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A comparative, controlled clinical investigation of a new acoustic feedback cancellation strategy in comparison with the currently marketed system. Clinical Study Protocol

Study Type:	Clinical trial with Investigational Medical Device (MD)
Study Categorisation:	Category C; MD without CE mark
Study Registration:	SNCTP, EudraCT
Study Identifier:	BF004-1901
Sponsor, Sponsor-Investigator or Principal Investigator:	Bernafon AG Morgenstrasse 131, 3018 Bern Barbara Simon bsim@bernafon.com +41 31 998 16 84
Investigational Product:	Hearing Instrument; Mermaid 9 S
Protocol Version and Date:	Version 2.0, Final Document

Signature Page(s)

Study number	SNCTP; EudraCT, registration number (TBD)
Study Title	A comparative, controlled clinical investigation of a new acoustic feedback cancellation strategy in comparison with the currently marketed system.

The Sponsor-Investigator and trial statistician have approved the protocol version 2.0 (dated 13.09.2018) and confirm hereby to conduct the study according to the protocol, current version of the World Medical Association Declaration of Helsinki, ICH-GCP guidelines or ISO 14155 norm if applicable and the local legally applicable requirements.

Sponsor: Bruno Keller, Senior Director Marketing and Channel Support

Bern, 26.9.2018 _____
Place/Date Signature

Printed name of Principle Investigator: Barbara Simon

Bern 2018.09.26 _____
Place/Date Signature

Printed name of Trial Statistician: Christophe Lesimple

Bern 2018.09.26 _____
Place/Date Signature

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STUDY SYNOPSIS

Sponsor / Sponsor-Investigator	Bernafon AG
Study Title:	A comparative, controlled clinical investigation of a new acoustic feedback cancellation strategy in comparison with the currently marketed system.
Short Title / Study ID:	BF004-1901
Protocol Version and Date:	2018.09.13; Version 2.0
Trial registration:	SNCTP, EudraCT
Study category and Rationale	Category C: Medical Device without CE mark
Clinical Phase:	Pre-market: Medical device validation study involving human subjects
Background and Rationale:	The amplification of sounds with a hearing aid is the most common treatment for hearing loss. Benefits of amplification and accessories used with it outweigh any risks in mild to profound hearing-impaired subjects. The literature shows both significant improvements in speech intelligibility and life quality (Kochkin, 2011). Additionally, a study by Johnson et al. (2018) shows that hearing aids provide a benefit for people with only a mild sensorineural hearing loss, people who were previously counselled to wait to purchase hearing aids until their hearing loss became more significant. The benefits are obtainable for both unilateral and bilateral fittings and are both short term and durable on long term. Acoustic feedback is a critical problem to all hearing aids. The acoustic coupling between the hearing aid receiver and the microphone occurs when an endless loop is formed so that the microphone is re-amplifying sound from its own receiver. The higher the amplification of the system, the more unstable it becomes and the more likely an acoustic feedback will occur. When this happens the hearing aid user and those around them hear a loud whistling noise. A common method used to combat this problem is feedback cancellation, more specifically adaptive feedback cancellation. The goal of feedback cancellation is to quickly identify feedback path changes and make adjustments to preserve the stability of the system while maintaining a high sound quality and still providing a high stable gain compared to the gain achieved without an active feedback reduction. For this study, Bernafon AG will carry out testing with participants who have hearing loss to validate the performance of the new feedback cancelling algorithm. Studies have investigated the advantages and disadvantages of different feedback cancellation techniques (Spriet and Moonen, 2010). However, it is accepted by professionals that having a feedback system is better than not using feedback cancellation. Bernafon has used an adaptive feedback cancellation algorithm since 2010. For the current study the new adaptive algorithm will be compared to the current algorithm implemented in the hearing aids that are CE marked and sold on the market. The aim is to determine if less feedback is experienced using the new system in comparison to the old system.

Objective(s):	The purpose of this study is to show that the performance of the new feedback cancellation system is better in preventing acoustic feedback than the feedback system used in the currently CE marked devices. Speech understanding should not be negatively affected by the new system and there should be no consequential artefacts or unwanted noises caused by the new system.
Outcome(s):	Primary Endpoint: The primary objective is to assess the new feedback system with different hearing losses and levels of amplification using different hardware. A live feedback test will be used to elicit acoustic feedback and to test how the systems manage it. Secondary Endpoint: A secondary objective is to assess the overall performance of the instrument with the new system based on speech understanding and sound quality. A standardized speech test and a product questionnaire that addresses specific items at risk from the feedback system will be used for evaluation. Other/Safety Endpoint: The study aims to find any new risk factors and to ensure the safety of the devices with the newly implemented feedback system.
Study design:	This is a controlled, comparative clinical evaluation conducted monocentric at the premises of Bernafon AG in Bern, Switzerland. It will be conducted in three phases. All phases consist of the same schedule and tests. They only differ by the style of hardware. The first phase will compare the miniRITE BTE-T, the second phase will compare the miniRITE BTE rechargeable, and the third phase will compare the Super Power BTEs.
Inclusion / Exclusion criteria:	Inclusion Criteria: • All classifications of hearing loss (sensorineural, conductive, mixed) • If the hearing loss is conductive or mixed it must be approved for amplification by a physician • All shapes of hearing loss (flat, sloping, reverse slope, notch) • Severity ranging from mild to profound • German speaking • Current hearing aid users • Both genders • Ages 18 and older • Ability and willingness to sign the consent form Exclusion Criteria: • Contraindications for amplification • Active ear disease • New hearing aid users • Inability to follow the procedures of the study due to language problems, psychological disorders, dementia, or other cognitive problems of the participant • A reduced mobility making them unable to attend weekly study appointments • Uncooperative so that it is not possible to record a valid pure tone audiogram • A strongly reduced dexterity • Central hearing disorders • Bernafon employees • Family members of Bernafon employees

Measurements and procedures:	**Amplification** is verified and compared with targets using Real Ear Measurements **Live Feedback** is tested in the lab with a visual analogue scale. Using the scale, subjects rate their annoyance level when feedback is elicited using typical actions that might cause feedback in daily situations. **Speech intelligibility** tested in quiet or with background noise. The test used will be the Wallenberg and Kollmeier Rhyme Test (WaKo), Speech tests are normally set up with speech in the front and noise in the back or at varying degrees around the test client. The WaKo is tested at a fixed SNR ratio. **Subjective perception of devices** is tested with questionnaires asking the participants various questions concerning the sound quality of the hearing devices. They can be given independently for the two different devices (with the new system and with the old) and then compared against one another. **Preference testing** allows the participant to choose the device that they prefer, which rates the feedback system indirectly.
Study Product / Intervention:	Mermaid 9 S The new investigational medical device (IMD) will be the Mermaid 9 S BTE hearing device. The Mermaid 9 is already marketed. The Mermaid 9 S is the same except for the new acoustic feedback cancellation system. Three hardware styles will be used to test the feedback system as each style may react uniquely to the feedback canceller. The three styles for the IMD are the miniRITE-T, the rechargeable (RC) miniRITE-T, and the Super Power BTE. The miniRITE-T and the rechargeable miniRITE-T are small receiver-in-the hearing aids. They have the same maximum output capability. The only difference is that the miniRITE -T uses disposable batteries, and the miniRITE-T rechargeable is recharged using a charging box. Hearing instruments are worn approximately 8-10 hours per day and removed at night. The test participants will wear the new devices for a time period of 10 +/-5 days per hardware style. The IMD will be in a stable stage of development. This means that system testing will have been completed to ensure correct implementation of the feedback system onto the chip and safe behaviour of the devices before any testing on people is conducted. The corresponding software will also be at a stable stage of development.
Control Intervention (if applicable):	The reference devices are Mermaid 9 BTE hearing instruments that are CE marked and sold on the market with the current feedback cancellation system as well as the SP BTE device sold on the market. The Mermaid 9 BTE will be the comparator for the Mermaid 9 S miniRITE-T and rechargeable miniRITE-T in Phase 1 and Phase 2 respectively. There is no currently marketed rechargeable device to compare to the miniRITE-T rechargeable. The currently marketed SP BTE device is called Supremia and will be the comparator for the Mermaid 9 S Super Power BTE in Phase 3.
Number of Participants with Rationale:	There will be a confirmatory data analysis for the live feedback test and an exploratory analysis for the rest of the collected data. The total number of participants will be 33-55 (Phase 1: 22, phase 2: 22, phase 3: 11). Participants from Phase 1 will have the option to also participate in Phase 2. If the same 22 test subjects participate in Phase 2, the total overall number of participants including those from Phase 3 will be 33. If an entire new group of 18 participate in Phase 2, the overall number will be 55.

Study Duration:	Approximately 1 year The screening of participants is planned to begin in October 2018 and the final data collection will occur in August 2019.
Study Schedule:	The first participants will begin in October 2018 and the final data collection appointments will occur in August 2019.
Investigator(s):	Barbara Simon, Research Audiologist, Doctor of Audiology Morgenstrasse 131 3018 Bern, CH bsim@bernafon.com +41 31 998 16 84
Study Centre(s):	The testing will be performed at a single site in Bern, Switzerland at the Bernafon AG headquarters.
Statistical Considerations:	The analysis and documentation will be performed by the statistician using the latest validated R version with R Studio as IDE. Appropriate data analysis will be performed with parametric and non-parametric tests on a live feedback test, questionnaire outcomes, hearing threshold measures, and speech test scores.
GCP Statement:	This study will be conducted in compliance with the protocol, the current version of the Declaration of Helsinki, the ICH-GCP or ISO EN 14155 (as far as applicable) as well as all national legal and regulatory requirements.

ABBREVIATIONS

AE	Adverse Event
BASEC	Business Administration System for Ethical Committees, (https://submissions.swissethics.ch/en/)
BTE	Behind-the-Ear
CA	Competent Authority (e.g. Swissmedic)
CEC	Competent Ethics Committee
CRF	Case Report Form
ClinO	Ordinance on Clinical Trials in Human Research *(in German: KlinV, in French: OClin, in Italian: OSRUm)*
eCRF	Electronic Case Report Form
CTCAE	Common terminology criteria for adverse events
DSUR	Development safety update report
GCP	Good Clinical Practice
IB	Investigator's Brochure
Ho	Null hypothesis
H1	Alternative hypothesis
HRA	Federal Act on Research involving Human Beings *(in German: HFG, in French: LRH, in Italian: LRUm)*
IFU	Instructions for Use
IMD	Investigational Medicinal Device
IIT	Investigator-initiated Trial
ISO	International Organisation for Standardisation
ITT	Intention to treat
MD	Medical Device
MedDO	Medical Device Ordinance *(in German: MepV, in French: ODim)*
PI	Principal Investigator
REM	Real Ear Measures
RITE	Receiver-in-the-Ear
RMD	Reference Medical Device
SDV	Source Data Verification
SOP	Standard Operating Procedure
SP	Super Power
SPC	Summary of product characteristics
SUSAR	Suspected Unexpected Serious Adverse Reaction
TMF	Trial Master File

STUDY SCHEDULE

The following tables outline the visits for each phase. The scheduled visits and the testing is the same for each phase. The only difference is the hardware style that will be tested.

Phase 1 (miniRITE-T)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	Day 0	10 +/- 5 days	20 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

Phase 2 (miniRITE-T rechargeable)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	50 +/- 15 days	60 +/- 5 days	70 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

Phase 3 (Super Power BTE)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	180 +/- 30	190 +/- 5 days	200 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

1. STUDY ADMINISTRATIVE STRUCTURE

1.1 Sponsor, Sponsor-Investigator

Bernafon AG

Morgenstrasse 131, 3018 Bern

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The role of the sponsor is to provide the site for the testing as well as the equipment used during testing. The sponsor will provide the hearing devices, the IMD, and the RMD used for the study. The results will be used by the sponsor to prove the performance of the IMD. The sponsor may audit the clinic as well as the processes and documentation performed by the investigators at that site.

1.2 Principal Investigator(s)

Barbara Simon, Research Audiologist

Morgenstrasse 131, 3018 Bern

Tel. +41 31 998 16 46

Email: bsim@bernafon.com

1.3 Statistician ("Biostatistician")

Christophe Lesimple

Morgenstrasse 131, 3018 Bern

Tel. +41 31 998 17 03

Email: cles@bernafon.com

1.4 Laboratory

Not applicable – no samples

1.5 Monitoring institution

Bernafon uses monitoring to oversee the study and verify that the conduct of the clinical investigation complies with the approved CIP, subsequent amendment(s), ISO14155, and the applicable regulatory requirement(s). There will be a specific person assigned as the Monitor (sec. 1.7).

1.6 Data Safety Monitoring Committee

There will not be a data safety monitoring committee employed. The data will be stored using an accepted and validated data storage management system.

1.7 Any other relevant Committee, Person, Organisation, Institution

Julie Tantau will monitor the investigation. She works within the Product Validation group at Bernafon. She is certified in GCP, and familiar with ISO 14155. She has also been certified in Clinical Monitoring and has a CAS I in Clinical Trial Practice and Management.

2. ETHICAL AND REGULATORY ASPECTS

Before the study will be conducted, the protocol, the proposed patient information and consent form as well as other study-specific documents shall be submitted to a properly constituted Competent Ethics Committee (CEC) and Swissmedic. Any amendment to the protocol must as well be approved (if legally required) by these institutions.

The decision of the CEC and Swissmedic concerning the conduct of the study will be made in writing to the Sponsor before commencement of this study. The clinical study can only begin once approval from all required authorities has been received. Any additional requirements imposed by the authorities shall be implemented.

2.1 Study registration

The study shall be registered in the EU registry of clinical trials, EudraCT (https://eudract.ema.europa.eu/eudract-web/index.faces). Additionally, the study will be registered in German in the Swiss national clinical trials portal (SNCTP).

2.2 Categorisation of study

The clinical trial of these medical devices falls under Category C because the hearing aids will not yet have the conformity marking at the time of the trial. The Investigational Medical Device (IMD) is equivalent in all except hardware to the RMD with CE Declaration of Conformity and will be used with the same intended purposes as those with the conformity marking.

Use of the devices is not prohibited in Switzerland.

2.3 Competent Ethics Committee (CEC)

The responsible investigator ensures that approval from an appropriately constituted Competent Ethics Committee (CEC) is sought for the clinical study.

The responsible investigator will report any changes as well at the end of study within the allowed time frame (including changes to the research activity and all unanticipated problems involving risks to humans; including in case of planned or premature study end and the final report). No changes will be made to the protocol without prior Sponsor and CEC approval, except where necessary to eliminate apparent immediate hazards to study participants.

Premature study end or interruption of the study is reported within 15 days. The regular end of the study is reported to the CEC within 90 days, the final study report shall be submitted within one year after study end. Amendments are reported according to chapter 2.10.

2.4 Competent Authorities (CA)

The Sponsor will obtain approval from the competent authority (Swissmedic) before the start of the clinical trial. CA approval is necessary for all studies category C (MD).

The Sponsor will report any changes as well as the end of study within the allowed time frame (including changes to the research activity and all unanticipated problems involving risks to humans, including in case of planned or premature study end and the final report) No changes will be made to the protocol without prior Swissmedic approval, except where necessary to eliminate apparent immediate hazards to study participants.

Premature study end or interruption of the study is reported to the CA and Swissmedic within 15 days. The regular end of the study is reported to the CA within 90 days, the final study report shall be submitted within one year after study end. Amendments are reported according to chapter 2.10.

2.5 Ethical Conduct of the Study

The study will be carried out in accordance to the protocol and with principles enunciated in the current version of the Declaration of Helsinki, the guidelines of Good Clinical Practice (GCP) issued by ICH, in case of medical device: the European Regulation on medical devices 2017/745 and the ISO Norm 14155 and ISO 14971, the Swiss Law and Swiss regulatory authority's requirements. The CEC and regulatory authorities will receive annual safety and interim reports and be informed about study stop/end in agreement with local requirements.

2.6 Declaration of interest

It is the policy of Bernafon AG that the conduct of employees and all other persons acting as its representatives should be always in the best interests of Bernafon AG, its members and the public. In performing their duties, Bernafon AG representatives should not be influenced by desire for personal gain. Accordingly, Bernafon AG has adopted rules to guide disclosure of potential conflicts of interest and the society's response thereto that shall apply to those who agree to serve Bernafon AG in any official capacity.

2.7 Patient Information and Informed Consent

The participants will be informed about the study by the PI during the first visit. The explanation will include the type of testing that will be involved, how long it will last, and who will perform the testing. Consent is sought from each participant. They will be compensated with hearing aid accessories (i.e. Batteries, cleaning supplies) that will not exceed a value of 100 CHF.

The investigator will explain to each participant the nature of the study, its purpose, the procedures involved, the expected duration, the potential risks and benefits and any discomfort it may entail. Each participant will be informed that the participation in the study is voluntary and that he/she may withdraw from the study at any time and that withdrawal of consent will not affect his/her subsequent medical assistance and treatment.

The participant is informed that his/her medical records may be examined by authorised individuals other than their treating physician.

All participants for the study will be provided a participant information sheet and a consent form describing the study and providing sufficient information for participants to make an informed decision about their participation in the study. Enough time needs to be given to the participants to decide whether to participate or not. The first appointment is scheduled for 1.5 hours; however, if they require more time than the allotted 1.5 hours they can take the information home and have 24 hours in which to decide.

Otherwise, the participants will sign the consent form in the clinic during the first visit if they choose to become a participant, and the first visit will proceed as described in the scheduling overview.

The patient information and consent form will be submitted to the CEC to be reviewed and approved. The formal consent of a participant, using the approved consent form, must be obtained before the participant is submitted to any study procedures. Therefore, if they take the consent home form to make their decision a new screening appointment will be scheduled.

The participant should read and consider the statement before signing and dating the informed consent form and will be given a copy of the signed document. The consent form will also be signed and dated by the investigator (or his designee) at the same time as the participant sign, and it will be retained as part of the study records.

2.8 Participant privacy and confidentiality

The investigator will permit trial-related monitoring, audits, IRB/IEC review, and regulatory inspections, and will provide direct access to source data and/or documents.

The investigator affirms and upholds the principle of the participant's right to privacy and that they shall

comply with applicable privacy laws. Especially, anonymity of the participants shall be guaranteed when presenting the data at scientific meetings or publishing them in scientific journals.

Individual subject medical information obtained as a result of this study is considered confidential and disclosure to third parties is prohibited. Subject confidentiality will be further ensured by utilising subject identification code numbers to correspond to treatment data in the computer files.

The subject identification numbers have no relation to any subject private data (e.g. Birthdate). The numbers are assigned as the subjects join the subject pool. The number and corresponding subject name are written in a document that is stored in a secured document management system. The document can be opened with a security access code of 11 characters that is only given to study personnel that work with subjects (e.g. investigators/ audiologists).

For data verification purposes, authorised representatives of the Sponsor (-Investigator), Swissmedic, or an ethics committee may require direct access to parts of the medical records relevant to the study, including participants' medical history.

2.9 Early termination of the study

The Sponsor and/or CEC and/or Swissmedic may terminate the study prematurely according to certain circumstances for example:

- ethical concerns,
- insufficient participant recruitment,
- when the safety of the participants is doubtful or at risk, respectively,
- alterations in accepted clinical practice that make the continuation of a clinical trial unwise,
- early evidence of benefit or harm of the experimental intervention

2.10 Protocol amendments

The PI is allowed to amend the protocol or to provide suggestions for a protocol amendment. Any plans for protocol modifications will first be approved by the relevant parties (including other investigators, CEC, and Swissmedic) before amending the protocol.

Substantial amendments are only implemented after approval of the CEC and CA respectively.

Under emergency circumstances, deviations from the protocol to protect the rights, safety and well-being of human subjects may proceed without prior approval of the sponsor and the CEC/CA. Such deviations shall be documented and reported to the sponsor and the CEC/CA as soon as possible.

All non-substantial amendments are communicated to Swissmedic as soon as possible if applicable and to the CEC within the Annual Safety Report (ASR).

3. BACKGROUND AND RATIONALE

3.1 Background and Rationale

Hearing aid amplification is the most common treatment for hearing loss. Benefits of amplification and accessories used with it outweigh any risks in mild to profound hearing-impaired subjects. A clinical literature evaluation is maintained and updated by Bernafon for new products. The evaluation concludes that, hearing device use is “a non-invasive, comparatively low risk option with considerable potential benefits”. As presented in the general literature evaluation, substantial scientific clinical literature shows that amplification of sound provides the claimed benefit for hearing impaired persons. The literature shows both significant improvements in speech intelligibility and improved life quality (Kochkin, 2011). Additionally, a study by Johnson et al. (2018) shows that hearing aids provide a benefit for people with only a mild sensorineural hearing loss, people who were previously counselled to wait until their hearing loss became worse to purchase hearing aids. The benefits are obtainable for both unilateral and bilateral fittings and are both short term and durable on long term.

Acoustic feedback is a critical problem to all hearing aids. The acoustic coupling between the hearing aid receiver and the microphones occurs when an endless closed-loop system is formed so that the microphone is re-amplifying sound from its own receiver. As more gain is applied in the hearing aid, the system becomes more unstable increasing the chances of feedback. When this happens the hearing aid user and those around them hear a loud whistling noise. A common method used to combat this problem is feedback cancellation, more specifically adaptive feedback cancellation. The goal of feedback cancellation is to quickly identify feedback path changes and make adjustments to preserve the stability of the system. It should still provide a high stable amount of gain compared to that which can be provided without a feedback reduction system and maintain a high sound quality.

Bernafon constantly strives to improve its feedback cancellation system. In June 2017 Bernafon released a hearing aid to the market with a new chip capable of more memory and faster processing. They will now release hearing aids with an upgraded version of that chip that can support a new adaptive feedback cancellation algorithm. The new release will only include behind-the-ear (BTE) styles of hearing aids.

For this study, Bernafon AG will carry out testing with participants who have hearing loss to validate the performance of the new feedback algorithm. Studies have investigated the advantages and disadvantages of different feedback cancellation techniques (Spriet and Moonen, 2010). However, it is accepted by professionals that having any kind of feedback system is better than not using feedback cancellation. Bernafon has used an adaptive feedback cancellation algorithm since 2010. For the current study the new adaptive algorithm will be compared to the current algorithm implemented in the hearing aids that are CE marked and sold on the market. The aim is to determine if less feedback is experienced using the new system in comparison to the old system.

For the current study, three BTE hearing aids with the new chip (Mermaid 9 S miniRITE-T, miniRITE-T rechargeable, and Super Power BTE) are the IMD, and the BTE styles that are currently sold on the market (Mermaid 9 miniRITE-T and Supremia Super Power BTE) will be the RMD and comparator. The results of the trial will be used to examine differences in benefit provided by the feedback cancellation systems as well as identify further optimization of the tested products. The hearing aids will be programmed with the prescribed gain and features. Objective measures of the output of both the IMD and the RMD will be made with Real Ear Measures (REM) and speech tests. Subjective differences will be measured with a live feedback test and questionnaires.

All participants are hearing impaired persons. There are three phases of testing (one for each IMD style), and each phase consists of the same visits. The participants will be fit with the RMD for the first field test and the IMD for the second field test of each phase during the trial. There are only small potential differences expected in achievable gain as a result of the feedback systems. It is expected that the IMD performs better than the RMD for the live feedback test and equally as good as the RMD for the speech testing.

In summary, the primary goal of this study is to evaluate the new hearing aids regarding the audiological performance of the new feedback cancellation algorithm and their safety before they’re released to the market.

3.2 Investigational Product (device) and Indication

The IMD is a class IIa medical device. The brand name is Mermaid 9 S, manufactured by Bernafon AG. The software used to program the devices is Oasis^{nxt}. The device is intended for people with hearing loss that are over 36 months of age. The hearing aids are equivalent to those with CE Declaration of Conformity except that they contain an additional acoustical feedback cancellation algorithm. The device consists of a body made of plastic that houses the microphone(s), and chip. A speaker that is covered with a plastic dome is attached by a piece of thin plastic that goes over the ear. The plastic dome is the only part that is in contact with skin inside the ear canal. Only those trained as a hearing care professional in the fitting of hearing devices should program the device. However, anyone who receives a minimum amount of explanation concerning the use of the device is qualified to use it. The device is non-invasive and requires no surgical procedures.

3.3 Preclinical Evidence

Bernafon requires evidence of operational safety and medical effectiveness of the devices before testing them with human subjects. This evidence includes the device-related performance data in accordance with IEC 118-7: Measurement of the maximum output level and the maximum gain. In addition to the performance testing, the hearing aids are verified with system tests to ensure that they function according to the requirements. The safety of the fitting software is demonstrated by a beta version that has passed through a complete systematic software test and ensures the functionality of the hearing aids in combination with the software. Please see chapter B3e of the IB.

3.4 Clinical Evidence to Date

A clinical literature evaluation is maintained and has been updated in 2018. The basic benefit of hearing aids does not change with newly released devices. They are designed to amplify sound. The benefit of hearing aids has been shown in various studies (Kochkin, 2011). The evaluation includes an analysis of adverse events for Bernafon products as well as competitor devices and is used as post market analysis of the devices. The Mermaid 9 device was released to the market in early 2017. To date, there have been no adverse events reported on the U.S Food and Drug (FDA) Manufacturer and User Facility Device Experience (MAUDE) website.

A risk assessment is performed for all new devices. The primary risk identified is the possibility of over amplification from excessive sound pressure levels (further described in sec. 3.7). This risk is mediated by printing a warning in the Instructions for Use for hearing aids with high sound pressure level output capability. Additionally, when this type of instrument is selected in the software, there is a message warning the hearing care professional (HCP) of the sound pressure capability. Overall, Bernafon AG has had no adverse event reported in the last 16 years including no required modifications or recalls of products.

3.5 Medical Device: Rationale for the intended purpose in study (pre-market MD)

The IMD will be used in accordance with the current use of hearing devices. The intended purpose of the study is to compare the performance of the IMD with the RMD that is currently sold on the market. To make an effective comparison the test participants will wear the IMDs for approximately 10 days with a daily average use of 8-10 hours.

3.6 Explanation for choice of comparator (or placebo)

The comparison device will be the current equivalent Bernafon BTE style of hearing aid (RMD) that has

been available on the market since early 2017. The test participants will be fit with these devices during the trial to be able to compare them to the IMD. The reason for using the RMD is to control for performance differences caused by the new feedback cancellation system. Only changing the feedback system should, in theory, not adversely affect the performance of the device.

3.7 Risks / Benefits

A device risk analysis and risk assessment have been conducted for the new device according to EN ISO 14971. This describes the anticipated adverse device effects, residual risks associated with the investigational device and the procedures involved in its use. It also explains that the anticipated clinical benefit outweighs the potential risks. Please see the Risk Assessment for details.

The audiological and psychoacoustic investigations are conducted using volunteer test participants with sound pressure levels that will not endanger their residual hearing. The test participants will be advised of the type, content, extent, and possible risks of the test beforehand. As psychometric methods are involved in the data collection, the risk for the test participants is judged to be extremely minor. However, the following risks shall be addressed:

Risk of hearing loss to residual hearing at too high a level in audiological and psychoacoustic experiments: The hardware can provide an output that exceeds 132 dB SPL; however, only those with appropriate hearing loss (moderate to profound) will be fit with such devices reducing the risk to participants' residual hearing. During audiometry (test of hearing loss with audiometer) a level of more than 100 dB SPL must be used for test subjects who are profoundly hard of hearing. The risk is mitigated by the fact that the benefit of wearing hearing aids with a high output is higher than the risk to their minimal residual hearing.

Post-trial care is organized in a manner that allows the test participants to contact the sponsor site and arrange an appointment for any maintenance of their own devices as needed as they are all current hearing aid users.

3.8 Justification of choice of study population

The choice of study population was determined by the goal of the study. No minors or otherwise vulnerable participants will be included. The intended purpose of the study is to compare current Bernafon device performance with the existing feedback system against the new device with the new feedback system and not the overall effect of amplification. Therefore, only participants that are hearing impaired and experienced hearing aid users will be included. Bernafon has its own database of test subjects that are used for clinical trials. They are current hearing aid users that use the Bernafon clinic for adjustments to fittings and general maintenance of their hearing aids performed by the audiologists working at Bernafon. These test subjects do not consist of employees of Bernafon or family members of employees. The test subjects for the current study will be chosen from this internal subject database.

The comparison between devices shall be made with experienced hearing aid users. It is important to compare the performance of the devices and the subjective opinions of the intended users. Testing normal hearing participants would not contribute information to this study. Test participants must be able to sign and understand the consent form to be included in the study.

For emergency situations, the following applies:

The standard procedure is to recommend that a subject see the ENT with whom they have an established relationship. If a subject does not have an ENT then it is agreed with Dr. Carvacchio (Inselspital, Bern) that, if necessary, subjects from the trial could be referred to him.

4. STUDY OBJECTIVES

4.1 Overall Objective

The purpose of this study is to evaluate whether the IMD provides a better feedback performance than the RMD. The study aims to provide a final validation and quality control of the IMD before it is released for sales.

4.2 Primary Objective

The study seeks to assess the performance of the new acoustic feedback cancellation system in comparison to the current feedback system. Scores from a live feedback test of the IMD will be compared to those of the RMD.

4.3 Secondary Objectives

Secondary objectives are to assess the performance of the IMD using speech testing and questionnaires (standardized and product). The performance of the IMD should not be inferior to that of the RMD.

4.4 Safety Objectives

The study aims to validate the overall implementation of the new feedback system by testing for unexpected behaviour from the IMD and to identify any new risk factors to ensure the safety of the devices before they are released to the market.

5. STUDY OUTCOMES

5.1 Primary Outcome

The primary outcome variable will be measured with a live feedback test that subjectively measures feedback annoyance that the participants experience in simulated real-life situations that typically elicit feedback. It will be measured in two conditions: aided with the RMD and aided with the IMD.

5.2 Secondary Outcomes

The secondary outcome will be measured with a standardized speech test and with questionnaires (standardized and product). The speech test will be measured in three conditions: unaided, aided with the RMD, and aided with the IMD. The questionnaires will be answered for both the RMD and the IMD, and then the answers compared. The product questionnaire will focus on the performance of the device with specific questions regarding feedback and sound quality. The Speech, Spatial, Quality (SSQ) questionnaire is a standardized questionnaire of overall performance and directly compares the RMD to the IMD.

5.3 Safety Outcomes

The product questionnaire that is used for the secondary outcome will also contain questions to measure the safety of the devices. These questions will specifically address unexpected noise or behaviour from the devices. Unexpected behaviour includes unprovoked feedback or whistling, distorted sounds or artefacts, spontaneous muting or shutting off of the device, and any unexplained warning signals, beeps, or loud sounds.

6. STUDY DESIGN

6.1 General study design and justification of design

This is a controlled, randomised, comparative clinical investigation conducted monocentric at the premises of Bernafon in Bern, Switzerland. The study will be conducted in three phases.

The exploratory study is based on a population of 33-55 hearing impaired people that have a hearing loss appropriate for the IMD. There are three phases of testing with the following minimum number of test participants required per phase: Phase 1 - 22, phase 2 - 22, phase 3 - 11. Participants from Phase 1 will have the option to also participate in Phase 2. If the same 22 test subjects participate in Phase 2, the total overall number of participants including those from Phase 3 will be 33. If an entire new group of 22 participate in Phase 2, the overall number will be 55.

As an RMD, the subjects will be fit with Mermaid 9 BTEs during the trial. Additionally, a control situation will be the unaided test condition for speech testing.

There is no placebo or device that does not provide amplification. The study is separated into three phases as each phase will test a specific hardware style that may react differently to the feedback cancellation system. The third phase will include a population with stronger hearing loss that requires more amplification and therefore, has a higher chance of experiencing feedback. For each phase, a single-group assignment design is used with test subjects that will be fit with the RMD and IMD during the trial. The field testing is unblinded as the difference between the IMD and the RMD is physically noticeable and obvious to the end user that it's different.

The first and second phases will consist of hearing impaired subjects with hearing loss ranging from mild to severe and appropriate for testing of the miniRITE-T and the miniRITE-T rechargeable hardware styles as well as the comparator miniRITE-T style. The third phase will consist of hearing impaired subjects with hearing loss ranging from moderate to profound and appropriate for the testing of the super power BTEs.

The lab testing (speech and feedback) will be blinded and randomised in a simulated environment. It is possible to blind the lab tests because the test subject will not place the hearing aids on their ears themselves. Before the lab testing begins they will hand over the hearing aids that they are wearing. As the PI will have the other set of hearing aids as well, they can discreetly choose the pair required by the randomisation list and place the hearing aids on the subjects without letting them see the devices. Once the devices are on/in the ears, there is no way to distinguish one style from the other. Feedback and speech testing conditions will be randomised. For the feedback tests, the test subjects will be tested in two aided conditions (comparator and IMD), and for speech, the test subjects will be tested in the unaided condition and two aided conditions. Speech tests will also be randomised by the word list.

The subjects in each phase are expected to participate for approximately 1 month. The participants from Phases 1 and 2 will have the option of participating in one or both phases of the study. The testing will include a combination of field and lab tests. There are two lab tests planned for each phase during which the participants will not spend more than 1.5 hours in the clinic (including breaks). The field test periods will not last more than 10 +/- 5 days.

The sequence for each phase of testing is the same. Each sequence will begin with the screening appointment in which participants are invited to the clinic for testing to determine if they are candidates for the trial. The entire test procedure will be explained, and they will be given a Patient Information and Informed Consent which will need to be signed, dated, and returned before any testing begins. If they choose to participate, a hearing test will be made to determine if they have an appropriate hearing loss and the RMD will be fitted.

The following appointments will include fitting of the IMD, two separate field tests during which they will wear the RMD (field test 1) and the IMD (field test 2), respectively, and lab tests in the clinic. There will be a total of 3 appointments, 1 before and after each field test, for each phase. Each appointment will not exceed 1.5 hours. During the lab tests in the clinic they will participate in live feedback testing and speech testing. Test subjects will be given questionnaires to complete at home and in the clinic.

After they have completed all appointments, the subjects will receive instructions about the continued use of their own hearing aids, and the reminder that they are welcome to come to the clinic for any maintenance or other follow-up of the hearing aids.

6.2 Methods of minimising bias

6.2.1 Randomisation

A single group assignment to the IMD will be used for the field trial. All subjects will wear the RMD for the first field test period and then the IMD for the second field test period. This procedure will be followed for all three phases. The lab tests, which include the live feedback test and the speech test, conducted in the clinic will be randomised. The live feedback and speech test order will be randomised based on a list created by the statistician. This means that for the live feedback and speech tests the subjects will be randomised by the hearing aid condition. This reduces bias by using a different starting and ending condition as the last condition has a higher chance of scoring higher due to a learning effect from the speech test. Additionally, the speech lists used for the speech test will be randomised as each list presents the same words but in different orders. The randomisation list will not be concealed from the PI but should be in the ISF so that the PI knows in which condition order to test each subject.

6.2.2 Blinding procedures

The field tests will be unblinded as the differences in some of the hardware styles make it impossible to blind. As stated in section 6.2.1 all subjects will wear the RMD in the first field test period and the IMD in the second field test period. However, the lab tests in which feedback and speech are tested will be single blinded. In order to maintain the blind, the hearing aids will be taken from the subjects before the lab testing begins. They will be placed in the sound booth and seated in the middle of the speaker array. The PI will then enter the booth with the hearing aids hidden in their hand. The PI will approach the subjects from behind and place the hearing aids on the test subjects' ears without allowing them to see which hearing aids they are wearing during each testing session. The differences can be seen but not felt once the hearing aids are in position on the ears. The tubing and dome that fit in the ear canal are the same for each IMD style and their comparator; therefore, they will all feel the same to the subjects. The statistician will create a list to randomise the order of the blinded test condition using A and B to define which hearing aid (RMD or IMD) should be used for each round of tests. The PI will follow this list.

6.2.3 Other methods of minimising bias

The RMD will be programmed to a standard first fit setting that will be consistent with the first fit setting of the IMD. They will wear the RMD for approximately 10 +/- 5 days with the standard fitting before returning to the clinic for the IMD fitting. The equivalent fitting will reduce bias that subjects may otherwise have due to the fitting and ensure that the only difference between the two hearing aids is the feedback system.

6.3 Unblinding Procedures (Code break)

The field test portion of the study is performed unblinded. The blinding for the lab tests will be based on an A/B assignment with a list created by the statistician. The list will be located in the ISF so that the PI has access and knows which assignment to use for each appointment.

7. STUDY POPULATION

The study will take place in the clinic at Bernafon AG in Bern. No other sites will be used for the testing. A plan of action due to low enrolment is not necessary as subjects are recruited from a Bernafon database containing sufficient hearing impaired, experienced hearing aid users from which to choose.

7.1 Eligibility criteria

Participants fulfilling all of the following inclusion criteria are eligible for the study:

- All classifications of hearing loss (sensorineural, conductive, mixed)
- If the hearing loss is conductive or mixed, it must be approved for amplification by a physician

- All shapes of hearing loss (flat, sloping, reverse slope, notch)
- Hearing loss severity ranging from mild to profound
- German speaking
- Current hearing aid user
- Both genders
- Ages 18 and older
- Ability and willingness to sign the consent form

The presence of any one of the following exclusion criteria will lead to exclusion of the participant:

- Contraindications for amplification
- Active ear disease
- Inability to follow the procedures of the study due to language problems, psychological disorders, dementia, or other cognitive problems
- A reduced mobility making them unable to attend weekly study appointments
- A reduced ability to describe auditory impressions and the usage of the hearing aids
- Uncooperative so that it is not possible to record a valid pure tone audiogram
- A strongly reduced dexterity
- Central hearing disorders
- Bernafon employees
- Family members of Bernafon employees

7.2 Recruitment and screening

Bernafon has its own database of test subjects that use the Bernafon clinic for updated fittings and general maintenance of their hearing aids. These test subjects do not consist of employees of Bernafon or family members of employees. The test subjects for the current study will be chosen from the internal subject database. Bernafon does not advertise as a method of recruiting participants. Participants are collected and added to the database by word of mouth. If a current person from the database knows of another person with hearing loss they may give them the contact information of an audiologist within Bernafon. The person can then contact Bernafon if they wish to have a hearing test and determine if they're eligible to participate in a study. They are given a diagnostic audiological exam to determine if they have a hearing loss and the severity. If there are any medical indications it is recommended that they see a physician and then return if there are no contra-indications for hearing aids. During the hearing exam and medical history discussion it is determined whether the person is cognitively able to act on their own behalf. Additionally, if the person comes alone or if they are accompanied will help to determine their level of independence. If there is a study that is ready to take place, then that will be explained at this time including an estimation of how much time/number of appointments would be required of them. If there is no immediate study planned, the normal study process will be explained to the subjects and they will be put on a waiting list. It is explained that the general compensation for their time is by means of a box of batteries and cleaning accessories.

7.3 Assignment to study groups

For the field tests the allocation is single group; therefore, all the test subjects will be assigned to the same group. The field test 1 will be with the RMD and the filed test 2 with the IMD.

For the live feedback and speech tests in the lab, the assignment to the test condition order will be randomised by the statistician. The test condition order will be randomised using an A/B assignment. This will minimize bias created when one test condition is tested in the final or last position all the time.

7.4 Criteria for withdrawal / discontinuation of participants

Participants are allowed to withdraw from the study at any time and for any reason. They do not have to share the reasons with the investigator. They will be asked to return the IMD. If the decision to withdraw is made by the investigator, the PI will inform the subject in person that they are no longer needed for the study. Reasons for withdrawing a participant from the study could be for non-compliance during testing, unreliable responses, medical reasons such as an ear infection, or the study may need

to be stopped or postponed. Any data gathered from these subjects will be used for the current study. All data will remain encoded because results are only recorded using the identification code of the subject. There are normally at least five “back-up” test participants on the list to replace those that withdraw or are withdrawn. The “back-up” participants have already been screened and deemed to be appropriate for the study.

8. STUDY INTERVENTION

8.1 Identity of Investigational Products (medical device)

For all three phases the treatment will be approximately 10 days of use with the IMD during which they will not use the RMD. They will be fit with the RMD for the first 10 +/- 5 days field test and then switch to the IMD for the assigned period of 10 +/- 5 days.

There will be lab tests during which the participants will use the RMD and the IMD, for up to 1.5 hours at a time during testing in the clinic.

8.1.1 Experimental Intervention (medical device)

The investigation product (IMD) is a medical device. It is a new version of a Bernafon hearing device. The name is Mermaid 9 S BTE. An initial version of the Mermaid 9 BTE was released to the market in early 2017. The new Mermaid 9 S does not deviate from the current commercial product except for the implementation of an updated chip with a new feedback cancellation system. Three BTE styles will be used for the IMD as it is important to test the feedback system with various hearing losses and hardware. The styles include a miniRITE-T which is appropriate for mild to severe hearing losses, a miniRITE-T (RC) rechargeable which also fits mild to severe hearing losses but uses a rechargeable battery and should be tested to ensure that the strength of the charge does not affect the performance of the feedback system. Lastly a super power (SP) BTE that fits moderate to profound hearing losses will be tested. Increased output of gain is a primary cause of feedback; therefore, it is important to test a BTE style that is expected to generate high amounts of gain.

The BTE is fitted with the body of the device over the ear, and a dome or earmold inside of the ear canal. Performance of the IMD is expected to be the same or better than the RMD. They are non-invasive devices. The dome that is worn inside the ear canal is made from non-toxic plastic and the earmolds are made of non-toxic plastic with an acrylic coating. An illustration of the three IMD BTE styles is shown in Figure 1.

Figure 1. Mermaid 9 S BTEs from left: miniRITE-T, miniRITE-T (RC), and SP BTE.

8.1.2 Control Intervention (comparator medical device)

The Reference Medical Device (RMD) is the current Mermaid 9 BTE. It is a CE marked hearing aid that was released to the market in 2017. The intended purpose of both the IMD and the RMD is the same - to amplify sounds. The strength of the amplification is programmed according to the subject's individual hearing loss. There is no placebo treatment used as the study uses the accepted standard treatment for hearing loss as the control. The only differences between the RMD and IMD are the upgraded chip that is capable of running the new feedback cancellation system and the rechargeable BTE style that has been added to the portfolio. The RMD and the IMD will be programmed based on each participant's hearing loss. The amplification will be verified for the devices using the REM. The two RMD BTE styles are shown in Figure 2.

Figure 2. Mermaid 9 miniRITE-T (left) and Supremia SP BTE (right).

8.1.3 Packaging, Labelling and Supply (re-supply)

The IMD is labelled by printing the name of the device directly onto the device. There is an individual serial number that also printed on the device. The production batch can be tracked through this serial number. The hearing aids are shipped in a box with a label on the outside of the box that states the name of the product, the serial number, and a short description. Inside the box is a case that houses the hearing aids. The HCP removes the case from the box, and the case is generally given to the end user in which to place the hearing aids whenever they are not worn. The packaging and labelling are the same for the IMD and the RMD.

8.1.4 Storage Conditions

The IMD devices are shipped as soon as they are produced because they are custom devices which are made to order. Therefore, they are not stored on any shelves. The conditions in which they should be shipped and kept by the end user are described in the IFU. They should not be exposed to temperatures below -25° and not above 60° Celsius.

8.2 Administration of experimental and control interventions

8.2.1 Experimental Intervention

The IMD is worn over the ear with a dome or earmold anchored inside the ear canal. It is non-invasive. The amplification is prescribed based on the participant's hearing loss. The IMD will be worn by each participant for approximately 10 days to give the subjects enough time to wear the devices in different environments and make a comparison between the IMD and the RMD. Normal use of a hearing aid is 8-10 hours per day. The participants will wear the IMD for the same amount of time during the day that they wear the RMD. The hours of daily use will be controlled with a data logging feature in the software that programs the hearing aids.

The study procedure will use a single group assignment design in which the subjects will wear the IMD at the same time. As stated previously, the device is non-invasive and requires no surgical procedure.

The subjects themselves will place the device in their ears each morning and remove them each night for sleeping. The test subjects are experienced hearing aid users and will require minimal explanation and/or training to use the IMD. They will be given an Instructions for Use booklet that explains how to insert the device and provides further instructions concerning cleaning, battery changing, and warnings.

8.2.2 Control Intervention

The RMD is worn over the ear with a dome or earmold anchored inside the ear canal. The RMD is the current marketed device. Participants will use the RMD programmed for the current study for approximately 10 days and then switch to the IMD. They will compare the IMD to the RMD after the field test with the IMD. Normal use of a hearing device is 8-10 hours per day. They will wear the RMD and the IMD for the same amount of time per day during the field tests. The hours of daily use will be

controlled with a data logging feature in the software that programs the hearing aids.

The study procedure will use a single group assignment design. The subjects will have already worn the RMD during the first period and will then all wear the IMD at the same time during the second period. As stated previously, the device is non-invasive and requires no surgical procedure. The RMD device is placed over the ear and the dome or earmold is placed inside the ear canal.

The subjects themselves will place the device in their ears each morning and remove them each night for sleeping. The test subjects are experienced hearing aid users and will require minimal explanation and/or training to use the RMD. They will be given an Instructions for Use booklet that explains how to insert the device and provides further instructions concerning cleaning, battery changing, and warnings.

8.3 Dose / Device modifications

The IMD will provide the same amplification as the RMD; therefore, the subjects should not experience any significant negative differences that would make them want to discontinue use of the device. However, if a subject does report such differences, that can be improved with fine tuning, fine tuning can be made to improve the situation enough for the subject to continue with the study. If the subject requests to discontinue they can immediately remove the IMD from their ear and return to using their own BTEs. They will be asked to return the IMD to Bernafon AG, but their data will still be included in the results for the current study. All data will remain encoded because the results are only recorded using the identification code of the subject.

8.4 Compliance with study intervention

It is clearly explained to the subjects that during each specific period of intervention it is important to the study that they only wear the RMD and IMD. However, their own BTEs are left in their possession for safety reasons in the event that they choose to discontinue their participation in the trial or a problem arises with the test devices. For ethical purposes, the subjects must have a back-up solution for their hearing impairment.

The data logging feature of the software monitors the average number of hours that the devices are worn each day. Therefore, it will be noted if the RMD and IMD have not been worn a standard or expected amount of time.

8.5 Data Collection and Follow-up for withdrawn participants

Any data that is collected will be kept in the data management database. The data will remain encoded because results are only recorded using the identification code of the subject. The analysis and report will include a summarized section based on the data available from all recruited subjects and another section based on the data from the subjects that complete the entire protocol will be analysed. Withdrawn subjects will have the same follow-up as those subjects that complete the trial. As all subjects are taken from the Bernafon database, all participants, including those that withdraw, are welcome to return to the clinic for fine-tuning and maintenance as needed.

8.6 Trial specific preventive measures

The performance of a hearing aid is not impacted by medication. The subjects will continue to take whatever type of medication that they normally take. There will be no impact on the study objectives.

8.7 Concomitant Interventions (treatments)

Test subjects will continue to receive any concomitant care and medication that they normally receive during the trial. All test subjects will already be hearing aid users and will have, therefore, used them while receiving other types of care or medications. There will be no impact on the study objectives.

8.8 Medical Device Accountability

The RMD and IMD devices have serial numbers by which the individual device can be identified, and the production history traced. The devices will be shipped from the production lab in Poland. The serial numbers will provide traceability of their production. All devices undergo testing in production before being shipped. Only IMD that are from a tested batch will be used in the study.

8.9 Return or Destruction of Study Drug / Medical Device

At the end of the study all of the subjects will return the IMD to the site in Bern. It will be noted in the device accountability log and CRF that the devices were returned.

The PI will then return the devices to the Sponsor.

9. STUDY ASSESSMENTS

9.1 Study flow chart(s) / table of study procedures and assessments

The following tables outline the visits for each phase. The scheduled visits and the testing is the same for each phase. The only difference is the hardware style that will be tested.

Phase 1 (miniRITE-T)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	Day 0	10 +/- 5 days	20 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

Phase 2 (miniRITE-T rechargeable)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	50 +/- 15 days	60 +/- 5 days	70 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

Phase 3 (Super Power BTE)

Study Activity	Intervention Period		
	Screening/Visit 1	Visit 2	Visit 3
	180 +/- 30	190 +/- 5 days	200 +/- 5 days
Patient Information and Consent	x		
Demographics	x		
Medical/Hearing History	x		
In-Exclusion Criteria	x		
Randomisation and blinding (of feedback tests)		x	
Randomisation and blinding (of speech tests)			x
Otoscopy	x	x	x
Audiometry	x		
Administer Medical Device	x	x	
REM	x	x	
Primary Variable (Live Feedback Test)		x	
Secondary Variables (Speech Testing)			x
Other Variables (SSQ Questionnaire)			x
Other Variables (Product Questionnaire)	x	x	
Preference Questionnaire			x
Adverse Events	x	x	x

9.2 Assessments of outcomes

9.2.1 Assessment of primary outcome

The primary outcome is the live feedback testing results of the IMD compared with the RMD. The hearing aids will be programmed with the same gain and feedback elicited in simulated real-life situations that cause feedback including: Inserting and removing the hearing aids from the ears, holding a telephone up to the ear, sitting close to a wall, putting the hand up to the ear. The subjects will answer questions about the annoyance caused by the elicited feedback. The feedback test will be tested with the RMD and the IMD at the second appointment.

9.2.2 Assessment of secondary outcomes

Speech will be assessed using a standardized speech test (Wallenberg & Kollmeier's Rhyme Test (WaKo)) at the third appointment. Subjects will respond to the speech testing in an unaided condition and aided conditions with the RMD and the IMD. They will also complete product questionnaires with specific questions about feedback, sound quality, and unexpected behaviour. The questionnaires are given to them to take home on the first and second appointments. A standardized questionnaire (SSQ) that directly compares the IMD and RMD and a preference questionnaire will be completed at the third appointment.

9.2.3 Assessment of safety outcomes

Questions concerning unexpected events, sounds, and behaviour are included in the questionnaire that is given to the subjects to complete at home on the first and second appointments.

9.2.3.1 Adverse events

For the recording of adverse events the subjects will be asked for a description of the event including time/date of onset, how long it lasted, how many times it occurred, and if it caused discomfort or pain or a disruption of hearing ability. Before the end of each appointment, the subjects will be asked if they have experienced any adverse events. It will be explained that adverse events are not restricted to problems related to the hearing aids or their hearing but can include allergies, broken legs, headaches, etc. They will be recorded on the AE forms in the CRF.

9.2.3.2 Laboratory parameters

Not applicable

9.2.3.3 Vital signs

Not applicable

9.2.4 Assessments in participants who prematurely stop the study

After the study concludes the subjects will return the IMD. The follow-up procedure will be the same as for all active test subjects. They will be instructed to return to the clinic for any required maintenance or fine-tuning of their own devices. Those that prematurely withdraw from the study will still be wearing their own devices; therefore, their follow-up treatment will be the same as for the other participants that finish the study.

9.3 Procedures at each visit

First Phase

9.3.1 Screening/First Visit

Screening visit, Day 0: The potential participants will be given the Patient Information and Informed Consent form. The trial will be explained including how many visits are expected as well as the type of testing that they will complete. They are given time during the appointment to decide whether to participate in the study. If they choose not to take part in the study they will not sign the consent form, and the appointment will finish. If they choose to join the trial they will sign and date the consent form. No trial activities will be performed before the consent form is signed and dated by the subject and the investigator. Subjects will receive a copy of the signed consent form. A hearing history is then taken, and otoscopy is performed. A hearing test is performed, and inclusion/exclusion criteria will be determined. The RMD is programmed to a first fit and adjusted using REM data to match the gain targets. They are given an IFU about the RMD and the product questionnaire to complete at home regarding the RMD. They are scheduled for the second visit. Any AEs are reported in the CRFs.

9.3.2 Fitting/Second Visit

Fitting Visit, Day 10 +/- 5: Otoscopy is performed, and the subjects are fitted with the IMD. Output of the IMD is measured, and the fitting adjusted using REM to better match the gain targets. They are randomised regarding the hearing aid order and blinded for the live feedback test which is performed with the RMD and the IMD. The subjects return the RMD. The subjects return the completed product questionnaire from the first visit and are given the same questionnaire to complete at home regarding the IMD. They are given an IFU about the IMD. They are scheduled for the third visit. Any AEs are reported in the CRFs.

9.3.3 Final/Third Visit

Final Visit, Day 20 +/- 5: Otoscopy is performed. They are randomised regarding the test condition order and the word lists and blinded for the speech testing. Speech tests are made with the WaKo in three conditions: unaided, aided with the RMD, and aided with the IMD. The subjects return the IMD. The subjects return the completed product questionnaire from the second visit and complete a standardized questionnaire (SSQ) and a preference questionnaire during the appointment. They are notified that the testing has finished. They will return to wearing their own hearing aids. They are reminded to make appointments at the clinic for any fine-tuning or maintenance of their own hearing aids. Any AEs are reported in the CRFs.

Second Phase

9.3.4 Screening/First Visit

Screening Visit, Day 50 +/- 15: The potential participants will be given the Patient Information and Informed Consent form. The trial will be explained including how many visits are expected as well as the type of testing that they will complete. They are given time during the appointment to decide whether to participate in the study. If they choose not to take part in the study they will not sign the consent form, and the appointment will finish. If they choose to join the trial they will sign and date the consent form. No trial activities will be performed before the consent form is signed and dated by the subject and the investigator. Subjects will receive a copy of the signed consent form. A hearing history is then taken, and otoscopy is performed. A hearing test is performed, and inclusion/exclusion criteria will be determined. For subjects that choose to participate in phase one and phase two, a new consent form is not required, and the screening will not be completed again. The RMD is programmed to a first fit and adjusted using REM data to match the gain targets. They are given an IFU about the RMD and a product questionnaire to complete at home regarding the RMD. They are scheduled for the second visit. Any AEs are reported in the CRFs.

9.3.5 Fitting/Second Visit

Fitting Visit, Day 60 +/- 5: Otoscopy is performed, and the subjects are fitted with the IMD. Output of the IMD is measured, and the fitting adjusted using REM to better match the gain targets. They are randomised regarding the hearing aid order and blinded for the live feedback test which is performed with the RMD and the IMD. The subjects return the RMD. The subjects return the completed product

questionnaire from the first visit and are given the same questionnaire to complete at home regarding the IMD. They are given an IFU about the IMD. They are scheduled for the third visit. Any AEs are reported in the CRFs.

9.3.6 Final/Third Visit

Final Visit, Day 70 +/- 5: Otoscopy is performed. They are randomised regarding the test condition order and the word lists and blinded for the speech testing. Speech tests are made with the WaKo in three conditions: unaided, aided with the RMD, and aided with the IMD. The subjects return the IMD. The subjects return the completed product questionnaire from the second visit and complete a standardized questionnaire (SSQ) and a preference questionnaire during the appointment. They are notified that the testing has finished. They will return to wearing their own hearing aids. They are reminded to make appointments at the clinic for any fine-tuning or maintenance of their own hearing aids. Any AEs are reported in the CRFs.

Third Phase

9.3.7 Screening/First Visit

Screening visit, Day 0: The potential participants will be given the Patient Information and Informed Consent form. The trial will be explained including how many visits are expected as well as the type of testing that they will complete. They are given time during the appointment to decide whether to participate in the study. If they choose not to take part in the study they will not sign the consent form, and the appointment will finish. If they choose to join the trial they will sign and date the consent form. No trial activities will be performed before the consent form is signed and dated by the subject and the investigator. Subjects will receive a copy of the signed consent form. A hearing history is then taken, and otoscopy is performed. A hearing test is performed, and inclusion/exclusion criteria will be determined. The RMD is programmed to a first fit and adjusted using REM data to match the gain targets. They are given an IFU about the RMD and a product questionnaire to complete at home regarding the RMD. They are scheduled for the second visit. Any AEs are reported in the CRFs.

9.3.8 Fitting/Second Visit

Fitting Visit, Day 10 +/- 5: Otoscopy is performed, and the subjects are fitted with the IMD. Output of the IMD is measured, and the fitting adjusted using REM to better match the gain targets. They are randomised regarding the hearing aid order and blinded for the live feedback test which is performed with the RMD and the IMD. The subjects return the RMD. The subjects return the completed product questionnaire from the first visit and are given the same questionnaire to complete at home regarding the IMD. They are given an IFU about the IMD. They are scheduled for the third visit. Any AEs are reported in the CRFs.

9.3.9 Final/Third Visit

Preference Visit, Day 20 +/- 5: Otoscopy is performed. They are randomised regarding the test condition order and the word lists and blinded for the speech testing. Speech tests are made with the WaKo in three conditions: unaided, aided with the RMD, and aided with the IMD. The subjects return the IMD. The subjects return the completed product questionnaire from the second visit and complete a standardized questionnaire (SSQ) and a preference questionnaire during the appointment. They are notified that the testing has finished. They will return to wearing their own hearing aids. They are reminded to make appointments at the clinic for any fine-tuning or maintenance of their own hearing aids. Any AEs are reported in the CRFs.

10. SAFETY

The Sponsor's SOPs provide more detail on safety reporting.

10.1 Medical Device Category C studies

Device deficiencies and all **adverse events (AE)** including all **serious adverse events (SAE)** are collected, fully investigated and documented in the source document and appropriate case report form (CRF) during the entire study period, i.e. from patient's informed consent until the last protocol-specific procedure, including a safety follow-up period [ISO 14155]. Documentation includes dates of event, treatment, resolution, assessment of seriousness and causal relationship to device and/or study procedure.

The information on AEs is systematically collected by the clinician at each study visit. They will follow the procedures outlined in SOP ID106_AE Reporting. The subjects are asked at each appointment if they have experienced any events since the last appointment. During the appointments the subjects are then asked questions about the event to gather details and to determine the severity of the event. If a subject reports pain that results in the inability to use the device, he will be withdrawn from the study in order to avoid any pain from using the device and to remove partial data from the study. For reports of pain caused by insertion or the dome itself, the problem can be addressed in the clinic. For example, a different style or size of dome can be placed on the hearing aid, and re-training of insertion can be performed with the subject to avoid wrong or forceful insertion of the device. For reported pain they will be advised to not wear the device for 24 hours before resuming use.

Foreseeable adverse events outlined in the risk management file include discomfort caused by the domes, domes or filters falling off in the ear, no amplification coming from the device causing alarms or traffic to not be heard by the subject, skin reaction if chemical profile of device is changed, maximum output of the device exceeding 132 dB SPL, battery exploding or catching fire, swallowing of a lithium battery, and the device affecting other medical devices worn by the subject. The incidence of all of these risks or adverse events is improbable. To mitigate the risk, the IFU describes how to insert the device, how to change the domes, and how to change a battery in case of no amplification. The IFU describes how to clean the device, domes, and filters in order to not introduce cleaning agents that might change the chemical profile of the hardware of the device. The labelling warns of the potential maximum output of the device. The IFU instructs the user to keep the device away from explosive environments, and to keep them away from children or pets that might swallow the batteries. The IFU warns of interference with implantable devices.

10.1.1 Definition and Assessment of (Serious) Adverse Events and other safety related events

Adverse Event (AE)

Any untoward medical occurrence, unintended disease or injury or any untoward clinical signs (including an abnormal laboratory finding) in participants, users or other persons whether or not related to the investigational medical device [ISO 14155: 3.2].

This includes events related to the IMD or the RMD and to the procedures involved. For users or other persons this is restricted to events related to the investigational medical device.

Adverse Device Effect (ADE)

Adverse event related to the use of an investigational medical device [ISO 14155: 3.1].

This includes any adverse event resulting from insufficient or inadequate instructions for use, deployment, implantation, installation, operation, or any malfunction of the investigational medical device. This includes any event that is a result of a use error or intentional misuse.

AEs/ADEs include:

- Exacerbation of a pre-existing disease or condition.

- Increase in the frequency or intensity of a pre-existing episodic disease or medical condition.

- Any disease or medical condition detected or diagnosed after treatment with the study intervention device even though it may have been present yet undetected prior to the start of the clinical investigation.

- Any continuous persistent disease or symptoms present at baseline that worsen following the start of the clinical investigation.

- Events considered by the investigator to be related to any of the clinical investigation-mandated procedures.

- Abnormal assessments, e.g. physical examination findings, will be reported as AEs/ADEs if they represent a clinically significant finding that was not present at baseline or that has significantly worsened during the course of the clinical investigation.

- Test abnormalities will be reported as AEs/ADEs if they represent a clinically significant finding, symptomatic or not, which was not present at baseline or has significantly worsened during the course of the clinical investigation.

AEs/ADEs do not include:

- Pre-planned interventions or occurrences of endpoints specified in the CIP are not considered AEs/ADEs, if not defined otherwise.

- Unrelated medical or surgical procedures, e.g. surgery, endoscopy, tooth extraction, transfusion. However, the event leading to the procedure may be considered an AE. If this event is serious, the procedure will be described in the SAE/SADE narrative.

- Any pre-existing disease or medical condition that remains stable and does not worsen during the course of study participation.

- Situations in which an adverse change did not occur, e.g., hospitalizations for unrelated cosmetic elective surgery or for social and/or convenience reasons.

Serious Adverse Event (SAE) [European regulation on medical devices 2017/745, art. 58].

Any adverse event that led to any of the following:

(a) death,
(b) serious deterioration in the health of the subject that resulted in any of the following:
  (i) life-threatening illness or injury,
  (ii) permanent impairment of a body structure or a body function,
  (iii) hospitalisation or prolongation of patient hospitalisation,
  (iv) medical or surgical intervention to prevent life-threatening illness or injury or permanent impairment to a body structure or a body function,
  (v) chronic disease,
(c) foetal distress, foetal death or a congenital physical or mental impairment or birth defect.

This includes device deficiencies that might have led to a serious adverse event if a) suitable action had not been taken or b) intervention had not been made or c) if circumstances had been less fortunate. These are handled under the SAE reporting system. A planned hospitalisation for pre-existing condition, or a procedure required by the protocol, without a serious deterioration in health, is not considered to be a serious adverse event.

Device deficiency

Inadequacy of a medical device related to its identity, quality, durability, reliability, safety or performance, such as malfunction, misuse or use error and inadequate labelling [ISO 14155: 3.15].

Health hazards that require measures

Findings in the trial that may affect the safety of study participants and, which require preventive or corrective measures intended to protect the health and safety of study participants SAE [ClinO Art. 37].

Causal Relationship of SAE [MEDDEV 2.7/3 revision 3, May 2015].

A causal relationship towards the medical device or study procedure should be rated as follows:

- **Not related:** The relationship to the device or procedures can be excluded.
- **Unlikely:** The relationship with the use of the device seems not relevant and/or the event can be reasonably explained by another cause, but additional information may be obtained.

- **Possible:** The relationship with the use of the investigational device is weak but cannot be ruled out completely. Alternative causes are also possible.
- **Probable:** The relationship with the use of the investigational device seems relevant and/or the event cannot reasonably be explained by another cause.
- **Causal relationship:** The serious event is associated with the investigational device or with procedures beyond reasonable doubt.

Device deficiencies that might have led to an SAE are always related to the medical device.

10.1.2 Reporting of (Serious) Adverse Events and other safety related events

Reporting to Sponsor

The following events are to be reported to the Sponsor within 24 hours upon becoming aware of the event:

- All SAEs
- Health hazards that require measures
- Device deficiencies

The Sponsor will evaluate SAEs with regard to causality and seriousness. Device deficiencies are assessed regarding their potential to lead to an SAE.

Reporting to Authorities [ClinO Art. 42]:

In Category C studies it is the Investigator's responsibility to report **serious adverse events** in Switzerland which are

- related or possibly related to the medical device under investigation
- related or possibly related to study procedures

to the Ethics Committee via BASEC within 7 days. The Sponsor reports within the same timeline to Swissmedic (incl. events from abroad).

- **Health hazards** that require measures are reported via BASEC within 2 days [ClinO Art. 37].

Periodic safety reporting:

In Category C studies a yearly safety update-report is submitted by the Investigator to the Ethics Committee and by the Sponsor to Swissmedic.

10.1.3 Follow up of (Serious) Adverse Events

The adverse event shall be followed by the PI until its resolution or until the adverse event is recognized as permanent or stable condition by the PI. Follow-up investigations may be necessary according to the PI's medical judgement. In this situation, the follow-up does not have to be documented in the CRF but must be noted in the source documentation.

In case of SAE / SADE the sponsor can be contacted following the list below. If the first person in the list cannot be timely contacted, the PI should try to contact the next and so on.

Contact order

Contact order	Name	Mobile	Office	E-Mail
1	Michael Ernst	+41 31 998 15 57	Head of SIV	mier@bernafon.com
2	Bruno Keller	+41 31 998 15 92	Senior Director	brke@bernafon.com

Table1. Contact information of the sponsor in case of SAE/SADE

11. STATISTICAL METHODS

11.1 Hypothesis

The feedback canceller used in the IMD is an extension of the feedback canceller implemented in the RMD but newly designed for dynamic situations, e.g. insertion of the device, phone call, removal… Regarding feedback performances, we can expect less annoyance of feedback in some dynamic situations which are tested within the live feedback test. The feedback canceller in static situations is based on the same principle and functions the same in the IMD as in the RMD.

Variance in the results can come from manipulation, individual programmed gain, acoustical coupling within the ear canal, or individual rating. However, there are no technical reasons that feedback annoyance with IMD should be higher than with the RMD. Therefore, a one-sided test will be used to evaluate the benefit of the IMD in terms of feedback annoyance.

11.2 Determination of Sample Size

The primary outcome, the live feedback test, measures the feedback annoyance on a visual analogue scale for different manipulations that could produce feedback. An internal pilot test found an average improvement of 1.54 points (SD 1.63 points) with the newly developed feedback canceller (prototype) on the feedback annoyance scale. This effect was obtained on a group of listeners with moderate to severe hearing loss.

A test with a homogenous group of participants, i.e. hearing loss and hearing aid style, and repeated measures would require 11 subjects to show an effect with an alpha value of 2.5%, a power of 80%, and an effect size of 0.94. Similar conditions can be found in subjects who are eligible to be fitted with the Super Power BTE device. Therefore, 11 participants should be recruited for the third phase.

For the first and second phases, the inclusion criteria for the hearing loss degree covers a larger range of configurations. The IMD styles, i.e. miniRITE-T and miniRITE-T rechargeable, offer also more acoustical options than the SP style during the fitting. These 2 parameters, the hearing loss degree and acoustical coupling, are known to influence the risk of acoustical feedback. This added variation might reduce the effect size of the feedback annoyance with the IMD and must be compensated with an increased sample size. For the first and second phases, we propose to expand the sample size to 22 subjects to compensate for the effect size reduction. A power of 83% can be achieved with an effect size of 0.65, alpha value of 2.5% and 22 subjects.

11.3 Statistical criteria of termination of trial

There are no plans for early termination of the trial.

11.4 Planned Analyses

11.4.1 Datasets to be analysed, analysis populations

Primary analysis of the primary outcome will be based on the intention-to-treat (ITT). The ITT population will include all participants with associated primary outcome data, excluding only subjects who were deemed ineligible following the screening visit, those who withdrew from the trial and were unwilling for their previously collected data to be utilised or those who failed to provide baseline.

11.4.2 Primary Analysis

The live feedback test provides a measure of feedback annoyance on a visual analogue scale. A paired t-test will be used to evaluate if the observed difference (RMD - IMD) is higher than 0 in a first intention. However, the following factors are identified and should be included within a second analysis based on mixed-effect regression:

- Test device RMD vs IMD which is the main fixed effect,
- Participant as a random effect for the repeated measures, and the side (left-right) as nested random factor within participant,
- Feedback risk with the acoustical coupling, the hearing loss degree, and maximum gain measured from the REM,
- Manipulation as fixed effect.

The second analysis should provide more details about the dependencies between hearing loss degree, acoustical option and feedback annoyance.

11.4.3 Secondary Analyses

Speech Test

Speech is measured with a standardized test called the WaKo Rhyme test from Wallenberg and Kollmeier (1989). The WAKO test is a closed word recognition test, i.e. one word is presented acoustically, and the subject must choose one answer out of five proposals. The outcome of each tested item is either 0 and 1 which can be modelled by a logistic mixed effect regression. Fixed effects are test condition, listening condition, hearing loss, i.e. 4- frequencies average of the best ear. Random effects are the participants and the tested item.

Product Questionnaire

Experienced acoustical feedback and sound quality are reported via a 5-points Likert scale. Differences between test conditions will be analysed with Wilcoxon signed-rank test.

11.4.4 Interim analyses

We plan to have 3 interim and one final analyses. A separate analysis will be performed after each completed phase. These interim analyses are based on a one-sided superiority hypothesis, i.e. there is less feedback annoyance with the IMD than with the RMD.

Valuable information may also be gained by summarizing the results of all the conducted comparisons at the end of the study. It should be presented in an identical form to allow direct comparison on the estimates and their confidence limits.

11.4.5 Safety analysis

The adverse event risks of taking part in the study have been assessed to be low. Numbers of adverse events and serious adverse events will be cross-tabulated for each IMD style and categorised by severity. No formal statistical analysis will be conducted, but AEs and SAEs will be closely monitored throughout the process.

11.4.6 Deviation(s) from the original statistical plan

Due to the home-based nature of the trial, it is possible that there will be a few deviations from the study protocol, e.g. not wearing hearing aid, manipulation issues, misplacement, etc.

As well as non-compliance with the protocol, there could be other protocol deviations, for example if follow-up assessments took place outside the pre-specified ±10 days window. The numbers and proportions of participants with protocol deviations will be summarised with details of type of deviation provided. No formal statistical testing will be undertaken.

11.5 Handling of missing data and drop-outs

Unless specified otherwise in each objective, no statistical techniques will be used to impute missing data. If a subject's data are missing for any reason, that subject will not be included in that portion of the analysis. The number of subjects included in each analysis will be reported so that the potential impact of missing data can be assessed.

12. QUALITY ASSURANCE AND CONTROL

The Sponsor is responsible for implementing and maintaining quality assurance and quality control systems with written SOPs and Working Instructions. The PI is responsible for proper training of all involved study personnel.

12.1 Data handling and record keeping / archiving

Data will be archived with an electronic data management system. The subjects will be given numbers to maintain anonymity. There are also hard copies of subjects' charts that are kept in a locked file cabinet inside of the clinic room. Only the PI, statistician, Monitor, and Auditor will have access to the information. The information will always be archived under the identification number with a key to the identification codes stored in another location (described in chapter 2.8).

12.1.1 Case Report Forms

Participant identities are coded using a participant identification number.

The PI will enter protocol defined data into a web based Electronic Case Report Forms using an EDC-software that conforms to 21 CFR Part 11 (FDA guidance) requirements. Site staff will be given access to the EDC system after a training. The data are checked automatically for plausibility and discrepancies. The generated appropriate error messages, allow the data to be confirmed or corrected before being saved in the database. At the end of the study, the PI must certify that the data entered into the Electronic Case Report Forms are complete and accurate. After database lock, the PI will receive a CD-ROM of the patient data for archiving at the site.

The CRF contains the following information:

Field	**Author**
Date of examination	PI
Subject birth year	PI
Participant identification number	PI
Age	PI
Sex	PI
Otoscopy	PI
Standard audiometry	PI
Hearing loss classification	PI
Eligibility	PI
Trial information provided	PI
Date of Informed Consent	PI
Inclusion / Exclusion Criteria	PI
Ear disease	PI
Control hearing device serial numbers	PI
Real ear measure	PI
Investigational device serial numbers	PI
Results from WaKo	PI
Questionnaires received	PI
Questionnaires returned	PI

Devices returned	PI
IFU received	PI
Results from preference questionnaire	PI
Results from product questionnaire	PI
Results from SSQ questionnaire	PI
AEs / SAEs, ADE / SADE	PI
Next appointment	PI
Name, date, signature of PI	PI

12.1.2 Specification of source documents

The Principle Investigator will maintain adequate and accurate records to enable the conduction of the study to be fully documented and the study data to be subsequently verified. These documents will be classified into two different categories: PI's file, and subject clinical source documents. There will be a PI file or Investigator Site File (ISF) as well as corresponding subject files with source documents.

The PI's file will contain the CIP/amendments, IB/Instructions for use, CRFs, site standard operation procedures (SOPs) or reference to it, EC and CA approval with correspondence, informed consent, device records, staff curriculum vitae and authorization forms, screening and enrolment logs, site-specific subject identification code logs, and other appropriate documents/ correspondence as required by EN ISO 14155 and local regulations.

Subject clinical source documents include, but are not limited to subject hospital/clinic records, physician's and nurse's notes, appointment book, hearing test results, questionnaires, consultant letters, visit dates, signed Informed Consent Forms, randomisation numbers, SAEs, AEs, etc.

These two categories of documents must be kept on file by the PI for 10 years. If source documents are not durable as long as needed they must be preserved as a copy. When source documents are required for the continued care of the subject, appropriate copies should be made for storing outside of the site. The information will always be archived under the identification number with a key to the identification codes stored in another location (described in chapter 2.8).

For each subject enrolled an encoded electronic CRF must be completed and e-signed by the PI. This also applies to those subjects who fail to complete the study. If a subject withdraws from the study, the reason must be noted on the CRF.

Case report forms are to be completed immediately after the visit.

Source data corrections will only be performed by study site staff, authorized by the PI. All forms should be completed using a blue permanent pen and must be legible. Errors should be crossed out but not obliterated, the correction inserted, and the change initialled and dated by the PI, co-PI or other investigator.

The entries will be checked by the Monitor and any errors or inconsistencies will be checked immediately. The Sponsor will collect original completed eCRFs on a CD-ROM at the end of the study. The CD-ROM with the completed and e-signed CRFs will remain on site and archived.

Source data must be available at the site to document the existence of the study participants. Source data must include the original documents relating to the study, as well as the medical treatment and medical history of the participant.

12.1.3 Record keeping / archiving

(ICH/E6 6.13)
ICH: Data Handling and Record Keeping

All study data must be archived for a minimum of 10 years after study termination or premature termination of the clinical trial.

Trial documentation is stored in water and fire resistant locked boxes in the basement of the Sponsor's building,

12.2 Data management

12.2.1 Data Management System

The CRFs in this trial are implemented electronically using a dedicated electronic data capturing (EDC) system. The EDC system is activated for the trial only after successfully passing a test procedure.

All data entered in the CRFs are stored on a Windows server in a dedicated database located in Denmark.

12.2.2 Data security, access and back-up

The server hosting the EDC system and the database is kept in a locked server-room in Denmark. Only the system administrators have direct access to the server. A role concept with personal passwords (site investigator, statistician, monitor, administrator etc.) regulates permission for each user to use the system and database as he/she requires.

All data entered into the CRFs are transferred to the database using Secure Sockets Layer (SSL) encryption. Each data point has attributes attached to it identifying the user who entered it with the exact time and date. Retrospective alterations of data in the database are recorded in an audit table. Time, table, data field, original value and altered value, and the person are recorded (audit trail).

A multi-level back-up system is implemented. Back-ups of the whole system including the database are run several times per day. The back-up-data are stored in a secure place on a different storage-server.

12.2.3 Analysis and archiving

At final analysis, data files will be extracted from the database into statistical packages to be analysed. The database will be locked at this time, recorded in special archiving format and securely stored for at least 1 year. In addition, the PI will receive a CD-ROM of the trial data for archiving at the site.

12.2.4 Electronic and central data validation

Data can be entered into the database only after a check of completeness and plausibility. Furthermore, selected data points are cross-checked for plausibility with previously entered data for that participant.

Monitoring is used to validate entries with source data.

12.3 Monitoring

The study site will be monitored by an employee of the Sponsor. A minimum of 5 visits will be performed; one site initiation visit, at least 3 (1 during each phase) routine monitoring visits and one close out visit. The number of routine monitoring visits will be increased if needed based on the course of the study. The first routine monitoring visit will take place shortly after at least 5 patients have been enrolled.

Source documents will be made available for the monitor and the principle investigator or a delegated and authorized person will be available during the visits to answer questions.

100% source data verification will be completed for 3 patients at the first interim visit. For any additional interim visits, another 3 patients of 100% source data verification will be completed at each visit.

Subject to SDV for all patients are:

Patient Informed Consent Form

Eligibility criteria

Diagnosis

Visit dates

Study intervention details related to:

Procedural success

Procedure date and time

(Serious) Adverse Events Device deficiencies

The content of Investigator Site File (ISF) will be checked during each monitoring visit.

12.4 Audits and Inspections

CEC as well as CA have the right to execute inspections at the study site. The Sponsor may at any time conduct an audit of the study site.

The study documentation and the source data/documents must be made accessible to auditors/inspectors and questions have to be answered during audits/inspections. All involved parties must keep the participant data strictly confidential.

12.5 Confidentiality, Data Protection

Direct access to source documents will be permitted for the purposes of monitoring, audits and inspections and only authorized persons involved in those activities are allowed to have direct access to source documents and must keep participants data strictly confidential.

12.6 Storage of biological material and related health data

No biological samples are taken or stored. Data collected during the trial will be stored and potentially reused for further analysis only with the participants' consent independent of the study. The data will remain encoded because results are only recorded using the identification code of the subject.

13. PUBLICATION AND DISSEMINATION POLICY

Trial results will be communicated to participants at the end of the trial. The trial results primary purpose is for internal product validation to ensure safety and performance of the device. The results will be communicated to other relevant groups (e.g., via publication, reporting in results databases, and other internal data sharing arrangements) as needed and for the purpose of sharing scientific information within the industry. The only people with authorship eligibility will be those that worked on the trial including the PI, statistician, and any other clinicians involved in testing. Any plans for writing will not include access to the full protocol but a description of it as well as a description of the participants. Statistics will be described sufficiently so that the reader understands the analysis and any conclusions made from it. Ultimately the decision to submit the report for publication and the ultimate authority over any of the activities is held by the Sponsor, Bernafon

14. FUNDING AND SUPPORT

14.1 Funding

The Sponsor will financially support the trial including providing the clinic and all materials needed to complete the testing. This includes the devices themselves as well as equipment.

15. INSURANCE

Insurance will be provided by the Sponsor. A copy of the certificate is filed in each investigator site file and the trial master file.

16. REFERENCES

Provide a list of the references cited in the protocol.

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16. Spriet, A. and Moonen, M. (2010). Evaluation of feedback reduction techniques in hearing aids based on physical performance measures. *Journal of the Acoustical Society of America. 128*(3). 1245-1261.
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17. APPENDICES

1. Medical Devices: IB (according to ISO 14155)
2. Medical Devices: Assurance of producer
3. Medical Devices: List of norms (vollständig eingehaltene, teilweise eingehaltene)
4. Case Report Form (e.g.) CRF
5. Instructions for Use
6. Statistical Plan
7. Patient Information and Informed Consent
8. List of study sites / PIs
9. Questionnaires