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New aspects for exercise testing on dynamometer

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Introduction:
Isokinetic tests are a common method to quantify strength capacity in single and multi joint movements. Especially in high speed movements there are still substantial limitations to reach preset speed, due to the effect of gravity and even more due to the moment of inertia [1,2,4]. Purpose of this study was to investigate the specific effect of compensating the moment of inertia in single and multijoint movements at different speeds.

Methods:
N = 25 healthy male and female subjects (age: 27 ± 4.4 years) with different activity levels (no exercise up to daily excercise) participated in the study. After a warm up phase, maximum torque/force measurments (5 repetitions) where executed for four movements: single joint knee extension and flexion (K), multijoint lower limb extension and flexion (L), multijoint trunk extension and flexion (T) and a complex shoulder/arm extension (S) movement, on rotational and linear dynamometers (Con-trex MJ/LP/TP/WS CMV AG). K and S was measurment at 60, 180 and 360°/s, T at 60 and 120°/s and L at 0.3, 0.6 and 0.9 m/s (linear leg press). Two measurement modi (isokinetic classic: only gravity compensation; isokinetic new: gravity and inertia compensation) were tested conentrically in randomised order proceeding from slow to fast movement speeds. The test order of the four movements was also randomised. Main Outcome measure was the realized maximum velocity at preset speed limit. Data was analysed descriptively with mean and 95% confidence interval.

Table 1

Realized maximum speed in knee and lower limb flexion and shoulder/arm extension at preset speed

joint/movement	preset speed	ext/flex	modus	N	realized max speed (mean)	95% CI
K	360 [°/S]	flex	classic	24	346.8 [°/S]	± 3.0
K	360 [°/S]	flex	new	24	349.1 [°/S]	± 3.0
L	0.9 [m/s]	flex	classic	25	0.42 [m/s]	± 0.02
L	0.9 [m/s]	flex	new	25	0.68 [m/s]	± 0.02
S	360 [°/S]	ext	classic	25	144.6 [°/S]	± 9.6
	360 [°/S]	ext	new	25	310.7 [°/S]	± 9.6

Results:
In healthy subjects there were no differences at the knee between the classic and the new mode. At the lower limb there were higher realized velocities in the new mode in flexion with increasing speed (difference: 0.24 m/s at 0.9 m/s preset speed), but no differences in extension. For the trunk movement were no differences at 60°/s but with preset 120°/s, a mean difference of 20°/s was observed (Fig. 1). The realized maximum speed at the shoulder/arm extension (preset 360°/s) was on average 170°/s faster in the new mode (Table 1).

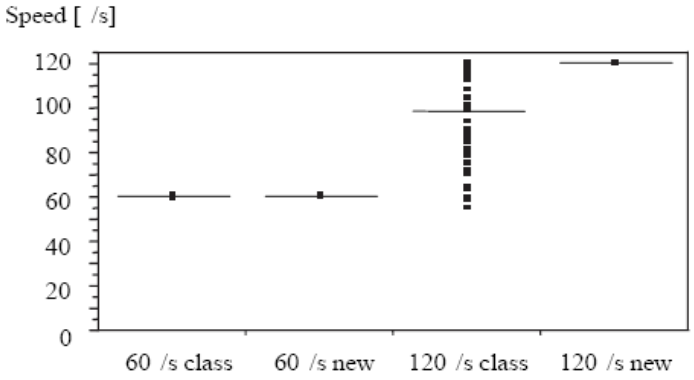

Fig. 1. Realized maximum speed: Trunkflexion at preset 60 and 120°/s in classic and new measurement mode (comparison: no compensation – with compen-sation of the moment of inertia) [°/s].

Discussion:
Desired high speed tests (preset speed) on dynamometer are not always high speed in real [2,3]. With compensation of inertia, healthy subjects are able to reach the preset speed limit as far the range of motion allows.

Conclusion:
New measurement modi, which compensate for the moment of inertia, seem to be highly relevant in desired high speed tests. In all movements with large involved body segements absolut high test speeds are only possible with a compensation of both, gravitiy and moment of inertia. Patients with lower strength levels will probably also benefit at low test speeds and tests (e.g. knee) with small inertia.

References

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