



SYSTEMATIC REVIEW

Aesthetic Aspects in the Process of Individual Hearing Aid Fitting

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ABSTRACT

This paper presents the possibilities of contemporary hearing prosthetics, encompassing a broad spectrum of solutions currently available to patients. Based on the authors' clinical experience and data from international research centers, the most important aesthetic aspects from the patients' perspective are identified and discussed. The paper reviews types of hearing aids in clinical use, their applicability depending on the type and severity of hearing loss, and the degree of device miniaturization. The dominant preferences in hearing aid selection include aesthetic appeal and discretion, as well as options for wireless connectivity and control via mobile applications. Owing to the development of wireless technologies in hearing aids, patients increasingly opt for solutions that enable device management and access to the internet and multimedia through smartphones. Furthermore, the availability of colorful housings and earmolds has led to an emerging trend in which hearing aids are used to emphasize the individual style of the wearer.

Keywords: face aesthetic, hearing aids, earmoulds.

Introduction

Advances in technology and the miniaturization of electronic devices have enabled increasingly discreet solutions in the field of hearing aids. These developments respond to patients' expectations for hearing rehabilitation tools that effectively compensate for hearing impairment while remaining minimally noticeable. Contem-

porary miniaturization and the continuously increasing processing capacity of modern processors make it possible to design highly discreet hearing aid systems.

Hearing loss affects individuals across the entire age spectrum, including children, adolescents during their educational period, professionally active adults, and particularly older adults. In the latter group, age related hearing

loss (presbycusis) is most common; it typically manifests as high frequency hearing impairment associated with aging of the auditory system [1] and prolonged exposure to multiple iatrogenic and environmental factors.

Despite differences in age and lifestyle, patients share similar expectations: restoration of effective communication with their surroundings and achieving this goal in a manner that is as unobtrusive as possible. Contrary to common assumptions, cosmetic considerations play a crucial role, as they significantly influence acceptance of hearing aids and daily wearing time. Both factors have a substantial impact on the communicative benefits derived from hearing aids as well as on the effectiveness of auditory rehabilitation and revalidation.

Materials and methods

This study presents a review of available solutions addressing the aesthetic aspects of hearing aids, which constitute a key concern for patients. In cases of sensorineural hearing loss and a wide range of mixed hearing losses (in which deficits in sound transmission coexist), air conduction hearing aids are the primary method of compensating for impaired auditory perception.

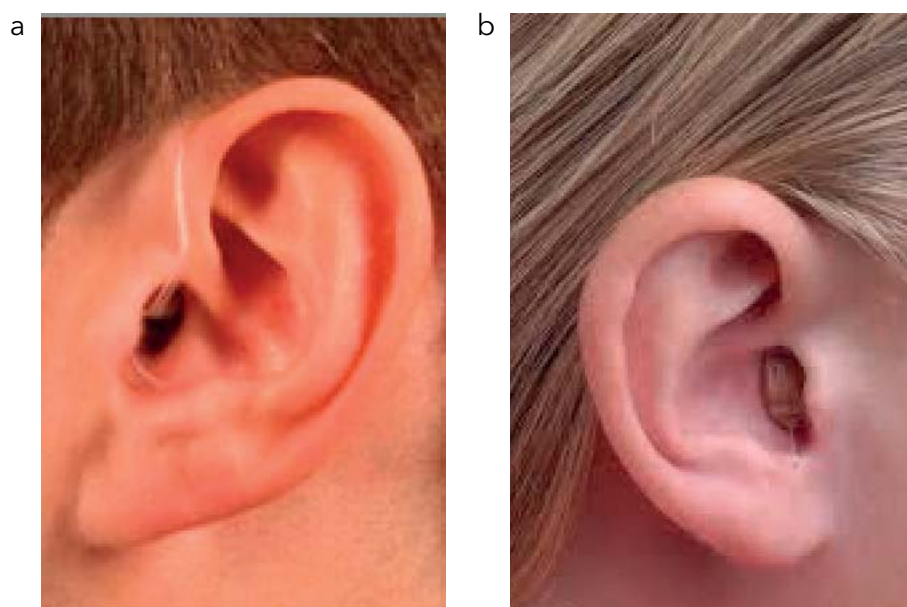
Behind the ear (BTE) hearing aids are the most commonly used devices (see **Figure 1a**).

In patients with lesser degrees of hearing loss, various in the ear (ITE) solutions are available (see **Figure 1b**).

Technological development and aesthetic considerations- in recent years, BTE hearing aids have undergone a profound technological transformation, both in terms of miniaturization and the sophistication of acoustic signal processing. Thin sound tubes are now widely used, as well as solutions in which the receiver is placed directly in the external auditory canal and connected to the hearing aid housing by an extremely thin electrical wire, replacing the traditional acoustic tube.

Compared with classical sound tubes and full earmolds, these solutions provide greater discretion and improved user comfort. Such miniaturized designs have been made possible by the dynamic development of feedback cancellation systems. Previously, tightly fitting full earmolds were required to acoustically isolate the amplified signal delivered to the external auditory canal and prevent it from being recaptured by the microphone, which caused audible feedback. These older solutions were often conspicuous and compromised user comfort due to their size and visibility.

Modern feedback management systems allow for the use of open fittings and thin wires without sacrificing acoustic performance. As a result, the current generation of BTE hearing aids with the receiver located in the ear canal



▲ **Figure 1.** Hearing aids a) Behind The Ear (BTE) b) In The Ear (ITE).

(RIC – Receiver in the Canal) is often more discreet than in the ear devices, while offering greater technical capabilities and considerably easier handling (see **Figure 2**).

Color, personalization, and design trends—considering aesthetics, device invisibility, and patient acceptance, manufacturers offer a wide range of housing color options. The color of the casing is often matched to hair color (e.g., black, white, brown, champagne), whereas brightly colored housings with decorative motifs are commonly offered for children (see **Figure 3**).

These approaches reflect two primary aesthetic strategies driven by patient preferences: maximizing invisibility or intentionally highlighting the hearing aid as a decorative element. In recent years, colorful housing designs have gained increasing popularity, particularly among children and adolescents (see **Figure 4a**).

Among professionally active adult users, a parallel trend has emerged in which hearing aid colors are selected to complement clothing,

jewelry, and an active lifestyle. Due to their small size and wide color palette, hearing aids are increasingly perceived as accessories that enhance an individual's dress style rather than merely medical devices.

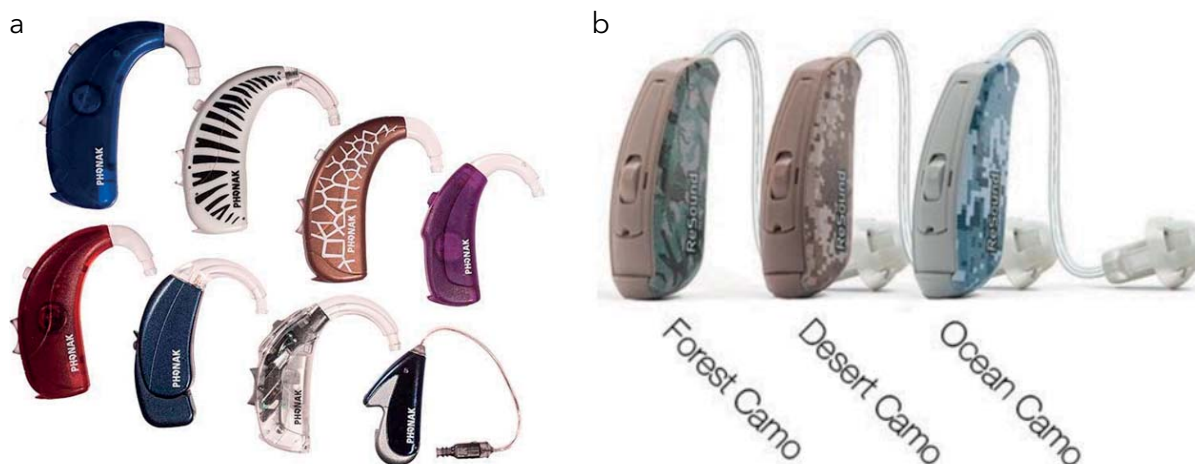
This shift is associated with growing public awareness and an increasing prevalence of hearing aid use. As the number of users rises, aesthetic evaluation of hearing aids becomes more common, similarly to eyeglasses. In both hearing prosthetics and optical correction, devices may emphasize personal style, hair color, or facial features. The importance of the issues addressed by the patient and professional community is significant. Global and European organizations are increasingly addressing the issue of changing the way we think about perceptual and cognitive impairments. This is especially true given the increasing prevalence of these issues, which now affect hundreds of millions of people worldwide. Current examples include debates on changing the way we think about hearing loss and World Hearing Day at



▲ **Figure 2.** Hearing aids type Receiver In the Canal (RIC).



▲ **Figure 3.** Examples colored housings of hearing aids.



▲ Figure 4. Examples design of behind the ear type of hearing aids.

the European Parliament. Polish representatives, including both hearing care professionals and manufacturers, are actively participating in these activities.

Digital manufacturing and wireless technologies—special attention should be given to the role of 3D printing in the production of earmolds and custom in the ear hearing aid shells. Currently, the entire production process is conducted digitally, based on scans of the external auditory canal or digitized ear impressions. This approach allows for highly precise computer-aided design using dedicated software in otoplasty laboratories.

The final stage involves high quality 3D printing. Both openwork earmolds and full shell designs with precisely controlled ventilation can be produced. Ventilation is particularly important for otological reasons, including maintaining appropriate microbiological conditions in the external auditory canal and reducing the acoustically unfavorable occlusion effect. Colors may be selected according to patient preference, ranging from transparent to multicolored designs, with the option of incorporating decorative elements that match hearing aid housings or personal jewelry.

At present, two dominant trends can be identified: highly discreet hearing aid fittings achieved through miniaturization and color matching, and deliberate accentuation of personal style through color, treating hearing aids as distinctive accessories. Similar tendencies are observed in eyewear optics, where frames are either minimalist or designed to highlight facial features and preferred color schemes. Invisible

operation of hearing aids is a priority for both patients and manufacturers. Thanks to wireless transmission from external devices to hearing aids—most commonly implemented via Bluetooth and Wi-Fi protocols—it is possible to rapidly transmit audio signals from external sources such as wireless microphones, streamers, and mobile phones. These capabilities, combined with the development of dedicated smartphone applications, allow users to exercise comprehensive control over their hearing aids in a manner that remains imperceptible to others. Functions such as volume adjustment, program selection, and adaptation of hearing aids to various acoustic environments (e.g., concerts, cafés, workplaces; situational or comfort programs) are now primarily integrated into smartphone applications. Telephone calls, as well as audio streaming from social media platforms, internet services, and podcasts, are also conducted wirelessly in a way that is inconspicuous to surrounding individuals.

The new Bluetooth Low Energy (LE) data transmission technology requires minimal battery power in hearing aids while enabling efficient digital data transfer. In the near future, the Auracast system will allow hearing aid users to access millions of broadcast points and hotspots in public venues such as railway stations, airports, museums, information centers, cinemas, and many other locations. In light of these technological solutions, the concept of hearing loss as an “invisible impairment” acquires a fundamentally new meaning—an invisible impairment that is fully compensated in terms of communicative functioning.

Results and discussion

The aesthetics of modern hearing aids are shaped by two contrasting yet equally prevalent trends: complete discretion and contemporary design that aligns hearing aids with elegant technological gadgets or jewelry.

The principal aesthetic trends include:

- › Discretion (invisibility, camouflage): In the ear (ITE) and completely in the canal (CIC) hearing aids are the smallest available devices and are positioned deep within the ear canal, rendering them virtually undetectable. These devices are suitable for moderate hearing loss, sufficient ear canal dimensions, and adequate manual dexterity.
- › Technological minimalism: Behind the ear devices, particularly RIC models, have become progressively smaller and slimmer. Their appearance often resembles modern wireless earbuds, which helps reduce the stigma associated with hearing impairment.
- › Personalization and jewelry inspired design: Manufacturers provide extensive color options, ranging from skin and hair matching shades to metallic finishes such as gold and silver, allowing hearing aids to function as stylistic accessories.

In the publication *Consumer Perspectives on Improving Hearing Aids* [4] a qualitative study demonstrated that patients appreciate technological progress; however, they also expect improvements in aesthetics, user control over device settings, and sound clarity. An important factor identified in this study is the development of trust between the patient and the hearing care professional, a relationship characteristic of most medical professions. *User Preferences for Hearing Aid Features* [5] is a dissertation analyzing differences between premium-class and basic hearing aids. Despite the absence of objective differences in speech understanding test outcomes, the majority of patients preferred premium models due to additional features, such as compatibility with remote fitting and access to media services (internet connectivity, Bluetooth 5.0 LE, and smartphone application control). According to the authors' own observations, patient age is often not a limiting factor. Widespread access to smartphones and increasingly intuitive application interfaces significantly enhance the accessibility of modern wireless technologies.

In *Factors Influencing Hearing Aid Use, Benefit and Satisfaction* [6], a systematic review

of 46 articles published over the past decade identified the main determinants of satisfaction as hearing sensitivity, patient attitudes and beliefs, and social support from close relatives. The study *Listening Preferences of New Adult Hearing Aid Users* [7] revealed that new users often prioritize physical comfort during the initial fitting over maximal sound clarity. Preferences varied depending on whether comfort or precision of hearing in noisy environments was considered the primary goal.

In *Consumer Preferences for Hearing Aid Attributes* [8] analysis showed that patients are willing to pay significantly more for devices that provide improved functionality in noisy environments. This functionality was found to be twice as important as other attributes when making purchasing decisions. The *Study Preference and Outcomes for Fast vs. Slow Compression* [9] suggests that the degree of hearing loss directly influences technical preferences. Patients with more severe hearing impairment more frequently prefer slower compression speeds, which in turn affects overall satisfaction with hearing aid performance.

In *Satisfaction with Hearing Aids Based on Technology and Style* [10] shows a correlation was confirmed between high satisfaction with personal image and the selection of in-the-ear (ITE) hearing aids. The aesthetics of "self-image" emerged as a key subscale of overall satisfaction. The *Study Impact of Hearing Aid Technology Level* [11] indicated that although premium technology provides slightly better subjective perceptions of hearing quality, differences compared to basic models may be difficult for patients to discern in everyday life. In *Factors in Client-Clinician Interaction* [12], a concept-mapping study demonstrated that the most influential factor in the decision to purchase a hearing aid is ensuring patient comfort and the clinician's understanding of the patient's individual needs).

Conclusions

Based on the authors' clinical experience, a review of the literature, and data from hearing care professionals, the following conclusions can be drawn:

- › Technological advances enable hearing care professionals to offer solutions that take into account individual facial aesthetics and personal preferences.

- › Personalized selection of hearing aid type, housing color, and earmold design effectively addresses expectations related to lifestyle and self image.
- › An increasingly observed trend combines device miniaturization that ensures discreet use with personalization that emphasizes individual style.
- › Patients frequently choose hearing aids that provide direct access to multimedia content and smartphone based control.

Declarations

Conflict of interest statement

The authors declares no conflict of interest.

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