GSI Corti: New Features to Enhance Workflow

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Introduction

- Experience as a Clinical Audiologist in hospital and neuro-otology settings for many years.
- Past 10 years worked for audiology equipment manufacturing in education and support role

Agenda

1. Introduction and Review
2. DPOAE Normative Data Review
3. Interpretation of DPOAE Test Results
4. Accessing OAE Collection Parameters and Settings
5. Data Management: Reporting and Printing Options

Course Objectives

- Participants will be able to use published DPOAE normative data as a guide when interpreting DPOAE test results
- Participants will be able to list 3 ways to electronically print and save OAE test results
- Participants will be able to access 3 advanced OAE test options included with the GSI Corti

OAE Review

- Described by Kemp in 1978
- Acoustic sounds generated by movement of the hair cells in the cochlea
- Emissions are usually present when 'hearing' is normal
- Pre-neural and represent cochlear function

OAE Review

- Ear, site and frequency specific
- Very sensitive test of outer hair cell function: OHC damage is closely linked to hearing loss
- Objective in that patient response is not required
- Pediatric and Adult applications

4 Types of OAE

1. **Stimulus Frequency** OAE (SFOAE): elicited by one continuous, low-level sinusoidal signal.
2. **Spontaneous** OAE (SOAE): recorded in the ear canal with no stimulus (not evoked)
3. **Transient** or TEOAE: Stimulus is a broadband click. Activates a wide frequency region. Level is 80 dB SPL

4 Types of OAE

4. **Distortion Product DPOAE**
   Elicited by 2 pure tones (F1 and F2)
   (F2/F1 ratio 1.22 example: F2=2000 and F1=1639Hz)
   At intensity levels (L1 and L2) 65/55
   DP measured at: 2F1-F2 (largest distortion)
   F2 is cochlear place being stimulated
   Use different pure tone pairs to elicit OAE's over a wide range of frequencies

How is it measured?

- Probe contains speakers and a microphone
- Speakers deliver the evoking stimuli
- Microphone picks up the sound energy in the ear canal which includes the emission and noise
- Measure the sound pressure level (SPL) present in the *sealed* ear canal

How is it analyzed?

- OAE system analyses the spectrum of the sound and separates the “noise” and the “emission”
- An emission usually should be about 4-6 dB higher than the noise floor (NF)
- Can use additional criteria for screening when analyzing data that requires a minimum OAE amplitude or compare to normative data

(Example NF = -20, OAE = -14)

Pediatric Applications

- Newborn Hearing Screening
- Mandatory component of pediatric test battery (AAP)
- Dx of ANSD (OAE present/ABR absent-ABN)
- Ototoxicity Monitoring
- Pre-school and school screenings
- Malingering

“Cross-check Principle”

Adult Applications

- Dx cochlear vs retro cochlear dysfunction
- Malingering
- Ototoxicity Monitoring
- Noise Exposure
- Tinnitus Assessment
- Obscure Auditory Dysfunction (normal audiogram with complaints of hearing loss)

Normative Data

Normative Data Reference

Ear & Hearing:
December 1997 - Volume 18 - Issue 6 - pp 440-455
Articles

From Laboratory to Clinic: A Large Scale Study of Distortion Product Otoacoustic Emissions in Ears with Normal Hearing and Ears with Hearing Loss

Gorga, Michael P.; Neely, Stephen T.; Ohlrich, Brenda; Hoover, Brenda; Redner, Joelle; Peters, Jo

A Few Study Goals

- Describe DP's in subjects of all hearing levels (normal and HI) using a large subject sample
- Develop a way to determine the probability that a response was coming from a normal or impaired ear
- Develop a clinical tool

Details

- 1267 ears
- 806 individual subjects
- Ranging in age from 1-96 yrs
- No middle ear dysfunction determined by tympanograms performed at 226 Hz and sometimes otoscopic exam by ENT
- Patients with A-B gap of 10 dB at any single frequency were not included

Details

- Subjects audiogram was considered the gold standard
- All DPOAE test results were compared to was the subjects audiogram (750-8000 Hz)
- Measurements conducted in a quiet room or “typical clinical condition”

DP Stimuli

- F2 (test) frequencies ranged from 750-8000Hz
- F2/F1 ratio of 1.22 (this ratio produces the largest DP)
- Most prominent DP occurs at 2f1-f2
- L1=65, L2=55 (10dB separation, under ~70dB, f2 area of cochlea stimulated/most accurate separation of normal and HI)

DP Stimuli

- 500Hz was not included
- Not reliable in predicting auditory status
- F2/F1 = 1.22

F2=500Hz F1=410Hz

2F1-F2 = 820 – 500 = 320Hz

Results

- DP amplitudes were largest for ears with normal hearing
- DP's obtained from hearing impaired ears were not completely separated from DPs from normal hearing ears—**overlap**
- When comparing to audiogram, DPs at 1500-6000 Hz best
- Best correlation when normal hearing is defined as 20-30 dB HL
- Based on test data, were able to develop a way to determine the probability that a response was coming from a normal or impaired ear that could be used clinically

Fig 8: Amplitude/F2

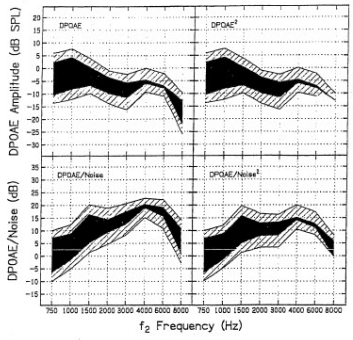
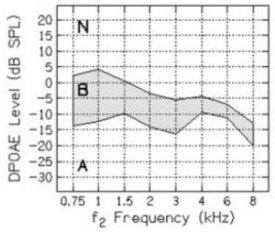


Figure 8. DPOAE amplitude (dB SPL) and DPOAE/noise (dB) as a function of f2 frequency. The top row represents DPOAE amplitude measurements while the bottom row represents DPOAE/noise estimates. The left column represents the case when no effort was made to account for any floor effects. The right column shows results when DPOAE and noise amplitudes less than −20 dB SPL were set equal to −20 dB SPL. The solid line limiting the top of the hashed areas represents the 95th percentile from the distributions of responses derived from impaired ears. The solid line limiting the bottom of the hashed areas represents the 5th percentile from the distributions of responses from ears with normal hearing. The dashed line limiting the top of the shaded areas represents the 90th percentile from the impaired distributions. The dashed line limiting the bottom of the shaded areas represents the 10th percentile from the normal distributions. Normal hearing was defined as audiometric thresholds of 20 dB HL or less. The values represented in this figure are provided in an Appendix.

Clinical Tool: BT DP Report



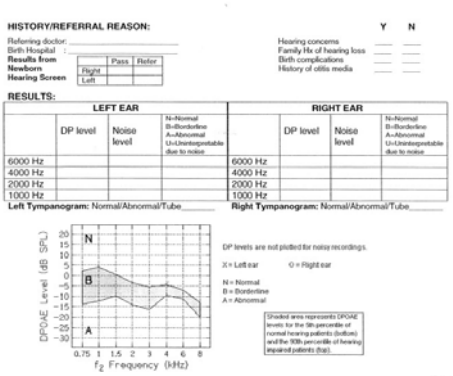
DP levels are not plotted for noisy recordings.

X = Left ear O = Right ear

N = Normal
B = Borderline
A = Abnormal

Shaded area represents DPOAE levels for the 5th percentile of normal hearing patients (bottom) and the 90th percentile of hearing impaired patients (top).

Plotting DP amplitude. SNR = 6dB



HISTORY/REFERRAL REASON:

Referring doctor: _____
Birth Hospital: _____
Results from Newborn Hearing Screen

	Pass	Refer
Right		
Left		

	Y	N
Hearing concerns		
Family Hx of hearing loss		
Birth complications		
History of otitis media		

RESULTS:

LEFT EAR				RIGHT EAR			
	DP level	Noise level	N=Normal B=Borderline A=Abnormal U=Uninterpretable due to noise		DP level	Noise level	N=Normal B=Borderline A=Abnormal U=Uninterpretable due to noise
6000 Hz				6000 Hz			
4000 Hz				4000 Hz			
2000 Hz				2000 Hz			
1000 Hz				1000 Hz			

Left Tympanogram: Normal/Abnormal/Tube_____ **Right Tympanogram:** Normal/Abnormal/Tube_____

DP levels are not plotted for noisy recordings.

X = Left ear O = Right ear

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A = Abnormal

Shaded area represents DPOAE levels for the 5th percentile of normal hearing patients (bottom) and the 90th percentile of hearing impaired patients (top).

Norms in Data Manager

Coming Soon

Same normative data will be available on the Corti

Test Interpretation

US CPT Codes

- **92558**: DP 4S/2S or TE64/TE32 Screening
- **92587**: DP1.5-6.0. TE.7-4.0
  - DPOAE, limited 3-6 frequencies with interpretation and reporting in medical record
  - TEOAE, with interpretation and reporting in medical record
- **92588**: DP1.6-8.0, DP1.5-12
  DPOAE, comprehensive, minimum 12 frequencies, with interpretation and reporting in medical record

Screening Test: 92558

- Automated pass/refer screening at fixed number of frequencies at a single intensity level
- Test interpretation is not required as all tests will end with a Pass or Refer result
- Used in NHS, nurseries, preschools for this reason

Screening Results: DM

US CPT Codes

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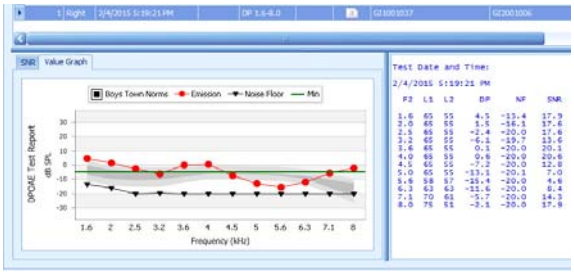
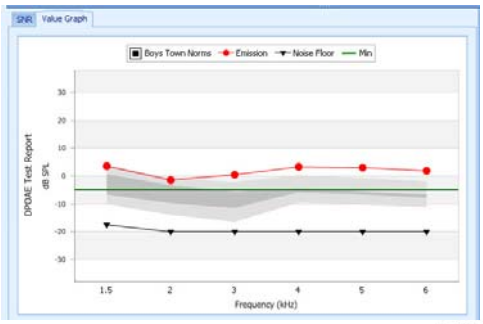
- **92587**: DP1.5-6.0. TE.7-4.0
  - DPOAE, limited 3-6 frequencies with interpretation and reporting in medical record
  - TEOAE, with interpretation and reporting in medical record
  - No Automated pass/refer by default

- **92588**: DP1.6-8.0, DP1.5-12
  DPOAE, comprehensive, minimum 12 frequencies, with interpretation and reporting in medical record
  No Automated pass/refer

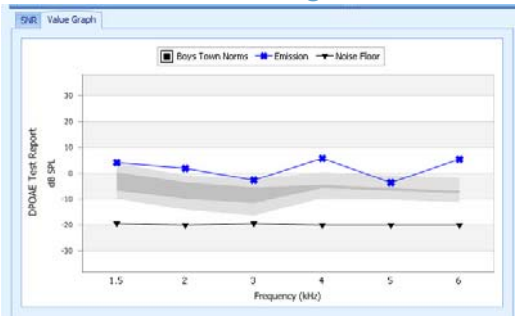
DX Results: Data Manager



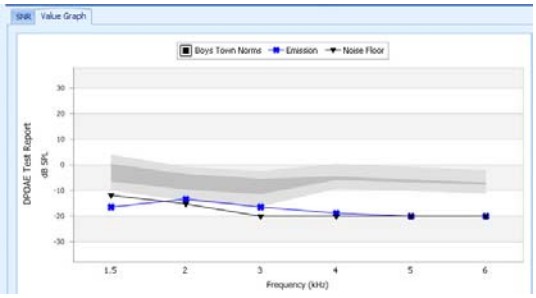
RE Data: Using Norms



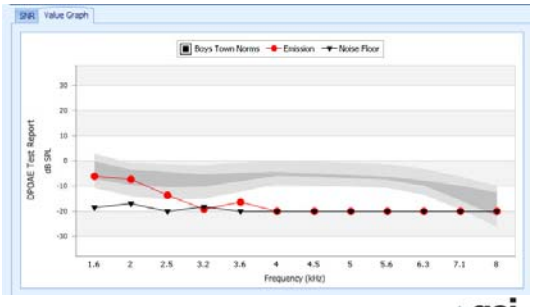
Left Ear: Using Norms



Left Ear 1.5-6.0

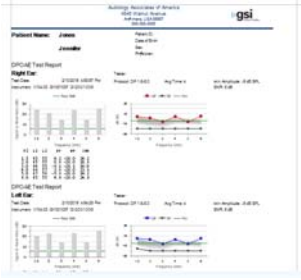


Right Ear 1.6-8.0



Reporting

Normative data will appear in reports



Accessing OAE Collection Parameters and Settings

NOTE 1: Have your device in hand
NOTE 2: Some of these are coming soon

Corti Default Settings

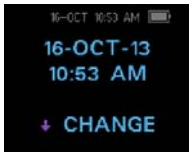
- L/R Mode
- **Min Value OFF**
- **Graph display: SNR bar graph**
- No **Normative data**
- Diagnostic protocols do not have pass/refer requirements

2 'Hidden' Sub-Menus

1. Overall System Options Menu
   (changes are global)
2. Advanced TE and DP OAE (diagnostic) Settings Menu
   (changes will affect selected protocol)

How to Get to Overall System Menu?

From the Corti main screen, press the down button until you reach the time and date screen:



From the Time and Date screen:

2. Press and **hold the down** button for 3 seconds or until the green “READY” light turns off. You should see:

New BT is the first item in General system Sub-menu

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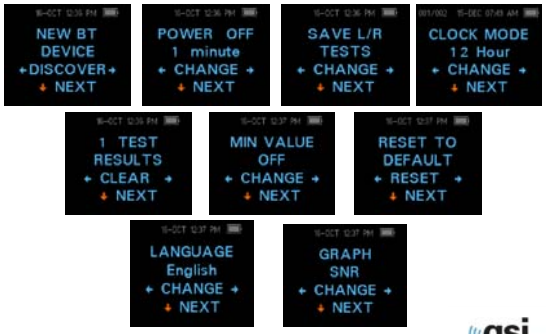
New BT is the first item in General system Sub-menu

Overall Systems Menu

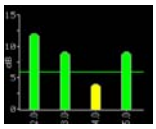


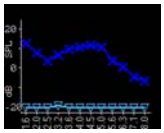
Making a Change: Screening

DPOAE: Min Amp ON enables -5dB as an additional requirement to PASS

TEOAE: Min Amp ON enables -5 OR -10dB as an additional requirement to PASS

Making a change: SNR or Value Graph?





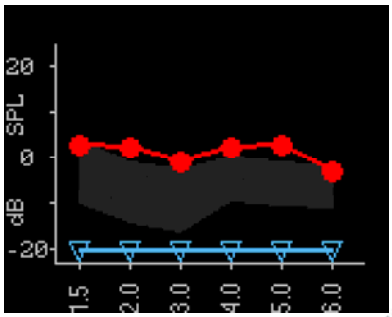
Making a Change: Value Graph with Norms

Set to ON: Boys Town Norms will appear on Corti

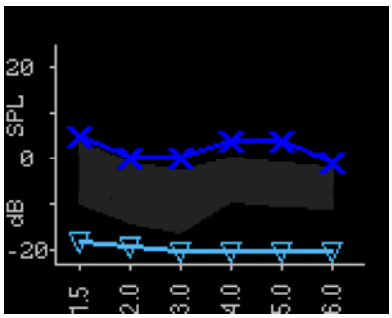
Why Norms on Corti?

- Norms will display for all diagnostic DP protocols
- Can be used as a guide when interpreting results
- Provides instant interpretation assistance before results are imported to the Data Manager

What Do Norms Look Like?

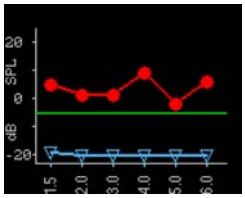


What Do Norms Look Like?



gsi

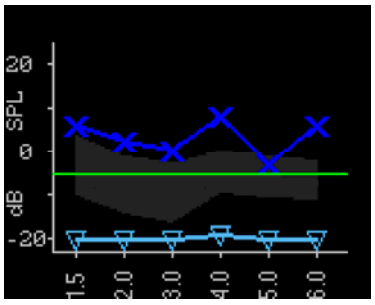
Making a Change: Min Amp



NEW

gsi

Min Amp + Norms



gsi

Advanced Options
Diagnostic

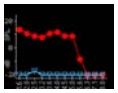
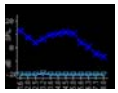
Advanced DP Menu

Diagnostic Protocols

DP 1.5 to 6.0	(6 freq)
DP 1.6 to 8.0	(12 freq)
DP 1.5 to 12.0	(12 freq)

Diagnostic protocols do not have pass/refer results. Audiologist is tasked with test interpretation.

DPOAE: Advanced Parameters

- L1/L2 Intensity
- SNR
- Averaging Time per Frequency
- # Freq to Pass

How to Get to DP Advanced Options Menu?

1. Select a diagnostic DP protocol
2. From the Corti main screen, press the down button until you reach the time and date screen:

From the Date screen:

2. Press and **hold the down** button for 3 seconds or until the green “READY” light turns off. You should see:

From the New BT Device:

Press and **hold the down** button for 3 seconds or until the green “READY” light turns off. You should see:

DP Advance Options:

Norms will not appear if L1 or L1 levels are changed.

6 Freq Protocols TE or DP

Allows user to enable Pass criteria for the specified number of frequencies

SNR/Min Amp/# of Freq

If implemented a Pass/Refer will appear at the end of the test

12 Freq Protocols DP

Allows user to enable Pass criteria for the specified number of frequencies

SNR/Min Amp/# of Freq

P will appear on report/DM per freq. Overall pass/refer will not appear

How to Save Changes?

Modified Protocol "*"

TE Advanced Options

New Feature: Printing Feature

Printing Options

- Print to small thermal printer
- Print full page results using Data Manager
- NEW: Auto Print

Auto Print

- Tool where user can by-pass data management functionality while maintaining the ability to quickly print OAE test results.
- For sites that want to print test results but use a different system for reporting test results.
- For customers who do not need a database or do not want to transfer names and data back and forth.

NEW: Auto Print

PDF, any PC based printer OR PC based label printer

Report Options: **Norms, Name, Logo**

Name can be added if in L/R mode.

How does it work?

- Set Up printer and report settings
- Minimize Auto Print software
- As soon as Corti is connected to PC, results will be accessed and printed
- Can connect via micro USB cable OR while in the Corti cradle

Print to PDF

- When in L/R mode, enter patient name
- Report will print to any location on the PC
- Report can be uploaded into EMR system or attached to audiometric report

Print to PC Based Label Printer

- Can rapidly print any number of results to high quality labels
- When in L/R mode, can add name to label

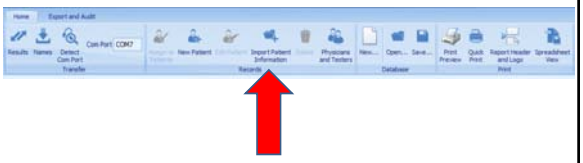
New Feature: Import Names

Import Patient Names

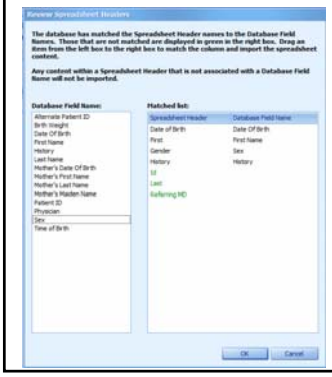
- Quick way to add names to the Data Manager
- Can import an unlimited number of patient names from a spreadsheet

How does it work?

Import patient list from excel spreadsheet



How?



- Match GSI Database field name to the spreadsheet field name.
- Click OK!
- Names will appear in the Patients Tab

Conclusion

- All new features will be available with the next release of software
- Software is in final testing

Have Questions?

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