POST AKTİVASYON POTANSİYELİ

Neşe Şahin

- Bir kas grubunun sergileyeceği performans, o kas grubunun kontraktil geçmişi tarafından pozitif ya da negatif olarak etkilenebilir.

Yorgunluk Aktivasyon Sonrası Potansiyel (PAP)

↓↓ ↑↑

Sale DG. Postactivation potentiation: role in human performance. Exerc Sport Sci Rev 2002 Jul; 30 (3): 138-43

PAP NEDİR ?

MAKSİMAL YA DA MAKSİMALE YAKIN KASILMALAR

(ÖN YÜKLENME AKTİVİTESİ - ÖN KONDİSYONLANMA)

↓

POST AKTİVASYON POTANSİYALİZASYONU (PAP)

↓

PERFORMANS ↑↑

Tillin N, Bishop D. (2009). Factors Modulating Post-Activation Potentiation and Its Effect on Performance of Subsequent Explosive Activities, Sports Medicine, 39(2), 147-166

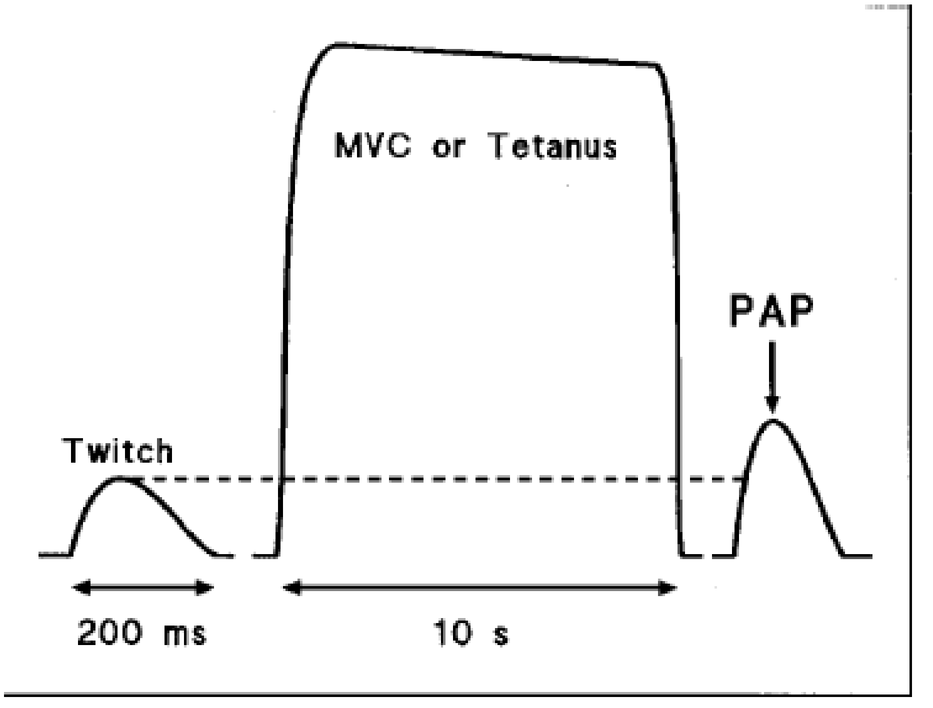

Figure 1. An example of postactivation potentiation (PAP). First, a baseline twitch is evoked in a muscle that has been at rest for some time. Then, a conditioning contraction, such as an electrically evoked tetanic contraction or a maximal voluntary contraction (MVC) is done. A twitch contraction evoked soon after the conditioning contraction shows the increased force and shortened time course typical of PAP. For an example of actual twitch recordings, see (7).

Sale DG. Postactivation potentiation: role in human performance. Exerc Sport Sci Rev 2002 Jul; 30 (3): 138-43

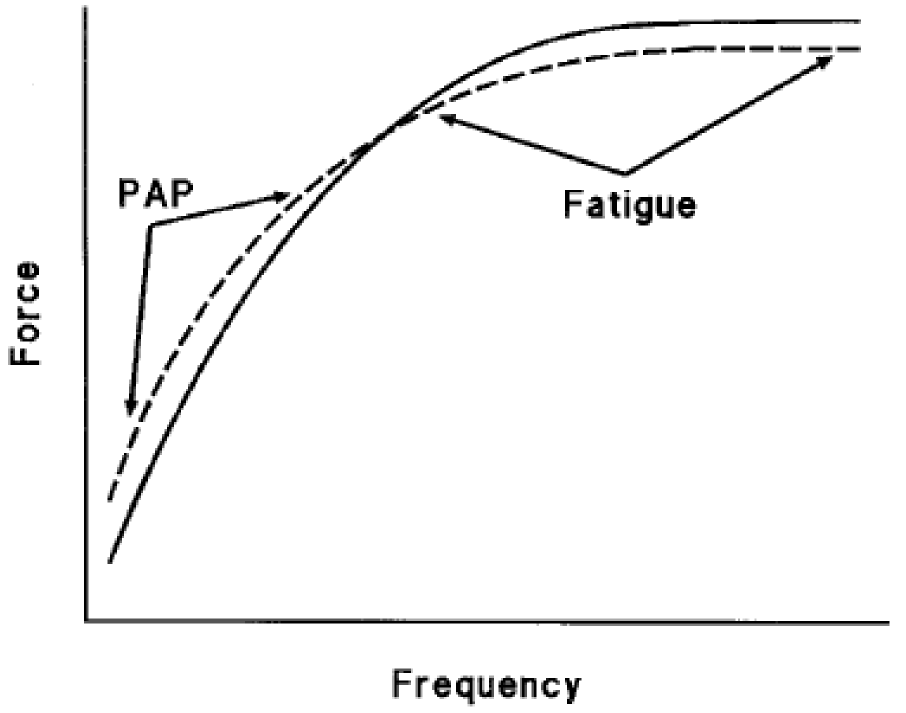

Figure 2. Effect of PAP on the isometric force-frequency relation. Force increases and then plateaus as the frequency of stimulation increases (*solid line*). After a conditioning activity, the induced PAP (*dashed line*) increases low- but not high-frequency tetanic force. The conditioning activity may, by causing fatigue, actually decrease high-frequency force, as shown. See text for references on which this schematic figure is based.

Sale DG. Postactivation potentiation: role in human performance. Exerc Sport Sci Rev 2002 Jul; 30 (3): 138-43

MEKANİZMALAR

Teori 1;

Miyozin düzenleyici hafif zincirin fosforilize edilmesi

Tetanik kasılma sonucunda; Seğirme potansiyeli ve Fosfat içeriğindeki artış !..

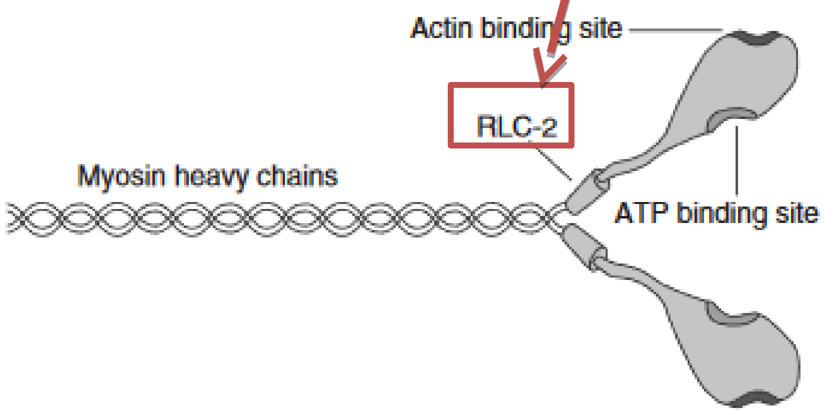

Fig. 1. One myosin molecule. Each myosin molecule is composed of two myosin heavy chains. Regulatory light chain (RLC)-2 represents a pair of RLCs positioned at the neck of a myosin head. Each RLC can incorporate a phosphate molecule, altering the structure of the myosin head. At each myosin head there is an actin and adenosine triphosphate (ATP) binding site.

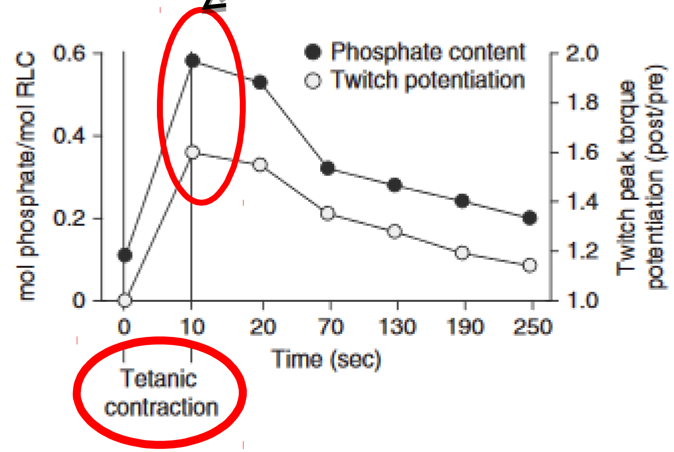

Fig. 2. The time-course of regulatory light chain (RLC) phosphorylation and twitch peak torque potentiation, following a 10-second pre-conditioning tetanus. Potentiation is represented as a ratio of the post-maximal voluntary contraction (MVC) peak torque value to the pre-MVC peak torque value (post/pre). These results indicate a possible relationship between RLC phosphorylation and twitch tension potentiation (reproduced from Moore and Stull,[7] with permission).

Tillin N, Bishop D. (2009). Factors Modulating Post-Activation Potentiation and Its Effect on Performance of Subsequent Explosive Activities, Sports Medicine, 39(2), 147-166

Teori 2;

Sinaptik kavşak ve Omurilik kord seviyelerinde u

potansiyellerinin artırılması !..

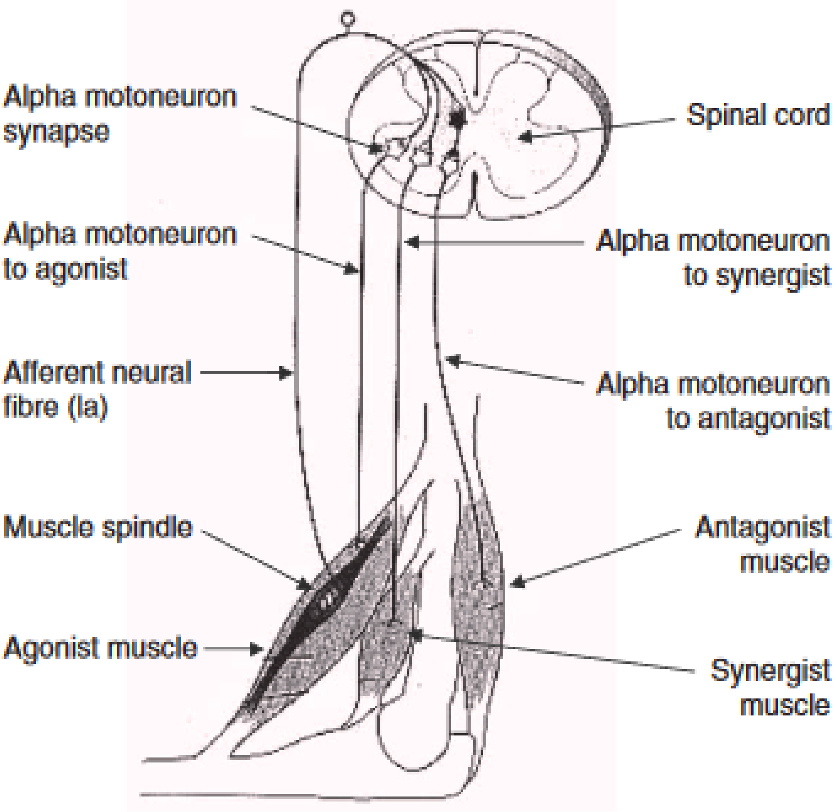

Fig. 3. The neural volleys of a Ia afferent fibre. An action potential generated at the Ia afferent neural fibre travels to the spinal cord, where it is transferred to the adjacent α-motoneuron of the agonist muscle. The action potential then travels directly to the agonist muscle, initiating the processes of muscular contraction.

Tillin N, Bishop D. (2009). Factors Modulating Post-Activation Potentiation and Its Effect on Performance of Subsequent Explosive Activities, Sports Medicine, 39(2), 147-166

Teori 3;

- Güçlendirilmiş bir uyaran, kastaki pennat açıda azalma meydana getirerek, kas fibrilinden tendona güç aktarımını kolaylaştırır. Bu kolaylaşma kasın sergileyebileceği güç ve kuvvet oranlarını artırabilir !..

Tillin N, Bishop D. (2009). Factors Modulating Post-Activation Potentiation and Its Effect on Performance of Subsequent Explosive Activities, Sports Medicine, 39(2), 147-166

HANGİ ÖN YÜKLENME HAREKETLERİ PAP'U AKTİVE EDER ???

- ✓ İstemli izometrik kontraksiyonlar
- ✓ Uyarılmış izometrik kontraksiyonlar
- ✓ Tekrarlı maksimal istemli kontraksiyonlar
- ✓ Tekrarlı dinamik kontraksiyonlar

- ✓ Her türlü kontraktil aktivite PAP mekanizmasını aktive edebilir !..

Lima LCR, Oliveira FBD, Oliveira TP, Assumpção CDO, Greco CC, Cardozo AC, et al. Postactivation potentiation biases maximal ısometric strength assessment. BioMed Research International. 2014

PAP STRATEJİLERİ

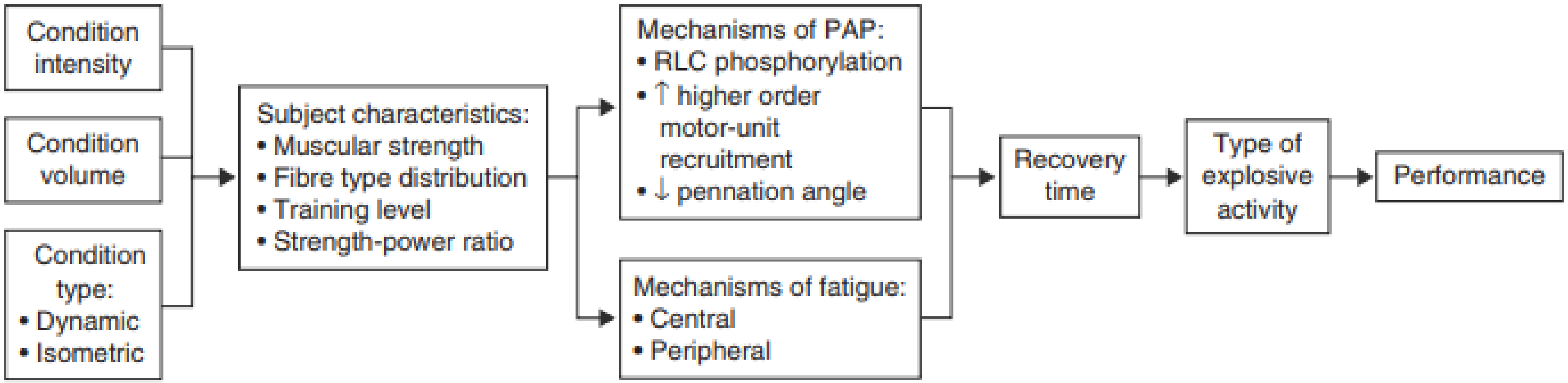

Fig. 9. The complex factors influencing performance of a voluntary explosive activity following a conditioning contraction (condition). Condition intensity, volume and type will affect individuals differently, depending on their subject characteristics. Collectively, these factors will influence the extent to which the mechanisms of post-activation potentiation (PAP) and fatigue are affected. The interaction between the mechanisms of PAP and fatigue will determine whether subsequent performance is potentiated, and the recovery period required to realize potentiation. Regardless of the previous interactions, however, the response of some explosive activities to the condition may be different to the response of other explosive activities. **RLC** = regulatory light chain.

ÖN KONDİSYONLANMA SÜRE ve ŞİDDETİ

PAP etkisi > Yorgunluk

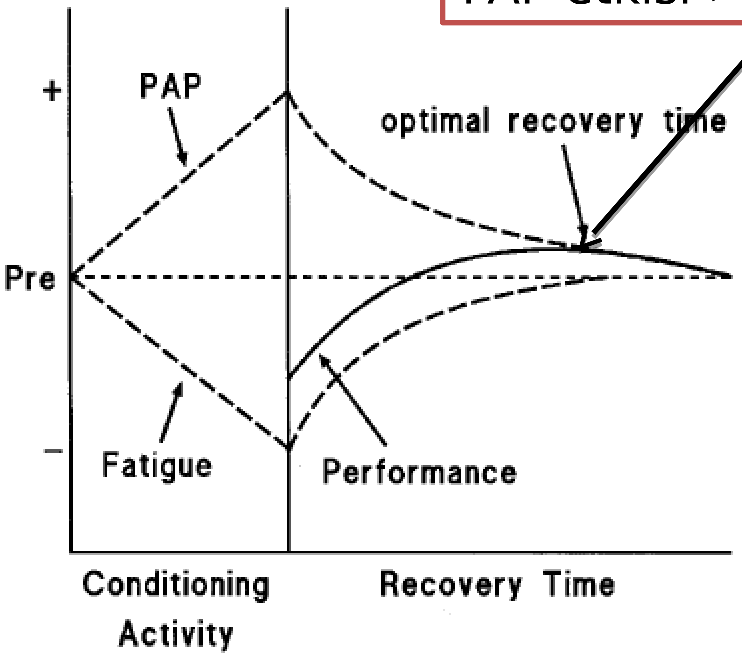

Figure 7. Strategy for exploiting PAP to improve strength/speed performance. The conditioning activity activates PAP, monitored as the change in twitch force, and induces fatigue, monitored as the change in high-frequency tetanic force. Strength/speed performance (*e.g.*, vertical jump), also involving high-frequency motor unit firing rates, would therefore be depressed immediately after the conditioning activity, despite the presence of PAP. However, if fatigue dissipates faster than PAP decays, as illustrated, performance will transiently (optimal recovery time) exceed the best performance before the conditioning activity (Pre). The optimal recovery time is determined by trial and error, taking into account factors such as the performance to be enhanced, the nature of the conditioning activity, and the fiber-type composition and training status of the subjects.

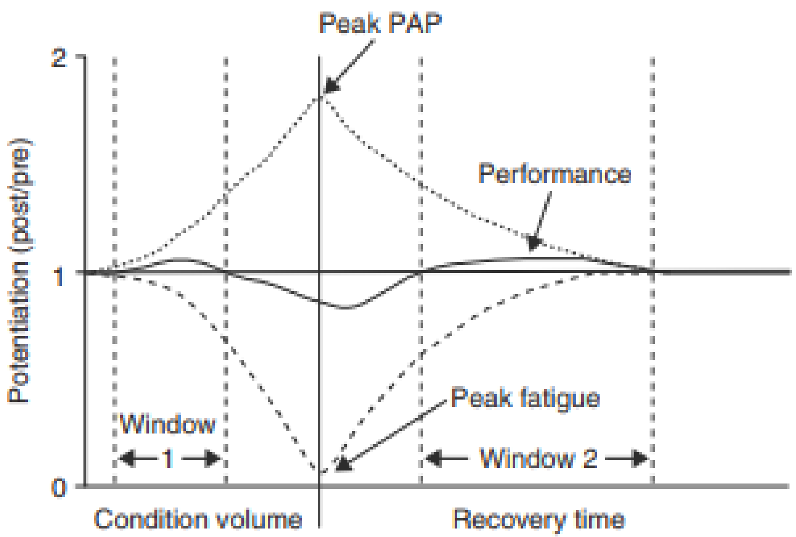

Fig. 8. A model of the hypothetical relationship between post-activation potentiation (PAP) and fatigue following a pre-conditioning contraction protocol (condition).[3] When the condition volume is low, PAP is more dominant than fatigue, and a potentiation in subsequent explosive performance (post/pre) can be realized immediately (window 1). As the condition volume increases, fatigue becomes dominant, negatively affecting subsequent performance. Following the condition, fatigue dissipates at a faster rate than PAP, and a potentiation of subsequent explosive performance can be realized at some point during the recovery period (window 2).

ÖN KONDİSYONLANMA SÜRE ve ŞİDDETİ

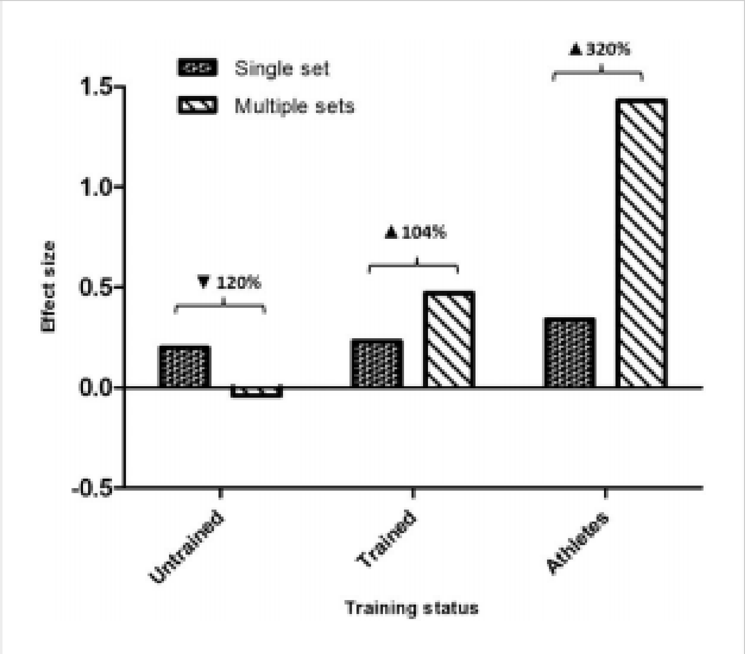

Figure 1. Effects of a single vs. multiple sets conditioning mode protocol on power in untrained, trained, and athletic populations.

Wilson JM, Duncan NM, Marin PJ, Brown LE, Loenneke JP, Wilson SMC, et al. Meta-analysis of postactivation potentiation and power: Effects of conditioning activity, volume, gender, rest periods, and training status. The Journal of Strength & Conditioning Research, 2013; 27(3): 854-859

KASILMA TİPİ

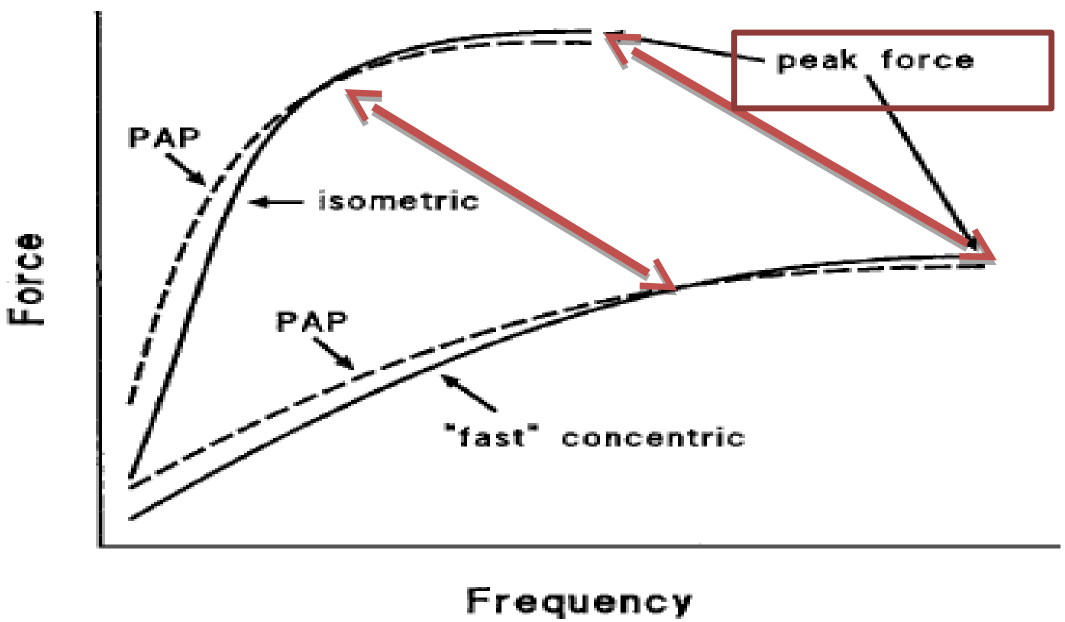

Figure 3. Effect of contraction type on the force-frequency relation and range of frequency over which PAP extends. An isometric and a "fast" concentric contraction condition are compared. A higher frequency is required to attain the plateau or peak force (*solid lines*) in the concentric contraction. Also, PAP induced by a conditioning activity (*dashed line*) extends to a higher frequency in the concentric contraction. Note that the maximum isometric force is greater than the maximum concentric force, in accordance with the force-velocity relation. Also, in this example, fatigue produced by the conditioning activity caused a decrease in high-frequency force (see also Fig. 1 and (1)).

KONSANTRİK KASILMALARDA , İZOMETRİK KASILMALARA ORANLA PAP ETKİSİ UZAR !..;

NEDENİ ;

ZİRVE KUVVET ve PLATOYA ULAŞMAK İÇİN DAHA YÜKSEK FREKANS SIKLIĞI, ve YORGUNLUK ETKİSİ

FİBRİL TİBİ

PAP:

TİPII >>> TİP I

↓

Myosin düzenleyici hafif zincir fosforilizasyonunun yüksek olması

ANCAK !..

Maksimal kuvvet ya da hız gerektiren aktivitelerde motor ünite ateşlenme oranları, en yüksek seviyelerde olmasında dolayı PAP' nu hemen hemen yok olur !..

ÖN KONDİSYONLANMA ve TOPARLANMA SÜRESİ

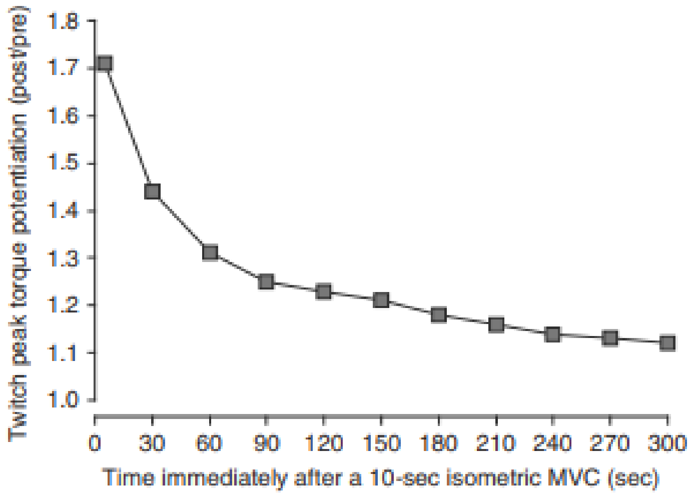

Fig. 7. The time-course of twitch peak torque potentiation immediately after a 10-second isometric maximal voluntary contraction (MVC).[12] Potentiation is represented as a ratio of the post-MVC peak torque value to the pre-MVC peak torque value (post/pre).

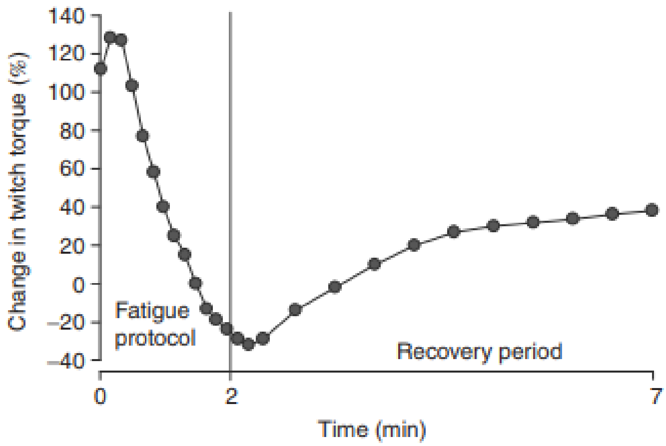

Fig. 10. The time-course of knee extensor twitch torque during a fatigue protocol and throughout a subsequent 5-minute recovery period. The fatigue protocol consisted of 16 5-second MVCs separated by 3 seconds of recovery. A twitch contraction was recorded pre-fatigue protocol, between each MVC, 5 seconds post-fatigue protocol, and then every 30 seconds throughout the recovery period. Twitch torque is given as percentages of pre-fatigue values.[14]

ÖN KONDİSYONLANMA ve TOPARLANMA SÜRESİ

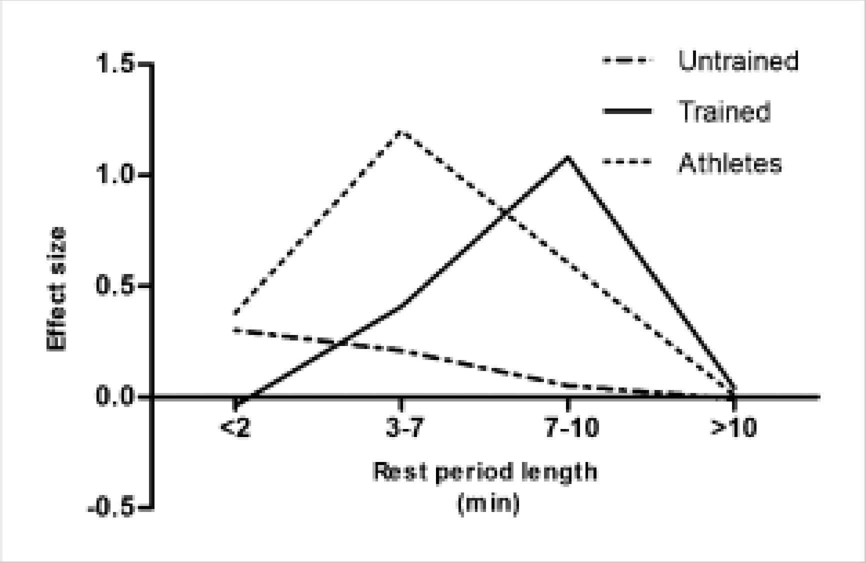

Figure 2. Power after immediate (<2 minutes), short (3–7 minutes), moderate (7–10 minutes), and long (>10 minutes) rest period lengths in untrained, trained, and athletic populations.

Wilson JM, Duncan NM, Marin PJ, Brown LE, Loenneke JP, Wilson SMC, et al. Meta-analysis of postactivation potentiation and power: Effects of conditioning activity, volume, gender, rest periods, and training status. The Journal of Strength & Conditioning Research, 2013; 27(3): 854-859

KUVVET ANTRENMANLARINDA PAP

YÜKSEK FREKANSLI UYARANLAR !..

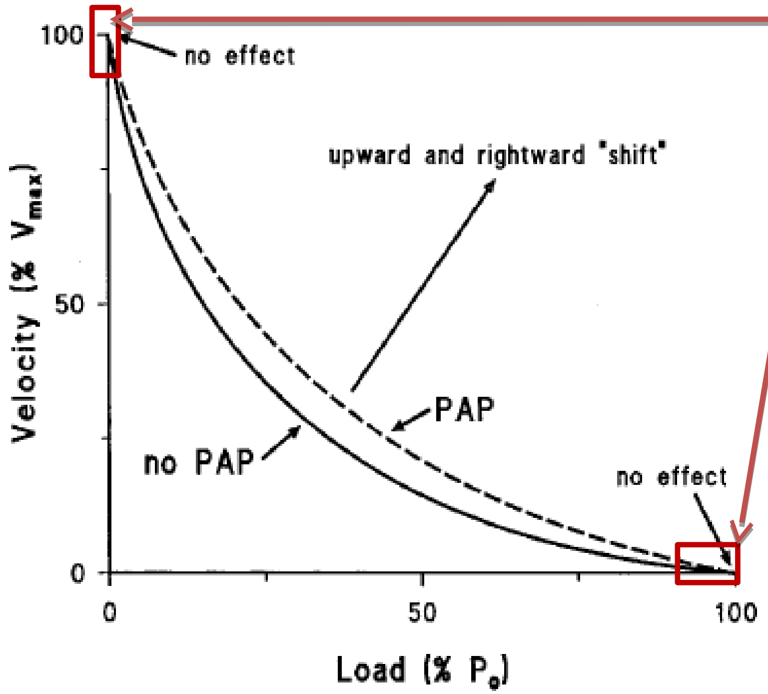

Figure 5. Hypothesized effect of PAP on the load (force)-velocity relation. PAP cannot increase maximum isometric force (P_o) or maximum shortening velocity (V_{max}), because P_o and V_{max} are determined with high-frequency stimulation. In contrast, PAP can increase rate of force development at high frequencies (see Fig. 6), an effect that may increase the acceleration and hence velocity attained with loads intermediate between the extremes of P_o and V_{max}. If this were to occur, the load-velocity relation would become less concave, *i.e.*, shifted upward and to the right.

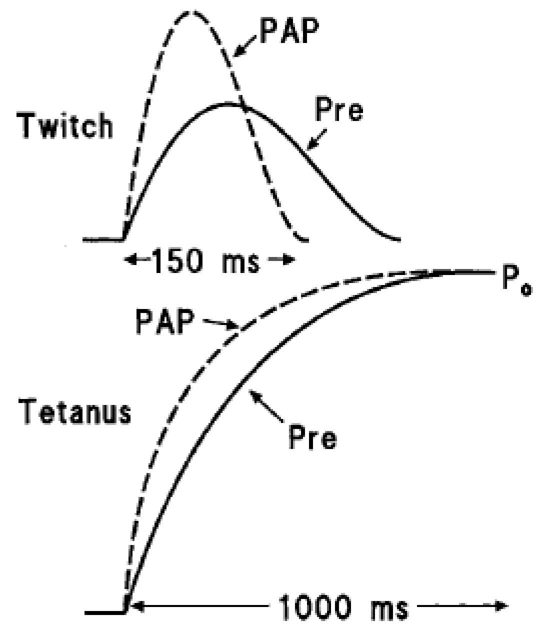

Figure 6. Comparison of effect of PAP on isometric force and rate of force development of twitch and high-frequency tetanic contractions. PAP increases both the rate of force development and the peak force of twitch and low-frequency tetanic contractions (the latter not shown), but only the rate of force development of the high-frequency tetanic contraction is increased. This latter effect may alter the shape of the load-velocity relation (see Fig. 5) and potentially enhance strength and speed performance.

Table I. A summary of studies that have investigated the effects of a pre-conditioning contraction on a subsequent activity

Study	Subjects	Pre-conditioning contraction (condition)	Volume	Rest interval	Performance test	Performance changes
Batista et al.[47]	10 UT M	Isovelocity MVC, knee extension	10 (30 sec RI)	4 min 6 min 8 min 10 min	Isovelocity knee extensions at all rest intervals	6% ↑ P_t* at each rest interval
Behm et al.[34]	9 UT M	Isometric MVC, knee extension	1 × 10 sec 2 × 10 sec (1 min RI) 3 × 10 sec (1 min RI)	1, 5, 10, 15 min for all volumes	Isometric MVC knee extensions at all rest intervals	↔ ↔ 10-min post: 8.9% ↓ P_f* 15-min post: 7.5% ↓ P_f*
Chatzopoulos et al.[48]	15 UT M	Back-squat	10 × 1 rep 90% 1 RM (3 min RI)	3 min 5 min	30-m sprint 30-m sprint	↔ 3% ↓ 0–10-m sprint time*, 2% ↓ 0–30-m sprint time*
Chiu et al.[20]	24; 7 RT, 17 UT (12 M, 12 F)	Back-squat	90% 1 RM × 5 (2 min RI)	5 min 6 min 7 min 5 min 6 min 7 min	CMJ: 30% 1 RM 50% 1 RM 70% 1 RM SJ: 30% 1 RM 50% 1 RM 70% 1 RM	RT: 1–3% ↑, UT: 1–4% ↓. RT > UT* RT: 1–3% ↑, UT: 1–4% ↓. RT > UT* RT: 1–3% ↑, UT: 1–4% ↓. RT = UT RT: 1–3% ↑, UT: 1–4% ↓. RT > UT* RT: 1–3% ↑, UT: 1–4% ↓. RT = UT RT: 1–3% ↑, UT: 1–4% ↓. RT = UT

BPT = bench press throw; **CMJ** = counter movement jump; **C-sprint** = cycle sprint; **DJ** = drop jump; **F** = females; **GRF** = ground reaction force; **JH** = jump height; **KE** = knee extensions; **LCMJ** = loaded counter movement jump; **M** = males; **MVC** = maximum voluntary contractions; P_f = peak force; P_p = peak power; P_t = peak torque; **RFD** = rate of force development; **RI** = rest interval; **RM** = repetition maximum; **RT** = resistance/athletically trained; **SJ** = squat jump; **UT** = un/recreationally trained; ↑ indicates increase; ↓ indicates decrease; ↔ indicates no differences; * $p < 0.05$.

Table I. A summary of studies that have investigated the effects of a pre-conditioning contraction on a subsequent activity

Study	Subjects	Pre-conditioning contraction (condition)	Volume	Rest interval	Performance test	Performance changes
Ebben et al.[49]	10 RT M	Dynamic bench-press	3–5 RM	0–5 sec	Medicine ball BPT	↔ GRF
French et al.[50]	14 RT (10 M, 4 F)	Isometric MVC, knee extension	3 sec × 3 (3 min RI) 5 sec × 3 (3 min RI)	0–5 sec	CMJ DJ 5 sec C-sprint Isovelocity KE CMJ DJ 5 sec C-sprint isovelocity KE	↔ 5.0% ↑ * (4.9% ↑ GRF*) ↔ 6.1% ↑ P_t * ↔ ↔ ↔ 3.0% ↓ P_t *
Gilbert et al.[51]	7 RT M	Back-squat	100% 1 RM × 5 (5 min RI)	2 min 10 min 15 min 20 min 30 min	Isometric MVC at all rest intervals	5.8% ↓ RFD 5.8% ↓ RFD 10.0% ↑ RFD 13.0% ↑ RFD* ↔
Gossen and Sale[11]	10 UT (6 M, 4 F)	Isometric MVC, knee extension	10 sec	20 sec 40 sec	Dynamic KE Dynamic KE	↔ ↔

BPT = bench press throw; **CMJ** = counter movement jump; **C-sprint** = cycle sprint; **DJ** = drop jump; **F** = females; **GRF** = ground reaction force; **JH** = jump height; **KE** = knee extensions; **LCMJ** = loaded counter movement jump; **M** = males; **MVC** = maximum voluntary contractions; $\mathbf{P_f}$ = peak force; $\mathbf{P_p}$ = peak power; $\mathbf{P_t}$ = peak torque; **RFD** = rate of force development; **RI** = rest interval; **RM** = repetition maximum; **RT** = resistance/athletically trained; **SJ** = squat jump; **UT** = un/recreationally trained; ↑ indicates increase; ↓ indicates decrease; ↔ indicates no differences; * $p < 0.05$.

Table I. A summary of studies that have investigated the effects of a pre-conditioning contraction on a subsequent activity

Study	Subjects	Pre-conditioning contraction (condition)	Volume	Rest interval	Performance test	Performance changes
Gourgoulis et al.[15]	20 M (11 RT, 9 UT)	Back-squats	2 reps of: 20%, 40%, 60%, 80%, and 90% 1 RM (5 min RI)	0–5 sec	CMJ	2.4% ↑ RT + UT* RT: 4.0% ↑ UT: 0.4% ↑
Gullich and Schmidtbleicher[10]	Study 1: 34 RT (22 M, 12 F) Study 2: 8 RT	Isometric MVC, leg press Isometric MVC, plantarflexion	3 × 5 sec (5 min RI) 5 × 5 (1 min RI)	3 min, then every 20 sec. 8 jumps measured 1 min, then every 2nd min for 13 min	CMJ and DJ Isometric MVC, plantarflexion	3.3% ↑ CMJ*. ↑ DJ* 13% ↓ RFD 1 min post*. RFD 3 min post. 19% ↑ RFD 5–13 min post*
Hanson et al.[52]	30 UT (24 M, 6 F)	Back-squats	4 reps of 80% 1 RM	5 min	CMJ	↔
Jenson and Ebben[53]	21 RT (11 M, 10 F)	Back-squats	5 RM	10 sec 1 min 2 min 3 min 4 min	CMJ CMJ CMJ CMJ CMJ	4–13% ↓* ↔ ↔ ↔ ↔
Kilduff et al.[54]	23 RT M	Dynamic back-squats Dynamic bench-press	1 × 3RM 1 × 3 RM	15 sec 4 min 8 min 12 min 16 min 20 min 15 sec 4 min 8 min 12 min 16 min 20 min	CMJ CMJ CMJ CMJ CMJ CMJ Barbell BPT Barbell BPT Barbell BPT Barbell BPT Barbell BPT Barbell BPT	2.9% ↓ P_p* ↔ 6.8% ↑ P_p* 8.0% ↑ P_p* ↔ ↔ ↔ 4.7% ↓ P_p* ↔ 2.8% ↑ P_p* 5.3% ↑ P_p* 0.8% ↑ P_p*

Table I. A summary of studies that have investigated the effects of a pre-conditioning contraction on a subsequent activity

Study	Subjects	Pre-conditioning contraction (condition)	Volume	Rest interval	Performance test	Performance changes
Magnus et al.[55]	10 UT M	Back-squats	90% 1 RM	3 min	CMJ	↔
Rahimi[45]	12 RT M	Back-squats	2×4 reps of 80% 1 RM (2 min RI)	4 min	40-m sprint	3% ↓ 0–40 m sprint time*
Rixon et al.[56]	30 UT (15 M, 15 F)	Dynamic back-squats Isometric MVC back-squats	3 RM 3×3 sec (2 min RI)	3 min 3 min	CMJ CMJ	2.9% ↑ JH *, 8.7% ↑ P_p * ↔ JH, 8.0% ↑ P_p *
Robbins and Docherty[57]	16 UT M	Isometric MVC back-squats	3×7 sec (8 min between each set)	4 min	CMJ after each set of isometric MVC	↔
Young et al.[58]	10 UT M	Back-squats	5 RM	4 min	LCMJ	2.8% ↑ *

BPT = bench press throw; **CMJ** = counter movement jump; **C-sprint** = cycle sprint; **DJ** = drop jump; **F** = females; **GRF** = ground reaction force; **JH** = jump height; **KE** = knee extensions; **LCMJ** = loaded counter movement jump; **M** = males; **MVC** = maximum voluntary contractions; P_f = peak force; P_p = peak power; P_t = peak torque; **RFD** = rate of force development; **RI** = rest interval; **RM** = repetition maximum; **RT** = resistance/athletically trained; **SJ** = squat jump; **UT** = un/recreationally trained; ↑ indicates increase; ↓ indicates decrease; ↔ indicates no differences; * $p < 0.05$.

KAYNAKÇA

1. Sale DG. Postactivation potentiation: role in human performance. Exerc Sport Sci Rev 2002 Jul; 30 (3): 138-43
2. Tillin N, Bishop D. (2009). Factors Modulating Post-Activation Potentiation and Its Effect on Performance of Subsequent Explosive Activities, Sports Medicine, 39(2), 147-166
3. Wilson JM, Duncan NM, Marin PJ, Brown LE, Loenneke JP, Wilson SMC, et al. Meta-analysis of postactivation potentiation and power: Effects of conditioning activity, volume, gender, rest periods, and training status. The Journal of Strength & Conditioning Research, 2013; 27(3): 854-859

TEŞEKKÜRLER… ㅆ