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TRAININGSBEGLEITENDES MONITORING DES MUSKELFUNKTIONSTATUS

Ist die Tensiomyografie im Feld praxistauglich?

VP	Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag
1	morgens: Boxen 90 min. abends: Kick/Thai 90 min.	morgens: Kraft abends: Kick/Thai 90 min.	abends: Kick/Thai 90 min.	morgens: Kraft abends: Boxen 90 min.	abends: Ringen 90 min.	morgens: Ringen 90 min. abends: Kraft 30 – 45 min	abends: Kick/Thai 90 min.
2	mittags – abends: Boxen, Thai und Kraft 180 min.	abends: Kardio u. Boxen 90 min.	mittags – abends: Boxen, Thai und Kraft 180 min.	abends: Kardio u. Boxen 90 min.	mittags – abends: Boxen, Thai und Kraft 180 min.	mittags: Kardio 30 – 45 min BJJ 90 min.	Pause
3	abends: Kick 90 min.	Kraft 30 – 45 min	abends: Kick 90 min.	Kardio 30 – 45 min	morgens: Kraft 30 – 45 min abends: Boxen 90 min.	morgens: Kick 90 min.	Pause
4	abends: Kick 90 min.	Kraft 30 – 45 min	Kraft 30 – 45 min	Pause	Kraft 30 – 45 min abends: Kick 90 min.	Kraft 30 – 45 min	Kardio 30 – 45 min
5	abends: Boxen 90 min.	abends: Kick/Thai und BJJ 120 min. Kraft 30 – 45 min	mittags: Kardio	abends: Kick/Thai und BJJ 120 min. Kraft 30– 45 min	abends: Boxen 90 min.	mittags: Kick/Thai 120 min.	abends: Kick/Thai und BJJ 120 min. Kraft 30 – 45 min

Tabelle: Überblick zur wöchentlichen Trainingsstruktur der Versuchspersonen (VP 1 bis 5) (Legende: Kick = Kickboxen, Thai = Thaiboxen, BJJ = Brazilian Jiu Jitsu)

Literatur

Alentorn-Geli, E., Alvarez-Diaz, P., Ramon, S., Marin, M., Steinbacher, G., Boffa, J. J., Cuscó, X., Ballester, J. & Cugat, R. (2015). Assessment of neuromuscular risk factors for anteriorcruciate ligament injury through tensiomyography in male soccer players. *Knee Surgery, Sports Traumatology, Arthroscopy*, 23 (9), 2508–2013.

Dahmane, R., Valenčič, V., Knez, N. & Eržen, I. (2001). Evaluation of the ability to make non invasive estimation of muscle contractile properties on the basis of the muscle belly response. *Medical and Biological Engineering and Computing*, 39 (1), 51–55.

de Paula Simola, R. A., Harms, N., Raeder, C., Kellmann, M., Meyer, T., Pfeiffer, M. & Ferrauti, A. (2015). Assessment of neuromuscular function after different strength training protocols using tensiomyography. *Journal of Strength and Conditioning Research*, 29 (5), 1339–1348.

de Paula Simola, R. A., Raeder, C., Wiewelthove, T., Kellmann, M., Meyer, T., Pfeiffer, M. & Ferrauti, A. (2016a). Muscle mechanical properties of strength and endurance athletes and changes after one week of intensive training. *Journal of Electromyography and Kinesiology*, 30, 73–80.

de Paula Simola, R. A., Harms, N., Raeder, C., Kellmann, M., Meyer, T., Pfeiffer, M. & Ferrauti, A. (2016b). Tensiomyography reliability and prediction of changes in muscle force after eccentric strength exercise using muscle mechanical properties. *Sports Technology*, 8, 58–66.

Ditroilo, M., Hunter, A. M., Haslam, S. & De Vito, G. (2011). The effectiveness of two novel techniques in establishing the mechanical and contractile responses of biceps femoris. *Physiological Measurement*, 32 (8), 1315–1326.

Ditroilo, M., Smith, I. J., Fairweather, M. & Hunter, A. M. (2013). Long-term stability of tensiomyography

measured under different muscle conditions. *Journal of Electromyography and Kinesiology*, 23 (3), 558–563.

García-Manso, J. M., Rodríguez-Ruiz, D., Rodríguez-Matoso, D., de Saa, Y., Sarmiento, S. & Quiroga, M. (2011). Assessment of muscle fatigue after an ultra-endurance triathlon using tensiomyography (TMG). *Journal of Sports Sciences*, 29 (6), 619–625.

García-Manso, J. M., Rodríguez-Matoso, D., Sarmiento, S., de Saa, Y., Vaamonde, D., Rodríguez Ruiz, D. & Da Silva-Grigoletto, M. E. (2012). Effect of high-load and high-volume resistance exercise on the tensiomyographic twitch response of biceps brachii. *Journal of Electromyography and Kinesiology*, 22 (4), 612–619.

Gil, S., Loturco, I., Tricoli, V., Ugrinowitsch, C., Kobal, R., Abad, C. C. C. & Roschel, H. (2015). Tensiomyography parameters and jumping and sprinting per-

formance in Brazilian elite soccer players. *Sports Biomechanics*, 14 (3), 340-350.

Hecksteden, A., Skorski, S., Schwindling, S., Hammes, D., Pfeiffer, M., Kellmann, M., Ferrauti, A. & Meyer, T. (2016). Blood-borne markers of fatigue and recovery in competitive athletes. Results from a simulated training camp. *PLoS ONE*, 11 (2), e0148810.

Hunter, A., Galloway, S., Smith, I., Tallent, J., Ditroilo, M., Fairweather, M. & Howatson, G. (2012). Assessment of eccentric-induced muscle damage of the elbow flexors by tensiomyography. *Journal of Electromyography and Kinesiology*, 22 (3), 334-341.

Košiček, A. (2014). *TMG-S1 Muscular Measuring Device. User Manual* (Version 3,5). Ljubljana, Slowenien.

Križaj, D., Simunic B. & Žagar, T. (2008). Short-term repeatability of parameters extracted from radial displacement of muscle belly. *Journal of Electromyography and Kinesiology*, 18 (4), 645-651.

Martinez-Cabrera, F. I. & Nunez-Sanchez, F. J. (2016). Acute effect of a foam roller on the mechanical properties of the rectus femoris based on tensiomyography in soccer players. *International Journal of Human Movement and Sports Sciences*, 4 (2), 26-32.

Meyer, T., Ferrauti, A., Kellmann, M. & Pfeiffer, M. (2016). *Regenerationsmanagement im Spitzensport. REGman - Ergebnisse und Handlungsempfehlungen*. Köln: Sportverlag Strauß.

Raeder, C., Wiewelhove, T., De Paula Simola, R., Kellmann, M., Meyer, T., Pfeiffer, M. & Ferrauti, A. (2016). Assessment of fatigue and recovery in male and female athletes after six days of intensified strength training. *Journal of Strength and Conditioning Research*, 30 (12), 3412-3427.

REGman-Projektgruppe (Hrsg.). REGman Newsletter 2/2017. Zugriff am 22.11.2017 unter www.regman.org.

Rey, E., Lago-Peñas, C. & Lago-Ballesteros, J. (2012). Tensiomyography of selected lower-limb muscles in professional soccer players. *Journal of Electromyography and Kinesiology*, 22, 866-872.

Rodríguez-Ruiz, D., Rodríguez-Mataseo, D., Quiroga, M. E., Sarmiento, S., García-Manso, J. M. & Da Silva-Grigoletto, M. E. (2012). Study of mechanical characteristics of the knee extensor and flexor musculature of volleyball players. *European Journal of Sport Science*, 12 (5), 399-407.

Rojas-Barrionuevo, N. A., Vernetta-Santana, M., Alvariñas-Villaverde, M. & Jesús-Bedoya, J. (2017). Acute effect of acrobatic jumps on different elastic platforms in the muscle response evaluated through tensiomyography. *Journal of Human Sport and Exercise*, 12 (3), 728-741.

Rusu, L., Cosma, G., Cernaianu, S., Marin, M., Rusu, P., Ciocanescu, D. & Neferu, F. (2013). Tensiomyography method used for neuromuscular assessment of muscle training. *Journal of Neuroengineering and Rehabilitation*, 10, 67.

Saw, A. E., Main, L. C. & Gastin, P. B. (2016). Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review. *British Journal of Sports Medicine*, 50 (5), 281-291.

Schroeder, J., Renk, V., Braumann, K.-M. & Hollander, K. (2017). Acute effects of foam rolling on contractile properties of the biceps femoris muscle in terms of tensiomyography compared to stretching and weight training - A randomized cross-over pilot study. *German Journal of Exercise and Sport Research*, 47 (4), 294-300.

Valenčič, V. & Knez, N. (1997). Measuring of skeletal muscles dynamic properties. *Artificial Organs*, 21 (3), 240-242.

Weir, J. P. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength and Conditioning Research*, 19 (1), 231-240.

Wiewelhove, T., Raeder, C., Meyer, T., Kellmann, M., Pfeiffer, M. & Ferrauti, A. (2015). Markers for routine assessment of fatigue and recovery in male and female team sport athletes during high-intensity interval training. *PLoS ONE*, 10 (10), e0139801.

Wiewelhove, T., Raeder, C., de Paula Simola, R. A., Schneider, C., Döweling, A. & Ferrauti, A. (2017). Tensiomyographic markers are not sensitive for monitoring muscle fatigue in elite youth athletes: a pilot study. *Frontiers in Physiology*, 8, 406.

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