








Tools used in the subjective evaluation of bone anchored hearing aid users: scope review

Ferramentas utilizadas na avaliação subjetiva de usuários de prótese auditiva ancorada no osso: revisão de escopo

Cláudia Daniele Pelanda Zamprônio¹ , Luara Rezende Madeira¹ , Leticia Faccim Padovani² , Eliane Aparecida Techi Castiquini¹ , Wanderleia Quinhoneiro Blasca² , Jerusa Roberta Massola Oliveira¹ , Luciana Paula Maximino² 

ABSTRACT

Purpose: to identify the questionnaires and scales used as subjective tools for the assessment process regarding the benefit and satisfaction of users of Bone-Anchored Hearing Aids to answer the following guiding question: Which questionnaires and scales are used in adults to evaluate the benefit and satisfaction of Bone-Anchored Hearing Aid users? **Research strategy:** the search was carried out in the PubMed, SciELO, Scopus, Web of Science, Lilacs and Embase databases and, in gray literature, Google Academic and Brazilian Digital Library of Theses and Dissertations were used as information sources. The descriptors used were: bone-anchored prosthesis, hearing loss, mixed conductive-sensorineural, quality of life, patient satisfaction, surveys and questionnaires. **Selection criteria:** studies that used questionnaires and scales to verify the benefit and satisfaction of users of Bone-Anchored Hearing Aid, published in Portuguese, English or Spanish, from 1999 to 2022, were included. **Results:** 176 articles were identified. Of this total, 67 were included in the scoping review. The literature indicated that the most used tools in the process of assessing benefit and satisfaction in Bone-Anchored Hearing Aid users were the Glasgow Benefit Inventory questionnaires, the Abbreviated Profile of Hearing Aid Benefit, and the Speech, Spatial, and Quality of Hearing Scale. **Conclusion:** There are several instruments to be used, such as the Glasgow Benefit Inventory and the Abbreviated Profile of Hearing Aid Benefit for benefits and the exclusive Audio Processor Satisfaction Questionnaire for the specific satisfaction of this population. As far as scales are concerned, The Speech, Spatial and Hearing Qualities Scale evaluates the benefit.

Keywords: Bone-anchored prosthesis; Hearing aids; Hearing loss; Patient satisfaction; Quality of life; Questionnaires

RESUMO

Objetivo: identificar os questionários e escalas utilizados na avaliação do benefício e da satisfação dos usuários de próteses auditivas ancoradas no osso, respondendo a questão norteadora: “Quais questionários e escalas são utilizados para avaliar o benefício e a satisfação dos usuários de prótese auditiva ancorada no osso?”. **Estratégia de pesquisa:** busca realizada nas bases de dados Public Medicine Library, Scopus, Web of Science, LILACS e Embase. Na literatura cinzenta, utilizou-se a fonte de informação Google Acadêmico e a Biblioteca Digital Brasileira de Teses e dissertações, por meio dos descritores: prótese ancorada no osso (*bone-anchored prosthesis*), perda auditiva condutiva-neurosensorial mista (*hearing loss, mixed conductive-sensorineural*), qualidade de vida (*quality of life*), satisfação do paciente (*patient satisfaction*), inquéritos e questionários (*surveys and questionnaires*). **Crítérios de seleção:** incluídos estudos que utilizaram questionários e escalas para verificar o benefício e a satisfação dos usuários de prótese auditiva ancorada no osso, publicados em português, inglês ou espanhol, de 1999 até 2024. **Resultados:** foram identificados 176 artigos e, destes, 67 foram incluídos na revisão de escopo. A literatura apontou que as ferramentas mais utilizadas foram os questionários *Glasgow Benefit Inventory*, o *Abbreviated Profile of Hearing Aid Benefit* e a escala *Speech, Spatial, and Quality of Hearing Scale*. **Conclusão:** vários são os instrumentos utilizados na avaliação do benefício e da satisfação dos usuários de próteses auditivas ancoradas no osso, como o *Glasgow Benefit Inventory* e o *Abbreviate Profile of Hearing Aid Benefit* para benefício e o *Audio Processor Satisfaction Questionnaire*, exclusivo para satisfação específica dessa população. Quanto à escala tem-se a *Speech, Spatial and Qualities of Hearing Scale* para avaliar benefício.

Palavras-chaves: Prótese ancorada no osso; Auxiliares de audição; Perda auditiva; Satisfação do paciente; Qualidade de vida; Questionários

Study carried out at Divisão de Saúde Auditiva, Hospital de Reabilitação de Anomalias Craniofaciais – HRAC, Universidade de São Paulo – USP – Bauru (São Paulo), Brasil.

¹Divisão de Saúde Auditiva, Hospital de Reabilitação de Anomalias Craniofaciais – HRAC, Universidade de São Paulo – USP – Bauru (SP), Brasil.

²Departamento de Fonoaudiologia, Faculdade de Odontologia – FOB, Universidade de São Paulo – USP – Bauru (SP), Brasil.

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Corresponding author: Cláudia Daniele Pelanda Zamprônio. E-mail: claudiazam@usp.br

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INTRODUCTION

Bone-anchored hearing aids (BAHA) are bone sound conduction devices through which vibrations from the skull are transferred to the inner ear and transformed into auditory sensation⁽¹⁾. The discovery that a titanium implant can be firmly fixed to the bone through a process called osseointegration favored the development of these devices⁽²⁾. In addition to the surgically positioned titanium implant, the devices have an externally allocated audio processor, with or without abutment, percutaneous, or transcutaneous, respectively, both capable of decoding sounds and transmitting them through vibration directly to the cochlea⁽¹⁾.

Since the 1970s, BAHA has been implemented worldwide, becoming a standard of care for individuals who present unilateral conductive, mixed, or sensorineural loss, and who do not benefit from the conventional sound amplification device, whose transmission occurs by air conduction^(3,4). In Brazil, following the recommendations of the Food and Drug Administration (FDA), the Brazilian Health Regulatory Agency (ANVISA) recommends that BAHA be indicated for the population over 5 years of age, as long as they have sufficient skull bone thickness, according to medical criteria^(5,6). Currently, there are two percutaneous systems available on the market, BAHA® Connect (Cochlear, New South Wales, Australia) and Ponto® (Oticon Medical, Herning, Denmark), which are coupled with the external unit via a titanium pin implanted in the bone⁽⁷⁾.

More than 200,000 patients worldwide have received percutaneous BAHA, with a high long-term success rate and a low complication rate^(8,9), proving its benefits in auditory rehabilitation⁽¹⁰⁾.

In the transcutaneous system, an internal magnet is surgically implanted and the sound processor is coupled to the external magnet, which will remain in direct contact with the skin⁽¹¹⁾. Thus, the magnet contact region remains intact, excluding post-surgical skin problems observed with percutaneous devices⁽¹²⁾. However, the attenuation caused by sound transmission to the skin results in limited acoustic gain at high frequencies⁽¹³⁾.

BAHA are widely used for auditory rehabilitation and are indicated in cases of conductive and mixed hearing loss and unilateral sensorineural hearing loss⁽⁷⁾. Considering the auditory rehabilitation process resulting from the indication of BAHA, it is essential to use standardized protocols to monitor individuals.

When evaluating and monitoring BAHA, procedures such as free-field audiometry and speech tests, with and without noise, are selected to investigate the performance of users of these hearing devices⁽¹⁴⁾. However, these tests do not consider the individual's opinion regarding BAHA's use, making this subjective assessment necessary.

When evaluating the results of the indicated therapeutic resource, such as BAHA, it is essential to verify the user's point of view. The aspects that need to be verified are benefit and satisfaction, measures of individual's judgment. Such verification must be based on rigorous scientific bases. Therefore, searching the literature for tools such as questionnaires and scales that measure the benefit and satisfaction of users with transcutaneous and percutaneous BAHA is opportune.

In a previous database search, it was found that there is no scoping review that identifies the questionnaires and scales that evaluate the benefits and satisfaction of BAHA users, proving the need to conduct this type of review.

AIM

This scoping review aimed to verify in the literature the tools, such as questionnaires and scales, that measure the benefit and satisfaction of BAHA users.

SEARCH STRATEGY

This is a scoping review conducted using the *Reviewer's Manual: Methodology for JBI Scoping Reviews* with the results presented according to the *Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews* (PRISMA-ScR)⁽¹⁵⁾ and registered at *Open Science Framework* (OSF) with DOI 10.17605/OSF.IO/V8B7U. Scientific evidence was collected by mapping the existing literature according to the following question: "Which questionnaires and scales are used in adults to evaluate the benefit and satisfaction of Bone-Anchored Hearing Aid users?" adopting the Population, Concept, and Context (PCC)⁽¹⁶⁾ strategy, with Population: users of bone-anchored hearing aids; Concept: questionnaires and scales to assess benefit and satisfaction; Context: clinical assessment process.

Database and search strategy

The descriptors in Portuguese were selected from the Health Science Descriptors (DeCS) and in English from the Medical Subject Headings (MeSH). The search for materials considered publications from 1999 to March 2024, carrying out a complete scan of the literature over a long period, with adult and elderly individuals, in the following databases: Latin American and the Caribbean Literature in Health Sciences (LILACS), Public Medicine Library (PubMed), Scientific Electronic Library Online (SciELO), Scopus, Embase, Web of Science and, as gray literature, Google Scholar and the Brazilian Digital Library of Theses and Dissertations (BDTD) were used as information source. The search strategies for PubMed, other international databases and gray literature were: 1- (Bone Conduction) OR (Hearing Aids) OR (Bone-Anchored Prosthesis) OR (Osseointegration) AND2- (Hearing Loss, Conductive) OR (Hearing Loss, Mixed Conductive-Sensorineural) AND3- (Quality of Life) OR (Patient Satisfaction) OR (Treatment Outcome) OR (Patient Reported Outcome Measures) AND4- (Surveys and Questionnaires). Before carrying out the scoping review, the MEDLINE database (PubMed), the scoping review research manager Open Science Framework (OSF) and the Joanna Briggs Institute (JBI) database were checked, certifying that there were no current or pending review on the subject.

SELECTION CRITERIA

The identification of materials in the databases, with descriptors, was carried out using search strategies. Duplicate materials were excluded using the "Endnote®" reference management system. After excluding duplicate materials, the selection was carried out independently by two reviewers. Initially, the studies were pre-selected for reading the title

and abstract, to check whether they corresponded to the aim proposed for the review. The pre-selected documents were then read in full, identifying in detail and precisely their relevance for the research, in addition to considering the inclusion criteria. Divergence between the reviewers were resolved by a third reviewer, in both stages. The full texts were entered into the scientific materials management application Rayyan®. The article selection process was compiled into a flowchart (Figure 1).

DATA ANALYSIS

A table was developed to insert data of interest from the included studies, extracted by two independent reviewers: year of publication, first author, country of origin, objective, questionnaire and scale used.

RESULTS

The results of the scoping review that identified the questionnaires and scales used as subjective tools in the process of evaluating the benefit and satisfaction of users of bone-anchored hearing aids, to answer the guiding question, are presented in Table 1.

Initially, 176 studies were identified in the databases, namely: PubMed (79), Scopus (38), Embase (25), LILACS (2), Web of Science (7), and 25 in the gray literature. After excluding

duplicates, 144 studies remained, and 78 after reading the title and abstract. Of these, 11 were removed due to the following factors: 6 because the subjects evaluated did not fit into the stipulated age range (18 years or older); 2 for not specifying the questionnaire used; 1 for evaluating the cost of the device used; 1 for being applied in the pre-surgical condition and 1 for being in the Russian language. Therefore, 67 articles were included in the scoping review, 65 of which were published in English and 2 in Spanish.

As for the year of publication, the 67 scientific materials, made available as articles, were published in periods from 1999 to March 2024, in different countries and with greater predominance in European countries such as the Netherlands, the United Kingdom and Germany. The objectives of the studies were varied and ranged from verifying the results of audiological exams, evaluating speech perception, verifying quality of life, benefit and satisfaction.

In the process of evaluating BAHA user satisfaction, the most cited questionnaires used in the research methodology were: (24) *Glasgow Benefit Inventory* (GBI)⁽⁸³⁾, (24) *Abbreviate Profile of Hearing Aid Benefit* (APHAB)⁽⁸⁴⁾, (6) *Glasgow Hearing Aid Benefit Profile* (GHABP)⁽⁸⁵⁾, (5) *International Outcome Inventory for Hearing Aids* (IOI-HA)⁽⁸⁶⁾, (5) *Health Utilities Index* (HUI)⁽⁸⁷⁾, (4) *Audio Processor Satisfaction Questionnaire* (APSQ)⁽²⁷⁾. Regarding the scale, the most used was the *Speech, Spatial and Qualities of Hearing Scale* (SSQ)⁽⁸⁸⁾, used for data collection in 14 studies.

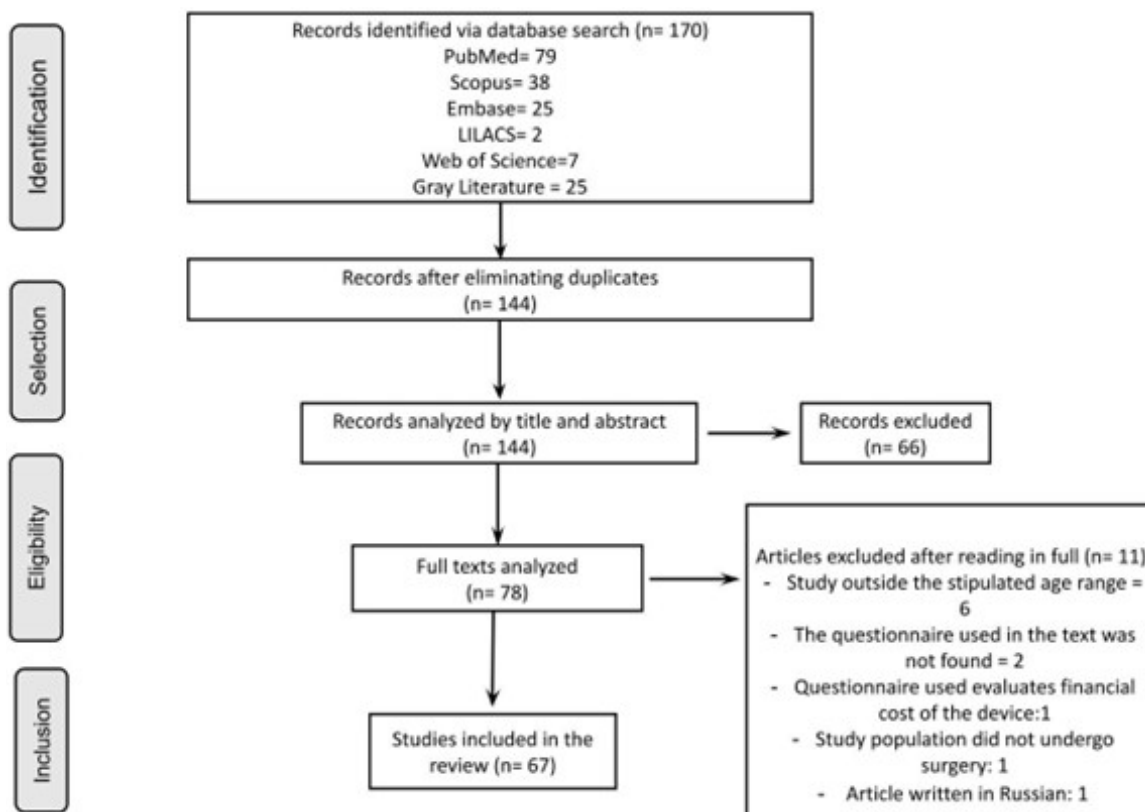


Figure 1. Flowchart of data collection and selection of studies that make up the sample
Subtitle: n= number of publications

Table 1. Characterization of articles included in the review

Author (year)	Study Location	Questionnaire/ Scales Used	Aim of the Study
Cowan et al. ⁽¹⁷⁾ – 2024	Austrália	HUI-3/ APHAB/ SSQ	• To investigate the 2-year postoperative hearing performance reported by adult hearing-impaired patients using the OSIA SYSTEM.
Hua and Lewis ⁽¹⁸⁾ – 2024	Sweden	HUI-3/SSQ	• To investigate how auditory rehabilitation with bone conduction hearing implants impacts the quality of life in working-age adults.
Young et al. ⁽¹⁹⁾ -2023	USA	GBI	• To Examine clinical, audiological and quality of life outcomes in patients undergoing OSIA implantation.
Nevoux et al. ⁽²⁰⁾ – 2023	Germany	QoL/APHAB/SSQ/ HUI-3	• To compare hearing results and quality of life in patients who were users of a BAHA ATTRACT system to the OSIA SYSTEM.
Portelli et al. ⁽²¹⁾ – 2023	Germany	APHAB/GBI	• To assess the differences between two types of bone-anchored hearing aids (BAHA), percutaneous versus transcutaneous implants, in terms of audiological and psychosocial outcomes.
Rausch et al. ⁽²²⁾ – 2022	Germany	SSQ/APHAB/ HUI-3	• To investigate long-term data on audiological outcomes and hearing-related quality of life for the OSIA SYSTEM
Willenborg et al. ⁽²³⁾ -2022	Germany	APHAB / BBSSD	• To evaluate the surgical procedure, audiological results, and patient satisfaction for the Osia device (Cochlear) in patients with SSD.
Lewis et al. ⁽²⁴⁾ – 2022	Sweden	HUI-3 /SSQ	• To examine how Bone Conduction Hearing Implantation affects health-related quality of life and Hearing impairment in adult patients with chronic otitis media.
Irmer et al. ⁽²⁵⁾ – 2022	Germany	AQoL-8D / SSQ12-B: APSQ	• To determine quality of life, subjective Hearing experience and patient satisfaction after Bone conduction implantation.
Garcier et al. ⁽²⁶⁾ – 2021	France	APHAB / EVA	• To evaluate the ease of implantation, Hearing performance and the benefit reported by the patient using active Bone Conduction Hearing Implantation
Billinger-Finke et al. ⁽²⁷⁾ -2020	Germany/ Australia	APSQ	• To develop and validate a specific, standardized questionnaire that focuses on user satisfaction with your audio processor.
Ordóñez-Ordóñez et al. ⁽²⁸⁾ – 2020	Colombia	GBI	• To describe audiological results and changes in quality of life after switching from Baha Connect (percutaneous) to Baha Atract (transcutaneous).
Hundertpfund et al. ⁽²⁹⁾ - 2020	Germany	SSQ12-B APSQ	• To evaluate the benefit over time in the quality of life, satisfaction and time of use of patients rehabilitated with active Transcutaneous Bone Conduction Hearing Implantation.
Persson et al. ⁽³⁰⁾ –2020	Sweden	APHAB / GBI / IOI-HA	• To present audiometric results and reports from patients implanted with osteoAnchored prosthesis through questionnaires.
Svagan et al. ⁽⁴⁾ – 2019	Slovenia	GBI	• To discover how satisfaction differs between people who use percutaneous transcutaneous devices, and whether satisfaction influences the time of use and whether the indication of the device affects satisfaction.
Pérez-Carbonell et al. ⁽³¹⁾ –2019	Spain	APHAB / GBI	• To evaluate the functional and subjective gains of the PontoTMSuperPower device in patients with moderate to severe mixed Hearing loss.
Nevoux et al. ⁽³²⁾ –2018	France	APHAB / GHSI / GBI	• To analyze the surgical, Hearing and quality of life results of patients implanted with the Baha Atract.
Bosman et al. ⁽³³⁾ -2018	Netherlands	APHAB / SSQ / EVS	• To compare the performance of a super-powerful Bone-Anchored Hearing implantation, Baha Cordelle from Cochlear, and its successor, Baha 5 SuperPower (BCD2).
Pérez-Carbonell et al. ⁽³⁴⁾ -2017	Spain	GBI / APHAB	• Not available.
Hougaard et al. ⁽³⁵⁾ –2017	Denmark	IOI-HA / SSQ12 / CQ	• To examine objective and subjective audiological outcomes with a Bone-Anchored device transcutaneous (BAHA attract) in addition to important surgical parameters.
McLean et al. ⁽³⁶⁾ -2017	Australia	GBI / BAQ	• To describe the audiological and quality of life results with the use of the Sophono transcutaneous implant (Medtronic; Boulder, Colorado).
Weis et al. ⁽³⁷⁾ – 2017	Germany	BBSSD	• To examine functional Hearing results in relation to speech perception and sound localization after implantation of the Bonebridge active Bone conduction device (MED-EL, Innsbruck, Austria) and assess patient acceptance using a questionnaire.
Schmerber et al. ⁽³⁾ – 2017	France and Belgium	APHAB / GBI / IOI-HA	• To validate the safety and efficacy in the treatment of conductive and mixed Hearing loss or single-sided deafness with the Bonebridge Bone conduction processor 12 months after surgery.
Gawęcki et al. ⁽³⁸⁾ – 2016	Poland	GBI / APHAB / BAHU	• To evaluate the surgical, functional and audiological results of the Baha ® Atract system.
Carr et al. ⁽³⁹⁾ – 2016	UK	GBI	• To determine whether carry out the percutaneous Bone conduction Hearing Aid implantation in the elderly brings sufficient benefit and whether there is an association with the rate of complications compared to the population under 60 years of age.
Ihler et al. ⁽⁴⁰⁾ – 2016	Germany	GBI / APHAB	• To compare speech recognition in noise with a BoneBRIDGE transcutaneous Bone conduction device to external stimulation from a Bone conduction device.
Iseri et al. ⁽⁴¹⁾ – 2015	Türkiye	GBI	• To compare audiological clinical outcomes and patient satisfaction in Bone-Anchored Hearing Aid surgery with percutaneous and transcutaneous BAHA.
Busch et al. ⁽⁴²⁾ - 2015	Germany	APHAB / SSQ-C / QPA	• To compare the audiological result, handling and operation of the device and patient satisfaction with the two Bone conduction devices.
Reinfeldt et al. ⁽¹¹⁾ - 2015	Sweden	APHAB / GBI	• To investigate the audiological and quality of life outcomes of an active transcutaneous device, where the transducer is implanted under intact skin

Caption: APHAB = *Abbreviated profile of hearing aid benefit*; APSQ= *Audio Processor Satisfaction Questionnaire*; AQoL-8D = *Validity and reliability of the assessment of quality of life*; BAHA = *Bone anchored hearing aid* BAHU = *BAHA aesthetic, hygiene and use*; BAQ = *Entific medical systems bone-anchored hearing aid questionnaire*; BBSSD = *Bern benefit in single-sided deafness questionnaire*; COSI = *Client oriented scale of improvement*; EVS = *Analogic visual scale* GBI = *Glasgow benefit inventory*; GHABP = *Glasgow hearing aid benefit profile*; GHADP = *Glasgow hearing aid difference profile*; GHSI = *Glasgow health status inventory*; HDSS = *Hearing device satisfaction scale*; HHIA = *Hearing handicap inventory for adults*; HUI-3 = *Health utilities index-mark III*; IOI-HA = *International outcome inventory for hearing aids*; NQ = *Nijmegen questionnaire*; QoL = *Quality of life*; CQ = *Copenhagen Questionnaire*; QPA = *Questionnaire prepared by the author*; SF-36 = *36-item Short-form health survey*; SSD = *Single-sided deafness questionnaire*; SSQ = *Speech, spatial, and qualities of hearing scale*; SSQ12-B = *Speech, spatial and qualities of hearing scale*; SSQ-C = *Spatial and qualities of hearing scale for experienced user*

Table 1. Continued...

Author (year)	Study Location	Questionnaire/ Scales Used	Aim of the Study
Carr et al. ⁽⁴³⁾ – 2015	UK	GBI / COSI	<ul style="list-style-type: none"> To evaluate results with a new transcutaneous Bone conduction prosthesis.
Hill-Feltham et al. ⁽⁴⁴⁾ – 2014	UK	GHABP / QPA	<ul style="list-style-type: none"> To verify the satisfaction of experienced BAHA users and compare the benefit and satisfaction with two new devices: BAHA BP 100 Cochlear and Ponto Pro (Oticon).
Fan et al. ⁽⁴⁵⁾ – 2014	China	<i>Daily Use of BAHA</i>	<ul style="list-style-type: none"> To evaluate the speech recognition of Mandarin-speaking patients with percutaneous Bone-Anchored Hearing implantation, as well as patient satisfaction using 2 questionnaires.
Ihler et al. ⁽⁴⁶⁾ –2014	Germany	GBI	<ul style="list-style-type: none"> To review the functional outcomes and quality of life of the first patients implanted with a Bone conduction implant system (BONEBRIDGE).
McNeil et al. ⁽⁴⁷⁾ – 2014	Canada	SSQ / HHIA	<ul style="list-style-type: none"> To compare objective measurements of Hearing level with BAHA in a sound field and subjective assessments of its benefit; understand the individual and subjective aspects of Hearing and compare the benefits perceived by the partners or spouses of BAHA users with those perceived by the patients themselves.
Sprinzel et al. ⁽⁴⁸⁾ – 2013	Áustria	HDSS	<ul style="list-style-type: none"> To investigate the safety and efficacy of a new transcutaneous Bone conduction Hearing implant during a 3-month follow-up period.
Lekue et al. ⁽⁴⁹⁾ - 2013	Spain	GBI	<ul style="list-style-type: none"> To evaluate the improvement in the quality of life of patients using BAHA, the variations in results, the etiology of Hearing loss and the change in pre-operative tinnitus with the use of the device.
Zeitler et al. ⁽⁵⁰⁾ – 2012	USA	GHABP	<ul style="list-style-type: none"> To evaluate objective Hearing results and subjective benefits in patients undergoing Bone-Anchored Hearing Aids, in unilateral losses with residual Hearing.
Saroul et al. ⁽⁵¹⁾ – 2011	France	<i>Entific BAHA</i>	<ul style="list-style-type: none"> To evaluate patient satisfaction with percutaneous Bone-Anchored prosthesis (BAHA) and the role of preoperative audiometric testing.
Dotú et al. ⁽⁵²⁾ – 2011	Spain	EVS	<ul style="list-style-type: none"> To evaluate the audiological evolution and satisfaction of patients with severe to profound bilateral mixed Hearing loss in BAHA CORDELE II users.
Pfiffner et al. ⁽⁵³⁾ – 2011	Switzerland	APHAB	<ul style="list-style-type: none"> To verify, quantify and compare the benefit of the Baha BP100 with its immediate predecessor, the Baha Divino in terms of speech understanding in silence, noise and the subjective benefit perceived by users.
Ghossaini et al. ⁽⁵⁴⁾ -2010	USA	QPA	<ul style="list-style-type: none"> To report preliminary findings on long-term outcomes for users of the BAHA device.
Dun et al. ⁽⁵⁵⁾ – 2010	Netherlands	<i>Daily use of BAHA / SSQ</i>	<ul style="list-style-type: none"> To presents clinical data and quality of life questionnaire results in children and young adults with bilateral Bone-Anchored Hearing Aids (BAHA).
de Wolf et al. ⁽⁵⁶⁾ – 2010	Netherlands	GBI / APHAB	<ul style="list-style-type: none"> To analyze the benefit and quality of life in elderly users of Bone-Anchored Hearing Aids (BAHA).
Martin et al. ⁽⁵⁷⁾ – 2010	UK	GBI / SSQ	<ul style="list-style-type: none"> To evaluate the effectiveness of Bone-Anchored Hearing Aid (BAHA) in the rehabilitation of single-sided deafness (SSD).
Ho et al. ⁽⁵⁸⁾ – 2009	UK	GBI	<ul style="list-style-type: none"> To investigate whether the adaptation of a bilateral Bone-Anchored Hearing Aid (BAHA) improves patients' quality of life.
Ho et al. ⁽⁵⁹⁾ – 2009	UK	BAQ	<ul style="list-style-type: none"> To evaluate patient satisfaction with the CORDELLE (BAHA) device and identify user and device related issues.
de Wolf et al. ⁽⁶⁰⁾ – 2009	Netherlands	IOI-HA	<ul style="list-style-type: none"> To study age-related patient satisfaction with Bone Anchored Hearing Aids (BAHA).
Linstrom et al. ⁽⁶¹⁾ -2009	USA	APHAB / SSD	<ul style="list-style-type: none"> To examine the short- and long-term effectiveness of the Bone-Anchored Hearing Aid (BAHA) in adults with single-sided deafness.
Wazen et al. ⁽⁶²⁾ 2008	EUA	QPA	<ul style="list-style-type: none"> To determine the incidence and type of complications, as well as patient satisfaction, associated with the BAHA system.
Tringali et al. ⁽⁶³⁾ –2008	Netherlands	QPA	<ul style="list-style-type: none"> To compare satisfaction rates between patients with bilateral mixed/conductive Hearing loss and patients with unilateral deafness, users of BAHA osteointegrated prostheses.
Kunst et al. ⁽⁶⁴⁾ -2008	Netherlands	SSQ	<ul style="list-style-type: none"> To study the unilateral adaptation of the Bone Anchored Hearing Aid (BAHA) and the subjective auditory benefit in patients with congenital unilateral conductive Hearing loss.
Kompis et al. ⁽⁶⁵⁾ - 2007	Switzerland	APHAB	<ul style="list-style-type: none"> To compare speech understanding in quiet, noise and subjective results of two Bone-Anchored Hearing Aids: the newly developed Baha Divino and the BAHA COMPACT.
Sánchez-Camón et al. ⁽⁶⁶⁾ -2007	Spain	GBI	<ul style="list-style-type: none"> To quantify changes in quality of life resulting from the use of BAHA.
Badran et al. ⁽⁶⁷⁾ - 2006	UK	BAQ	<ul style="list-style-type: none"> To Carry out a self-assessment of quality of life and the benefits associated with the use of Bone-Anchored Hearing Aids and identify potential improvements in relation to previous conventional Hearing Aids.
Gillett et al. ⁽⁶⁸⁾ – 2006	Reino Unido	GBI	<ul style="list-style-type: none"> To report the clinical results of a Bone-Anchored Hearing Aid (BAHA) program in a general hospital compared with those in a large university hospital center.
Hol et al. ⁽⁶⁹⁾ – 2005	Netherlands	Questionário de Chung and Stephens (1986) ⁽⁷⁰⁾	<ul style="list-style-type: none"> To evaluate the benefit of a Bone-Anchored Hearing Aid (BAHA CROS) in patients with single-sided deafness
Hol et al. ⁽⁷¹⁾ – 2005	Netherlands	NQ	<ul style="list-style-type: none"> To study the long-term results (use, care, satisfaction, otitis and audiometry) of the application of a Bone-Anchored Hearing Aid (BAHA) in patients who had previously used an air conduction hearin Aids.

Caption: APHAB = *Abbreviated profile of hearing aid benefit*; APSQ= *Audio Processor Satisfaction Questionnaire*; AqoL-8D = *Validity and reliability of the assessment of quality of life*; BAHA = *Bone anchored hearing aid* BAHU = *BAHA aesthetic, hygiene and use*; BAQ = *Entific medical systems bone-anchored hearing aid questionnaire*; BBSSD = *Bern benefit in single-sided deafness questionnaire*; COSI = *Client oriented scale of improvement*; EVS = *Analogic visual scale* GBI = *Glasgow benefit inventory*; GHABP = *Glasgow hearing aid benefit profile*; GHADP = *Glasgow hearing aid difference profile*; GHSI = *Glasgow health status inventory*; HDSS = *Hearing device satisfaction scale*; HHIA = *Hearing handicap inventory for adults*; HUI-3 = *Health utilities index-mark III*; IOI-HA = *International outcome inventory for hearing aids*; NQ = *Nijmegen questionnaire*; QoL = *Quality of life*; CQ = *Copenhagen Questionnaire*; QPA = *Questionnaire prepared by the author*; SF-36 = *36-item Short-form health survey*; SSD = *Single-sided deafness questionnaire*; SSQ = *Speech, spatial, and qualities of hearing scale*; SSQ12-B = *Speech, spatial and qualities of hearing scale*; SSQ-C = *Spatial and qualities of hearing scale for experienced user*

Table 1. Continued...

Author (year)	Study Location	Questionnaire/ Scales Used	Aim of the Study
Hol et al. ⁽⁷²⁾ – 2005	Netherlands	APHAB / GHABP / IOI-HA / SSD	• To study the effect of a Bone-Anchored Hearing Aid (BAHA) in patients with unilateral conductive Hearing loss.
Hol et al. ⁽⁷³⁾ – 2004	Netherlands	SF-36	• To evaluate the impact of Bone-Anchored Hearing Aids (BAHA) on the quality of life of adults and test the hypothesis of this improvement due to a reduction in otorrhea and/or skin irritations.
Hol et al. ⁽⁷⁴⁾ , 2004	Netherlands	APHAB	• To evaluate the benefit of a contralateral Bone-Anchored Hearing Aid (BAHA) (CROS system) in 20 patients with single-sided deafness.
McLarnon et al. ⁽⁷⁵⁾ –2004	UK	GBI	• To study quality of life benefits in patient subgroups using the validated Glasgow Benefits Inventory (GBI).
Bosman et al. ⁽⁷⁶⁾ -2003	Netherlands	APHAB	• To verify the experiences of nine parents of patients with unilateral deafness before the intervention, with a CROSS Conventional Hearing Aid and after intervention with the percutaneous BAHA.
Niparko et al. ⁽⁷⁷⁾ – 2003	USA	APHAB / GHABP	• To evaluate the benefit to patients with unilateral sensorineural loss fitted with a prosthesis Anchored to the Bone.
McDermott et al. ⁽⁷⁸⁾ – 2002	UK	GHABP	• To evaluate the effectiveness of auditory rehabilitation with Bone-Anchored Hearing Aids
McDermott et al. ⁽⁷⁹⁾ – 2002	UK	GHABP and GHADP	• To assess patient satisfaction with their current Bone Anchored Hearing Aid compared to their previous conventional air Bone or Bone conduction Hearing Aids.
Arunachalam et al. ⁽⁸⁰⁾ – 2001	UK	GBI	• To evaluate the benefit of patients using BAHA, using the Glasgow Benefits Inventory to quantify changes in quality of life.
van der Pouw et al. ⁽⁸¹⁾ – 1999	Netherlands	Questionários de Mylanus et al. (1994) ⁽⁸²⁾	• To obtain data from a consecutive series of BAHA users, all equipped with a BAHA HC200/300, who had previously used a conventional Bone conduction Aid .

Caption: APHAB = *Abbreviated profile of hearing aid benefit*; APSQ= *Audio Processor Satisfaction Questionnaire*; AqoL-8D = *Validity and reliability of the assessment of quality of life*; BAHA = *Bone anchored hearing aid* BAHU = *BAHA aesthetic, hygiene and use*; BAQ = *Entific medical systems bone-anchored hearing aid questionnaire*; BBSSD = *Bern benefit in single-sided deafness questionnaire*; COSI = *Client oriented scale of improvement*; EVS = *Analogic visual scale* GBI = *Glasgow benefit inventory*; GHABP = *Glasgow hearing aid benefit profile*; GHADP = *Glasgow hearing aid difference profile*; GHSI = *Glasgow health status inventory*; HDSS = *Hearing device satisfaction scale*; HHIA = *Hearing handicap inventory for adults*; HUI-3 = *Health utilities index-mark III*; IOI-HA = *International outcome inventory for hearing aids*; NQ = *Nijmegen questionnaire*; QoL = *Quality of life*; CQ = *Copenhagen Questionnaire*; QPA = *Questionnaire prepared by the author*; SF-36 = *36-item Short-form health survey*; SSD = *Single-sided deafness questionnaire*; SSQ = *Speech, spatial, and qualities of hearing scale*; SSQ12-B = *Speech, spatial and qualities of hearing scale*; SSQ-C = *Spatial and qualities of hearing scale for experienced user*

DISCUSSION

BAHA is a resource for individuals who find it impossible or difficult to use an electronic amplification device⁽⁸⁹⁾, and the verification of results, according to the aspects of benefit and user satisfaction, needs to be measured assertively when choosing instruments for assessment, such as questionnaires and/or scales⁽⁹⁰⁾.

This study was carried out to verify, in the literature, measurement instruments, such as questionnaires and scales, which were intended to evaluate the benefit and satisfaction of users of bone-anchored hearing aids.

In general, the results presented in Table 1, with the compilation of studies, showed that the questionnaires and scales are used separately or together, as observed by authors^(17,19). Furthermore, evidence demonstrated that more than one subjective measurement instrument is used to measure BAHA results.

Another finding of this scoping review was that many of the questionnaires and scales were not developed exclusively to verify just one dimension or one aspect of auditory rehabilitation. The questionnaires simultaneously verified, for example, benefit, daily use or satisfaction, which is a deficient point of these instruments in the results evaluation process.

The IOI-HA questionnaire, for example, assesses benefit, daily use of hearing aids, difficulty in participation, impact on others and quality of life. In this questionnaire, the satisfaction construct is also measured, however, among others, it is not effective to verify this construct for decision-making⁽⁸⁶⁾.

The questionnaires used to evaluate results in BAHA users in the auditory rehabilitation process, such as the GBI, APHAB, GHABP, HUI-3 (5), APSQ and the SSQ scale (14) presented in this scoping review have different objectives.

The GBI questionnaire is a measure that verifies patient benefit and was developed especially for otorhinolaryngological interventions, to verify the change in health status after an otorhinolaryngological surgical or medical intervention. It consists of 18 items, in which the general benefit or change in the individual's health status after an intervention is verified. The questionnaire consists of three subdomains: general, social and physical benefit and was validated in previous research⁽⁸³⁾. It is observed, therefore, that the possibility of correlating different areas of health is a positive aspect that the questionnaire presents, however, it was not developed to evaluate the satisfaction of BAHA users.

Another example of a frequently used questionnaire is the APHAB, which assesses the benefit of adapting the electronic device, through the difference between the condition without and with the device, divided into four subscales: ease of communication (EC), reverberation (RV), background noise (BN) and sound aversiveness (AV) for hearing aid users. The first three subscales EC, RV and BN address speech understanding in various everyday environments. The fourth subscale, AV, quantifies negative reactions to environmental sounds⁽⁹¹⁾.

Developed to verify the efficacy and effectiveness of rehabilitation services for adults with hearing impairment, the GHABP questionnaire was validated by authors⁽⁸⁵⁾ and assesses the use and benefit of hearing aids, residual disability and patient satisfaction with their hearing aids. It consists of two parts, the first of which covers four predetermined environments and, in the second part, the patient can choose four additional situations in which they experience hearing difficulties.

In the selected studies, it was found that general quality of life was measured using the HUI (Health Utilities Indexes) questionnaire, a validated, self-reported, multi-attribute health

status system consisting of 15 items covering eight dimensions of health: sensation, mobility, emotion, cognition, self-care, pain and fertility⁽⁸⁷⁾. The HUI-3 is sensitive to changes in quality of life and is recommended for capturing changes in auditory interventions⁽⁹²⁾. It aims to measure health status, report health-related quality of life and produce device utility scores, as in patients' experience of therapy, the long-term outcomes associated with the disease or therapy, the efficacy, effectiveness and efficiency of health interventions and the health status of populations in general.

Another questionnaire used in the study was the Audio Process Satisfaction Questionnaire (APSQ), specifically developed to check user satisfaction with their audio processor, assessing satisfaction, comfort when using, social life and usability. Although its use has not been demonstrated, it was developed for users of implantable devices, highlighting that its development and validation are recent⁽²⁷⁾

Regarding the scales used, the SSQ, consisting of 49 questions: 14 items scored in speech recognition, 17 in spatial hearing, and 18 in other functions and qualities of hearing, was found. It is a widely used tool in clinical practice and hearing research, being reported to be sensitive to changes in hearing function after treatment with a variety of hearing therapies, including implantable and non-implantable hearing devices. It presents a reduced version (SSQ-12), consisting of 12 questions that describe everyday situations, assess the patient's ability to hear speech and locate sounds, as well as the quality of sounds⁽⁸⁸⁾.

Although it was not evident in the studies, with regard to a specific measuring instrument that assesses the satisfaction of the population of BAHA users, the literature presents the BAHA questionnaire (Bone Anchored Hearing Aid Questionnaire), developed by authors⁽⁵¹⁾, which was based on another standardized questionnaire, the Entific Medical System Questionnaire, designed to assess satisfaction, however, with the population of bone-anchored hearing aid users and no longer with hearing aid users. The purpose of the questionnaire is to quantify the daily use of the prosthesis in various situations, evaluating the resulting satisfaction and improvement in quality of life on a numerical scale. It consists of 13 questions, 11 of which are multiple-choice, one is dichotomous and one is open⁽⁹³⁾. It presents more practical day-to-day information, leading to accurate decision-making by the professional.

As emphasized in the literature, it is evident that new research needs to be carried out in favor of developing questionnaires and scales that verify different aspects of the auditory rehabilitation process, considering the population of individuals using BAHA. This way, the clinician will have the necessary support to verify the results, as they will be faced with efficient questionnaires and scales.

Considering the APSQ and BAHA questionnaires, specific for measuring satisfaction in BAHA users, it is suggested that they should be used more in the clinical routine of public and private services and research, mainly concomitantly, as they complement each other.

Finally, this scoping review brought forward the possibility of elucidating the subjective assessment tools used as auditory rehabilitation resources in clinical practice, in users of bone-anchored hearing aids. On the other hand, the limitation was concentrated on the fact that some studies did not present the information clearly, such as what psychometric properties were applied, and were therefore not exposed in the compilation of the studies.

CONCLUSION

The most commonly used instruments for evaluating the benefit and satisfaction of users of bone-anchored hearing aids, such as questionnaires and scales, are the Glasgow Benefit Inventory and the Abbreviate Profile of Hearing Aid Benefit, used to evaluate the benefit, and the Audio Processor Satisfaction Questionnaire, used exclusively to assess the specific satisfaction of this population. As for the scale, the Speech, Spatial and Qualities of Hearing Scale is used to assess the benefit.

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