MS ve Uyarılmış Potansiyeller

Nefati Kıylıoğlu
Adnan Menderes Üniversitesi
Nöroloji AD
Aydın

Uluslararası Türk Dünyası Multipl Skleroz Kongresi – Ankara 2019

Sunum seyri

Uyarılmış potansiyel nedir, nasıl elde edilir?

Hangi uyarılmış potansiyel çalışmaları kullanılır?

MS'teki yeri ve güncel literatür eşliğinde değişen yeri

Katkı ve sorular

Amaç

Afferent ve efferent fizyolojik yolaklar sağlam mı?

Etkilenmenin doğası – Aksonal ya da demyelinizan mı?

Seri incelemeler ile sürecin seyrinde değişme var mı?

Tedaviye yanıt olup olmadığı

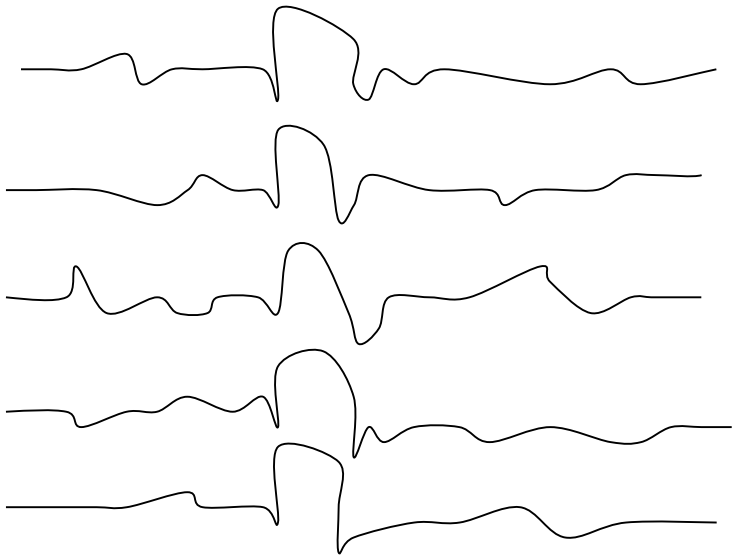
Neyi ölçeriz?

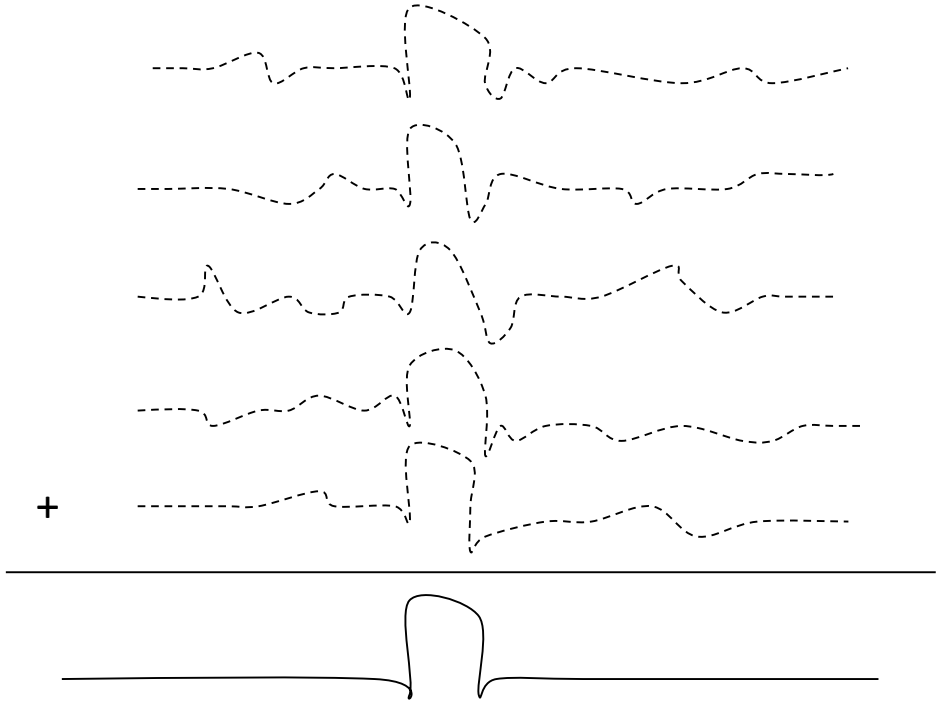
Uyaran ile ortaya çıkan yanıtın özellikleri

Yanıt amplitüdü 0.1-20 µV - EEG amplitüdü 60-100 µV

Nasıl ölçeriz?

Averajlama





Süperpoze etmek

Sinyal /Gürültü = $\sqrt{\text{Tekrar sayısı}}$

$= 5 = 2^5 = 32$

En büyük sorunumuz nedir? = Artefakt

- Elektrod direnci (<5 kΩ) ve toprak bağlantısı
- Deri temizliği (su zımparası, alkol, SF)
- Sağlam kablo
- Statik yüklerin nötralizasyonu
  - (Araştırıcı, yatak, cihazın topraklanması)
  - Elektromanyetik alan karışımının engellenmesi (kafesleme)

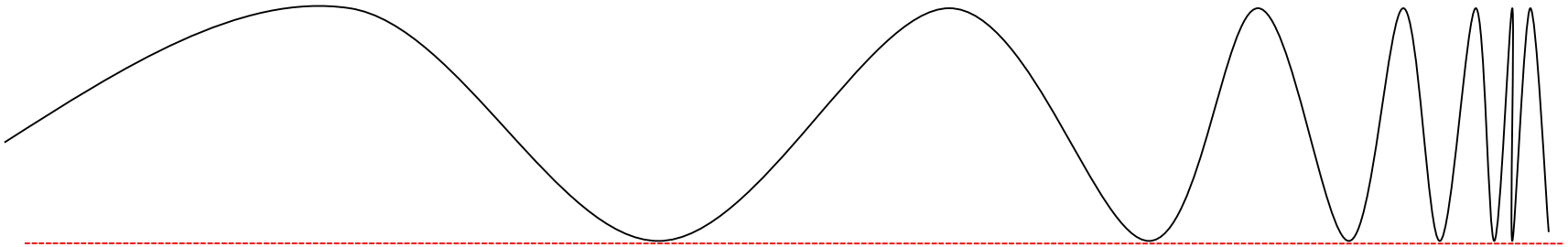
“Ortamı ve cihazı iyi tanımak, malzemeyi titiz kullanmak ve bakımını yapmak”

Nasıl tanımlar ve değerlendiririz?

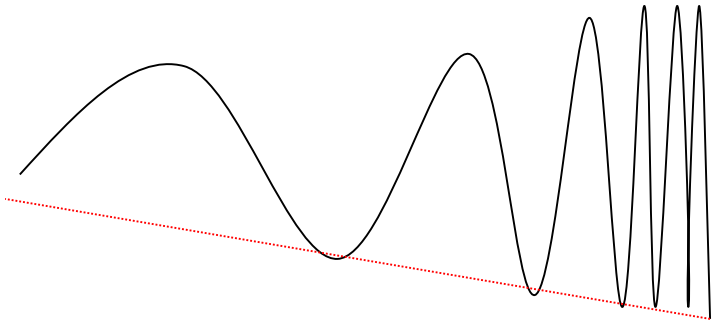
- Zaman ve polarite (pozitif, negatif)
- Varlık ya da yokluk, latansın normal olup olmadığı (başlangıç ya da pikler arası, hemisferik asimetri durumu)
    - (±2.5-3 SD)
- İnceleme koşulları
    - Filtre değerleri, elektrod yerleşim pozisyonları, uyarı türü ve frekansı, kişiler arası yaş-boy-cinsiyet farklılıkları

Tarama zamanı Sensitivite

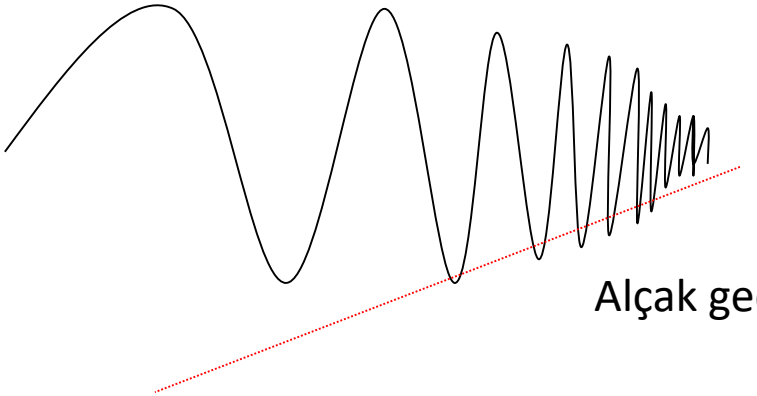
2 Hz – 10 kHz



Filtreler



Yüksek geçiren



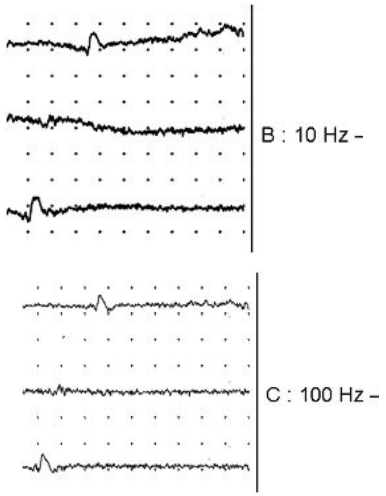
Alçak geçiren

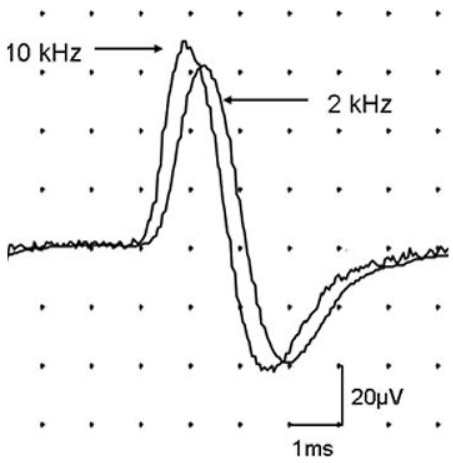
20 kHz

Alçak geçiren

Yüksek geçiren

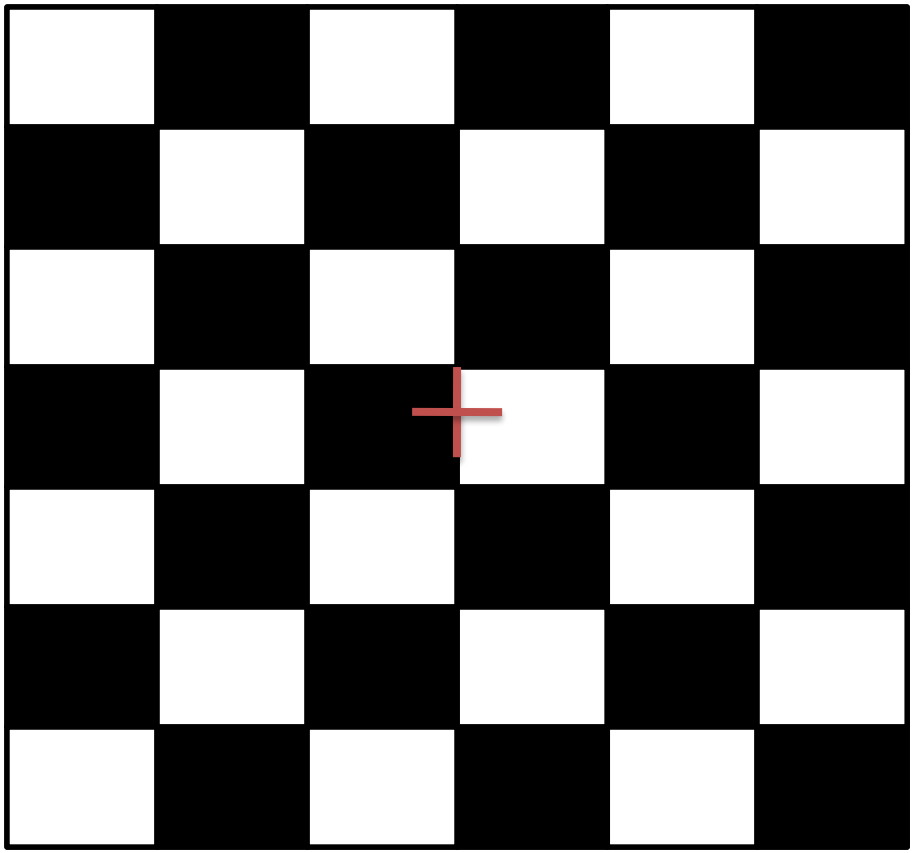
1 Hz





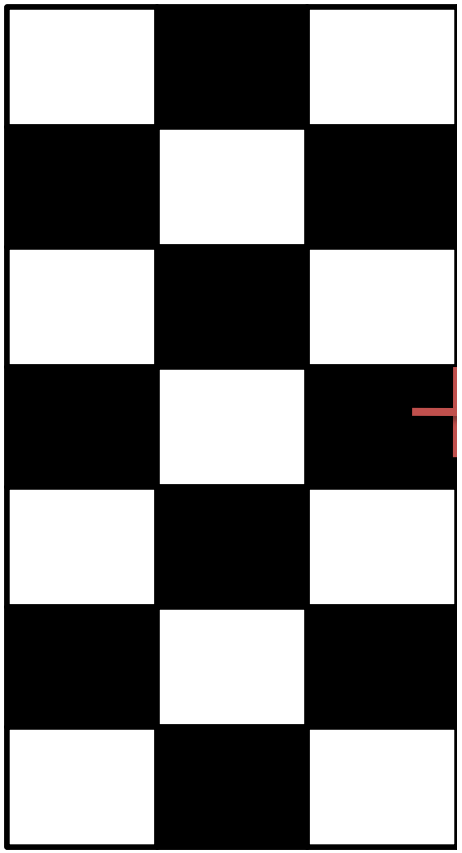
GUP - VEP - mfVEP

Yöntem Tanımlaması



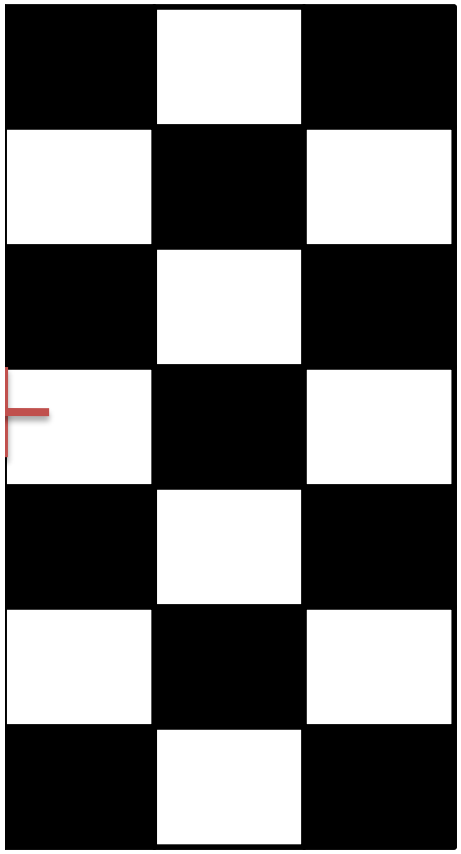
GUP - VEP - mfVEP

Yöntem Tanımlaması



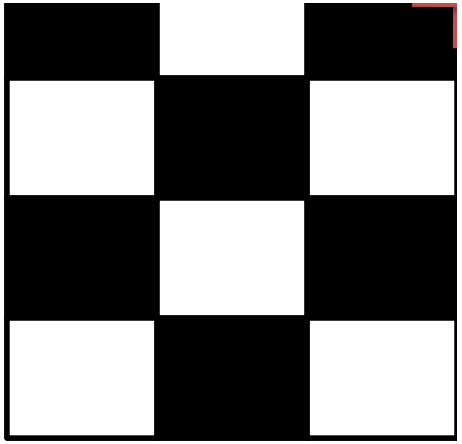
GUP - VEP - mfVEP

Yöntem Tanımlaması



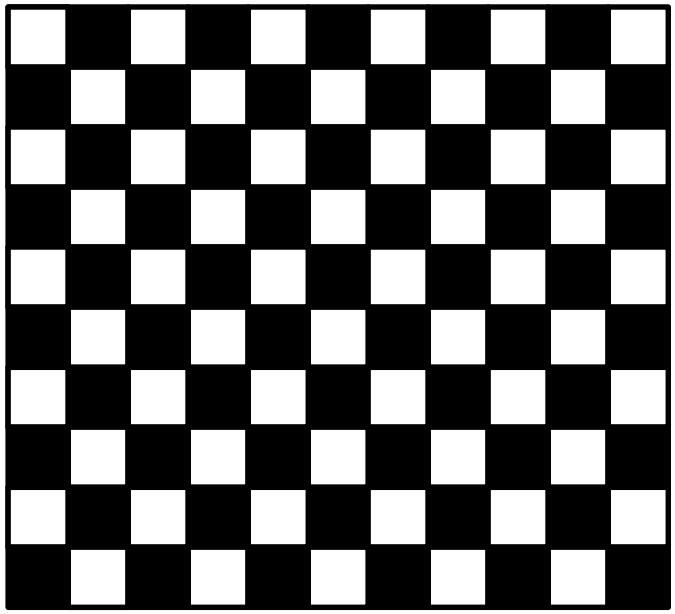
GUP - VEP - mfVEP

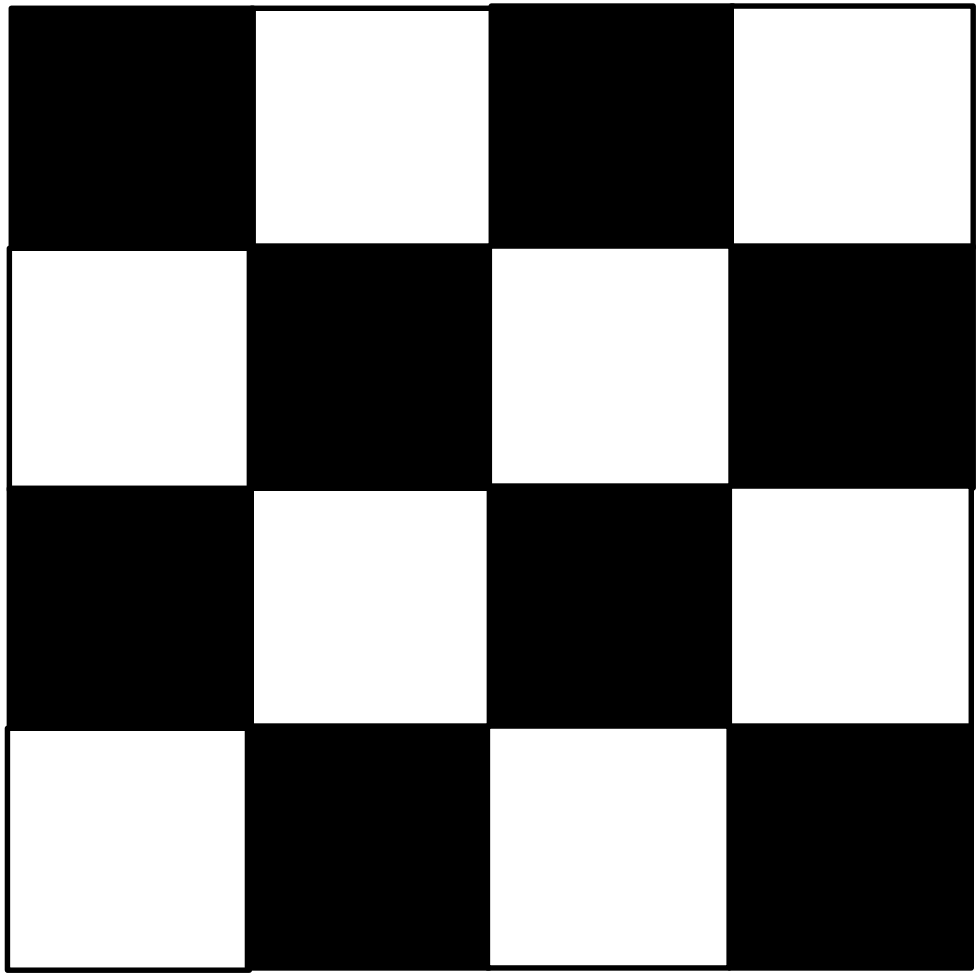
Yöntem Tanımlaması

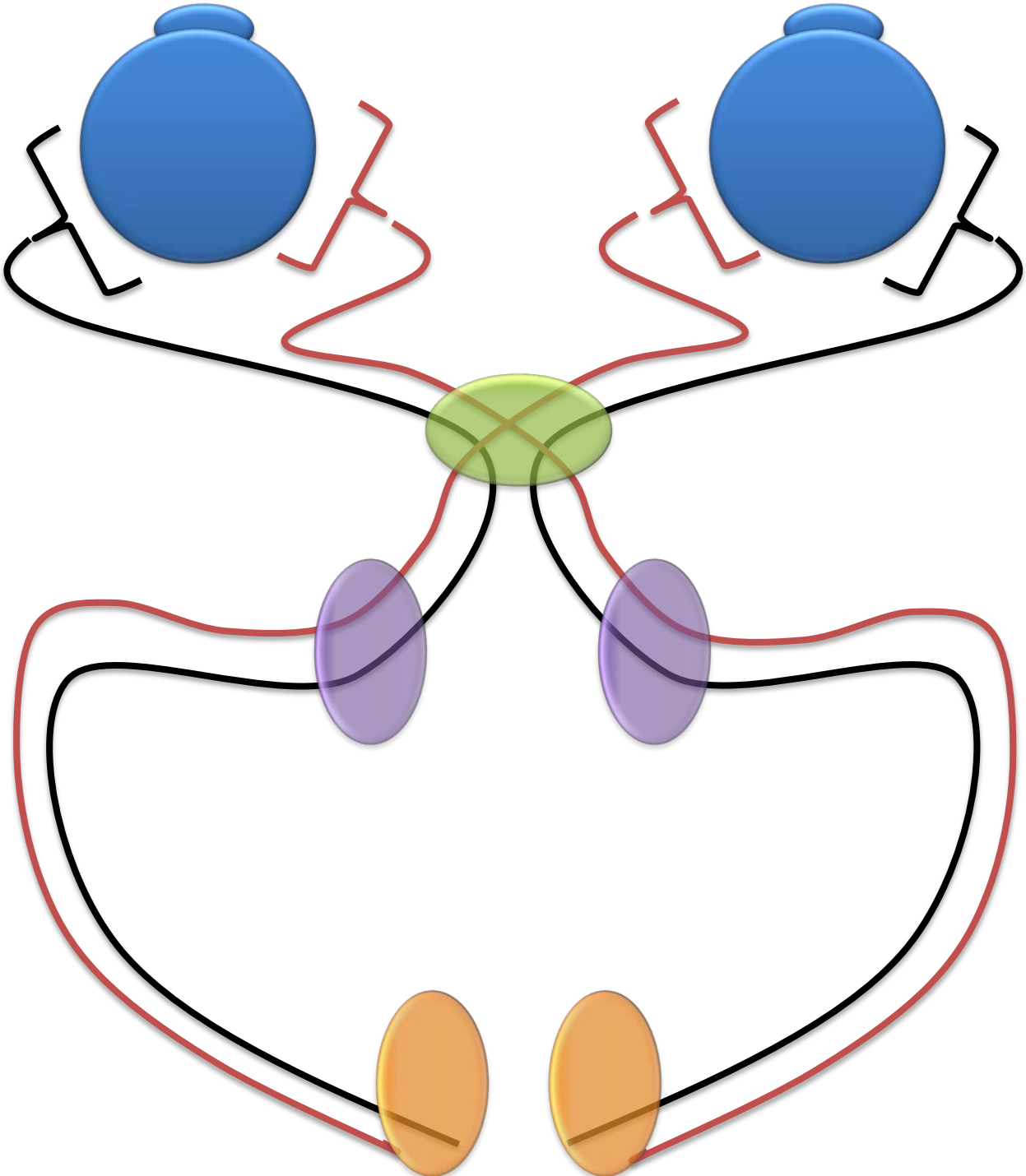


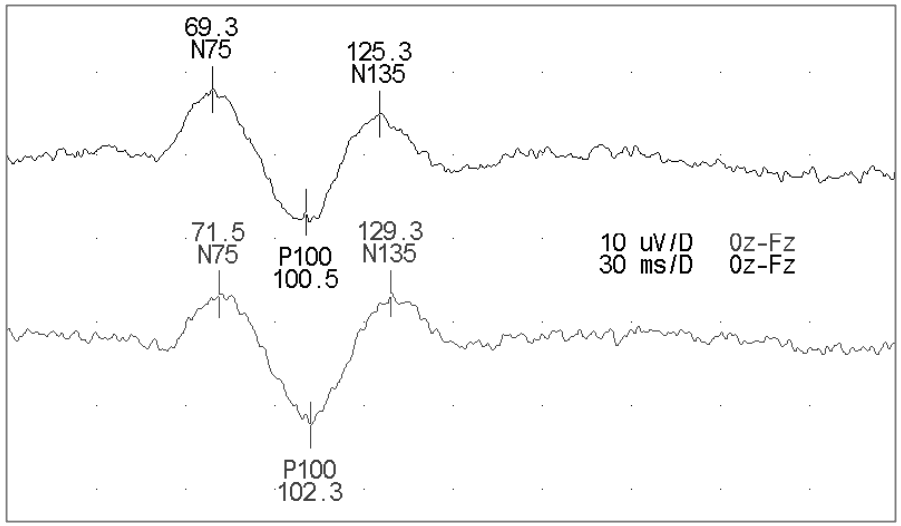
GUP - VEP - mfVEP

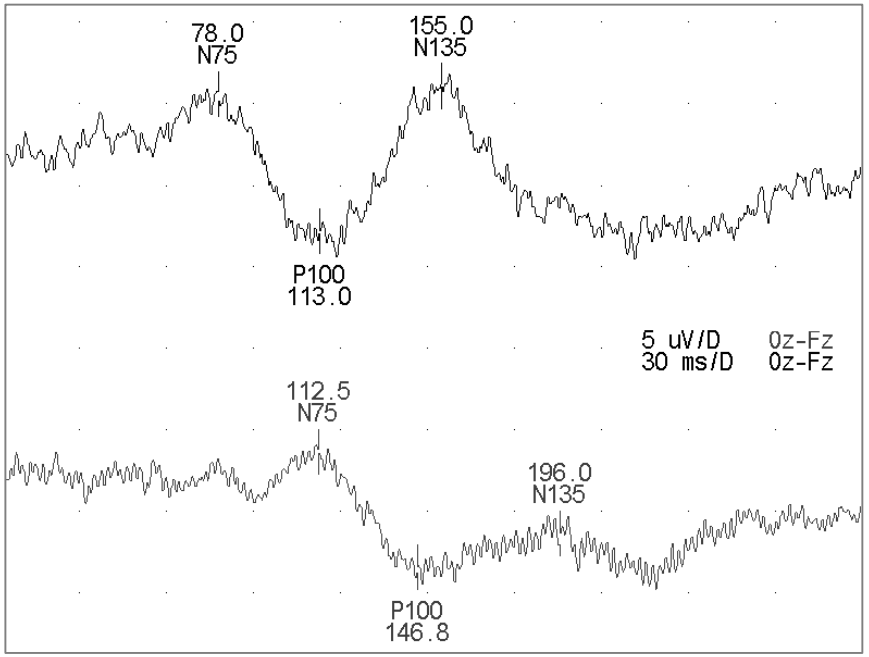
Yöntem Tanımlaması

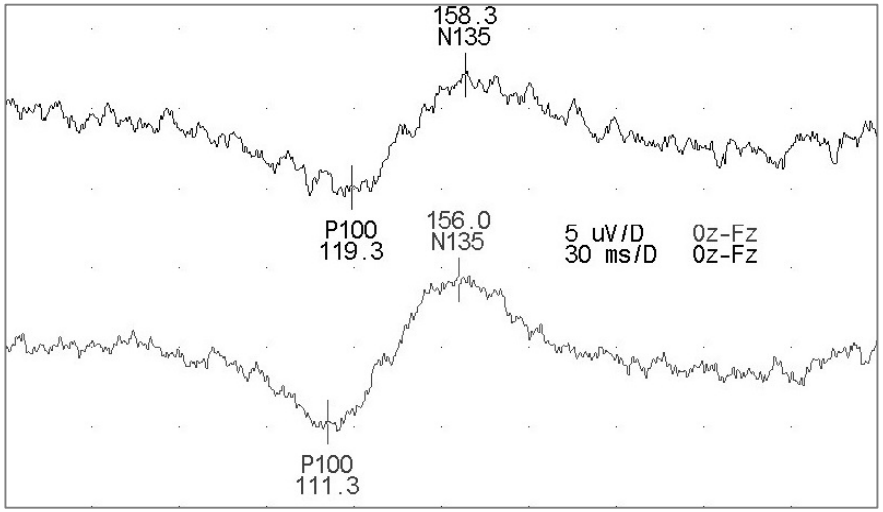


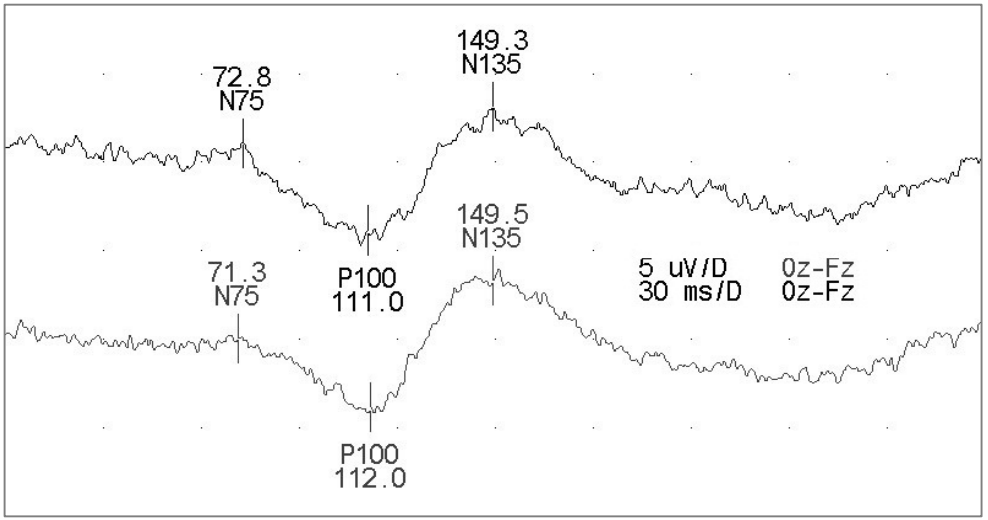





69.3
N75
125.3
N135
71.5
N75
P100
100.5
129.3
N135
10 uV/D 0z-Fz
30 ms/D 0z-Fz
P100
102.3


78.0
N75
155.0
N135
P100
113.0
5 uV/D 0z-Fz
30 ms/D 0z-Fz
112.5
N75
196.0
N135
P100
146.8


158.3
N135
P100
119.3
156.0
N135
5 uV/D 0z-Fz
30 ms/D 0z-Fz
P100
111.3


149.3
N135
72.8
N75
149.5
N135
71.3
N75
P100
111.0
5 uV/D 0z-Fz
30 ms/D 0z-Fz
P100
112.0

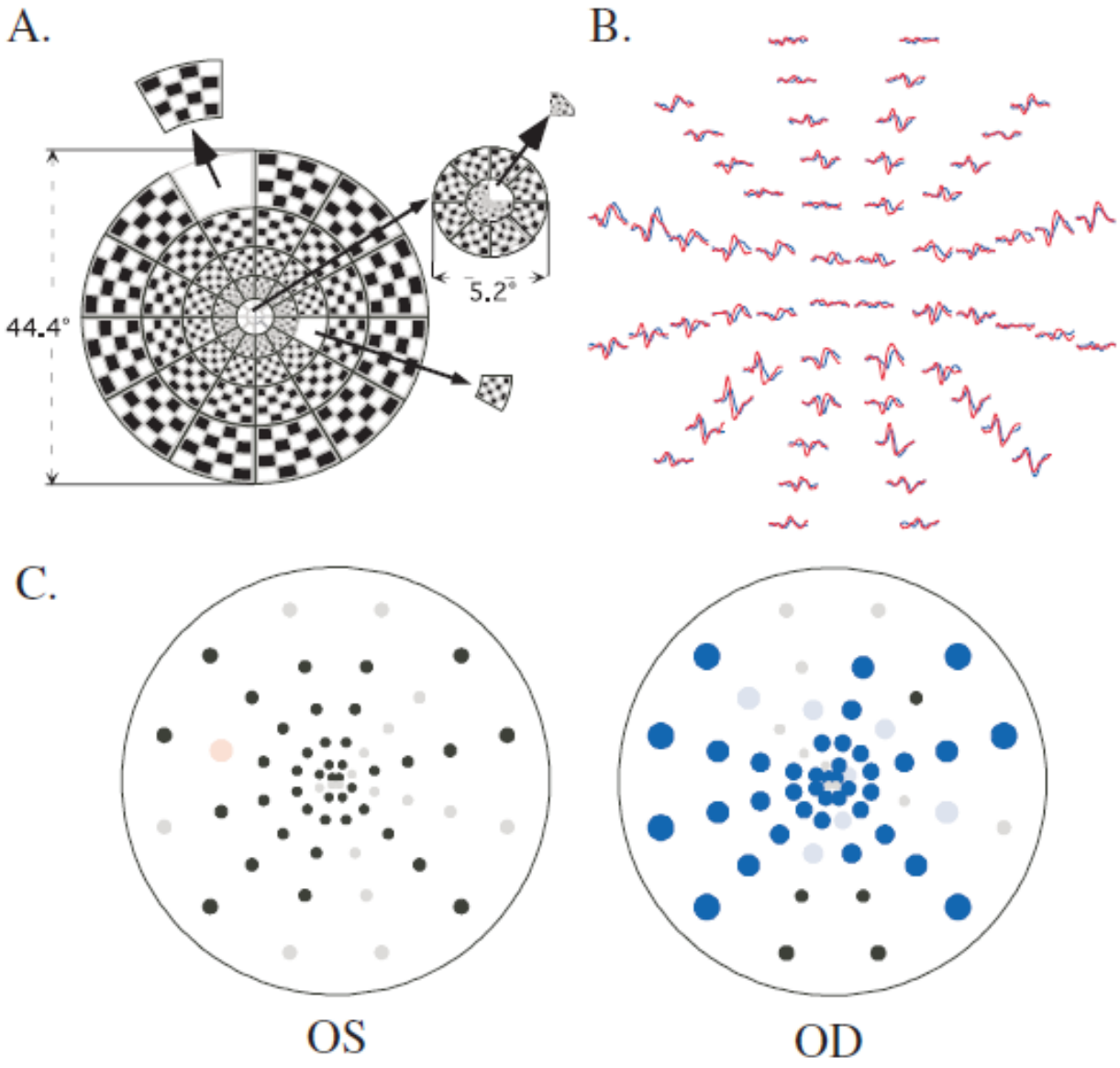


FIGURE 1. (A) mfVEP stimulus display of 60 cortically scaled sectors. (B) Sample responses for patient 2 for left eye (*red*) and right (*blue*) eye monocular stimulations. (C) Latency probability plots for the left (OS) and right (OD) eyes.

Yöntemlerin kıyaslanması

- 15 °'lik santral görme alanı uyarılır, periferal retina uyarılmaz
- Üst görme alanı VEP yanıtında çok fazla yer almadığı için buradaki defektler sinyale yansımaz
- Tek bir ortalama yanıt elde edilir, topoğrafik sonuçlar değerlendirilemez
- Klinik iyileşme ile korelasyonu iyi değildir

- Eksantrik yerleşmiş 60 adet 4x4 dama taşı paterni ile uyarılır
- 4 ayrı elektrod ve software yardımı ile kayıtlanır
- Tek sinyalden 60 adet mfVEP ayrıştırılır
- 24°'ye kadar uyarılabilir.
- Topoğrafik haritalama, latans ve amplitüd

Clinical Neurophysiology 128 (2017) 1234–1245

Review

Multifocal visual evoked potentials in optic neuritis and multiple sclerosis: A review

Gorm Pihl-Jensen*, Mathias Falck Schmidt, Jette Lautrup Frederiksen

Clinic of Optic Neuritis and Clinic of Multiple Sclerosis, Department of Neurology, Rigshospitalet - Glostrup, University of Copenhagen, Nordre Ringvej 57, 2600 Glostrup, Denmark

MS'teki anlamı ve çalışmalardan örnekler

MS tanısında % 70 anormal

MR'da >2 lezyon KİS olgularında % 30 anormal

mfVEP latans anormalliği + olguların MS'e dönme oranı % 36.4 iken

normal latanslı ON olgularında MS yok

Etkilenmeyi gösterir ancak progresyonu göstermede faydalı değildir

Journal of Clinical Neuroscience (2003) **10**(1), 67–70

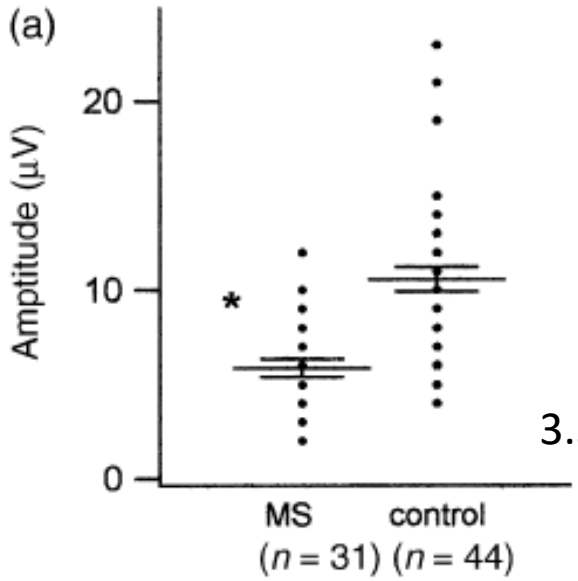
DOI:10.1016/S0967-5868(02)00172-8

Clinical study

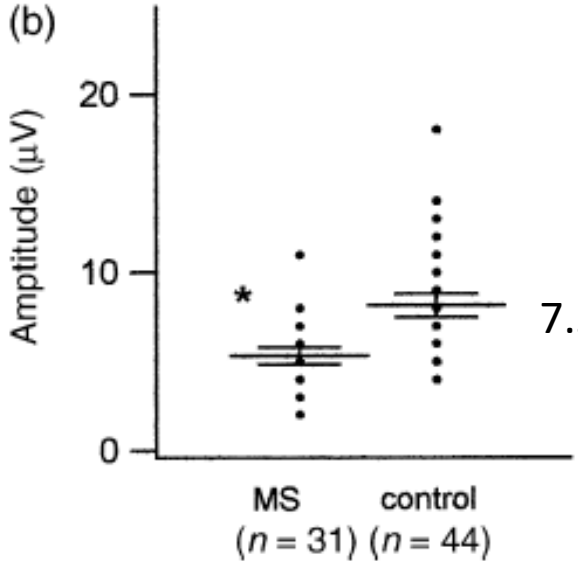
n multiple sclerosis patients
ty: a VEP study

25 MS olgusu ve NK

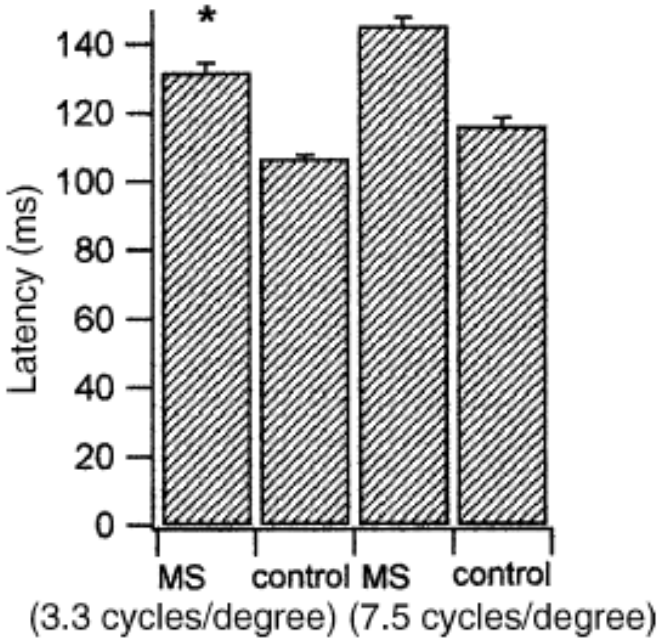
075 Göttingen, Germany
076 Tübingen, Germany



3.3 cycle/degree



7.5 cycle/degree



)1), **124,** 468–479

Long-tern
A 2-year vi
study

Adriana Brusa,[1] St

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trology and
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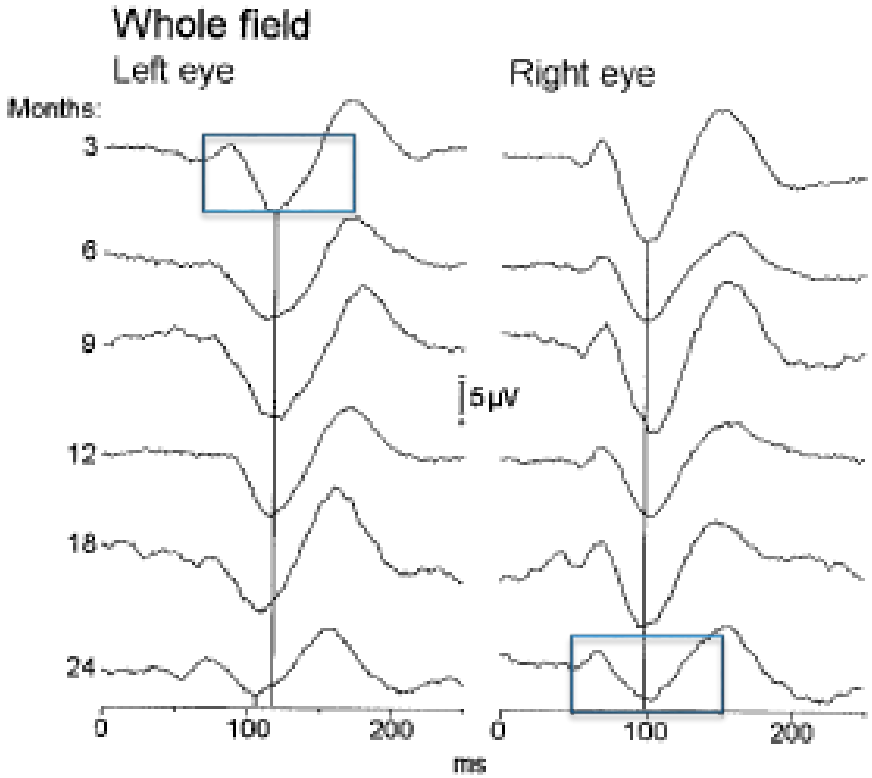
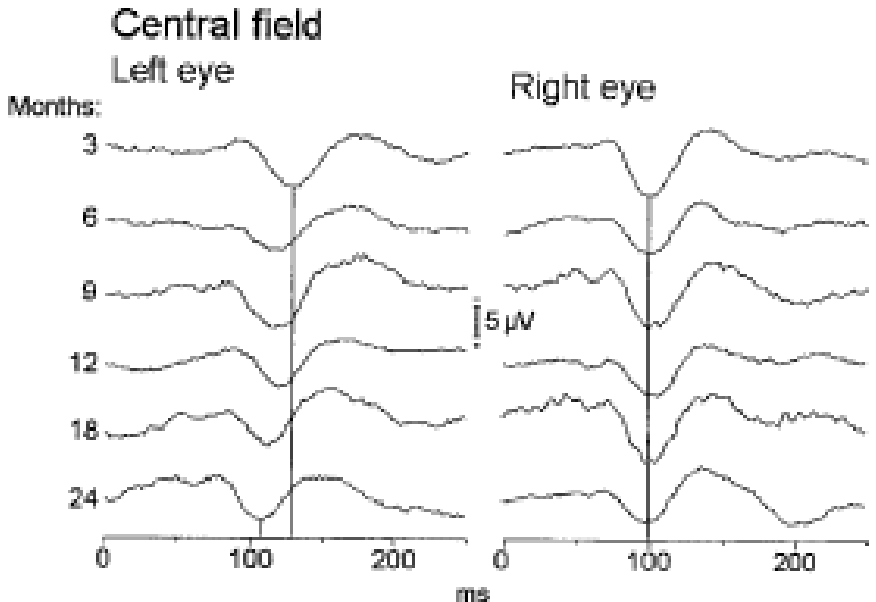


1. yılda etkilenen g yıla kadar ek 4 ms)



Visual Evoked Potentials in Differential Diagnosis of Multiple Sclerosis and Neurobehcet's Disease

Hande Turker,[1] Murat Terzi,[1] Oytun Bayrak,[1] Nilgun Cengiz,[1] Musa Onar[1] and Onder Us[2]

[1]Ondokuz Mayis University, Faculty of Medicine, Department of Neurology, Samsun, Turkey
[2]Marmara University, Faculty of Medicine, Department of Neurology, Istanbul, Turkey, Marmara University, Department of Neurophysiology, Istanbul, Turkey

Behcet's disease, a multisystemic vascular inflammatory disorder of unknown origin, is relatively rare and central nervous system involvement is seen in 5% of affected individuals. This form of the disease, called as neurobehcet's disease (NB), can be misdiagnosed as multiple sclerosis (MS), a demyelinating disorder of central nervous system, so their differential diagnosis is important. In this study, to identify the parameters of electrophysi-

Table 3. Statistical distribution of P100 amplitude over the groups.

Groups		P 100 Amplitude Mean ± S.D.	Test Value; *p*
Normal		10.5 ± 3.8	F = 7.8
NB		6.2 ± 1.8	0.001**
MS		8.0 ± 4.7	
Normal-NB	*p*	Tukey HSD = 4.4	0.001**
Normal-MS	*p*	Tukey HSD = 2.6	0.004**
NB-MS	*p*	Tukey HSD = 2.4	0.018*

F, Oneway Anova test and Post Hoc tests Tukey HSD.
*$p < 0.05$, **$p < 0.01$.

Evoked potential studies in the antiphospholipid syndrome: differential diagnosis from multiple sclerosis

D Paran, J Chapman, A D Korczyn, O Elkayam, O Hilkevich, G B Groozman, D Levartovsky, I Litinsky, D Caspi, Y Segev, V E Drory

Ann Rheum Dis 2006;**65**:525–528. doi: 10.1136/ard.2005.040352

See end of article for authors' affiliations

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Accepted 15 August 2005
Published Online First 17 August 2005

Background: The CNS manifestations of the antiphospholipid syndrome (APS) can mimic multiple sclerosis both clinically and radiologically.
Objective: To compare evoked potential studies in APS patients and patients with multiple sclerosis with similar neurological disability.
Methods: 30 APS patients with CNS manifestations and 33 patients with definite multiple sclerosis and similar neurological disability underwent studies of visual evoked potentials (VEP), somatosensory evoked potentials (SSEP) in the upper and lower limbs (UL, LL), and sympathetic skin responses (SSR) in the upper and lower limbs.
Results: The neurological manifestations in the APS patients included stroke (n = 17), transient ischaemic attacks (n = 10), and severe headache with multiple white matter lesions on brain MRI (n = 3). Abnormal SSEP (LL), and SSR (UL; LL) were seen in APS patients (37%, 27%, and 30%, respectively) but VEP and UL SSEP were rarely abnormal (10% and 6%, respectively in APS *v* 58% and 33% in multiple sclerosis; $p = 0.0005$, $p = 0.008$). Mean VEP latencies were more prolonged in multiple sclerosis (116 ms *v* 101 ms, $p < 0.001$). Only one APS patient had abnormal findings in all three evoked potential studies, compared with seven patients in the multiple sclerosis group ($p = 0.04$)
Conclusions: Abnormal VEPs are uncommon in APS in contrast to multiple sclerosis. Coexisting abnormalities in all other evoked potentials were similarly rare in APS. In patients with brain MRI findings compatible either with multiple sclerosis or APS, normal evoked potential tests, and especially a normal VEP, may support the diagnosis of APS.

Evoked potential	APS	MS	p Value
VEP	10%	58%	0.0005
UL SSEP	6%	33%	0.008
LL SSEP	37%	45%	NS
UL SSR	27%	27%	NS
LL SSR	30%	35%	NS

Neurol Sci (2014) 35:781–783
DOI 10.1007/s10072-014-1635-6

BRIEF COMMUNICATION

First-ever optic neuritis: distinguishing subsequent neuromyelitis optica from multiple sclerosis

Young-Min Lim · So Young Pyun · Hyun Taek Lim · In Hye Jeong · Kwang-Kuk Kim

Abstract To identify factors distinguishing subsequent neuromyelitis optica (NMO) from multiple sclerosis (MS) after first-ever optic neuritis (ON), we compared ophthalmic findings and MRI features of 24 NMO and 55 MS patients who initially presented with ON. The female-to-male ratio was higher, and bilateral ON was more common in NMO patients than in MS patients ($p = 0.044$ and $p = 0.020$, respectively). The visual acuity (VA) score was higher in NMO patients ($p = 0.034$), and a greater proportion of NMO patients had a VA score ≥ 5 ($p = 0.003$). The frequency of patients without pattern-reversal and flash visual evoked potentials was higher in the NMO group ($p = 0.015$). Brain MRI abnormalities were more common in the MS group ($p = 0.001$). The optic chiasm was affected in 25 % of NMO patients and was unaffected in MS patients, although it did not reach statistical significance ($p = 0.096$). There were no differences with respect to the severity of swelling and enhancement of the optic nerve. In conclusion, severe optic nerve damage at the first ON attack was associated with subsequent development of NMO, whereas presence of brain MRI abnormalities was associated with developing MS.

A comparison of multifocal and conventional visual evoked potential techniques in patients with optic neuritis/multiple sclerosis

Larissa K. Grover · Donald C. Hood · Quraish Ghadiali · Tomas M. Grippo · Adam S. Wenick · Vivienne C. Greenstein · Myles M. Behrens · Jeffrey G. Odel

19 MS ve 40 NK

Table 1 The area under the ROC curve for different criteria

	Monocular	Interocular
cVEP(60′)	0.947	0.919
cVEP(15′)	0.865	0.885
mfVEP(latency)	0.924	0.922
mfVEP(percent abnormal)	0.900	0.953
mfVEP(cluster)	0.863	0.960

Table 2 Sensitivity for different monocular criteria for a specificity of 95%

	Sensitivity	Specificity	Misses
cVEP(60′)	57.9	95.0	8
cVEP(15′)	52.6	95.0	9
mfVEP(latency)	57.9	95.0	8
mfVEP(percent abnormal)	57.9	95.0	8
mfVEP(cluster)	47.4	95.0	10

Table 3 Sensitivity for different interocular criteria for a specificity of 95%

	Sensitivity	Specificity	Misses
cVEP(60′)	78.9	95.0	4
cVEP(15′)	68.4	95.0	6
mfVEP(latency)	68.4	95.0	6
mfVEP(percent)	84.2	95.0	3
mfVEP(cluster)	89.5	95.0	2

Table 4 Sensitivity and specificity for different monocular OR interocular criteria

	Sensitivity	Specificity	Misses
cVEP(60′)	84.2	90.0	3
cVEP(15′)	73.7	90.0	5
mfVEP(latency)	78.9	90.0	4
mfVEP(percent)	89.5	90.0	2
mfVEP(cluster)	94.7	90.0	1

OPEN ACCESS Freely available online

PLOS ONE

Relationship between Optical Coherence Tomography and Electrophysiology of the Visual Pathway in Non-Optic Neuritis Eyes of Multiple Sclerosis Patients

Prema Sriram[1], Chenyu Wang[2], Con Yiannikas[3], Raymond Garrick[4], Michael Barnett[2], John Parratt[5], Stuart L. Graham[1,6], Hemamalini Arvind[1,6], Alexander Klistorner[1,6]*

1 Australian School of Advanced Medicine, Macquarie University, Sydney, Australia, **2** Brain and Mind Research Institute, University of Sydney, Sydney, Australia, **3** Concord Hospital, Sydney, Australia, **4** St Vincent's Hospital, Sydney, Australia, **5** Royal North Shore Hospital, Sydney, Australia, **6** Save Sight Institute, Department of Ophthalmology, University of Sydney, Sydney, Australia

Received March 20, 2014; **Accepted** June 19, 2014; **Published** August 28, 2014

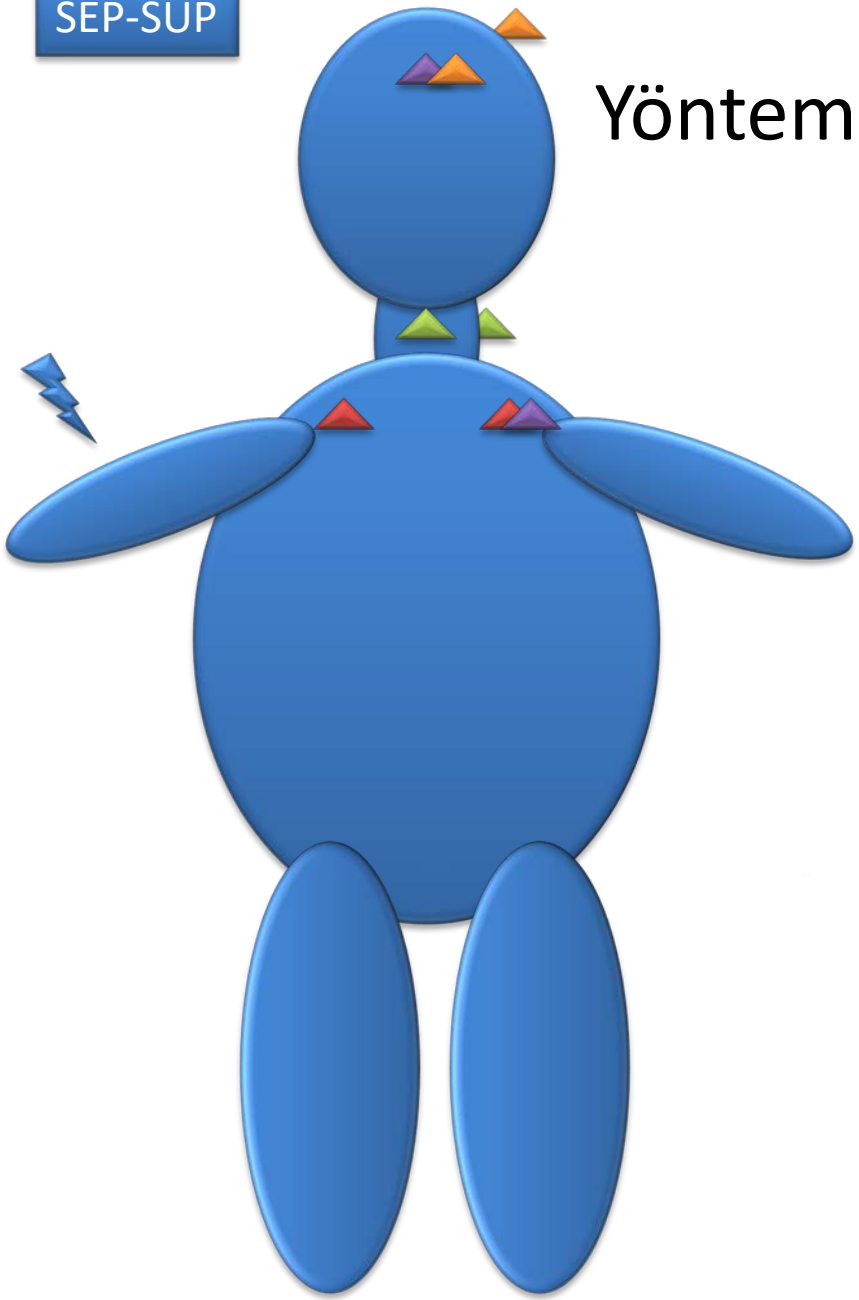
Methods: Sixty-two patients with relapsing remitting multiple sclerosis with no previous history of optic neuritis in at least one eye were enrolled. All patients underwent a detailed ophthalmological examination in addition to low contrast visual acuity, Optical Coherence Tomography, full field electroretinogram (ERG) and multifocal visual evoked potentials (mfVEP).

Results: There was significant reduction of ganglion cell layer thickness, and total and temporal retinal nerve fibre layer (RNFL) thickness ($p<0.0001$, 0.002 and 0.0002 respectively). Multifocal VEP also demonstrated significant amplitude reduction and latency delay ($p<0.0001$ for both). Ganglion cell layer thickness, total and temporal RNFL thickness inversely correlated with mfVEP latency ($r=-0.48$, $p<0.0001$ respectively; $r=-0.53$, $p<0.0001$ and $r=-0.59$, $p<0.0001$ respectively). Ganglion cell layer thickness, total and temporal RNFL thickness also inversely correlated with the photopic b-wave latency ($r=-0.35$, $p=0.01$; $r=-0.33$, $p=0.025$; $r=-0.36$, $p=0.008$ respectively). Multivariate linear regression model demonstrated that while both factors were significantly associated with RGC axonal and neuronal loss, the estimated predictive power of the posterior visual pathway damage was considerably larger compare to retinal dysfunction.

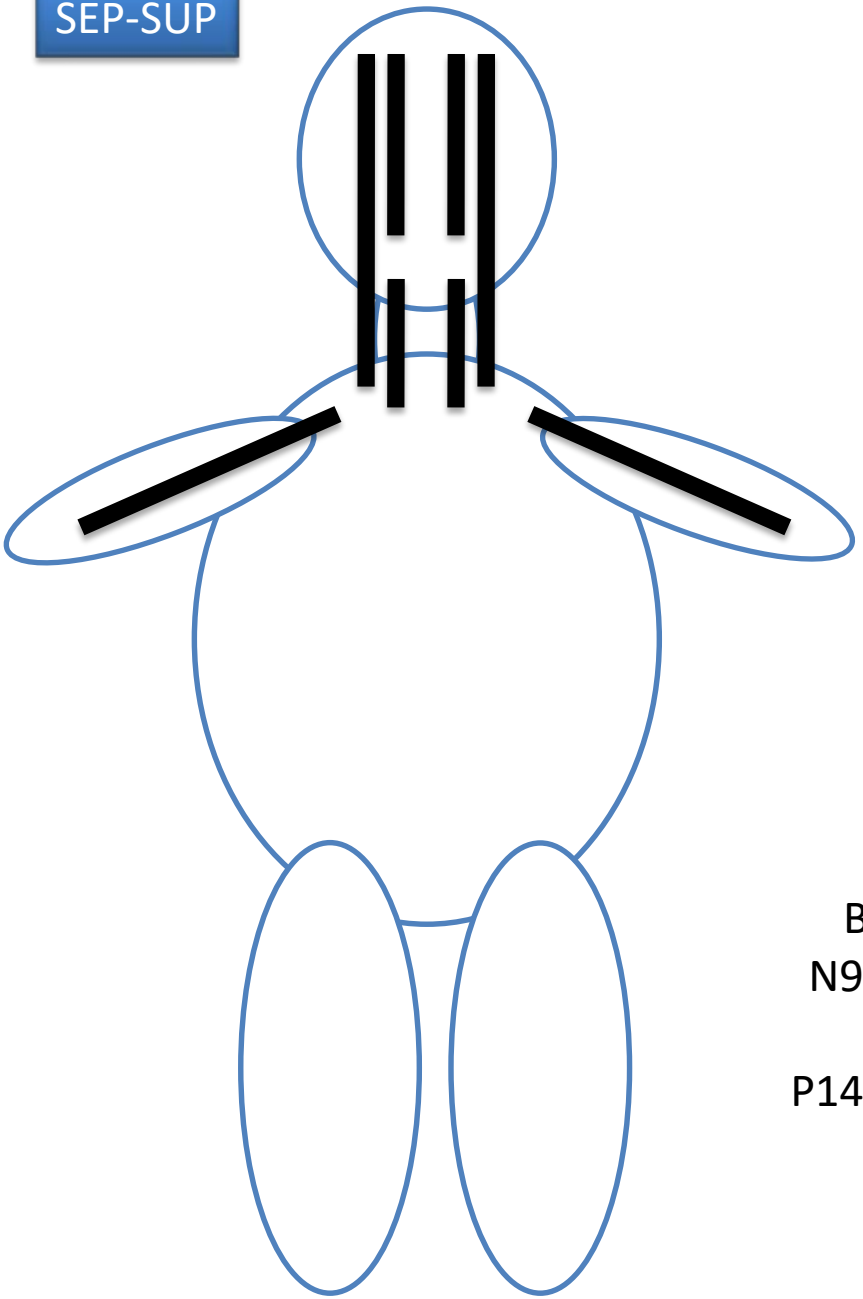
Conclusion: The results of our study demonstrated significant association of RGC axonal and neuronal loss in NON-eyes of MS patients with both retinal dysfunction and post-chiasmal damage of the visual pathway.

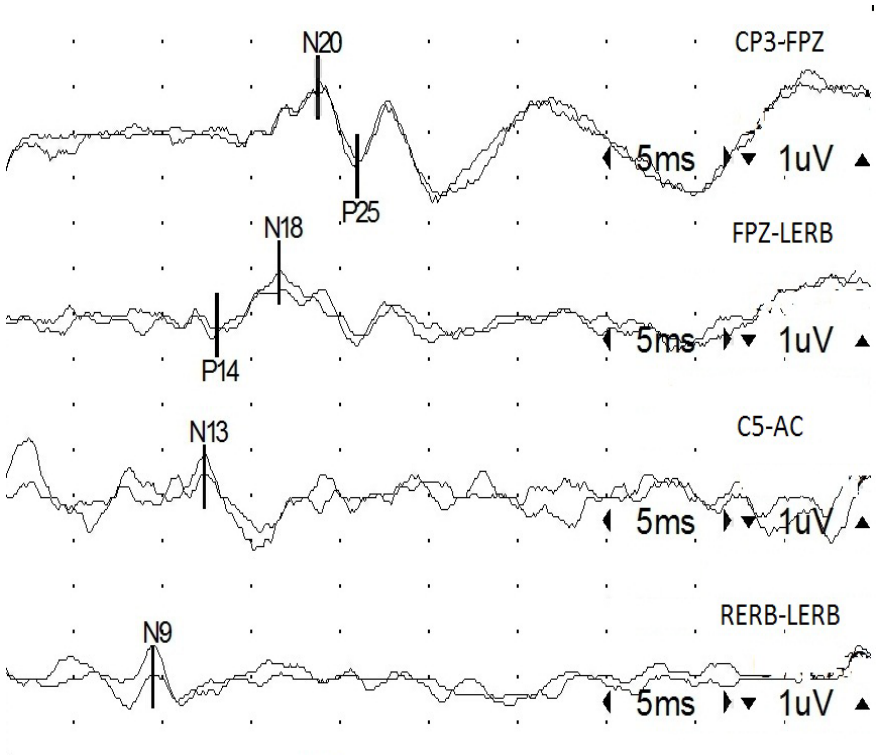
SEP-SUP

Yöntem Tanımlaması



SEP-SUP





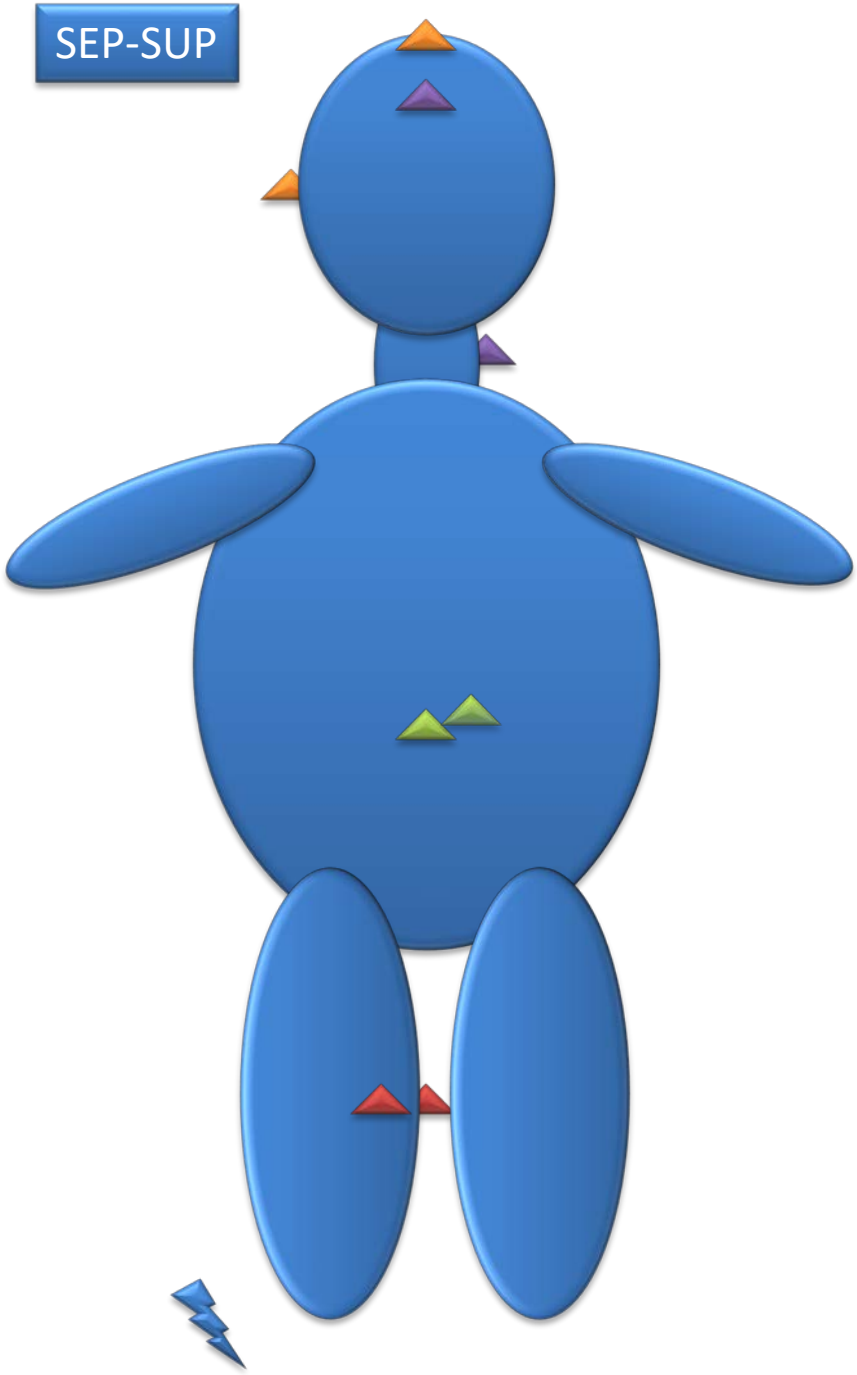
Bilek – erb mesafesi/N9 = periferik iletim hızı

N9-P14 = Pleksus – medial lemniskus arası iletim
(Pleksus servikomedüller bileşke zamanı)

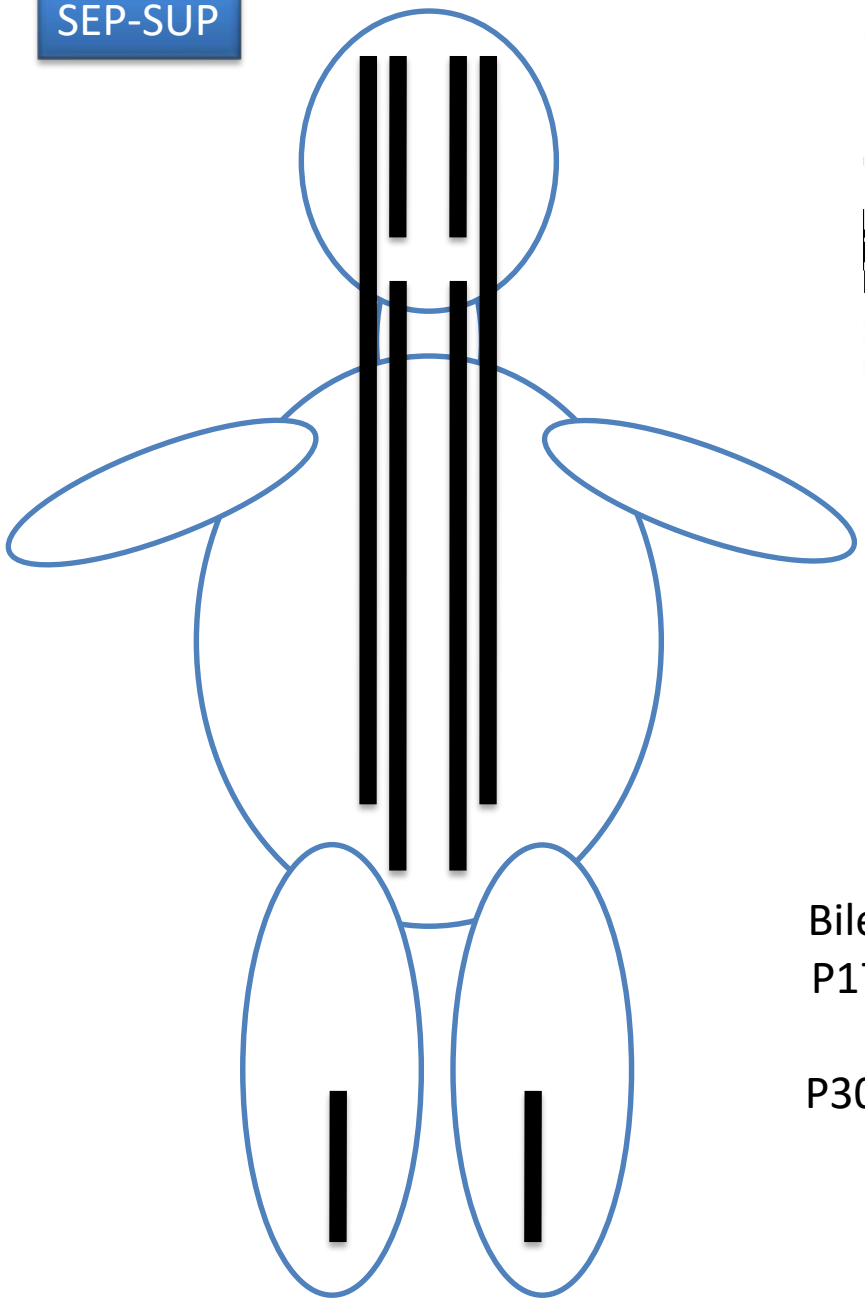
P14-N20 = Medial lemniskus – korteks arası iletim
(İntrakortikal iletim zamanı)

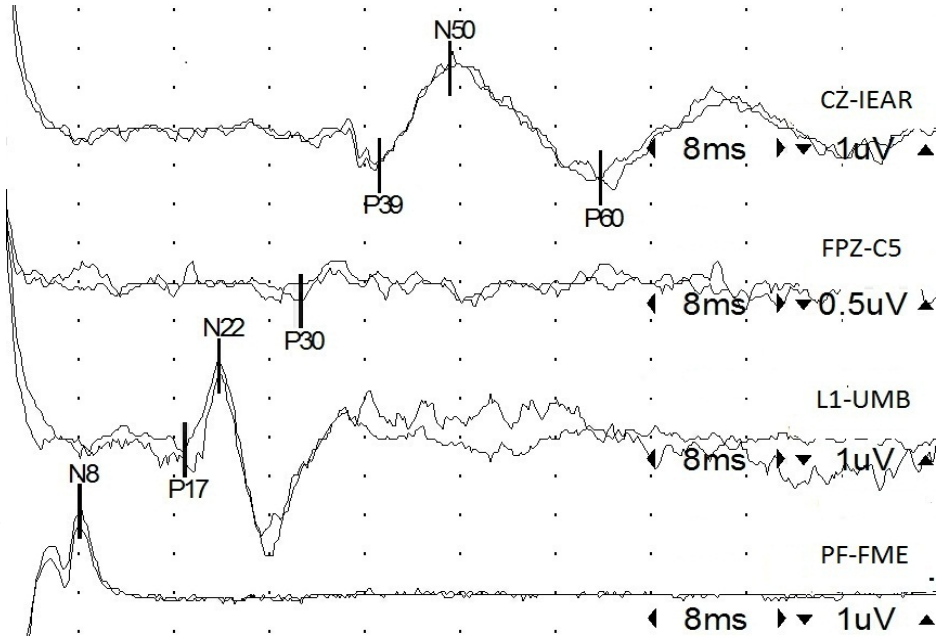
N13-N20 = Spinal + intrakortikal iletim
(Santral iletim zamanı)

SEP-SUP



SEP-SUP





Bilek – poplitea mesafesi/N8 = periferik iletim hızı
P17-P30 = Pleksus – medial lemniskus arası iletim
(Pleksus servikomedüller bileşke zamanı)
P30-P39 = Medial lemniskus – korteks arası iletim
(İntrakortikal iletim zamanı)
N22-P39 = Spinal + intrakortikal iletim
(Santral iletim zamanı)

SEP’in MS’teki rolü nedir?

MS tanısında % 60 anormal

Asemptomatik olgularda % 51 anormal

Posterior kord patolojisini gösterir*

Klinik pozitif semptomlar veya vibrasyon duyumunun yitimi ile iyi korelasyon göstermez*

Spinotalamik traktus fonksiyonu ölçülebilir mi?

ELSEVIER

Clinical Neurophysiology 114 (2003) 992–1002

www.elsevier.com/locate/clinph

Sensitivity of laser-evoked potentials versus somatosensory evoked potentials in patients with multiple sclerosis

Jörg Spiegel[a,1], Christiane Hansen[a,b], Ulf Baumgärtner[a], Hanns Christian Hopf[b], Rolf-Detlef Treede[a,*]

[a]*Institute of Physiology and Pathophysiology, Johannes Gutenberg-University, Saarstrasse 21, D-55099 Mainz, Germany*
[b]*Department of Neurology, Johannes Gutenberg-University, Mainz, Germany*

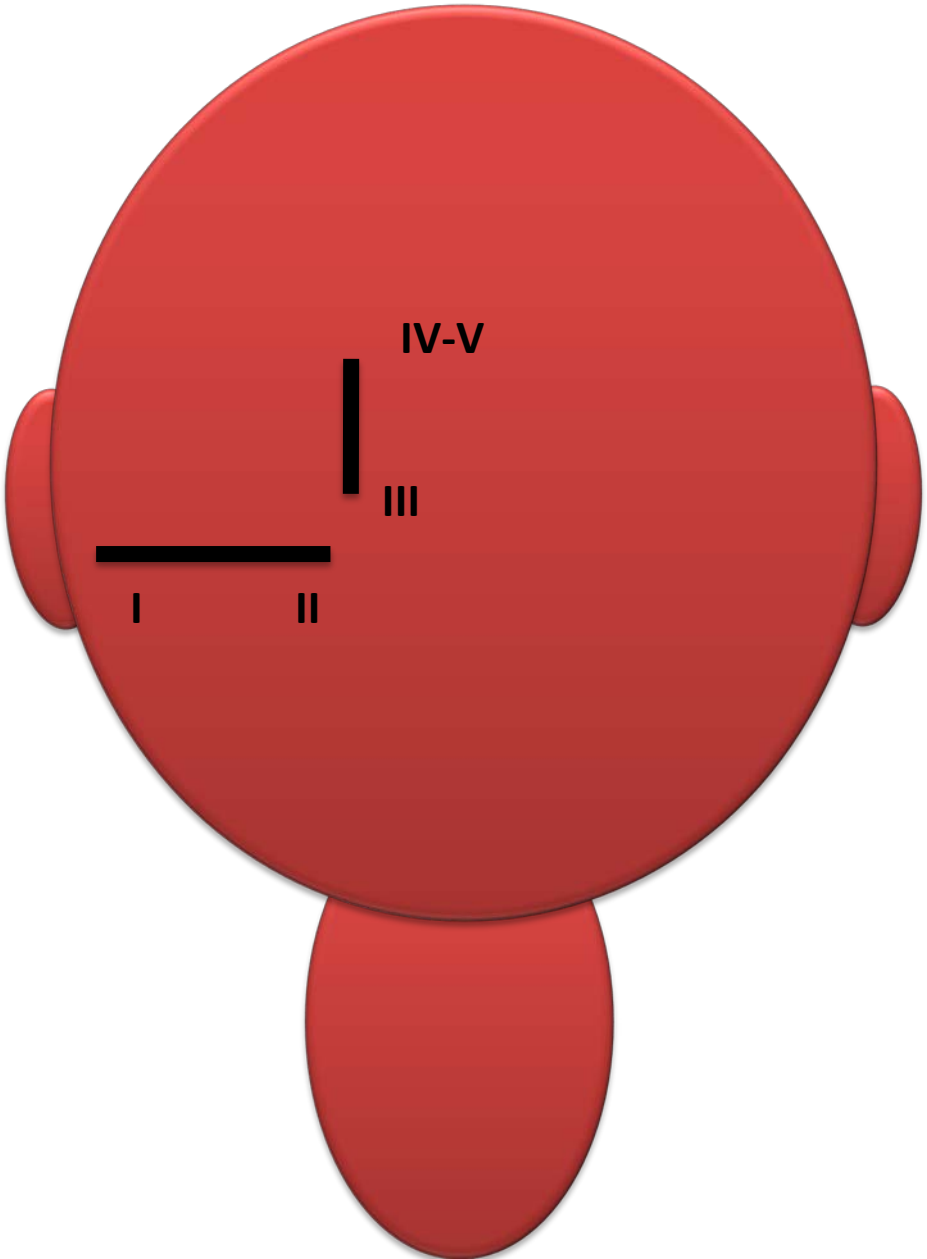
Accepted 11 February 2003

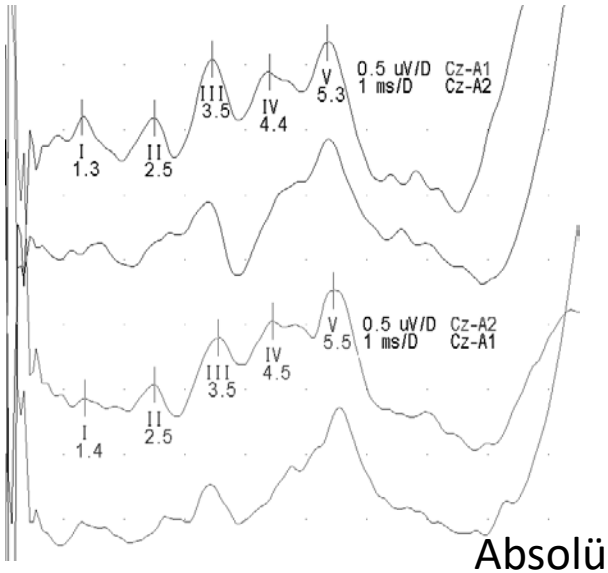
20 kesin / 6 olası MS - 22 kontrol olgusu
= amplitüd ve latans anormalliği + (LEP % 60, SEP %40 anormal)
kombine kullanım ile sensitivite % 75

İUP - BAEP - MLAEP - P300

Yöntem Tanımlaması

İUP - BAEP - MLAEP - P300

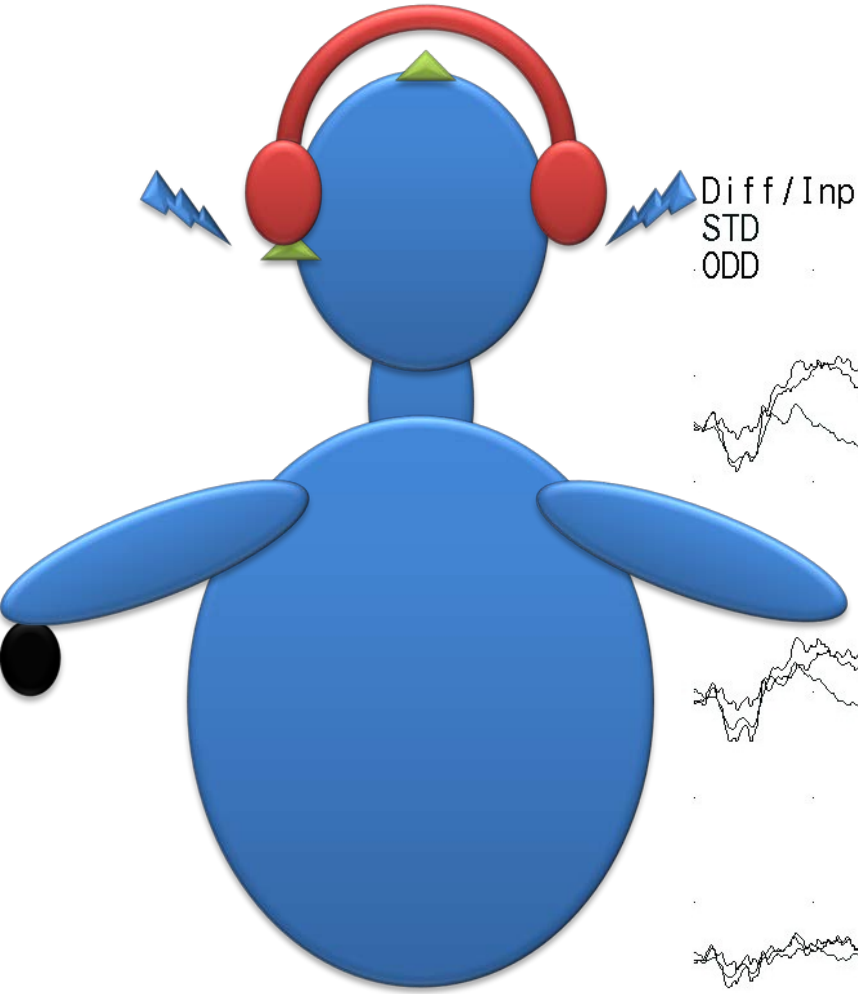




Absolü latanslar
I – III latansı
III – V latansı
I – V latansı
I/V amplitüdü
Taraf farkları

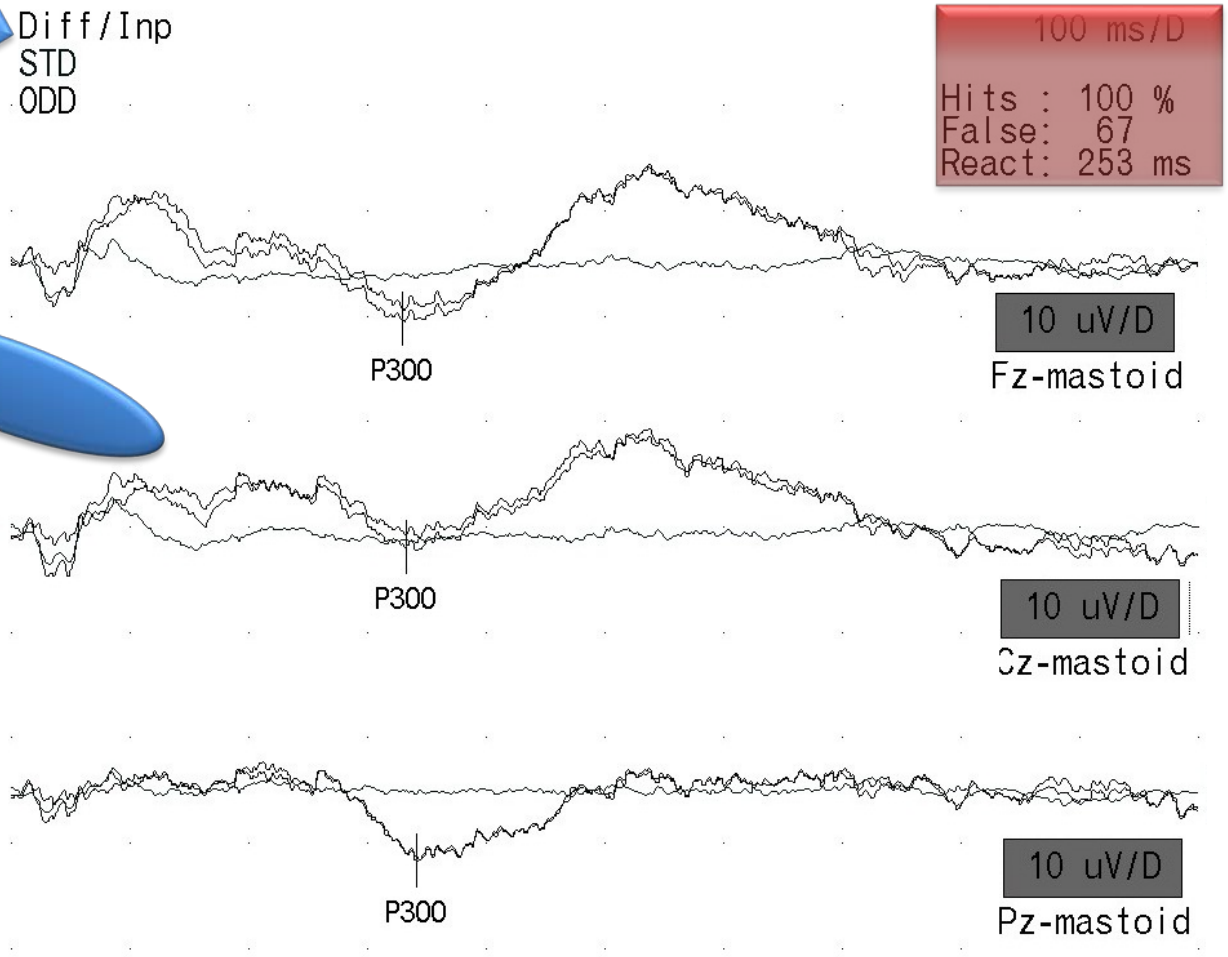
Koklear sinir distal bölge
Koklear sinir proksimal bölge, nükleus
Trapezoid cisimcik-süperior olivar nükleus
Lateral lemniskus
Periferik sinir I. ve II. Dalga
Alt pons III. Dalga
Üst pons ve alt mezensefalon IV.-V. dalga

İUP - BAEP - MLAEP - P300



Oddball paradigması

Dorsolateral prefrontal korteks,
Temporo-paryetal bileşke ve süperior temporal korteks
Latans – Bilgi işlemleme zamanı
Amplitüd – Bilgi işlemlemede kronodispersiyon ya da katılan bölgelerin azalması



MS’teki anlamı ve çalışmalardan örnekler

BAEP

MS tanısında % 32 anormal

Asemptomatik olgularda % 21 anormal

Klinik beyin sapı tutulumu varlığında, MRG’ye göre daha duyarlıdır

MS olgularında P300 latansının uzadığı, kognitif durum ve dizabilite ile de korele olduğu gözlenmiştir

BMC Neuroscience

BioMed Central

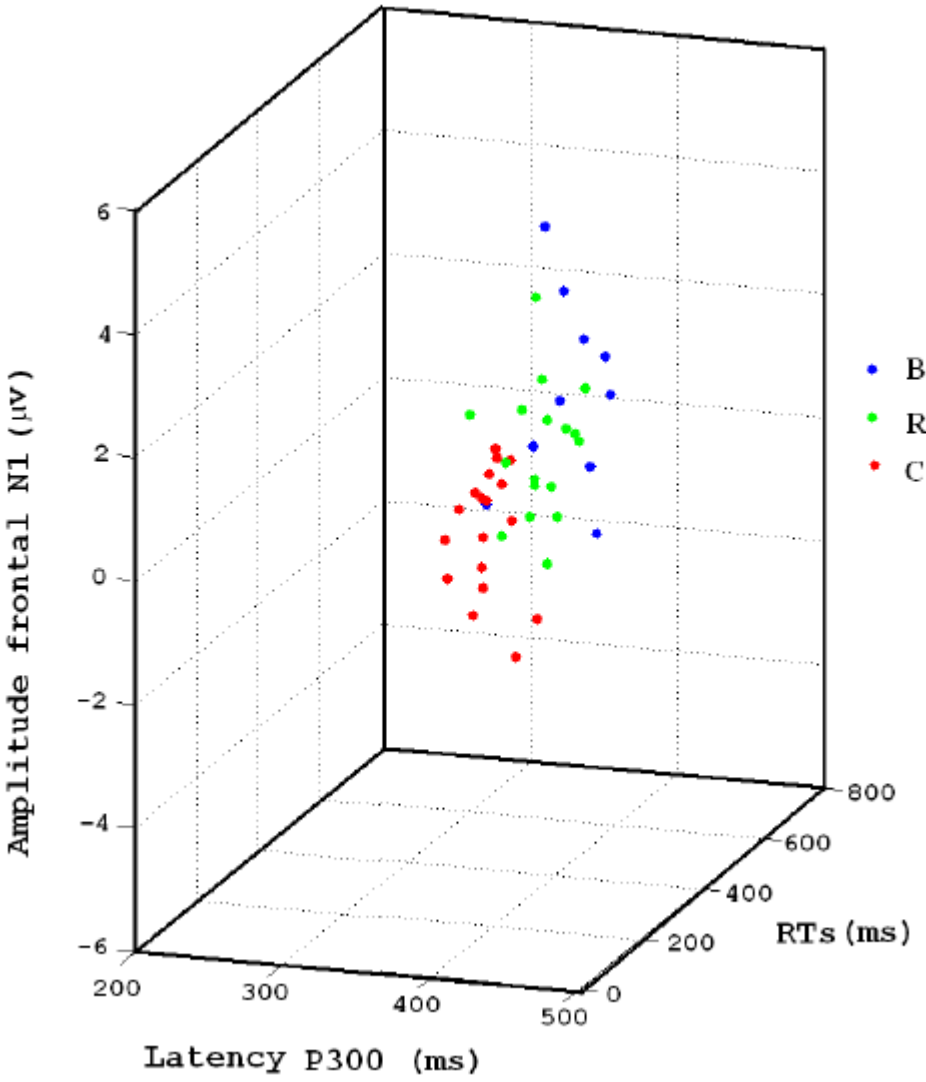
Research article

Open Access

Differential c ultiple sclerosis

Javier J Gonzal
Encarnacion V Gamero[1],
Carlos M Gom

17 RRMS 7 yıl), 18 NK



ELSEVIER

Journal of Clinical Neuroscience

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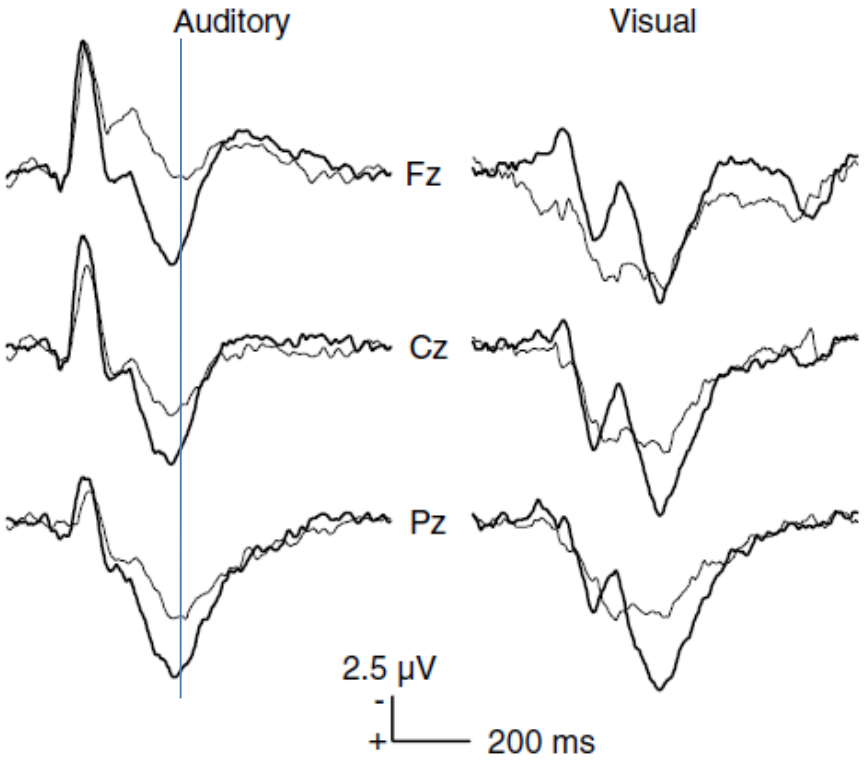
P300 and treatm nultiple sclerosis

G. Na os [a,d],



33 RRMS 100 mg/gün/4 hafta

Yorgunluk - VAS skalası

İşitsel ve görsel P300 çalışmaları var

Kısa P300 latansı olanlar daha iyi yanıt +

Tahmin etmede % 76 spesifite ve % 75 sensitivite

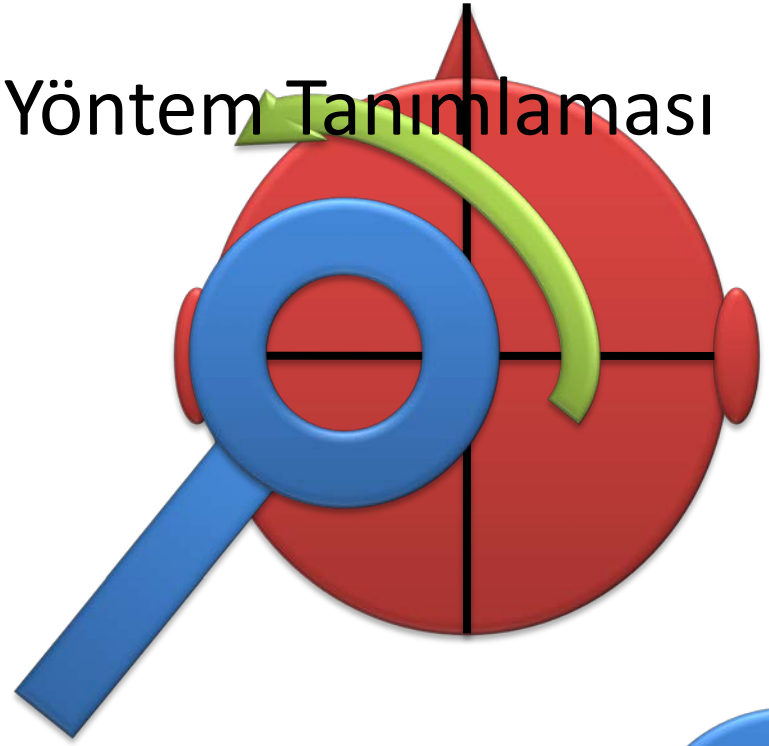
(350 ms)

Görsel P300 ile benzer yanıt yok

P300 değişimi ile klinik düzelme arasında korelasyon yok

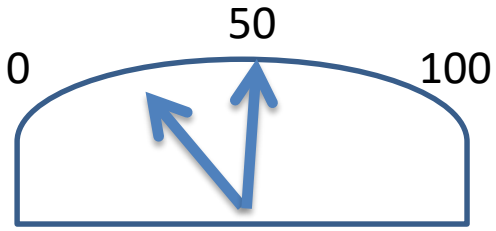
MEP-MUP

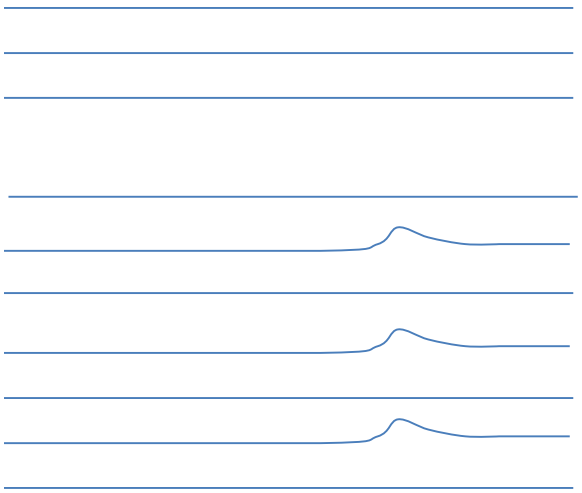
Yöntem Tanımlaması



MEP-MUP

Motor eşik ölçümü

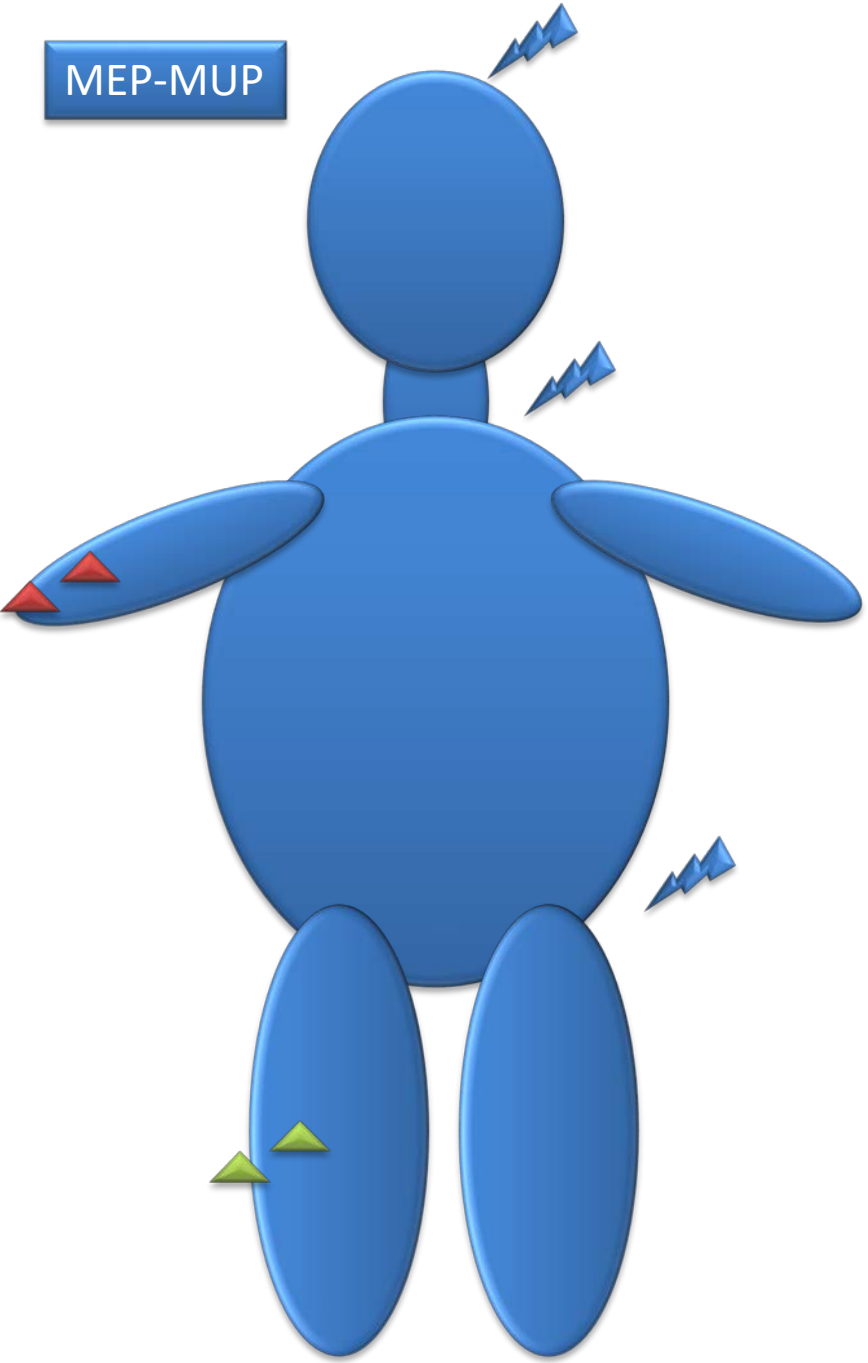




50-100 µV

10-20 uyarının ½’sinde

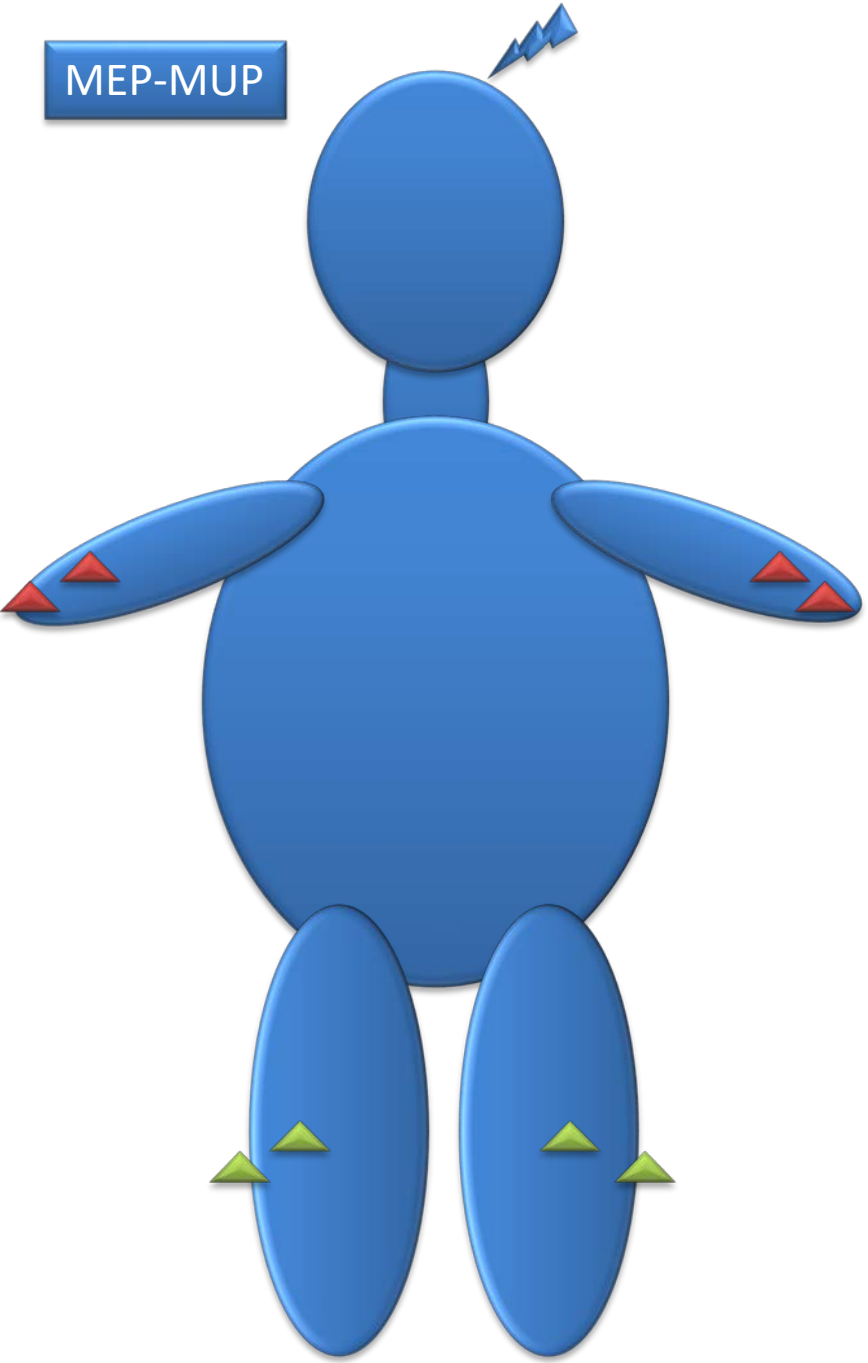
MEP-MUP

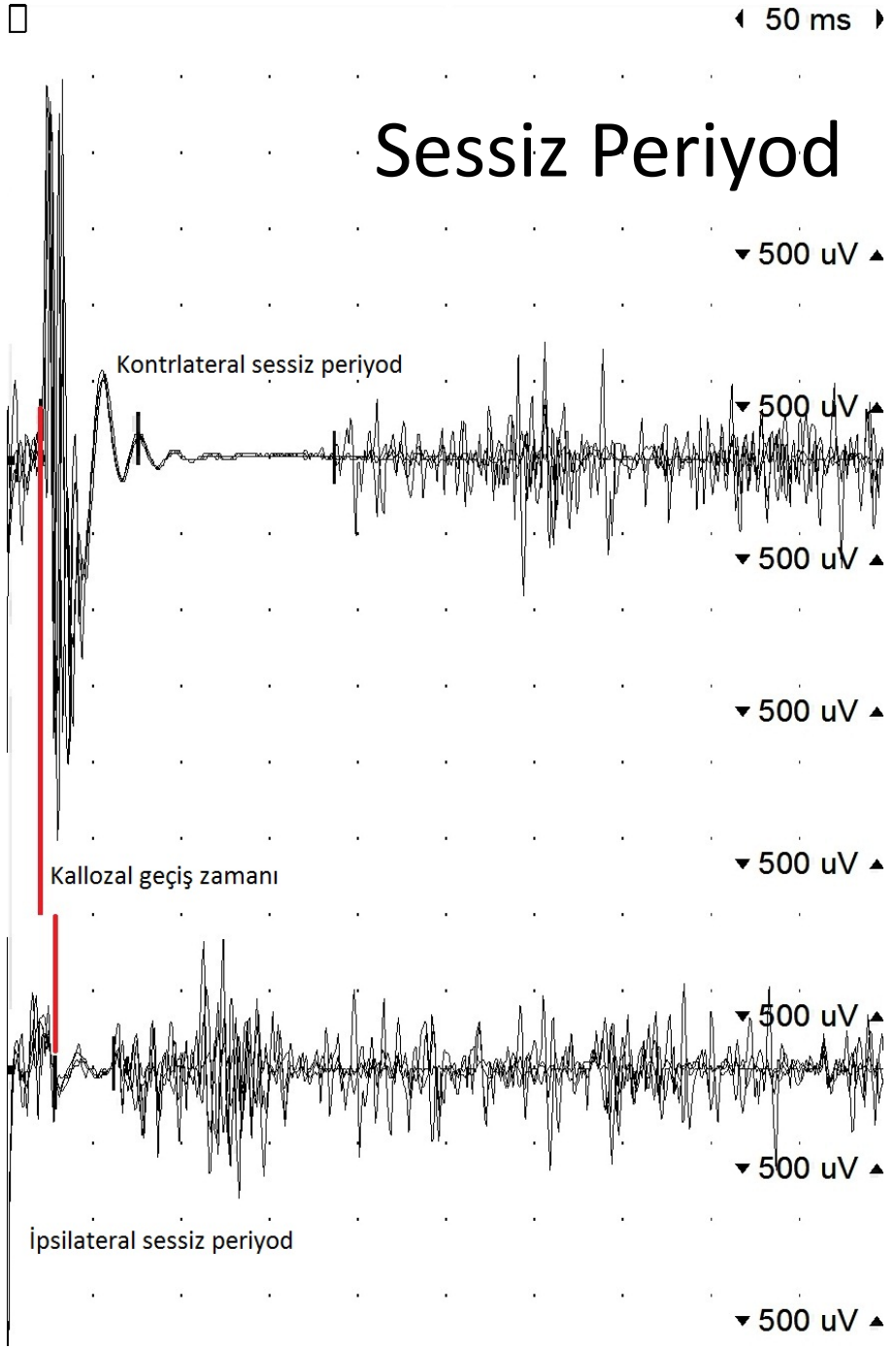


Santral Motor Gecikme

(F+M-1)/2

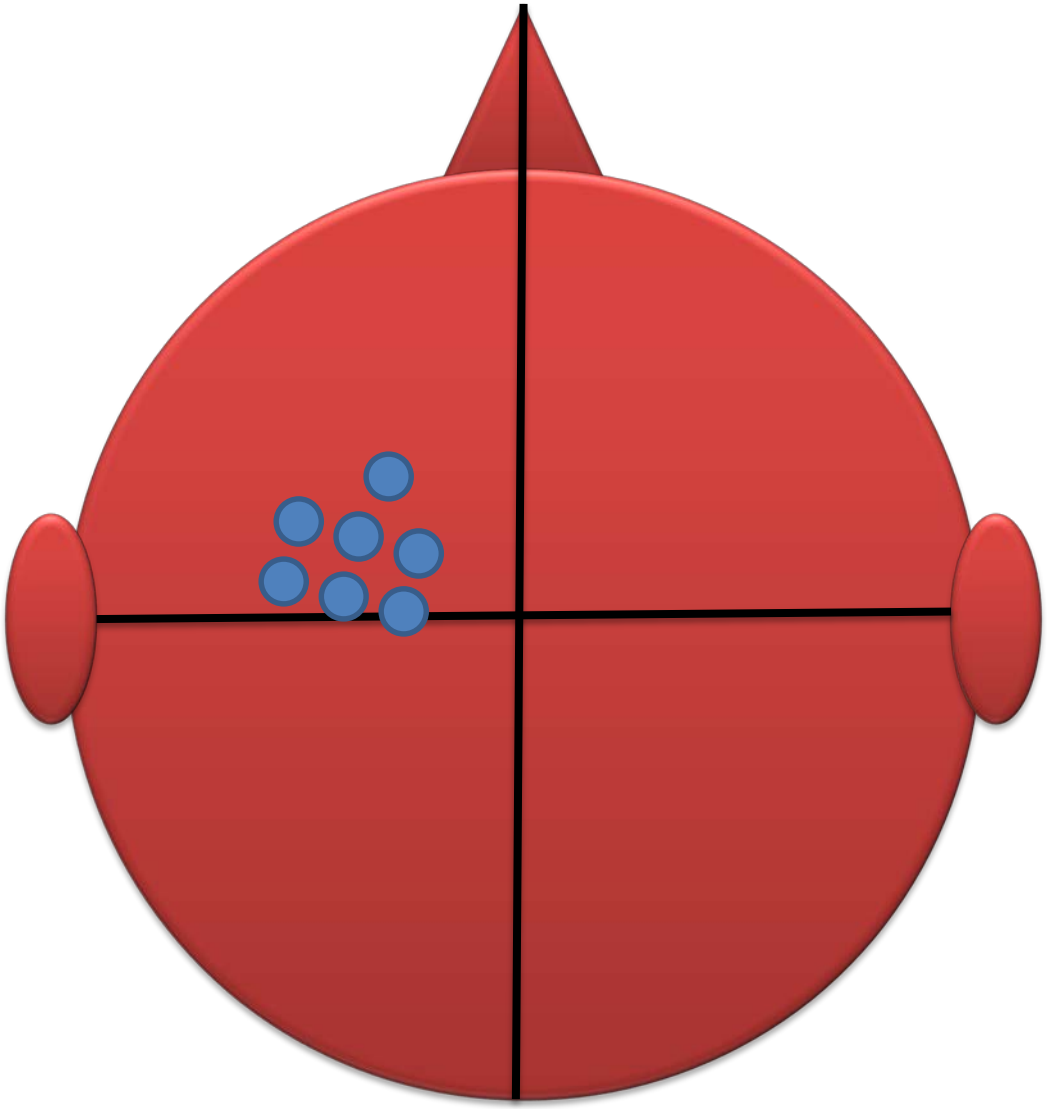
MEP-MUP




50 ms
Sessiz Periyod
500 uV
Kontrlateral sessiz periyod
500 uV
500 uV
500 uV
Kallozal geçiş zamanı
500 uV
500 uV
İpsilateral sessiz periyod
500 uV

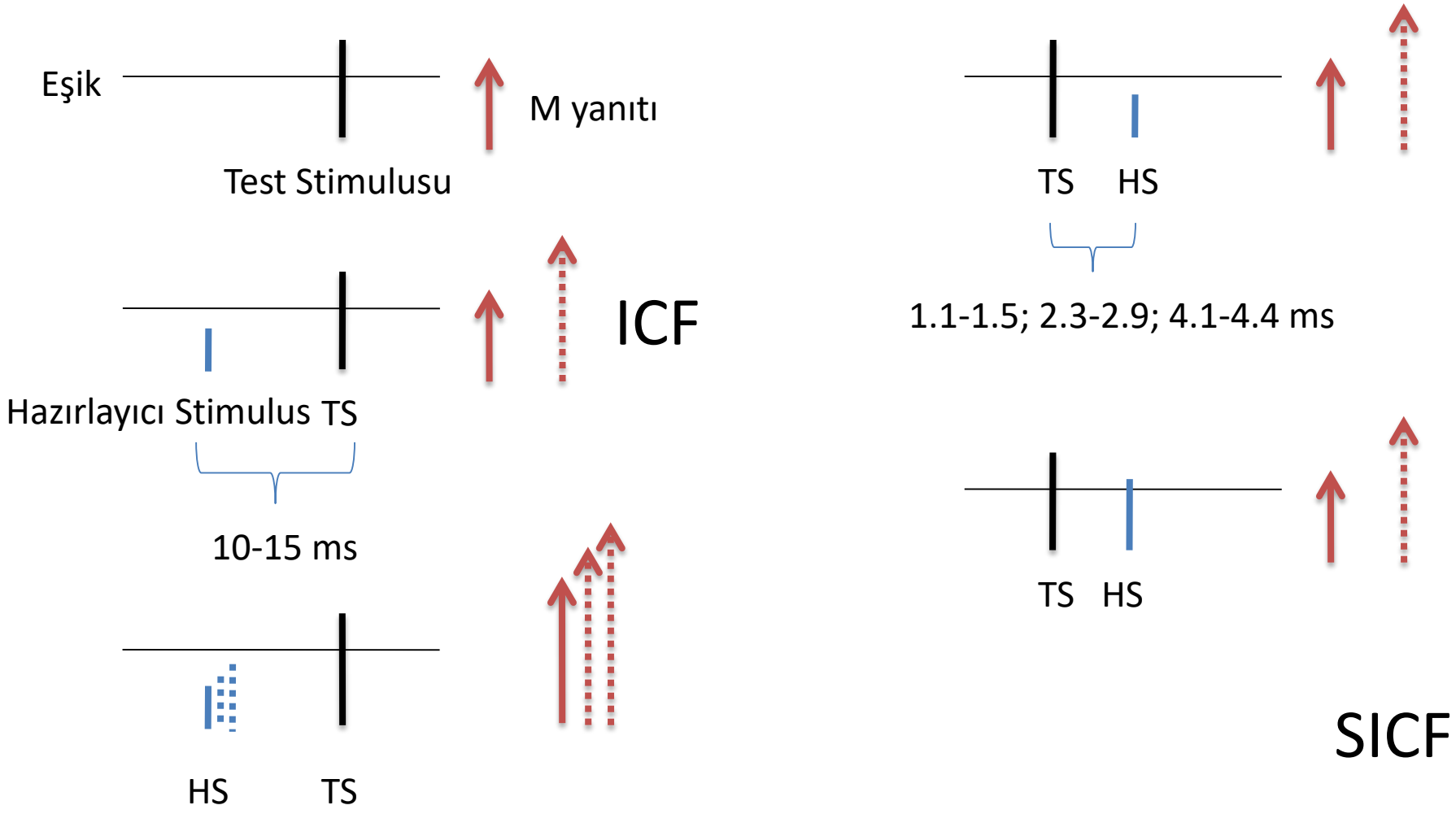
MEP-MUP

Haritalama



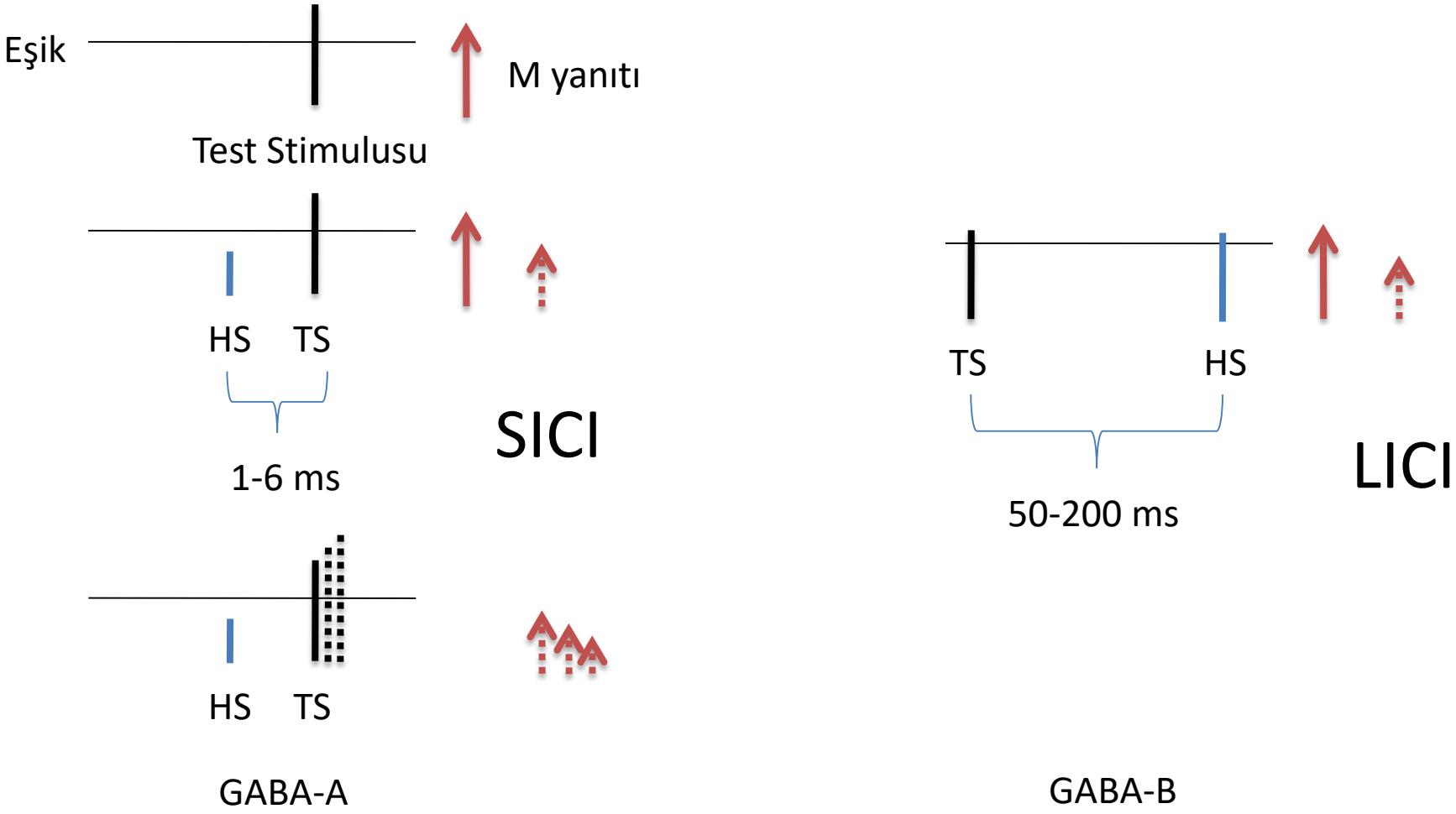
MEP-MUP

Çift Uyarım – Fasilitasyon / İnhibisyon



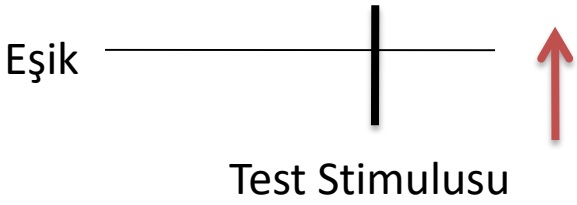
MEP-MUP

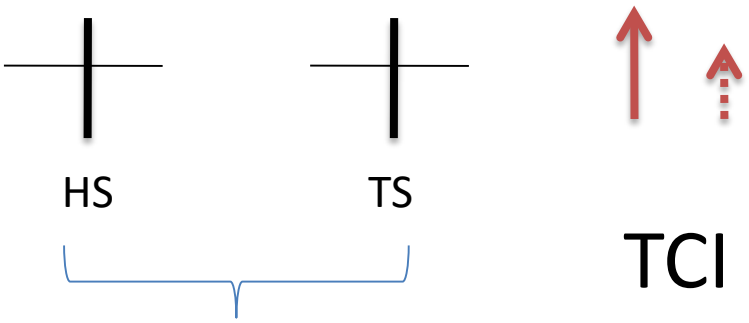
Çift Uyarım – Fasilitasyon / İnhibisyon



MEP-MUP

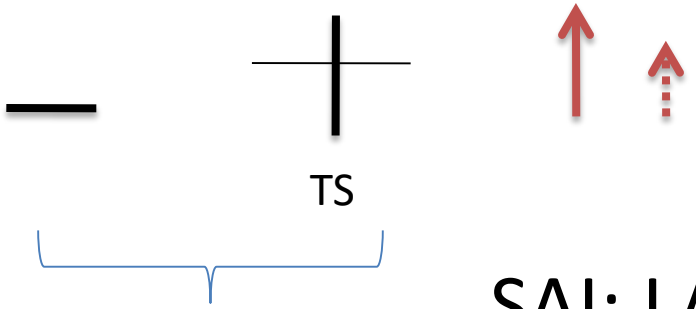
Çift Uyarım – Fasilitasyon / İnhibisyon





TCI

Kallozal geçiş

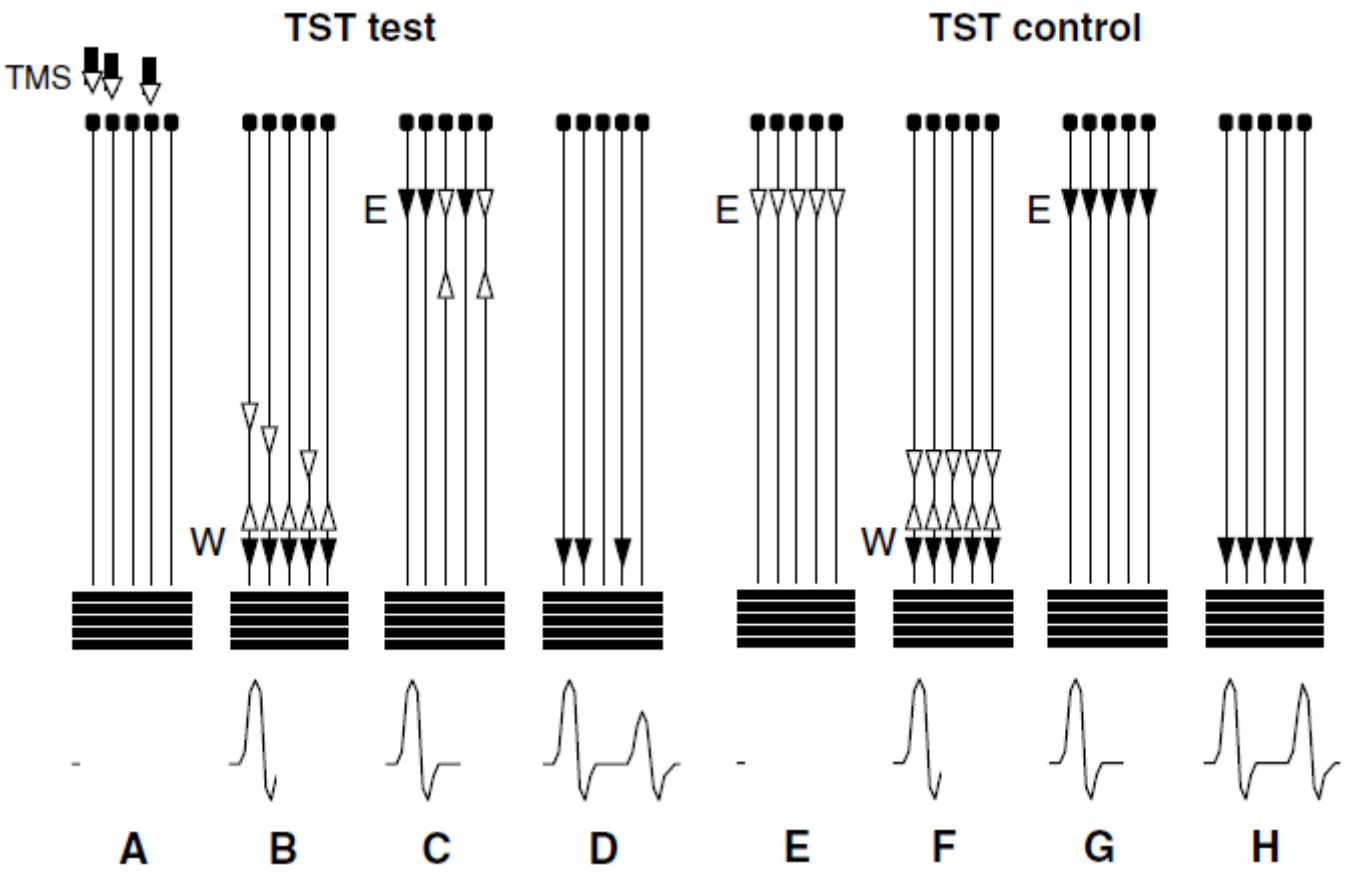


SAI; LAI

Muskarinik

MEP-MUP

Üçlü uyarım metodu



MS’teki anlamı ve çalışmalardan örnekler

MS tanısında % 68 anormal

Asemptomatik olgularda % 20 anormal

Birden fazla MEP yöntemin beraber kullanılması ve taraf karşılaştırmaları ile anormallik oranı artar

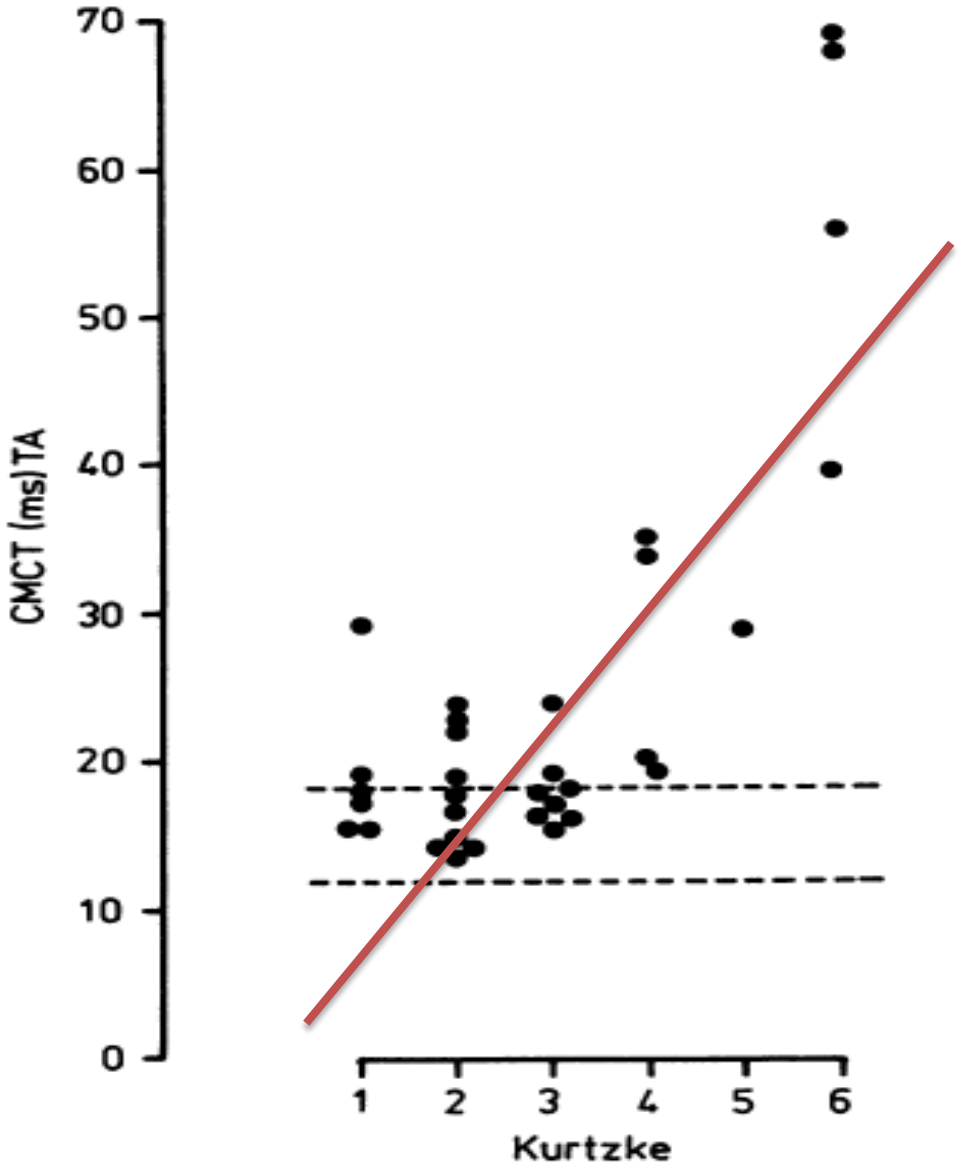
MEP anormalliği ile klinik bulgular korelasyon gösterir

Journal of Neurology, Neurosurgery, and Psychiatry 1988;**51**:487–494

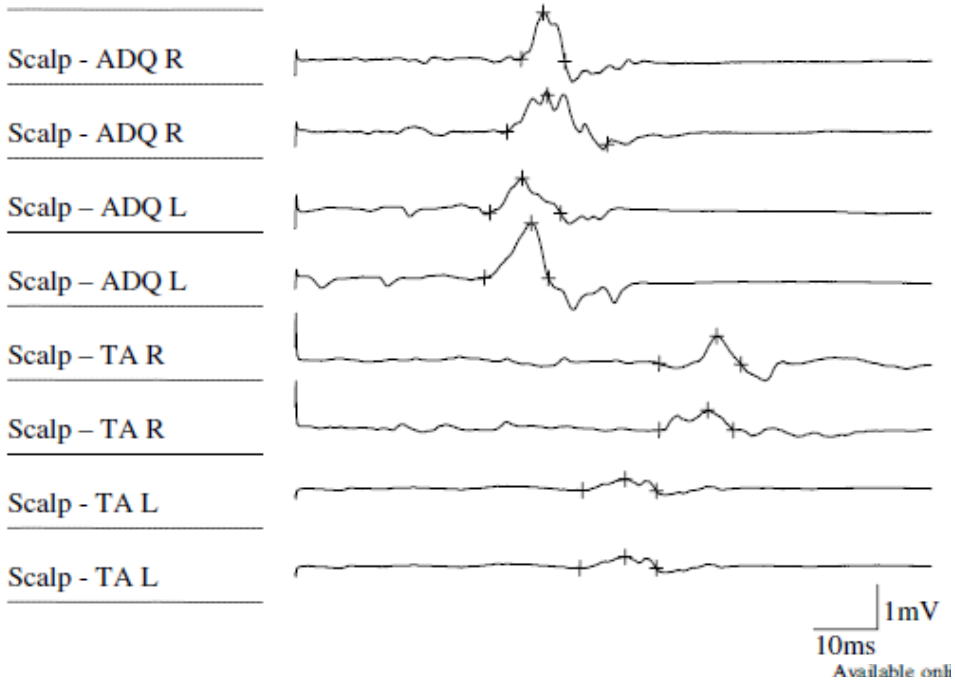
Central motor conduc
evaluation of abnorm
transcutaneous magne

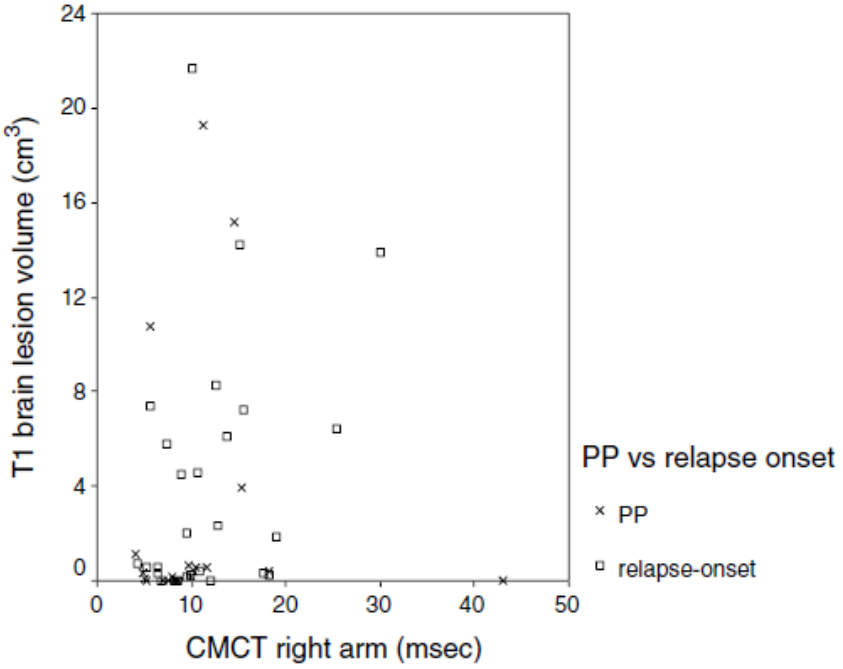
D A INGRAM, A J THOMPSON,

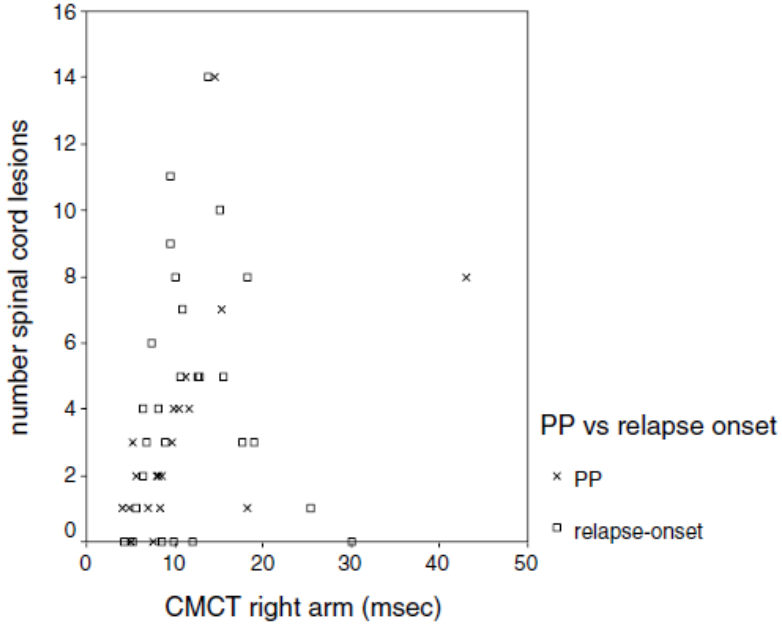
From the Departments of Clinical Neurophys

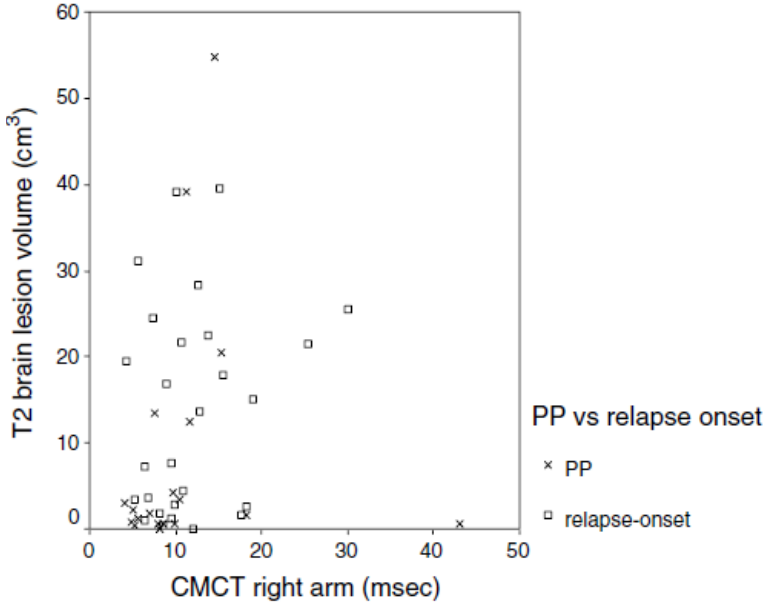


20 RRMS ile 10 NK
Mobilize ve stabil olgular


Scalp - ADQ R
Scalp - ADQ R
Scalp – ADQ L
Scalp – ADQ L
Scalp – TA R
Scalp – TA R
Scalp - TA L
Scalp - TA L
1mV
10ms


T1 brain lesion volume (cm3)
CMCT right arm (msec)
PP vs relapse onset
PP
relapse-onset


number spinal cord lesions
CMCT right arm (msec)
PP vs relapse onset
PP
relapse-onset


T2 brain lesion volume (cm3)
CMCT right arm (msec)
PP vs relapse onset
PP
relapse-onset

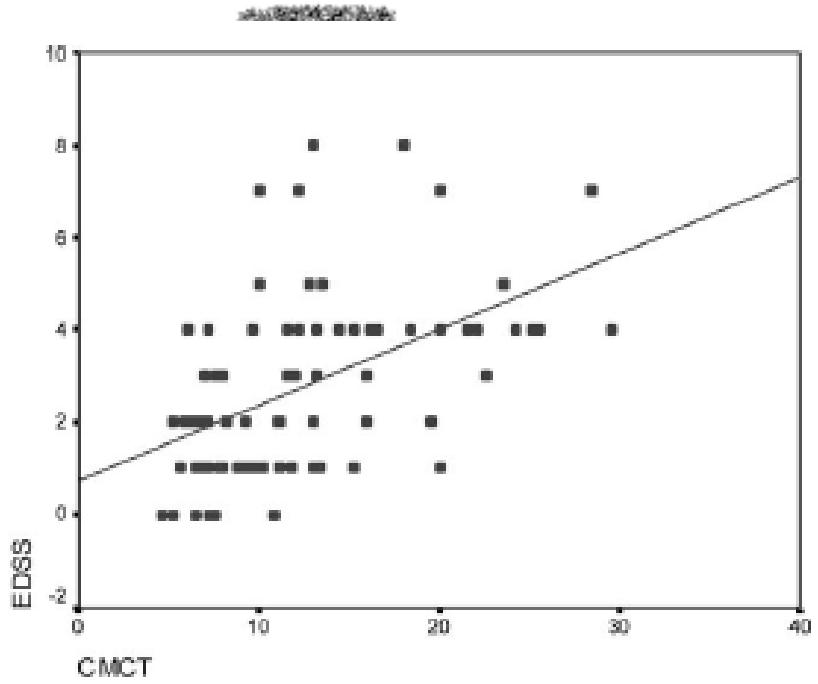


Fig. 1. The correlation between EDSS and CMCT (r: 0.61, P: 0.0001).

Clinical Neurology and Neurosurgery

and Neurosurgery 105 (2003) 105–110

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otor evoked potentials in patients with ltiple sclerosis

Egemen Idiman [b], Raif Cakmur [b], Fethi Idiman [b]

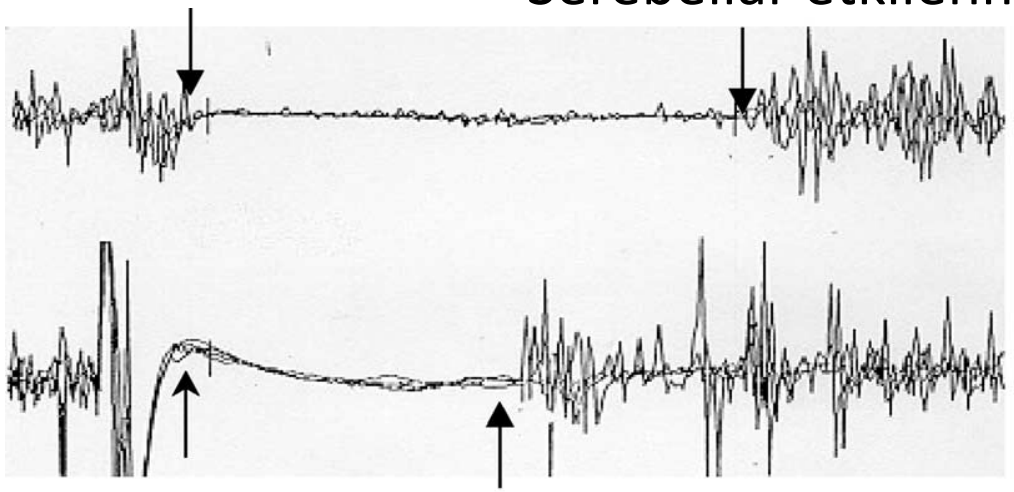
y of Medicine, Mersin University, Mersin 33079, Turkey
lty of Medicine, Dokuz Eylul University, Izmir, Turkey

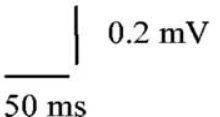
evised form 25 October 2002; accepted 25 October 2002

58 MS (RRMS-37, SPMS-21) ile 31 NK

SMG (%75.2), SP (%69), beraber (%89.7)

Serebellar etkilenmede SP uzaması





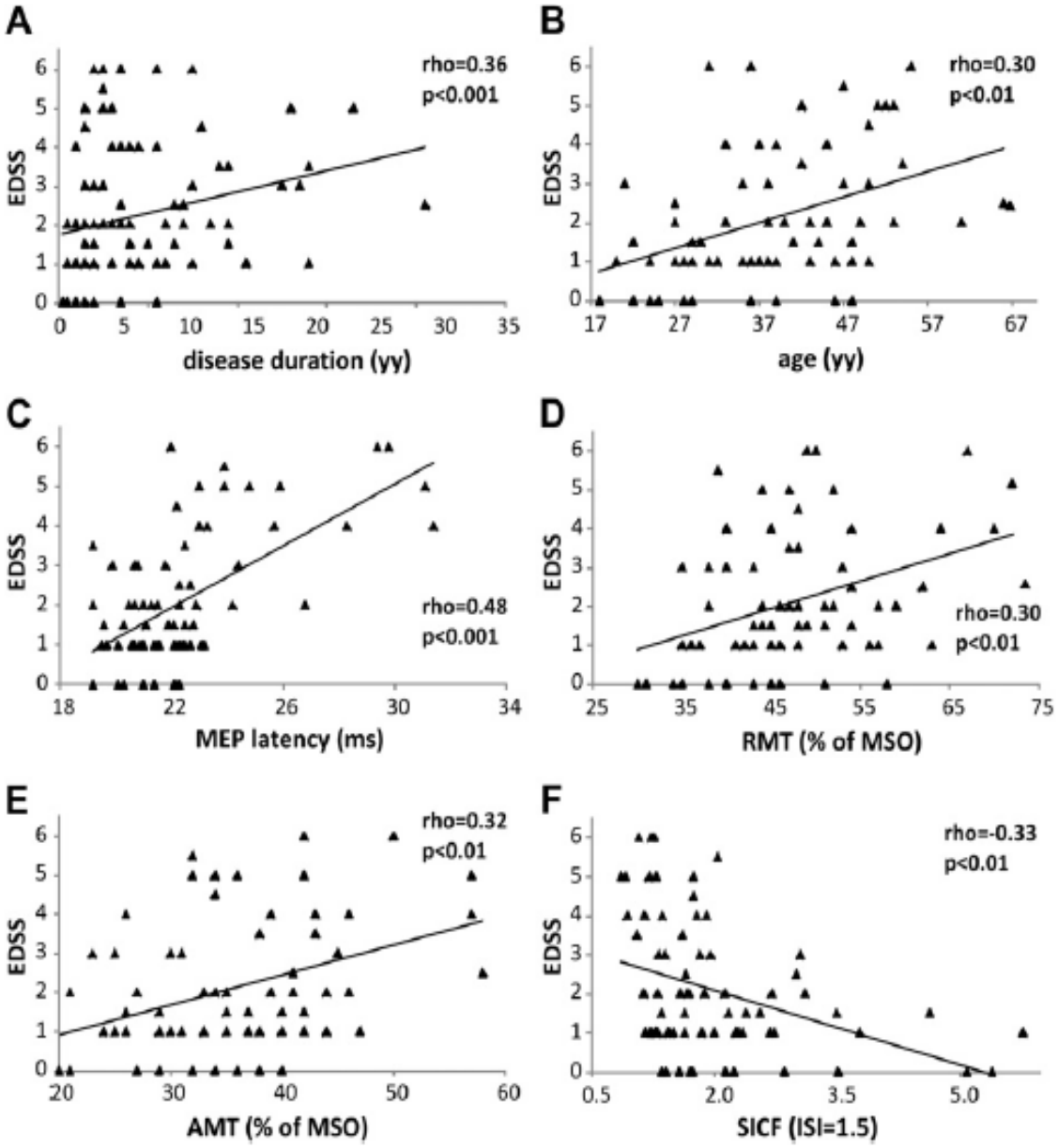


Figure 1. Correlation plots between EDSS and A) disease duration, B) patients' age, C) MEP latency, D) RMT, E) AMT and F) SICF at 1.5 ms ISI, expressed as conditioned/unconditioned MEP amplitude.

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Clinical Neurophysiology 115 (2004) 956–965

www.elsevier.com/locate/clinph

Brain excitability changes in the relapsing and remitting phases of multiple sclerosis: a study with transcranial magnetic stimulation

M. Donatella Caramia[a,b,*], M. Giuseppina Palmieri[a,b], M. Teresa Desiato[a,b], Laura Boffa[a,b], Pierluigi Galizia[a,b], Paolo M. Rossini[c,d], Diego Centonze[a,b], Giorgio Bernardi[a,b]

[a]*Dipartimento di Neuroscienze, Clinica Neurologica, Università di Tor Vergata, Via Montpellier 1, 00133 Rome, Italy*
[b]*Fondazione S. Lucia, Rome, Italy*
[c]*Divisione di Neurologia, Ospedale Fatebene Fratelli, AfaR, Rome, Italy*
[d]*Clinica Neurologica, Università Campus Biomedico, Rome, Italy*

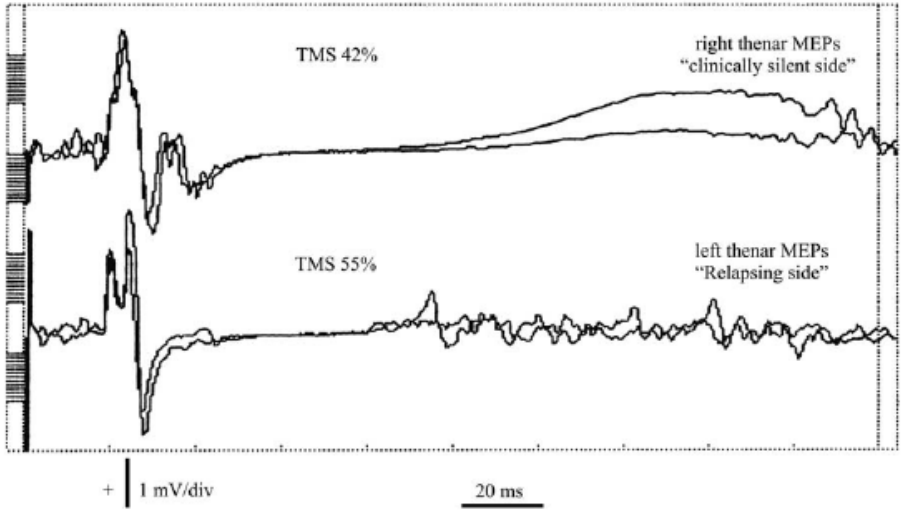
Accepted 17 November 2003

79 MS tek ve çift uyarım - atak ve remisyondaki davranışları

Motor eşik, SP, SMG, ICI

Relapsta eşik yüksek, SP kısa, ICI kayıp bulunurken

Remisyonda ise eşik normale dönmüş ve SP uzamış



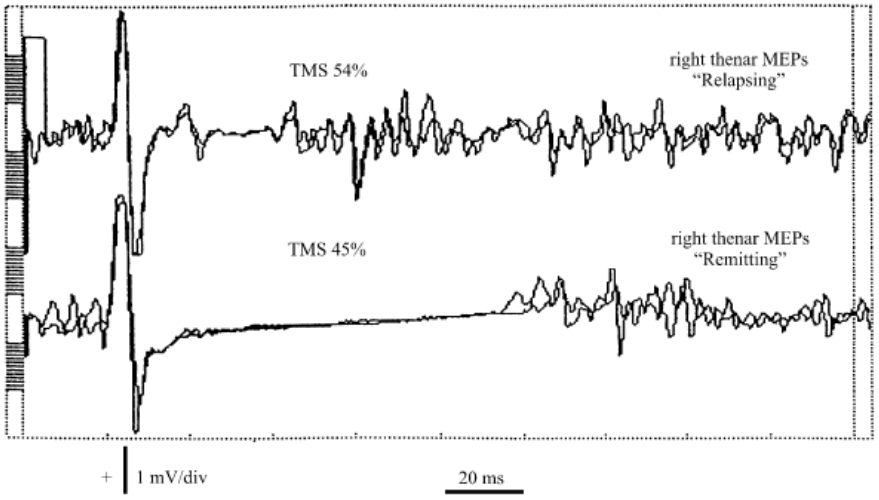


Table 1 Sensitivities and detection rates of subclinical lesions (%) of evoked potentials at baseline

	VEP	BAEP	UL-SEP	LL-SEP	UL-MEP	LL-MEP	iSP
Sensitivity	62.2	28.6	24.3	56.8	32.4	67.6	27.0
Detection rate of subclinical lesions[a]	34.0	12.0	8.3	15.2	9.1	53.6	N/A[b]

VEP, visual evoked potentials; BAEP, brainstem auditory evoked potentials; SEP, somatosensory evoked potentials; MEP, motor evoked potentials; UL, upper limb; LL, lower limb; iSP, ipsilateral silent period.
[a]Separate analysis for left and right side.
[b]iSP is not related to any known clinical deficit.

3-6

0-normal; 1-taraflar aras mplitüd asimetrisi;
3-lata)

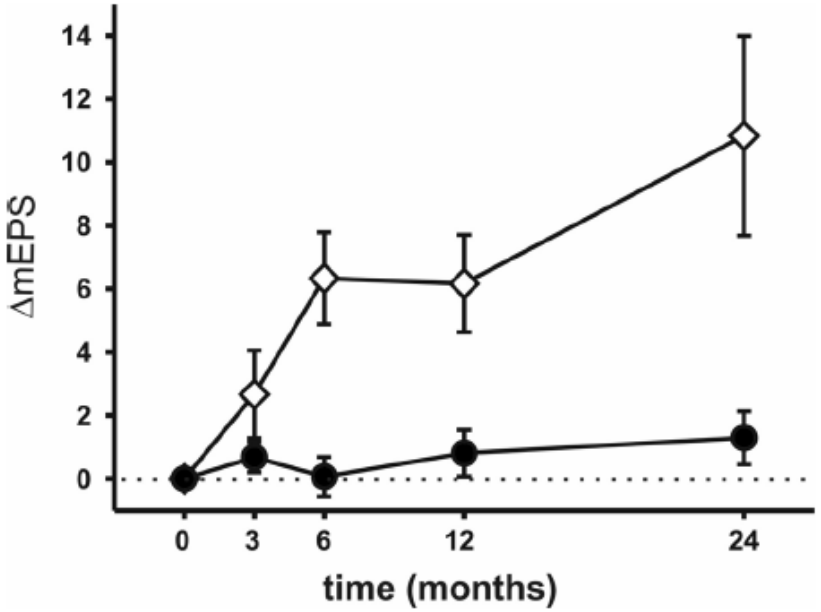


Figure 1 Changes in the multimodal evoked potential score (ΔmEPS) in RRMS patients with (open diamonds, $n = 7$) or without (filled circles, $n = 30$) relevant EDSS progression during the 24-month follow-up. Starting at month 6, ΔmEPS was significantly higher in progressive than stable patients (all $p < 0.01$).

Clinical Neurophysiology 123 (2012) 406–410

Contents lists available at ScienceDirect

Clinical Neurophysiology

journal homepage: www.elsevier.com/locate/clinph

Combined evoked potentials as markers and predictors of disability in early multiple sclerosis

Regina Schlaeger [a], Marcus D'Souza [a], Christian Schindler [b,c], Leticia Grize [b,c], Ludwig Kappos [a], Peter Fuhr [a,*]

[a] Department of Neurology, University Hospital Basel, Switzerland
[b] Swiss Tropical and Public Health Institute, Socinstrasse 57, P.O. Box, 4002 Basel, Switzerland
[c] University of Basel, Petersplatz 1, CH-4003 Basel, Switzerland

Objective: To prospectiv … nd predictors of the dis-
ease course of early MS …
Methods: Fifty patients … ctively received visual,
somatosensory and mot … months intervals during
3 years. Spearman rank … between *z*-transformed
EP-latencies (*z*-EPL) and … to predict EDSS at year
3 (T7) in function of *z*-E … ross-validation.
Results: At each of the s … -EPL ($0.64 \leqslant rho \leqslant 0.79$,
$p < 0.001$). The change … of $EDSS_{T7-T1}$ (rho = 0.51,
$p = 0.001$). $EDSS_{T7}$ as pre … number of pathological
EP results at baseline c … rs (rho > 0.70, $p < 0.001$,
for both measures).
Conclusions: Multimoda … tional and longitudinal
comparison in early MS …
Significance: EPs seem w … n clinical trials and bear
potential for supporting …

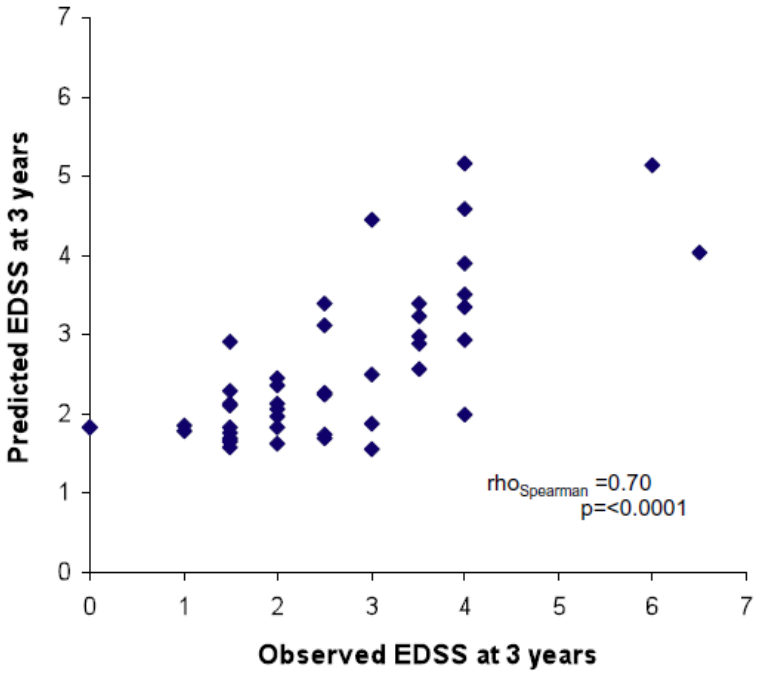


Fig. 1. Observed and predicted EDSS at year 3 using the linear Model 1.

Research Paper

MULTIPLE SCLEROSIS JOURNAL | MSJ

Combined visual and motor evoked potentials predict multiple sclerosis disability after 20 years

Multiple Sclerosis Journal
2014, Vol. 20(10) 1348–1354

DOI: 10.1177/1352458514525867
msj.sagepub.com
SAGE

Regina Schlaeger[1], Christian Schindler[2,3], Leticia Grize[2,3], Sophie Dellas[4], Ernst W Radue[4,5], Ludwig Kappos[1,3] and Peter Fuhr[1,3]

Background: The development of predictors of multiple sclerosis (MS) disability is difficult due to the complex interplay of pathophysiological and adaptive processes.

Objective: The purpose of this study was to investigate whether combined evoked potential (EP)-measures allow prediction of MS disability after 20 years.

Methods: We examined 28 patients with clinically definite MS according to Poser's criteria with Expanded Disability Status Scale (EDSS) scores, combined visual and motor EPs at entry (T0), 6 (T1), 12 (T2) and 24 (T3) months, and a cranial magnetic resonance imaging (MRI) scan at T0 and T2. EDSS testing was repeated at year 14 (T4) and year 20 (T5). Spearman rank correlation was used. We performed a multivariable regression analysis to examine predictive relationships of the sum of z-transformed EP latencies ($s\text{-EP}_{T0}$) and other baseline variables with $EDSS_{T5}$.

Results: We found that $s\text{-EP}_{T0}$ correlated with $EDSS_{T5}$ (rho=0.72, $p<0.0001$) and $\Delta EDSS_{T5\text{-}T0}$ (rho=0.50, $p=0.006$). Backward selection resulted in the prediction model: $E(EDSS_{T5})=3.91-2.22\times\text{therapy}+0.079\times\text{age}+0.057\times s\text{-EP}_{T0}$ (Model 1, $R^2=0.58$) with therapy as binary variable (1=any disease-modifying therapy between T3 and T5, 0=no therapy). Neither $EDSS_{T0}$ nor T2-lesion or gadolinium (Gd)-enhancing lesion quantities at T0 improved prediction of $EDSS_{T5}$. The area under the receiver operating characteristic (ROC) curve was 0.89 for model 1.

Conclusions: These results further support a role for combined EP-measures as predictors of long-term disability in MS.

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Early disturbances in multimodal evoked potentials as a prognostic factor for long-term disability in relapsing-remitting multiple sclerosis patients

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HIGHLIGHTS

- There is an unmet need for markers predicting long-term disability in multiple sclerosis patients.
- Multimodal EP alterations at diagnosis predict future disability worsening in RRMS patients.
- Correlation with long-term disease burden was the highest for MEPs, BAEPs and upper limb SSEPs.

Objective: The aim of this study was to investigate whether early alterations in evoked potentials (EPs) have a prognostic value in relapsing-remitting multiple sclerosis (RRMS).

Methods: We retrospectively selected 108 early MS patients with a neurological follow-up ranging from 5 to 15 years, in whom multimodal EPs (visual, brainstem auditory, somatosensory and motor) were performed at diagnosis. A conventional ordinal score was used to quantify the observed abnormalities.

Results: The extent of change in the composite EP score was well correlated to the Expanded Disability Status Scale (EDSS) at ten years (Y_{10}) and up to 15 years (Y_{11-15}) after disease onset. Analysis of the predictive value of the EP score showed an increased risk of disability progression at Y_{10} and Y_{11-15} of 60% ($p < 0.0001$) and 73% ($p < 0.0001$) respectively in patients with an EP score >4. Conversely, the risk of disability progression at Y_{10} and Y_{11-15} associated with a lower EP score ($\leqslant 4$) was reduced to 16% and 20% respectively.

Conclusions: Our data support the good predictive value for long-term disability progression of multimodal EPs performed early after disease onset in RRMS patients.

Significance: This study, performed in a homogeneous RRMS cohort with long term follow-up, demonstrates the value of an early comprehensive neurophysiological assessment as a marker for future disability.

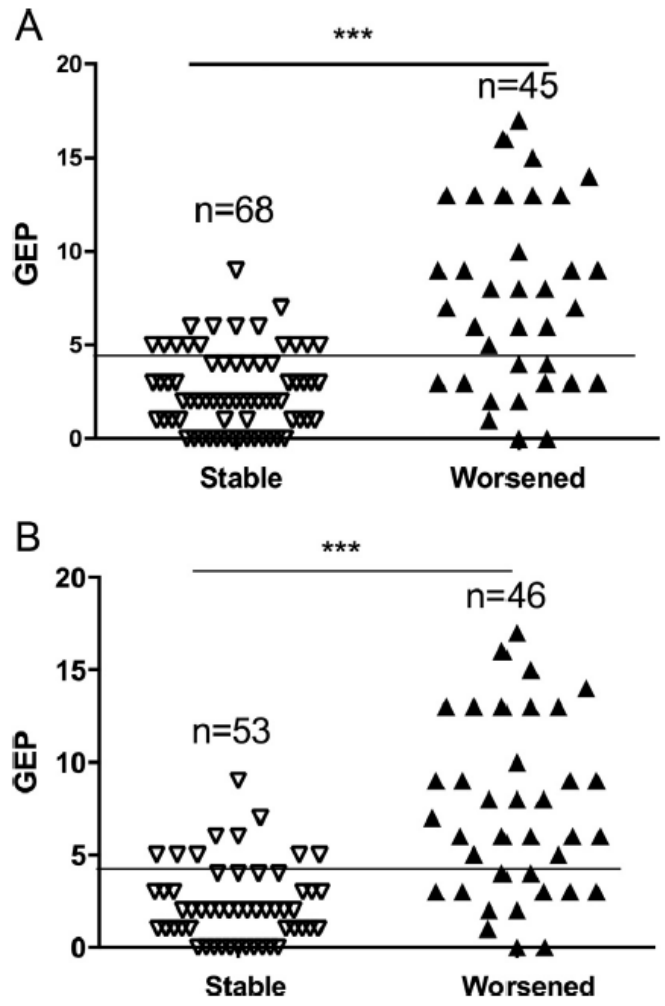

Fig. 4. Distribution of the global evoked potential score (GEP) in worsened and stable RRMS patients according to the median GEP score of the studied cohort (4) at Y_{10} (A) and Y_{11-15} (B). *** indicates a p value of <0.0001 using the Mann–Whitney test.

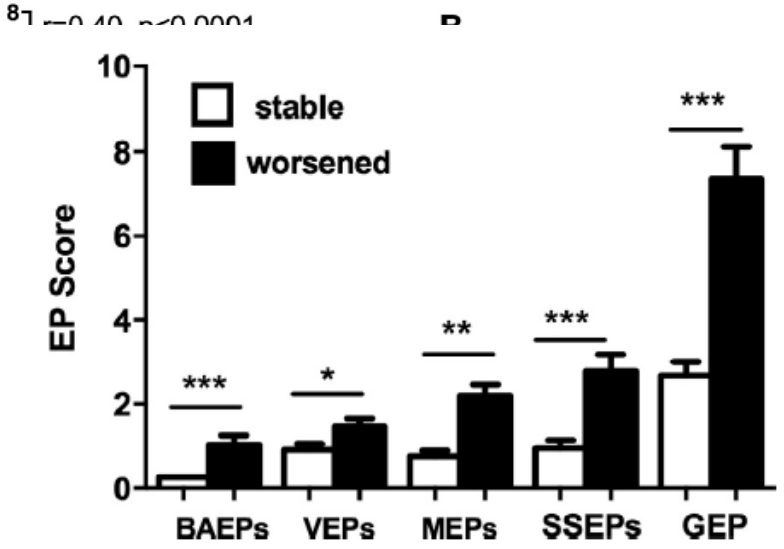

Fig. 5. Baseline BAEP, VEP, MEP, and SSEP and global evoked potential scores in RRMS patients with EDSS stability (white bars) and EDSS worsening (black bars) at last follow-up. BAEP, brainstem auditory evoked potentials; VEP, visual evoked potentials; MEP, motor evoked potentials; SSEP, somatosensory evoked potentials; GEP, global evoked potential score. EDSS, Expanded Disability Status Scale. *, ** and *** indicate p values of <0.05, <0.01 and <0.0001 respectively, using the Mann–Whitney test. Error bars represent 95% confidence intervals.

ores at Y_0 (A), Y_5 (B), Y_{10} (C) and Y_{11-15} (D) using Spearman's rank correlation coefficient.

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BMC Neurology

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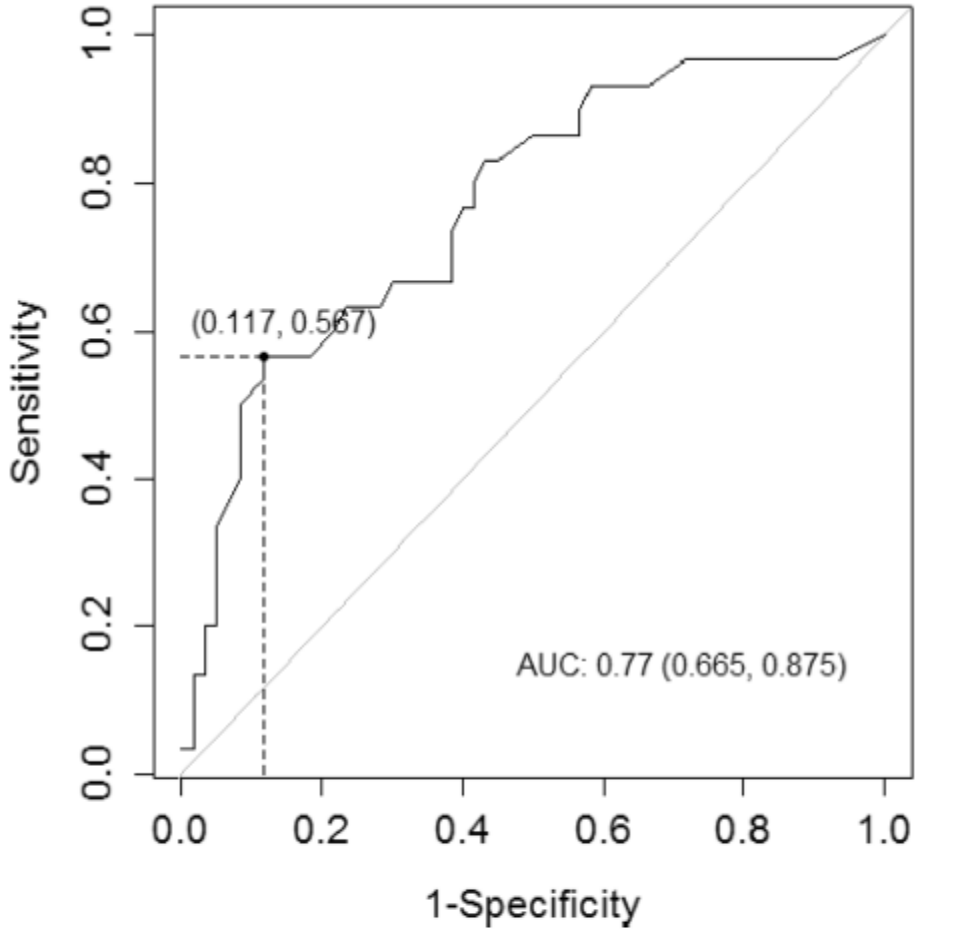

Fig. 2 ROC curve of baseline global EP score with respect to EDSS worsening. Area under the ROC curve (AUC = 0.77) and best cut-off point (Global EP score = 17/30) with a sensitivity of 56.7 % and a specificity of 88.3 %. EDSS worsening (Yes/No) was defined as a 1-point increase from T0 to T1 given a baseline EDSS <5.5 or an increase of 0.5 point given a baseline EDSS ≥5.5

Abstract

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Table 3
Longitudinal correlations between EP-Scores and EDSS over 3 years.

Score	$\Delta EDSS_{T4-T0}$		
	rho	*p*	95% CI
$\Delta q\text{-}EPS_{T4-T0}$	0.47	**<0.001**	0.25–0.64
$\Delta o\text{-}EPS_{T4-T0}$	0.41	**0.003**	0.14–0.62
$\Delta sq\text{-}EPS_{T4-T0}$	0.39	**0.004**	0.16–0.58

EP: evoked potentials. EDSS: expanded disability status scale. Rho: spearman rank rho; T0: baseline, T4: year 3; q-EPS: quantitative EP-Score, o-EPS: ordinal EP-Score, sq-EPS: semi-quantitative EP-Score. 95%-Confidence intervals (CI) were calculated using bootstrapping with 1000 iterations.
p values ≤0.01 are bolded.

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Table 4
Predictive correlations between EP scores at baseline and clinical development over 3 years.

Score	$EDSS_{T4}$			$\Delta EDSS_{T4-T0}$		
	rho	*p*	95% CI	rho	*p*	95% CI
$q\text{-}EPS_{T0}$	0.85	**⩽0.001**	0.76–0.91	0.46	**⩽0.001**	0.25–0.64
$o\text{-}EPS_{T0}$	0.84	**⩽0.001**	0.77–0.89	0.44	**⩽0.001**	0.22–0.62
$sq\text{-}EPS_{T0}$	0.86	**⩽0.001**	0.79–0.90	0.44	**⩽0.001**	0.22–0.63
$\Delta q\text{-}EPS_{T1-T0}$	0.56	**⩽0.001**	0.34–0.73	0.56	**⩽0.001**	0.37–0.71
$\Delta o\text{-}EPS_{T1-T0}$	0.21	0.091	−0.09 to 0.47	0.16	0.197	−0.10 to 0.42
$\Delta sq\text{-}EPS_{T1-T0}$	0.15	0.234	−0.07 to 0.36	0.30	0.014	0.08 to 0.51

EP: evoked potentials. EDSS: expanded disability status scale. Rho: spearman rank rho; T0: baseline, T1: month 6, T4: year 3; q-EPS: quantitative EP-Score, o-EPS: ordinal EP-Score, sq-EPS: semi-quantitative EP-Score. 95%-Confidence intervals (CI) were calculated using bootstrapping with 1000 iterations.
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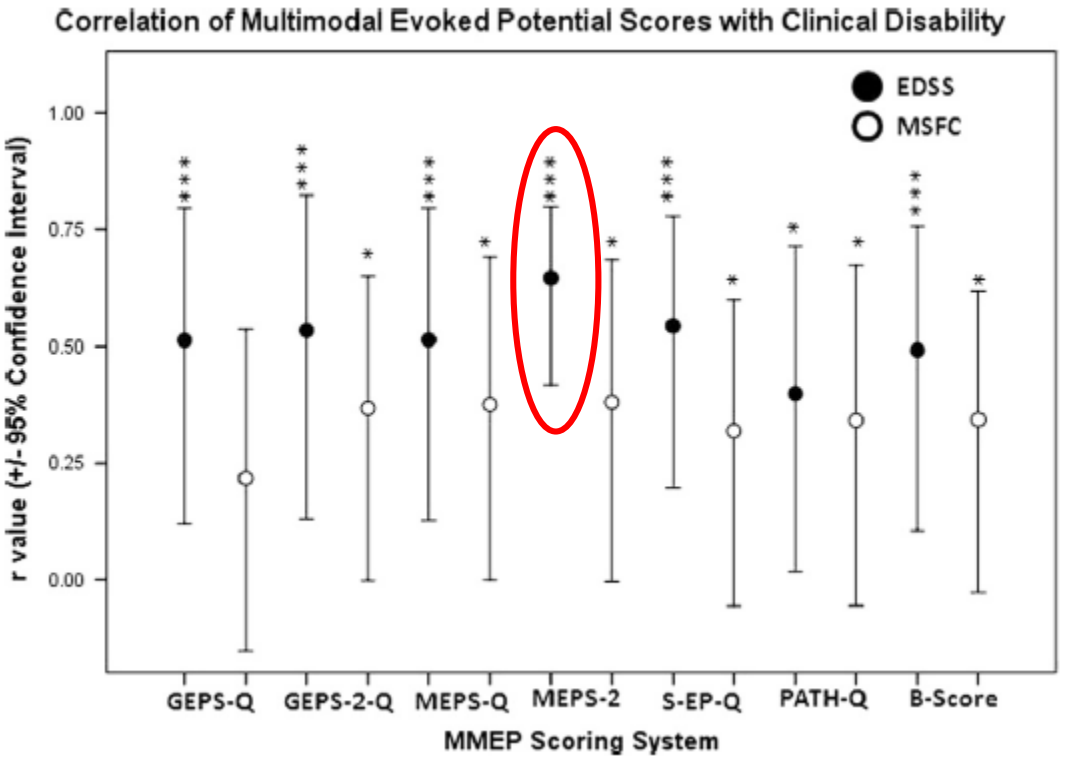

Conclusions:
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$$\text{GEPS–Q} = \frac{\Sigma(\textit{GEPS for all modalities})}{\text{Number of EPs performed}}$$

GEPS–2 = ΣGEP for each modality but excluding SSEP of Upper Limbs

$$\text{mEPS–Q} = \frac{\Sigma(\textit{mEPS of VEP, SSEP UL \& LL, Motor EP UL \& LL})}{\text{Number of EPs Performed}}$$

mEPS – 2 = Σ(mEPS of VEP, BSAEP and SSEP of UL & LL)

Quantitative methods

Pathological quotient

$$\text{PATH} - \text{Q} = \frac{\text{Number of Abnormal EPs}}{\text{Number of EPs recorded}}$$

Summed EP Latency *Z* Quotient Score

$$\text{S} - \text{EPL} - \text{Q} = \frac{\Sigma(Z \text{ Transformed EP Latencies})}{\text{Number of EPs performed}}$$

BrAMS Score

$$\text{BScore} = \sqrt{\Sigma(Z \text{ transformed EP Latencies})^2}$$

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Multimodal evoked potentials follow up in multiple sclerosis patients under fingolimod therapy

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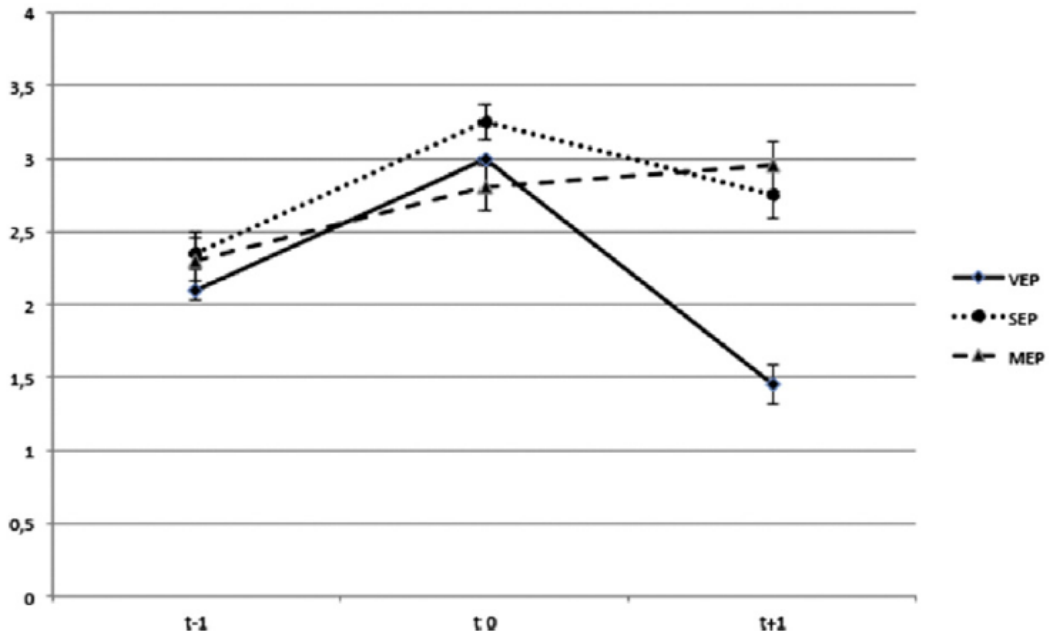

Fig. 1. Developmental of EP scores before and under fingolimod treatment. During pre-treatment period (1 year) VEP, SEP and MEP worsened ($p = 0.01$) while one year after fingolimod treatment VEP and SEP ameliorated ($p = 0.01$) and MEP remained stable ($p = 0.39$). VEP = visual evoked potential; SEP = sensory evoked potentials; MEP = motor evoked potentials.

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Research Article

Operant Up-Conditioning of the Tibialis Anterior Motor-Evoked Potential in Multiple Sclerosis: Feasibility Case Studies

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Damage to the corticospinal pathway often results in weak dorsiflexion of the ankle, thereby limiting the mobility of people with multiple sclerosis (MS). Thus, strengthening corticospinal connectivity may improve locomotion. Here, we investigated the feasibility of tibialis anterior (TA) motor-evoked potential (MEP) operant conditioning and whether it can enhance corticospinal excitability and alleviate locomotor problems in people with chronic stable MS. The protocol consisted of 6 baseline and 24 up-conditioning sessions over 10 weeks. In all sessions, TA MEPs were elicited at 10% above active threshold while the sitting subject provided 30–35% maximum voluntary contraction (MVC) level of TA background EMG. During baseline sessions, MEPs were simply measured. During conditioning trials of the conditioning sessions, the subject was encouraged to increase MEP and was given immediate feedback indicating whether MEP size was above a criterion. In 3/4 subjects, TA MEP increased 32–75%, MVC increased 28–52%, locomotor EMG modulation improved in multiple leg muscles, and foot drop became less severe. In one of them, MEP and MVC increases were maintained throughout 3 years of extensive follow-up sessions. These initial results support a therapeutic possibility of MEP operant conditioning for improving locomotion in people with MS or other CNS disorders, such as spinal cord injury and stroke.

Clinical Correlations of Motor and Somatosensory Evoked Potentials in Neuromyelitis Optica

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Methods and Findings: Clinical symptoms and examination findings at relapses of 30 NMO patients were retrospectively reviewed. Abnormal MEPs were observed in 69.2% of patients. Patients with abnormal motor central conduction time (CCT) of the lower limbs had higher Kurtzke Expanded Disability Status Scale (EDSS) scores than those with normal responses (P=0.027). Abnormal SSEPs were found in 69.0% of patients. Patients with abnormal lower limb sensory CCT had higher EDSS scores than those with normal responses (P=0.019). In 28 patients followed up more than 6 months, only one of 11 patients (9.1%) with normal SSEPs of the lower limbs had new relapses within 6 months, whereas 8 of 17 patients (47.1%, P=0.049) with abnormal SSEPs of the lower limbs had new relapses.

Conclusions: These results indicate MEPs and SSEPs of the lower limbs are good indicators for the disability status at relapses of NMO. Lower limb SSEPs may be a good tool for reflecting the frequency of relapses of NMO.

“Hiçbir yöntem MS için spesifik olmadığı gibi etkilenmeyi de sınırlı bir sensitivite ile gösterir”

Fizyolojik etkilenmeyi ve etkilenmenin doğasını;
Seri incelemeler ile sürecin seyrini;

Pognozu tahmin etmeyi…

Tedavi ajanına yanıt olup olmayacağını;
Tedavi değişme gerekliliğini;
Tedaviyi;

Teşekkür ediyorum...

MULTIPLE SCLEROSIS JOURNAL | MSJ

Topical Review

A new role for evoked potentials in MS? Repurposing evoked potentials as biomarkers for clinical trials in MS

Martin Hardmeier, Letizia Leocani and Peter Fuhr

Multiple Sclerosis Journal

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Evidence-based guidelines on the therapeutic use of repetitive transcranial magnetic stimulation (rTMS)

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