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Alleviation of pain with the use of Farabloc, an electromagnetic shield: A review

Two studies have shown that Farabloc reduces pain in human subjects who suffer from phantom limb pain or delayed onset muscle soreness, but the mechanism is unknown.

ABSTRACT:

Objective: **Review the research on the alleviation of pain by Farabloc, a fabric with electromagnetic shielding properties.**

Data source and selection: **Review the results of two studies on the efficacy of Farabloc on phantom limb pain and delayed onset muscle soreness in human subjects:**

Conine TA, Hershler C, Alexander SA, et al. The efficacy of Farabloc in the treatment of phantom limb pain. *Can J Rehab* 1993;6:155.

Zhang J, Clement DB, Taunton JE. The efficacy of Farabloc, an electromagnetic shield in attenuating delayed onset muscle soreness. *Clin J Sport Med* 2000;10:15-21.

Main results: **The placebo-controlled double-blind cross-over study demonstrated reduced phantom limb pain when using double layers of Farabloc covering the stump of the amputated limb. The placebo-controlled single-blind cross-over study on delayed onset muscle soreness demonstrated reduced pain, less loss of muscle strength, and reduced blood markers of inflammation.**

Conclusion: **Farabloc fabric, which is demonstrated to have electromagnetic shielding properties when covering the stump of an amputated limb or when wrapped around the thigh muscle perturbed by delayed onset muscle soreness, significantly reduces pain in human subjects.**

Farabloc was devised by Frieder Kempe in 1978 in an effort to relieve phantom limb pain experienced by a family member. Initial work by G.L. Bach reported beneficial effects on phantom limb pain and later suggested that Farabloc may also reduce rheumatic pain (unpublished report, 1990).

Farabloc is a fabric made of a woven mesh of stainless steel and nylon thread and has been proven to have electromagnetic shielding properties (S. McDiarmid and M. Trudeau, unpublished report, 1998). The fabric is made of 9.5% steel wire consisting of iron, nickel, and chromium. Farabloc was found to block electromagnetic fields four times more effectively than placebo fabric, and to be an effective electromagnetic shield at frequencies greater than 1 MHz. It has been suggested that Farabloc has limited shielding effects on electromagnetic radiation in the low-frequency electromagnetic field (EMF), particularly the very low-frequency (<10 KHz), extremely low-frequency, and super and extremely high-frequency range (>10 000 MHz). Farabloc is most effective in shielding against EMF in the high- and ultrahigh-frequency range characteristic of radio frequency.

A variety of studies have proposed that the alteration of EMF has an effect on biologic systems.[1] Alteration of EMF does not create pain in humans but Grundler[2] and Eichwald and Walleczek[3] have suggested that enzyme systems that are sensitive may modulate calcium dynamics at a cellular membrane level with changes in EMF. Sandyk[4] performed a study in which patients with Parkinson's symptoms experienced an increase in central dopamine levels secondary to extracerebral exposure to low-frequency EMF.

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Detlavs[5] demonstrated a greater inflammatory response in rats with full thickness dermal wounds after exposure to modulated nonthermal EMF. Valberg[6] postulated a variety of mechanisms in which EMF may produce biological effects. It is suggested that energy transfer by acceleration of ions and charged proteins modifies cell membranes and receptor proteins. Electric fields induced inside the body exert force on electric charges and electric moments. The magnetic moments of ferromagnetic particles and free radical molecules interact with magnetic fields.[7] Research has been conducted using EMF in extra low-frequency range to enhance healing in bone fractures and cell metabolism.[1,8,9]

Anecdotal reports of relief by patients suffering from phantom limb pain and decreased creatine phosphokinase serum levels in horses after exercise when using Farabloc prompted the initiation of randomized placebo-controlled studies. Search of the literature at this time reveals only two controlled studies. A review of these two studies follows in this article.

Phantom limb pain

This distressing syndrome following amputation affects the majority of individuals with healed stumps.[10] It is characterized by a cramping, stabbing, or crushing sensation in the missing extremity, which may be of an episodic or continuous nature.

A multitude of treatments for this condition were investigated including neurosurgical, pharmacological, physical, and psychological treatments. None were found to be more successful in the control of phantom limb pain than placebo.[11]

Thirty-four patients with amputation of either the lower or upper extremity, all with complaints of phantom limb pain, were divided into two groups in a randomized double-blind cross-over design and treated with either Farabloc/placebo or placebo/Farabloc fabric fitted over the stump. At least a double thickness of fabric was used for more than 4 hours per day. Patients were excluded who had stump complications, compensation involvement, prosthetic fitting complications, or neuropsychological problems. Of the total, 24 patients had loss of a lower extremity, while the remaining 10 had upper extremity amputations. There was no restriction of any other therapy including drugs or physiotherapy during the period of study, as previous research showed none to be effective.

Table 1. The result of the repeated measures analysis of variance comparing the difference in the Visual Analog Scale mean scores for each period by the two groups.

Source	*D.F.*	Sum of squares	*F*-value	*p*
Group	1	1.76	0.25	0.6237
Period	3	106.84	16.17	0.0000
Group x period	3	50.83	7.69	0.0001
Subjects	32	222.17	–	–
Error	96	211.46	–	–
TOTAL	135	593.06	–	–

Table 2. The mean and standard deviation values for the Visual Analog Scale scores for the four periods: pretreatment, Farabloc-placebo group 1, placebo-Farabloc group 2, washout, and alteration of treatment.

	PERIOD			
	Pretreatment	Farabloc-placebo group 1, placebo-Farabloc group 2	Washout	Alteration of treatment
	Mean (*sd*)	Mean (*sd*)	Mean (*sd*)	Mean (*sd*)
Group 1	1.22 (1.08)	3.96 (2.75)	1.54 (1.04)	2.36 (1.28)
Group 2	1.31 (0.90)	2.43 (1.93)	1.99 (1.30)	4.27 (3.12)

Outcome measures

Pain was evaluated by the use of a visual analog scale (VAS). The zero point on a 10 cm line represented "no pain relief" and the other extreme represented "complete pain relief."[12] VAS was measured at the outset, the end of the first phase, after the cross-over and washout period, and at the conclusion of the study.

Statistical analysis

Repeated measures analysis of variance and Tukey's multiple pairwise comparison range test were used to analyze the results. Significance was set at $p<0.01$ and $p<0.05$ respectively.

Results

Pain was significantly reduced in the Farabloc group compared to the placebo group as shown in **Table 1** ($p<.001$). The pretreatment, placebo, and Farabloc means shown in **Table 2** demonstrate a significant effect on pain reduction by Farabloc ($p<.05$).

Discussion

The greatest pain relief in the 34 subjects occurred during the period when double layers of Farabloc covered the

stump of the amputated extremity.[13] Nine of the subjects reported pain relief of greater than 5 points on the VAS scale, while the average relief was measured at 3 points. One subject reported increased pain while using Farabloc. The nature of the study does not allow for any explanation of these positive results.

Delayed onset muscle soreness

Stimulated by the positive conclusions from the study of phantom limb pain and previous observation of reduced serum creatine phosphokinase in horses after exercise, a study to evaluate the use of Farabloc on a muscle injury model using human subjects was undertaken.[14] The common feature of muscle injury and phantom limb pain is the quest for analgesia. The etiology of the pain is not similar in each condition.

The muscle injury model used was created by 37 minutes of eccentric knee extension consisting of 20 sets of 10 repetitions with 10 seconds of recovery between sets using a Biodex dynamometer. This created delayed onset muscle soreness that produced pain and strength loss secondary to muscle damage for 5 to 7 days. A randomized single-blind placebo-controlled crossover design was used (**Figure 1**).

Twenty untrained volunteers (10 men and 10 women) ranging in age from 20 to 38 years were recruited using specific inclusion and exclusion criteria. Research protocol was approved by the University of BC Screening Committee for Research Involving Human Subjects.

Farabloc or placebo fabric was wrapped in double layers around the right thigh of each subject for 5 days immediately following the eccentric work.

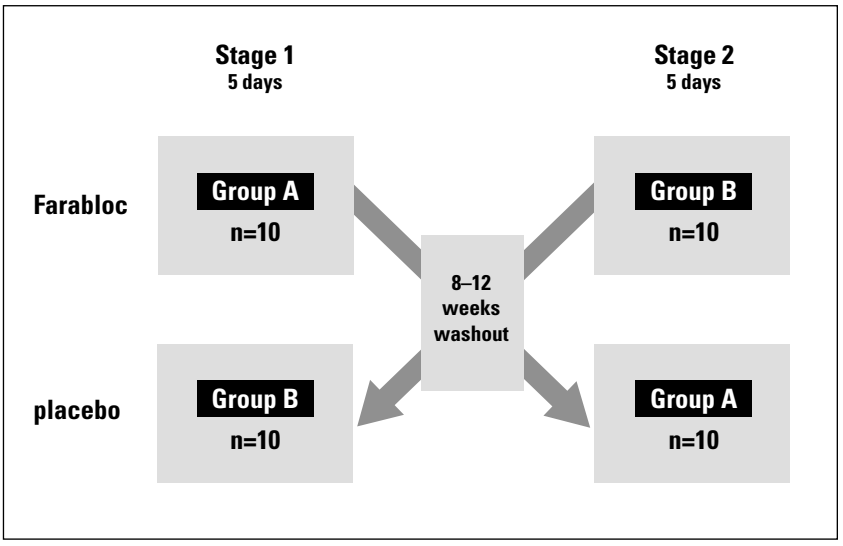

Figure 1. Schematic showing the randomized single-blind placebo-controlled crossover study design with washout period. Used with permission from *Clin J Sport Med* 2000;10(1):15-21.

Outcome measures

Muscle soreness was evaluated by use of a VAS and eccentric torque of the knee extensors measured with the Biodex Dynamometer daily for 5 days. Serum indices of muscle damage were selected for serial assessment five times in the first 48 hours. Creatine phosphokinase and myoglobin are indicative of muscle cell membrane disruption.[15,16] Malondialdehyde is an index of lipid peroxidation that is increased in the process of free radical damage secondary to severe eccentric induced muscle stress.[17] Since white blood cells are known to increase with severe exercise and muscle damage as a sign of inflammatory response, leukocytes and neutrophils were assessed.

Statistical analysis

A repeated measures factorial analysis of variance was performed on the combined data from the 20 participants for all seven variables in the two stages. Significance was set at $p=<0.01$.

Results

VAS and eccentric torque of the knee are shown in **Figure 2** with significantly different results (p=0.00) and (p=0.003) respectively between Farabloc and placebo. Malondialdehyde (**Figure 3**), creatine phosphokinase, myoglobin, (**Figure 4**), white blood cells, and neutrophils (**Figure 5**) again showed significant results (p=0.000, p=0.000, p=0.000 and p=0.008) respectively between Farabloc and placebo fabric.

Discussion

Double layers of Farabloc fabric wrapped around the thigh of human subjects after eccentric exercise demonstrates attenuation of symptoms, signs, and muscle inhibition associated with delayed onset muscle soreness. There was statistically significant reduction in pain and a reduction in loss of strength when Farabloc was used immediately after exercise compared to placebo.

The magnitude of these results suggest a substantial clinical reduction in

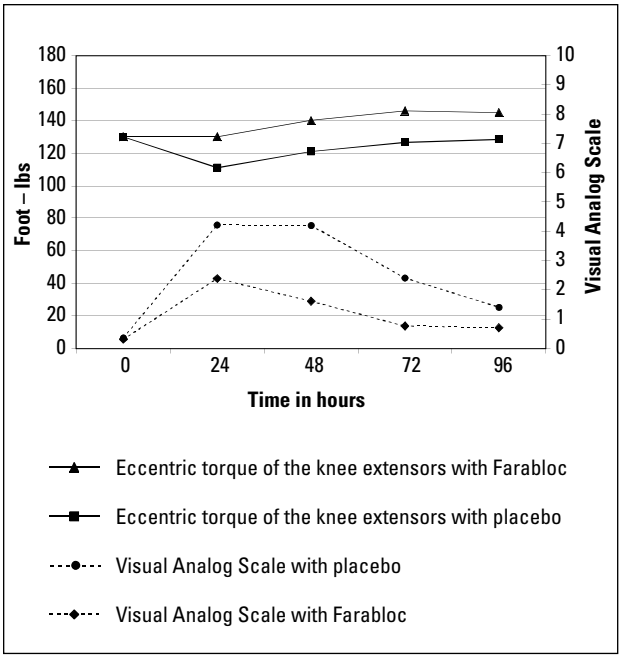

Figure 2. Comparison of Farabloc to placebo with eccentric torque of the knee and the visual analog scale. Used with permission from *Clin J Sport Med* 2000;10(1):15-21.

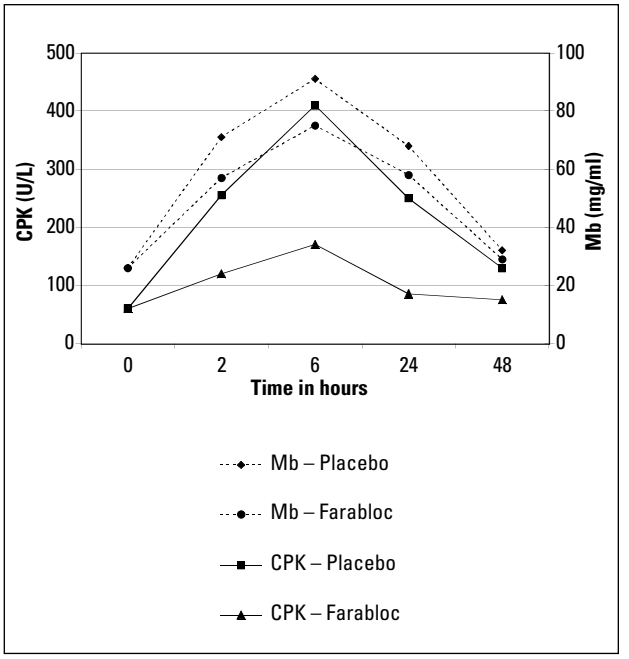

Figure 4. Comparison of levels of creatine phosphokinase (CPK) and myoglobin (Mb) in participants treated with Farabloc and placebo. Used with permission from *Clin J Sport Med* 2000;10(1):15-21.

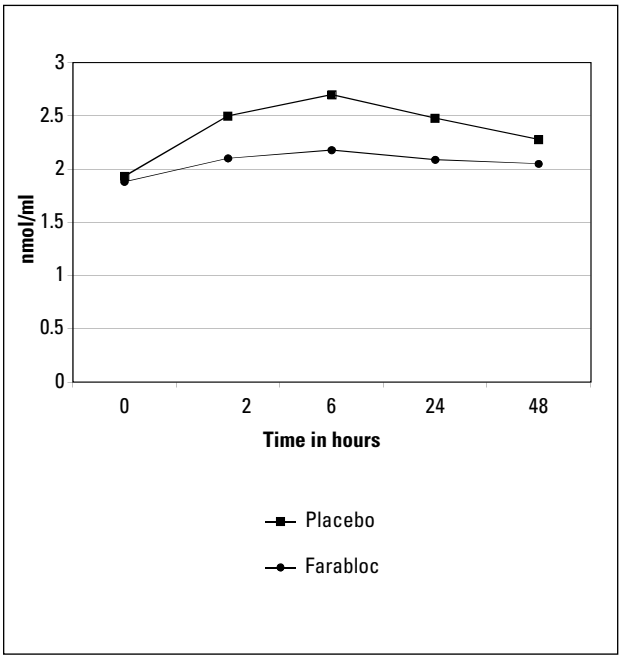

Figure 3. Comparison of levels of malondialdehyde in participants treated with Farabloc and placebo. Used with permission from *Clin J Sport Med* 2000;10(1):15-21.

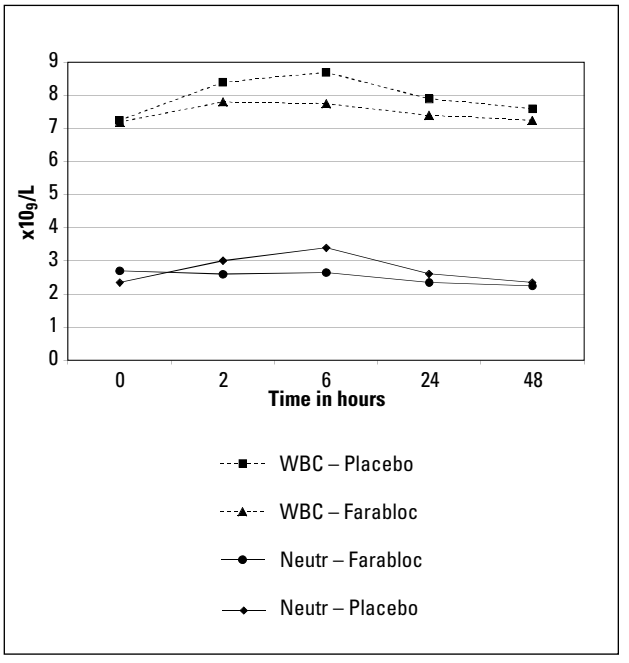

Figure 5. Comparison of levels of leukocytes (WBC) and neutrophils (Neutr) in participants treated with Farabloc and placebo. Used with permission from *Clin J Sport Med* 2000;10(1):15-21.

post-exercise disability. These results are consistent with the finding in the study of phantom limb pain. Pain reduction of approximately 3 points on the VAS scale was surprisingly similar in both studies. Lower pain and higher peak torque with the use of Farabloc compared to placebo suggests that muscle damage is limited in some manner but does not identify a mechanism by which the effect occurs. The reduced malondialdehyde response with the use of Farabloc is consistent with reducing free radical damage and reduced lipid peroxidation. Reductions of creatine phosphokinase and myoglobin are consistent with the possibility that Farabloc stabilizes the muscle cell membrane and reduces the escape of these substances into the serum. All muscular activity will create some increase in creatine phosphokinase levels. The more severe and uncommon the muscular activity, the higher the level of muscle cell disruption and the subsequent serum levels of creatine phosphokinase. Pain or stiffness in the muscle group is more likely to occur when the level of exercise is unaccustomedly high.

Conclusion

Farabloc, an electromagnetic shielding fabric, reduces pain in human subjects who suffer from phantom limb pain or delayed onset muscle soreness when assessed in placebo-controlled cross-over designed studies. The mechanism behind these observations is not known. Other authors have speculated that alteration in EMF may have biological effects secondary to stabilization of the cell membrane and enhancement of antioxidant properties. This could explain the reduced levels of anti-inflammatory markers in the delayed onset muscle soreness study. Alteration of EMF by shielding from high-frequency exposure could alter the permeability of the cell membrane, and the subsequent reduced transfer of ions may stabilize the cell's response to excess exercise. Neither study reported any negative observations or side effects.

Clearly these results require much greater study as the potential application of an external fabric that has protective and anti-inflammatory properties may have broad clinical application in a wide variety of conditions.

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