

Phonak Insight

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Real-ear Measurement with Lyric Clinical Insights

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Introduction

Since 2008, Lyric has presented people with mild to moderate hearing loss a unique solution: 24/7 extended wear technology with deep ear canal placement that provides acoustic benefits along with complete device imperceptibility. Although the cosmetic and ease-of-use benefits of Lyric are relatively straightforward to assess, the acoustic advantages and resulting audibility improvement enabled by deep ear canal placement of the device can be more difficult for clinicians to capture. In this regard, real-ear measurement (REM) is a valuable verification technique that can objectively and accurately document the acoustic performance of a hearing instrument and offer details regarding the suitability of the device output relative to the patient's dynamic range.

In this paper, we will discuss and illustrate procedures that can be employed to increase the probability of successful and accurate REMs with Lyric.

REM Techniques with Lyric

When conducting REM with Lyric you will generally follow the same principles used when conducting this verification technique with any traditional hearing instrument. For instance, considerations involving proper probe tube calibration, visualization of the ear canal via lighted magnification, loudspeaker placement, and probe tube placement still apply as described by multiple authors (e.g., Mueller et al., 1992; Revit, 2000; Pumford and Sinclair, 2001).

The major challenges associated with the application of REM with Lyric include the additional focus on ensuring the probe tube is extended beyond the medial end of the device while not contacting the tympanic membrane given the deep canal placement and small residual volume. In addition, given the small distance between the microphone and receiver along with the compressible nature of the outside foam material attached to the Lyric device, feedback due to slit leak venting created by the presence of the probe tube can be problematic.

To help you navigate these REM challenges and increase your probability of a successful and accurate measurement, we have outlined a number of techniques and principles in the sections below. That being said, it is understood that there may still be patients for whom REM cannot be reasonably completed with Lyric despite your best efforts. In these cases, we recommend you revert to your standard verification approach for Lyric.

The following steps, here illustrated with the AudioscanR VerifitR system, can be generally applied to any REM system in your practice.

Microscope or loupe assessment of ear canal

Prior to conducting REM, it is important to ensure that the patient's ear canal is clear of debris and cerumen and is deemed "OK for immediate refit" per standard Lyric fitting protocols. In this regard, use your standard approach for assessing and cleaning the ear canal for a Lyric patient. A microscope or loupe assessment with speculum is recommended as per typical Lyric fitting protocol (Figures 1 and 2).



Figure 1 (top) and Figure 2 (bottom)

Microscope evaluation of the ear canal. Evaluation is conducted under illumination and magnification with a speculum to assess ear canal status and aid in cerumen removal, if necessary. The ear canal should be free of any debris or cerumen prior to conducting a REM with Lyric.

REM Techniques with Lyric

Patient positioning

Position the patient using the standard REM approach and per your REM manufacturer's recommendations (Figure 3). In this regard, choose a quiet measurement location and position the patient/test speaker away from reflective surfaces to minimize the negative impact that these variables can have on the accuracy of your measurements.

Probe tube preparation

Many REM manufacturers provide markers on their probe tubes to assist with decision making around the appropriate depth of insertion so the probe is close enough to the eardrum to accurately assess the entire frequency region of interest, but not so close as to result in discomfort from contact with the eardrum.

Beyond ensuring an appropriate distance between the end of the probe tube and the eardrum, there is also the need to ensure the probe tube is beyond the medial end (receiver) of the Lyric device during the measurement. That is, probe tube positioning involves a consideration of both:

a) the appropriate insertion depth to accurately measure the output being received at the eardrum; and b) the appropriate distance beyond the end of the Lyric device to ensure that the device output is being measured correctly.

To assist with these considerations, markers can be placed on the probe tubes to provide insertion depth guidance. Initially, slide the probe tube marker to a position on the probe tube designed to ensure the appropriate depth of insertion relative to the eardrum. Below are some general marker position guidelines:

For adult males: place the "depth of insertion marker" approximately 32 mm from the end of the tube.*

For adult females: place the "depth of insertion marker" approximately 30 mm from the end of the tube.*

* Note: these guidelines are general and do not apply to every individual being tested. Given normal anatomical variation placement to these depths may be possible in some patients and not in others. The general goal is to achieve a location that is just beyond the Lyric receiver and within ~ 2–3 mm of the ear drum.



Figure 3
Patient positioned according to REM manufacturer's recommendations (e.g., 0 degrees azimuth, 0.45 m–0.6 m from test speaker).

REM Techniques with Lyric

Once the marker is lined up with the intertragal notch it should result in positioning where the end of the probe tube is approximately 2–3 mm from the eardrum. Additionally, using a permanent pen or marker, make a secondary mark at 14 mm from the end of the probe tube to help ensure the probe tube will extend beyond the Lyric device (Figure 4). As the Lyric device is 12 mm in length this "depth of Lyric" marker will allow for at least 2 mm of probe tube length beyond the receiver. Furthermore, as the Lyric device insertion process is designed to result in at least 4 mm separation between the medial end of the device and the eardrum, this "depth of Lyric" probe tube marker will serve to ensure that the end of the probe tube lies within the residual ear canal cavity (i.e., beyond the Lyric device yet not touching the eardrum).

Confirmation that the probe tube is extending past the Lyric device is indicated when the "depth of Lyric" marking is not visualized once the device is in place. Once the two markings are complete, attach the probe tube to the probe module as recommended by the REM manufacturer.

Probe tube placement in the ear canal

Consider applying a small amount of lubricant (e.g., glycerin) along the probe tube prior to insertion. The lubricant may assist with maintaining the probe tube location in the ear canal and help decrease the chance of any slit leak venting that may occur when the Lyric device is inserted. It is important to ensure the lubricant does not plug the end of the probe tube.

Feed the probe tube around the front of the blue retention cord holding the probe module on the ear (AudioscanR equipment) as friction from the cord will help hold the tube in place. Using an otoscope or loupes, insert the probe tube down the ear canal until the marker has approximated the intertragal notch (Figure 5). Prior to full insertion, visualize the location of the end of the probe tube and its proximity to the eardrum. An otoscope can be beneficial during this task (Figure 6). If needed, adjust the insertion depth of the probe tube while being cautious to avoid contact with the eardrum for comfort purposes. Remember that the goal is to ensure probe tube placement just beyond the medial end of the Lyric device and within ~ 2–3 mm of the eardrum.

Note the location of the probe tube marker and its proximity to the intertragal notch as it will help ensure the appropriate probe tube location is maintained during Lyric device insertion. One method that may help maintain the probe tube location is to place a dollop of lubricant with a Qtip at the intertragal notch or along the probe tube in the canal.

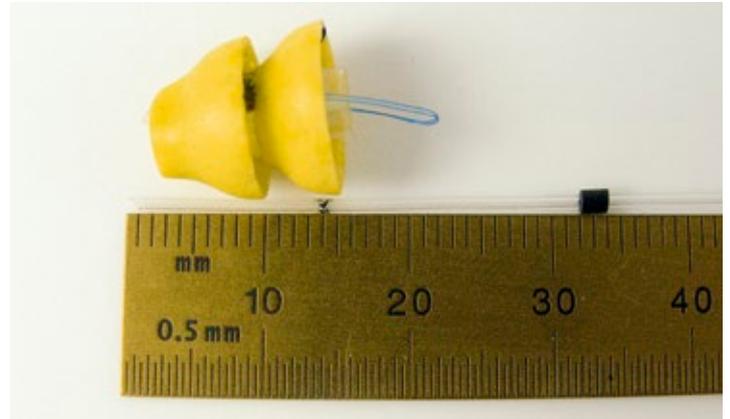


Figure 4

Depth of Lyric marking at 14 mm which is ~ 2 mm beyond the Lyric device and can be used as a guide to ensure the probe tube extends past the Lyric device once placed in the ear canal. Also note the "depth of insertion" marking at 32 mm which can guide appropriate positioning of the end of the probe tube relative to the eardrum.



Figure 5

Placement of the probe tube prior to Lyric device insertion. The probe tube is wrapped around the blue retention cord and the marker is lined up with the intertragal notch.



Figure 6

Utilizing otoscopy to help visualize location of the probe tube in the ear canal.

REM Techniques with Lyric

Placement of Lyric device

As with any other Lyric placement, pre-program the Lyric device and ensure the device is activated. Attach the device to the insertion tool and set the insertion depth using your standard approach. Apply lubricant (e.g., glycerin) to the Lyric seals to help ease insertion and minimize the likelihood of any slit leak venting introduced by the presence of the probe tube (Figure 7).

To increase efficiency of Lyric placement and reduce any necessary troubleshooting during the measurement, it may be helpful to use loupes for the REM component as they provide portable magnification and illumination (Figure 8).

Insert the Lyric device using the standard approach with the device turned on and lubricated as described above. Carefully watch that the probe tube location is maintained throughout the insertion process (Figure 9) by visualizing the location of the "depth of insertion" marker on the probe tube. Once the device is placed at the desired insertion depth, proper illumination should be used to ensure that the "depth of Lyric marking" made at 14 mm on the probe tube is not visualized, which can help ensure that the probe tube is extended beyond the Lyric device. Should you note feedback following final placement of Lyric, carefully use the Lyric1 insertion tool or duckbill forceps to adjust the insertion depth and/or rotate the angle of the device. In some cases, you may need to remove and reinsert the Lyric device to address feedback issues.

Some REM systems provide headphones that can be worn by the fitter to assist with identifying the presence of feedback and allow clinicians to listen in on the output of the hearing instrument while it is in the patient's ear canal (Figure 8). Wearing the headphones may help you identify, and then address any low-level feedback prior to conducting the measurement.



Figure 7
Applying lubrication to the Lyric device seals can help ease insertion and reduce the chance of feedback due to slit leak venting introduced by the probe tube.



Figure 8
Loupes provide portable magnification and illumination advantages during Lyric insertion for REM procedures. Headphones can also be used with some REM



Figure 9
Insertion of the Lyric device with REM probe tube placement.

REM Techniques with Lyric

Perform REM

Following placement of the Lyric device, you can proceed to conduct REM using your standard REM hearing instrument verification strategy (Figures 10 and 11). The steps and principles followed at this stage would be the same as those used when conducting REM with any traditional hearing instrument. One may refer to Mueller et al., 1992; Revit, 2000; or Pumford and Sinclair, 2001 for additional guidance regarding the typical verification steps followed when using REM.

Following completion of REM, carefully remove the probe tube from the ear canal by gently extracting it and remove the probe housing and assembly from the outer ear. The Lyric can remain in place and does not necessarily need to be removed and reinserted if the desired insertion depth of the device was achieved and maintained during the REM process without patient concern or discomfort.

As with any hearing instrument, when conducting REMs with Lyric, the clinician may run into measurement issues that, if not addressed appropriately, could lead to inaccurate conclusions regarding the performance of the product. While the procedural

steps outlined above are designed to increase the likelihood of successful and accurate measurements, it is still possible that measurement issues may arise. In this respect, it serves clinicians well to familiarize themselves with possible REM issues and methods to address them. On the following pages, you will find answers to common questions you may have during or after REM with Lyric.



Figure 10
Final placement of REM probe tube and Lyric device for conducting REM.

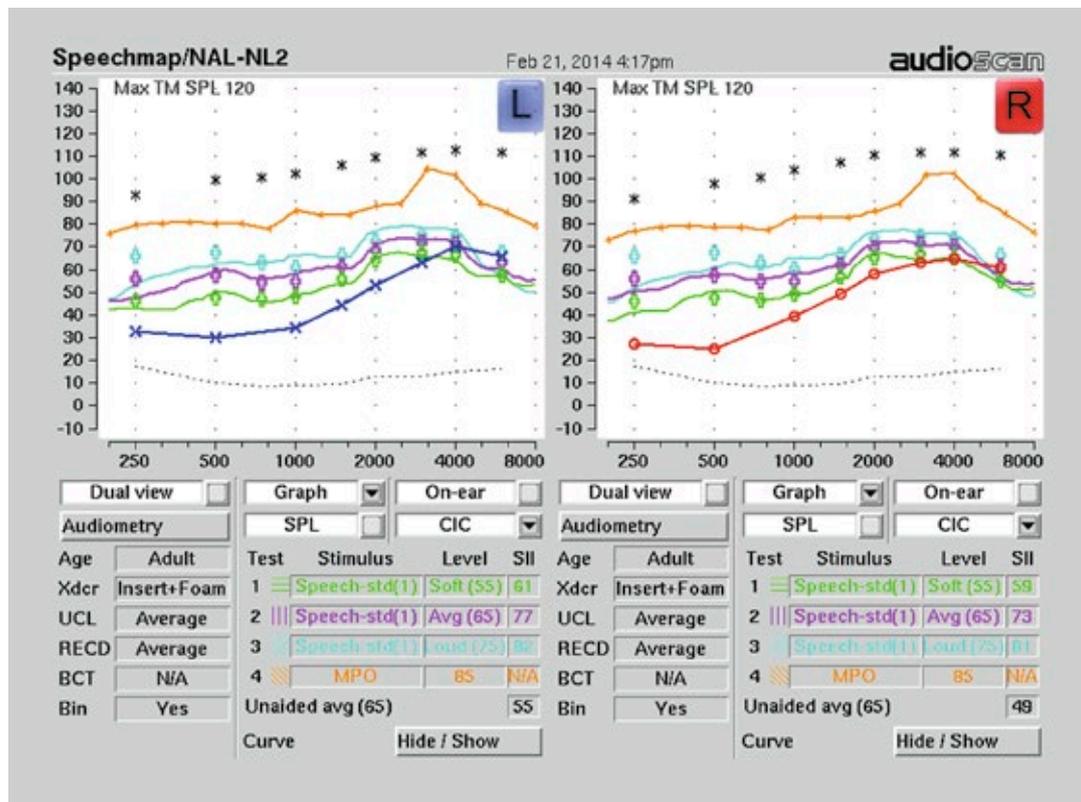


Figure 11
Example of final REM captured for Lyric3 hearing device.

Troubleshooting Lyric Real-ear Measurements

Why am I seeing a notch or dip in the REM in the mid-high frequency region?

A notch or dip in the REM in the mid-to-high frequency region may be the result of the probe tube terminating alongside the Lyric device (Figure 12). This notch may indicate that the probe tube should be repositioned closer to the eardrum and beyond the medial end of the hearing instrument as the measurement is not accurately indicating the sound level at the eardrum. Consider removing Lyric and advancing the probe tube further into the ear canal prior to reinserting and remeasuring the device. Also, confirm that the "depth of Lyric" probe tube marking is not visualized as described earlier in the document.

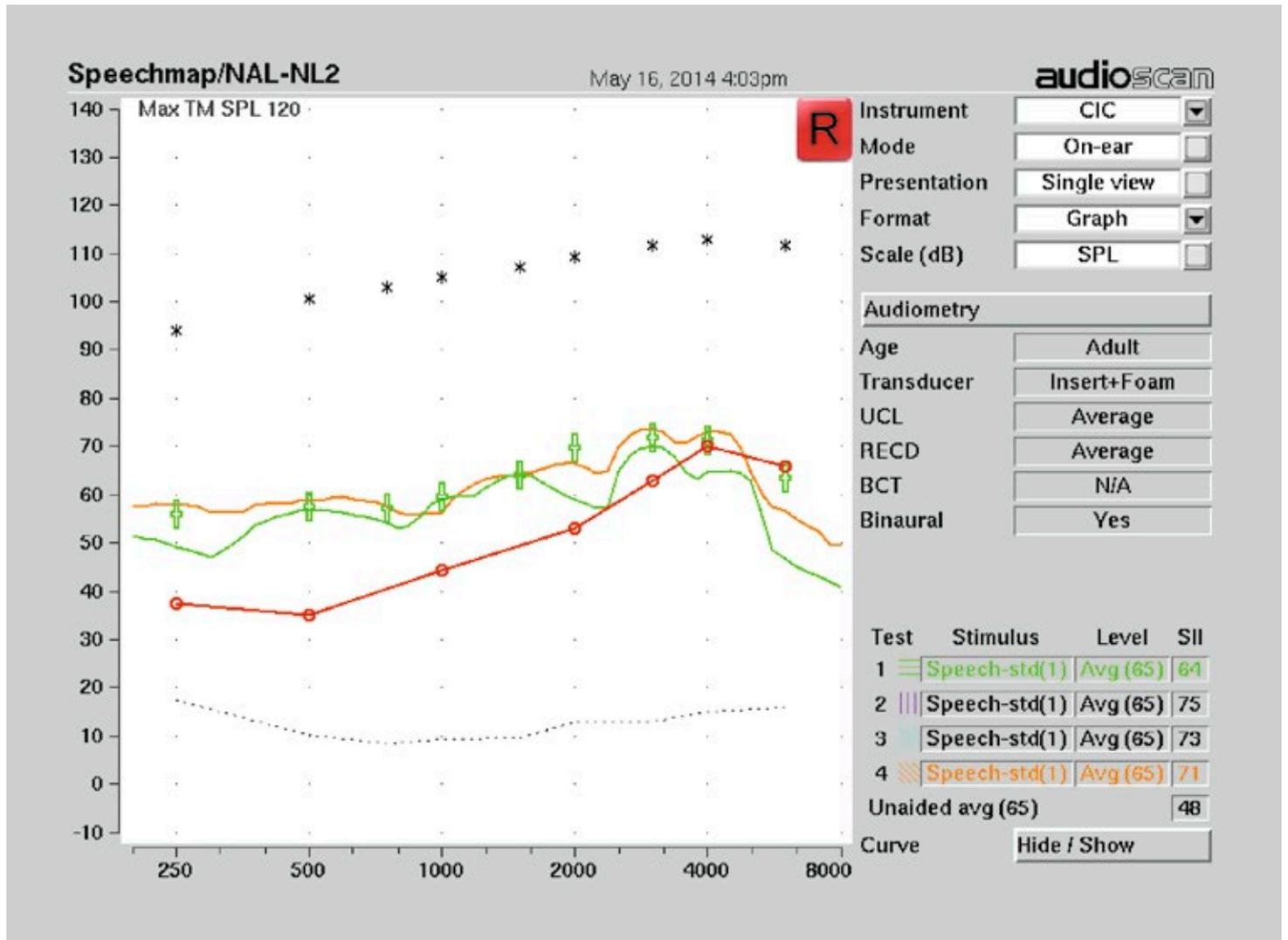


Figure 12
Real-ear measurement showing a notch in the response around 2000 Hz (green tracing). Comparative measurement (orange tracing) following repositioning of the probe tube for the same Lyric device with the same settings indicating proper probe tube depth of insertion (i.e., closer to the eardrum and beyond the medial end of the hearing instrument).

Troubleshooting Lyric Real-ear Measurements

Why are the REMs appearing considerably lower than expected across all frequencies?

If your REMs with Lyric are considerably lower than anticipated across the entire frequency range, it may be that the probe tube is pinched, blocked with debris, or is not inserted beyond the end of the Lyric device (Figure 13). Try pinching the probe tube outside of the ear canal and/or turn the device on and off to see if there is any change in the measured responses. If no changes are occurring, remove the Lyric device, inspect the probe tube for blockage and replace with a new probe tube, if necessary. Reposition the probe tube using the previously described insertion depth guidelines and reinsert the Lyric device. After reinsertion, use proper illumination to ensure that the marking made at 14 mm from the end of the probe tube is not visualized to ensure the probe tube is extended beyond the Lyric device.

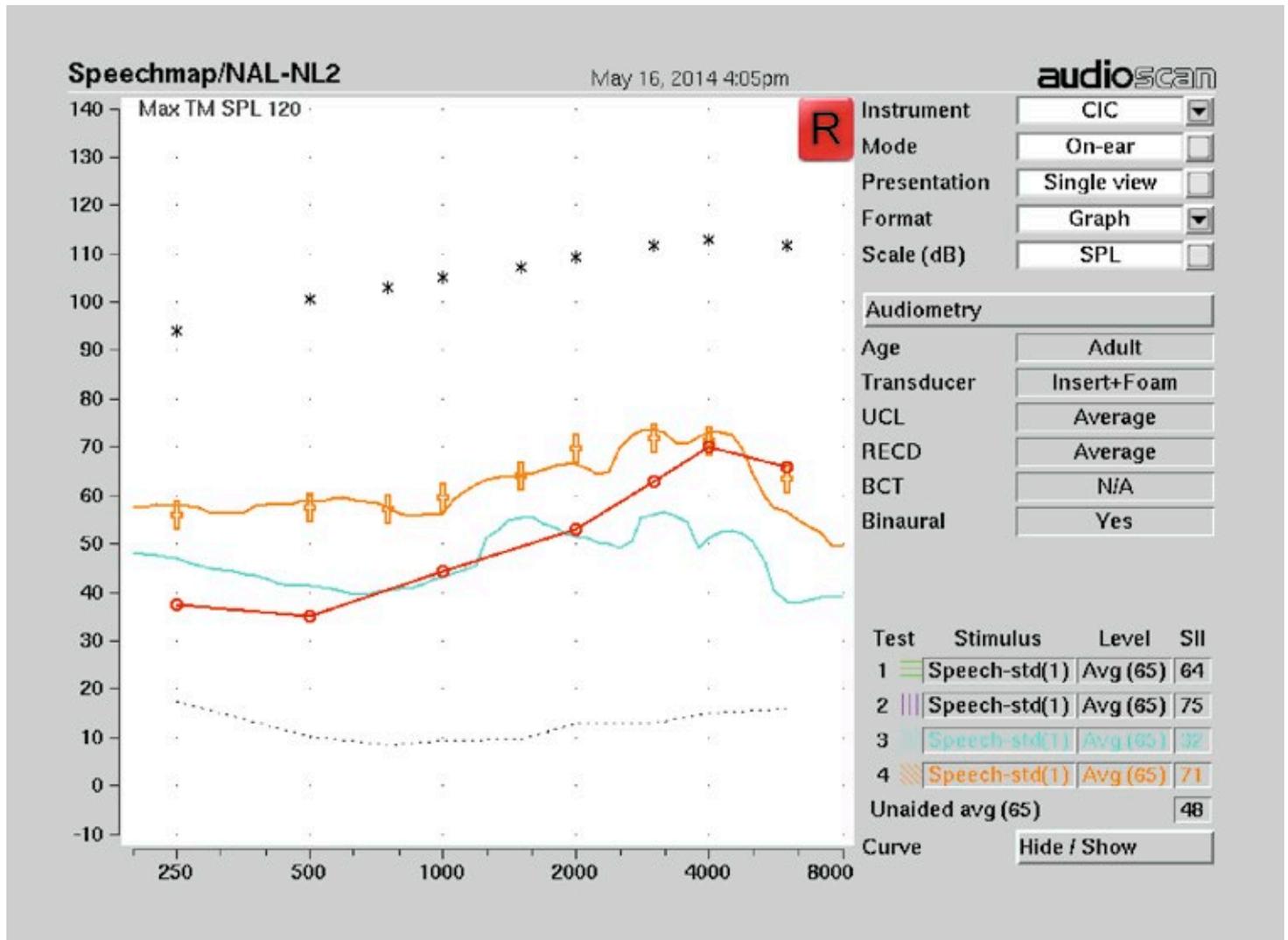


Figure 13 Real-ear measurement showing a low output response across all frequencies (blue tracing) prior to probe tube and device repositioning. Comparative measurement (orange tracing) following probe tube and device repositioning that is consistent with a probe tube that is not pinched and extended beyond the same Lyric device at the same settings.

Troubleshooting Lyric Real-ear Measurements

Why do I notice peaks in the REM in the mid-to-high frequency region?

If peaks in the real-ear measurement are noticed in the mid-to-high frequency region, it is possible that feedback is present (Figure 14). To address this issue, you may need to adjust the location and/or angle of the Lyric device. Carefully use the Lyric1 insertion tool and/or duckbill forceps to conduct these manipulations. Use small, gentle adjustments to avoid injuring the ear canal and ensure you do not exceed the previously measured maximum insertion depth of the product for the patient in question. In some cases, you may need to remove and reinsert the Lyric device. In addition, there may be a need to apply more lubrication (e.g., glycerin) to the ear canal and/or Lyric seals if a minimal amount was used initially.

As stated previously, there may be situations in which REM cannot be reasonably completed given the presence of feedback regardless of the troubleshooting steps followed. In these cases, we recommend that you revert to your standard verification approach for Lyric.

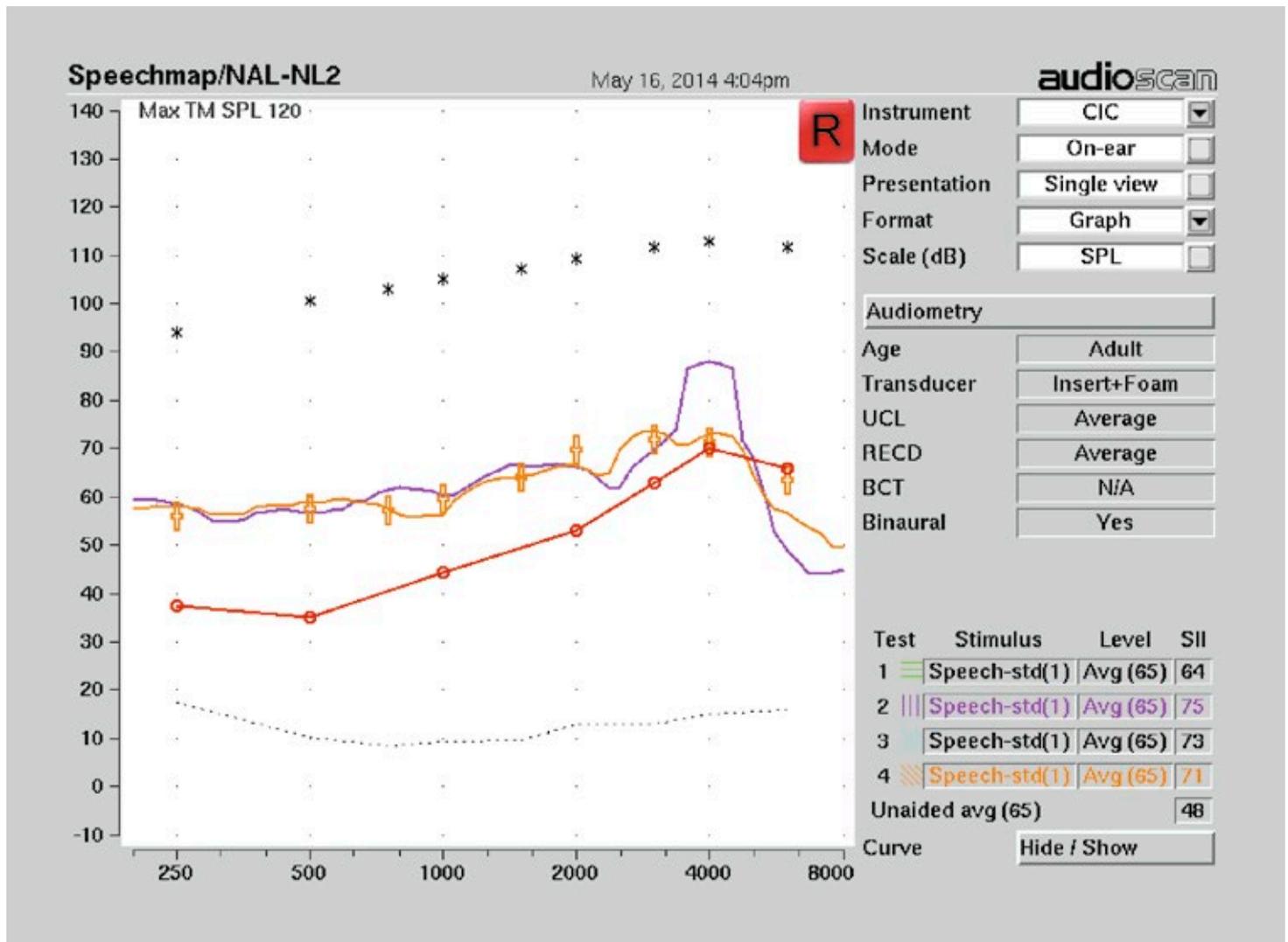


Figure 14
Real-ear measurement showing a high frequency peak around 4000 Hz consistent with feedback. Comparative measurement (orange tracing) obtained following the application of lubricant and reinsertion of the Lyric device with appropriate response and no indication of feedback.

Troubleshooting Lyric Real-ear Measurements

How can REM help me troubleshoot programming?

REM can assist the fitter with programming decisions should a patient report concerns regarding audibility, sound quality, and/or the general amplification performance of their hearing device. As with traditional hearing devices, REM provides a visual representation that indicates how programming changes affect the device output. This process can facilitate a greater understanding of the potential reasons behind your patient's amplification concerns (e.g., lack of audibility in a particular frequency region at a particular input level) and ultimately assist you in the determination of appropriate programming changes (Figure 15).

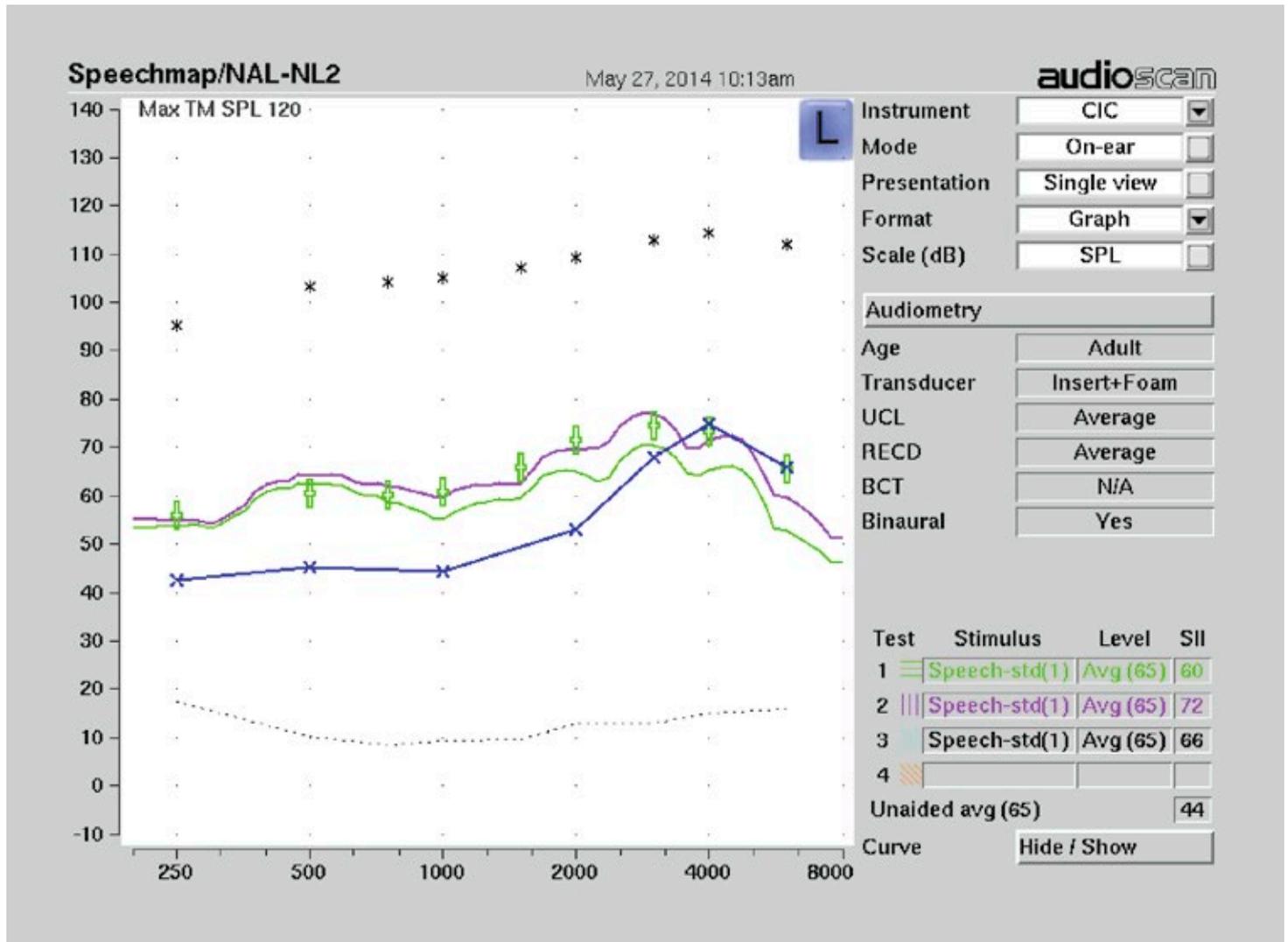


Figure 15 Real-ear measurements showing the effect of programming adjustments. The initial response (green tracing) indicated the need for more mid to high frequency output for the input test signal (i.e., Average Speech (65 dB SPL)) relative to the fitting formula targets. Following programming adjustments, REM was measured again for the same input test signal (pink tracing) and is shown to provide additional audibility and a closer match to the fitting formula targets for the mid to high frequencies compared to the initial tracing.

Conclusion

The verification of hearing instrument performance is an important part of any fitting. REM represents the gold standard approach for verification and is a valuable component in the hearing aid fitting process. REM can be used to ensure that devices are performing appropriately based on the auditory needs of your patients and aid in the troubleshooting and programming of Lyric.

While REM with Lyric can present a number of unique challenges, recent evidence suggests that this procedure can be accomplished with many patients, thereby offering clinicians another tool to facilitate successful fittings. Suggestions and troubleshooting techniques have been presented throughout this paper to assist fitters during the REM process with the aim to increase the probability of successfully integrating this verification technique into your practice.

References

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