved by the Ethics Committee of the University of Seville.

15 Procedures

16 All subjects performed the tests at the High Performance Sports Centre in Sierra Nevada
17 (Granada: atmospheric pressure 1003 hPa, absolute, relative humidity: 93.3%,
18 elevation: 2320 m above sea level and temperature: 15 °C).

19 The trials were carried out on the bench press by an exercise that exercises the upper
20 limbs. The subjects adopted the following starting position: lying supine on the bench,
21 knees flexed and feet resting on the bench, elbows bent to 90° and shoulders abducted to
22 90°. Grip width was assessed previously and enabled the aforementioned joint angles to
23 be maintained at the starting position (5, 6; 13). The subjects were asked to perform a
24 free-weight vertical lift, moving the barbell (25kg) as fast as possible during the
25 concentric phase. As this was a concentric phase the beginning was when the bar was at
26 rest and the end was when the bar had been lifted to its greatest height. After a gradual
27 warm-up, all the trials were performed at a frequency that included a three minutes rest
28 period. The two devices employed in this comparative study were secured in accordance
29 to specified instructions, on to the same lateral edge of the barbell. The following test
30 variables were analyzed simultaneously:

1 Peak Power (W), calculated from the force-velocity relationship registered during the
2 movement.

3 Maximum velocity (cm/s), obtained from the time-space variation.

4 Maximum Force (N), calculated from the additional load-acceleration relationship
5 registered during the entire movement.

6 Statistical Analyses

7 Three simple lineal regression models were developed based on the three variables
8 supplied by the LPM (criterion variable) and on the basis of the AC data (predictor
9 variable).

10 The assumption of independence of errors was compared by means of the Durbin-
11 Watson test, due to its effect on the increase to error rate type 1. For the statistical
12 process control of possible autocorrelation, partial autocorrelation coefficients were
13 calculated in each instance, contemplating a single series produced from the measures
14 provided by both devices and a delay equal to the number of trials performed. Statistical
15 significance level was set at $p < 0.05$ for all tests. Additionally, the effect size obtained
16 in each concurring case was evaluated in accordance with levels proposed by Cohen
17 (14, 15). The data were smoothed using the software supplied as part of each device.
18 Data analysis was carried out using the Statistical Package for the Social Sciences
19 (SPSS Inc., version 18, Chicago).

20 RESULTS

21 A higher average value was detected in the majority of the variables measured by the
22 AC device compared to the LPM.

23 The mean and standard deviations for each of the measurements analyzed in the series
24 of three tests are set out in Table 1. The average measurements supplied by the AC
25 device are higher in the majority of cases compared to the average LPM measurements,
26 with the exception of the maximum force variables of subject 3 and the maximum
27 velocity variables of subject 1. At the same time, the standard deviations of the AC
28 measurements are higher than those of the LPM on all occasions except one; the
29 measurement of maximum force of the third subject.

30 *****Table 1 about here*****

1 In Table 2 the statistical values of the Durbin-Watson test are shown for each and every
2 one of the trials. The only instance, in which this is clearly not the case is in the
3 measurement of maximum force for subject 1; in four instances, the test data are not
4 conclusive, thereby indicating that autocorrelation may be present. In the remaining
5 cases the presence of autocorrelation is apparent.

6 However, not even in the aforementioned instances of possible increase in error rate
7 type 1 did significant correlation prevail insofar as the measurements provided by both
8 devices were concerned. In the non-conclusive data cases, only one statistically
9 significant correlation was found and with a large effect size; the peak power
10 measurement of subject 1, $r(10) = 0.640$, $p = 0.024$.

11 In the remaining instances, autocorrelation aside, only two statistically significant
12 correlations were found and with a large effect size; the measurement of peak power
13 and velocity of the third subject, $r(14) = 0.670$ $p = 0.005$, in both cases.

14 The high correlation factor between these measurements for subject 3 cannot be
15 considered as replicated by the measurement of maximum force in subject 1, given the
16 existence of autocorrelation between the error terms of independent variables.

17 *****Table 2 about here*****

18 In order to obtain additional support for the absence of positive correlation between
19 both devices, partial autocorrelation was calculated for the statistical control of the
20 possible existence of autocorrelation between the measurements obtained from a single
21 subject using the same device. Table 3 gives these partial autocorrelations and their
22 respective confidence intervals.

23 As can be seen, the majority of the autocorrelation values proved negative, including
24 some of those corresponding to measurements where a positive statistically significant
25 correlation was found by means of linear regression analysis. This indicates that an
26 increase in the data provided by one device occurs as a decrease in the data provided by
27 the other, meaning that their similarity cannot be endorsed. This notion is also supported
28 by the fact that the only partial positive autocorrelation present is very small. In any
29 event, none of the correlations surpassed the 95% confidence interval, so that they
30 cannot be said to be statistically significant.

31 *****Table 3 about here*****

1 DISCUSSION

2 The reliability of data obtained between measuring devices is an ongoing and as yet
3 unresolved issue, which, as highlighted above (1), continues to be of key concern to the
4 scientific community. This, in conjunction with the observation made (2) that the main
5 variability of data arises when measuring individual athlete performance, poses an
6 additional challenge. This factor has been considered of great importance when
7 designing and subsequently analyzing the statistical data in this report. The control of
8 characteristics derived from the error produced by data dependence for the same subject
9 in successive trials has enabled results to be obtained in keeping with the purpose of this
10 technical report.

11 This assertion results from the non-existence of widespread high positive correlation
12 between the two sets of data obtained from the two devices under examination, in which
13 the presence of a substantial low and even negative correlation was apparent. This has
14 also been evident in other inter-machine comparability studies that have been carried
15 out (4, 16, 2, 3). Furthermore, we concluded that a strong (11), positive correlation
16 existed between the AC device and a computerized linear transducer and force platform
17 system (Celesco linear transducer of the directly interfaced BMS system, Ballistic
18 Measurement System Innervations Inc, Fitness Technology force plate, Skye, South
19 Australia, Australia)

20 The values obtained in our study denote how the AC device shows higher average
21 values and a higher standard deviation (Table 1) with the exception of two instances; the
22 peak power measurement of the third subject and the velocity maximum measurement
23 of the first. This leads us to deduce that when employing this device, the values
24 measured will be higher, as was the case in the data obtained regarding the
25 overestimation of jumping height by the AC device when compared to another linear
26 position measuring device (12). Obtaining higher values, as well as greater dispersion in
27 AC compared to LPM, is yet a further reason showing that data obtained from both
28 devices should not be used simultaneously, so confirming the aims of this Report.
29 Moreover these higher values will therefore be less accurate, since the data distribution
30 registered higher dispersion when compared to data obtained from the LPM device. On
31 the other hand, the LPM device registered lower average values with less dispersion,
32 which may imply greater accuracy.

1 As to the assumption of independence of errors in accordance with the Durbin-Watson
2 test (not found to be applied in previous cited studies), in only one instance was this not
3 found; the measurement of maximum force for subject 1, although in four other
4 instances the test data was non-conclusive, which indicated that autocorrelation could be
5 present. This analysis allowed for the possible existence of inter-machine correlation
6 when this is due to the autocorrelation of the subjects in successive trials. Only one
7 statistically significant correlation was found, with a large effect size and with no
8 autocorrelation - the peak power measurement of subject 1, $r(10) = 0.640$, $p = 0.024$,
9 although the data revealed a non-conclusive value of independence which makes
10 replication of this affirmation for all the results obtained impossible. In order to confirm
11 the analysis, partial negative autocorrelation was found and only a very small positive
12 autocorrelation but none of these autocorrelations surpassed the 95% confidence
13 interval limits, which meant that they could not be considered to be of statistical
14 significance (Table 3).

15 It could also be confirmed that on measuring the test variables with the AC device, there
16 is an increase in the value of uncertainty of the measurement (a concept that represents a
17 quantitative measure of quality of the result of measuring, enabling the results obtained
18 from the devices to be compared with other results, references, specifications or rules)
19 which is, referred to as typical value of uncertainty Type A by the Spanish Center of
20 Metrology (17). This parameter is associated with the result of a measurement which
21 characterizes dispersion of the values that can be reasonably attributed to each measure.
22 This is apparent in Figure 1, in which the values of each variable measured by each
23 device are reflected and the relative distance to an established value from an absolute
24 value of zero, which must correspond with the real value of the measurand.

25 Considering these values (Figure 1), in the maximum velocity variable the results from
26 the three trials obtained from the AC device are very different to those obtained from
27 the LPM device. In the central image (maximum force) and on the basis of the values of
28 this variable, this difference occurs in 6 trials. Finally, and as a result of the estimate
29 from the algorithms of each device, in the third variable (peak power) there is a greater
30 dispersion in the AC device compared to that of the LPM device for the two groups of
31 trials related to the previous variables, as was to be expected given the calculations
32 made.

1 The algorithms could be the cause of these issues, particularly in the case of the AC
2 device, as has been revealed by other studies carried out on this device (12, 13).

3 The uncertainty of the results of a measurement reflects the impossibility of knowing
4 the exact value of the measurand. This could be due to: a finite resolution of the
5 measuring device or its discrimination threshold, inexact values of measurement
6 standards; the inexact values of the patterns and other parameters drawn from outside
7 sources and used in the data processing algorithms (17).

8 *****Figure 1 about here*****

9 It should be noted that possible differences in the technical characteristics of both
10 devices, for example the different velocities of data collection (LPM; 1000 Hz
11 compared to AC; 200-500 Hz) may explain these variations. In this respect, the relevant
12 aspects regarding the existing calibration specifications of the LPM device have to be
13 considered. These are obtained by a direct comparison with the inexact values of
14 measurement standards or the certified reference materials. Due to the presence of data
15 variability obtained from testing a standardized bout of treadmill walking (16), the
16 authors of that study reached the conclusion that appropriate calibration protocols are
17 needed to ensure the reliability of the measures analyzed in four different types of
18 accelerometer (CSA/MTI, Biotrainer Pro, Tritrac-R3D, and Actical). According to the
19 Spanish Center of Metrology (18), the existence of the calibration protocol of a device
20 demonstrates the traceability to which it is subject, guarantees that its readings are
21 compatible with other measurements, determines the accuracy of the readings of the
22 monitoring device and establishes its reliability.

23 This study does not set out to question the accuracy of the results obtained from both
24 devices, since this is not its objective. That is the objective of the organizations that deal
25 with this matter, as is the comparison of the accepted reference value (true or actual
26 value) for each of the variables studied.

28 PRACTICAL APPLICATIONS.

29 The purpose of this technical report was to examine the reliability between both
30 monitoring devices by comparing the values of one over the other. The non-
31 confirmation of correlation was established between the T-Force device (LPM) and the

1 Myotest Sport accelerometer (S4P model) (AC), meaning that the data obtained from
2 one could not be predicted on the basis of the data obtained from the other, which in
3 turn means that the statistical assumption could not be confirmed. Statistical hypothesis
4 3 established the presence of a statistically significant correlation between the results
5 obtained from both devices, under the research conditions established, between the
6 variables of maximum velocity, estimated maximum force and estimated peak power
7 when performing the bench press exercise. Therefore, we conclude that it is necessary
8 to advise against the interchangeable use of both devices as instruments to assess and
9 monitor resistance training. It is recommended that the same device is always employed
10 and that the data obtained from the same is used as the sole means of comparing data in
11 subsequent training sessions. In this way, confusion as to the interpretation of any
12 increase or decrease that may be manifested in the results, key to monitoring the results
13 obtained in training, would be avoided, as would any confusion with regards to the
14 input of reference values in successive testing. These conclusions have been reached
15 taking into account the control of independence of errors between tests carried out on
16 each of the subjects who participated. The data revealed the presence of a generalized
17 autocorrelation by means of the assumption of independence of errors in accordance
18 with the Durbin-Watson test. Independence of errors between the results of the same
19 subject was only apparent in one instance (subject 1 –maximum force variable), which
20 permits us to assert that that the data obtained from the athletes were characterized by a
21 generalized autocorrelation, thereby confirming statistical assumption 2. For future
22 tests, it is recommended that design strategies that reflect error control resulting from
23 the data dependence factor be applied when measuring an athlete's performance.

24 The AC device (Myotest) revealed higher and more disperse values than the LPM
25 device (T-Force). This was confirmed in 16 of the 18 cases considered, although this
26 was not the case for the peak power measurement of the third subject and the maximum
27 velocity measurement of the first. Evidence therefore points to an overestimation and
28 greater dispersion and a lack of accuracy in the data given by the AC device when
29 compared to the LPM device.

30 Bearing all the above in mind, since there are risks in the concordance of the data
31 between the two devices, trainers and athletes are recommended to take special care
32 when using the variables power peak, maximum force and maximum velocity,
33 controlling such values and comparing them only with the values obtained from the

1 same device. Finally since both devices are used habitually, we would recommend that
2 all results are measured, controlled and compared using the same device. Mixing the
3 data of measurements obtained indiscriminately from one or the other can falsify the
4 results of training

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1 Figure Legends:

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5 3 Figure 1. Data distribution of the variables analyzed from an absolute zero point by AC
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7 4 and LPM.

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11 6 Table Legends:

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16 8 Table 1. Descriptive Statistics of the three measurements recorded by each device used
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18 9 in each of the test series.

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21 10 Table 2. Empirical and theoretical (interval) values of the statistician Durbin-Watson
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23 11 and simple linear regression analysis data for each measurement with the data collected
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25 12 by the Linear Position Measuring Device (LPM) as the criterion variable and the data
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27 13 from the accelerometer as the predictor variable.

28
29 14 Table 3. Partial autocorrelations for the different measurements obtained from each
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31 15 subject.

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62
63
64
65

Table 1. Descriptive Statistics (M = mean/average and SD = Standard deviation) of the three measurements recorded by each device used in each of the test series.

| Subjects | | Peak Power | | Max. Strength | | Max. Velocity | |
|----------|-----|------------|-----------|----------------|---------------|----------------|-----------|
| | | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| 1 | LPM | 920.270 | 62.750 | 408.390 | 17.770 | 225.210 | 8.460 |
| | AC | 1169.830 | 316.050 | 559.170 | 191.700 | <u>215.170</u> | 32.710 |
| 2 | LPM | 655.170 | 46.540 | 346.980 | 12.130 | 188.670 | 8.610 |
| | AC | 780.580 | 256.260 | 355.670 | 27.290 | 220.250 | 74.200 |
| 3 | LPM | 410.810 | 45.220 | 322.260 | 42.750 | 129.450 | 20.550 |
| | AC | 462.810 | 153.270 | <u>307.940</u> | <u>20.540</u> | 148.190 | 42.530 |

AC = Acelerometer; LPM= Linear Position Measuring Device

Table 1. Empirical and theoretical (interval) values of the statistician Durbin-Watson¹ and simple linear regression analysis data for each measurement with the data collected by the Linear Position Measuring Device (LPM) as the criterion variable and the data from the accelerometer as the predictor variable.

| Subjects | | <i>D-W</i> | Interval | <i>b</i> | β | <i>t</i> | <i>df</i> | <i>p</i> |
|----------|---------------|--------------------|-------------|----------|---------|----------|-----------|----------|
| 1 | Max. Strength | 0.700* | | 0.010 | 0.140 | 0.450 | 10 | 0.663 |
| | Peak Power | 1.170 [?] | 0.810-1.580 | 0.130 | 0.640 | 2.660 | 10 | 0.024* |
| | Max Velocity | 1.250 [?] | | -0.010 | -0.040 | -0.120 | 10 | 0.904 |
| 2 | Max. Strength | 1.490 [?] | | -0.140 | -0.320 | -1.080 | 10 | 0.304 |
| | Peak Power | 1.570 [?] | 0.810-1.580 | -0.050 | -0.250 | -0.820 | 10 | 0.429 |
| | Max. Velocity | 2.060 | | -0.040 | -0.310 | -1.020 | 10 | 0.333 |
| 3 | Max Velocity | 1.580 | | 0.020 | 0.010 | 0.037 | 14 | 0.971 |
| | Peak Power | 1.690 | 0.980-1.540 | 0.200 | 0.670 | 3.350 | 14 | 0.005* |
| | Max. Velocity | 2.130 | | 0.320 | 0.670 | 3.350 | 14 | 0.005* |

* Statistically significant autocorrelation; ? non-conclusive data.

Tabla 1. Partial autocorrelations for the different measurements obtained from each subject.

| | Peak Power | Max. Strength | Max. Velocity |
|-----------|------------|---------------|---------------|
| Subject 1 | -0.180 | -0.110 | -0.180 |
| Subject 2 | -0.350 | -0.290 | -0.290 |
| Subject 3 | -0.010 | 0.050 | -0.070 |

Figure

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