Visual reinforcement audiometry
with insert earphones – part 1
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Joint venture in setting up the room and procedure by Connevans and Surrey Education’s Physical and Sensory Support Service

This article has been written in order to share the experiences of Surrey’s Physical and Sensory Support Service in linking with a local manufacturer, Connevans, in order to provide a service that was not available in the local hospitals. We hope that it will be useful to other services who are thinking along the same lines.

Background

In 1996 the inaugural meeting of the South Educational Audiologists Group met in London. Professor John Bamford of Manchester University was invited to speak about Visual Reinforcement Audiometry (VRA) with Insert Earphones (IE). Following this talk, two profoundly deaf children aged 9 months and 18 months were taken separately to Dorset by Margaret Glasgow and Katie Moger to be tested by Educational Audiologists who had set up VRA with IE in a hospital.

Connevans offered Surrey the use of a room for testing and Pauline Hughes, Head of Profession for Surrey’s Physical and Sensory Support Service (PSSS) met with the Head of Special Educational Needs Development to ensure this fitted in with Surrey County Council’s Development Plan.

Fund-raising began for £8000. Contributors are acknowledged on a plaque in the Surrey Suite corridor at Connevans. Contributions ranged from a few pounds from cake stalls in a nursery school to £2500 from the Burwood Park Foundation.

When the room was completed and all the equipment had been installed, the two Educational Audiologists leading the project together with Connevans decided to call the room ‘The Surrey Suite’.

Gathering of information and our own INSET

A day was spent in Dorset with Dr Martin Smith, Head of Service and Educational Audiologist to check the set up and the specific equipment we needed and the names of the suppliers.

At a BATOD South Educational Audiologist Group (SEAG) meeting, Roger Green ran a workshop where he explained how to set up Soundfield VRA and how to calibrate the soundfield.

Roz Pither, Head of Service in Berkshire and Educational Audiologist, gave an INSET to the Surrey Service on VRA. Roger Green was visited at King Edward VII Hospital, Windsor where he demonstrated procedures and protocol for VRA. A letter was sent to Professor Bamford at Manchester University about our proposed layout of the room and he replied with suggestions and advice. PC Werth gave us advice and help re calibration of the equipment and soundfield. Connevans gave us ongoing advice and help with the setting up of cameras, editing, videoing and numerous other snippets of information.

Setting up the Surrey Suite

The original room that had been given for our use proved to need major soundproofing to make it suitable. Connevans therefore offered the use of another room which had the advantage of an adjacent room which we could also use. Noise from heating and lighting appliances were checked and the route from the car park to the room checked for safe access. Connevans made the room acoustically viable by replacing a door with an appropriate wall and treating the walls. The room after treatment still appeared to be acoustically unacceptable and it was decided to put lined curtains around the walls. This was very successful although a great deal of work for the Teacher of the Deaf who volunteered. A system was set up whereby the procedure can be videoed and watched by others in the adjoining room. Soundfield was set up and calibrated with advice from PC Werth.
Purchasing of Equipment

The equipment came from various suppliers or was made by Connevans, our technician and PC Werth. Here is a list of the major items:

2. 3A insert earphones and foam tips – PC Werth
3. 2 loudspeakers Jamo compact 700 – PC Werth
4. 4 visual reinforcers – juggler, clown, train and flashing light
   - Toys for the Handicapped.
5. 2 stands for reinforcers – made by Connevans
6. 3 foot pedals – made by our technician
7. 1 high chair – donation
8. Chairs and tables – donation from Connevans
9. Selection of toys – various suppliers
10. 3 security cameras – Reigate supplier
11. 1 television – Reigate supplier
12. 2 video recorders – Reigate supplier
13. 1 digital AV mixer – Reigate supplier
14. 1 tympanometer – PC Werth
15. 1 otoscope – Connevans
16. 2 fabric covers for reinforcers and loud speakers – made by ToD
17. 1 sound level meter for soundfield measurements – PC Werth

Various lengths of leads – made by Connevans and PC Werth

Room layout

Much discussion took place re the layout. The factors taken into consideration were:

- it was not possible to have an observation window therefore the audiometer and tester had to be in the same room as the child
- the person who would be operating the audiometer had to have a clear view of the baby/toddler
- there needed to be enough space for the parent/carer to sit close to the child
- baby/toddler needed to be positioned so that the speakers and reinforcers were at 45 degrees azimuth
- the cables from the reinforcers, speakers and audiometer had to be made safe
- cameras had to be positioned so that responses and audiometer could be seen on the video.

Trials to check protocols, use of equipment and procedures for VRA with IE.

A great deal of care was taken to ensure that the testers were confident using the equipment and were employing the correct child handling skills for the test. Many hearing babies and toddlers had their hearing checked whilst we were practising and we also checked by testing an adult hearing impaired person who had a known audiogram. PC Werth came during this period and rechecked the insert earphones calibration which is calibrated to dBHL so we do not have to do calculations to achieve our true levels.

Points we learned during the trials

This was a very valuable time and the use of two rooms was soon recognised as being crucial. One room is only used for the test and the other is used for welcoming the family, performing otoscopy and tympanometry, watching the video, explaining the test, parent/carer role and discussing results. Only the child, parent/carer and two testers are in the test room. Others watch the video in the adjoining room. When entering the test room we found the following procedure worked well. The insert earphones were already clipped to the back of the high chair which was positioned so that the baby could not pull the leads. Tester one who operates the
audiometer inserts the earphones whilst tester two plays with the baby. If at any time during the test the insert earphones come out, tester one puts them back in. The positioning of the parent/carer needs to be close to the baby but not in the way of the testing. The role of the second tester is not the same as for the distraction test. The tester keeps the baby in the forward position, tries to stop the earphones being pulled out and the attention is controlled in a very low key manner. Often a young baby will sit happily with one toy. This tester helps with the insertion of the insert earphones by keeping the baby amused. S/he is often the one who talks to the parent/carer. Conditioning is more difficult than using soundfield VRA because the second tester cannot hear when the sounds are introduced and sometimes it is helpful to condition by soundfield. An agreed method of communication between the two testers is needed.

Presentation of the stimuli is not ordered as for a conventional pure tone audiogram. Timing of the presentation of the signal is crucial and enough time is needed for the baby to stop checking. An LED on the back of the reinforcer is needed so that tester one can be sure that the reinforcer is working. The baby/toddler may sit in a high chair, at a small table or on parent/carer’s lap. More time is available than in a normal clinic set up and if the baby becomes restless a break can be taken. Parents need to be prepared that results may not be achieved as insert earphones may not be tolerated or the baby does not like the reinforcers.

The Surrey Suite is presented as an opportunity to add to the jigsaw rather than to give a diagnosis.

Launch of the Surrey Suite in June 1999

The Surrey Suite was launched nearly three and a half years after attending the talk by Professor Bamford. The Local Press attended and the following people were invited to two afternoon sessions:

- Surrey County Council officials
- Financial contributors
- Health Service Personnel
- Educational Audiologists from neighbouring authorities
- Physical and Sensory Support Team in Surrey
- Audiological manufacturers

A separate launch was given to the Connevans staff.

The project would not have been completed without the teamwork of the PSSS, Surrey County Council, the Health Authorities covering the County of Surrey and the hearing aid and radio aid manufacturers. The Surrey Suite has been successfully running for over a year and we will report on our statistics and findings, including case studies, in a later article.

Floor plan for the Surrey Suite
Visual reinforcement audiometry (VRA) with insert earphones – Part 2

Katie Moger, Sue Jillians and Margaret Glasgow Educational Audiologists, Surrey Physical and Sensory Support Service continue their report of the developing resource supported by Connevans to provide a service of Visual Reinforcement Audiometry (VRA) with Insert Earphones (IE), that was not available in the local hospitals. This article is a follow up to the explanation of how the facility was set up including installation of Insert Earphones and calibration of Sound Field (Magazine January 2001, pages 20-21). Statistics, findings and some case studies are reported.

During the Autumn Term of 1999 a third Educational Audiologist was trained to do VRA with IE and children diagnosed with hearing loss started to be assessed in December.

Thirty five children had their hearing tested at the Surrey Suite. Their ages have ranged from eight months to three years five months. Ages of children with complex needs have ranged from one year six months to seventeen years one month. Seven children have been seen two or three times.

Several children with complex needs have been tested. In one instance the equipment was successfully moved to the school. Children with Downs Syndrome and severe learning difficulties have been tested. A deaf blind boy has visited us three times and each time we have gained additional information.

The Surrey Educational Audiologists and Connevans have welcomed visitors to observe testing procedures. The parents are always asked if they agree to an observer. Consultant Audiological Physicians, Audiology Technicians, Educational Audiologists from other counties/boroughs, Senior Medical Officers, trainee Educational Audiologists have all attended sessions. The exchange of good ideas from their observations and discussions has proved invaluable.

In order to make the best use of Surrey Suite appointment time, we have learned the following: We are aware that children seen in the Surrey Suite attend other hospital appointments, particularly with Consultant Audiological Physicians and at Cochlear Implant Centres. We are careful not to offer appointments too close to other audiological assessments by ensuring that a period of three weeks is left between assessments. Our rôle is to work with the professionals at the hospital the child attends. Our work is not diagnostic but adds to the existing information. We always seek permission from the parents and discuss the appointment with the Consultant Audiological Physician.

The developmental age of the child is also a consideration. We have seen two children who, developmentally, were beyond VRA but who could not manage play audiometry. It is essential to liaise with the referring ATOHI to discuss how the child is functioning. We request previous audiological and pre-school reports and follow up reports in order to keep a comprehensive record of audiological assessments.

We are fortunate to be able to work at the pace of the child and to take necessary breaks so that the child does not become too tired. We allow time to discuss results with the parents/carers and to answer their questions. Parents are giving favourable written and verbal comments indicating they value both the comprehensive nature of the assessment and the time we can give to it. The fact that the ATOHI is often present shows that we work collaboratively.

Margaret Glasgow working in the Surrey Suite
The single most valuable facility has been the use of VRA with bone conduction. Bone conductors are still not
designed for small heads but can be used successfully with foam padding.

**Case studies**

The following case studies illustrate some of the valuable outcomes for our service.

**Child A:**

Born 26 weeks gestation. Diagnosis at six months (uncorrected)* of severe, possibly mixed, hearing loss. Brainstem Electric Response Audiometry indicated right side response at 70dBnHL and left side no response at 70dBnHL. Child A was fitted with body worn hearing aids (normal).

Seen at the Surrey Suite aged sixteen months (uncorrected)*. VRA with insert earphones and unmasked bone conduction VRA were carried out.

- **Insert earphones:** mild hearing loss left and right.
- **Bone conduction:** within normal limits.
- **Outcome:** Advisory teacher involvement reduced from weekly to monthly visits to family to give support and management.

**Child B:**

Child B has a first cousin with severe sensori-neural hearing loss. Previous distraction testing indicated a moderate hearing loss and glue ear. A low powered hearing aid was fitted on the right.

Seen in the Surrey Suite aged eighteen months. VRA with insert earphones and unmasked bone conduction were carried out.

- **Insert earphones:** mild hearing loss left and right.
- **Bone conduction:** within normal limits.
- **Outcome:** hearing aid withdrawn by the hospital.

ATOHI involvement reduced from weekly to six monthly visits to monitor development of communication skills.

**Child C:**

Child C has bilateral meatal atresia. Previous unaided soundfield VRA gave responses at:

- 70dBA @ 1000Hz
- 50dBA @ 4000Hz

Child C wears a bone conduction hearing aid. No information on type of hearing loss or aided levels were available. Seen at the Surrey suite age two yrs one month. Bone conduction VRA, headphone air conduction VRA and aided soundfield VRA assessments were made.

- **Bone conduction:** within normal limits
- **Air conduction:** 70 dB hearing loss left and right ears
- **Aided:** Responses across the frequency range at 30/35 dBA
- **Outcome:** Advisory teacher involvement remained the same. Management strategies were refined because of additional information. A suitable candidate for bone anchored hearing aid.

**Child D**

Child D had meningitis at eleven months, also glue ear. Grommets were fitted at seventeen months and a moderate/severe hearing loss was diagnosed. Low-powered BTE hearing aids were fitted at eighteen months.

Seen at the Surrey Suite at nineteen months. VRA with insert earphones and unmasked bone conduction were carried out.

- **Insert earphones:** hearing within normal limits on the left and a severe loss on the right.
- **Bone conduction:** within normal limits
- **Outcome:** hearing aids are no longer worn. The advisory teacher involvement reduced from weekly to monthly visits to monitor speech and language development.
Child E:

Age seventeen years, has complex needs and has worn high powered BTE hearing aids for several years. School was concerned that child E constantly pulled out the hearing aids and staff queried their value. The equipment was taken to the school placement where a very quiet room was provided. Two Educational Audiologists, the ATOHI and a member of the school staff were present for the assessment.

Air conduction VRA with insert earphones and bone conduction VRA were assessed. Child E’s responses to sound stimuli differed from the conventional response of looking for a visual reward. Child E made a definite head turn to look at the Audiologist operating the audiometer. This response was reliable and repeatable.

**Insert earphones:** severe hearing loss on the right, no measurable hearing on the left.

**Bone conduction:** severe hearing loss

**Outcome:** request to hospital to review the hearing aids.

School attitude markedly improved, now believing hearing aids to be beneficial. The student is encouraged to wear hearing aids, also to use an ATU. Feedback reports student wearing hearing aid consistently and appearing more alert and aware. Advisory teacher involvement remains the same for time but is more productive.

Evaluation

For 86% of children we have used VRA with IE to establish hearing levels in each ear. For 89% of the children unmasked bone conduction measurements were established.

For 63% of the children aided or unaided Sound Field results have been achieved.

**In 94% of cases additional information to that which the hospitals had reported was obtained.**

For 31% of the children the management has been changed. Children with hearing within normal limits have been discharged, others have required less involvement by the ATOHI. Some children were given more appropriate hearing aids and for others the ATOHI has been better informed and therefore able to put in place more appropriate strategies and advice. Pre-school children in Surrey with any hearing loss are visited monthly until we are sure that both their speech and language development are progressing well.

The imminent roll-out of the Universal Neonatal Hearing Screen (UNHS) means that Teachers of the Deaf (ToDs) will have more young babies on their caseloads and audiological information will be incomplete. It is essential that ToDs have as much knowledge as possible about the baby’s hearing status in order to advise the families and to monitor the child’s development. The Surrey Suite is working collaboratively with other professionals and industry in providing the early information so that preventative working can be established and the child and his/her family have the most appropriate support and management.

Future use of the Surrey Suite

Some ideas are:

- introduction of Oto Acoustic Emissions tests
- hearing aid evaluation
- evaluation of listening skills
- using the video facility to record and evaluate speech and language and development of communication skills
- training other professionals.

*uncorrected age refer to the chronological age of the child*

*corrected age refers to premature babies and their expected developmental stages from birth*