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Multi-MUP Analysis of Palatal Muscles in Healthy Men

Sağlıklı Erkeklerde Palatal Kasların Multi-MÜP Analizi

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Summary

Introduction: The palatal muscles play an important role in the patency of upper airway together with other pharyngeal muscles. Studying their function will be helpful for delineating the pathophysiology of disorders affecting the upper airway patency like obstructive sleep apne syndrome.

Materials and Methods: Eight healthy volunteer men were involved in this study. Anthropological data and electromyographic (EMG) studies including the rise time, amplitude, duration, area, thickness, number of phases and turns of motor unit potentials (MUPs) were evaluated.

Results: The mean age was 40.25±9.11 years, the mean body mass index (BMI) was 23.64±2.51 kg/m^2, and the mean neck circumference was 36.75±2.49 cms. The rise time and duration of MUPs were shorter; the amplitude, area and thickness of MUPs were smaller in uvular muscle with a higher number of phases and turns in compared to palatoglossus and palatopharyngeus muscles, though not significant. The older age was not correlated with any EMG variables. Both the BMI (rs=0.77, p<0.05) and the neck circumference (rs=0.76, p<0.05) were positively correlated with the number of phases of uvular muscle.

Discussion: This study presents the quantitative multi-MUP analysis of palatal muscles; palatoglossus, palatopharyngeus, and uvular muscles in healthy men. The quantitative multi-MUP analysis might increase the sensitivity and specificity of palatal electromyography. (*JTSM 2014;2:43-5)*

Key Words: Multi-MUP analysis, palatal muscles, palatoglossus, palatopharyngeus, uvula

Özet

Giriş: Palatal kaslar, diğer farenjeal kaslar ile birlikte üst hava yolunun açıklığının korunmasında önemli rol aynar. Bu kasların fonksiyonlarının tam olarak ortaya konulması, Obstrüktif uyku apne sendromu gibi üst hava yolu açıklığını etkileyen hastalıkların patofizyolojisinin açıklanmasına yardımcı olacaktır.

Gereç ve Yöntem: Çalışmamızda sekiz sağlıklı erkek birey incelendi. Antropolojik ve elektromiyografik (EMG) verileri elde edildi. EMG verileri arasında, çok sayıdaki motor ünite potansiyellerinin (multi-MÜP) çıkış zamanı (rise time), amplitüt, süre, alan, kalınlık, faz ve dönüş (turn) değerledirildi.

Bulgular: Ortalama yaş 40,25±9,11 yıl, ortalama vücut kitle indeksi (VKİ) 23,64±2,51 kg/m^2 ve ortalama boyun çevresi 36,75±2,49 cm olarak hesaplandı. Palatoglosal ve palatofarenjeal kaslara kıyasla, uvuladan elde edilen multi-MÜP'lerin çıkış zamanı ve süresi daha kısa, amplitüt, alan ve kalınlıkları daha küçük olarak elde edildi; faz ve dönüş sayısı da uvulada daha yüksek idi. Buna karşın, bu farklılıklar istatistiksel olarak anlamlı bulunmadı. EMG verileri ile yaş arasında anlamlı korelasyon izlenmedi. Ancak, hem VKİ (rs=0,77, p<0,05) hem de boyun çevresi (rs=0,76, p<0,05) uvulada artmış faz sayısı ile pozitif korelasyon gösterdi.

Sonuç: Bu çalışmamızda sağlıklı erkek bireylerde palatoglosal, palatofarenjeal ve uvula olmak üzere palatal kasların kantitatif multi-MÜP analizi yapılmıştır. Kantitatif multi-MÜP analizinin palatal EMG'nin hassasiyetini ve özgüllüğünü arttıracağını düşünmekteyiz. (*JTSM 2014;2:43-5)*

Anahtar Kelimeler: Multi-MÜP analizi, palatal kaslar, palatoglosal kas, palatofarenjeal kas, uvula

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Introduction

Although there are many studies evaluating the pharyngeal or laryngeal muscle, palatal electromyography (EMG) has not drawn much attention in the literature. There is one study investigating the influence of sleep on acitivity of palatal muscles in healthy subjects (1), and few studies has examined the EMG activity of palatal muscles in apneic patients (2-4). Because palatal muscles play an important role in the patency of upper airway together with other pharyngeal muscles, studying their function or dysfunction will be helpful for delineating the pathophysiology of disorders such as sleep apnea syndrome. To our knowledge, there is no report of quantitative motor unit potential (MUP) analysis of palatal muscles. Here, we aimed to demonstrate the reference values for palatoglossus (PG), palatopharyngeus (PP) and uvular muscles (U) using multi-MUP analysis.

Materials and Methods

Eight healthy volunteer men were involved in this study. None of them had any neurological disorder, or any other disorder affecting upper airway, or neck surgery. The study was approved by the local ethical committe, and informed consent form was signed by all subjects. Anthropological data including age, weight, length, body mass index (BMI), and neck circumference were recorded.

EMG measurements were taken with the subjects relaxed and in a supine position. The skin temperature was maintained at 32 ˚C. The principal investigator (FKS) explained all procedures to the subjects before testing. A four-channel EMG apparatus was used (Keypoint EMG-equipment, Medtronic), and all instruments were calibrated before data collection. We used a concentric needle electrode with a length of 30 mm, diameter of 0.30 mm, and a recording area of 0.0021 mm^2. Filter setting was 10 kHz high cut, and 5 Hz low cut. Sweep speed was set as 5 ms/div, and the gain was 100 µV/div.

Before the EMG-recordings, a topical lidocaine spray (40 mg) was applied to oropharynx and the needle electrodes were inserted perorally 5 mm deep into the palatoglossus muscles located beneath the anterior arch of pharyngeal fauces, into palatopharyngeus muscle located beneath the posterior arch of pharyngeal fauces, and uvular muscle (Figure 1). This procedure was performed by two investigators (FKS and AK). We waited for 20 minutes to allow the effects of lidocaine to wear off, by which time all subjects reported that the sensation was normalized. We then obtained the optimal EMG recording from these muscles. We collected 30 MUPs, and selected 20 MUPs with good quality for final analysis. We examined the rise time, amplitude, duration, area, thickness (area divided by amplitude), number of phases and turns of MUPs.

In statistical analysis, the EMG variables obtained from PG, PP and uvular muscles were compared by using Friedman test. Spearman's correlation coefficients were used to measure correlations between EMG and clinical data. Continous variables were given as mean±standard deviation or percentiles. The threshold level for statistical significance was established at a p value equal to or less than 0.05.

Results

A total of 8 healthy men with a mean age of 40.25±9.11years (ranging between 27 and 50 years) were involved in the study. The mean BMI was 23.64±2.51 kg/m^2 (ranging between 18.2 and 26.7) and the mean neck circumference was 36.75±2.49 cm (ranging from 32 to 40 cm).

The multi-MUP analysis of three palatal muscles is given in Table 1. None of the MUP characteristics showed any statistical difference between three muscles. The rise time and duration of MUPs were notably shorter; the amplitude, area and thickness of MUPs were smaller in uvular muscle with a higher number of phases and turns in compared to palatoglossus and palatopharyngeus muscle. On the other hand, this difference did not reach statistical significance.

Correlation analysis of electromyographic findings with anthropological data showed that older age was correlated with higher BMI (r_s=0.87, $p<0.01$), but not correlated with neck circumference, or any electromyographic data in three palatal muscles. BMI index was positively correlated with neck circumference (r_s=0.91, $p<0.01$). Furthermore, both BMI and neck circumference were positively correlated with the number of phases of uvular muscle (r_s=0.77, $p<0.05$ and r_s=0.76, $p<0.05$, respectively).

Discussion

This study presents the quantitative multi-MUP analysis of palatal muscles, palatoglossus, palatopharyngeus, and uvular muscles in healthy men. We observed that this is a technically feasible and well-tolerated method. There were no complications during or after the procedure. During recordings, steady activation for capturing multiple motor unit potentials was easily obtained, and needle position did not lead to significant changes in MUP configuration. Although the use of topical analgesics has caused some delay in the procedure, no problems occurred, such as electrode displacement.

Our multi-MUP analysis in healthy men showed that the mean rise time in palatal muscles varied between 0.2 to 1.6 ms; the mean MUP amplitudes ranged between 254-528 µV; the mean MUP durations was 2.05 to 2.48 ms; the mean MUP area was at least 131.57 µV ms in uvular muscle, and at most 399 µV ms in palatoglossus muscle; and the mean MUP thickness varied between 0.53 to 0.77. The mean number of phases or turns was never more than 2.

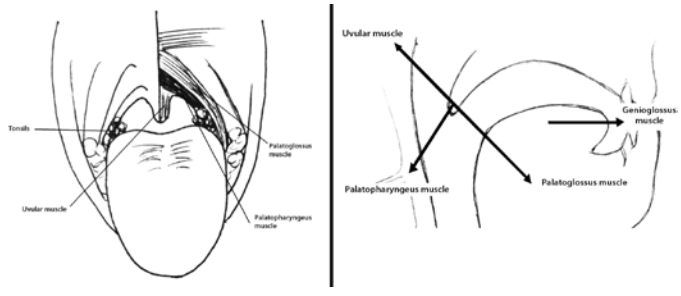

Figure 1. The schematic drawing of palatoglossus, palatopharyngeus, and uvular muscles.

Table 1. The multi-MUP analysis of the palatal muscles

MUP Analysis	Palatoglossus Muscle			Palatopharyngeus Muscle			Uvular Muscle		
	Mean±SD	Median	Min.-Max.	Mean±SD	Median	Min.-Max.	Mean±SD	Median	Min.-Max.
Rise time	0.77±0.40	0.7	0.4 - 1.6	0.77+0.32	0.8	0.2 - 1.2	0.44±0.36	0.3	0.2 - 1.2
Amplitude	528.93±283.11	476.0	164.0 - 907.0	291.56±141.44	258.0	112.0 - 554.5	254.50±96.55	220.0	128.0 - 359.0
Duration	2.48±0.57	2.2	1.8 - 3.5	2.38±0.52	2.5	1.4 - 3.1	2.05±0.32	2.0	1.8 - 2.6
Area	399.0±236.84	366.5	89.0 - 810.0	224.62±162.33	154.5	86.5 - 551.5	131.57±57.33	127.0	50.0 - 226.0
Thickness	0.74±0.25	0.68	0.49 - 1.20	0.77±0.27	0.82	0.34 - 1.08	0.53±0.31	0.41	0.38 - 1.24
Number of phases	1.62±0.44	1.75	1.0 - 2.0	1.25±0.46	1.0	1.0 - 2.0	1.64±0.47	2.0	1.0 - 2.0
Number of turns	1.25±0.75	1.25	0 - 2.0	1.12±0.64	1.0	0 - 2.0	1.57±0.53	2.0	1.0 - 2.0

*p>0.050 for all variables, tested by Friedman test

It was interesting to observe that the age was found to be unrelated to any electromyographic variables. On the other hand, anthropological characteristics including body mass index and neck circumference were positively correlated with the number of phases of uvular muscle, while other features of motor unit potentials were not. This correlation was observed in uvular muscle only, which displayed smaller MUPs with shorter duration, though not significant. This data might be important in examplifying the influences of anthropological features on motor unit potentials of palatal muscles, however; it needs to be searched in larger series.

In addition to visual analysis of spontaneous activity and the interference patterns of palatal muscles, the quantitative multi-MUP analysis might increase the sensitivity and specificity of palatal electromyography. The early signs of axonal involvement or sometimes demyelination may be seen by this method before clinical signs. This safe, well-tolerated and easily applicable method could therefore be useful in investigations of neuromuscular disorders affecting the upper airway patency.

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