Évaluation fonctionnelle instrumentale des muscles du tronc chez le sportif

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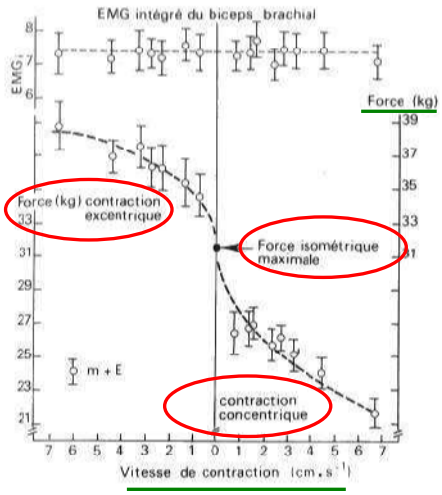
Les différents types de contraction musculaires



Quels sont les outils pour mesurer la force

- Jauge de contrainte
  → mesure force isométrique
- Dynamomètre isocinétique → mesure moment de force
- Accéléromètre
  → mesure de la puissance musculaire

Reproductibilité des mesures

Reproducibility of trunk isokinetic strength findings in healthy individuals

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Reproducibility analysis

	CVsd	ICC	SEM (Nm)	SEM mean%	Smallest real difference (Nm)
Trunk flexors concentric at 30°/sec	0.39	0.87	3.47	2.72%	9.61
Trunk extensors concentric at 30°/sec	3.99	0.87	6.02	2.93%	16.68
Trunk flexors eccentric at 30°/sec	2.5	0.9	3.52	2.42%	9.75
Trunk extensors eccentric at 30°/sec	1.52	0.78	17.69	7.09%	49.00
Trunk flexors concentric at 60°/sec	0.32	0.87	3.96	3.41%	10.97
Trunk extensors concentric at 60°/sec	9.77	0.69	17.31	5.17%	48.00
Trunk flexors eccentric at 60°/sec	6.46	0.81	6.33	4.62%	17.53
Trunk extensors eccentric at 60°/sec	1.92	0.95	6.61	2.69%	18.33

CVsd – coefficient of variation of standard deviation, ICC – intraclass correlation coefficient, SEM – standard error of measurement.

Comparison of reproducibility parameters from previous studies

Author	Testing velocity	Flexors		Extensors	
		ICC	SEM	ICC	SEM
Karatas et al. [16]	60 and 90°/sec	0.89–0.95	NA	0.80–0.92	NA
Dvir and Keating [9]	20 and 40°/sec	NA	NA	0.50–0.78	31–50 Nm
Keller et al. [18]	60°/sec	NA	NA	0.80–0.98	NA
Hupli et al. [14]	60, 90 and 120°/sec	> or = 0.90	NA	> or = 0.90	NA
Wessel et al. [28]	NA	> 0.83	8.9–19.2 Nm	> 0.81	6.9–19.2 Nm
Delitto et al. [5]	60, 120, 180°/sec	0.74–0.88	13.9–45.4 Nm	0.79–0.88	18.9–63.4 Nm
Dervisevic et al. (2006)	30°/sec	0.87	3.47 Nm	0.87	6.02 Nm
	60°/sec	0.87	3.96 Nm	0.69	17.3 Nm

NA – not available. Bolded numbers in brackets are references.
All data are for concentric mode of contraction and healthy male subjects.

Inter-session, inter-tester and inter-site reproducibility of isometric trunk muscle strength measurements

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Table 2
Coefficients of variation (CV) for the inter-session, inter-tester and inter-site reproducibility of peak-torque (PT) in the healthy group

	Inter-session CV (%)	Inter-tester CV (%)	Inter-site CV (%)
Ext PT	6.9	8.1	12.7*
Fle PT	3.4*	3.4	4.2
LF right PT	7.6	3.9	6.3
LF left PT	5.8	6.5	7.9*
Rot right PT	4.5	4.9	7.9
Rot left PT	3.5	4.3	7.7

*$p < 0.05$.
Ext = trunk extensors, Fle = trunk flexors, LF = trunk lateral-flexors, Rot = trunk rotators.

Pas de consensus sur le meilleur système d'évaluation au niveau de la région lombaire

Pourquoi mesurer la force musculaire chez le sportif

- Importance du groupe musculaire sur la performance sportive
- Identifier des déficiences spécifiques dans la fonction musculaire de l'athlète
- Identification de talents
- Suivi de l'entraînement/rééducation

Abernethy et al. Sports Med 1995

Quelle est l'évidence?
Importance du groupe musculaire pour la performance sportive

P Aagarrd et al. Scand J Med Sci Sports 1998

Isokinetic muscle strength and hiking performance in elite sailors

Trunk extension and hiking performance (male):
- p<0.05 static hiking
- p<0.01 dynamic hiking

Trunk extension and hiking performance (female):
ns

Trunk flexion and hiking performance (male):
ns

Trunk flexion and hiking performance (female):
p<0,01 static hiking
ns dynamic hiking

Trunk extension strength sailor>control

Trunk flexion strength sailor = control

Quelle est l'évidence?
Identifier des déficiences spécifiques dans la fonction musculaire de l'athlète

Iwai et al: Med Sci Sports Exerc, 2004:

Trunk muscle strength and disability level of low back pain in collegiate wrestlers

2 groupes: lutteurs avec anomalies radiologiques (AR) et sans anomalies radiologiques (SAR)

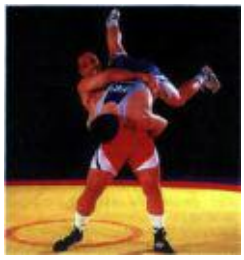
Force extension tronc identique entre les 2 groupes

Force flexion tronc identique entre les deux groupes

Incidence de lombalgie chronique identique entre les deux groupes (± 40%)

Corrélation entre « disability score » et force extension dans groupe SAR

Pas d'autres corrélations



Quelle est l'évidence?
Identifier des déficiences spécifiques dans la fonction musculaire de l'athlète

T. Renkawitz et al. Spine J, 2006

The association between low back pain, neuromuscular imbalance and trunk extension strength in athletes

Pas de relation entre force extenseurs du tronc et
- lombalgies
- dysbalance neuromusculaire

Relation entre dysbalance neuromusculaire et lombalgies

Testing clinique de la mobilité du tronc et de la flexibilité musculaire ont seulement une faible corrélation avec dysbalance neuromusculaire et lombalgies

Quelle est l'évidence?
potentiel athlétique en fonction discipline sportive

0195-9131/98/2005-0587$2.00/0
MEDICINE AND SCIENCE IN SPORTS AND EXERCISE

Trunk muscle strength in athletes

EVA ANDERSSON, LEIF SWÄRD, and ALF THORSTENSSON

TABLE 2. Mean values (± 1 SD) for peak torque in N·m·kg^{-1} body weight in hip and trunk flexion and extension movements at a constant angular velocity of 15 deg·s^{-1}.

	Hip ext	Hip flex	Trunk ext	Trunk flex

A retenir:
Normes en fonction des disciplines sportives
Sport > contrôle
♂ >♀

The smallest differences between the groups for statistical significance (analysis of variance) are shown at the bottom of each column. In the table only the significant differences for the athletes as compared to the normals are indicated: * $P < 0.05$, ** $P < 0.01$.

Interestingly, preliminary results from clinical studies on the same material have demonstrated the most frequent radiological anomalies of the lumbar spine in the athlete groups with the highest trunk muscle strength, namely the gymnasts and the wrestlers.

Quelle est l'évidence?
potentiel athlétique en fonction discipline sportive

Dynamic Trunk Strength of Canadian Football Players, Soccer Players, and Middle to Long Distance Runners

Soccer (N=16)	211			
Football (N=15)	236.1*†	57.8	2.5	0.4
Runners (N=15)	156.2	38.3	2.1	0.4
Recreation (N=15)	169.1	50.4	2.3	0.4

	Concentric Extensors			
Football (N=15)	428.7*	127.4	4.5	1.2
Runners (N=15)	297.5	87.3	4.0	1.2
Recreation (N=15)	367.0	99.1	4.9	1.5

A retenir:
Normes différent en fonction de l'appareil
Sportifs compétition pas supérieurs aux sportifs loisir

Williams et al: JOSPT 1997

Quelle est l'évidence?
potentiel athlétique en fonction discipline sportive

Abstract

Concentric and eccentric strength of trunk in athletes*

A retenir:
Même niveau de compétition: ♂>♀
Ratios flex/ext 0.5-0.8 identique ♂ et♀
Ratios ecc/conc 1.3-1.4 identique ♂ et♀

Mean values (SD) ... at CONC and ECC contraction modes

Group		CONC	ECC	CONC	ECC	CONC	ECC	ECC/CONC ratio	
						ratio		flexion	extension
Men	PT	4.34 (0.71)	5.78 (0.57)	3.42 (0.4)	4.47 (0.45)	0.79 (0.09)	0.77 (0.06)	1.31 (0.06)	1.34 (0.14)
	BW	4.09 (0.64)	5.27 (0.66)	3.58 (0.46)	4.26 (0.51)				
Women	PT	3.77 (0.69)	5.51 (1.3)	3.13 (0.31)	4.13 (0.44)	0.85 (0.14)	0.78 (0.15)	1.32 (0.06)	1.45 (0.17)[a]
	BW	3.57 (0.51)	5.33 (1.1)	3.31 (0.38)	3.97 (0.53)				

[a]Significatively different to the CONC/ECC flexion ($p < 0.05$).

Quelle est l'évidence?
potentiel athlétique en fonction discipline sportive

Isokinetics and Exercise Science 12 (2004) 253–261
IOS Press

Trunk strength patterns in elite rowers

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[a]Musculoskeletal Surgery, Faculty of Medicine, Imperial College London, UK
[b]Bioengineering, Imperial College London, UK

A retenir:
Différence force entre♀ et ♂ moins importante chez les Sportifs que dans population contrôle

Table 2
Isokinetic concentric peak torque (mean and standard deviation)

		Males		Females	
a) Rowers					
0°/sec	Peak torque	222.6 ± 25.3	280.2 ± 48.2	181.7 ± 28.2	220.1 ± 50.9
	Normalised peak torque	260.0 ± 25.3	369.6 ± 79.6	251.0 ± 35.2	276.4 ± 68.7
30°/sec	Peak torque	229.5 ± 38.7	276.5 ± 63.3	171.9 ± 30.0	184.3 ± 44.9
	Normalised peak torque	258.1 ± 83.4	310.0 ± 107.9	236.9 ± 36.1	254.1 ± 59.0
60°/sec	Peak torque	182.8 ± 62.2	225.0 ± 80.4	94.1 ± 38.5	116.6 ± 40.5
	Normalised peak torque	225.4 ± 43.7	295.7 ± 65.4	142.7 ± 27.3	182.4 ± 64.2
90°/sec	Peak torque	210.3 ± 36.7	229.1 ± 67.0	135.1 ± 31.3	119.1 ± 32.0
	Normalised peak torque	252.6 ± 31.5	285.0 ± 74.4	207.1 ± 27.0	183.2 ± 43.2
120°/sec	Peak torque	194.3 ± 46.6	194.5 ± 77.2	127.3 ± 36.1	107.1 ± 45.5
	Normalised peak torque	242.5 ± 45.5	244.0 ± 82.8	199.1 ± 40.4	158.6 ± 65.3
b) Non-rowers					
0°/sec	Peak torque	200.2 ± 43.02	186.0 ± 65.4	114.0 ± 42.1	92.5 ± 43.5
	Normalised peak torque	248.4 ± 33.7	228.9 ± 68.6	174.1 ± 51.2	141.3 ± 66.8
30°/sec	Peak torque	198.8 ± 49.2	166.5 ± 57.5	98.6 ± 45.9	80.3 ± 51.0
	Normalised peak torque	244.6 ± 28.4	206.4 ± 63.3	147.9 ± 57.0	121.6 ± 75.9

Table 4
…tios (%) during isokinetic testing

			Non-rowers	
		…ension	Flexion	Extension
		53.6	64.2	52.0
		56.6	65.5	54.2
90°/sec	70.6	57.6	56.9	49.9
120°/sec	62.4	53.0	49.6	48.2

Quelle est l'évidence?
Identification de talents- potentiel athlétique

Cave:
Décroissance physiologique de la force avec l'âge > 35 ans

Quelle est l'évidence?
La rééducation

T. Renkawitz et al. Spine J, 2006

The association between low back pain, neuromuscular imbalance and trunk extension strength in athletes

Table 2
Exercise program, description of exercises

	Description of exercise
Warm-up	Rope skipping or power-walking on the spot
Mobilization	Standing trunk rotation, alternately rotating right/left
	Standing arm stretching to the ceiling, standing on tiptoe in the end, alternately right/left
	Lying lumbar mobilization with knees bent, knees alternately pushed down slightly right/left
Strength, stabilization, and coordination	Lying abdominal muscle strengthening, raising upper body
	Lying abdominal and hip muscles strengthening, raising legs and bending knees simultaneously
	Stomach lying extension muscle strengthening, lifting chest and leg
	Side position lateral trunk strengthening, lifting pelvis to a straight line between trunk and legs
	Lying pelvic muscle strengthening, lifting pelvis while shoulders remain on the ground
	Coordinated strengthening on all fours with simultaneous arm and leg extension
Stretching	Standing lateral trunk stretching
	Lying erector spinae stretching with knees bent alternately facing right/left
	Lying hamstrings stretching
	Kneeling iliopsoas stretching
Cool-down	Lying knee-chest stretch

- **Conclusion:** Entraînement spécifique du tronc diminue nombre de lombalgies et de dysbalances

En résumé

- **Mesure**: Pas de « gold standard »
- Relation **force-performance**: évidence faible
- **Pas** de **relation** évidente entre **lombalgie et force musculaire**
- **Potentiel athlétique**
  - Sportif ≥ contrôle
  - Sportif masculin>féminin
  - ≠ entre les sports
  - Attention aux normes/fonction des machines
- **Reeducation**:

  est-ce que la stabilité (core stability) n'est pas plus la clé que la force chez le sportif?

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