BONE CONDUCTION: CHOOSING, FITTING AND VERIFYING THE PATHWAY

A practical guide to devices, coupling and real-world value

Bill Hodgetts, PhD • Canadian Academy of Audiology • 2026

A technically good fitting can still fail.

And a less-than-perfect fitting can become deeply valuable.

The outcome is not inside the device.

It emerges from the relationship between signal, care and life.

Three interacting systems

01

Signal

Prescription
Coupling
Audibility
Dynamic range

02

Care

Judgement
Explanation
Validation
Follow-up

03

Life

Listening demands
Effort
Identity
Participation

OPENING

A 50-minute route through the decisions

4 MIN

Why outcomes vary

18 MIN

Choose the pathway

18 MIN

Prescribe + verify

6 MIN

Cases + synthesis

Target landing: minute 45 • Built-in flexibility: ~5 minutes

01

Choosing the pathway

What problem are we solving—and which coupling can solve it?

The decision begins before the device

GOAL

Bypass an air–bone gap?

GOAL

Reroute from a deaf side?

CONSTRAINT

How much cochlear reserve?

CONSTRAINT

What coupling is acceptable?

“Bone-conduction candidate” is not a sufficiently specific diagnosis.

A useful device taxonomy

DIRECT DRIVE

Vibration reaches bone directly

Percutaneous abutment

Active transcutaneous implant

Less attenuation from skin and soft tissue

SKIN DRIVE

Vibration crosses intact skin

Softband / headband / SoundArc/Instant Hearband

Adhesive coupling

Passive transcutaneous magnet

Transmission depends on coupling and tissue

DEVICE + CANDIDACY

EXAMPLES—NOT AN EQUIVALENCE TABLE

The current Canadian landscape

Non-implanted

Softband / HearBand
SoundArc
ADHEAR

Percutaneous

Ponto 5 Mini / SuperPower
Baha 7

Active transcutaneous

Osia system
Sentio system
BONEBRIDGE

Passive transcutaneous

Baha Attract and other legacy magnet systems

Important for existing users; less central to new selection

The fitting range is a boundary—not a promise.

It says the manufacturer permits the fitting. It does not say the target can be met across frequency, input level and coupling.

Published fitting ranges overlap

Ponto 5 Mini	Ponto 5 SuperPower	Baha 7	Osia	Sentio 1 Mini	BONEBRIDGE
Up to 45 dB HL BC	Up to 65 dB HL BC	Up to 55 dB HL BC	Up to 55 dB HL BC	Up to 45 dB HL BC	Typically shown to 45 dB HL BC

These labels use different devices, transducers, coupling pathways and evidence bases.

BC PTA is not enough

1

Shape

High-frequency thresholds may determine speech access before the PTA reaches the limit.

2

Headroom

MFO/MPO and compression determine the usable window above threshold.

3

Coupling

Skin, magnet force, placement and feedback change realized output.

4

Goal

Rerouting for SSD is not the same as aiding a mixed loss.

Decision 1: bypass or reroute?

CHL / MHL

Bypass the conductive component

Potential benefit grows with the air–bone gap.

Cochlear thresholds determine how much output is needed.

Bilateral access may matter when both cochleae are aidable.

SSD

Reroute to the better cochlea

Reduces the head-shadow problem in favourable geometries.

Does not restore binaural hearing.

Benefit depends strongly on where speech and noise are located.

For conductive or mixed loss, ask two audiometric questions

A

How large is the air–bone gap?

This determines the penalty an air-conduction device must overcome—and therefore the potential advantage of bypassing it.

B

How good is cochlear reserve?

This determines the force output and dynamic range required from the BCD.

C

Is the loss stable?

A device chosen at the edge of its range leaves little room for progression.

For SSD, the listening geometry is the indication

BEST CASE

Speech on deaf side

VARIABLE

Speech in front

CAN WORSEN

Noise on deaf side

Aided testing should move speech and noise—not merely compare aided and unaided in one arrangement.

Decision 2: trial, bridge or long-term non-surgical solution?

Softband / headband

Broad trial access
Paediatric bridge
Pressure and stability trade-offs

SoundArc / rigid coupling

Alternative retention
Useful for demonstration
Position and pressure still matter

Adhesive

Pressure-free retention
Conductive loss or SSD
Output limited by skin-drive pathway

Decision 3: skin drive or direct drive?

SKIN DRIVE

Intact skin carries the vibration

No percutaneous site
Simpler or no surgery
Attenuation and variability
Retention pressure / magnet comfort
More feedback risk

DIRECT DRIVE

The transducer couples to bone

More efficient transmission
More predictable high-frequency access
Percutaneous skin-site care or implanted transducer surgery
Device-specific MRI and anatomy constraints

Percutaneous: maximum access, visible interface

Why choose it

Efficient transmission
High output options
Straightforward processor exchange
Direct verification reference

What can limit it

Skin-site care
Trauma / irritation risk
Cosmetic preference
Feedback and processor power still matter

Clinical question

Does the additional output and predictability justify the lifelong interface for this person?

Passive transcutaneous: the magnet retains—and the skin transmits

Advantage

Intact skin
Simple external processor pathway
Familiar established option for existing users

Acoustic cost

Skin attenuation
Reduced high-frequency output
Pressure needed for retention
Variability with tissue thickness

Today

Often a legacy comparison rather than the default new implant choice where active systems are available.

Active transcutaneous: intact skin, implanted transducer

Osia

Piezoelectric implanted transducer
Nominal fitting range to 55 dB HL BC
High-frequency output is a major design claim

Sentio

Electromagnetic active implant
Nominal fitting range to 45 dB HL BC
New clinical pathway with limited independent comparative evidence

BONEBRIDGE

Electromagnetic floating-mass transducer
Nominal candidacy region around 45 dB HL BC
Anatomy and implant placement matter

DEVICE + CANDIDACY

THE REAL TRADE-OFF

Percutaneous or active transcutaneous?

	PERCUTANEOUS	ACTIVE TRANSCUTANEOUS
Transmission	Direct and externally accessible	Direct through implanted transducer
Output options	Broadest range; SuperPower available	Device-specific ceiling and frequency response
Skin	Abutment requires ongoing care	Intact after healing
Surgery / anatomy	Implant + abutment pathway	Larger implant; anatomy and placement constraints
Verification	Established skull-simulator pathway	Requires device/pathway-specific approach
Future change	Processor exchange is straightforward	Implanted transducer remains part of upgrade path

DEVICE + CANDIDACY

DECISION CASE

Case 1: bilateral congenital atresia

AUDIOLOGY

BC thresholds 0–15 dB HL

Large bilateral air–bone gaps
Early access matters
Bilateral listening goal
Cochlear reserve is excellent

DECISION

Start with access, preserve options

Reliable non-surgical coupling now
Verify each side
Monitor use and developmental function
Revisit implant pathway with age, anatomy and family preference

DEVICE + CANDIDACY

DECISION CASE

Case 2: mixed loss at the edge of the range

AUDIOLOGY

BC PTA ≈ 42 dB HL

High frequencies poorer than the PTA
Large air–bone gap
History suggests progression
Patient strongly prefers intact skin

DECISION

Eligibility is not adequacy

Compare active transcutaneous with percutaneous SuperPower
Examine frequency-specific target match and MFO
Discuss reserve for progression
Let verified output inform the preference conversation

DEVICE + CANDIDACY

DECISION CASE

Case 3: single-sided deafness

GOAL

Hear people on the deaf side

Better-ear thresholds normal
Main difficulty: meetings, passenger seat, walking beside a partner
No expectation of restored localization

DECISION

Test the geometry

Compare CROS and BCD when feasible
Move speech and noise
Ask about sound quality, effort and willingness to use
Treat non-use as information—not non-compliance

DEVICE + CANDIDACY

DECISION CASE

Case 4: the passive transcutaneous user who is “doing fine”

OBSERVATION

Aided thresholds look reasonable

Uses the device consistently
Reports fatigue in group conversation
High-frequency speech remains inconsistent
Magnet strength is already at comfort limit

QUESTION

Is the pathway now the bottleneck?

Verify speech-level output
Inspect headroom and high-frequency access
Compare against an active or percutaneous route
Do not wait for total rejection before reconsidering the system

Device selection is the first fitting decision.

Coupling determines attenuation, output, headroom, verification strategy and the kind of compromise the person is being asked to accept.

The knowledge-to-action gap is still the gap

WE KNOW	WE CAN	WE OFTEN
Output varies	Measure it	Accept first fit

The existence of a verification method does not create a verified fitting.

The processor is a black box only if we choose not to look.

Prescription makes the intended output explicit. Verification tests the result.

Aided thresholds answer a detection question

THEY CAN TELL US

Can the listener detect it?

Useful for audibility at threshold

Familiar and intuitive

Sensitive to test conditions

THEY CANNOT FULLY TELL US

What happens to speech?

Soft, average and loud speech

Compression and MPO

Usable dynamic range

Frequency-specific output

Speech arrives at more than one level

75 dB SPL

Loud

65 dB SPL

Average

55 dB SPL

Soft

A fitting needs to preserve audibility without collapsing comfort or headroom.

A prescription is a translation

INPUT	MODEL	OUTPUT
Hearing thresholds	**Speech + coupling**	**Targets in force level**

Not “turn it up.” A frequency- and level-specific hypothesis about useful access.

DSL-BCD: the target is the start of a conversation

VERSION 1.1

A common reference

Speech-based targets

Input-level specific

Accounts for device output limits

Supports verification

VERSION 2.0

Refine the translation

Updated evidence and implementation

Better alignment across coupling pathways

Still requires clinical judgement

PRESCRIPTION + VERIFICATION

PRESCRIPTION UPDATE

DSL-BCD 2.0: one framework across pathways

What stays

Speech-based targets
Soft, average and loud inputs
Maximum force output
Audibility and dynamic-range logic

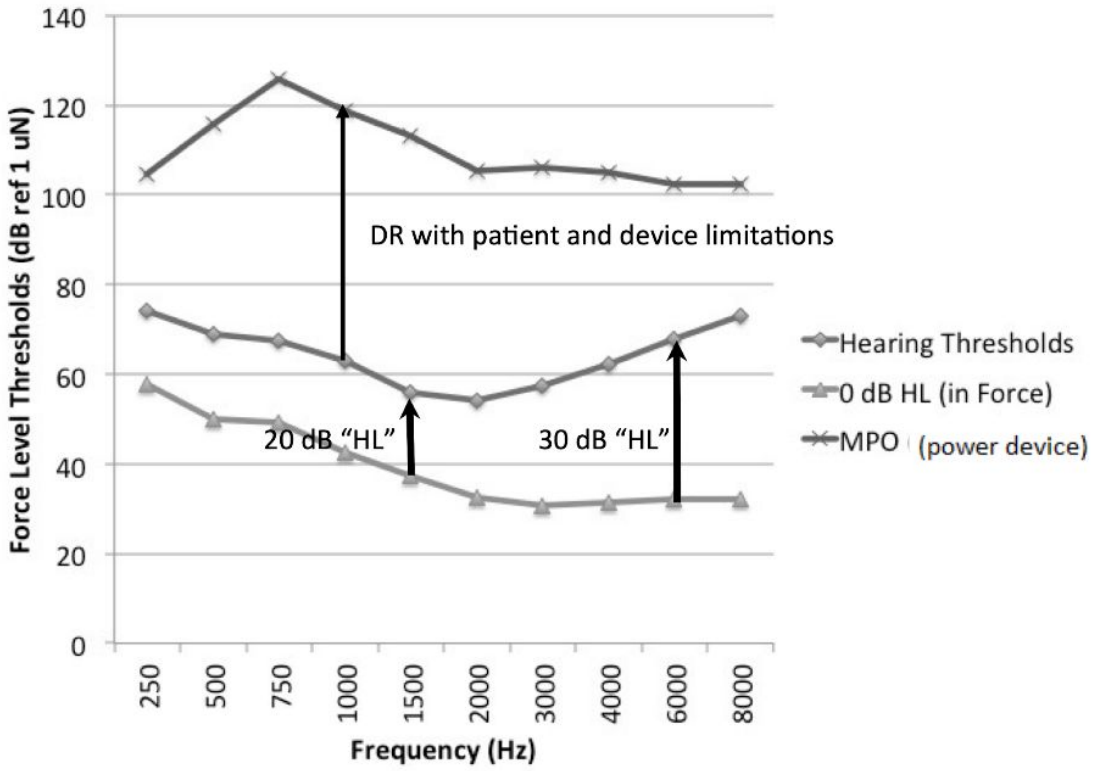
What expands

Percutaneous and transcutaneous pathways
Coupling-specific transforms
A shared clinical language across devices

What it does not do

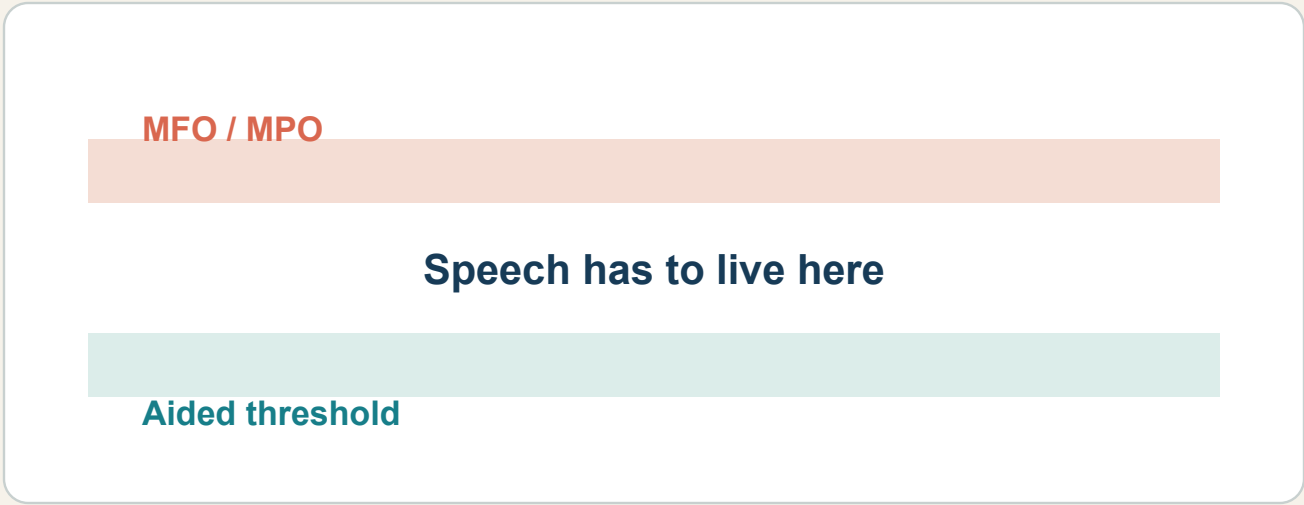
Guarantee that a processor can meet target
Replace verification
Choose the acceptable trade-off for the person

FLogram



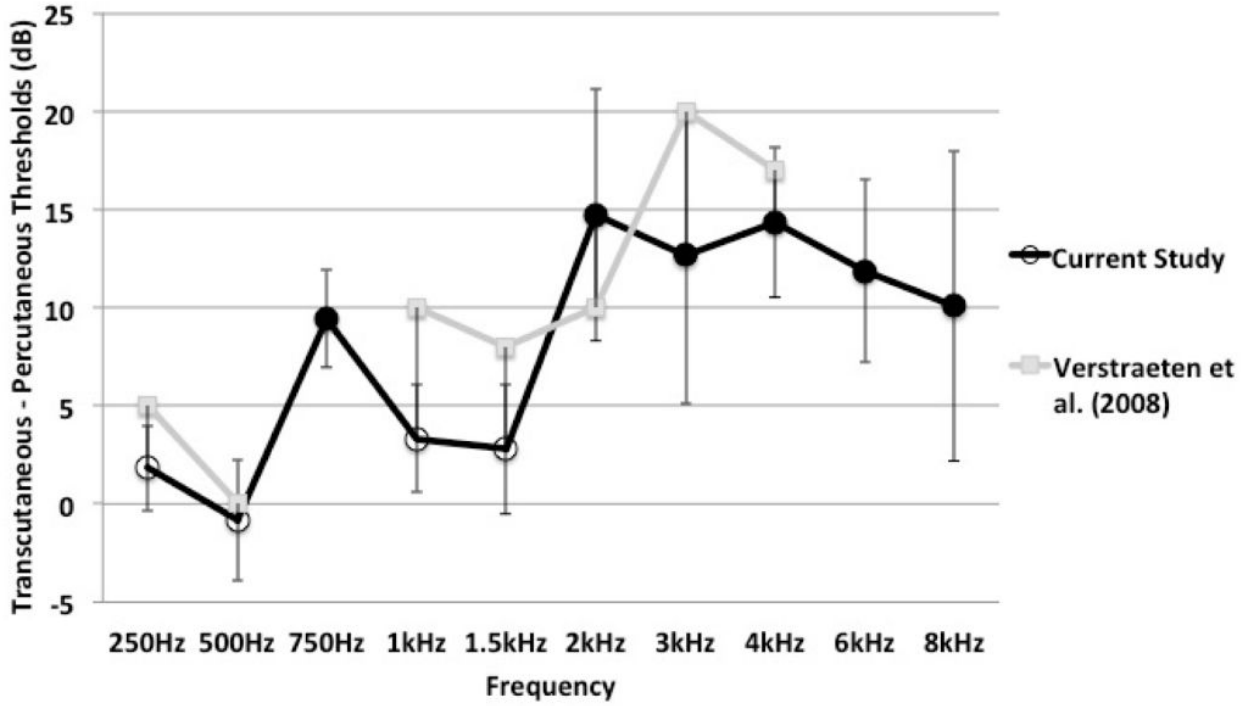
Existing visual: the FLogram makes audibility and headroom visible on one scale.

The useful window is bounded at both ends



Too little gain reduces access. Too little headroom reduces usable contrast.

Skin Drive vs Direct Drive



Existing visual: coupling pathway changes the delivered signal.

Skin attenuation is not a constant

Frequency

Transmission changes across the spectrum.

Coupling

Pressure, placement and interface matter.

Person

Anatomy and tissue properties add variability.

A generic correction can be useful. An in-situ measure is more honest about the individual pathway.

Pay more attention to MPO

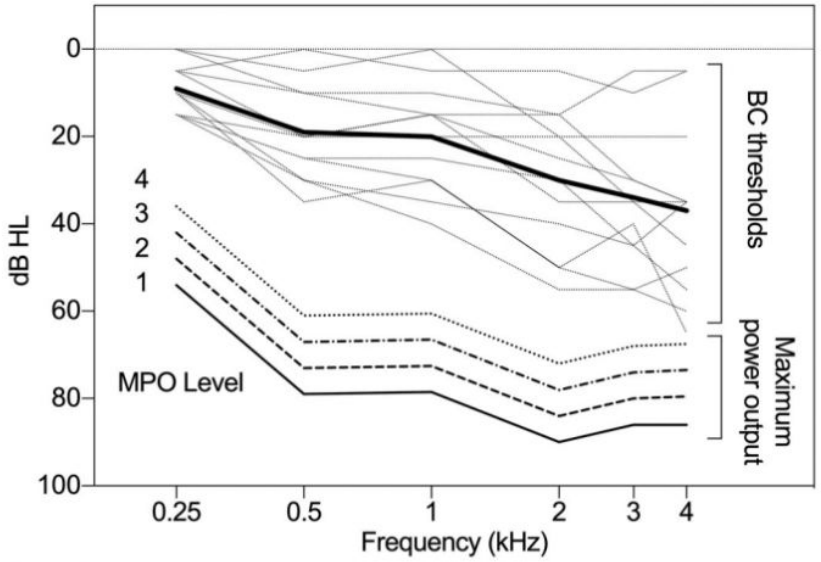


Figure 2. Upper part: BC hearing thresholds (better ears only) of the participants. The average BC threshold is shown as a solid line. Lower part: the 4 MPO levels used in the tests (in dB HL).

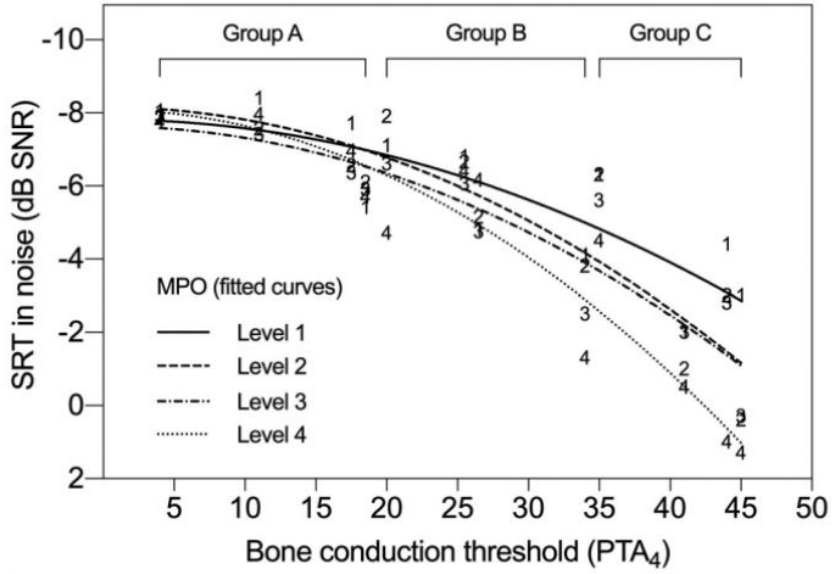


Figure 4. Aided speech reception thresholds (SRT) in noise as a function of the mean BC-threshold over the frequency range 500–400 Hz (PTA_4). Individual measurements are shown with numerals 1 through 4, corresponding to the MPO levels used.

Gawliczek et al., 2020

Existing visual: maximum force output is part of the fitting—not a product footnote.

Verification needs more than one route

A

Skull simulator

Stable and efficient

Excellent for coupler-based output

Requires a pathway correction

B

Surface microphone

Measures near the individual coupling

Useful for skin-drive verification

C

In-situ + validation

Tests the pathway and the lived result

Needed when constraints remain

PRESCRIPTION + VERIFICATION

EMERGING APPROACH

Surface-microphone verification

1

Measure vibration near the coupling

2

Apply a validated transform

3

Estimate delivered force output

4

Compare with speech targets

The idea is public. The implementation is still emerging.

Keep the discussion principle-based: measurement location, transform validity, input levels and uncertainty.

SIGNAL ACCESS

NEW EVIDENCE

What happens in routine fittings?

37%

RMSE ≤ 5 dB

N = 79 percutaneous fittings

More than half were within ±5 dB at most frequencies.

Fit was less consistent at 750, 6000 and 8000 Hz.

Poorer in-situ thresholds predicted lower aided SII and larger deviations.

Fine-tuning changed the answer

DAILY SETTINGS

37%

Overall RMSE within 5 dB

Reflects routine clinical settings, preference and feedback constraints

FINE-TUNED ON SIMULATOR

79%

Overall RMSE within 5 dB in the measured subset

Shows that closer matching was technically possible

Verification answers: did we deliver what we intended?

It does not answer: was that intention useful in this person’s life?

04

A usable outcome model

How do we connect the fitting to the life?

Four questions define the outcome

1

Can they access speech?

Audibility, bandwidth, headroom

2

What does it cost?

Effort, fatigue, attention

3

Do they use it?

Consistency, handling, repair

4

Does it fit their life?

Identity, roles, participation

Benefit can be lost at any transition

LAYER 1

Signal access

LAYER 2

Communicative tracking

LAYER 3

Social inference

LAYER 4

Identity + participation

Necessary does not mean sufficient.

A four-step clinical loop

1

Verify

What did the device deliver?

2

Validate

What changed in performance and cost?

3

Understand

What does the solution mean to this person?

4

Revisit

What changed after real use?

At the first follow-up, diagnose the layer

IF THEY SAY

“It is not helping.”

Check output and coupling
Check scene-specific access
Check effort and fatigue
Check handling and use
Check personal fit

AVOID

One explanation too early

Not automatically under-amplified

Not automatically unmotivated

Not automatically unrealistic

Find the layer before choosing the fix

One change for Monday morning

Add one question after verification:

“Where will this fitting still ask too much of you?”

The answer points toward validation, counselling, technology—or a different goal.

Good outcomes require alignment.

The signal must be available. The listening cost must be sustainable. The solution must make sense in the person’s life.

VERIFY THE SIGNAL.
VALIDATE THE EXPERIENCE.
UNDERSTAND THE PERSON.

Thank you