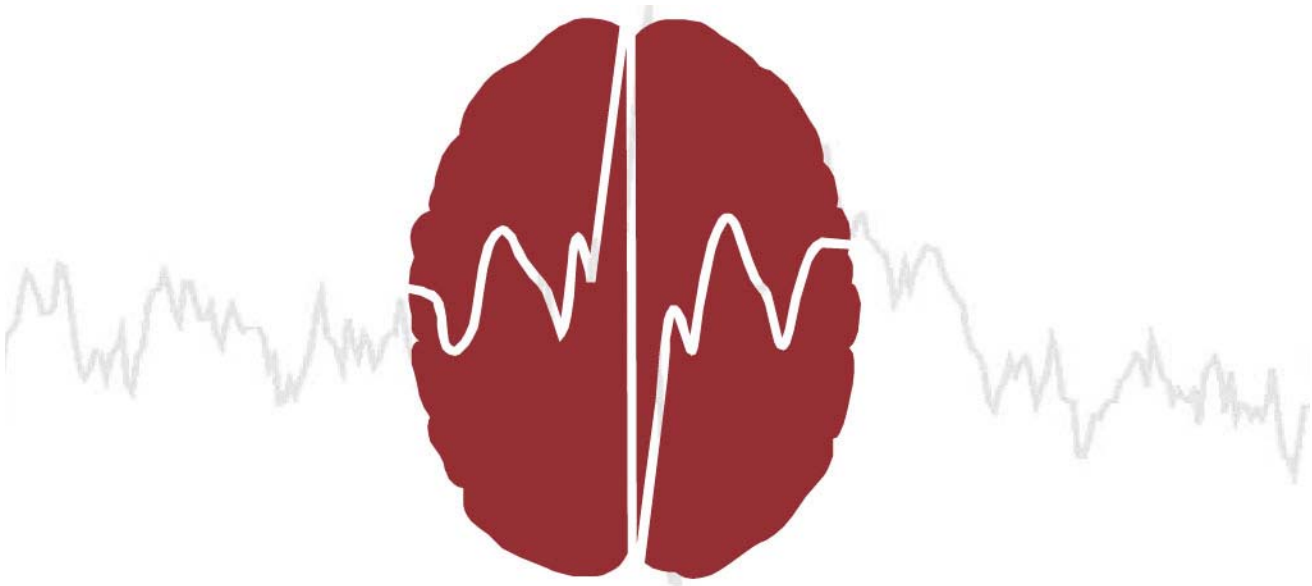
4th Annual ACMEGS Conference

Febuary 4th, 2010



ACMEGS

AMERICAN CLINICAL MEG SOCIETY

Westin Gaslamp Quarter

San Diego, CA

ACMEGS **American Clinical MEG Society February 4, 2010 in San Diego, CA**

Welcome to San Diego! On the behalf of the Organizing Committee, I hope that you enjoy your visit to San Diego in the beautiful south of California.

This is the 4th annual meeting of the ACMEGS. And for the first time we try a new format: A joint meeting with the American Clinical Neurophysiology Society (ACNS). The goal of this format is to save ACMEGS members who are also ACNS members one trip to a conference, as well as to spark some interest with members of ACNS who are not so familiar with MEG technology. We also invited some ACNS members to present their posters at our meeting.

We moved the business meeting and the economical MEG topic into the first half of the day to encourage interested ACNS members to join us in the afternoon for the scientific presentations. During this year's business meeting the ACMEGS board will present a proposal that will potentially improve our bylaws significantly by providing clear rules for election of board members.

During the scientific afternoon sessions we will focus on MEG/EEG Co-registration. If this shows to be a positive change from our "traditional" model, we should more thematic sessions for future meeting. A special highlight of this years program will be a live demonstration of MEG and EEG source localization, presented by John Ebersole and Susan Hawes-Ebersole.

The meeting provides an informal and friendly atmosphere for discussing and exchanging recent studies that might lead to new clinical indications for MEG and increase the economic success of MEG. We can help our member hospitals to promote the appropriate use of the technology. And it is important to work closely with the local payors and governmental regulatory bodies to ensure accurate and successful reimbursement.

We also welcome Dr. Stefan Rampp, from the German group in Erlangen, for delivering the third John Gates Memorial Lecture.

Since this is a national conference involving many clinical sites, under no circumstances should anyone divulge their institutional billing rates or other actual billing rates.

Please enjoy the conference and dinner.

Sincerely,

Michael E Funke, M.D., Ph.D.
President, American Clinical Magnetoencephalography Society

Organizing Committee:
Anto Bagic, University of Pittsburgh Medical Center, Pittsburgh PA
Greg Barkley, Henry Ford Hospital, Detroit MI
Michael Funke, University of Utah, Salt Lake City UT
Robert Knowlton, University of Birmingham, Birmingham AL
Roland Lee, University of California San Diego, San Diego CA
Steven Stufflebeam, Mass. General Hospital, Boston MA

PROGRAM

Thursday, February 4, 2010

8:30 am **Arrival / Breakfast Reception**

9:30 am **ACMEGS Presidential Address**
Welcome and Introduction (Michael Funke, Salt Lake City, UT)

9:40 am **Business Meeting (for ACMEGS members only)**
a) Financial Report (Anto Bagic, Pittsburgh PA)
b) Old business
c) New business

10:40 am **Reimbursement Round Up – Successes, Opportunities, Chalanges** (Michael Longacre, Crofton MD)

11:40 am **Lunch / ACMEGS Photo shooting**

1:00 pm **Comparison of MEG techniques for localizing and characterizing the epileptogenic focus (chair: Richard Burgess, Cleveland OH)**
- **Introductory remarks** (Richard Burgess, Cleveland OH)
- **The Cleveland Clinic experience** (Richard Burgess, Cleveland OH)
- **The CHOP experience** (Erin Schwartz, Philadelphia PA)
- **The MGH experience** (Naoaki Tanaka, Boston MA)
- **MEG/EEG Co-registration: Concordances and Disagreements** (Ernst Rodin, Sandy UT)

Rationale: Clinical MEG centers use a variety of techniques to localize and characterize the epileptogenic focus. These include dipole modeling, CSD variations, beamformers, etc. Seldom are these methods directly compared. Participant centers will present spike/seizure analyses of several clinical cases using at least two different techniques on the same data. For each patient, these results will be compared to the clinical history, individual MRI, pre-surgical evaluation, intracranial EEG, and surgical-outcome, if available.

2:20 pm **Coffee Break**

2:45 pm **Poster Session (ACMEGS posters and invited ACNS posters)**

3:15 pm **Interactive, real-time workshop in comparative and combined MEG/EEG spike analysis (chairs: John and Susan Ebersole, Chicago IL)**
Rationale: Although most clinical MEG centers record EEG along with MEG, few centers model the EEG and compare these results to that of the simultaneous MEG. Combined MEG/EEG source models are likewise seldom used clinically. Finally, most centers model the spike peak and do not consider spike propagation. Using several patient files these issues will be addressed in an on-line, real-time analysis of simultaneous MEG and EEG data with audience participation

4:45 pm **John-Gates-Lecture 2010**
Clinical MEG in 2020 – Hypotheses (Stefan Rampp, Erlangen, Germany)

5:30 pm **Meeting Adjourn**

5:40 pm **ACMEGS** Dinner at the OCEANAIRE restaurant (in walking distance)

Michael Funke

ACMEGS Presidential Address

Michael Funke, M.D., Ph.D.
Department of Neurology, University of Utah, Salt Lake City, UT

ACMEGS

AMERICAN CLINICAL MEG SOCIETY

4th Annual Society Meeting

San Diego

February 4, 2010

AMERICAN CLINICAL MEG SOCIETY

1st Announcement and Inscription

August 25, 2006

15th International Conference on Biomagnetism, Vancouver, BC

AMERICAN CLINICAL MEG SOCIETY

1st Clinical and Economic Workshop

July 12-13, 2007

University of Pittsburgh Medical Center, Pittsburgh, PA

ACMEGS

AMERICAN CLINICAL MEG SOCIETY

2nd Clinical and Economic Workshop
November 6-7, 2008

Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA

AMERICAN CLINICAL MEG SOCIETY

3rd Clinical and Economic Workshop
May 15, 2009

Clinical Neurosciences Center, University of Utah, Salt Lake City

In Retrospect . . .

- Complete CMS project ✓
- Informational meeting with CMS
- Publication of Position Statement ✓
- Continuing to work with national carriers ✓
- Improve Website (www.acmegs.org) ✓

In Retrospect . . .

- Establish national payer analysis document ✓
- Work toward practice guidelines and QC/QA parameters for clinical MEG (✓)
- Engage with advocacy groups (✓)
- Joint meetings with ACNS ✓
- Fund-Raising ✓

Accomplishments in 2009

- MEG specific Revenue Code (Funke, Longacre)
- Published Position Statement (Bagic, Funke, Ebersole)
- MEG now part of NAEC guidelines (Bagic)
- Worked successfully with commercial payers (Barkley, Bagic, Funke, Longacre)
- New web site (Bowyer, Funke, Bagic)

Accomplishments in 2009

- Commented on CMS HOPPS (Funke, Longacre)
- Requested "MEG line" in CMS cost report (Funke, Longacre)
- Still ongoing, subsequent activities:
  - Involvement of UT senator (Funke, Longacre)
  - Request for Audience with CMS (Funke, Longacre)

Accomplishments in 2009

- AETNA, WellPoint, BCBS MI, BCBS NE
- Together they cover 57.4 Mio members
- Additional 16% of US population

Accomplishments in 2009

- This has a significant and tangible positive effect on all clinical MEG centers:
  - More approved patients and revenue
  - Less hassle with pre-auth
  - Less time expansive appeals

Today ACMEGS represents . . .

- Professional organization with highest level of competence in clinical MEG and clinical MEG research in the US.
- Professional organization with most comprehensive knowledge and competence in MEG reimbursement & coverage in the US.

Challenges and Goals in 2010

- MEG line in CMS cost report
- Clinical practice guidelines
- National commercial payers
- Regional commercial payers
- Outreach to patient advocacy groups
- Outreach to MEG/EEG techs

Mark your calendar . . .

17th BIOMAG

March 28 – April 1st

Dubrovnik, Croatia

You will love it!

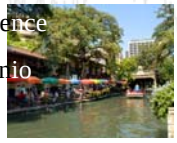
Mark your calendar . . .

5th ACMEGS Annual Conference

February 3, 2011 – New Orleans

6th ACMEGS Annual Conference

February 9, 2012 – San Antonio



Acknowledgments

- Active participation of ACMEGS members
- ACNS staff

  Thank you Jackie Coleman!
- Educational grants

Words of Caution

- Please do not share with each your institutional reimbursement rates and your billing rates.
- Sharing such information could be considered collusion and could have legal ramifications for you and the society.

Enjoy the Meeting!

(And . . . Roland Lee promised us a great dinner!)

ACMEGS BUSINESS MEETING

1. Financial Report — Anto Bagic

2. Old Business — Michael Funke
   - Webpage
   - Annual Meeting 2010

3. New Business
   - Proposal to amend bylaws
   - Annual Meeting 2011
   - PR Committee
   - Scientific Committee
   - Other

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AMERICAN CLINICAL MEG SOCIETY

Financial Report

September 2009 – January 2010

Anto Bagic
ACMEGS Treasurer

Actual Balance Sheet

(As of January 31, 2010)

Actual Income

• Transferred balance	$28,120.37
• Grants	$15,000.18
Total	$43,120.55

Actual Expenses

• Bank Service Charges	$20.00
• Consulting	$6,532.75
• Web site costs	$661.83
Total	$7,214.58

Current Balance **$35,905.97**

Prospective Changes On The Balance Sheet

Prospective Income

• Annual Meeting support grant by Elekta	$6,500.00
• Annual Meeting support grant by ANT	$1,000.00
• Membership Dues	in progress
• Meeting registrations	in progress
• Sustain support for Executive Director	in progress

Prospective Expenses

- Annual Meeting
- Consulting
- Tax preparations
- Web site costs
- Other operational costs

Financial Goals in 2010

- **An Assertive Membership Drive**
  - Institutional memberships
  - Individual membership
- **An Assertive Sponsorship Drive**
  - MEG vendors
  - Related vendors

BYLAWS
OF
AMERICAN CLINICAL MAGNETOENCEPHALOGRAPHY SOCIETY, INC., A NON-PROFIT CORPORATION

ARTICLE I
ORGANIZATION

1.1 The name and charitable purposes of the organization shall be as set forth in its Articles of Organization. In addition to the charitable purposes as set forth in the Articles of Organization, the organization may work cooperatively with other national and international magnetoencephalography (MEG), neurology, neurosurgery, and radiology organizations in determining how best to meet the clinical needs of MEG sites within the United States. These Bylaws, the powers of the organization and of its directors and officers, shall be subject to the Articles of Organization as in effect from time to time. The principal office of the organization in the Commonwealth of Massachusetts shall initially be located at the place set forth in the Articles of Organization.

1.2 The organization may have a seal which shall be in such form as the Board of Directors may, from to time to time, adopt or amend.

1.3 The organization may at its pleasure by a vote of the Members (as hereinafter defined) change its name.

1.4 The pronoun “he” or “his,” when appropriate, shall be construed to mean also “she” or “her” and the word “chairman” shall be construed to include a female.

ARTICLE II
MEMBERSHIP

2.1 Membership in this organization shall be open to those who support the purpose statement of the organization as set forth in the Articles of Organization and meet the qualifications set forth in Section 2.2. Continuing membership is contingent upon being up-todate on membership dues which shall be paid annually on or before September 1st of each year.

2.2 There shall be three (3) classes of membership in the organization; namely, a Site-Designated Member class, a General Member class and an Associate Member class.

A. “Site-Designated Members” are those individuals so designated by each clinical site that has paid its membership dues. Each site may designate up to 2 members. Only site-designated members are eligible to be members of the Board of Directors”.

B. "General Members" shall include those individuals involved in the clinical use of magnetoencephalography (MEG) alone or in combination with electroencephalograms (EEGs), magnetic resonance imaging (MRI) or computerized axial tomography (CAT) scans and possessing a medical degree (M.D.), a Ph.D. in one of the aforementioned fields, or some equal equivalent degree.

C. "Associate Members" shall include clinicians, or their clinical assistants, involved with the use of magnetoencephalography (MEG) alone or in combination with electroencephalograms (EEGs), magnetic resonance imaging (MRI) or computerized axial tomography (CAT) scan equipment and students with an interest in any of those fields. [To be eliminated: Associate members do not have voting privileges].

2.3 Individuals wishing to join the membership of this organization for either the General or Associate class of membership shall apply for admission and be nominated by two (2) existing members of the member class for which membership is sought; provided, however, that those individuals identified as directors in the Articles of Organization as originally filed with the Massachusetts Clerk of the Commonwealth shall be automatically admitted into the Member class of this organization without further application. The Membership Committee shall review and recommend either admission or denial into the membership of this organization for each application submitted, after which the entire Board of Directors shall vote to accept or reject the Membership Committee's recommendation. The vote of the Board of Directors shall be final.

2.4 The dues for each membership class shall be reviewed and set annually by the Board and any proposed changes shall be voted on at the annual membership meeting.

2.5 Only those members who are current on their membership dues and are in the Members class shall be eligible to vote at any annual or special meetings of the membership.

ARTICLE III
MEMBERSHIP MEETINGS

3.1 The first annual membership meeting of this organization shall be held on August 26, 2006 and thereafter shall be held on such date as determined by vote of the membership at the prior year's annual membership meeting.

3.2 The Clerk shall cause to be mailed to every member in good standing at its address as it appears in the membership roll book in this organization a notice telling the time and place of such annual meeting.

3.3 Meetings of the membership may be held at such time and place, within or without the Commonwealth of Massachusetts, as shall be stated in the notice of the

meeting or in a duly executed waiver of notice thereof. Notices of meetings shall be sent to all members at their addresses as they appear in the membership roll book at least ten (10) days before the scheduled date set for such meeting. If mailed, notice is given when deposited in the United States mail, postage prepaid, directed to the member at such member's address as it appears on the records of the organization. Without limiting the manner by which notice otherwise may be given effectively to members, any notice to members given by the organization shall be effective if given by a form of electronic transmission consented to by the member to whom the notice is given. Any such consent shall be revocable by the member by written notice to the organization. Any such consent shall be deemed revoked if (1) the organization is unable to deliver by electronic transmission two consecutive notices given by the organization in accordance with such consent and (2) such inability becomes known to the Clerk or an Assistant Clerk of the organization, or other person responsible for the giving of notice; provided, however, the inadvertent failure to treat such inability as a revocation shall not invalidate any meeting or other action.

3.4 The presence of not less than a majority of the Members class shall constitute a quorum and shall be necessary to conduct the business of this organization; but a lesser percentage may adjourn the meeting for a period of not more than four (4) weeks from the date scheduled by these Bylaws and the Clerk shall cause a notice of this scheduled meeting to be sent to all those members who were not present at the meeting originally called. A quorum as herein before set forth shall be required at any adjourned meeting.

3.5 Special meetings of the members may be called by the President when he deems it for the best interest of the organization. Such notice shall state the reasons that such meeting has been called, the business to be transacted at such meeting and by whom it was called. At the request of a majority of the members of the Board of Directors or a majority of the Members class, the President shall cause a special meeting to be called but such request must be made in writing at least ten (10) days before the requested scheduled date.

3.6 No other business but that specified in the notice may be transacted at such special meeting without the unanimous consent of all present at such meeting.

ARTICLE IV
VOTING

4.1 When a quorum is present at any meeting, the vote of a majority of the Members class present in person or represented by proxy shall decide any question brought before such meeting, unless the question is one upon which by express provision of the statutes or of the Articles of Organization a different vote is required in which case such express provision shall govern and control the decision of such question.

4.2 Unless otherwise provided in the Articles of Organization or these Bylaws, each member of the Members class shall at every meeting of the membership be entitled to

one (1) vote in person or by proxy, but no proxy shall be voted on after three (3) years from its date, unless the proxy provides for a longer period.

4.3 Unless otherwise provide in the Articles of Organization, any action required to be taken at any annual or special meeting of the membership of the organization, or any action which may be taken at any annual or special meeting of such members, may be taken without a meeting, without prior notice and without a vote, if a consent in writing, setting forth the action so taken, shall be signed by the members of the Members class having not less than the minimum number of votes that would be necessary to authorize or take such action at a meeting at which such members of the Members class were present and voted. Prompt notice of the taking of the action without a meeting by less than unanimous written consent shall be given to those members who have not consented in writing.

ARTICLE V
BOARD OF DIRECTORS

5.1 The business of this organization shall be managed by a Board of Directors consisting of six voting Directors plus the past president who is eligible to vote only in case of ties.

5.2 Only site-designated members will be eligible to serve on the Board. A site-designated member is a member that has been designated as eligible by a site that has paid its site-membership dues.

5.3 Each Board member will serve a three year term. Terms will be staggered accordingly [to these modified bylaws], with new members voted into office during each year's annual business meeting. [Attachment 1 provides details of the staggering procedure for the next three years].

5.4 All members will be eligible to vote for the Directors.

5.5 During presidential years, the Board of Directors will internally choose who the next president shall be. The presidential term shall be three years, starting from the date of appointment.

5.6 The Board shall appoint, on an annual basis, a Treasurer and Clerk from among the current board members.

5.7 An individual may serve only one term as president. Members of the Board may serve two consecutive terms, if so voted by the general membership.

5.8 The Board of Directors shall have the control and management of the affairs and business of this organization. Such Board of Directors shall only act in the name of the organization when it shall be regularly convened by its president after due notice to all the directors of such meeting.

5.9 A majority of the members of the Board of Directors shall constitute a quorum and the meetings of the Board of Directors shall be held regularly as such dates and times as the Board of Directors may determine, but no less than quarterly. The Board of Directors may hold meetings, both regular and special, either within or without the Commonwealth of Massachusetts.

5.10 Each active director shall have one (1) vote and such voting may not be done by proxy. The past-president will cast the deciding vote in the case of a tie.

5.11 Special meetings of the Board may be called by the President on five (5) days' notice to each director by mail or forty-eight (48) hours notice to each director either personally or by electronic means of communications, including electronic mail and facsimile transmission; special meetings shall be called by the President or Clerk in like manner and on like notice on the written request of one (1) director.

5.12 Unless otherwise restricted by the Articles of Organization or these Bylaws, any action required or permitted to be taken at any meeting of the Board of Directors or of any committee thereof may be taken without a meeting, if all members of the Board or committee, as the case may be, consent thereto in writing, and the writing or writings are filed with the minutes or proceedings of the Board or committee.

5.13 Unless otherwise restricted by the Articles of Organization or these Bylaws, members of the Board of Directors, or any committee designated by the Board of Directors, may participate in a meeting of the Board of Directors, or any committee, by means of conference telephone or similar communications equipment by means of which all persons participating in the meeting can hear each other, and such participation in a meeting shall constitute presence in person at the meeting.

5.14 Unless otherwise restricted by the Articles of Organization or these Bylaws, any director may be removed, with or without cause, by a majority of the members entitled to vote on such directorship. Any director may resign at any time by giving written notice of resignation to the Board of Directors, to the President or to the Clerk. Any such resignation shall take effect upon receipt of such notice or at any later time specified therein. Unless otherwise specified in the notice, the acceptance of a resignation shall not be necessary to make the resignation effective.

5.15 Vacancies in the Board of Directors shall be filled by the members entitled to vote on such directorship.

ARTICLE VI
OFFICERS

6.1 The officers of the organization shall be chosen by the Board of Directors and shall be a President, a Clerk and a Treasurer, all of whom shall be site-designated Members. The Board of Directors may also choose one or more Assistant Clerks and

Assistant Treasurers. Any number of offices may be held by the same person, unless the Articles of Organization or these Bylaws otherwise provide.

6.2 The Board of Directors at its first meeting after each annual meeting of the membership shall choose a Clerk and a Treasurer from those members of the Board of Directors, and may elect one or more Assistant Clerks and Assistant Treasurers as the Board of Directors shall deem to be in the organization's best interests. Presidential appointments are for three (3) years.

6.3 The Board of Directors may appoint such other officers and agents as it shall deem necessary who shall hold their offices for such terms and shall exercise such powers and perform such duties as shall be determined from time to time by the Board.

6.4 No officer shall for reason of his office be entitled to receive any salary or compensation, but nothing herein shall be construed to prevent an officer or director for receiving any compensation from the organization for duties other than as a director or officer.

6.5 The officers of the organization shall hold office until their successors are chosen and qualify. Any vacancy occurring in any office of the organization shall be filled by the Board of Directors. Any officer elected or appointed by the Board of Directors may be removed at any time by the affirmative vote of a majority of the Board of Directors. Any officer may resign at any time by giving written notice of resignation to the Board of Directors, to the President or to the Clerk. Any such resignation shall take effect upon receipt of such notice or at any later time specified therein. Unless otherwise specified in the notice, the acceptance of a resignation shall not be necessary to make the resignation effective.

6.6 The President shall be the chief executive officer of the organization, shall have general and active management of the business of the organization and shall see that all orders and resolutions of the Board of Directors are carried into effect. The President shall preside at all meetings of the membership and of the Board of Directors at which he is present. The President shall have all powers and duties usually incident to the office of the President except as specifically limited by a resolution of the Board of Directors. T he President shall have such other powers and perform such other duties as may be assigned to him from time to time by the Board of Directors.

6.7 The Clerk shall attend all meetings of the Board of Directors and all meetings of the membership and record all the proceedings of the meetings of the organization and of the Board of Directors in a book to be kept for that purpose and shall perform like duties for the standing committees when required. He shall give, or cause to be given, notice of all meetings of the membership and special meetings of the Board of Directors, and shall perform such other duties as may be prescribed by the Board of Directors or President, under whose supervision he shall be. He shall have custody of the corporate seal of the organization and he, or an Assistant Clerk, shall have authority to affix the same to any instrument requiring it and when so affixed, it may be attested by his signature or by the

signature of such Assistant Clerk. The Board of Directors may give general authority to any other officer to affix the seal of the organization and to attest the affixing by his signature.

6.8 The Assistant Clerk, or if there be more than one, the Assistant Clerks in the order determined by the Board of Directors (or if there be no such determination, then in order of their election) shall, in the absence of the Clerk or in the event of his inability or refusal to act, perform the duties and exercise the powers of the Clerk and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

6.9 The Treasurer shall have the custody of the corporate funds and shall keep full and accurate accounts of receipts and disbursements in books belonging to the organization and shall deposit all monies and other valuable effects in the name and to the credit of the organization in such depositories as may be designated by the Board of Directors. He shall disburse the funds of the organization as may be ordered by the Board of Directors, taking proper vouchers for such disbursements, and shall render to the President and the Board of Directors, at its regular meetings, or when the Board of Directors so requires, an account of all his transactions as Treasurer and of the financial condition of the organization. He shall exercise all duties incident to the office of Treasurer.

6.10 The Assistant Treasurer, or if there shall be more than one, the Assistant Treasurers in the order determined by the Board of Directors (or if there be no such determination, then in the order of their election) shall, in the absence of the Treasurer or in the event of his inability or refusal to act, perform the duties and exercise the powers of the Treasurer and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

ARTICLE VII
COMMITTEES

7.1 The Board of Directors may create committees as needed, such as executive, audit, and public relations. There shall be one standing committee – the Membership Committee. Except for members of the Membership Committee, membership in any committee created by the Board of Directors may contain such numbers of Members and Associate Members as the Board of Directors may reasonably determine.

7.2 No less than three (3) directors of the Board of Directors shall be appointed by the Board of Directors and shall serve as the members of the Membership Committee.

7.3 The Membership Committee shall have responsibility for reviewing applications for admission and making recommendations with respect such applications to the full Board of Directors.

ARTICLE VIII

GENERAL PROVISIONS

CHECKS

8.1 All checks or demands for money and notes of the organization shall be signed by such officer or officers or such other person or persons as the Board of Directors may from time to time designate.

FISCAL YEAR

8.2 The fiscal year of the organization shall be fixed by resolution of the Board of Directors.

BOOKS AND RECORDS

8.3 The books of the organization shall be kept at such place as the Board of Directors shall designate by resolution.

ARTICLE IX
INDEMNIFICATION; LIMITATION ON LIABILITY

9.1 Each director and officer of the organization shall be indemnified to the fullest extent now or hereafter permitted by law in connection with any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative, by reason of the fact that he is or was a director or officer of the organization or is or was serving at the request of the organization as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise. Without limiting the generality of the foregoing, the organization shall indemnify each person within the scope of the foregoing to the extent to which it is given the power to do so by Section 8.56 of the Massachusetts Business Corporations Act of the Commonwealth of Massachusetts as in effect on the effective date of these Bylaws or as thereafter amended. To the extent permitted by applicable law, the organization shall have power to purchase and maintain insurance on behalf of any person who is or was a director, officer, employee or agent of the organization, or is or was serving at the request of the organization as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against any liability asserted against him and incurred by him in any such capacity or arising out of his status as such whether or not the organization would have the power to indemnify him against such liability under applicable law.

9.2 A director of the organization shall not be personally liable to the organization or its members for monetary damages for breach of fiduciary duty as a director except for liability (i) for any breach of the director's duty of loyalty to the organization or its members, (ii) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (iii) under Section 8.56 of the Massachusetts Business Corporations Act of the Commonwealth of Massachusetts, as the same exists or

hereafter may be amended, or (iv) for any transaction from which the director derived an improper personal benefit. If the Massachusetts Business Corporations Act hereafter amended to authorize the further elimination or limitation of the liability of directors, then the liability of a director of the organization, in addition to the limitation on personal liability provided herein, shall be limited to the fullest extent permitted by the amended Massachusetts Business Corporations Act. Any repeal or modification of this Article IX by the members of the organization shall be prospective only, and shall not adversely affect any limitation on the personal liability of a director of the organization existing at the time of such repeal or modification.

ARTICLE X
AMENDMENTS

10.1 These Bylaws may be altered, amended, repealed or added to by an affirmative vote of not less than a majority of the members entitled to vote thereon.

Proposal for Bylaws
Attachment 1

Current Board – 2009/2010

Michael Funke, President
Steve Stufflebeam [Past-President]
Robert Knowlton
Anto Bagic [Treasurer]
Greg Barkley
Roland Lee [Clerk]

2010/2011 Board

Michael Funke, President
Steve Stufflebeam [Past-President]
Robert Knowlton
Anto Bagic
Greg Barkley
New Director A
New Director B

2011/2012 Board

Michael Funke, President
Steve Stufflebeam [Past-President]
Robert Knowlton
New Director A
New Director B
New Director C
New Director D

2012/2013 Board

Michael Funke, [Past-President]
New Directors A, B, C, D, E, F

The Board will chose one of the New Directors as the New President.

NOTES

NOTES

Reimbursement Round Up – Successes, Opportunities, Challenges

Michael Longacre
Executive Director, ACMEGS

Michael Longacre

ACMEGS
AMERICAN CLINICAL MEG SOCIETY

4th Annual Society Meeting

San Diego

February 4, 2010

Michael Longacre
Executive Director

ACMEGS
AMERICAN CLINICAL MEG SOCIETY

Reimbursement Roundup
Successes
Opportunities
Challenges

Successes

Aetna

Number: 0279
Policy
Aetna considers magnetic source imaging (MSI) or magnetoencephalography (MEG) medically necessary for presurgical evaluation in patients with intractable focal epilepsy to identify and localize areas of epileptiform activity, when discordance or continuing questions arise from among other techniques designed to localize a focus. Aetna considers MEG or MSI experimental and investigational when used as a stand-alone test or as the first order of test after clinical and routine electroencelphalographic (EEG) diagnosis of epilepsy.
Aetna considers magnetic source imaging (MSI) or magnetoencephalography (MEG) experimental and investigational for all other indications, including the evaluation of persons with Alzheimer's disease, autism, brain tumors, cognitive and mental disorders, developmental dyslexia, multiple sclerosis, Parkinson's disease, schizophrenia, stroke rehabilitation, and traumatic brain injury.

ACMEGS

Successes

Anthem

Medically Necessary:
Magnetoencephalography (MEG) is considered **medically necessary** for:
1. preoperative evaluation of patients with intractable focal epilepsy to identify and localize area(s) ofepileptiform activity when other techniques designed to localize a focus are indeterminate; **or**
2. preoperative localization of eloquent cortex prior to surgical resection of brain tumor or vascular malformations in order to maximize preservation of eloquent cortex.

Magnetic source imaging (MSI) is considered **medically necessary** for:
1. preoperative evaluation of patients with intractable focal epilepsy to identify and localize area(s) of epileptiform activity when other techniques designed to localize a focus are indeterminate; **or**
2. preoperative localization of eloquent cortex prior to surgical resection of brain tumor or vascular malformations in order to maximize preservation of eloquent cortex.

Investigational and Not Medically Necessary:
Magnetoencephalography (MEG) and magnetic source imaging (MSI) are considered **investigational and not medically necessary** for all other indications.

ACMEGS

Successes

HIGHMARK. Blue Cross Blue Shield

Magnetoencephalography and Magnetic Source Imaging
Magnetoencephalography (MEG) (95965, 95966, 95967) and Magnetic Source Imaging (MSI) (S8035) are eligible for use in the presurgical evaluation of certain patients with medically refractory epilepsy.* This includes:

- non-lesional superficial cortical epilepsy
- lesional epilepsy within or adjacent to the eloquent cortex,
- epilepsy associated with large structural lesions,
- ongoing or recurrent seizure activity following previous resections for epilepsy, and
- cases where the seizure focus has not been detected or well localized by traditional methods.

*Medically refractory epilepsy refers to the failure of adequate trials of different classes of FDA approved antiepilepsy medications to control seizure activity, when taken in appropriate doses and carefully monitored for effectiveness and patient compliance.
MEG/MSI is also considered eligible for use in presurgical functional brain mapping (PSFBM) (96020) for the preoperative evaluation of intracranial lesions located near the eloquent cortex or essential functional areas of the brain.
Other uses of MEG/MSI are considered experimental/investigational, and are not covered. A participating, preferred, or network provider can bill the member for the denied service.

ACMEGS

Successes

BlueCross BlueShield of Alabama

Policy: Magnetoencephalography meets Blue Cross and Blue Shield of Alabama's medical criteria for coverage for the purpose of determining the eloquent language function, as a substitute for the Wada test, in patients undergoing diagnostic workup for evaluation of surgery for epilepsy, brain tumors, and other indications requiring brain resection.
Magnetoencephalography does not meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage is considered **investigational** for all other indications, including localization of seizure focus for patients undergoing evaluation for surgical treatment of intractable seizures**.**

ACMEGS

Successes

Successes

TOP 20 Commercial Health Plans

Company	Enrollment
UnitedHealth Group	**32,702,445**
WellPoint Inc.	**30,622,381**
Aetna Inc.	**16,318,625**
Health Care Service Corp.	12,218,623
Cigna Healthcare Inc.	9,922,135
Kaiser Permanente	8,532,951
Humana Inc.	**8,486,913**
Health Net Inc.	**6,180,395**
Highmark Inc.	**5,182,186**
BlueCrossBlueShield of Michigan	5,011,359
Coventry Health Care Inc.	**4,762,000**
Emblem Health Inc.	4,035,710
Medical Mutual of Omaha	3,929,677
WellCare Group of Companies	3,537,777
Independent BlueCross	3,480,168
BlueShield of California	**3,474,951**
Horizon BlueCrossBlueShield	**3,474,951**
CareFirst Inc.	3,044,880
BlueCrossBlueShield of Massachusetts	**3,012,396**
BlueCrossBlueShield of Alabama	**2,971,869**

Challenges

Coverage Policy

- **CIGNA does not cover magnetoencephalography (MEG) or magnetic source imaging (MSI) for any condition because they are considered experimental, investigational or unproven.**

Opportunity

Medical Society Recommendations
- American Academy of Neurology Policy
- ACMEGS Policy

Commercial Payers
- Aetna Medical Coverage Policy
- Wellpoint Coverage Policy
- Anthem BCBS Coverage Policy
- Highmark Coverage Policy
- BCBS of California Coverage Policy
- BCBS of Alabama Coverage Policy
- TriCare Coverage Policy

Challenges

CMS 2010 OPPS Proposed Rule

HCPCS	Description	APC	Claims	Units	Charges	2008 Payment	Cost
95965	Meg, spontaneous	0067	**29**	29	**$ 293,051**	$ 114,261	$ 81,357
95966	Meg, evoked, single	0065	**21**	21	**$ 92,034**	$ 21,956	$ 24,783
95967	Meg, evoked, each add'l	0065	**13**	21	**$ 71,567**	$ 22,102	$ 22,880
95812	Eeg, 41-60 minutes	0213	**4,855**	4,883	**$ 3,681,380**	$ 688,138	$ 977,751
95813	Eeg, over 1 hour	0213	**1,594**	1,611	**$ 1,787,260**	$ 239,978	$ 475,840
95816	Eeg, awake and drowsy	0213	**51,632**	51,810	**$33,597,301**	$ 7,545,532	$ 9,200,528
95819	Eeg, awake and asleep	0213	55,095	55,316	$38,798,782	$ 8,053,136	$10,502,668

Challenges

CMS
- Obtain a fair calculation of reimbursement based solely on the MEG cost data
  - Medicare Cost Report
    - Line 54 - EEG
    - No CPT codes listed
  - OPPS - APC
    - UB-04 Revenue Code is same as EEG
    - MEG CPT codes

Successes

NUBC
National Uniform Billing Committee

Role of the NUBC

One of the NUBC's major roles is to maintain the integrity of the UB-04 data set. In addition, the NUBC serves as the forum for discussions that lead to mutually agreed data elements for the claim as well as the data elements for other claim related transactions.

In determining the data to be included, the NUBC strives to balance the need for the information **against the burden of providing that information.**

Over the years, the NUBC has realized that the UB data set has become more than a billing instrument. It is also used by many others, including public health and health researchers, as a tool to gauge the delivery of health care services to patients. Therefore, the data set has broad policy implications for shaping the future of our health delivery system.

Successes

NUBC
National Uniform Billing Committee

On August 11, 2009, ACMEGS appealed to the National Uniform Billing Committee to grant MEG a unique revenue code. The committee unanimously granted our request and created a new revenue code category 086x – Magnetoencephalogy (MEG) **effective April 1, 2010**.

Activities

- Comments; Medicare Cost report
  - Addition of separate line item for MEG on the cost report
- Letter to Senator Robert F. Bennett
  - *We respectfully request a letter be sent to the Director of CMS appealing the decision in CMS-1414-FC that concerns MEG*
- Letter to Dr. Edith L. Hambrick, M.D., J.D. (CMS)
  - *Our request is for a fair calculation of reimbursement based solely on the MEG cost data provided. Our contention is that this can't be determined today given that MEG and EEG both share a revenue code and the same line item on the Medicare Cost Report. If our contention is in error then we would like to understand why it is in error. This is why we are asking to sit down with you and your representatives and discuss this matter.*

Activities

Good Afternoon Dr. Funke,

This is a follow up to my voice mail I left you on Thursday, January 28, 2010. I am trying to arrange a conference call for you to discuss your issues. Please contact me at your earliest convenience. Thank you.

Ella Howard
Office Assistant
Division of Outpatient Care
410-786-4532
Email address: ella.howard@cms.hhs.gov

Challenges

BlueCrossBlueShield of Michigan (09/01/09)

BCBS Maximum Payment Schedule

Code		Fee		OPPS
95965	9	**$1,126.53**	$1,091.61	**$3,571.78**
95965	K	$574.49	$556.68	
95965	P	$552.02	$534.93	
95966	9	**$548.62**	$531.61	**$962.61**
95966	K	$274.31	$265.81	
95966	P	$274.31	$265.81	
95967	9	**$499.81**	$484.32	**$962.61**

Challenges

ACR Appropriateness Criteria®

Radiologic Procedure	Rating	Comments	RRL
Variant 1: Chronic epilepsy, poor therapeutic response. Surgery candidate.			
MEG/MSI	**5**	Data probably equivalent to BOLD and SPECT	None
Variant 2: New onset seizure. ETOH, and/or drug related.			
MEG/MSI	**2**		None
Variant 3: New onset seizure. Aged 18-40 years.			
MEG/MSI	**2**		None
Variant 4: New onset seizure. Older than age 40.			
MEG/MSI	**2**		None

Rating Scale: 1=Least appropriate, 9=Most appropriate

Last review date: 2006

Challenges

OHTAC Ontario Health Technology Advisory Committee

OHTAC Recommendations:

Based on the results of the health technology and policy assessment, OHTAC made the following recommendations:

Epilepsy

1. A field evaluation should be conducted in Ontario to determine the potential substitutive role of MEG vs. invasive EEG.
2. A study of the barriers to access to epilepsy surgery in Ontario should be conducted.

January 25, 2007

Challenges

Increased Utilization – MEG Awareness

- Physician Education
  - Increased referrals
- Advocacy (National and Regional)
  - Patient Education
  - Commercial payer support

2010 Key Goals

1. CMS
   a. Medicare Cost Report Inclusion
   b. Fair APC calculation of reimbursement
2. National Carriers; UnitedHealthcare and Cigna
3. Commission Third Party Reimbursement Report
4. Regional Carriers – Support
5. Advocacy Groups – Increase utilization
6. Represent ACMEGS in Washington, DC

ACMEGS in 2010

- What are your key concerns?
- Questions

HOPPS

Outpatient Prospective Payment System

- Hospital outpatient services
- Require annual update of payment weights, relative payment rates, wage adjustments, outlier payments, other adjustments, and ambulatory payment classification (APC) groups

HOPPS

Ambulatory Payment Classifications

In most cases, the unit of payment under the OPPS is the individual service or procedure. Services are assigned to APCs based on similar clinical characteristics and similar costs. The payment rate and copayment calculated for an APC apply to each service within the APC.

HOPPS

How Payment Rates Are Set

The payment rates for most separately payable medical and surgical services are determined by multiplying the scaled relative weight for the service's clinical APC by a conversion factor (CF) to arrive at a national unadjusted payment rate for the APC. The scaled relative weight for an APC measures the resource requirements of the service and is based on the median cost of the services in that APC.

HOPPS

The annual review of APCs and their relative weights considers:

- Changes in medical practice
- Changes in technology
- Addition of new services
- New cost data
- Consultation with the APC Advisory Panel; and
- Other relevant information

The OPPS is a budget neutral payment system in which the CF is also updated annually by the hospital market basket update

1st ACMEGS POSTER PRESENTATION

MEG-Clinic: A Comprehensive Software Application to Optimize the Workflow of Clinical MEG Data

Bock E, Medical College of Wisconsin

As the use of MEG becomes more prevalent in the clinical setting, the need for an optimized workflow has become imperative. A comprehensive solution will relieve the reliance on the scientist and physician and move the majority of the workload to automated algorithms and a trained technician. The solution will include a user interface that will guide a technician through the entire workflow, while automating steps to reduce the time to reporting. The current workflow includes data acquisition, data conditioning, data analysis and report generation. MEG-Clinic has been developed as an integrated solution using Java and Matlab. This application manages the patient workflow by organizing and displaying those files associated with each patient, while providing a "wrapper" to several existing software packages that provide for data conditioning and analysis. MEG-Clinic lays out the workflow, step by step. As the technician completes each step, either by launching a manual process or reviewing the results of an automated process, new data are available for analysis and the next steps can be completed. MEG-Clinic is currently being developed for the Elekta-Neuromag System but could be extended to other MEG systems using appropriate file format conversion. Supported software packages include MaxFilter, MNE, Brainvisa, Brainstorm and Prism. Appropriate functions from these packages are called from MEG-Clinic when needed. If the process is automated (MEG-Clinic runs the process in the background and provides an output), the technician will be required to review the outputs. MEG-Clinic automates several steps of data conditioning, including MaxFilter (signal-space separation), artifact removal (ECG, EOG, etc), data averaging for functional protocols and Elekta FDA Source Analysis. In addition to this data conditioning, MEG-Clinic currently interacts with Brainstorm for final analysis and Prism for final reporting. The ongoing development will include integration of additional analysis programs.

Propagation of frontotemporal spikes represented by spatiotemporal source analysis of magnetoencephalography and diffusion tensor imaging

Naoaki Tanaka, Matti S. Hämäläinen, Steven M. Stufflebeam
Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, MA

Rationale: Spatiotemporal source analysis of magnetoencephalographic (MEG) spikes may be useful for understanding their propagation. However, it is unclear whether these propagation patterns correlate with an anatomical basis. In this study, we compared the propagation represented by MEG/intracranial EEG (IEEG) and white matter tracts obtained from diffusion tensor imaging (DTI) in epileptic patients with frontotemporal spikes.
Methods: Five patients were studied. MEG was recorded with a 306-channel whole-head system. For each spike, spatiotemporal source distribution was calculated based on minimum norm estimate. MPARGE and DTI sequences were acquired with a high-

resolution 3T MRI scanner. All patients underwent IEEG recordings with an ipsilateral fronto-temporal coverage. We determined the locations of intracranial electrodes on the MRI-derived cortical surface, by using CT images including these electrodes. MEG source waveforms were calculated from the source distribution at each electrode site. Time courses of these source waveforms and IEEG spikes were compared at the corresponding sites. We also performed tractographic analysis of DTI by using TrackVis software.
Results: The mean value of time difference of each individual patient ranged from 24 to 41 ms on MEG, and from 29 to 41 ms on IEEG. MEG and IEEG showed quite similar time differences without any statistical difference in all patients. Tractographic analysis showed a fiber connection suggesting uncinate fasciculus between these two areas.
Conclusion: Spatiotemporal source analysis of MEG spikes may represent the spike propagation appropriately as observed on IEEG. DTI analysis may be useful for demonstrating the white matter tracts connecting the areas involved in the spike propagation.

MEG and DTI Detect Mild Traumatic Brain Injury in Military and Civilian Patients

Huang MX, Theilmann RJ, Robb A, Angeles A, Cui L, Nichols S, Lee RR, University of California San Diego, San Diego CA

Purpose: Traumatic brain injury (TBI) is a leading cause of sustained cognitive deficits in the civilian population, and in military personnel (blast injury). However, conventional neuroimaging techniques have limited sensitivity to the physiological alterations caused by TBI, and poor utility for predicting long-term outcome. Mild (and some moderate) TBI can be difficult to diagnose because the injuries are often not visible on conventional acute MRI or CT. The present study used an integrated multimodal neuroimaging approach involving Magnetoencephalography (MEG) and diffusion tensor imaging (DTI) to test their utility for diagnosing and monitoring mild TBI in military personnel and civilians in whom conventional CT and MRI did not show visible lesions.
Materials and Methods: Ten patients (age 25.0 +/- 11.5 years, education 12.7 +/- 4.7 years) with mild TBI, and fourteen age- and education-matched controls, were studied. Injured brain tissues in TBI patients generate pathological low-frequency neuronal magnetic signal (delta waves: 1-4 Hz) that can be measured and localized by MEG. Awake, spontaneous MEG activity was recorded continuously for 15 minutes using a 306-channel whole-head MEG system, in a 6-layer magnetically shielded room. Data was preprocessed using Signal Space Separation and independent component analysis, then run through a 1-4 Hz band-pass filter. Signal amplitude with Z-score > 2.5 compared to the normative database of the 14 normal controls represents abnormal slow waves, which was then localized using vector-based spatial-temporal analysis using L1-minimum norm (VESTAL). We hypothesized that abnormal MEG delta-waves come from gray-matter neurons that experience de-afferentation due to axonal injury to the underlying white-matter fiber tracts. DTI (1.5T; 2.5mm slices, TR = 15.1 s; TE = 80.4 ms; 51 directions, b = 1000 s/mm2; isotropic voxels 2.5mm3) was analyzed using the FSL software package and used to detect reduced diffusion anisotropy related to axonal

injuries in white matter. Diffusion indices including fractional anisotropy, eigenvalues and eigenvectors were obtained, and FA-scaled color maps were correlated with loci of MEG slow-waves. We also studied the neurophysiological basis of TBI-related cognitive impairments using an N-back working memory MEG task in mild TBI patients.
Results: (1) the multimodal imaging approach with MEG and DTI is substantially more sensitive than conventional CT and MRI in detecting subtle neuronal injury in mild TBI; (2) reduced DTI anisotropy in white-matter fiber tracts is highly associated with the generation of abnormal MEG delta-waves from neurons that are linked to the injured white-matter fibers; (3) DTI abnormalities and MEG delta-wave generation are closely linked to deficits in the working-memory network as measured by the MEG N-back task; (4) findings from the multimodal imaging approach is consistent with post-concussive symptoms and results of neuropsychological exams; (5) in some cases, abnormal MEG delta-waves were observed in mild TBI patients without DTI abnormality, indicating that MEG is more sensitive than DTI in diagnosing mild TBI.
Conclusion: The multimodal imaging approach with MEG and DTI can improve detection of subtle neural injuries that are invisible with conventional neuroimaging techniques, and can improve our understanding of the neuronal mechanisms underlying mild TBI.

The Effect of Spatiotemporal Signal Space Separation (tSSS) on the Localization of Interictal Spikes

M. Funke, S. Taulu*, University of Utah, Salt Lake City UT, *Elekta-Neuromag, Helsinki, Finnland

Introduction: An increasing number of patients with intractable epilepsy are being treated with the vagus nerve stimulator (VNS) while in pursuit of resective neurosurgery. In addition, significant artifact contamination can be caused due to prior craniotomies and dental work. Processing such artifact contaminated clinical data using tSSS seems a promising solution for interference removal. But can localization results obtained from tSSS processed data be trusted? In this study, we investigate the effect of the tSSS on the localization of interictal transients in uncontaminated data sets.
Methods: MEG data from ten (10) clinical patients with intractable epilepsy were acquired with a 306-channel whole-head MEG system. Simultaneous EEG was recorded using a 60-channel electrode array. Sleep was induced by prior sleep deprivation. Approximately 60 minutes of continuous data were recorded. None of the patients demonstrated significant artifacts. The spatiotemporal signal space separation method (tSSS) [1], an extended version of the spatial SSS [2], was applied off-line to the raw data. For each patient data were and bandpass filtered 1-70 Hz and ten (10) interictal spikes were localized using all 102 magnetometers and 204 gradiometers. Localization results for a single dipole fit, Goodness of Fit (GOF) as well as the Confidence Volume were compared for raw data as well as the for tSSS processed data.
Results: The localization results between raw data and tSSS processed data across subjects showed a difference of 1.69 mm (SD: 0.52 mm; range: 1.10 mm - 2.41 mm). The GOF differences across subjects improved on average by 12.59% (SD: 4.82%; range:

5.55% - 18.10%). The Confidence volume decreased by 0.02 mm^3 (SD: 0.04 mm^3; range: 0 mm^3 - 0.08 mm^3).
Conclusions: Source localization of interictal spikes in tSSS filtered data changed the localization on average by less than 2 mm, compared to unfiltered data, while GOF of the fitted dipoles increased noticeably. The Confidence Volume decreased minimally. Overall, tSSS seems to have very little effect on the localization of interictal spikes but improves the GOF due to noise reduction, ergo increasing slightly the SNR of epileptiform transients.

Spatiotemporal Signal Space Separation (tSSS) in Clinical Practice – A Five Year Review

M. Funke, S. Taulu*, University of Utah, Salt Lake City UT, *Elekta-Neuromag, Helsinki, Finnland

Introduction: An increasing number of patients with intractable epilepsy are being treated with the vagus nerve stimulator (VNS) and still are in pursuit of resective neurosurgery. Even if the stimulator is turned off for the duration of the MEG recording, unavoidable movement-related artifacts induced by VNS usually rendering the data worthless. In addition, significant artifact contamination can be caused due to prior craniotomies and dental work. In this study, we review the efficacy of the tSSS in severely contaminated MEG data of 42 patients with intractable epilepsy, referred between 04/2005 and 10/2009.
Methods: MEG data were acquired with a 306-channel whole-head MEG system. Simultaneous EEG was recorded using a 60-channel electrode array. Sleep was induced by prior sleep deprivation. Approximately 60 minutes of continuous data were recorded. The spatiotemporal signal space separation method (tSSS) [1], an extended version of the spatial SSS [2], was used off-line to remove the artifacts.
Results: Artifacts were caused due to implanted VNS devices in 23 patients, due to prior craniotomies in 11, due to dental work in nine due to other sources in four. Complete data reconstruction was achieved in 35 cases, partially in six, and failed in one. Interpretation of the tSSS filtered data revealed abnormal findings in 24 cases, it was inconclusive in 16, and data quality did not allow for interpretation in two.
Conclusions: The tSSS filter is an important additional tool for the analysis of clinical MEG that extends the indication for MEG scans in patient s previously not considered suitable for MEG evaluation.

Multimodal analysis of magnetoencephalographic and electroencephalographic discharges: A technical report.

Nao Suzuki(1), Naoaki Tanaka(1), Ellen Grant (1,2), Matti S. Hämäläinen(1), Ann M. Bergin(2), Steven M. Stufflebeam(1)
(1) Athinola A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA (2) Department of Neurology, Children's Hospital Boston, Boston, MA

Rationale: Source analysis of magnetoencephalographic (MEG) and electroencephalographic (EEG) spikes is a powerful tool for localizing and characterizing the epileptogenic zone in presurgical evaluation of epilepsy. In general, source localization of MEG and EEG spikes are approximately consistent although they are known to have differential sensitivity which is reflected in the characteristics of the epileptic spikes. We report a subject with medically intractable epilepsy and compared the difference in the sensor and source localization of the of MEG and EEG spikes.
Case description and methods: A 11-year-old boy with a partial seizures since the age of 4 years. His typical seizures were characterized by left arm extension followed by hypermotor movements. A right mesial frontal lesion was seen on MRI. Simultaneous interictal MEG/EEG showed right frontocentral spikes on the EEG electrodes and right frontotemporal sensor spikes on MEG. We calculated equivalent current dipoles (ECDs) for these MEG & EEG spikes. Spatiotemporal source maps were also obtained by using a distributed source model.
Results: ECDs obtained from MEG spikes localized to the right lateral frontal lobe. In contract, the ECDs from the EEG spikes localized to the mesial frontal cortex, close to the lesion. Spatiotemporal source maps demonstrated activation in the lateral and mesial frontal regions for MEG and EEG spikes, respectively. Diffusion tensor images (DTI) showed abnormal fibers suggestive for a strong connection of these areas. Frequent mesial frontal spiking was observed in an intracranial EEG recording.
Conclusions: The "mislocalization" of MEG spikes may be caused by its higher sensitivity to the lateral cortex than EEG. Combination of MEG and EEG source analysis and DTI may be useful for understanding the pathophysiology in this case.

Invited Posters from ACNS Members

CURRENT DIPOLE ORIENTATION AND DISTRIBUTION OF EPILEPTIFORM ACTIVITY CORRELATES WITH CORTICAL THINNING IN LEFT MESIOTEMPORAL EPILEPSY

***Claus Reinsberger, **Naoaki Tanaka, **Andrew Cole, *Jong Woo Lee, *Barbara Dworetzky, *Edward Bromfield, ***Lorie Hamiwka, ***Blaise Bourgeois, Alexandra Golby, ***Joseph Madsen, and **Steven Stufflebeam**
** Brigham and Women's Hospital, Boston, MA*
*** Massachusetts General Hospital, Charlestown, MA*
**** Children's Hospital, Boston, MA*

To evaluate cortical architecture in mesial temporal lobe epilepsy (MTLE) with respect to electrophysiology, we analyze both magnetic resonance imaging (MRI) and magnetoencephalography (MEG) in 19 patients with left MTLE. We divide the patients into two groups: 9 patients (Group A) had vertically oriented antero-medial equivalent current dipoles (ECDs). 10 patients (Group B) had ECDs that were diversely oriented and widely distributed. Group analysis of MRI data showed widespread cortical thinning in Group B compared with Group A, in the left hemisphere involving the cingulate, supramarginal, occipito-temporal and parahippocampal gyri, precuneus and parietal lobule, and in the right hemisphere involving the fronto-medial, -central and -basal gyri

and the precuneus. These results suggest that regardless of the presence of hippocampal sclerosis, in a subgroup of patients with MTLE a large cortical network is affected. This finding may, in part, explains the unfavorable outcome in some MTLE patients after epilepsy surgery.

SERIAL-BIPOLAR (SB) VS. COMMON REFERENCE (CR) EEG DISPLAY: DOES WAVEFORM OF INTERICTAL FOCAL EPILEPTOFIRM TRANSIENTS (IFET) DIFFER?

Fumisuke Matsuo
University of Utah, Salt Lake City, UT

Polygraphic display remains to be the essential tool for EEG waveform analysis. Digital EEG recording has altered clinical practice, but the clinical interpreter maintains a preferred set of display derivations experientially developed for waveform analysis on analog EEG tracing. This investigation was designed to compare IFET waveform displayed in BS and CR derivations. The author reported IFET in a total of 111 EEG during 2004 and 2005. One best formed IFET was chosen from each EEG, and examined in SB and CR derivations. SB derivations included both anterior-posterior and transverse chains, and their vertically flipped images. A pair of IFET displays were finally chosen in single SB and CR derivations, and superimposed in transparent images by adjusting amplitude (gain) only to obtain the best fit. Within-pair concordance of IFET waveform between SB and CR derivations was in marked contrast to a wide variation between IFET on visual inspection. Of possible explanations of the result, counterintuitive as it may appear, the author suggests 3 as most significantly affecting the interpreter's ability to examine EEG waveform; first, display gain adjustment, second, reversal of IFET waveform in SB derivations, and third, CR choice, common average vs. an arbitrary site.

NOTABLE INTERICTAL AND ICTAL FINDINGS DURING MEG TESTING IN PATIENTS WITH EPILEPSY: THE FIRST 100 MEG STUDIES AT THE CLEVELAND CLINIC EPILEPSY CENTER

Richard C. Burgess, Kazutaka Jin, John Mosher, and Andreas Alexpoulos
Cleveland Clinic, Cleveland, OH

Rationale: Use of magnetoencephalography in epilepsy is expanding. Our MEG laboratory has been in clinical operation for 18 months, and our preconceived notions about the limitations of MEG have, with experience, given way to a more refined view. Methods: We reviewed the last 100 MEGs obtained on epilepsy patients at our center, looking at new localization information revealed by MEG, relationship of MEG and EEG, ictal MEG results, and recording quality in difficult circustances. Where available, we compared MEG localizations with results of intracranial EEG (ICEEG). Results: In more than 30% of cases, MEG provided new localizing information. The overwhelming majority of MEG studies showed more spikes than on the EEG; in 18 with positive MEG findings, there were no EEG abnormalities. Ictal recordings were obtained in 9. Recordings were satisfactorily obtained in 14 patients with VNS, 1 with pacemaker, 6

with simultaneous ICEEGs, and many frequently-moving impaired or extremely young patients without anesthesia. Conclusion: During our first 100 clinical MEGs, successful recordings have consistently been obtained despite potential interference, partly due to sophisticated noise cancellation (tSSS) and continuous head-position-tracking. The frequency of interictal epileptiform MEG activity (especially when EEG is normal) and ictal MEG recordings have been surprisingly high.

The Cleveland Clinic experience

Richard Burgess, M.D., Ph.D.
Department of Neurology, Cleveland Clinics, Cleveland, OH

The CHOP Experience

Erin Schwartz, M.D.
Department of Radiology, Childrens Hospital of Philadelphia (CHOP), Philadelphia, PA

Erin Schwartz

Naoaki Tanaka

The MGH Experience _

Naoaki Tanaka, M.D., Ph.D.
Martinos Center for Biomedical Imaging, Charlestow, MA

Spatiotemporal source analysis of MEG spikes

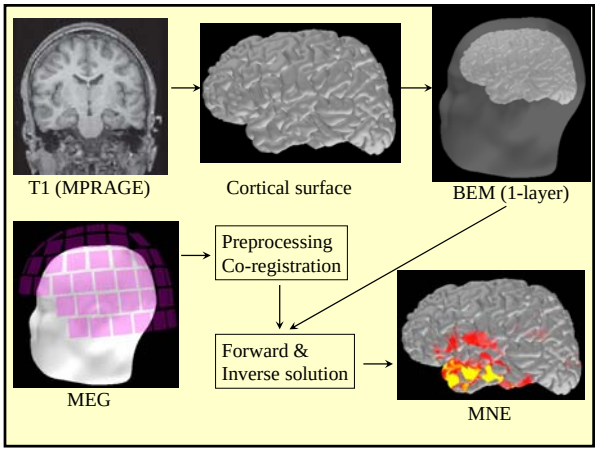
Naoaki (Naoro) Tanaka, MD, PhD
MGH/MIT/HMS Athinoula A. Martinos Center
for Biomedical Imaging, Charlestown, MA, USA

1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
2. Analysis on “MNE tools”
3. Source localization of interictal spikes
4. Source localization of ictal spikes
5. Current clinical application & issues

1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
2. Analysis on “MNE tools”
3. Source localization of interictal spikes
4. Source localization of ictal spikes
5. Current clinical application & issues

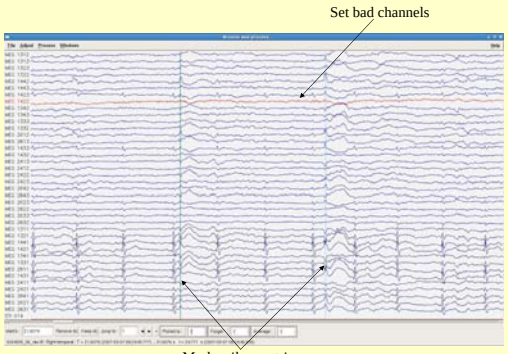
Source analysis using MNE

- Use distributed source models
  - The cortical surface is tessellated with 5120 (or 10240) triangles for employing unit dipoles
  - Grid of dipoles in a surface
  - Find an optimal solution among those fitting the data
- Source locations (and orientations) constrained to the cortical mantle
- Forward solution with BEM (boundary elemental method)
- Inverse solution with noise-covariance matrix

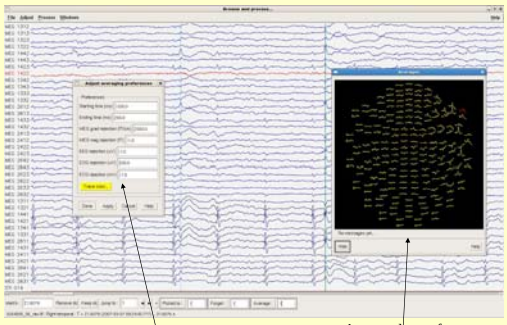


1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
2. Analysis on “MNE tools”
3. Source localization of interictal spikes
4. Source localization of ictal spikes
5. Current clinical application & issues

Preprocessing - spike selection & mark mad channels



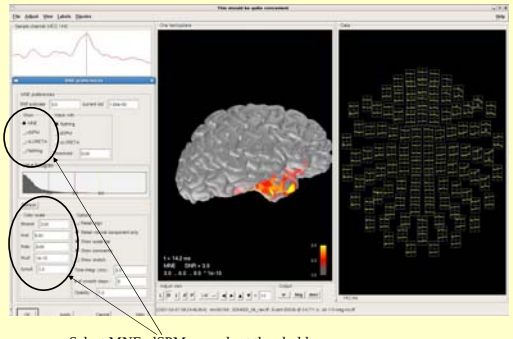
Preprocessing – averaging spikes



Preprocessing – noise covariance

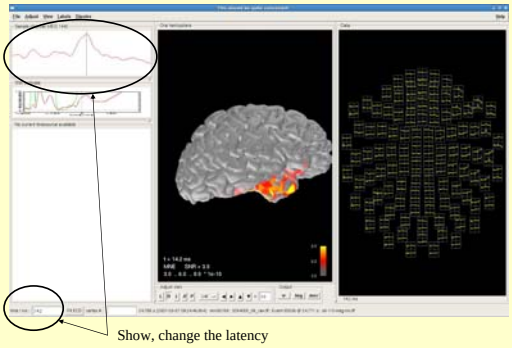
- Using real data
  - Statistically appropriate – compare spike & non-spike data from the same patient
  - Large covariance – sometimes difficult to represent small spikes
- Using empty room's data
  - Small covariance – sensitive to artifacts, background activities
  - Can represent small spikes

Exploring spatiotemporal maps – setting up



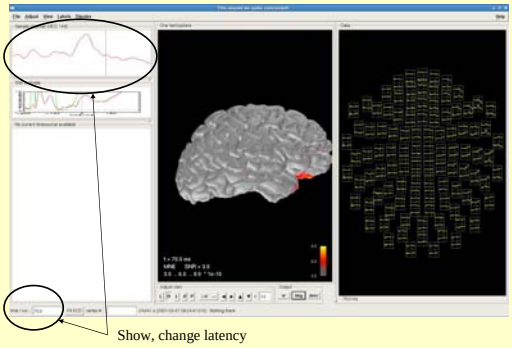
Select MNE, dSPM, …and set thresholds

Exploring spatiotemporal maps – time course



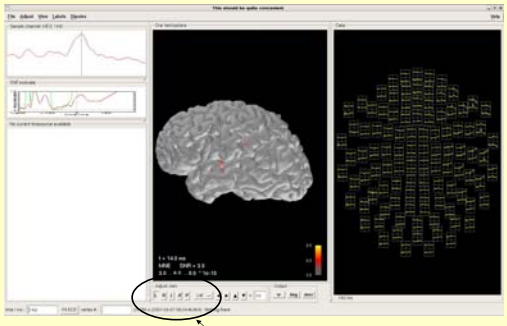
Show, change the latency

Exploring spatiotemporal maps – time course

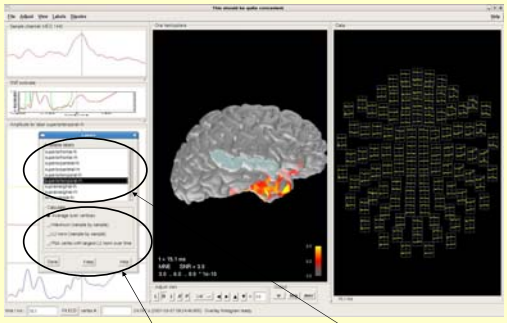


Show, change latency

Exploring spatiotemporal maps – exploring surfaces



Exploring spatiotemporal maps –parcellations

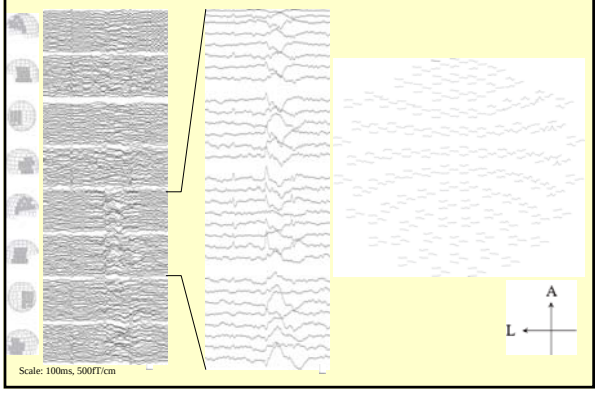


1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
2. Analysis on “MNE tools”
3. Source localization of interictal spikes
4. Source localization of ictal spikes
5. Current clinical application & issues

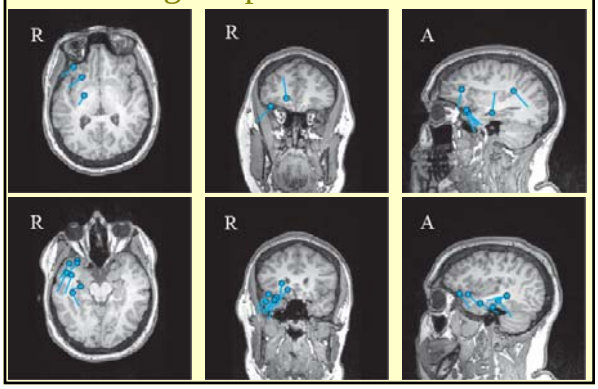
Case 1 - representing spike propagation

- 15 y.o., female
- Seizures with grumbling feeling in the abdomen, staring, unresponsiveness since 10 years of age
- Rt. temporal interictal & ictal spikes on EEG
- Rt. hippocampal atrophy on MRI

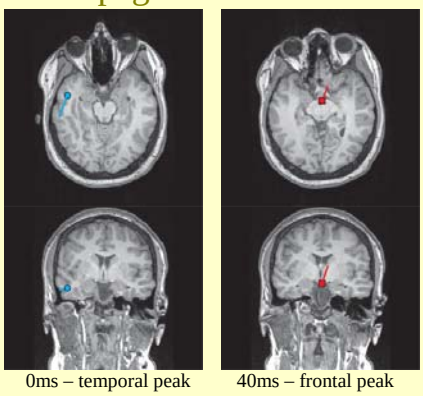
MEG spike



Single dipole distribution

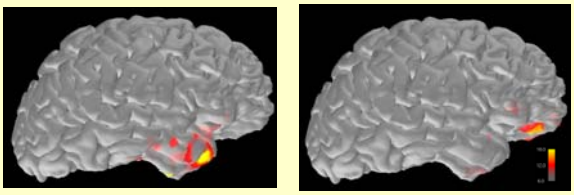


Propagation? - ECDs



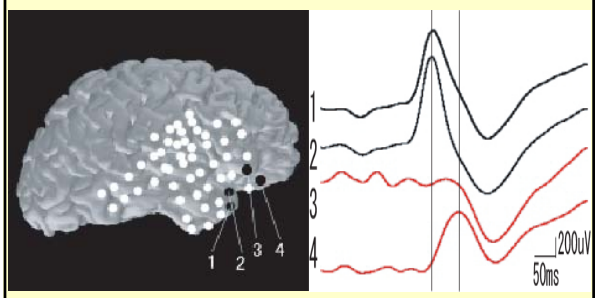
0ms – temporal peak 40ms – frontal peak

Propagation? - MNE



0ms – temporal peak 40ms – frontal peak

G&S



1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
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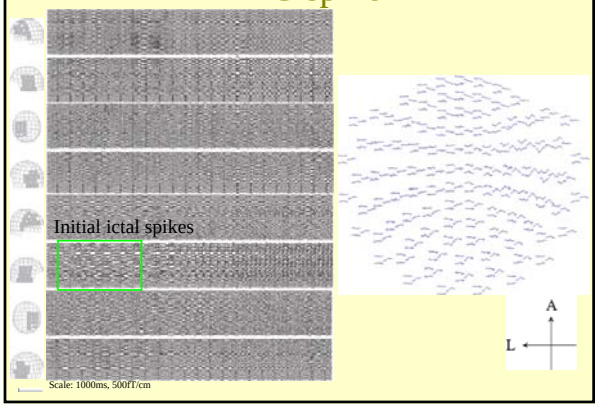
5. Current clinical application & issues

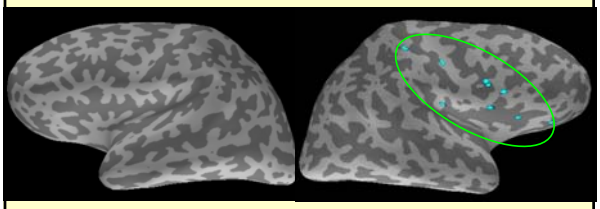
Case 2 – localizing ictal spike sources

- 14 y.o., male
- Seizures with continuous left facial twitching (EPC) since 13 years of age
- Rt. frontotemporal spikes on EEG
- Rt. frontotemporal atrophy on MRI – Rasmussen syndrome

MEG spike

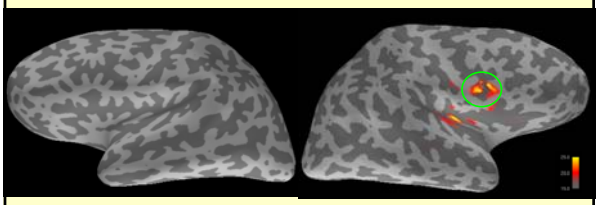


Single dipole distribution



Left lateral (Inflated) Right lateral (Inflated)

MNE (Typical single spike)



Left lateral (Inflated) Right lateral (Inflated)

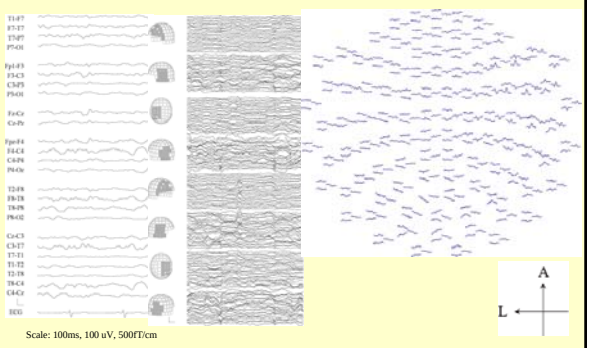
1. Overview of spatiotemporal source analysis using minimum norm estimate (MNE)
2. Analysis on “MNE tools”
3. Source localization of interictal spikes
4. Source localization of ictal spikes
5. Current clinical application & issues

Case 3 – mislocalizing deeper sources?

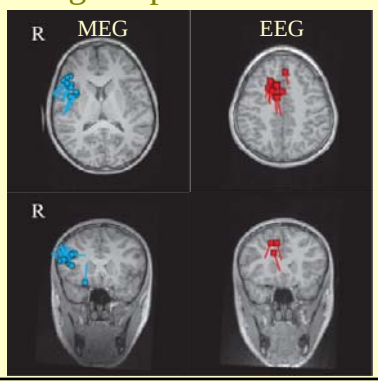
- 11 y.o., male
- Seizures with left arm extension followed by hypermotor movements since age 4
- Bilateral frontal spikes on EEG
- Rt. Mesial frontal lesion on MRI

(Presented in Nao Suzuki's poster)

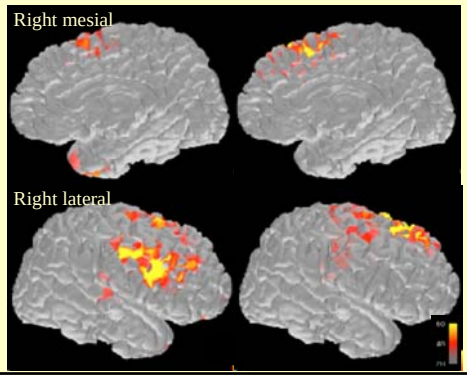
Typical spike



Single dipole distribution



MNE (Typical single spike)



Why MNE ?

- Ambiguous single dipole localization – localization error, widespread spikes, low SNR, etc. (Shiraishi et al., 2005, Hara et al., 2007, Tanaka et al., 2009)
- Time course of spatiotemporal maps may represent spike propagation on the cortical surface. (Tanaka et al., Neuroimage 2010)
- Do not need to consider many parameters on interpretation (GOF, moment, CV, etc)

Current issues for clinical application

- Setting up the threshold for mapping cortical activation - The extent of the source is difficult to determine.
- Missing deeper sources?
- More than one map for one spike – difficult to get a summarized image – averaged spike?
- Clinical correlates should be clarified
- Hard to justify by physiology & anatomy – need to know functional & anatomical connectivity first?
- Need more machine power…

Current procedure of spike analysis

- Collect single dipoles using a sphere model (or BEM) – for all spikes
- Make spatiotemporal maps for “typical” spikes – two or more spike types in some cases
- Use source waveforms on the cortical surface as “virtual IEEG” ?

memo

- movies

Thank you!

Ernst Rodin

MEG/EEG Co-registration: Concordances and Disagreements

Ernst Rodin, M.D.
Adjunct Professor, Department of Neurology, University of Utah, Salt Lake City, UT

MEG-EEG Coregistration

An Electroencephalographer's Perspective

Ernst Rodin MD
Adj. Prof. Dept. of Neurology
University of Utah

GENERAL INFORMATION

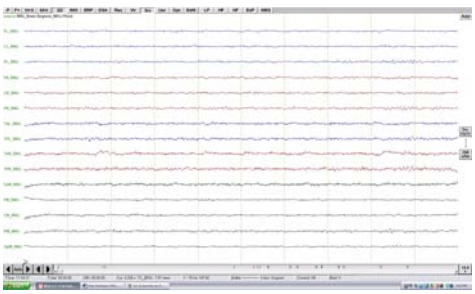
- Data were acquired on an ELEKTA® System with 204 Gradiometer, 102 Magnetometer and 60 EEG channels.
- Data workup with BESA® software.
- No commercial or other conflict of interest.

Normal Person

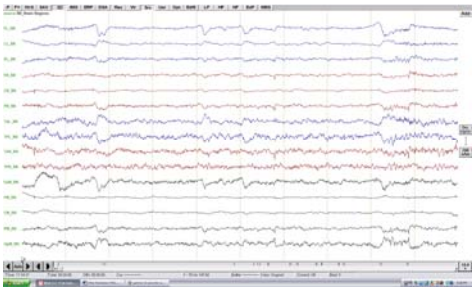
10 seconds Eyeblinks
EEG Double Banana Montage

Same Eyeblink
Gradiometers Selected Channels

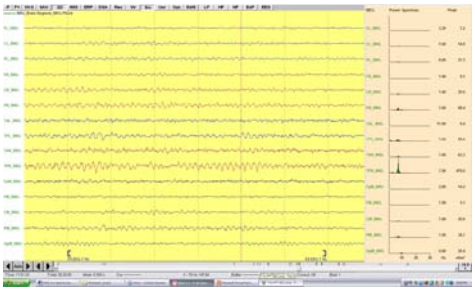
10 seconds Gradiometer
Source Montage



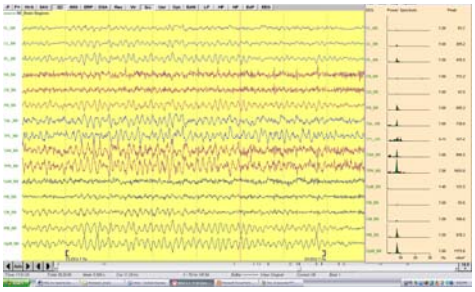
10 seconds co-registered EEG Source Montage



Meditation 7 Hz Rhythm Gradiometer



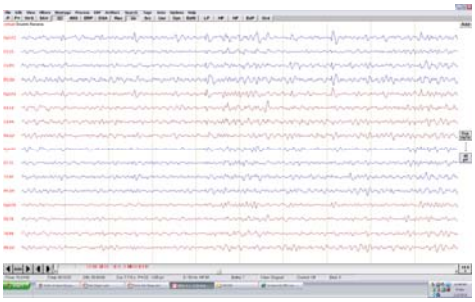
Meditation 7 Hz Rhythm EEG



Patient 1
Focal spikes

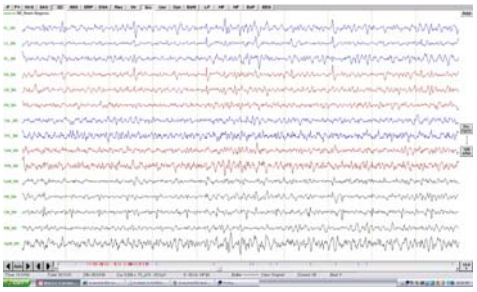
10 seconds Gradiometers
Relevant Channels Only

10 seconds EEG
Double Banana montage

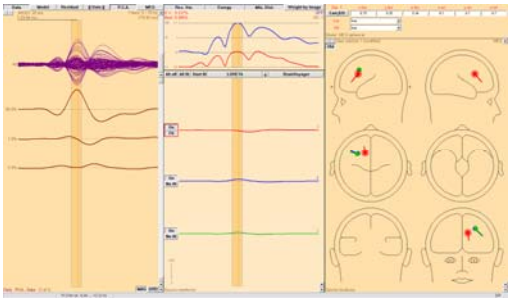


10 seconds EEG
Average Reference

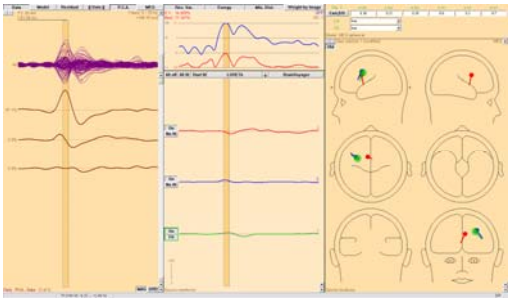
10 seconds EEG
Source Montage



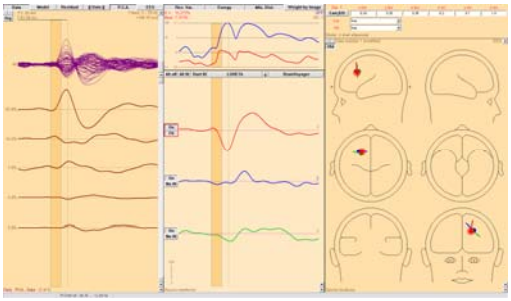
N20 averaged from M0323
Source models for spike peak



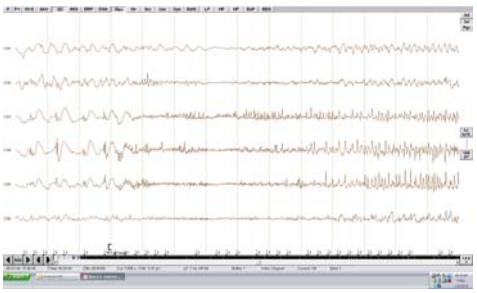
N20 averaged from F3
Source Models for Spike Peak



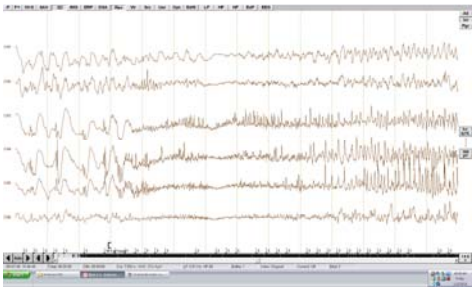
N20 averaged from F3
Source Models for Spike Onset



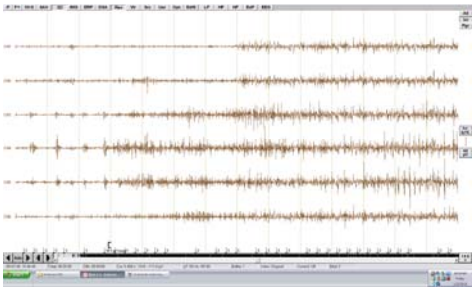
Corticography Seizure Onset
LF 1 Hz HF open



Same data
Filters 0.01 Hz - open

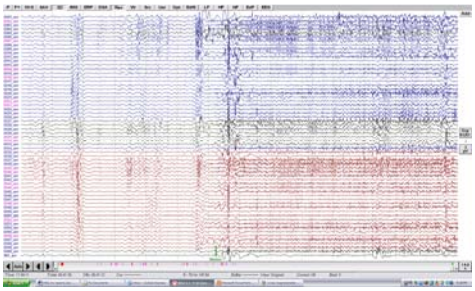


Same data
Filters LF 50 Hz HF open

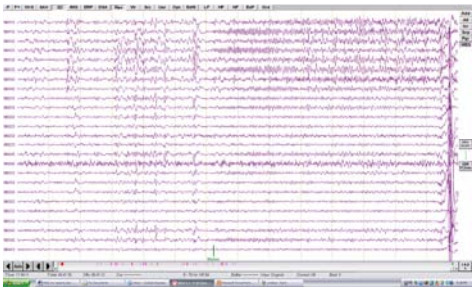


Patient 2
Focal seizure

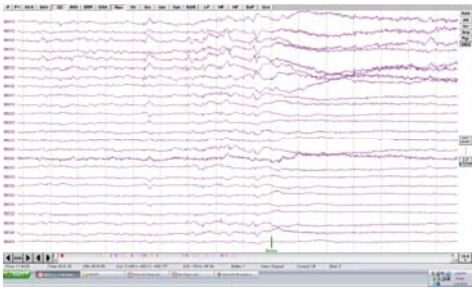
Seizure Onset Filters 5-70 Hz EEG



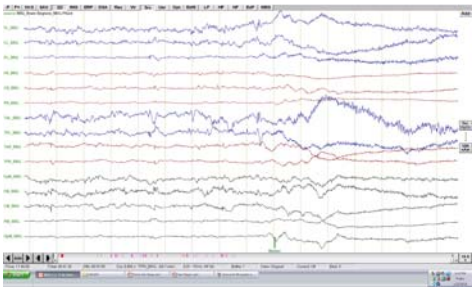
Seizure Onset Filters 5-70 Hz Gradiometer



Same Gradiometer Data LF 0.01Hz HF 70 Hz

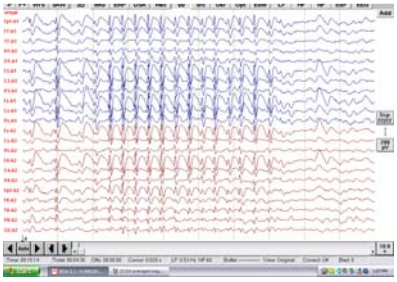


Same Data
Gradiometer Source Montage

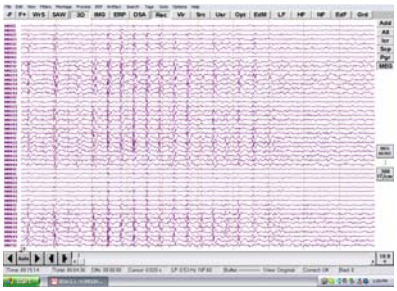


Patient 3
Absence seizure

Absence Seizure
EEG A1/A2 Reference

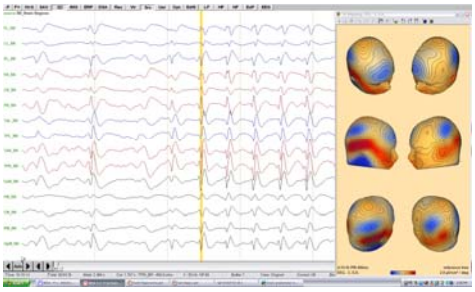


Same Seizure Selected Channels Gradiometer



Single spike Source Montage EEG Voltage Map

Single spike Source Montage Current Source Density Map



Single spike Source Montage Gradiometer Map

MAIN CONCLUSIONS

- At present MEG is underutilized, deserves to be ordered in all cases of medically intractable epilepsy and needs not be restricted to MSI.
- The co-registered EEG component should be evaluated to the same extent as the MEG with adequate electrode coverage and the same type of data analysis as the MEG.
- To establish the relative merit of MEG vs. EEG for presurgical workup further studies will be required by keeping the above in mind as well as long-term follow-up of patients in whom epileptogenic tissue was removed.

Interactive, real-time workshop in comparative and combined MEG/EEG spike analysis

John Ebersole, M.D.
Susan Hawes-Ebersole R.EEG T.
Adult Epilepsy Center, The University of Chicago Medical Venter, Chicago IL

John Ebersole

NOTES

NOTES

John Gates Lecture 2010

Clinical MEG in 2020 – Hypotheses

Stefan Rampp, Dr. med.
Epilepsycenter Erlangen, Universitätsklinikum Erlangen, Germany

Stefan Rampp

John Gates Lecture 2010

Clinical MEG in 2020 - hypotheses

S. Rampp
Epilepsycenter Erlangen
Director: Prof. H. Stefan

ACMEGS

Universitätsklinikum Erlangen

„2009 will be a historic year for the MEG[-lab]“
- basically all coworkers of the Erlangen MEG-lab, 2008

We were right, just not how we thought we would...

The Biomag Blog

Tuesday, February 17, 2009

4D Neuroimaging ceases operation

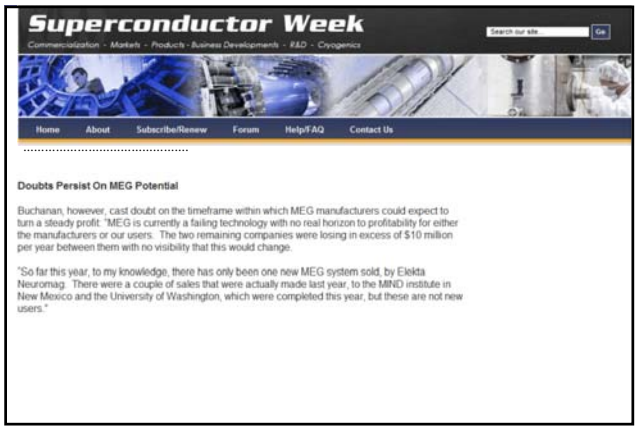
Rumours that 4D had closed its doors circulating since late last week were made official today, when an open letter to Customers was posted on the 4D Neuroimaging website. The letter says operations have ceased because of a lack of financing to offset the continuing losses. Those most affected will be the customers with systems that need support and servicing, the letter says that a method of continuing service is being worked on.

Although I have always worked for competitors of 4D, I do regret the loss of a worthy adversary that competed long and hard in a difficult business. They will be missed and the repercussions of recent events will be felt for some time. Good luck to the former 4D staff now looking for jobs.

So what now? The market seems to be pretty strong right now and there will be lots of new systems installed this year. Will a new company attempt to enter the market? Will the CTF or 4D technology be revived by new investors? Or will it become a sole-source market for the Neuromag MEG system? I'm sure I don't know...

Posted by Jim at 8:10 PM

Labels: 4D Neuroimaging, CTF, MEG, Neuromag



Superconductor Week

Commercialization - Markets - Products - Business Developments - R&D - Cryogenics

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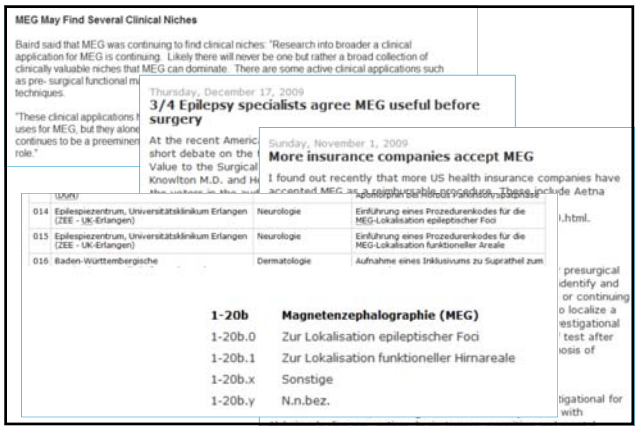
Doubts Persist On MEG Potential

Buchanan, however, cast doubt on the timeframe within which MEG manufacturers could expect to turn a steady profit. "MEG is currently a failing technology with no real horizon to profitability for either the manufacturers or our users. The two remaining companies were losing in excess of $10 million per year between them with no visibility that this would change.

"So far this year, to my knowledge, there has only been one new MEG system sold, by Elekta Neuromag. There were a couple of sales that were actually made last year, to the MIND institute in New Mexico and the University of Washington, which were completed this year, but these are not new users."



MEG May Find Several Clinical Niches

Baird said that MEG was continuing to find clinical niches: "Research into broader a clinical application for MEG is continuing. Likely there will never be one but rather a broad collection of clinically valuable niches that MEG can dominate. There are some active clinical applications such as pre- surgical functional m techniques.

"These clinical applications uses for MEG, but they alon continues to be a preemine role."

Thursday, December 17, 2009

3/4 Epilepsy specialists agree MEG useful before surgery

At the recent Americ short debate on the Value to the Surgical Knowlton M.D. and H

Sunday, November 1, 2009

More insurance companies accept MEG

I found out recently that more US health insurance companies have accepted MEG as a reimbursable procedure. These include Aetna

014	Epilespiezentrum, Universitätsklinikum Erlangen (ZEE - UK-Erlangen)	Neurologie	Einführung eines Prozedurenkodes für die MEG-Lokalisation epileptischer Foci
015	Epilespiezentrum, Universitätsklinikum Erlangen (ZEE - UK-Erlangen)	Neurologie	Einführung eines Prozedurenkodes für die MEG-Lokalisation funktioneller Areale
016	Baden-Württembergische	Dermatologie	Aufnahme eines Inklusivums zu Suprathel zum

1-20b	**Magnetenzephalographie (MEG)**
1-20b.0	Zur Lokalisation epileptischer Foci
1-20b.1	Zur Lokalisation funktioneller Hirnareale
1-20b.x	Sonstige
1-20b.y	N.n.bez.

Future of clinical MEG?

2009 2010 2020

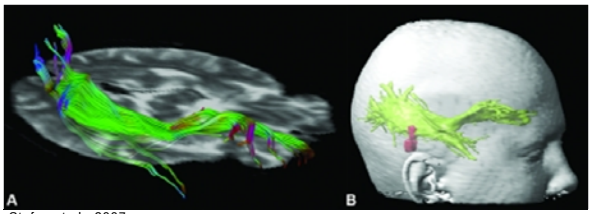
Hy urrent development

current applications
cations in clinical routine
New instrumentation
Organization

Hypothesis 1: Epilepsy will still be a major clinical application of MEG, supported by new methods

Epileptic focus localization

Essential for epilepsy surgery
…to define strategy/area of surgery
…to investigate relation of foci, lesions and functional areas



Stefan et al., 2007

…currently relies on spikes, sometimes/rarely on ictal rhythms.

Problem: Spike frequency

Literature: 20-30% of patients without spikes

Stefan et al., 2004: Magnetic brain source imaging of focal epileptic activity: a synopsis of 455 cases
455 patients with MEG, 320 with spikes
approx. 30% with no spikes

Paulini et al., 2007: Lobar localization information in epilepsy patients: MEG--a useful tool in routine presurgical diagnosis.
105 patients with MEG, 72 with spikes
approx. 31% with no spikes

Solutions?

Increase spike yield by activation – current means

- Sleep deprivation (complete, partial)
- AED withdrawal (e.g. during video-monitoring)

- Hyperventilaton (movement artifacts!)
- Photostimulation (only in some patients)
- Pharmacological (e.g. methohexital, clonidine)

Increase spike yield by activation – a new solution?

Etomidate

Used for general anaesthesia/sedation

Some evidence for activation effect:
Gancher et al., 1984; Ebrahim et al., 1986; Duysens et al., 1991; Avramov et al., 1995; Pastor et al., 2008

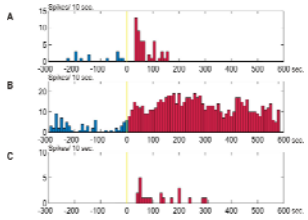
Some evidence for use in MEG, when anesthesia/sedation is needed:
Balakrishnan et al., 2007

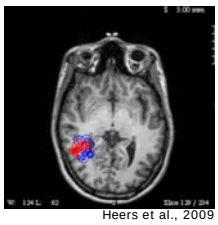
Effective to reduce movement artifacts, while activating spikes at the same time?

Increase spike yield by activation – a new solution?

Etomidate

3 Patients
Baseline spontaneous MEG
i.v. administration of low-dose etomidate (0.1mg/kg)
First changes after ~25 seconds: slow, high-amplitude rhythm
… and spikes



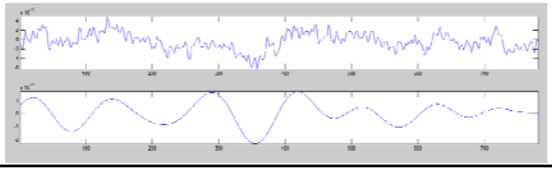


Heers et al., 2009

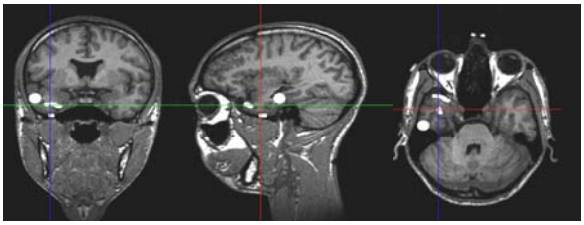
Hypothesis 2: There are alternatives to spikes and seizures for epileptic focus localization

Spike alternatives – Slow waves

- Slow waves (~2-6Hz)
- Association with different pathologies has been shown:
  - Ischemic attacks (Stippich et al., 2000; Leistner et al., 2007)
  - Brain tumors (Kamada et al., 2001)
  - Alzheimer's disease (Fernandez et al., 2002)
  - Schizophrenia (Wienbruch et al., 2003)
  - Epilepsy (Ishibashi et al., 2002; Baayen et al., 2003; Fernandez et al., 2004)



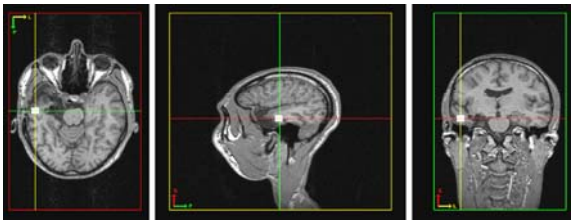
Slow wave - Localization



Spikes: small spheres
Slow wave maximum: large sphere

Slow wave - Localization

Tailored resection
Outcome: Engel 1b (2 years post-OP)



Presurgical slow wave localization on post-OP MRI

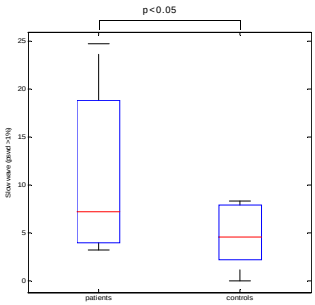
Slow wave – Patients without spikes

12 patients, seizure free outcome
(Engel 1a, b)
10 controls

Significant difference, less clear

More patients with no increase
(~50%)

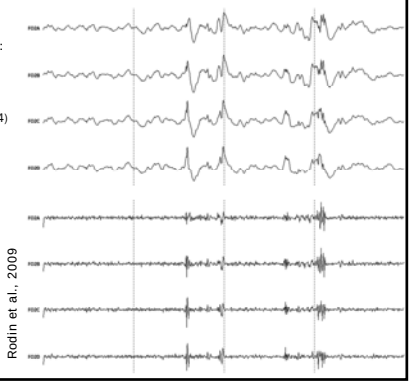
If there was a clear increase,
localization within operated lobe



Boxplots with median, upper/lower quartile, extreme values
Kaltenhäuser et al., in review

Spike alternatives: High frequency oscillations

- Oscillatory activity
- Classification (Bragin et al., 1999):
  - „Ripples“ ((60/)80-160 Hz)
  - „Fast Ripples“ (250-500 Hz)
- And:
  - 60-100Hz (Worrel et al., 2004)
  - >500Hz (Xiang et al., 2009)



Rodin et al., 2009

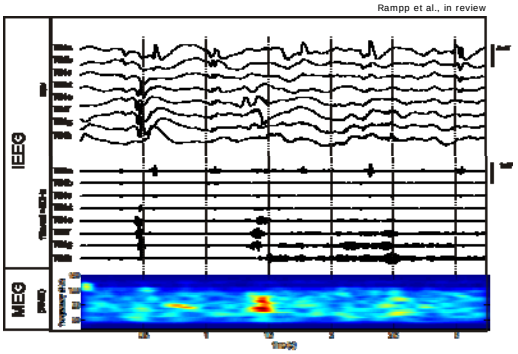
High frequency activity in epilepsy

- Occurence in epileptogenic seizure origins and excitotoxic lesions (Staba et al., 2002; Worrell et al., 2004; Urrestarazu et al., 2007; Jacobs et al., 2008;Rodin et al., 2009; ...)
- Existence shown in animal and human brain using invasive methods
- Invasive macroelectrodes are able to detect HFO, frequency somewhat slower (Worrell et al., 2008)

Non-invasive methods (MEG/EEG)?
Analysis of „higher“ frequencies useful for epileptic focus localization?

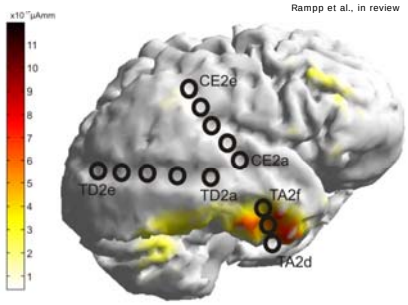
High frequency oscillations in MEG

Rampp et al., in review



Epileptic high gamma oscillations in MEG

Rampp et al., in review



⇒Tailored resection right temporal neocortical, only minimal hippocampal resection
⇒Outcome 1A after 2 years
⇒Histology: Neocortical atrophy, gliosis, no clear signs of hippocampal sclerosis

High frequency oscillations in MEG

Epileptic Disord. 2009 Jun;11(2):113-25. Epub 2009 May 27.

Frequency and spatial characteristics of high-frequency neuromagnetic signals in childhood epilepsy.

Xiang J, Liu Y, Wang Y, Kirtman EG, Kotecha R, Chen Y, Huo X, Fujiwara H, Hemasilpin N, Lee K, Mangano FT, Leach J, Jones B, DeGrauw T, Rose D.

MEG Center, Division of Neurology, Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45220, USA. Jing.xiang@cchmc.org

PURPOSE: Invasive intracranial recordings have suggested that high-frequency oscillation is involved in epileptogenesis and is highly localized to epileptogenic zones. The aim of the present study is to characterize the frequency and spatial patterns of high-frequency brain signals in childhood epilepsy using a non-invasive technology. METHODS: Thirty children with clinically diagnosed epilepsy were studied using a whole head magnetoencephalography (MEG) system. MEG data were digitized at 4,000 Hz. The frequency and spatial characteristics of high-frequency neuromagnetic signals were analyzed using continuous wavelet transform and beamformer. Three-dimensional magnetic resonance imaging (MRI) was obtained for each patient to localize magnetic sources. RESULTS: Twenty-six patients showed high-frequency (100-1,000 Hz) components (26/30, 86%). Nineteen patients showed more than one high-frequency component (19/30, 63%). The frequency range of high-frequency components varied across patients. The highest freq
identified by magnetic re
concordant with intracran
demonstrated that childh
localization, MRI and intra
clinical management of ch

PMID: 19473946 [PubMe

Epileptic Disorders

Publication Types, Med

Neuroimage. 2008 Jan 15;39(2):661-8. Epub 2007 Sep 29.

Fast oscillations associated with interictal spikes localize the epileptogenic zone in patients with partial epilepsy.

Guggisberg AG, Kirsch HE, Mantle MM, Barbaro NM, Nagarajan SS.

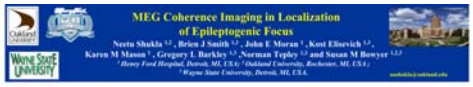
Biomagnetic Imaging Laboratory, Department of Radiology, University of California San Francisco, San Francisco, CA 94143-0628, USA. aguggis@gmail.com

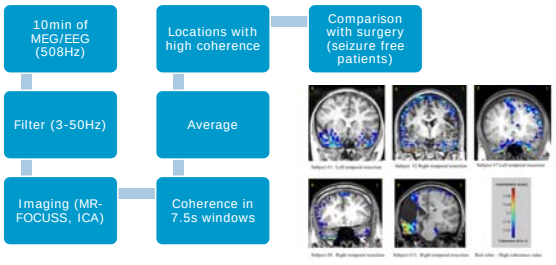
Although interictal epileptic spikes are defined as fast transient activity, the spatial distribution of spike-related high-frequency power changes is unknown. In this study, we localized the sources of spike-locked power increases in the beta and gamma band with magnetoencephalography and an adaptive spatial filtering technique and tested the usefulness of these reconstructions for determining the epileptogenic zone in a population of 27 consecutive presurgical patients with medication refractory partial epilepsies. The reliability of this approach was compared to the performance of conventional MEG techniques such as equivalent current dipole (ECD) models. In patients with good surgical outcome after a mean follow-up time of 16 months (Engel class I or II), the surgically resected area was identified with an accuracy of 85% by sources of spike-locked beta/gamma activity, which compared favorably with the accuracy of 69% found for ECD models of single spikes. In patients with a total of more than 50 spikes in their recordings, the accuracies increased to 100% vs. 88%, respectively. Imaging of spike-locked beta/gamma power changes therefore seems to be a reliable and fast alternative to conventional MEG techniques for localizing epileptogenic tissue, in particular, if more than 50 interictal spikes can be recorded.

PMCID: PMC2742724

PMID: 17977022 [PubMed - indexed for MEDLINE]

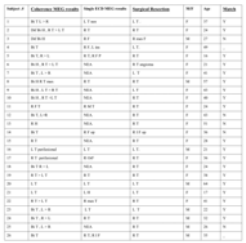
Spike alternatives: Coherence





Spike alternatives: Coherence

Comparison of MEG coherence with surgical outcome in seizure free Epilepsy Patients



Abbreviations: Bi = Bilateral, H = Hemisphere, T = Temporal, R = Right, L = Left, M = Middle, mes = Mesial, neo = Neocortical, P = Parietal, F = Frontal, I = Inferior, S = Superior, Dif = Diffuse, ins = insula, op = operculum, OrF = Orbital Frontal, NEA= No Epileptic Activity, - = undecided.

19/26 patients with coherence concordant with seizure site
6/9 patients with no spikes had coherence results matching surgery
5/6 patients with normal MRI correctly localized using coherence

Hypothesis 3: There will be new applications of MEG in epileptology

New applications in epilepsy

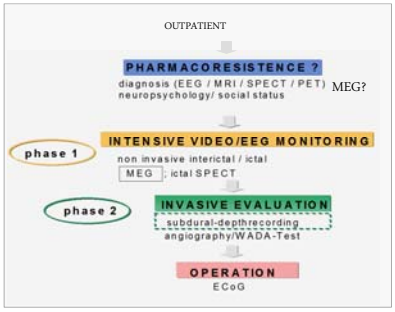
- Treatment monitoring (pre/post surgery)
- Differential diagnosis
  - Multifocal vs. generalized
  - Epilepsy vs. non-epileptic seizures?

and

- Screening

Screening

MEG in presurgical workup (2010)



Screening

Magnetoencephalography Is More Successful for Screening and Localizing Frontal Lobe Epilepsy than Electroencephalography

*Pauly Ossenblok, †Jan C. de Munck, *Albert Colon, *Willem Drolsbach, and *‡Paul Boon

*Epilepsy Centre Kempenhaeghe, Heeze, The Netherlands; †Department of Physics and Medical Technology, VU Medical Center, Amsterdam, The Netherlands; and ‡University Hospital Gent, Gent, Belgium

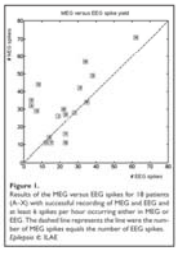


Figure 1.
Results of the MEG versus EEG spikes for 18 patients (A–X) with successful recording of MEG and EEG and at least 4 spikes per hour occurring either in MEG or EEG. The dashed line represents the line were the number of MEG spikes equals the number of EEG spikes.
Epilepsia © ILAE

- Successful MEG in 18/24 patients with frontal lobe epilepsy
- Spikes more frequent in MEG than in EEG (simultaneous recordings)
- Analysis successful in 14 (MEG) vs. 7 (EEG) patients

Screening

Use of Routine MEG in the Primary Diagnostic Process of Epilepsy

Albert J. Colon, Pauly Ossenblok,† Lotte Nieuwenhuis,‡ Kees J. Stam,§ and Paul Boon‖¶*

Journal of Clinical Neurophysiology • Volume 26, Number 5, October 2009

- 51 patients with suspicion of neocortical epilepsy, inconclusive routine EEG
- MEG and sleep deprivation EEG
- MEG: 63% gain in diagnostic value compared to final clinical diagnosis
- MEG without sleep deprivation comparable to sleep deprivation EEG
- MEG: no increased risk of seizures, available for outpatients, less stress

⇨ MEG as a screening method? ...in selected centers?
...MEG before sleep deprivation EEG?
...for patients with suspicion of neocortical epilepsy?

Hypothesis 4: There will be advances of functional mapping

Functional mapping

- Advances in methodology
  - Source localization of evoked fields
  - Cortico-muscular coherence for MEF
  - Combined MEG/EEG approaches
  - ...

- Applications
  - Somatosensory
  - Motor
  - Visual
  - Language
  - (Memory?)

  For:
  - Epilepsy surgery
  - Tumor surgery

Current problems and future solutions

- Language: Bilateral language representations
- Memory

⇒ Alternative to the WADA-test

Lively discussions going on, various studies, further development of methodology

...for now, focus will be on a less known, but very relevant problem...

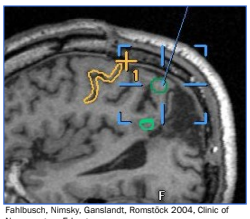
Halle (Saale)

Coregistration

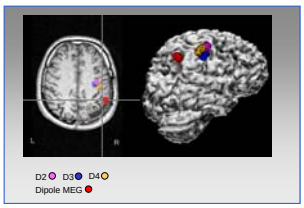
Major questions of „non-MEG“ neurosurgeons
(not limited to MEG):

„How reliable and accurate are MEG results for neuronavigation?“
=>„How reliable is coregistration?“

(vs. intraoperative mapping and under everyday circumstances)



Fahlbusch, Nimsky, Ganslandt, Romstöck 2004, Clinic of Neurosurgery, Erlangen



Causes of inaccuracies

MEG (EEG, fMRI, tractography, ...)

- SNR
- Localization error
- Coregistration error

Neuronavigation system (Suess et al., 2007)

■ Image resolution error	0.7-1.55mm
■ System inaccuracies/tolerances	1mm
■ Fiducial/target registration error	1.5mm
■ Fusion error (= MEG coregistration error)	2mm(?)
■ Position error (variation over time)	1mm
■ Brain shift	1.5mm
⇒ **Total**	**~4-8mm**

⇒ **“Safety distance” of non-invasive mapping?**
⇒ **Versus intraoperative mapping?**
⇒ **Also relevant for radiosurgery!**

Hypothesis 5: There will be new clinical applications

New clinical applications

Screening applications? (Differential) diagnosis?
Treatment monitoring?

- Alzheimer
- Depression
- Schizophrenia
- Dyslexia
- Migraine
- Head trauma
- Tinnitus
- ...


Leitthema

Magnetoenzephalo-graphie in der Psychiatrie

Tinnitus

- >300 million people affected worldwide
- >12 million people in the USA
- 3-4 million severely affected
- No cure but a multitude of treatments (diets, medication, masking, retraining…)

Tinnitus

The Laryngoscope
Lippincott Williams & Wilkins
© 2009 The American Laryngological, Rhinological and Otological Society, Inc.

Direct Electrical Stimulation of Heschl's Gyrus for Tinnitus Treatment

Michael D. Seidman, MD, FACS; Dirk De Ridder, MD; Koot Elsevich, MD, PhD; Susan M. Bowyer, PhD; Baaf Darrat, MD; Jason Dria, AuD; Brad Stach, PhD; Quan Jiang, PhD; Norman Tepley, PhD; James Ewing, PhD; Marlee Seidman; Jinsheng Zhang, PhD

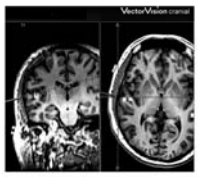


Fig 3. Patient one's neuronavigational magnetic resonance imaging (MRI) image with magnetoencephalography tonotopic localizations (grey squares) indicating the target for locations for electrode implant.

2 patients – proof-of-concept

fMRI and MEG to localize tonotopic maps for tinnitus frequency

Localizations used as target areas for electrical stimulation

Sustained reduction to near elimination in 1 patient, unsustained reduction in the other.

⇒Tailoring of individual therapy

Tinnitus

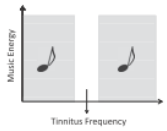
PNAS

Listening to tailor-made notched music reduces tinnitus loudness and tinnitus-related auditory cortex activity

Hidehiko Okamoto[a,1], Henning Stracke[a,1], Wolfgang Stoll[b,2], and Christo Pantev[a,2]

[a]Institute for Biomagnetism and Biosignalanalysis, Westfalian Wilhelms-University, Malmedyweg 15, Muenster, Germany; and [b]Department of Otorhinolaryngology, Head and Neck Surgery, Muenster University Hospital, Kardinal-von-Galen-Ring 10, 48149 Muenster, Germany

Edited by Michael M. Merzenich, University of California at San Francisco, San Francisco, CA, and approved December 3, 2009 (received for review September 30, 2009)

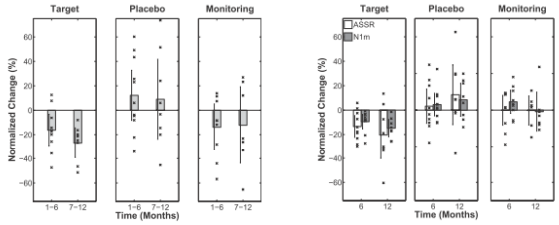


39 tinnitus patients

Treatment with modified music (notched at tinnitus frequency)

Subjective loudness and objective MEG-ASSR amplitudes as parameters of successful treatment

Tinnitus



⇒MEG as an objective parameter of successful treatment

Hypothesis 6: Advances in instrumentation will really change the field

Instrumentation

Probably most promissing, most hypothetical and furthest away for clinicians

- Closed-cycle systems
- Low-field MRI
- High-temperature SQUIDs
- Alternative to SQUIDs
- …

iMEG 2020?

Closed-cycle helium systems

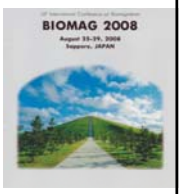
Abstract / Poster: 10 Instrumentation (4)

10-19: A Helium Circulation System for MEGs

*Tshunehiro Takeda, Masayoshi Okamoto, Kazuhiro Atsuda, Keishi Katagiri

Graduate School of Frontier Sciences, The University of Tokyo

MEGs are very expensive to operate because of their cooling system. They use about 10 litters per day (l/D) of liquid helium (LHe), and commonly waste all of it by letting it escape into the atmosphere, necessitating the troublesome task of refilling the Dewar with LHe once or twice per week, which must be done by a trained technician. This is one of the major factors that the usage of MEGs has not widespread yet.
Here we report a helium circulation system (HCS) that re-liquefies all the evaporating helium gas, consumes far less power and has extremely lower magnetic noise compared with conventional systems. It collects warm helium gas about 40 K at high above the surface of the liquid helium in a Dewar and returns it to the neck tube of the Dewar to keep it cold. It also collects helium gas just above the liquid helium surface while it is still cold, re-liquefies and returns it to the Dewar. A special transfer tube (TT) about 2 m length with 7 multi-concentric pipes was developed to allow the dual helium streams. It separates the HCS with a MEG to reduce magnetic noise. A refiner to collect the contaminating gases such as oxygen and nitrogen effectively by freezing the gases is developed. It has an electric heater to remove the frozen contamination in the form of gases into the air. A gas flow controller is also developed, which automatically control the heater to cleanup the contamination.
The developed TT has very low heat inflow less than 0.1W/m to the liquid helium ensuring the efficient operation. The HCS can re-liquefy up to 35.5 l/D of liquid helium from the evaporated helium gas using two 1.5W@4.2K GM cryocoolers (SRDK-415D, Sumitomo Heavy Industries, Ltd.). It has been confirmed that the HCS could be used with the real MEG system without any noise problem for over one year. The maintenance cost (electricity charges and cryocoolers maintenance fee) of the MEG has reduced to be less than 1/10 of the previous cost.



Reduction of upkeep costs by improved helium circulation systems?

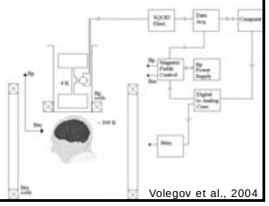
Low-field MRI

More Tesla, higher SNR?
…very high costs, technical problems, increasing noise, field inhomogenities…

Instead:
Use SQUIDs and low fields

Result:
NMR-spectroscopy, MRI
Cheaper
Less prone to susceptibility
Metal implants are less of a problem
Can be used in the OR

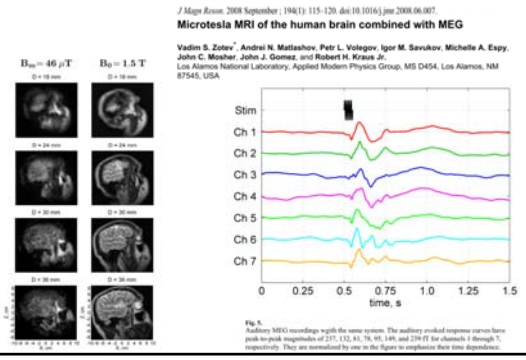
And…



Volegov et al., 2004

Low-field MRI

…can be combined with MEG.



J Magn Reson. 2008 September ; 194(1): 115–120. doi:10.1016/j.jmr.2008.06.007.

Microtesla MRI of the human brain combined with MEG

Vadim S. Zotev*, Andrei N. Matlashov, Petr L. Volegov, Igor M. Savukov, Michelle A. Espy, John C. Mosher, John J. Gomez, and Robert H. Kraus Jr.
Los Alamos National Laboratory, Applied Modern Physics Group, MS D454, Los Alamos, NM 87545, USA

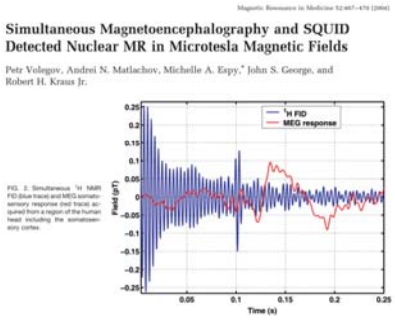
$B_m = 46\ \mu T$ $B_0 = 1.5\ T$

Stim
Ch 1
Ch 2
Ch 3
Ch 4
Ch 5
Ch 6
Ch 7
0 0.25 0.5 0.75 1.0 1.25 1.5
time, s

Fig. 5.
Auditory MEG recordings with the same system. The auditory evoked response curves have peak-to-peak magnitudes of 237, 132, 81, 78, 95, 149, and 239 fT for channels 1 through 7, respectively. They are normalized by one in the figure to emphasize their time dependence.

Low-field MRI

…can be combined with MEG.



Magnetic Resonance in Medicine 52:957–970 (2004)

Simultaneous Magnetoencephalography and SQUID Detected Nuclear MR in Microtesla Magnetic Fields

Petr Volegov, Andrei N. Matlachov, Michelle A. Espy,* John S. George, and Robert H. Kraus Jr.

^{1}H FID
MEG response
Field (pT)
Time (s)

FIG. 2. Simultaneous ^{1}H NMR FID (blue trace) and MEG somatosensory response (red trace) acquired from a region of the human head including the somatosensory cortex.

Causes of inaccuracies

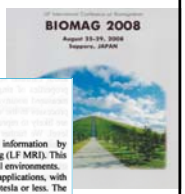
MEG (EEG, fMRI, tractography, ...)

- SNR
- Localization error
- Coregistration error

Neuronavigation system (Suess et al., 2007)

■ Image resolution error	0.7-1.55mm
■ System inaccuracies/tolerances	1mm
■ Fiducial/target registration error	1.5mm
■ Fusion error (= MEG coregistration error)	2mm(?)
■ Position error (variation over time)	1mm
■ Brain shift	1.5mm
⇒ **Total**	**~4-8mm**
⇒ **Total**	**~2mm**

Low-field MRI



W1-4: A 304-channel SQUID system for MEG and low field MRI

*Martin Burghoff[1]

[1]Physikalisch-Technische Bundesanstalt (PTB)

SQUID-based systems have potential for simultaneous recordings of functional brain information by magnetoencephalography (MEG) and anatomical information by low field magnetic resonance imaging (LF MRI). This is a very interesting issue for the growing number of users of MEG SQUID systems installed in clinical environments. We modified our 304-channel SQUID system, originally developed and optimized for biomagnetic applications, with the aim to employ it also for observing the precession of nuclear magnetism in low fields of a microtesla or less. The 304-channel SQUID system operates in a highly magnetically shielded environment provided by a 7-layer mu-metal walk-in room BMSR-2 (Berlin Magnetically Shielded Room - 2). The setup enables MEG recordings in a frequency bandwidth from DC up to 8 kHz.

To record magnetic resonance precession, coil systems for the polarization and for the observation of the nuclear magnetization were adapted to the SQUID set-up. In practice, the SQUID readout electronics has to be fast enough to switch off the SQUIDs during polarization (heavy for the SQUIDs) and for short dead times after switching off the polarizing field. In the case of the 304-channel SQUID system, a dead time of less than 300 microseconds can be realized (see poster of Hartwig).

The vector design of the 304-channel SQUID system allows the recording of the spatial structure of the MR precession in the polarized voxels. From the spatially resolved data and by using the known voxel positions, the magnetic moments of the voxels can be estimated. This means that LF MRI is already possible, to some extend, by using a multi-channel SQUID system without any frequency or phase encoding. This feature of the multi-channel SQUID system can be further improved by polarization encoding (see poster of Nieminen).

Hypothesis 7: Degree of professionalism will increase due to national and international societies and communities

Organization

ACMEGS

ISACM

Ask after February 17th

ECMEGS
European Clinical MEG Society

...

- Standards
- Teaching
- Support
- Community
- Meetings

- Reimbursement(?)

- Regulations?
- Multi-center studies?
- Maintenance?

INTERNATIONAL LEAGUE AGAINST EPILEPSY

...

Hypotheses

1: Epilepsy – still a (the?) major clinical application of MEG
2: Alternatives to spikes and seizures for epileptic focus localization
3: New applications of MEG in epileptology
4: Advances of functional mapping
5: New clinical applications
6: Advances in instrumentation
7: Professionalism

„You don‘t need eyes to see, you need vision“

Roland „Rollo“ Amstrong, Faithless

MAPQUEST

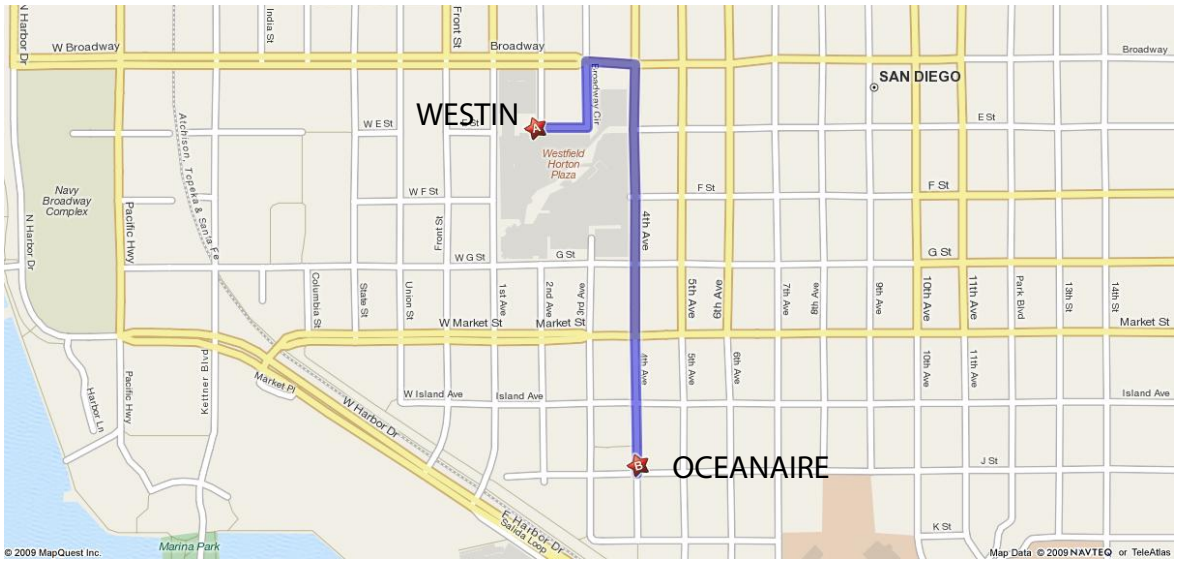
Starting Location

910 Broadway Cir
San Diego, CA 92101-6114

Ending Location

400 J St
San Diego, CA 92101-6980

Walking Time Estimate: **10 minutes** / **0.61 miles**



910 Broadway Cir WESTIN HOTEL
San Diego, CA 92101-6114

START	1.	Start out going **NORTH** on **BROADWAY CIR** toward **BROADWAY**.	0.1 mi
	2.	Turn **RIGHT** onto **BROADWAY**.	0.1 mi
	3.	Turn **RIGHT** onto **4TH AVE**.	0.4 mi
	4.	Turn **LEFT** onto **J ST**.	0.0 mi
END	5.	**400 J ST** is on the **LEFT**.	OCEANAIRE RESTAURANT

AKNOWLEDGMENT

Grateful acknowledgment is made to the following organizations for their generous support of this workshop in the form of unrestricted educational grants.

EVALUATION

Please identify yourself: ☐ Neurologist ☐ Neurosurgeon
☐ Radiologist ☐ Technologist
☐ Other _____

Please rate the effectiveness using the following scale:
1 = poor 2 = below average 3 = average 4 = above average 5 = excellent

	clarity of the information presented	relevance of the information to your clinical practice	objectivity, balance & scientific rigor
Michael Longacre	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
Richard Burgess	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
Naoaki Tanaka	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
Erin Schwartz	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
Ernst Rodin	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
John Ebersole	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤
Stefan Rampp	① ② ③ ④ ⑤	① ② ③ ④ ⑤	① ② ③ ④ ⑤

Rate your overall satisfaction with the opportunity to network with colleagues.	① ② ③ ④ ⑤
Rate your overall satisfaction with the quality of this conference/workshop.	① ② ③ ④ ⑤
Please rate your satisfaction with the organization of the conference/workshop.	① ② ③ ④ ⑤
How would you rate the cost of registration versus what you personally got out of the conference?	① ② ③ ④ ⑤

What other topics should ACMEGS address in future conferences?

1) _____

2) _____

3) _____

Additional comments?_____

_____

Did you perceive commercial bias in any of the presentations? ☐ No ☐ Yes

Explain: _____

ACMEGS BYLAWS

BYLAWS
OF
AMERICAN CLINICAL MAGNETOENCEPHALOGRAPHY SOCIETY, INC.,
A NON-PROFIT CORPORATION

ARTICLE I
ORGANIZATION

1.1 The name and charitable purposes of the organization shall be as set forth in its Articles of Organization. In addition to the charitable purposes as set forth in the Articles of Organization, the organization may work cooperatively with other national and international magnetoencephalography (MEG), neurology, neurosurgery, and radiology organizations in determining how best to meet the clinical needs of MEG sites within the United States. These Bylaws, the powers of the organization and of its directors and officers, shall be subject to the Articles of Organization as in effect from time to time. The principal office of the organization in the Commonwealth of Massachusetts shall initially be located at the place set forth in the Articles of Organization.

1.2 The organization may have a seal which shall be in such form as the Board of Directors may, from to time to time, adopt or amend.

1.3 The organization may at its pleasure by a vote of the Members (as hereinafter defined) change its name.

1.4 The pronoun “he” or “his,” when appropriate, shall be construed to mean also “she” or “her” and the word “chairman” shall be construed to include a female.

ARTICLE II
MEMBERSHIP

2.1 Membership in this organization shall be open to those who support the purpose statement of the organization as set forth in the Articles of Organization and meet the qualifications set forth in Section 2.2. Continuing membership is contingent upon being up-to-date on membership dues which shall be paid annually on or before September 1st of each year.

2.2 There shall be two (2) classes of membership in the organization; namely, a Member class and an Associate Member class.

a. “Members” shall include those individuals involved in the clinical use of magnetoencephalography (MEG) alone or in combination with electroencephalograms (EEGs), magnetic resonance imaging (MRI) or computerized axial tomography (CAT) scans and possessing a a medical degree (M.D.), aPh.D. in one of the aforementioned fields, or some equal equivalent degree. Each Member shall have one vote per person at all annual and special meetings of the members.

b. “Associate Members” shall include clinicians, or their clinical assistants, involved with the use of magnetoencephalography (MEG) alone or in combination with electroencephalograms (EEGs), magnetic resonance imaging (MRI) or

computerized axial tomography (CAT) scan equipment and students with an interest in any of those fields. There are no voting rights for Associate Members.

Individuals wishing to join the membership of this organization for either class of membership shall apply for admission and be nominated by two (2) existing members of the member class for which membership is sought; provided, however, that those individuals identified as directors in the Articles of Organization as originally filed with the Massachusetts Clerk of the Commonwealth shall be automatically admitted into the Member class of this organization without further application. The Membership Committee shall review and recommend either admission or denial into the membership of this organization for each application submitted, after which the entire Board of Directors shall vote to accept or reject the Membership Committee's recommendation. The vote of the Board of Directors shall be final.

2.3 The dues for each membership class shall be reviewed and set annually by the Board and any proposed changes shall be voted on at the annual membership meeting.

2.4 Only those members who are current on their membership dues and are in the Members class shall be eligible to vote at any annual or special meetings of the membership.

ARTICLE III
MEMBERSHIP MEETINGS

3.1 The first annual membership meeting of this organization shall be held on August 26, 2006 and thereafter shall be held on such date as determined by vote of the membership at the prior year's annual membership meeting.

3.2 The Clerk shall cause to be mailed to every member in good standing at its address as it appears in the membership roll book in this organization a notice telling the time and place of such annual meeting.

3.3 Meetings of the membership may be held at such time and place, within or without the Commonwealth of Massachusetts, as shall be stated in the notice of the meeting or in a duly executed waiver of notice thereof. Notices of meetings shall be sent to all members at their addresses as they appear in the membership roll book at least ten (10) days before the scheduled date set for such meeting. If mailed, notice is given when deposited in the United States mail, postage prepaid, directed to the member at such member's address as it appears on the records of the organization. Without limiting the manner by which notice otherwise may be given effectively to members, any notice to members given by the organization shall be effective if given by a form of electronic transmission consented to by the member to whom the notice is given. Any such consent shall be revocable by the member by written notice to the organization. Any such consent shall be deemed revoked if (1) the organization is unable to deliver by electronic transmission two consecutive notices given by the organization in accordance with such consent and (2) such inability becomes known to the Clerk or an Assistant Clerk of the organization, or other person responsible for the giving of notice; provided, however, the inadvertent failure to treat such inability as a revocation shall not invalidate any meeting or other action.

3.4 The presence of not less than a majority of the Members class shall constitute a quorum and shall be necessary to conduct the business of this organization; but a lesser percentage may adjourn the meeting for a period of not more than four (4) weeks from the date scheduled

by these Bylaws and the Clerk shall cause a notice of this scheduled meeting to be sent to all those members who were not present at the meeting originally called. A quorum as herein before set forth shall be required at any adjourned meeting.

3.5 Special meetings of the members may be called by the President when he deems it for the best interest of the organization. Such notice shall state the reasons that such meeting has been called, the business to be transacted at such meeting and by whom it was called. At the request of a majority of the members of the Board of Directors or a majority of the Members class, the President shall cause a special meeting to be called but such request must be made in writing at least ten (10) days before the requested scheduled date.

3.6 No other business but that specified in the notice may be transacted at such special meeting without the unanimous consent of all present at such meeting.

ARTICLE IV
VOTING

4.1 When a quorum is present at any meeting, the vote of a majority of the Members class present in person or represented by proxy shall decide any question brought before such meeting, unless the question is one upon which by express provision of the statutes or of the Articles of Organization a different vote is required in which case such express provision shall govern and control the decision of such question.

4.2 Unless otherwise provided in the Articles of Organization or these Bylaws, each member of the Members class shall at every meeting of the membership be entitled to one (1) vote in person or by proxy, but no proxy shall be voted on after three (3) years from its date, unless the proxy provides for a longer period.

4.3 Unless otherwise provide in the Articles of Organization, any action required to be taken at any annual or special meeting of the membership of the organization, or any action which may be taken at any annual or special meeting of such members, may be taken without a meeting, without prior notice and without a vote, if a consent in writing, setting forth the action so taken, shall be signed by the members of the Members class having not less than the minimum number of votes that would be necessary to authorize or take such action at a meeting at which such members of the Members class were present and voted. Prompt notice of the taking of the action without a meeting by less than unanimous written consent shall be given to those members who have not consented in writing.

ARTICLE V
BOARD OF DIRECTORS

5.1 The business of this organization shall be managed by a Board of Directors consisting of the President, Clerk, Treasurer and two (2) at-large members, all of whom shall be Members. The initial directors shall be appointed by the sole incorporator. Thereafter, the directors shall be elected at the annual meeting of the membership in accordance with these Bylaws. Each director elected shall hold office until his successor is elected and qualified.

5.2 The at-large directors shall serve for a term of two (2) years. There shall be no limits on the number of terms an at-large director may consecutively serve. The terms of the at-large

directors shall be staggered with their initial terms as set forth in the Articles of Organization as originally filed with the Massachusetts Secretary of the Commonwealth.

5.3 Any Assistant Treasurer(s) chosen by the directors in accordance with Section 6.1 of these Bylaws shall be an ex-officio member of the Board of Directors.

5.4 The Board of Directors shall have the control and management of the affairs and business of this organization. Such Board of Directors shall only act in the name of the organization when it shall be regularly convened by its chairman after due notice to all the directors of such meeting.

5.5 A majority of the members of the Board of Directors shall constitute a quorum and the meetings of the Board of Directors shall be held regularly as such dates and times as the Board of Directors may determine, but no less than quarterly. The Board of Directors may hold meetings, both regular and special, either within or without the Commonwealth of Massachusetts.

5.6 Each director shall have one (1) vote and such voting may not be done by proxy.

5.7 Special meetings of the Board may be called by the President on five (5) days' notice to each director by mail or forty-eight (48) hours notice to each director either personally or by electronic means of communications, including electronic mail and facsimile transmission; special meetings shall be called by the President or Clerk in like manner and on like notice on the written request of one (1) director.

5.8 Unless otherwise restricted by the Articles of Organization or these Bylaws, any action required or permitted to be taken at any meeting of the Board of Directors or of any committee thereof may be taken without a meeting, if all members of the Board or committee, as the case may be, consent thereto in writing, and the writing or writings are filed with the minutes or proceedings of the Board or committee.

5.9 Unless otherwise restricted by the Articles of Organization or these Bylaws, members of the Board of Directors, or any committee designated by the Board of Directors, may participate in a meeting of the Board of Directors, or any committee, by means of conference telephone or similar communications equipment by means of which all persons participating in the meeting can hear each other, and such participation in a meeting shall constitute presence in person at the meeting.

5.10 Unless otherwise restricted by the Articles of Organization or these Bylaws, any director may be removed, with or without cause, by a majority of the members entitled to vote on such directorship. Any director may resign at any time by giving written notice of resignation to the Board of Directors, to the President or to the Clerk. Any such resignation shall take effect upon receipt of such notice or at any later time specified therein. Unless otherwise specified in the notice, the acceptance of a resignation shall not be necessary to make the resignation effective.

5.11 Vacancies in the Board of Directors shall be filled by the members entitled to vote on such directorship. Each director chosen to fill a vacancy on the Board of Directors shall hold office until the next annual election of directors and until his successor shall be elected and qualified.

ARTICLE VI
OFFICERS

6.1 The officers of the organization shall be chosen by the Board of Directors and shall be a President, a Clerk and a Treasurer, all of whom shall be Members. The Board of Directors may also choose one or more Assistant Clerks and Assistant Treasurers. Any number of offices may be held by the same person, unless the Articles of Organization or these Bylaws otherwise provide.

6.2 The Board of Directors at its first meeting after each annual meeting of the membership shall choose a President, a Clerk and a Treasurer from those members of the Board of Directors, and may elect one or more Assistant Clerks and Assistant Treasurers as the Board of Directors shall deem to be in the organization's best interests.

6.3 The Board of Directors may appoint such other officers and agents as it shall deem necessary who shall hold their offices for such terms and shall exercise such powers and perform such duties as shall be determined from time to time by the Board.

6.4 No officer shall for reason of his office be entitled to receive any salary or compensation, but nothing herein shall be construed to prevent an officer or director for receiving any compensation from the organization for duties other than as a director or officer.

6.5 The officers of the organization shall hold office until their successors are chosen and qualify. Any vacancy occurring in any office of the organization shall be filled by the Board of Directors. Any officer elected or appointed by the Board of Directors may be removed at any time by the affirmative vote of a majority of the Board of Directors. Any officer may resign at any time by giving written notice of resignation to the Board of Directors, to the President or to the Clerk. Any such resignation shall take effect upon receipt of such notice or at any later time specified therein. Unless otherwise specified in the notice, the acceptance of a resignation shall not be necessary to make the resignation effective.

6.6 The President shall be the chief executive officer of the organization, shall have general and active management of the business of the organization and shall see that all orders and resolutions of the Board of Directors are carried into effect. The President shall preside at all meetings of the membership and of the Board of Directors at which he is present. The President shall have all powers and duties usually incident to the office of the President except as specifically limited by a resolution of the Board of Directors. The President shall have such other powers and perform such other duties as may be assigned to him from time to time by the Board of Directors.

6.7 The Clerk shall attend all meetings of the Board of Directors and all meetings of the membership and record all the proceedings of the meetings of the organization and of the Board of Directors in a book to be kept for that purpose and shall perform like duties for the standing committees when required. He shall give, or cause to be given, notice of all meetings of the membership and special meetings of the Board of Directors, and shall perform such other duties as may be prescribed by the Board of Directors or President, under whose supervision he shall be. He shall have custody of the corporate seal of the organization and he, or an Assistant Clerk, shall have authority to affix the same to any instrument requiring it and when so affixed, it may be attested by his signature or by the signature of such Assistant Clerk. The Board of Directors may give general authority to any other officer to affix the seal of the organization and to attest the affixing by his signature.

6.8 The Assistant Clerk, or if there be more than one, the Assistant Clerks in the order determined by the Board of Directors (or if there be no such determination, then in order of their election) shall, in the absence of the Clerk or in the event of his inability or refusal to act, perform the duties and exercise the powers of the Clerk and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

6.9 The Treasurer shall have the custody of the corporate funds and shall keep full and accurate accounts of receipts and disbursements in books belonging to the organization and shall deposit all monies and other valuable effects in the name and to the credit of the organization in such depositories as may be designated by the Board of Directors. He shall disburse the funds of the organization as may be ordered by the Board of Directors, taking proper vouchers for such disbursements, and shall render to the President and the Board of Directors, at its regular meetings, or when the Board of Directors so requires, an account of all his transactions as Treasurer and of the financial condition of the organization. He shall exercise all duties incident to the office of Treasurer.

6.10 The Assistant Treasurer, or if there shall be more than one, the Assistant Treasurers in the order determined by the Board of Directors (or if there be no such determination, then in the order of their election) shall, in the absence of the Treasurer or in the event of his inability or refusal to act, perform the duties and exercise the powers of the Treasurer and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

ARTICLE VII
COMMITTEES

7.1 The Board of Directors may create committees as needed, such as executive, audit, and public relations. There shall be one standing committee – the Membership Committee. Except for members of the Membership Committee, membership in any committee created by the Board of Directors may contain such numbers of Members and Associate Members as the Board of Directors may reasonably determine.

7.2 No less than three (3) directors of the Board of Directors shall be appointed by the Board of Directors and shall serve as the members of the Membership Committee.

7.3 The Membership Committee shall have responsibility for reviewing applications for admission and making recommendations with respect such applications to the full Board of Directors.

ARTICLE VIII
GENERAL PROVISIONS

CHECKS

8.1 All checks or demands for money and notes of the organization shall be signed by such officer or officers or such other person or persons as the Board of Directors may from time to time designate.

FISCAL YEAR

8.2 The fiscal year of the organization shall be fixed by resolution of the Board of Directors.

BOOKS AND RECORDS

8.3 The books of the organization shall be kept at such place as the Board of Directors shall designate by resolution.

ARTICLE IX
INDEMNIFICATION; LIMITATION ON LIABILITY

9.1 Each director and officer of the organization shall be indemnified to the fullest extent now or hereafter permitted by law in connection with any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative, by reason of the fact that he is or was a director or officer of the organization or is or was serving at the request of the organization as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise. Without limiting the generality of the foregoing, the organization shall indemnify each person within the scope of the foregoing to the extent to which it is given the power to do so by Section 8.56 of the Massachusetts Business Corporations Act of the Commonwealth of Massachusetts as in effect on the effective date of these Bylaws or as thereafter amended. To the extent permitted by applicable law, the organization shall have power to purchase and maintain insurance on behalf of any person who is or was a director, officer, employee or agent of the organization, or is or was serving at the request of the organization as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against any liability asserted against him and incurred by him in any such capacity or arising out of his status as such whether or not the organization would have the power to indemnify him against such liability under applicable. law.

9.2 A director of the organization shall not be personally liable to the organization or its members for monetary damages for breach of fiduciary duty as a director except for liability (i) for any breach of the director's duty of loyalty to the organization or its members, (ii) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (iii) under Section 8.56 of the Massachusetts Business Corporations Act of the Commonwealth of Massachusetts, as the same exists or hereafter may be amended, or (iv) for any transaction from which the director derived an improper personal benefit. If the Massachusetts Business Corporations Act hereafter amended to authorize the further elimination or limitation of the liability of directors, then the liability of a director of the organization, in addition to the limitation on personal liability provided herein, shall be limited to the fullest extent permitted by the amended Massachusetts Business Corporations Act. Any repeal or modification of this Article IX by the members of the organization shall be prospective only, and shall not adversely affect any limitation on the personal liability of a director of the organization existing at the time of such repeal or modification.

ARTICLE X
AMENDMENTS

10.1 These Bylaws may be altered, amended, repealed or added to by an affirmative vote of not less than a majority of the members entitled to vote thereon.

ACMEGS DOCUMENTS

- ACMEGS request for MEG Revenue Code
- ACMEGS comment on CMS Proposed Rules for 2010 (1414-P)
- ACMEGS comment on CMS Cost Report (2552-10)
- ACMEGS letter to Senator Bennett
- ACMEGS Letter to Dr. Hambrick, CMS
- ACMEGS Position Statement

ACMEGS
AMERICAN CLINICAL MEG SOCIETY

Petition to the

National Unified Billing Committee (NUBC)

for a unique MEG billing code

Submitted By: Michael Funke, MD

On behalf of the

American Clinical MEG Society

ACMEGS appreciates the opportunity to address the NUBC and commends the Panel on its efforts to evaluate and improve revenue codes.

ACMEGS is a non-profit 501c6 trade association with a membership of more than 20 specialized clinical magnetoencephalography (MEG) centers in the United States. Founded in 2006 by physician-leaders committed to setting a national agenda for quality epilepsy care, ACMEGS educates public and private policymakers and regulators about appropriate patient care standards, reimbursement and medical services policies.

ACMEG is committed to ensuring patient access to life-saving and life-enhancing devices in the most appropriate settings and supports a system with payment weights and payment rates that include sufficient resources to account for the costs of the medical technologies associated with hospital outpatient.

The chart below contains the most recent claims data (2008) referenced by CMS in calculating the 2010 OPPS proposed rule. The data demonstrates that EEG has a high utilization and low cost, while MEG has a low utilization and high costs. This represents a significant problem for MEG as it is grouped with EEG on the Medicare Cost Report and with the respective revenue code on the UB-04.

Procedure	**EEG**	**EEG**	**EEG**	**EEG**	**MEG**
APC	0213	0213	0213	0213	0067
CPT Code	95816	95819	95812	95813	95965
Utilization	37,894	40,938	3,401	1,180	25
Costs	$151.88	$164.06	$175.63	$257.73	$2,945.61

AMERICAN CLINICAL MEG SOCIETY

Michael E Funke, M.D., Ph.D. | 729 Arapeen Dr. Salt Lake City, UT 84108 | T: 801.585.6840 F: 801.585.5420 | **www.acmegs.org**

The current Medicare Cost Report has no specific line for MEG and therefore facilities utilize line 54 that is designated for EEG. When CMS cannot reconcile MEG from this data set, they default to the corresponding revenue code, which in our case is also for EEG. In one case, when MEG obtained a subscript to line 54.01 on the Medicare Cost Report, the CCR went from 0.31996 to 0.734581. In another case when MEG was isolated, its CCR went from .337 to .869. The ACMEGS is currently recommending to its members that they petition their MACs and request that MEG be allowed a subscript to line 54 (54.01) as a means to allow CMS to isolate MEG from EEG.

It is also our understanding that MEG needs to differentiate itself from EEG with an appropriate revenue code on the UB-04. Grouping MEG and EEG together with the same revenue code adversely affects MEG's CCR.

The financial impact of these errors on MEG has been significant. The chart below states the over-all percent decrease in reimbursement since MEG (95965) moved from a new technology APC to a clinical APC. The continued decrease in reimbursement will adversely affect the ability of patients to obtain the benefits of MEG. These benefits of MEG have been documented in a recently published position paper by the American Academy of Neurology.

- CPT 95965 by 33% (2005: $5,250; 2010: $3,506)
- CPT 95966 by 38% (2005: $1,450; 2010: $894)
- CPT 95967 by 5% (2005: $950; 2010: $894)

ACMEGS encourages the Panel to recognize the unique challenges associated with MEG and urges the Panel to carefully consider the adoption of a new revenue code for MEG.

Thank you

President,
American Clinical MEG Society

For additional information, please contact: Michael Funke, MD, PhD, President, American Clinical MEG Society, 729 Arapeen Drive, Salt Lake City, UT 84108;
email: michael.funke@hsc.utah.edu; phone (801) 585-6840.

For clinical information: American Academy of Neurology,
Magnetoencephalography (MEG) Policy Adopted May 8, 2009
http://www.aan.com/news/?event=read&article_id=7795&page=1016.378.33

Comments to

Centers for Medicare and Medicaid Services

CMS 1414-P

Proposed Changes to the Hospital Outpatient Prospective Payment System and CY 2010 Payment Rates

Submitted By: Michael Funke, MD

On behalf of the

American Clinical MEG Society

ACMEGS appreciates the opportunity to address the Centers for Medicare and Medicaid Services (CMS) on Ambulatory Payment Classification (APC) Groups and commends CMS on its efforts to evaluate and improve the APC groups under the hospital outpatient prospective payment system (OPPS).

ACMEGS is a non-profit 501c6 trade association with a membership of more than 20 specialized clinical MEG centers in the United States. Founded in 2006 by physician-leaders committed to setting a national agenda for quality epilepsy care, ACMEGS educates public and private policymakers and regulators about appropriate patient care standards, reimbursement and medical services policies.

ACMEGS is committed to ensuring patient access to life-saving and life- enhancing devices in the most appropriate settings and supports a system with payment weights and payment rates that include sufficient resources to account for the costs of the medical technologies associated with hospital outpatient care.

ACMEGS appreciates the opportunity to address CMS on Ambulatory Payment Classification (APC) Groups and appreciates your efforts to ensure that Medicare beneficiaries have timely access to new technologies. Our comments today will address two key topics:

- Data Used to Determine Reimbursement Rates for 95965, 95966, 95967
- Appropriate APC Placement for 95965, 95966, 95967

In 2005, MEG transitioned from a new technology APC to a clinical APC. The reimbursement for MEG has declined significantly since 2005. This dramatic reduction in reimbursement affects patient access to this valuable technology. The actual reductions are:

- CPT 95965 by 33% (2005: $5,250; 2010: $3,506) APC 67
- CPT 95966 by 38% (2005: $1,450; 2010: $894) APC 65
- CPT 95967 by 5% (2005: $950; 2010: $894) APC 65

It is the contention of the ACMEGS that these reductions are not representative of fact, but rather an acknowledgement of no specific line item for MEG on the Medicare Cost Report and the currently assigned revenue code for MEG.

There is no specific line to for MEG on the Medicare Cost Report. MEG costs are combined with EEG, on line 54, of the Medicare Cost Report. This has resulted in the costs for MEG, which is significantly higher with much lower utilization, being diluted by the much lower costs and higher utilization of EEG. The isolation of MEG on the Medicare Cost Report resulted in a significant impact on its calculated CCR. One facility petitioned Noridian and requested a subscript to line 54 to account for MEG. The appeal was granted and line 54.01 was generated. The recalculated CCR went from 0.319960 to 0.734581. In another institution, the recalculated CCR went from 0.337004 to 0.869100. In yet another institution the recalculated MEG CCR was 0.584461. The delta in all instances is significant and will have a dramatic effect in determining final Medicare reimbursement as well as setting future years payment rates.

The ACMEGS realizes that a separate line item is only half of what is necessary to accurately capture the costs of MEG. The current recommended revenue code for MEG is the same revenue code for EEG. On August 11, 2009, ACMEGS appealed to the National Uniform Billing Committee to grant MEG a unique revenue code. The committee unanimously granted our request and created a new revenue code category 086x – Magnetoencephalogy (MEG) effective April 1, 2010. The committee, which included CMS representatives, highly recommended to ACMEGS to make comments to the proposed modifications to the Medicare Hospital Cost Report.

It is the contention of ACMEGS that the combination of no specific line on the cost report and an EEG revenue code has significantly affected the reimbursement for MEG. Since 2005 when MEG was placed into a clinical APC, the reimbursement has been reduced upwards of 38%. We now have a specific revenue code (086x) effective April 1, 2010 and are asking for a specific line on the Medicare Cost report to account for the true costs of MEG.

The ACMEGS and the centers it represents are working to correct the errors mentioned above. As you are aware, these corrections take time to both accomplish as well as to be implemented into the over-all CMS database. It is for this reason that we are requesting that CMS restore the 2005 reimbursement rate for MEG.

- CPT 95965 2005: $5,250
- CPT 95966 2005: $1,450
- CPT 95967 2005: $950

Once the data has been corrected via an appropriate line item on the Medicare Cost report and a fully implemented new revenue code, the ACMEGS respectfully would request that CMS re-evaluate MEG as to its reimbursement and appropriate APC placement. The ACMEGS would greatly appreciate the opportunity to speak with CMS and discuss the outcomes of the correct cost data for MEG.

ACMEGS encourages CMS to continue to recognize the unique challenges associated with MEG and urges the Panel and CMS to carefully consider the timeliness, adequacy, and accuracy of the data and the unique perspective that our members bring to these issues.

Thank you

President,
American Clinical MEG Society

For additional information, please contact: Michael Funke, MD, PhD, President, American Clinical MEG Society, 729 Arapeen Drive, Salt Lake City, UT 84108;
email: michael.funke@hsc.utah.edu; phone (801) 585-6840.

For clinical information: American Academy of Neurology,
Magnetoencephalography (MEG) Policy Adopted May 8, 2009
http://www.aan.com/news/?event=read&article_id=7795&page=1016.378.33

Comments to

Centers for Medicare and Medicaid Services

CMS 2552-10

Information Collection Request: Hospital and Health Care Complexes Cost Report

Submitted By: Michael Funke, MD

On behalf of the

American Clinical MEG Society

The American Clinical Magnetoencephalogy Society (ACMEGS) appreciates the opportunity to make comments to CMS Form 2552-10.

ACMEGS is a non-profit 501c6 trade association with a membership of more than 20 specialized clinical magnetoencephalogy (MEG) centers in the United States. Founded in 2006 by physician-leaders committed to setting a national agenda for quality epilepsy care, ACMEGS educates public and private policymakers and regulators about appropriate patient care standards, reimbursement and medical policies.

ACMEGS is committed to ensuring patient access to a life-saving and life-enhancing technology and supports a system with payment weights and payment rates that include sufficient resources to account for the costs of the medical technology associated with hospital outpatient care.

The Social Security Act requires Medicare-participating providers to submit annual cost reports to the Centers for Medicare & Medicaid Services (CMS). The agency uses the hospital cost reports for many purposes, including determining final Medicare reimbursement due to or from the hospitals and setting future years' payment rate.

The ACMEGS is respectfully requesting CMS to add an additional line to the cost report which would account for the unique costs associated with magnetoencephalogy. There is no specific line for MEG on the Medicare Cost Report

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MEG costs are combined with EEG, on line 54, of the Medicare Cost Report. This has resulted in the costs for MEG, which is significantly higher with much lower utilization, being diluted by the much lower costs and higher utilization of EEG. The isolation of MEG on the Medicare Cost Report resulted in a significant impact on its calculated CCR. One facility petitioned Noridian and requested a subscript to line 54 to account for MEG. The appeal was granted and line 54.01 was generated. The recalculated CCR went from 0.3199 to 0.7345. In another institution, the recalculated CCR went from 0.3370 to 0.8691. In yet another institution the recalculated CCR was 0.5844. The delta in all instances is significant and will have a dramatic effect in determining final Medicare reimbursement as well as setting future years payment rates.

Table 1

Facility	**EEG CCR**	**MEG CCR**
University of Utah	0.3199	0.7345
Wake Forest University	0.3370	0.8691
University of Pittsburg	0.0974	0.5844
Alexian Brothers Hospital*	0.2138	0.4516
Average	***0.2420***	***0.6599***

* MEG operation is a joint venture, therefore only 50% of personnel cost are included

The ACMEGS realizes that a separate line item is only half of what is necessary to accurately capture the costs of MEG. The current recommended revenue code for MEG is the same revenue code for EEG. On August 11, 2009 ACMEGS appealed to the National Uniform Billing Committee to grant MEG a unique revenue code. The committee unanimously granted our request and created a new revenue code category 086x – Magnetoencephalogy (MEG) effective April 1, 2010. The committee, which included CMS representatives, highly recommended to ACMEGS to make comments to the proposed modifications to the Medicare Hospital Cost Report.

It is the contention of ACMEGS that the combination of no specific line on the cost report and an EEG revenue code has significantly affected the reimbursement for MEG. Since 2005 when MEG was placed into a clinical APC the reimbursement has been reduced upwards of 38%. We now have a specific revenue code (086x) effective April 1, 2010 and are asking for a specific line on the Medicare Cost report to account for the true costs of MEG.

ACMEGS appreciates the opportunity to bring this matter to the attention of CMS and asks that CMS recognize the unique challenges associated with MEG with the adoption of a new line on the cost report for MEG.

Thank you

President,
American Clinical MEG Society

For additional information, please contact: Michael Funke, MD, PhD, President, American Clinical MEG Society, 729 Arapeen Drive, Salt Lake City, UT 84108;
email: michael.funke@hsc.utah.edu; phone (801) 585-6840.

For clinical information: American Academy of Neurology,
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ACMEGS
AMERICAN CLINICAL MEG SOCIETY

Honorable Senator Robert F. Bennett

431 Dirksen Senate Office Building

Washington, DC 20510-4403

Dear Senator Bennett,

The American Clinical MEG Society (ACMEGS) would like your assistance in addressing a recent CMS decision concerning payment for Magnetoencephalography (MEG). We respectfully request that a letter be sent to the Director of CMS appealing the decision in CMS-1414-FC that concerns MEG.

In 2005, Magnetoencephalography (MEG) transitioned from a new technology APC to a clinical APC. The reimbursement for MEG has declined significantly since 2005. This dramatic reduction in reimbursement affects patient access to this valuable technology. The actual reductions are:

- CPT 95965 by 33% (2005: $5,250; 2010: $3,506) APC 67
- CPT 95966 by 38% (2005: $1,450; 2010: $894) APC 65
- CPT 95967 by 5% (2005: $950; 2010: $894) APC 65

These reductions are not representative of fact, but rather an acknowledgement of no specific line item for MEG on the Medicare Cost Report and the currently assigned revenue code for MEG.

There is no specific line to for MEG on the Medicare Cost Report. MEG costs are combined with EEG, on line 54, of the Medicare Cost Report. This has resulted in the costs for MEG, which is significantly higher with much lower utilization, being diluted by the much lower costs and higher utilization of EEG. The isolation of MEG on the Medicare Cost Report resulted in a significant impact on its calculated Cost-Charge-Ratio (CCR). The University of Utah facility petitioned Noridian (Medicare Administrative Contractor) and requested a subscript to line 54 to account for MEG. The appeal was granted and line 54.01 was generated. The recalculated CCR went from 0.31996 to 0.734581. In another institution, the recalculated CCR went from 0.337 to 0.869. In yet another institution the recalculated CCR was 0.584. Table 1 below is a composite of four facilities CCRs comparing EEG and MEG. On average, with one facility that is a joint venture, MEG has a CCR 2.73 times greater than EEG. The delta in all instances is significant and will have a dramatic effect in determining final Medicare reimbursement as well as setting future years payment rates.

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Table 1:

Facility	EEG CCR	MEG CCR
University of Utah Med Center	0.3199	0.7345
Wake Forest University Med Center	0.3370	0.8691
University of Pittsburg Med Center	0.0974	0.5844
Alexian Brothers Community Hospital*	0.2138	0.4516
Average	***0.2420***	***0.6599***

* MEG operation is a joint venture, therefore only 50% of personnel cost are included

The ACMEGS realizes that a separate line item is only half of what is necessary to accurately capture the costs of MEG. The current recommended revenue code for MEG is the same revenue code for EEG. On August 11, 2009, ACMEGS appealed to the National Uniform Billing Committee to grant MEG a unique revenue code. The committee unanimously granted our request and created a new revenue code category 086x – Magnetoencephalography (MEG) effective April 1, 2010. The committee, which included CMS representatives, highly recommended to ACMEGS to make comments to the proposed modifications to the Medicare Hospital Cost Report. We are currently awaiting CMS's decision on the addition of MEG to the cost report.

We submitted our facts to two, independent organizations, Noridian Administrative Services (MAC) and the National Uniform Billing Committee (NUBC). In both instances the organizations agreed to remedy a bureaucratic glitch which affected the calculated reimbursement for MEG. Regrettably when we presented this same information to CMS they made the following comment in CMS-1414-FC:

We have no reason to believe that the costs that we have derived from our standard cost estimation process for the CY 2010 OPPS fail to appropriately reflect the relative costs of MEG services in relation to the costs of other services paid under the OPPS, nor do we have reason to believe that payment at the rates under which these services were paid under the New Technology APCs in CY 2005 are justified.

Given the facts presented we would have hoped for a reply which was based on facts and not on a belief.

In light of the current focus on cost containment we would like to point out that CMS registered fewer than 30 claims for MEG in 2008. The fiscal impact on CMS in making an appropriate payment determination for MEG would be negligible. Reimbursement rates established by CMS are often utilized by commercial carriers to calculate a payment rate. CMS decision not to address the inadequacies of its current methodology in determining payment for MEG has a direct and negative effect on payment from commercial payers.

We are asking that CMS accept that its current payment methodology for calculating payment for MEG is in error. The ACMEGS is in the process of remedying these issues and would respectfully ask that CMS work with us by adding a specific line for MEG on the Medicare Cost Report and recalculating an appropriate payment for MEG.

Your support in this matter is greatly appreciated.

Sincerely,

President,
American Clinical MEG Society

Cc: Amber Sechrist, Health Legislative Assistant

For additional information, please contact: Michael Funke, MD, PhD, President, American Clinical MEG Society, 729 Arapeen Drive, Salt Lake City, UT 84108;
email: michael.funke@hsc.utah.edu; phone (801) 585-6840.

For clinical information: American Academy of Neurology,
Magnetoencephalography (MEG) Policy Adopted May 8, 2009
http://www.aan.com/news/?event=read&article_id=7795&page=1016.378.33

ACMEGS
AMERICAN CLINICAL MEG SOCIETY

January 26, 2010

Edith Hambrick, MD
Medical Officer
Centers for Medicare and Medicaid Services
Division of Outpatient Care
Hospital and Ambulatory Policy Group
Mailstop: C4-05-17
7500 Security Blvd
Baltimore MD 21244

RE: CMS Cost Report and MEG

Dear Dr. Hambrick:

The purpose of this letter is to request a meeting with CMS to discuss the ACMEGS contentions that the cost data utilized to determine the reimbursement for MEG is not correct.

I first brought MEG to the attention of the APC Panel in 2005. It was our contention then, as it is now, that the cost data utilized to determine a reimbursement rate for MEG is not correct. At the conclusion of the presentations the panel recommended that *CMS maintain CPT codes 95965, 95966 and 95967, magnetoencephalography (MEG), in their 2005 new technology APCs. The panel also recommended that CMS collect more external hospital cost data and provide a detailed review of data for the Panel's consideration at its next meeting.* Regrettably CMS did not agree with the panel's decision and placed MEG in a clinical APC at a significantly lower reimbursement. CMS further stated, *"As suggested by the APC Panel, we will continue to study the APC assignments for these procedures over the coming year and invite members of the public to submit any information they believe will be helpful to us."* Those of us that presented that day felt that the panel agreed that there were disparities in the cost data and had challenged us to determine the reason for these errors.

In our comments to the 2010 APC Proposed Rule we felt that we had identified the primary problem. There is no specific line for MEG on the Medicare Cost Report. MEG costs are combined with EEG, on line 54, of the Medicare Cost Report. This has resulted in the costs for MEG, which is significantly higher with much lower utilization, being diluted by the much lower costs and higher utilization of EEG. The isolation of MEG on the Medicare Cost Report resulted in a significant impact on its calculated CCR.

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MEG is also combined with the revenue code for EEG making it difficult to separate the two procedures on the cost report. In our quest for solutions two third party organizations agreed there was a problem and both took steps to help rectify the situation. You can imagine our frustration when we read the comments posted below form CMS-1414:

We have no reason to believe that the costs that ***we have derived from our standard cost estimation process for the CY 2010 OPPS fail to appropriately reflect the relative costs of MEG*** *services in relation to the costs of other services paid under the OPPS, nor do we have reason to believe that payment at the rates under which these services were paid under the New Technology APCs in CY 2005 are justified.*

No mention was made concerning our contention that MEG costs were being diluted by EEG thus negatively impacting the CCR for MEG. Instead the reviewer stated they had no reason to believe otherwise: *We are not able to create provider specific revenue code-to-cost center crosswalks that would use unique cost report subscripts that hospitals choose to create for particular services. In the case of a hospital reporting MEG costs on a subscripted line 54.01, the costs would be included as costs in cost center 5400 (the cost center to which 54.01 is a subscripted line), the standard cost center for electroencephalography.* ***In accordance with our standard revenue code-to-cost center crosswalk, we would apply the CCR for this cost center to the charges reported under revenue code 0740 (EEG (Electroencephalogram); General Classification)) if there is no CCR available for nonstandard cost center 3280 (EKG and EEG).***

In this case the reviewer agreed that our remedy recommend by Noridian will not allow the true CCR calculations of MEG. One would infer from this statement that only a separate line item on the Medicare Cost report will address this issue. (We have commented on the Medicare Cost Report and requested that MEG be allowed a separate line item.):
We recognize that the NUBC created a new revenue code for MEG on August 11, 2009, to be effective for services reported on or after April 1, 2010, if a hospital chooses to use it. ***We anticipate that we will propose to use claims for services furnished in CY 2010 to calculate OPPS payment rates for CY 2012.*** *Therefore, for the CY 2012 OPPS, we expect that we will propose to determine the primary, secondary and tertiary (if any) CCRs to be applied to the new revenue code as part of our standard rate setting process for the CY 2012 OPPS.*

The NUBC voted unanimously to create a new revenue code for MEG as a means for MEG to be able to separate itself from the costs of EEG, allowing for an accurate reimbursement calculation for MEG.

In my quest for the truth I have learned much about Medicare, but also acknowledge there is much to learn. Certainly my goal is to treat patients not to be totally conversant in the calculation of CCRs. I did take CMS at their word when they stated, *we will continue to study the APC assignments for these procedures over the coming year and invite members of the public to submit any information they believe will be helpful to us.* In good faith the ACMEGS has provided information to CMS. Is CMS proposing that we should wait an additional two years, until 2012, before MEG gets its in day in court?

Our request is for a fair calculation of reimbursement based solely on the MEG cost data provided. Our contention is that this can't be determined today given that MEG and EEG both share a revenue code and the same line item on the Medicare Cost Report. If our contention is in error then we would like to understand why it is in error. This is why we are asking to sit down with you and your representatives and discuss this matter.

If you have any questions regarding our request and comments, please feel free to contact me at (801) 585-6840 or via e-mail to michael.funke@hsc.utah.edu.

Sincerely,

President,
American Clinical MEG Society

Editorial: Assessing MEG

John S. Ebersole, Editor-in-Chief

As editor, I have taken pride in the fact that the *Journal of Clinical Neurophysiology* is seen as a venue in which new techniques in clinical neurophysiology can receive needed exposure and, at the same time, constructive critiques. One such technology, which is forty years old and, thus, new only in comparison with electroencephalography (EEG), is magnetoencephalography (MEG). Numerous original research articles and two special issues featuring MEG have been published in the *Journal*. Recently, I agreed to edit and then publish a position statement from another society, the American Clinical MEG Society (ACMEGS). Although we have published abstracts from meetings of other neurophysiological societies in the past, both as informational material for our readership and as a courtesy to these societies, this is the first time that we have published a "position statement." Let it be clearly understood from the outset that this action does not connote an "official endorsement" of the statement by the American Clinical Neurophysiology Society. Rather, it is simply a recognition that the views contained in it should have a reasonable public airing. In addition, I believe that the plight of colleagues, who have developed and use MEG clinically, yet cannot obtain reimbursement for their efforts, is a story about which we should all take heed.

Sometimes, in our zeal to be overly objective, we end up creating roadblocks to progress. Criteria applied critically to one aspect of medical practice may not be good in judging the worth of another. A case in point may be the rigidity of the evidence-based system for defining clinical usefulness of therapeutic measures and diagnostic tests. This methodology is undoubtedly appropriate for studies of new drugs or treatments, and its associated protocol criteria, such as prospective, double-blinded, placebo-controlled, broad study population, and normal controls, all make sense and are reasonable to accomplish. Applying similar criteria to the evaluation of diagnostic tests can be problematic. Comparisons against existing "gold standards" lead, in most cases, to a double standard, given that few accepted neurological diagnostic techniques have ever been subjected to evidence-based analysis. Yet, as clinicians, we know, for example, that EEG, electromyography (EMG), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), and single-photon emission computed tomography (SPECT) are all useful diagnostic procedures, although not proven by current methods.

In 1992, the Therapeutics and Technology Assessment (TTA) Subcommittee of the American Academy of Neurology (AAN) reviewed published data on MEG and decided that there was insufficient evidence of its clinical utility. Accordingly, it was deemed investigational. This decision unfortunately has been a basis for refusals by insurance companies to pay for MEG to the present day. This bias has persisted for seventeen years, despite significant advances in MEG technology and analysis, many traditionally constructed clinical neurophysiology studies, and acknowledgement via Medicare with Current Procedural Terminology (CPT) codes. Only recently have rigorous prospective studies been performed specifically to meet the current strict criteria. A revision of the 1992 Therapeutics and Technology Assessment is in progress, but undoubtedly it too will confront the same difficulty in using strict classes 1 and 2 study criteria to judge MEG's worth.

During the past year, I have had the opportunity to investigate MEG first hand. I quickly learned that clinical MEG has both strengths and weaknesses, like all of our diagnostic tools. In the evaluation of epilepsy, it is not a replacement for EEG or imaging studies, but it can provide both additive and enhanced functional information. That which it does best is localization, and in those situations in which this is key, such as presurgical identification of epileptic foci or eloquent cortex, MEG has clear advantages. When MEG spikes are recordable, localization of their cortical source is, indeed, more accurate than with EEG, sometimes by several centimeters. However, a number of patients have EEG spikes that are not seen by MEG, and seizures are infrequently recorded by MEG. Thus, it is not a matter of whether one technique is better than the other. Rather, multiple types of data are needed if one wishes to have the best set of information from which to make a clinical decision.

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I was gratified to read only a few days ago that other clinicians share my concerns about evaluating MEG solely by existing evidence-based criteria. I found most intriguing a new type of statement that is being put forward by the Medical Economics and Management (MEM) Committee of the AAN. These are called "model medical policies," and on May 8th of this year, the Academy Board of Directors approved one such policy regarding MEG (http://www.aan.com/news/?event=read&article_id=7795&page=1016.378.33). This document explains MEG, compares it with other localization techniques, provides a critical evaluation of MEG as a diagnostic technology, and outlines its indications and limitations. It was also interesting that the policy was directed at insurers, in the hope that they would adopt the principles outlined in developing their own policies. It seems that progress is finally being made.

In summary, our publishing the ACMEGS statement is consistent with the recognition that there may be more to clinical medicine than that which can be validated by strict objective criteria. Perhaps, the opinions of experts, who have acquired years of clinical experience, should not necessarily be relegated to a position of least importance in evaluation schema. I encourage you to take the time to read the ACMEGS position statement and the new AAN model medical policy on MEG. Overall, they are remarkably similar. Consistency of thought, when independently derived, usually bodes well for the concepts expressed.

American Clinical MEG Society (ACMEGS) Position Statement: The Value of Magnetoencephalography (MEG)/Magnetic Source Imaging (MSI) in Noninvasive Presurgical Evaluation of Patients With Medically Intractable Localization-related Epilepsy

Anto Bagic, Michael E. Funke,† John Ebersole,‡ for the ACMEGS Position Statement Committee*

The American Clinical Magnetoencephalography Society (ACMEGS) is a professional society of physicians and other professionals with doctoral degrees "involved in clinical use of magnetoencephalography (MEG), electroencephalography (EEG), magnetic resonance imaging, or computerized axial tomography" (ACMEGS, Inc, Bylaws, 2006). The ACMEGS is primarily focused on advancing clinical applications of MEG, while representing all American MEG centers and individual professionals concerned with clinical MEG. Currently, our membership is composed of more than 50 individuals and/or collective members, including the most prominent investigators who have made cardinal contributions to the development of the clinical MEG. A significant proportion of 4,000+, peer-reviewed, MEDLINE publications on "MEG" has been authored by members of the American MEG community, including the most sophisticated clinical MEG studies designed and published internationally (Knowlton et al., 2008a,b; Sutherling et al., 2008).

MEG/magnetic source imaging (MSI) is a modern and powerful technology for studying brain function directly and noninvasively by analyzing magnetic fields induced by synchronized neuronal activity that are recorded outside of the skull (Cohen, 1968, 1972; reviewed in Hamalainen et al., 1993; Okada et al., 1984, 1999; Williamson et al., 1991). Routinely, MEG can attain a temporal resolution of less than a millisecond and, under optimal circumstances, spatial resolution of several millimeters (Brenner et al., 1975; Hamalainen et al., 1993; Hari et al., 1988; Okada et al., 1984, 1999; Romani et al., 1982). During the last 40 years, MEG instruments have evolved from a single-channel portable system to the modern whole head systems with more than 300 channels that are housed in multilayered shielded rooms (reviewed in Barkley and Baumgartner, 2003; reviewed in Hamalainen et al., 1993). It is now accepted that MEG/MSI can provide clinicians with accurate and critical information regarding the location of important cerebral sources, such as epileptic foci (Baumgartner, 2000; Ebersole, 1997; Fischer et al., 2005; Iwasaki et al., 2002; Kirsch et al., 2007a; Knake et al., 2006; Knowlton, 2006, 2008; Knowlton et al., 2006; Knowlton et al., 2008a,b; Lin et al., 2003; Mamelak et al., 2002; Mohamed et al., 2007; Oishi et al., 2006; Papanicolaou et al., 2005; Pataraia et al., 2004; RamachandranNair et al., 2007; Rodin et al., 2004; Smith et al., 2000; Stefan et al., 2003; Sutherling et al., 2008; Verrotti et al., 2003), sensory-motor cortex (Alberstone et al., 2000; Brenner et al., 1975; Castillo et al., 2004; Ganslandt et al., 2004; Kirsch et al., 2007b; Korvenoja et al., 2006; Nakasato and Yoshimoto, 2000; Oishi et al., 2003; Okada et al., 1984; Pang et al., 2008), visual (Alberstone et al., 2000; Brenner et al., 1975; Ganslandt et al., 2004; Grover et al., 2006; Nakasato and Yoshimoto, 2000; Nakasato et al., 1996), auditory (Alberstone et al., 2000; Godey et al., 2001; Nakasato and Yoshimoto, 2000; Romani et al., 1982), and language cortex (Bowyer et al., 2004, 2005; Flagg et al., 2005; Ganslandt et al., 2004; Grummich et al., 2006; Hirata et al., 2004; Kamada et al., 2003; Lee et al., 2006; Merrifield et al., 2007; Papanicolaou et al., 2004, 2006; Salmelin, 2007) MEG/MSI findings may be displayed on a patient's magnetic resonance imaging or combined with other imaging modalities to form multimodal neuronavigational maps that can be used directly in stereotactic neuronavigation systems during surgery (Duffner et al., 2003; Firsching et al., 2002; Ganslandt et al., 1999; Kamada et al., 2003, 2007; Nimsky et al., 1999; Ochi and Otsubo, 2008; Rezai et al., 1995, 1996, 1997).

Nearly 3 million Americans are afflicted with epilepsy (Hauser and Hesdorffer, 1990). Approximately 30% suffer from seizures that are refractory to medications despite the 20 antiepileptic drugs that are currently available (Brodie, 2005; Kwan and Brodie, 2000). These patients are responsible for 80% of the $12.5 billon annual cost of epilepsy to society (Begley et al., 2000). A significant minority of these patients with epilepsy have localization-related or focal epilepsy that may be amenable to surgical therapy (Engel, 2003, 2008). Thus, competent estimates indicate that 100,000 to 200,000 patients with uncontrolled epilepsy may be surgical candidates (Engel, 2003; Engel and Shewmon, 1993). Epilepsy surgery has been proven to be superior to medical treatment in patients with temporal lobe epilepsy in a randomized controlled trial (Engel, 2008; Engel et al., 2003; Wiebe et al., 2001), and a recent analysis revealed that "the combination of surgery with medical treatment is four times as likely as medical treatment alone to achieve freedom from seizures" (Schmidt and Stavem, In press). Furthermore, long-term follow-up studies showed that many patients who underwent resective brain surgery remain seizure free (Spencer and Huh, 2008; Téllez-Zenteno et al., 2005, 2007, 2008) and that "in carefully selected patients, epilepsy surgery can control seizures, improve quality of life, and reduce costs of medical care" (Kuzniecky and Devinsky, 2007). However, for multiple reasons, epilepsy surgery, the only potential cure for epilepsy (Engel, 2003, 2008; Spencer and Huh, 2008; Wiebe et al., 2001), is offered to only 2% to 3% of potential surgical candidates (Engel, 2003).

The critical and often rate-limiting factor in epilepsy surgery is functional localization of the epileptic focus that may not be adequately supplied by traditional diagnostic investigations, including EEG, video-EEG monitoring, magnetic resonance imaging, and in some cases positron emission tomography (PET) and single-photon emission computed tomography (SPECT) scans (Barkley

From the *Center for Advanced Brain Magnetic Source Imaging (CABMSI), Departments of Neurology & Neurosurgery, The University of Pittsburgh, Pittsburgh, PA; †Magnetic Source Imaging, Department of Neurology, Clinical Neurosciences Center, The University of Utah, Salt Lake City, UT; and the Department of Neurology, The University of Chicago, Chicago, IL.

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and Baumgartner, 2003; Engel, 2003, 2008; Knowlton et al., 2006; Kuzniecky and Devinsky, 2007; Langfitt and Wiebe, 2008; Papanicolaou et al., 2005; Stefan et al., 2003; Wheless et al., 1999). Too frequently these studies fail to identify clearly the seizure focus (Barkley and Baumgartner, 2003; Knowlton, 2008; Knowlton et al., 2006; Knowlton et al., 2008a,b; Papanicolaou et al., 2005; Rodin et al., 2004; Stefan et al., 2003; Sutherling et al., 2008). Alternatively, the identified focus is complex, ambiguous, or closely positioned to the eloquent cortices, making surgery dangerous (Barkley and Baumgartner, 2003; Knowlton, 2008; Knowlton et al., 2006; Knowlton et al., 2008a,b; Rodin et al., 2004; Stefan et al., 2003; Sutherling et al., 2008). Clinicians uniformly agree that additional and nonredundant localizing information, preferably acquired noninvasively, are necessary for making clinical decisions in these situations (Barkley and Baumgartner, 2003; Knowlton, 2008; Knowlton et al., 2006; Knowlton et al., 2008a,b; Stefan et al., 2003; Sutherling et al., 2008).

The ability of MEG/MSI to fill this diagnostic gap has been demonstrated in numerous published studies (Assaf et al., 2004; Fischer et al., 2005; Iwasaki et al., 2002; Kirsch et al., 2007a,b; Knake et al., 2006; Knowlton et al., 2006; Knowlton, 2008; Knowlton et al., 2008a,b; Lin et al., 2003; Mamelak et al., 2002; Mohamed et al., 2007; Oishi et al., 2006; Papanicolaou et al., 2005; Pataraia et al., 2004; RamachandranNair et al., 2007; Rodin et al., 2004; Smith et al., 2000; Stefan et al., 2003; Sutherling et al., 2008; Verrotti et al., 2003). In fact, almost 700 peer-reviewed, MEDLINE publications on "MEG" are devoted to "epilepsy." These have established that MEG/MSI may locate epileptogenic foci, not otherwise identifiable or localizable, in up to 30% of patients (Stefan et al., 2003; Sutherling et al., 2008) and clarify the spatial relationships of these foci to eloquent cortices noninvasively (Castillo et al., 2004; Papanicolaou et al., 2004 2005; Pataraia et al., 2004). Two recent and meticulously designed studies have proven the usefulness and predictive value of MEG (Knowlton et al., 2008ab). In addition, the first prospective and blinded study of MEG/MSI demonstrated that nonredundant information that positively affected clinical decision making and proved to be beneficial for the outcome was obtained in 33% of patients (Sutherling et al., 2008).

The highest standards of clinical care include sound judgment and rational utilization of resources. Therefore, it is inappropriate to use an expensive study, if a more cost effective one provides clinically adequate results. Thus, it is only when traditional EEG studies (routine laboratory, ambulatory, and video-EEG long-term monitoring) fail to deliver sufficient localizing information for planning a direct surgical intervention or invasive monitoring that MEG is indicated (Knake et al., 2006; Knowlton, 2008; Knowlton et al., 2008ab; RamachandranNair et al., 2007; Sutherling et al., 2008). On the basis of the current published evidence (a few selected examples: Knake et al., 2006, Knowlton et al., 2006; Knowlton et al., 2008ab; RamachandranNair et al., 2007; Stefan et al., 2003; Sutherling et al., 2008), the ACMEGS supports the routine use of MEG/MSI in presurgical epilepsy evaluations because it can improve noninvasive evaluation that is ordinarily much cheaper and safer than invasive studies (Barkley and Baumgartner, 2003; Knowlton, 2008), and because it can enhance the yield of invasive studies by directing the placement of grids, strips, and depth electrodes (Knowlton et al., 2008ab; RamachandranNair et al., 2007; Sutherling et al., 2008). Overall, these may reduce costs and improve the accuracy of epilepsy evaluations, thus making surgery a more appealing treatment option (Barkley and Baumgartner, 2003; Knowlton et al., 2006; Knowlton, 2008; Knowlton et al., 2008ab; Papanicolaou et al., 2005; RamachandranNair et al., 2007; Stefan et al., 2003; Sutherling et al., 2008).

On the basis of the all available published evidence, the ACMEGS considers the current state of MEG/MSI technology to be completely mature for routine use in presurgical evaluations of patients with epilepsy. The ACMEGS also supports the widely accepted and scientifically supported position that MEG and EEG are complementary modalities that yield the best results when combined. Consequently, the debate about superiority among these two complementary modalities is clinically irrelevant for the acceptance of MEG as a routine clinical test. The ACMEGS does, however, encourage further comparative studies that may lead to new advancements in electromagnetic neuroimaging.

ACMEGS Position

Therefore, after considering the entire body of published evidence (MEDLINE search for "epilepsy" and "MEG" gleaned 665 hits; accessed on April 20, 2009) and appreciating the publication of a milestone class I study (Sutherling et al., 2008), the ACMEGS acknowledges that sufficient credible evidence has been published to support a position statement regarding the value of MEG in the presurgical evaluation of patients with medically intractable localization-related epilepsy. Accordingly, the following principles regarding the routine use of MEG/MSI are proposed.

The ACMEGS supports:

1. The routine clinical use of MEG/MSI in obtaining noninvasive, nonredundant localizing information in presurgical evaluation of patients with medically intractable localization-related epilepsy.
2. The determination of MEG/MSI indications for an individual patient by an epileptologist or a clinical team associated with a National Association of Epilepsy Centers-designated epilepsy center.
3. The routine use of MEG/MSI when traditional EEG methods and magnetic resonance imaging are implemented and provide insufficient localizing information.
4. The progressive movement of insurers toward complete coverage for MEG/MSI. It is in the best interest of patients to have appropriate and timely access to the best possible care. This includes MEG/MSI, as well as previously established diagnostic tests.
5. Uses for MEG/MSI indicated by accepted standards of clinical judgment and care and the rational utilization of resources without further restrictions.
6. Further systematic clinical research that seeks to establish other clinical indications for MEG/MSI.

The ACMEGS invites and encourages other medical societies and organizations including but not limited to the American Clinical Neurophysiology Society (ACNS), American Academy of Neurology (AAN), American Epilepsy Society (AES), and the American Society of Neuroradiology (ASNR) to support this statement and/or adopt complementary position statements. The ACMEGS intends to enhance the practice of clinical MEG/MSI further by developing practice parameters.

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