

Increasing High-Pass Filter (HPF) Cut-Off Frequency in Threshold Auditory Brainstem Response (ABR)

A Service Evaluation of High-Pass Filter Use in Threshold ABR Recordings

Author – Thomas Andrea, Lynn Megarbane, Joseph Schneck | Amjad Mahmood— Clinical Lead

Audiology & Cochlear Implant Service, Great Ormond Street Hospital for Children · July 2026

01 Background

The standard high-pass filter (HPF) setting used for Newborn Hearing Screening Programme (NHSP) Threshold ABR testing on the Interacoustics Eclipse system is 33 Hz, consistent with British Society of Audiology recommendations of approximately 30 Hz [Ref 1].

In environments with significant electrical interference, particularly operating theatres, mains baseline drift can make ABR interpretation more difficult. Increasing the HPF to 100 Hz may reduce interference but can reduce ABR response amplitude by up to 30% [Ref 2].

A 50 Hz display HPF can also be applied to reduce mains baseline drift. Because this filtering is applied after recording, it does not introduce phase shifts [Ref 3] and is most relevant to recordings acquired using a 33 Hz input HPF.

02 Aim

To review HPF use during Threshold ABR testing over a one-year period, to examine how often a 50 Hz display HPF was used, and to assess the effect of retrospectively applying the filter to recordings where interpretation was uncertain.

03 Key Filter Settings

33 Hz

BSA-recommended standard input HPF

50 Hz

Display filter, applied during or after acquisition

100 Hz

Reduces interference; can cut amplitude by up to 30%

A 50 Hz display HPF sits between these two settings — reducing mains baseline drift without the amplitude penalty of a 100 Hz input filter.

04 Why This Matters

Optimising HPF cut off frequency choice has two main aims: reducing the effects of mains interference on the ABR traces recorded, and to keep enough of the original ABR trace to interpret it with confidence. A display-only filter offers a low-risk way to try before committing to a higher irreversible input HPF.

05 Clinical Context

Threshold ABR underpins diagnostic follow-up within the Newborn Hearing Screening Programme and is also used for paediatric audiology and cochlear implant assessment at Great Ormond Street Hospital. Reliable and appropriately filtered recordings are important in assessing the hearing of child to enable appropriate hearing management.

01 Method

Threshold ABR sessions and PDF reports from 2025 were reviewed. The input HPF setting (33 Hz or 100 Hz) and any use of the 50 Hz display HPF were recorded for every session.

Recordings obtained using a 33 Hz input HPF were reviewed to identify cases where interpretation appeared uncertain and no display HPF had originally been applied. A retrospective 50 Hz display HPF was then applied. Filtered and unfiltered traces were then compared using a graphical noise-estimation tool [Ref 4]. (Recordings using a 100 Hz input HPF were excluded given that a 50Hz display HPF would have no effect).

02 Results: Filter Use

A summary of HPF use across all sessions is shown below in Figure 1. . Twenty-four ABR trace sets were identified as suitable for retrospective application of a 50 Hz display HPF.

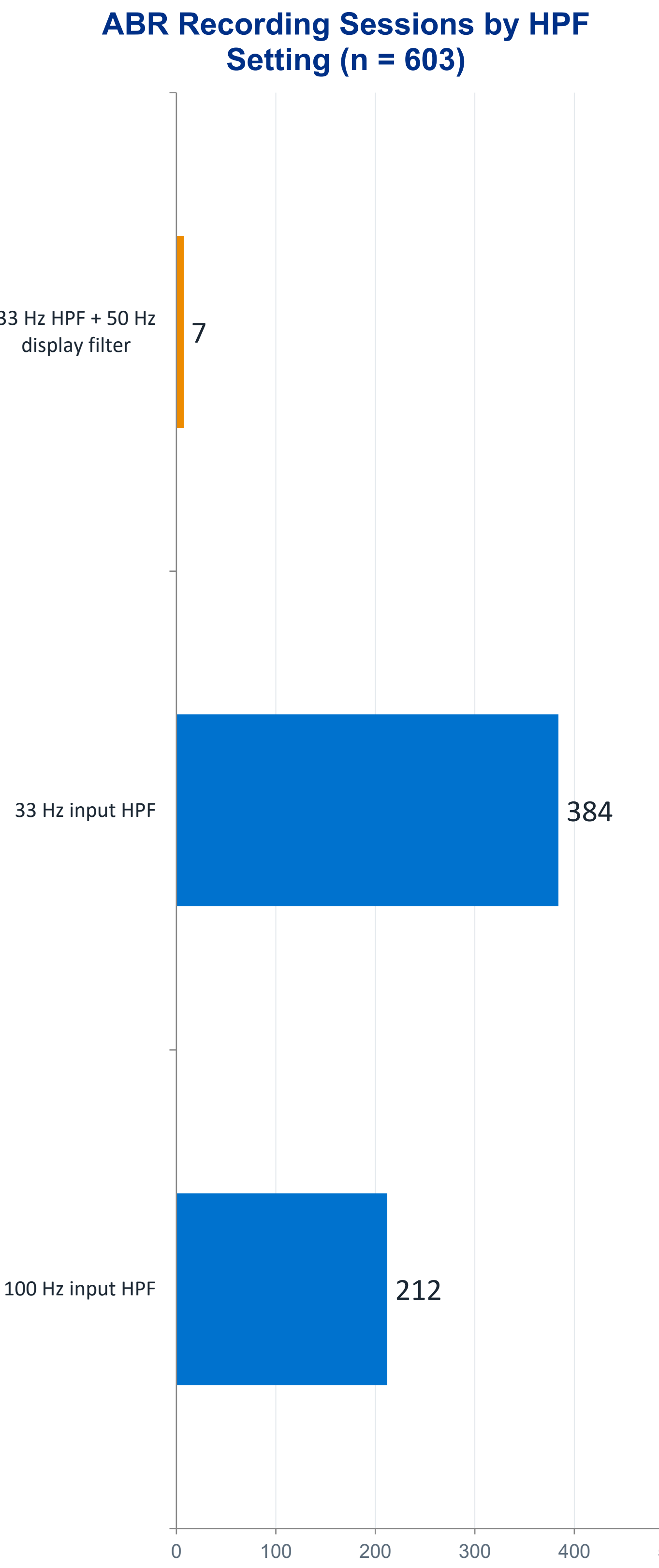


Figure 1. Totals of ABR test sessions with filter settings, 2025 (total recording sessions reviewed: 603).

03 Reading the Categories

INC = Inconclusive response
RA = Refer for Audiological follow-up
CR = Clear Response, meeting the 3:1 noise criterion

These are the interpretation categories used in Figure 2 (next column), before and after the 50 Hz display HPF was applied retrospectively.

01 Results: Interpretation

Interpretation changed in 9 of the 24 trace sets following retrospective filtering. These cases were intentionally selected because interpretation was considered uncertain before filtering.

24

Trace sets reviewed retrospectively

9 / 24

Changed interpretation after filtering

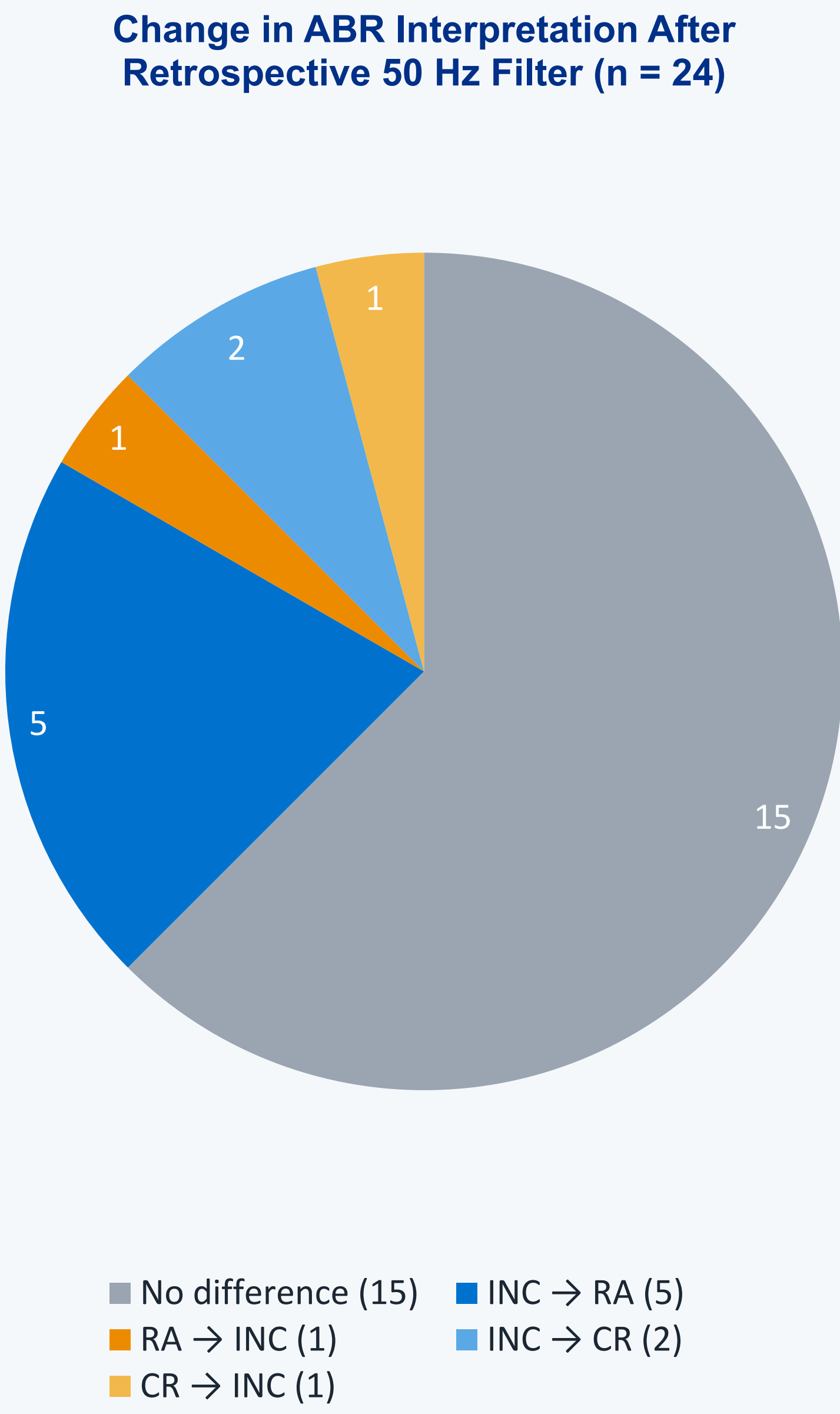


Figure 2. ABR interpretation change after retrospective 50 Hz display HPF (INC = Inconclusive, RA = Response Absent, CR = Clear Response).

02 Case Example

A trace initially marked ‘Clear Response’ at a 33 Hz input HPF did not meet the 3:1 signal-to-noise criterion. After a 50 Hz display HPF was applied retrospectively, the same trace met the criterion.

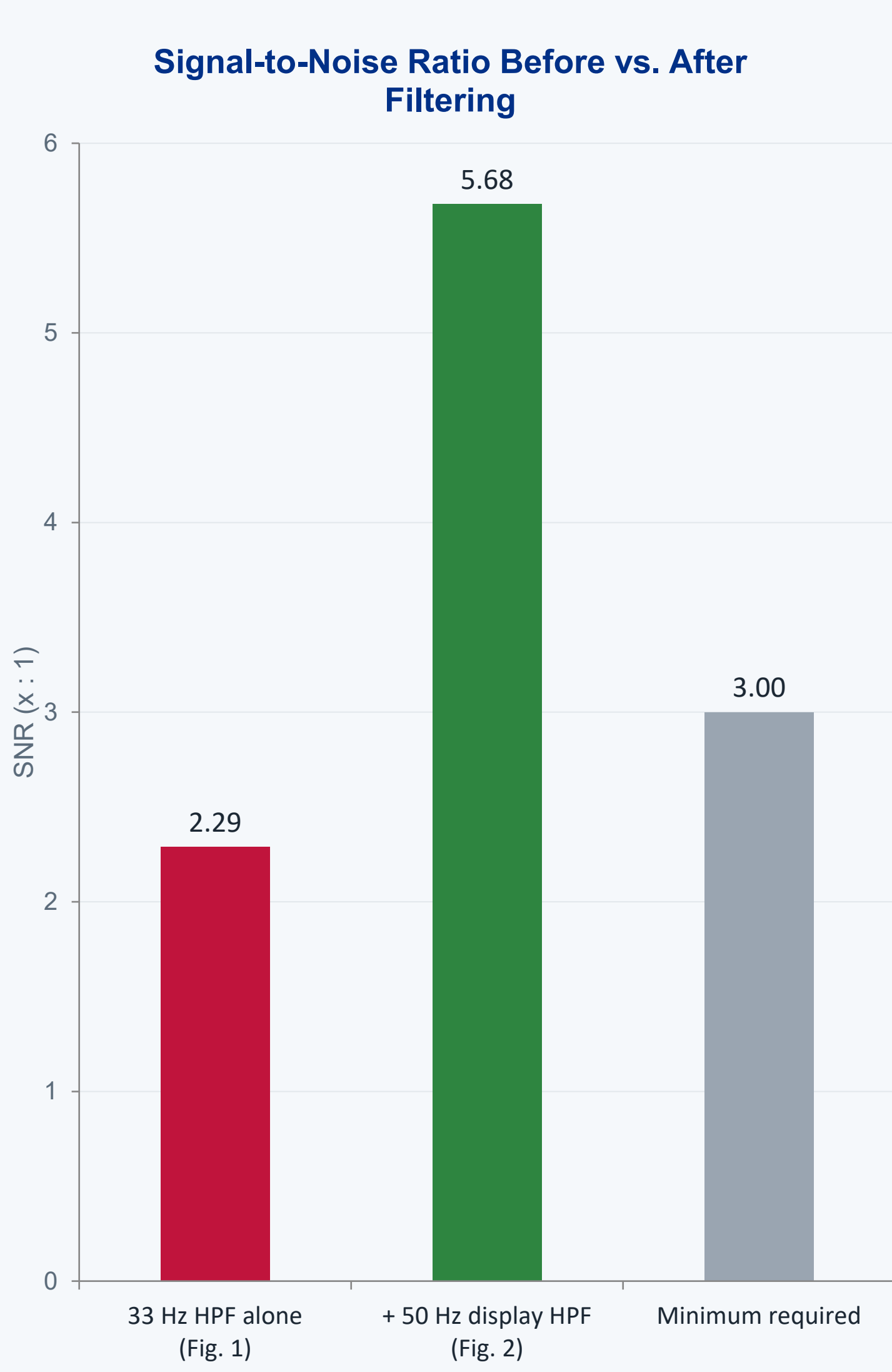


Figure 3. SNR values from the noise-estimation tool [Ref 4]: 86.50 nV average signal vs. 37.71 nV noise before filtering resulted in a ratio of 2.29:1.

After applying the 50Hz digital display HPF, this changed the ratio as follows, average signal 81.00 nV vs. 14.27 nV noise resulting in a ratio of 5.68:1. (A ratio of at least 3:1 is required for a Clear Response)..

01 Discussion

Both 33 Hz and 100 Hz input HPF settings were used in routine practice. The relatively frequent use of a 100 Hz cut-off frequency likely reflects testing undertaken in operating theatre environments, where electrical interference is more common. Current practice is to test using a 33 Hz HPF and increase the cut-off frequency only when necessary.

Although interpretation changed in 9 of the 24 recordings reviewed, these cases were intentionally selected because interpretation was considered uncertain. The findings do not indicate how frequently filtering would alter interpretation across all Threshold ABR recordings but suggest that retrospective application of a 50 Hz display HPF may be valuable in selected cases. As the filter can be applied after data acquisition, it may provide a useful intermediate step before increasing the input HPF to 100 Hz, particularly where low-frequency noise affects trace quality.

02 Service Implications

The findings support consideration of a 50 Hz display HPF when mains baseline drift affects trace quality and interpretation is uncertain. In some cases, display filtering may improve trace quality sufficiently to avoid using a 100 Hz input HPF, provided there is not excessive electrical interference.

03 Conclusion

This service evaluation examined HPF use in Threshold ABR recordings over a one-year period and assessed the impact of retrospectively applying a 50 Hz display HPF to recordings with uncertain interpretations. Interpretation changed in 9 of the 24 recordings reviewed following retrospective filtering. While limited to a small group of recordings with uncertain interpretations, the findings suggest a 50 Hz display HPF may be a useful aid in selected cases affected by mains baseline drift, and support considering this approach before increasing the input HPF to 100 Hz.

A 50 Hz display HPF can help resolve uncertain Threshold ABR interpretation when there is mains baseline drift and could be used before resorting to a 100 Hz HPF.

04 References

- Recommended Procedure – Auditory Brainstem Response (ABR) Testing in Newborns. BSA, 2026, p.19.
- Recommended Procedure – Auditory Brainstem Response (ABR) Testing for Post-Newborn and Adult. BSA, 2019, p.13.
- Analogue and Digital Filtering of Auditory Brainstem Responses. Scandinavian Audiology, Vol 10, No 2.
- ABR noise-estimation tool: <https://mask.audiolo.gy/noise/>