

Cochlear Implant Assessment of Adults

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Learning Objectives

- * After this course learners will be able to identify 3 audiologic assessments that may be conducted pre-operatively.
- * After this course learners will be able to list 2 medical assessments that are conducted during the cochlear implant process.
- * After this course learners will be able to describe the suggested audiological course of follow-up after cochlear implant surgery.
- * After this course learners will be able to name 2 sentence materials in the revised Minimum Speech Test Battery.

Topics for Discussion

- * **Pre-Operative Evaluation**
 - * Case History / Audiologic Testing (10 min)
 - * Speech Perception Testing (10 min)
 - * Medical Assessment (5 min)
- * **Post-Operative Evaluation**
 - * Medical Follow-Up (5 min)
 - * Audiologic Follow-up Care (5 min)
 - * Audiologic Testing (5 min)
 - * Speech Perception Testing (10 min)
 - * Original MSTB / More sensitive Assessments of Performance: New MSTB (10 min)
- * **Case Studies (pre- and post-op scores)** (if time allows)

Pre-Op: Case History

COCHLEAR IMPLANT EVALUATION CASE HISTORY			
Name: _____		UNC MR#: _____	
DOB: _____		DOV: _____	
Address: _____			
Phone Number: _____			
Referring Audiologist / Physician: _____			
	RIGHT EAR	LEFT EAR	COMMENTS
Age at Onset of Hearing Loss			
Age at Onset of Profound Loss			
Age at First Fit Amplification			
Length of Hearing Aid Use (Dates)			
Make & Model of Hearing Aids			
Better Ear			
Date of Last Phone Use			
Etiology of Hearing Loss			
Family History of Hearing Loss			
Tinnitus	Character: _____	Character: _____	
	Intensity: _____	Intensity: _____	
	Scale: T-19	Scale: T-19	
	Other: _____	Other: _____	
Vertigo			
Noise Exposure			
Hx of OME			
Medications			
Allergies to Medications			

Page 1 of 2

COCHLEAR IMPLANT EVALUATION CASE HISTORY			
Name: _____		UNC MR#: _____	
DOB: _____		DOV: _____	
Heart Disease			
Diabetes			
Hypertension			
Ear Surgeries			
Other Surgeries			
Depression			
Alcohol			
Smoking			
Education			
Mode of Communication			
Other Health Problems / Concerns			
Insurance	Primary	Secondary	

Page 2 of 2

Audiologic Testing

Pre-Op: Audiologic Testing

Unaided

- * Tympanometry
- * Acoustic Reflexes
- * Pure tone AC & BC thresholds
- * Speech Reception Threshold (SRT)
- * Word Recognition Score (WRS)
 - * Recorded
 - * W-22 versus CNC
- * OAEs
- * ABR

Aided

- * Sound field thresholds
 - * Assess functional gain of hearing aids
- * SRT
- * Speech Perception Testing
 - * Quiet
 - * Noise
- * Individual ears
- * Bilateral/Bimodal

Speech Perception Testing

Pre-Op: Speech Perception Testing

- * Assessment of patient performance with traditional amplification using recorded speech at a normal conversational level
- * Booth Set-Up
 - * Speaker to be one meter from a reference point at the center of the listener's head at 0° azimuth
 - * 60 dB SPL presentation level (remember to calibrate using SLM)
 - * Recorded speech testing
 - * Both speech and noise signals for the noise conditions presented from the same speaker

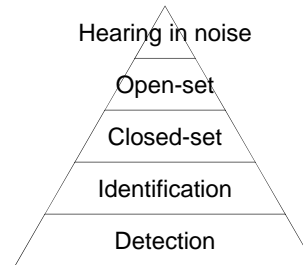
Hierarchy of Hearing: Closed-set versus Open-set

Closed-set: limited number of choices are available to the listener

- * Early Speech Perception (ESP)
- * 4-Choice

Open-set: unlimited number of choices

- * City University of New York (CUNY) sentences
- * Hearing in Noise Test (HINT) Sentences (Quiet & +10 SNR)
- * AzBio Sentences (Quiet & +10 SNR)
- * Consonant-Nucleus-Consonant (CNC) Words
- * Bamford-Kowal-Bench Sentence In Noise Test (BKB-SIN)



Closed-Set: ESP Test Sheet



Central Institute for the Deaf © 1999

ESP Pattern Perception

Closed-Set: ESP Score Sheet

ESP Pattern Perception
Score Sheet

	shoe	ball	fish	cookie	baby	apple	airplane	toothbrush	hotdog	hamburger	birthday cake	ice cream cone
shoe												
ball												
fish												
cookie												
baby												
apple												
airplane												
toothbrush												
hotdog												
hamburger												
birthday cake												
ice cream cone												

Closed-Set: 4-Choice

MED-EL Four Choice Spondee Test

Subject: _____ Tester: _____
Date: _____ Audiometer Dial Setting: _____ dB HL

Practice Items:

1. stairway	4. drugstore	10. hairbrush	16. sandman
2. football	5. churchbell	11. farewell	17. scarecrow
3. daylight	6. duckpond	12. football	18. doormat
7. streetcar	9. ashtray	13. downtown	19. meatball

Test Items:

1. birthday	7. peacock	13. oatmeal	19. dollhouse
2. blujay	8. sunset	14. padlock	20. aardvark
3. badminton	9. doorbell	15. toothbrush	21. woodwork
4. hotdog	10. bluejay	16. broomstick	22. sidewalk
5. sunset	11. playground	17. grandson	23. airplane
6. upstairs	12. schoolboy	18. toyshop	24. toothbrush
7. firewell	13. greyhound	19. greenhouse	25. whisker
8. kumquat	14. rocket	20. eyebrow	26. icecream
9. playmate	15. jackknife	21. schoolboy	22. dishpan
10. armchair	16. woodwork	23. cowboy	24. padlock
11. coughdrop	17. daylight	25. shotgun	26. bedroom

Test Interval: _____ Total Correct _____/20 Score _____%

MED-EL CORPORATION Four Choice Spondee Test Key Randomizations 1-4

Practice Items for all tests:

- 1. daylight ✓
- 2. shoelace ✓
- 3. baseball ✓

Words should be presented using the Med-El CD at 70 dB SPL. Listed below are the correct responses for each list. You may pause between words to allow enough time for a response.

Randomization 1	Randomization 2	Randomization 3	Randomization 4
1. blujay	1. stairway	1. stairway	✓ 1. dishpan
2. sunset	2. greenhouse	2. doorbell	✓ 2. whitewash
3. daylight	3. shotgun	3. hopecote	✓ 3. necktie
4. churchbell	4. coughdrop	4. playground	✓ 4. shotgun
5. drawbridge	5. daylight	5. whitewash	✓ 5. headlight
6. necktie	6. doorbell	6. ashtray	✓ 6. jackknife
7. doorbell	7. flashlight	7. blujay	✓ 7. backyard
8. greyhound	8. cupcake	8. airplane	✓ 8. ashtray
9. jackknife	9. ashtray	9. baseball	✓ 9. greenhouse
10. football	10. toothbrush	10. churchbell	✓ 10. bustop
11. daybreak	11. playmate	11. shoelace	✓ 11. woodwork
12. cupcake	12. sunshine	12. toothbrush	✓ 12. airplane
13. toothbrush	13. streetcar	13. birthday	✓ 13. daylight
14. toyshop	14. woodwork	14. cupcake	✓ 14. stairway
15. bedroom	15. mousetrap	15. outside	✓ 15. coughdrop
16. scarecrow	16. churchbell	16. pancake	✓ 16. sunshine
17. ashtray	17. icecream	17. broomstick	✓ 17. blackboard
18. playmate	18. blujay	18. football	✓ 18. bedroom
19. dollhouse	19. dollhouse	19. dishpan	✓ 19. toyshop
20. icecream	20. workshop	20. upstairs	✓ 20. playmate

Open-Set: CUNY

MED-EL
CORPORATION

CUNY Sentences List 9

Subject: _____ Tester: _____
Circle: Preop Eval III Eval IV Other: _____ Date: _____

Instructions: Sentences should be presented at 70 dB SPL-A. Circle the words the patient is able to repeat correctly.

PLEASE NOTE: YOU WILL FIND THESE SENTENCES ON THE COCHLEAR CORPORATION CUNY CD, CHANNEL 1 - TRACK 16.

PRACTICE ITEMS

1. They looked up at the blue sky. _____
2. I enjoy T.V. _____
3. Would you like to eat dinner now? _____

TEST ITEMS

1. He doesn't like his new boss. _____
2. Move the couch to the wall facing the window. _____
3. If you want to take good pictures, take a few photography classes. _____
4. I bought three pairs of shoes and a pair of boots last week. _____
5. Have you finished all your Christmas shopping yet? _____
6. Can I pay by check? _____
7. Do you go to the gym to exercise, or do you exercise at home? _____
8. Do you think he'll play the piano at the party? _____
9. Wear a heavy sweater since it's cold. _____
10. She's my daughter. _____
11. The desserts at that restaurant are very good, but very expensive. _____
12. Let the dog out. _____

TOTAL _____

- * CUNY: This test utilizes forty recorded sets of 12 sentences
- * Sentences vary in length and subject matter and are not designed specifically for word recognition
- * "Ready" indicator prior to start of each sentence

Open-Set: HINT

MED-EL
CORPORATION

Hearing in Noise Test List 15

Subject: _____ Tester: _____
Evaluation: Preop Biobased Preop Left Preop Right _____
Date: _____
Audiotape Dial Setting (dB HL): _____

Instructions: Be sure to administer the HINT practice list prior to beginning the test so that the patient may adjust the volume and familiarity to a comfortable level. Please pay special attention to the test calibration to ensure that the sentence material is presented at 70 dB SPL, 60, and that noise (if presented) should be at a level of 40 dB SPL (AL) regardless of the dial setting on the audiotape. You may pause between sentences to allow enough time for a response. Words in parentheses are correct if either word is given as a response.

Instructions to the patient:
HINT IN QUIET: "You will hear a man reading a sentence. Repeat everything you hear the man say, even if it is only part of the sentence. It is all right to guess. I will begin by giving you some practice sentences so you can become familiar with the man's voice and the listening task. Please feel free to ask questions or make comments while you are practicing the test."

Instructions to the patient:
HINT IN NOISE: "You will hear background noise. Then you will hear a man reading a sentence. Repeat everything you hear the man say, even if it is only part of the sentence. It is all right to guess. I will begin by giving you some practice sentences so you can become familiar with the man's voice and the listening task. Please feel free to ask questions or make comments while you are practicing the test."

Words/Correct

1. (A/The) house (has/had) nine bedrooms. _____
2. They're shopping for school clothes. _____
3. They're playing in (a/the) park. _____
4. Rain (is/was) good for the trees. _____
5. They sat on (a/the) wooden bench. _____
6. (A/The) child drank some fresh milk. _____
7. (A/The) baby slept all night. _____
8. (A/The) salt shaker (is/was) empty. _____
9. (A/The) policeman knows the way. _____
10. The buckets fill up quickly. _____

Total correct: 5/2
Score _____%

- * HINT: Designed as an adaptive noise test
- * Utilize in clinic with fixed noise
- * Each list consists of 10 recorded sentences with no ready indicator

Open-Set: AzBio

Patient ID: _____ Date: _____ Test Condition: _____

AzBio Sentence Test
List 1
(Left Channel = Speech, Right Channel = Noise)

Sentence	Test	Pass	Score
1	I could hear another conversation through the cordless phone.		
2	She relied on him for transportation.		
3	He was an ordinary person who did extraordinary things.		
4	How long has this been going on?		
5	His class was on Saturday.		
6	She was entitled to a bit of luxury occasionally.		
7	The reputation was cancelled on account of weather.		
8	The salon is not open on Mondays.		
9	She had a way to justify any of her wrongdoing.		
10	I feel sorry for my partner.		
11	On numerous occasions they left early.		
12	In private she let her hair down.		
13	A mother always has something better to do.		
14	You should be used to taking money from ladies.		
15	Who would be about cancer for attention?		
16	Hang the air freshener from your rearview mirror.		
17	You can use your computer to make greeting cards.		
18	I guess you know what you're doing.		
19	You must live in a gingerbread house!		
20	The cat was born with six toes.		

Words Correct _____
Words Possible 191
Percent Correct _____

Rev. 5/25/2011 Minimum Speech Test Battery Score Sheets Page 1

- * Developed at Arizona State University
- * 4 Talkers (2 male, 2 female)
- * Each list of 20 sentences contains 10 spoken by 2 female talkers, 10 spoken by 2 male talkers
- * 10 talker babble is recorded on channel 2

Open-Set: CNC Words

MED-EL CORPORATION CNC Test List 8

Subject: _____ Tester: _____
Evaluation: Prep Stimul Prep Left Prep Right Date: _____
Eval I Eval II Eval III Eval IV Eval V Audometer Del Setting dB HL: _____

Words should be presented using the MED Minimal Speech Test Battery CD at 70 dB SPL. Please mark the words that the patient repeats correctly. They may pause the CD between words to allow the patient enough time for a response.

Item	Response	Correct (S)	Item	Response	Correct (S)
1. moss			26. week		
2. rough			27. hoop		
3. stuff			28. bag		
4. into			29. gear		
5. calm			30. ring		
6. ball			31. gap		
7. poor			32. nose		
8. wheel			33. bath		
9. team			34. tip		
10. tooth			35. team		
11. page			36. vowel		
12. real			37. week		
13. date			38. road		
14. half			39. can		
15. some			40. wake		
16. sit			41. in		
17. afraid			42. park		
18. wet			43. gin		
19. bath			44. pose		
20. wall			45. ash		
21. shoe			46. lock		
22. cheap			47. guide		
23. near			48. bath		
24. him			49. head		
25. there			50. cub		

Total Words Correct _____/50 Score _____%

- * Developed to provide lists of monosyllabic words with equal phonemic distribution across lists
- * Each list should have approximately the same phonemic distribution as the English language
- * 10 lists of 50 words

Closed-Set: BKB SIN

Patient ID: _____ Date: _____ Test Condition: _____

BKB-SIN Test
List Pair 1
MSTB CD
Track 14 (Right Channel)

LIST PAIR 1

List 1A	Key Words	# Correct	SNR
1. They are looking at the clock.	4	_____	+21 dB
2. The cat meowed in surprise.	3	_____	+18 dB
3. Children like acrobatic acts.	3	_____	+15 dB
4. They are buying some bread.	3	_____	+12 dB
5. The guests dancing are noisy.	3	_____	+9 dB
6. He played with his toys.	3	_____	+6 dB
7. The baby sat in the grass.	3	_____	+3 dB
8. The boy ate a hamburger.	3	_____	0 dB
9. The water boiled quickly.	3	_____	-3 dB
10. The plane is landing in 30 seconds.	3	_____	-6 dB
Total Key Words Correct _____			
SNR-50 = (23.3) - (9 Correct) = _____ dB			

List 1B	Key Words	# Correct	SNR
1. The dog made me jump when it barked.	4	_____	+21 dB
2. They followed the path.	3	_____	+18 dB
3. Someone is climbing the wall.	3	_____	+15 dB
4. The machine started to buzz.	3	_____	+12 dB
5. The lady was by the front door.	3	_____	+9 dB
6. The lady after was angry.	3	_____	+6 dB
7. The lady asked for help.	3	_____	+3 dB
8. The policeman knows the way.	3	_____	0 dB
9. The lady did not finish.	3	_____	-3 dB
10. There are animals for children.	3	_____	-6 dB
Total Key Words Correct _____			
SNR-50 = (23.3) - (9 Correct) = _____ dB			

Average SNR-50, Lists 1A and 1B = _____ dB

Rev. 5/26/2011 Minimum Speech Test Battery Score Sheets Page 24

- * Designed to assess speech understanding in noise in CI listeners and those with HI
- * Spoken by a male in 4-talker babble
- * Prerecorded SNRs that decrease in 3 dB steps
- * Results are reported as the SNR in dB at which the subject understands 50% of the key words in the sentence



Medical Assessment

Medical Assessment

- * Medical examination and history review
 - * Previous surgeries (ear/other areas of body)
 - * Other medical conditions that prohibit surgery
- * Imaging (CT scan and/or MRI)
 - * Diagnose potential disease in the temporal bone
 - * Evaluate tissues
- * Minimum medical work-up:
 - * EKG, chest x-ray, blood work (CBC, PTT, chem 7, FTA-ABS)
- * Pre-op assessment by anesthesiologist
- * Chronic health conditions (diabetes, heart disease, stroke, hypertension and emphysema) rarely prohibit implantation, but must be considered

Medical Follow-Up

Surgery

- * 1.5-3 hours
- * General anesthesia
- * Same day / outpatient procedure
- * External bandage worn home

Post-op

- * Occurs 5-7 days post surgery
- * Bandage removed
- * Residual swelling
- * Abnormal middle ear status



<http://cochlearimplanthehelp.com/journey/surgery/>

Audiologic Follow-Up

Audiologic Follow-Up

- * Return 3-4 weeks later for initial activation and mapping
 - * Ensure patient is healing well; swelling reduced
- * Approximately 6 visits are required in the first year (2 hrs. in duration) for f/u testing & programming
 - * Initial Activation
 - * (2-weeks)
 - * 1-month
 - * 3-months
 - * 6-months
 - * (9-months)
 - * 1-year
- * Annual follow-up for maintenance of external equipment

Post-Op: Audiologic Testing

With Cochlear Implant

- * Sound field thresholds
 - * 250, 500, 1000, 2000, 3000, 4000 & 6000 Hz
 - * FM tone
- * SRT
- * Speech Perception Testing
- * Remember contralateral masking, if needed

Unaided

- Post-op hearing thresholds are often measured to assess whether the electrode insertion was atraumatic and inner ear structures were preserved
- * AC & BC Thresholds (typically tested at 1-month mark)

Post-Op: Speech Perception Testing

- * Assessment of patient performance with cochlear implant using recorded speech at a normal conversational level
- * Booth Set-Up
 - * Speaker to be one meter from a reference point at the center of the listener's head at 0° azimuth
 - * 60 dB SPL presentation level (remember to calibrate using SLM)
 - * Recorded speech testing
 - * Both speech and noise signals for the noise conditions presented from the same speaker

Post-Op: Speech Perception Testing

- * ESP, 4-Choice, CUNY
- * HINT in Quiet
- * HINT in Noise (+10 SNR, +5 SNR)
- * AzBio
- * AzBio in Noise (+10 SNR, +5 SNR, +0 SNR)
- * CNC Words
- * BKB-SIN

***Administration of tests is dependent on the speech understanding abilities of the listener

Testing Protocol for a “Typical” Patient

	Unaided Thresholds	HINT	HINT +10	CNC Words	AzBio	AzBio +10	AzBio +5	AzBio +0	BKB-SIN
1-month	X	X	X	X	X	X			
3-months	(X)			X	X	X	X	(X)	X
6-months	(X)			X	X	X	X	(X)	X
1-year	X			X	X	X	X	(X)	X

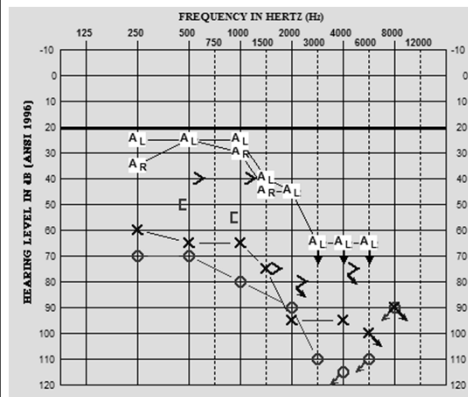
Original Minimal Speech Test Battery (MSTB)

- * **Original** Minimum Speech Test Battery (MSTB) for Adult Cochlear Implant Users
- * 1996 – Committee recommended set of materials to be used clinically and in research studies to assess the performance of adults with cochlear implants
 - * **Consonant-Nucleus-Consonant (CNC) test** (Peterson & Lehiste, 1962) to assess open-set word recognition
 - * **Hearing in Noise Test (HINT)** (Nilsson, Soli, & Sullivan, 1994) to assess open-set sentence recognition in quiet and in speech-spectrum noise

More Sensitive Assessments of Performance: New Minimal Speech Test Battery (MSTB)

- * MSTB for Adult Cochlear Implant Users 2011
 - * AzBio sentences presented in Quiet
 - * AzBio sentences presented in Noise
 - * CNC words
 - * BKB-SIN (pre- and post-operatively)
- * Recommended presentation level of 60 dBA
- * Recommended SNR of +10 or +5 for AzBio sentences in noise

Candidate 1

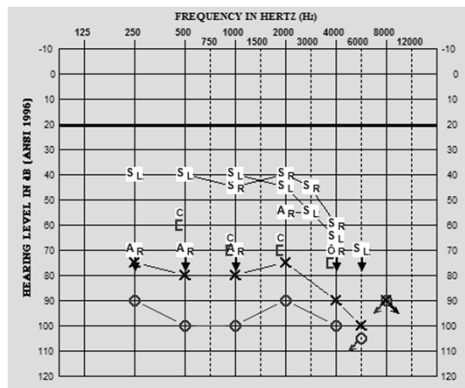


- * 81 year old male
- * Medicare age
- * Consistent HA user in both ears (20+ years)
- * Progressive HL, hx of noise exposure
- * **R PTA:** 80 dB HL
- * **L PTA:** 75 dB HL
- * **R:** Severe to profound SNHL
- * **L:** Moderately-severe to profound SNHL
- * **R WRS:** 20% @ 110 dB HL
- * **L WRS:** 36% @ 105 dB HL

Candidate 1

Interval	Condition	HINT Q	HINT +10	CNC	AzBio Q	AzBio +10
PreOp	HA R	25%	12%	16%	35%	0%
PreOp	HA L	38%	5%	4%	39%	0%
1 Month	CI R	96%	81%	52%	85%	27%
3 Months	CI R	95%	99%	54%	83%	58%
6 Months	CI R	98%	94%	58%	89%	50%

Candidate 2



- * 70 year old female
- * Medicare age
- * Consistent HA user in both ears (46 years)
- * Progressive loss with family hx of hearing loss, hx of middle ear surgeries
- * **R PTA:** 95 dB HL
- * **L PTA:** 80 dB HL
- * **R:** Profound SNHL
- * **L:** Severe to profound SNHL
- * **R WRS:** 12% @ 110 dB HL
- * **L WRS:** 36% @ 105 dB HL

Candidate 2

Interval	Condition	HINT Q	HINT +10	CNC	AzBio Q	AzBio +10
PreOp	HA R	DNT	DNT	22%	30%	9%
PreOp	HA L	DNT	DNT	24%	36%	16%
1 Month	CI R	97%	81%	74%	68%	36%
3 Months	CI R	98%	93%	72%	91%	49%
6 Months	CI R	96%	88%	76%	89%	49%

Questions?

