Authors:

Ta-Shen Kuan, MD, MS
Yueh-Ling Hsieh, PhD, RPT
Shu-Min Chen, MD
Jo-Tong Chen, MD, PhD
Wei-Chang Yen, MD
Chang-Zern Hong, MD

Affiliations:

From the Department of Physical Medicine and Rehabilitation, College of Medicine, National Cheng Kung University, Tainan, Taiwan (T-SK, S-MC, J-TC, W-CY, C-ZH); Department of Physical Therapy, Hungkuang University, Sha-Lu, Taichung, Taiwan (Y-LH, C-ZH); and Department of Rehabilitation Medicine, Han-Ming Hospital, Chang-Hua, Taiwan (C-ZH).

Correspondence:

All correspondence and requests for reprints should be addressed to Chang-Zern Hong, MD, Department of Physical Therapy, Hungkuang University, 34 Chung-Chie Road, Sha-Lu, Taichung 433, Taiwan.

Disclosures:

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the authors or upon any organization with which the authors are associated.

0894-9115/07/8603-0183/0
American Journal of Physical Medicine & Rehabilitation

DOI: 10.1097/PHM.0b013e3180320ea7

RESEARCH ARTICLE

The Myofascial Trigger Point Region

Correlation Between the Degree of Irritability and the Prevalence of Endplate Noise

ABSTRACT

Kuan T-S, Hsieh Y-L, Chen S-M, Chen J-T, Yen W-C, Hong C-Z: The myofascial trigger point region: correlation between the degree of irritability and the prevalence of endplate noise. Am J Phys Med Rehabil 2007;86:183–189.

Objective: This study was designed to investigate the correlation between the irritability of the myofascial trigger point (MTrP) and the prevalence of endplate noise (EPN) in the MTrP region of human skeletal muscle.

Design: Twenty normal subjects with latent MTrPs and 12 patients with active MTrPs in the upper trapezius muscles were recruited for this study. The patients reported the subjective pain intensity of the active MTrP (0–10). The MTrP and an adjacent non-MTrP site were confirmed and marked for the measurement of pressure pain threshold (with a pressure algometer) and the prevalence of EPN (with electromyographic recordings).

Results: The prevalence of EPN in the MTrP regions was significantly higher ($P < 0.01$) in the active MTrPs than in the latent ones. However, no EPN could be found in the non-MTrP region near either the active or the latent MTrPs. The pain intensity and the pressure pain threshold were highly correlated with the prevalence of EPN in the MTrP region ($r = 0.742$ and -0.716, respectively).

Conclusions: The irritability of an MTrP is highly correlated with the prevalence of EPN in the MTrP region of the upper trapezius muscle. The assessment of EPN prevalence in an MTrP region may be applied to evaluate the irritability of that MTrP.

Key Words: Electromyography, Endplate Noise, Muscle, Trigger Point, Pain

Myofascial trigger point (MTrP) presence is characteristic of myofascial pain syndrome.[1] An MTrP has been defined as a highly localized painful or sensitive spot in a palpable taut band of skeletal muscle fibers.[1] An active MTrP is an irritable spot with spontaneous pain or pain in response to movement, and a latent MTrP is a tender spot with pain or discomfort in response to compression only.[1] Two important characteristics of MTrP are referred pain and a local twitch response (LTR). LTRs can be elicited by snapping palpation on the MTrP in some muscles, or by needling in almost all cases.[1,2] More LTRs can be elicited by needling of a highly irritable MTrP than a less painful one.[3]

The mechanism of LTR has been extensively studied on the animal model developed by Hong and Torigoe.[4] The most tender spot in the hamstring muscle of rabbit could be identified by observing the animal's behavior. This hyperirritable spot was marked and the animal was anesthetized. It was found that many LTRs (similar to those observed in humans) could be elicited by needling of this hyperirritable spot, but this was possible in very few or none in the control sites. It was also found that LTRs could not be elicited after the transection of the innervation nerve (sciatic nerve). LTRs could also not be elicited in the hamstring muscle immediately after transection of the upper thoracic spinal cord, but they recovered almost to the original level after the spinal shock period (about 2.5 hrs later).[5] It has been concluded that LTR is elicited via the spinal reflex by stimulating the sensitive site in the MTrP region. Hong and Simons[2] have hypothesized that there are multiple sensitive loci in the MTrP region. Mechanical stimulation of this tiny locus can elicit pain, referred pain, and LTR (with high-pressure stimulation, such as needling).[2,6] This tiny sensitive site has been defined as a sensitive locus,[6] or an LTR locus.[2]

In 1993, Hubbard and Berkoff[7] recorded spontaneous electrical activity in the MTrP region of the upper trapezius muscle. Similar electrical activity could also be recorded from the rabbit skeletal muscles.[8] Hubbard and Berkoff[7] described this activity as the action potential generated from the intrinsic muscle fibers when a muscle spindle is mechanically irritated.[7] However, this low-amplitude electrical activity is similar to the endplate noise (EPN) rather than action potentials. After reviewing old literature, Simons[9] concluded that EPN is a consequence of excessive acetylcholine leakage, which may cause focal contracture in the endplate zone to form the contracture nodule or taut band.[1,9–11] In recent studies, Simons et al. have demonstrated that there is a much higher prevalence of EPN in the MTrP region compared with the non-MTrP site in either animals[8] or human subjects.[12] The tiny site from which EPN can be recorded in the MTrP region has been defined as active locus[2] or EPN locus.[13]

It has been suggested that the amount of sensitive loci (LTR loci) in an MTrP region is proportionate to the degree of irritability of the MTrP.[3,14] However, it is unclear whether the amount of active loci (EPN loci) is also related to the degree of irritability of MTrP. This study is designed to investigate the correlation between the prevalence of EPN loci and the degree of irritability (pain intensity, pain threshold) in the MTrP region.

MATERIALS AND METHODS

General Design

Normal subjects with latent MTrPs and patients with active MTrPs in one side of the upper trapezius muscles were included in this study. Patients were initially requested to report the subjective pain intensity of the active MTrP according to a numeric rating scale (0–10). For each subject (either normal subject or patient), pressure pain threshold was measured at both MTrP and non-MTrP sites. Then, the prevalence of EPN was assessed with needle electromyographic (EMG) recordings in both the MTrP region and non-MTrP region of the upper trapezius muscle for each subject.

Subjects

Twenty normal subjects (age 43.5 ± 11.1) with latent MTrPs and 12 patients (age 43.7 ± 11.9) with active MTrPs in the upper trapezius muscle were recruited for this study. Subjects in both groups were matched for age and sex. They all signed the informed consents as approved by the human subject research committee of the National Cheng Kung University, Tainan, Taiwan. The general criteria for selection of subjects included (1) no acute or serious medical problems, (2) no neurologic disorders other than muscle pain, (3) no coagulopathy or any other bleeding disorder, (4) no serum hepatitis B or acquired immunodeficiency syndrome, (5) no pain therapy (pain medications, physical therapy, etc.) for at least 2 wks, and (6) no cognitive impairment or psychiatric disorder.

Identification of MTrPs and Non-MTrPs

Normal Subjects with Latent MTrPs

Normal subjects who had latent MTrPs in the upper trapezius muscles in either side or both sides were recruited. If MTrPs existed in both sides of upper trapezius muscles, only one side was randomly selected for the study. The latent MTrP was identified on the basis of the following criteria: (1) a localized tender spot (without spontaneous pain) in a palpable taut band of muscle fibers, and (2) characteristic and consistent referred pain when it

was compressed firmly. As soon as this latent MTrP was confirmed, it was marked by an investigator who did not perform the assessment of pain threshold or EPN prevalence.

Patients with Active MTrPs

Patients who had active MTrPs in the upper trapezius muscles in either side or both sides were recruited. If MTrPs existed in both sides of upper trapezius muscles, only one side was randomly selected for this study. The active MTrP was identified on the basis of the following criteria, as recommended by Simons[9]: (1) a localized tender spot in a palpable taut band of muscle fibers, (2) recognized pain (as the usual clinical complaint) when the tender spot was compressed, and (3) characteristic and consistent referred pain. Similarly, this active MTrP was marked by the same investigator who marked the latent MTrP.

Localization of Non-MTrPs

After identification of the MTrP site in each subject, a control site (non-MTrP site) some distance away from the MTrP site was also marked by the same investigator who marked the MTrP site.

Subjective Pain Intensity (Numeric Rating Scale)

Initially, the patient was requested to report pain intensity of the selected MTrP on the basis of the numeric rating scale. The patient was informed of the numeric rating scale from 0 to 10. Zero represents no pain at rest or during movement, and 10 represents the worst pain ever experienced in one's life. The other numbers represent different degrees of pain level. In general, pain intensity below 5 is considered a tolerable level.

Pressure Pain Threshold Measurement

Measurement of pressure pain threshold on the MTrP and non-MTrP sites was performed before the EMG recordings. A pressure algometer was used for this measurement.[15] A study by Ohrbach and Gale[16] found that pain threshold measurement with this algometer was reliable and had no significant differences among multiple trials in painful muscles. Initially, the algometer was placed on the marked MTrP site, perpendicular to the surface of the skin. The pressure of compression was increased gradually at a rate of movement approximately 1–2 mm/sec until the subject began to feel any pain or discomfort (for latent MTrPs) or until the patient began to feel an increase of pain or discomfort (for active MTrPs). At that point, the subject informed the examiner by saying "yes." The compression stopped as soon as the subject said "yes." The subject was asked to remember this level of pain discomfort and to apply the same criterion for the consecutive measurements. The reading of pressure (kg/cm^2) at that point was considered the pressure pain threshold level. The subject might demonstrate pain by pulling away or grimacing, which would indicate that the pain threshold had been exceeded.[15] If this was the case, the subject would be given instructions again, and a repeat measurement would be taken to ensure that the "real" threshold was obtained. Three repetitive measurements at an interval of 30–60 secs were performed at each site. The average values of the three readings were used for data analysis. The same routine was also performed at the control site (non-MTrP site). Two investigators who participated in measuring the threshold were trained extensively to minimize the intratester and intertester variability. They were blinded as to whether subjects had latent or active MTrPs.

Electrophysiological Recordings

Equipment

A four-channel Nicolet EMG machine was used to record the electrical activity from MTrPs by using disposable monopolar Teflon-coated EMG needle electrodes.

Settings

As shown in Figure 1, the first channel recorded the electrical activity from the active electrode (experimental needle electrode) in the MTrP region. The reference needle electrode was placed in a site approximately 3–4 cm from MTrP. The second channel recorded the electrical activity from the control site. For the control recordings, the active recording electrode was placed in a non-MTrP region outside the endplate zone. The reference electrode was connected to the reference electrode of the first channel through a bridge connector (to form a common reference electrode). A ground electrode was placed on the skin near the recording sites. For both channels, the sensitivity of recording was set at 20 mV per vertical division, and the time-sweep speed was set at 10 msecs per horizontal division. The high-frequency filter was set at 10 kHz, and the low-frequency filter was set at 20 Hz.

Procedure

Regarding the assessment of EPN, the prevalence of EPN in 24 sites of three needle-insertion tracks in the MTrP region was measured as described in the previous reports (Fig. 2).[8,12] In this way, only one penetration into the skin was required. We did not measure the amplitude and duration of the EPN because the amplitude and duration varied during needle movement either because of changes in electrode distance or direct

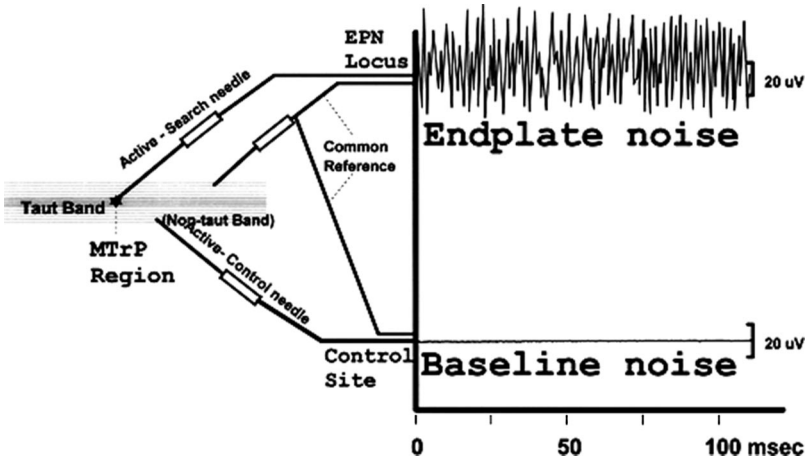

FIGURE 1 *Schematic arrangement of electrodes and typical examples of recordings.*

mechanical injuries to the muscle fibers. In the experimental study of one MTrP site, the exploring electrode (active recording needle electrode) was inserted progressively into the MTrP region. The needle was advanced gently and slowly through the least possible distance (usually 1–2 mm) by simultaneously rotating the needle to facilitate smooth entry through the tissue. After eight thrusts (advancements of the needle in one track), the needle was pulled out to the original insertion depth and reinserted in a slightly different direction (a near track). This procedure was repeated again to explore a total of 24 thrusts (eight thrusts per insertion; three insertions). All occurrences of EPN were recorded. As soon as an EPN appeared, the needle remained there without further movement. Sample EMG recordings (Fig. 1) were taken until the amplitude of the EPN activity became indistinguishable from that recorded from the control needle. The time required for the disappearance of EPN was less than 10 mins, usually 2–3 mins. Advancement of the needle continued after disappearance of the EPN. The subject reported the pain intensity and feeling when an EPN was recorded. The routine used at the control site (non-MTrP site) was the same as that used at the MTrP site with regard to insertion procedure. The investigator who performed this procedure was blinded as to whether subjects had latent or active MTrPs.

Data Analysis

Comparison Between Latent and Active MTrPs

The data of pressure pain threshold and prevalence of EPN in both MTrP and non-MTrP region were analyzed for the differences between normal subjects with latent MTrPs and patients with active MTrPs according to a *t* test (pain threshold data) or a Fisher test (EPN data). A *P* value less than 0.01 was considered statistically significant.

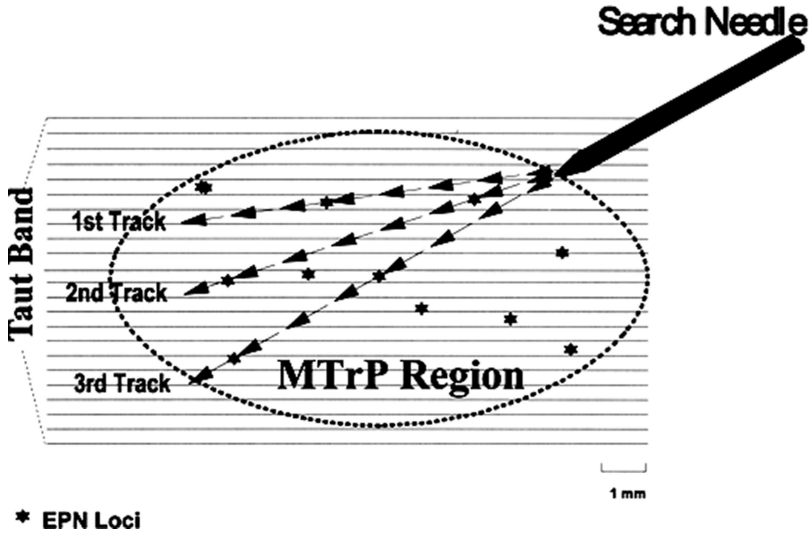

FIGURE 2 *Schematic of insertion procedure during the assessment of EPN prevalence.*

Comparison Between MTrP and Non-MTrP Sites

The data of pressure pain threshold and prevalence of EPN in both normal subjects and patients were analyzed for the differences between MTrP region and non-MTrP region according to a paired *t* test (pain threshold data) or a Fisher test (EPN data). A *P* value less than 0.01 was considered statistically significant.

Correlation Between the Prevalence of EPN and the Irritability (Pain Intensity or Pressure Pain Threshold) in the MTrP Region

The data of the pain intensity and the average values of three readings for each threshold measurement in all subjects (both normal subjects and patients) were analyzed for their correlation with the prevalence of EPNs. Pearson linear regression analysis was used to analyze statistical significance.

RESULTS

Latent MTrP (Normal Subjects) *vs.* Active MTrP (Patients)

As shown in Table 1, age and sex were fairly matched for patients and normal subjects. All patients had pain in the MTrP regions, but none had pain in the non-MTrP regions (with a mean pain intensity of 0.0 ± 0.0). Every patient reported pain localized in the shoulder without referral. The mean pressure pain threshold, either at the MTrP site (1.9 ± 0.3 kg/cm^2) or at the non-MTrP site (4.1 ± 0.6 kg/cm^2), was significantly lower ($P <$ 0.01) in the patients with active MTrPs compared with the normal subjects with latent MTrPs (3.7 ± 0.7 and 5.9 ± 1.0 kg/cm^2, respectively). The prevalence of EPN in the MTrP regions was also significantly higher ($P <$ 0.01) in the active MTrPs (7.2 ± 4.2 per 24 sites) than in the latent MTrPs (2.8 ± 1.4 per 24 sites).

MTrP *vs.* Non-MTrP

As expected, the mean pressure pain threshold at the MTrP site (3.7 ± 0.7 or 1.9 ± 0.3 kg/cm^2) was significantly lower ($P <$ 0.01) than at the non-MTrP site (5.9 ± 1.0 or 4.1 ± 0.6 kg/cm^2) for either latent or active MTrPs. However, no EPN could be recorded in the non-MTrP region for either latent or active MTrPs (Table 1).

Prevalence of EPN and Subjective Pain Intensity of MTrP

The high correlation ($r = 0.742$) between the prevalence of EPN and the pain intensity in the MTrP region for all subjects is demonstrated in Figure 3. This was also true when the normal subjects were excluded from the population for analysis.

Prevalence of EPN and Pressure Pain Threshold of MTrP

For all subjects, the prevalence of EPN was highly inversely correlated ($r = -0.716$) with the pressure pain threshold (Fig. 4). Similar to a previous study,[14] the pain intensity and the pressure pain threshold are also strongly inversely correlated.

TABLE 1 Pain intensity, pressure pain threshold, and prevalence of endplate noise (EPN) in the myofascial trigger point (MTrP) region and non-MTrP region

	All Subjects	Patients with Active MTrPs	Normal Subject with Latent MTrPs	Difference, Normal *vs.* Patient *P*
No. of subjects	32	12	20	
Male	14	5	9	
Female	18	7	11	
Age	43.5 ± 11.2	43.7 ± 11.9	43.5 ± 11.1	
Pain intensity (0–10)				
MTrP site	2.3 ± 3.1	6.2 ± 1.3	0.0 ± 0.0	<0.01
Non-MTrP site	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
Pressure pain threshold, kg/cm^2				
MTrP site	3.0 ± 1.0	1.9 ± 0.3	3.7 ± 0.7	<0.01
Non-MTrP site	5.3 ± 1.2	4.1 ± 0.6	5.9 ± 1.0	<0.01
Difference	$P <$ 0.01	$P <$ 0.01	$P <$ 0.01	
Prevalence of EPN, no./24 sites				
MTrP site	4.6 ± 3.6	7.2 ± 4.2	2.8 ± 1.4	<0.01
Non-MTrP site	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
Difference	$P <$ 0.01	$P <$ 0.01	$P <$ 0.01	

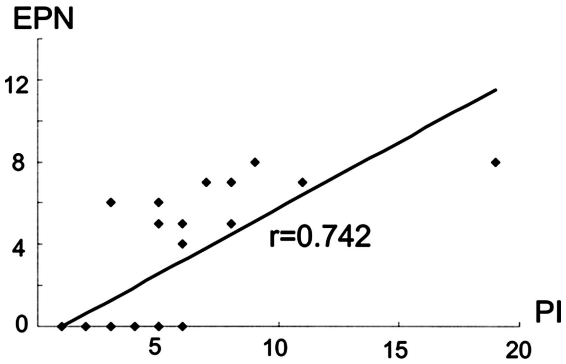

FIGURE 3 *The correlation between the prevalence of endplate noise (EPN) and subjective pain intensity (PI) of myofascial trigger points (MTrPs).*

DISCUSSION

The pathophysiology of the MTrP has become better understood as a result of recent studies on both human and animal subjects.[2–5,7,8,12,14,17–24] Hong has hypothesized that there are multiple basic units in an MTrP region.[2,6,25] He has speculated that each MTrP unit contains a sensitive locus (a minute site from which a LTR can be elicited when this site is mechanically stimulated) and an active locus (a minute site from which spontaneous electrical activity can be recorded).[2] The sensitive locus is probably nociceptors (sensory component),[2,20] and the active locus is possibly dysfunctional endplates (motor component).[2,8,9,12] Spontaneous electrical activity (EPN) recorded from an active locus of MTrP has been theorized to be abnormal endplate potentials attributable to excessive release of acetylcholine,[2,8,9,12] with the excessive acetylcholine release responsible for the formation of taut bands, which contain MTrPs.[2,8,9] In an electron microscopic study,[11] remarkable shortening of the sarcomeres in a contraction nodule (probably in or near the endplate zone) with lengthening of the sarcomeres outside the nodule was observed in some fibers (taut fibers). The total length of these muscle fibers was unchanged, but the tension of the muscle fibers was increased (taut band).

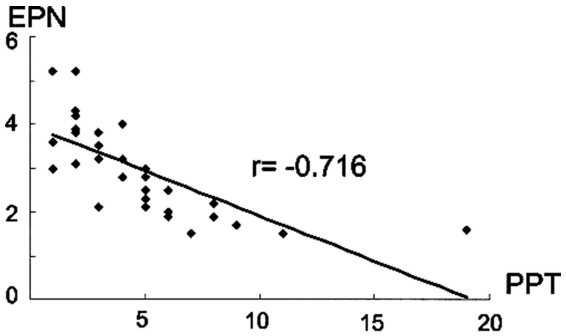

FIGURE 4 *The correlation between the prevalence of endplate noise (EPN) and pressure pain threshold (PPT) of myofascial trigger points (MTrPs).*

In previous studies, it has been suggested that the irritability of an MTrP is closed related to the LTR loci in the MTrP region.[3–6] The pressure pain threshold can be used for the assessment of MTrP irritability.[14–16] In this study, we have demonstrated the high correlation between the irritability (measured with pain intensity and pressure pain threshold) and the prevalence of EPN loci in an MTrP region of upper trapezius muscle. It is our experience during EMG examination that when the EMG needle approaches a painful locus, EPN frequently can be recorded from this site. Therefore, an EPN locus may be in the immediate vicinity of an LTR locus. However, it is unclear whether every EPN locus in the MTrP region is closely connected with an LTR locus. Because the irritability of MTrP is related to the prevalence of both LTR loci and EPN loci, it is very likely that the vast majority of EPN loci are connected with LTR loci. Stated differently, in most endplates in the MTrP region, there are nociceptors (free nerve endings, as observed in animal study[20]) in the nearby region. It has also been demonstrated that free nerve endings were frequently found near the sites from which EPN could be recorded.[21] However, this does not indicate any neural connection between an EPN locus and an LTR locus.

It has been suggested that MTrP formation is related to a central mechanism on the basis of the studies on referred pain[24] and LTRs.[5,19] However, the mechanism of the connection between EPN loci and LTR loci is unknown. The correlation between them is possibly attributable to a peripheral interaction rather than a central sensory connection. It is possible that the persistent contracture of taut band may cause hypoxia and ischemia in the local region (within the endplate zone), which subsequently cause the release of inflammatory substance to sensitize the nociceptors (LTR loci).[1] This is the peripheral sensitization of an MTrP. Gunn[26] also suggested that local contraction of the muscle fibers (local depolarization without action potentials) may cause hypersensitivity of nociceptors. Therefore, the sensitivity of the nociceptors (irritability of MTrP) seems closely related to the prevalence of EPN, which could be related to the degree of local depolarization.

In conclusion, the irritability of an MTrP in the upper trapezius muscle is closely related to the prevalence of EPN in this MTrP region. In future research, assessment of EPN prevalence may be used for the estimation of MTrP irritability.

REFERENCES

1. Simons DG, Travell JG, Simons LS: *Travell & Simons's Myofascial Pain and Dysfunction: The Trigger Point Manual*. Vol. 1, ed 2. Baltimore, Williams & Wilkins, 1999
2. Hong C-Z, Simons DG: Pathophysiologic and electrophysiologic mechanism of myofascial trigger points. *Arch Phys Med Rehabil* 1998;79:863–72
3. Hong C-Z, Kuan T-S, Chen J-T, et al: Referred pain elicited by palpation and by needling of myofascial trigger points: a comparison. *Arch Phys Med Rehabil* 1997;78:957–60
4. Hong C-Z, Torigoe Y: Electrophysiologic characteristics of localized twitch responses in responsive bands of rabbit skeletal muscle fibers. *J Musculoskelet Pain* 1994;2:17–43
5. Hong C-Z, Torigoe Y, Yu J: The localized twitch responses in responsive bands of rabbit skeletal muscle fibers are related to the reflexes at spinal cord level. *J Musculoskelet Pain* 1995;3:15–33
6. Hong C-Z: Lidocaine injection versus dry needling to myofascial trigger point: the importance of the local twitch response. *Am J Phys Med Rehabil* 1994;73:256–63
7. Hubbard DR, Berkoff GM. Myofascial trigger points show spontaneous needle EMG activity. *Spine* 1993;18:1803–7
8. Simons DG, Hong C-Z, Simons LS: Prevalence of spontaneous electrical activity at trigger spots and at control sites in rabbit skeletal muscle. *J Musculoskelet Pain* 1995;3: 35–48
9. Simons DG: Clinical and etiological update of myofascial pain from trigger points. *J Musculoskelet Pain* 1996;4:93–121
10. Simons DG: Diagnostic criteria of myofascial pain caused by trigger points. *J Musculoskelet Pain* 1999;7:111–20
11. Simons DG, Stolov WC: Microscopic features and transient contraction of palpable bands in canine muscle. *Am J Phys Med* 1976;55:65–88
12. Simons DG, Hong C-Z, Simons LS: Endplate potentials are common to midfiber myofascial trigger points. *Am J Phys Med Rehabil* 2002;81:212–22
13. Hong C-Z: New trends in myofascial pain syndrome (invited review). *Zhonghua Yi Xue Za Zhi (Taipei)* 2002;65:501–12
14. Hong C-Z, Chen Y-N, Twehous D, et al: Pressure threshold for referred pain by compression on the trigger point and adjacent areas. *J Musculoskelet Pain* 1996;4:61–79
15. Fischer AA: Pressure threshold meter: its use for quantification of tender spots. *Arch Phys Med Rehabil* 1986;67: 836–8
16. Ohrbach R, Gale EN: Pressure pain thresholds, clinical assessment, and differential diagnosis: reliability and validity in patients with myogenic pain. *Pain* 1989;39:157–69
17. Chen J-T, Chen S-M, Kuan T-S, et al: Phentolamine effect on the spontaneous electrical activity of active loci in a myofascial trigger spot of rabbit skeletal muscle. *Arch Phys Med Rehabil* 1998;79:790–4
18. Gerwin RD, Shannon S, Hong C-Z, et al: Identification of myofascial trigger points: interrater agreement and effect of training. *Pain* 1997;69:65–73
19. Hong C-Z, Yu J: Spontaneous electrical activity of rabbit trigger spot after transection of spinal cord and peripheral nerve. *J Musculoskelet Pain* 1998;6:45–58
20. Hong C-Z, Chen J-T, Chen S-M, et al: Histological findings of responsive loci in a myofascial trigger spot of rabbit skeletal muscle from where localized twitch responses could be elicited. *Arch Phys Med Rehabil* 1996;77:962
21. Hong C-Z, Chen J-T, Chen S-M, et al: Sensitive loci in a myofascial trigger point region are related to sensory nerve fibers. *Am J Phys Med Rehabil* 1997;76:172
22. Kuan T-S, Lin T-S, Chen J-T, et al: No increased neuromuscular jitter at rabbit skeletal muscle trigger spot spontaneous electrical activity sites. *J Musculoskelet Pain* 2000; 8:69–82
23. Kuan T-S, Chen J-T, Chen S-M, et al: Effect of botulinum toxin on endplate noise in myofascial trigger spots of rabbit skeletal muscle. *Am J Phys Med Rehabil* 2002;81:512–20
24. Mense S,: Considerations concerning the neurobiological basis of muscle pain. *Canadian J Physiol Pharmacol* 1991; 69:610–6
25. Hong C-Z: Pathophysiology of myofascial trigger point. *J Formos Med Assoc* 1996;95:93–104
26. Gunn CC: Radiculopathic pain: diagnosis and treatment of segmental irritation or sensitization. *J Musculoskelet Pain* 1997;5:119–34