Workshop
Epilepsy surgery in children: whom to operate, when, and what operation to perform?

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Dr. Andermann: In recent years, we have seen a tremendous upsurge of interest in the surgical treatment of epilepsy. One reason is that the treatment of generalized epilepsy has improved so much with the advent of better drugs and better utilization of these drugs. Patients with intractable seizures tend to stand out much more, and failure of medical treatment in these patients is quite obvious.

Two years ago, there were about 50 centers in the world where surgical treatment of epilepsy was being carried out; there are probably at least twice as many now.

One of the main issues when considering surgery in children is the evaluation of the likelihood that the attacks will cease spontaneously. One important factor is that the seizure pattern should be stable and not change over time. The prevention of behavioral complications is also important; it is, of course, a major concern in the treatment of children with intractable epilepsy. When there is manifest deterioration, either from a cognitive or from a behavioral point of view, one should seriously consider the possibility of a surgical approach.

In the past, several people, including Rasmussen, have evaluated the results of surgical treatment in children. He found that in the Montreal Neurological Institute series about 10% of the patients who had a temporal lobectomy for treatment of epilepsy were children. In a series of about 800 patients, there were 77 children below the age of 16 years. The results were very similar to the ones in adults. Similarly, Davidson and Falconer found that their results in children were fairly similar to those in adults. Murray and Falconer suggested earlier operation in order to try to prevent behavioral disruption or cognitive deterioration and downward social mobility.

At the Montreal Neurological Institute, our work-up follows the following pattern: First, a seizure history is obtained both from the patient and from witnesses. The child can often add details that the witnesses do not know, because they do not experience the seizure. The witnesses obviously can tell you much about the attack that the patient cannot. The medical record of early hospitalization is important, particularly because you may get details about prolonged febrile convulsions, and a record of early EEGs. The longitudinal study of patients is extremely important. If a child has had ten or 12 EEGs all left-sided, and then you have a few EEGs that are also left-sided when you investigate the patient, it is much more meaningful than having half the records showing abnormality on one side and half showing epileptic discharge on the other side. It is an important exercise to go back to the early studies and reports.

The neurological investigations may reveal various signs, such as facial asymmetry in patients with temporal lobe epilepsy, asymmetries of growth, or cutaneous abnormalities. Plain skull x-ray studies may show such signs as flattening of the vault or a smaller middle fossa on one side. Such studies are not used much now, although they may be very helpful.

The CT and the NMR represent important advances

in imaging. However it is essential to consult the neuroradiologist personally; if you do not, the area where structural abnormalities may be present and other valuable information may be missed.

The second aim of the investigation is the EEG studies. First we record on full medication, keeping in mind that one may not see very much. Since one does not know this in advance, such a screening record may be valuable. Then one records on reduced medication, until the epileptogenic abnormalities declare themselves. Usually one concentrates first on recording interictal epileptogenic discharge. If the interictal epileptogenic abnormality is always clearly lateralized and clearly localized, and if you have a critical mass of recording which you think is adequate (and the average in our center is about 12), then you may not need to go on to recording of seizures—this provided of course that the interictal discharge is fully congruous with clinical, imaging, neuropsychological, and other studies. Not everybody will agree with this approach, but it seems to work quite well. If you do only a few records, in patients with temporal lobe seizures for instance, these may not provide reliable evidence, and if you continue to record, you may have the surprise of seeing independent abnormalities emerge from the other side.

On the other hand, if you observe more than 10% or 15% of the interictal discharge coming from the opposite side independently, you have to go on to record seizures. You may or may not be able to localize their onset. If they all come from the same side and the same area, and if, as Williamson said, "all the ducks are lined up the same way," you may not have to go on to further investigation. If they are not very clearly lateralized or localized, you may have to go on to consideration of invasive recording techniques.

Neuropsychological testing represents the third area of investigation. Localizing studies may be possible in children and assessment of intelligence is important. When atypical representation of speech is suspected an intracarotid Amytal© test may be indicated. This is possible in cooperative older children. It remains, as it has been for a long time, a valuable tool of investigation.

We have used PET scanning mainly as an aid in lateralization of temporal lobe abnormalities. We look forward to the day when it will be helpful in localization as well.

When all these studies have been done, one must explain all the findings to the family and, age permitting, to the patient as well; at that point, you and they are finally in a position to make an informed decision. It is amazing to see that the family and the residents are surprised to find that this type of study is really a stepwise process of investigation and deduction and that at the beginning you often do not really know exactly what you are going to do and what you are going to be able to offer them. It is important not to provide contradictory or incomplete information, and a final decision is best left for the time when the studies are completed and all the evidence is in.

It has been heartening to see that a great deal of consensus seems to be developing over how a patient should be investigated and treated. The epic discords of ten or more years ago seem to be, fortunately, a thing of the past.

Dr. Lüders: When we look at the evaluation results used for resection surgery in children under 12, we see at once two major differences from adults. The clinical epileptic syndromes in adults are relatively well defined. They give a significant amount of information that can be used to localize or lateralize the epileptic focus. In children, the situation is different. The clinical syndromes are poorly defined. Very frequently, differentiation between focal seizures arising from different parts of the cerebral cortex is very difficult. Even the differentiation between a focal seizure disorder and a generalized seizure disorder may be unclear if only clinical criteria are used.

A second problem is the localizing value of the EEG findings. In the adult, EEG localization is usually extremely clearly defined. So, for example, in temporal lobe seizures of mesiotemporal origin, you usually can identify spikes arising from sphenoidal or nasopharyngeal electrodes.

In children, the localization value of EEG is usually poor. As Dr. Wyllie stressed in her presentation, in children frequently you do not find any interictal epileptiform discharges. Children under 8 only rarely have clearly defined epileptiform discharges arising from the sphenoidal or nasopharyngeal leads. In addition, the clinical seizures are poorly differentiated and, when you record from surface electrodes, you usually only get EEG seizure patterns that permit lateralization of the seizure but no precise localization.

A third factor which I think is very important in children is the uncertainty we have regarding the clinical evolution of the syndromes itself. We are too unfamiliar with the syndromes to be certain that the patient who has "intractable" seizures at a certain age, will remain intractable with maturation. The lack of more precise research in this area limits significantly the certainty with which we can decide in which cases

cortical resection is indicated.

Dr. Susan Spencer: We have established in this session that corpus callosum section is indicated for the control of secondary generalized seizures, and that it accomplishes that in 80% or so of patients who undergo the procedure. We also established that very few data are available to stratify children at different ages and decide whether the procedure should not be done at certain ages. But certainly what we have heard indicates that it is effective in all age groups which have been studied, at least on the basis of the available literature.

An important question still troubles us: what happens if corpus callosum is carried out under the age of 1? Does that affect development and reorganization? I raise that as a question, but know that we cannot really answer it with the data we have at the present time. Other important questions have also been raised in the past. Is corpus callosum section indicated for the treatment of complex partial seizures, without generalized seizures, or is it indicated for the treatment of primary generalized seizures? There is also the question of in which patients this procedure might be contraindicated. Is the procedure, for instance, not indicated in patients with contralateral representation of speech and handedness? Should it be contraindicated in those with low IQ? Finally, are there any behavioral indications or contraindications to this procedure? What effect does it have on abnormal behavior?

Dr. Shields: Hemispherectomy is different from the other types of surgery we have discussed, in that the patient is absolutely guaranteed a neurological deficit; therefore, some of the considerations surrounding hemispherectomy are somewhat different. One of our biggest problems occurs when we first raise the idea of hemispherectomy with the parent, and the referring physicians are rather horrified at the prospect of removing half of a child's brain. By the time we have finished the assessment, interestingly enough, the hardest thing is to tell parents that their child is not a candidate for surgery. The parents are much more distraught if their child cannot be operated on. Hemispherectomy is truly a procedure done in desperation. When we put a patient on medication and find we have made a mistake, we change medications. When we do a hemispherectomy, we cannot go back: we have to be right the first time.

Before hemispherectomy is attempted, several questions must be considered. Since we deal with many childhood seizures that cause a loss of developmental milestones, how low down the developmental quotient scale can we go and still consider doing the surgery? Many of these children regain lost development; so developmental quotient is something that we think about differently when we are doing hemispherectomy, at least in very young children.

How early should we consider doing a hemispherectomy? If one reviews the literature, one sees that most hemispherectomies have been performed in children who are 5 to 15 years old. Not that many have been carried out in the 1- or 2-year-old child, when one would expect the plasticity of the brain to be able to compensate for some of the changes caused by hemispherectomy.

How much of a neurological deficit should a child have before one considers hemispherectomy? Is there an epilepsy severe enough that one can create hemiparesis to cure the epilepsy?

Basically, under what circumstances can one, or ought one, to consider hemispherectomy an appropriate therapy?

Dr. Duchowny: Those of us who have been involved in the surgical therapy of epilepsy in children are learning that complex partial seizures which are focal in origin are rarely a diagnostic problem. Invariably, when you are confronted with a small child, under 6 or 8 years of age who has a temporal lesion, the most efficacious therapy is surgical.

I think our problem really lies with how to treat the more generalized epilepsies. It is particularly important to decide whether seizures are focal in origin or whether they are primarily generalized. We also have trouble determining how much cortex is functional and how much can be resected. We are also trying to understand the neurobehavioral sequence associated with doing larger resections, and I think we are beginning to feel that children may tolerate larger resections better. Certainly the results from the larger resections are encouraging when compared to adults.

Dr. Shields: I think you are, in essence, defining formally what nature has already done for the child. That is, the child has such a great deficit already, from a middle cerebral artery infarct or something similar, that surgery is not going to make a great difference. That is a relatively easy case to evaluate.

The difficult case is the child who appears normal on CT and MRI, but has terrible seizures, and the child who is degenerating from the seizures, but in whom you do not see a clear-cut structural lesion. How far should we go in pressing for a surgical approach in that child? The risk-benefits are still a little fuzzy to us, I think; there is the real problem.

Dr. Gates: One of the things I have found interesting about the conference is that so far we have seen precious few real data. We seem to be engaged in an exercise in "what do we think we should be doing with these children?"

I suspect that we do have surgeons in the audience who have had some experience with the younger age groups. We will be presenting our experience with callosotomy in eight children, with reasonable follow-up. In our experience, the answer is that one can operate on them with the expectation of reasonably good results. We will present limited, but at least encouraging preliminary data.

In practice, focal resection, I think, is not that dirty. We have a fairly good idea, in practice, of which children are appropriate candidates for an aggressive cortical resection in the absence of a structural lesion. We have done a subdural grid on a 22-month-old child that works well. So I would like to hear something from other surgeons on what their experience has been. Enough speculation without data.

Dr. Engel: I have a group of questions to address to Dr. Shields, who discussed the role of hemispherectomy in producing neurological deficit. How much of a deficit should we tolerate? How much of a surgery-related deficit should we encourage the parents to accept in order to reduce seizures? With some temporal lobe surgery, you accept quadrantanopsias as givens, and you do not even discuss them as a problem. Who should make the decision about whether there should be a deficit or not? The parents or the physician?

Dr. Shields: I think it is a decision which must be made jointly. The realities of practice are that you program the parents to accept what you think is appropriate. So, even though the parents make the decision, the reality is that they accept it, because that is how you have brought them along by the time you get to that point. You may say the parents are making the decision, but in reality you have to be prepared to make that decision.

From my point of view, it is appropriate to create a neurologic deficit if the epilepsy is so severe that the child's future is poor. Then the deficit becomes acceptable. If you have a child who has infantile spasms and you cannot get them under control, that child has a 90% chance, later on, of being very significantly retarded. Under such a circumstances, hemiparesis is not too great a price, if you can expect to get control of the seizures from the surgery. That, of course, is a very difficult question to answer, whether you can really be certain that you are going to be able to control the seizures by creating the deficit.

Dr. Vining: At Johns Hopkins, we have performed some 16 hemispherectomies in children, ranging from age 4 months up to the late teens; we have had one death. I can say very clearly that I believe it is the parents' decision; and it has to be, no matter where we leave them. I think ultimately they are the ones who have to be able to live with the outcome, whether it is a successful result, or a death. The decision, I think, is very clearly theirs.

Our experience is very varied. About half of our youngsters have what we presume to be Rasmussen's syndrome, however we define it. The rest have developmental congenital abnormalities of the brain. That leads me to ask an important question of Dr. Andermann about his concept of focal dysgenesis of the cortex. In our experience, I am not so sure how focal much of this dysgenesis may be. That is, it may be in terms of what we see sometimes in terms of MRI—but when we end up evaluating the patient, the EEG may lead us to believe that there is much greater involvement in terms of the total hemisphere. Certainly, when we have made the decision to do the hemispherectomy, we are corroborated by our pathology, in terms of abnormalities seen throughout the hemisphere.

When I think about the outcomes reported by Dr. Andermann, certainly he had some success, but by no means total success, after having taken out that which seemed most abnormal. Our one death was in a youngster in whose case we approached the principle of taking out the most abnormal tissue. She had some improvement but certainly not sufficient, and went back for the second surgery. She died in the immediate postoperative period. The pathology showed us very clearly that she continued to have dysgenetic cortex throughout that hemisphere, with the pathology of the other hemisphere available to us and being completely normal. So, when I think about how aggressive one needs to be in terms of these unihemispheric abnormalities, perhaps we need to be more aggressive in terms of some of our surgery.

Dr. Engel: How many of your patients did not have a severe hemiparesis?

Dr. Vining: All of our patients had at least some moderate degree of hemiparesis. None of them was completely unaffected. In the very much younger children—certainly the 4-month-old—it is much harder to delineate how much truly cortical control they had over that hand. It was certainly not a hemiplegia, but I would say that a hemiparesis existed in virtually all of our patients. You could delineate abnormality.

Dr. Andermann: It is unwise to undertake any surgical procedure which is going to create any increase in motor deficit. The parents will never accept that. The patients who are treated by hemispherectomy in our center have a motor deficit which is not going to be made worse by hemispherectomy. They have no useful finger movement; the hand movement is not going to change and the hand is usually used as an assistor. There is usually some reduction in spasticity. The gait does not get worse nor better. If such patients do not have a field defect, the situation is a little different. You try to save the visual field, but almost invariably you lose it. Leaving the posterior aspect of the hemisphere reduces the chances of complete cessation of seizures. An occipital removal will of course result in complete hemianopia; in young children this does not result in any noticeable disability.

Dr. Vining mentioned cortical dysplasia. In these children we usually have taken out the area which is most epileptogenic, but not necessarily the area which is structurally the most abnormal. None of these patients has had a hemispherectomy.

In patients with the Sturge-Weber syndrome, the situation is a little different. Some of them have severe seizures and much postictal paresis each time they have a bout of attacks. The likelihood of their eventually having nonfunctional fingers is very great. In such children an early hemispherectomy seems justified. On the other hand most patients with the Sturge-Weber syndrome are not automatically candidates for surgical treatment and certainly not for hemispherectomy.

As far as focal foreign tissue lesions are concerned, it is not enough just to remove them. These patients must be studied completely before surgery and the epileptogenic field outlined. It is usually important to do corticography as well. You cannot predict in advance what the epileptic field is. These patients are operated on after the same studies and technique used for other seizure patients.

Dr. Engel: This is a real difference. Your point of view is that the patient has to have a useless hand.

Dr. Shields: That is not my opinion. I can think of at least one case in which the child had only a very modest hemiparesis but was in bed in status five days out of seven, and had been so for nine years. The parents were fully aware that the child was going to have a much more significant hemiparesis when we finished. After a lot of deliberation in our own group, we decided that we should go ahead, and we did. We are now about a year out, and that child is much, much better off, even though we did create a significant hemiparesis. She is walking and starting to use the limb just as other children do who have a hemispherectomy. Certainly hemispherectomy is not a procedure that you are going to want to do on a regular basis, but there are situations in which the epilepsy is severe enough that creation of a neurologic deficit beyond what is already there may be an acceptable price to pay.

Dr. Engel: Many of these radical procedures are based on our confidence that we know what the natural history of this disease process is going to be; we know that the child is going to get worse in many different ways.

Dr. Vining: There are two questions here which perhaps a neurobiologist might be better able to answer. One problem concerns the whole area of these developmental abnormalities of the brain. If abnormality hits one part of the hemisphere, how likely are we to see it everywhere else? Our experience says, very likely.

The second question concerns the matter of plasticity: is it true that the earlier the operation, the greater the recovery? That is certainly what we think will be very likely to happen, but I am not completely certain that it is going to be true. The youngest ones that we have operated on—in the range of 4 to 13 months—probably had the most severe postoperative hemiplegias. Although you look at them in a period of time when you expect recovery to be very rapid, they seem to be very, very slow in their recovery. Ultimately, I think they may turn out to be very good. One of them is now 2 years out and really making spectacular moves. But it is not the speed you expected. You wonder whether or not they need even that abnormal hemisphere around for a period of time.

Dr. Andermann: You see this in older children and adults as well. Following hemispherectomy, they do not recover as quickly as do patients who have had temporal or frontal lobectomies. There is a period of a week to ten days when they have chemical meningitis and are quite depressed. Then they slowly improve.

Dr. Vining: Our middle-year children seem to do well. With the very young ones, it is as if you really wipe them out for a period of time. Ours are very variable. Unfortunately, even with our numbers, it is still limited experience.

Dr. Shields: Most children, I think, who are 2, 3, or 4 years into their disease have already done a significant part of their own hemispherectomy; and much of what is going to be transferred has already occurred. In the context of possible plasticity, the difficult question is how long you have to follow a child before you know

that he is not going to recover on his own. Right now, I think, the race still goes to making sure that you really have to do the surgery before you do it. I do not think we know enough to jump in too early, in most cases. I think a patient who has a degenerative kind of epilepsy is a different problem. With a patient who has infantile spasms or Lennox-Gastaut or some process where you know that his seizures are causing him increasing deficits in his cognitive areas, then perhaps earlier surgery makes more sense.

Participant One: The etiology of the seizures is important. In patients with congenital dysgenesis, the hemispherectomy has already taken place in utero. In those with Rasmussen's syndrome, we are dealing with a normally formed hemisphere that develops an epileptic process later on.

Dr. Duchowny: At Miami Children's Hospital, we have performed total resection in approximately 20 patients in the first two decades of life. Our youngest patient was 2 months of age. We have performed total resection in five infants. We have found that techniques which have been used in older children can basically be applied to treat focal seizure disorders in infancy, including a subdural grid, which actually was implanted in an 8- or 10-month old. The information derived, at least in terms of seizure localization, was very satisfying.

In our discussions of seizure disorders in childhood, it is important not to overlook the fact that the issues of psychosocial outcome and psychosocial situation are inextricably intertwined with the whole course of the disorder, both in terms of selection for surgery and of outcome. For example, one of our patients who was operated on in infancy was medically intractable with a malignant seizure disorder, whom we could not discharge from the hospital because of the seizure problem. No chronic-care facility would take this infant. Resection of an epileptic focus, however, and a significant reduction in seizure frequency allowed this child to be placed. It was very gratifying to the family.

The feedback we receive from families is not only in regard to seizure control, but is always in regard to schooling and social interaction. In some situations, the parents are just as pleased over the behavioral outcome as the outcome with respect to seizures. This has been very ably pointed out by Falconer, Lindsey, and Ounsted in England, who have known this for many years. Now we have encountered similar findings.

Dr. Dennis Spencer: May I ask you what was the etiology of the various diseases for which you did focal resections?

Dr. Duchowny: All five infants had pathology, including tuberous sclerosis, gangliocytoma, focal dysplasia, and cystic degeneration. Not all of them had gross structural lesions.

Participant Two: Did you know the pathology before you operated?

Dr. Duchowny: The gangliocytoma—we did not know what that was; we suspected the tumor, but did not prove it until pathology. The focal dysplasia did not show up on either of the imaging studies; that was a purely pathological finding. The cystic degeneration we knew about.

Dr. Engel: That was my question also: you operated on small babies without evidence of a structural lesion on MRI or CT scan? But you had good results.

Dr. Duchowny: Let me just also say that in terms of the development, it is very hard in the case of these infants to say whether a patient improves after surgery. One of our infants had been hospitalized up until time of surgery; so, I think developmental assessment must be suspect. But I can say that both the infants who were developmentally delayed, and the infants who were developing normally continued their patterns postoperatively. We do not as yet have long-term follow-ups.

Dr. Gates: It has been our observation in Minnesota, too, with very limited experience in patients below age 5, but certainly in our 7- or 8-year-olds, that some very dramatic improvements can take place in their intellectual capacity.

I would also like to mention that our feeling at Minnesota is that probably the optimal age to do something for these children is before they go through the psychosocial trauma of school. Preschool, in fact, is probably the optimal age for intervention in order to avoid the psychosocial rape, plunder and pillage. If you have the opportunity to pursue a surgical option of any sort in regard to focal resection, I think that is the period. And God knows it had better be before junior high.

Participant Three: Retarded children have a developmental schedule; it is slower, and it is different, but they do have a developmental schedule. Subjecting them to a major surgical procedure of this type will slow down that schedule, just that much more.

Dr. Gates: I think you are right. We do need more data on the selection process; but in practice, the selection process is not that difficult. If you cannot get the infant out of the hospital, making a decision about a surgical intervention becomes somewhat easier.

Dr. Engel: There are two issues here. One is that the

earlier the intervention, the greater the chance that the seizures are not going to disrupt the psychosocial development. That is a logical assumption, but it has to be demonstrated in individual categories of children. The other issue is that people are now operating on small children, in the absence of structural lesions, and their feeling is that their results are good.

Dr. Vining: Might I suggest that when some people say "psychosocial," they refer to the entire development of the child, not merely to the question of whether or not he is going to do well in school and make friends and so forth? If you are talking about the totally impaired child who is going nowhere except via the seizures, then I think you are able to say, "I am improving the psychosocial outcome." You are. These youngsters are doing nothing. We are not talking about trying to place them in institutions; we are talking about keeping them from the institutions. So I think if you look at the problem in the more global sense, in terms of what a youngster may or may not be able to do with his life, we are talking about the ultimate usefulness of surgery to the younger patient.

Dr. Shields: In regard to the matter of operating "when there is not a lesion," the question is not whether a lesion is present; the question is whether you can see the lesion on MRI or CT scan. There is a lesion! We can see them on PET scans very nicely, and we see them on corticography when we are doing the corticography, and then we see them at pathology. There is a lesion every time. We have not yet seen a patient without a lesion.

Dr. Engel: Let me ask the rest of the panel what they do when they do not have an obvious structural lesion in these small children.

Dr. Andermann: When you see a small child without an identifiable lesion, you become extremely uncomfortable. You cannot rely on psychology. Can you rely on the EEG exclusively? I suppose you can, at times; but it would be an extraordinary case.

In the presence of a persistent focal abnormality in an accessible area you would first try as hard as possible to find evidence for a structural abnormality with every possible means. Should no such abnormality be found the epileptogenic area can be removed on the basis of EEG evidence. It would be essential to first demonstrate that the focal EEG changes are stable over time. Not every group would be ready to consider a young child for surgical treatment under these circumstances.

Dr. Dennis Spencer: At Yale, the surgery done on infants is small. It is zero, in fact, right now. But in children we have treated and particularly in that age group clustered around 5 and 6, and 6 to 10, by and large, we have had at least an MRI image on which to base our initial approach. The extension of that approach may take the form of grids to do functional localization and to outline ictal events, but we have had positive imaging. The other children have been Lennox-Gastaut or patients in whom there was just not clear evidence of any lateralization.

That does not mean that if we had a lesion visible on MRI or CT in an infant, we would not study that patient assiduously and investigate that lesion. I agree with that previous interchange that the reason why the baby looks worse after one has removed a hemisphere at 6 or 8 months is that there has not been that ongoing injury to the brain which has caused some transfer. I worry much more about the child who is 6 to 8 years old, has a partial injury, and a major resection is performed on him. He is just not going to adapt fully to that lesion.

Much of what we do not know at present is caused by our not being able to define the diseases which occupy our attention, or define what we are doing. I would beg everyone to scrutinize the pathology and correlate it as well as possible with the historical events.

In infants and younger children, certainly, we would use our invasive techniques and resect. In fact, in the middle range of children, we have used subdural grids or subdurals in combination with depth electrodes. Children tolerate depth electrodes very well, in fact, probably better than they do the grids. But we are talking about a group of children who have terrible seizures: usually they do not have isolated little foci that you look for with depth electrodes.

I would like to hear more said about indications for temporal lobectomy, because I think such patients may constitute a separate group. The problem is that the median age of onset is somewhere between 8 and 12 years, and you do not see many children with, in particular, febrile seizures and standard temporal lobe epilepsy. We are talking about children who have more diffuse injury.

Dr. Engel: One approach is to work your way down from the usual adult evaluation for focal resection or temporal lobectomy; but that only works under certain conditions. These children, however, have different problems and require a different approach.

Dr. Dennis Spencer: You may eventually perform a standard localization and temporal lobectomy on a 12-year-old because age 10 may be the average age of seizure onset. You have treated him for 2 years, and he has not responded during that time. I submit that that

patient should be studied and operated on at age 12. I think there is valid evidence for that approach now. Even if there is evidence that 25% of these children may within 10 or 15 years stop having complex partial seizures, if you have less than a 1% mortality and morbidity in your workup and surgery, and you weigh that against the possibility of a 25% remission rate within 10 years, I submit that this is still an appropriate approach.

Dr. Lüders: The approach with children varies according to the type of surgery that you are planning. There are children in the age range of 3 or 4 years who have exquisitely focal electrical manifestations of their epilepsy, even if the clinical manifestations are misleading.

For example, we studied a case that had infantile spasms clinically. Analysis of the clinical symptomatology, using videotape recordings showed, however, that actually immediately preceding the infantile spasms, the patient had a deviation of the eyes to one side and the EEG showed an epileptogenic focus localized to a single electrode (F8). In that case, we were dealing with a patient who had a frontal focus and there was no overlap with any eloquent cortical area. Therefore, there was no reason to manage this child differently from an adult.

That scenario is quite different from the one in which we plan a resection, where we expect that the patient will have a certain degree of functional deficit. Under those circumstances we would be very reluctant to proceed with surgery, particularly since we do not know with certainty if the seizures can be brought under better control medically with maturation.

I am not necessarily saying that the decision to do surgery is wrong, or that the decision to wait is correct. I am just saying that at this point additional research will be necessary to define what is the correct approach in such cases.