



Original Article

## External auditory canal atresia: Surgical correction compared with bone anchored hearing device



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### المخلص

**أهداف البحث:** تهدف الدراسة لتقييم النتائج السمعية، ونسبة المضاعفات ورضا الوالدين من خلال اتباع نهجين مختلفين في علاج رتق القناة السمعية الخارجية.

**طرق البحث:** أجريت دراسة استيعادية بمراجعة ملفات 30 مريضاً لديهم رتق القناة السمعية الخارجية. خضع عشرون منهم لجراحة رتق القناة السمعية الخارجية، بينما خضع 10 منهم لمساعدات السمع المثبتة على العظم. تم قياس نتائج السمع قبل وبعد التدخل، والمضاعفات، ومعدل رضا الوالدين وتحسن النطق.

**النتائج:** أغلقت فجوة الهواء بين العظام إلى 30 وحدة لأقل من 50% في مجموعة الجراحة. بينما المجموعة التي خضعت لمساعدات السمع المثبتة على العظم فكان إغلاق فجوة الهواء بين العظام أقل من 15 وحدة. وكان رضا الوالدين أعلى في مجموعة مساعدات السمع المثبتة على العظم. وكانت المضاعفات الأكثر شيوعاً في مجموعة الجراحة هي ضيق الأنسجة الرخوة، أما مجموعة مساعدات السمع المثبتة على العظم فكانت المضاعفات الأكثر شيوعاً أضراراً جلدية وخيمة.

**الاستنتاجات:** حققت المساعدات السمعية المثبتة على العظم نتائج أفضل من الناحية السمعية في علاج رتق القناة السمعية. وكان رضا الوالدين أكثر والمضاعفات أقل بالمقارنة بالجراحة.

**الكلمات المفتاحية:** رتق القناة السمعية الخارجية؛ المساعدات السمعية المثبتة على العظم؛ أجهزة السمع

### Abstract

**Objectives:** The study evaluates the hearing result, complication rate and parental satisfaction following two different approaches in the management of external auditory canal atresia.

**Methods:** A retrospective chart review of 30 patients with external auditory canal atresia was conducted. Twenty of them underwent external canal atresia surgery and 10 had Bone Anchored Hearing Aid (BAHA). Hearing results, pre- and post-intervention, complications, parental satisfaction rate and speech improvement were measured.

**Results:** Closure of the air-bone gap (ABG) to 30 dB was seen in less than 50% in the surgery group. The BAHA group had closure of the ABG to less than 15 dB. Parental satisfaction was higher in BAHA group. The most common complications in the surgical and BAHA groups were soft tissue stenosis and adverse skin reactions for the BAHA group.

**Conclusion:** In the treatment of auditory canal atresia, BAHA provides superior hearing results, greater parental satisfaction and fewer complications as compared to surgery.

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## Introduction

External auditory canal atresia (EACA) is a rare congenital disorder. The incidence is 1 in 10,000–20,000 live births, with a unilateral to bilateral ratio of 3:1.<sup>1</sup> EACA is described as an external ear canal that fails to develop completely. The severe form of the disorder is characterized by the lack of an identifiable ear canal. If a hint of an external meatus is present, the ear canal may end in a shallow blind pouch. In less severe forms, the ear canal may be merely stenotic with a pinpoint aperture leading into a medial ear canal. The management of EACA has the potential for considerable physiological, psychological and cosmetic repercussions. Indeed, social stigma may be experienced because of cosmetic or developmental issues, especially as children enter school. In cases of bilateral EACA, hearing and language development is of particular concern.

The first operation to correct an EACA was performed in 1883 by Kiesselbach.<sup>2</sup> Surgical protocols have improved since then and objective measurements allow unbiased control of outcomes. More importantly, alternatives to surgical correction have emerged.<sup>3</sup> These include amplification devices, such as the bone-conducting hearing aid, as well as the more recently developed bone-anchored hearing aid (*BAHA*).<sup>3</sup> This device features an osteointegrated titanium post into the temporal bone. The transducer, which attaches to this titanium post, then delivers sound energy directly through the bone to the cochlea. Several studies have now proven this technology to be more efficient than the bone-conducting hearing aids.<sup>3,4</sup> This is largely because bone-conducting hearing devices require the sound to pass through soft tissue prior to reaching the bone, thereby impairing sound quality. Studies have demonstrated that speech reception threshold (SRT) of less than 20 dB are obtainable with the use of *BAHA* with this with good long-term outcomes.<sup>5,6</sup> Also the use of bilateral *BAHA* for patients suffering from bilateral EACA, therefore enabling them with sound localization ability is described in the literature.<sup>7</sup> While advancements with the use of *BAHA* are flooding the literature,<sup>8</sup> little can be found on its use as an alternative to surgical correction of EACA. The goal of this study is to evaluate the hearing results, complication rate and parental satisfaction following *BAHA* compared to traditional surgery in the treatment of external auditory canal atresia.

## Materials and Methods

Given the rare incidence of EACA, a retrospective study was conducted comparing the outcome of two treatment modalities; surgical correction of external auditory canal and *BAHA*. File review ranging from 1990 to 2003 identified a total of 30 patients with EACA, of which 20 had surgical correction and 10 had *BAHA*. Of note, *BAHA* was made available in Montreal early in our case series allowing for both treatment options to be discussed with parents. Since *BAHA* is funded by our hospital foundation, financial

concerns did not influence the choice of treatment. The same surgeon performed all EACA surgical corrections and another all *BAHA* placements. The study was approved by the human research ethics board at the University of Alberta, Canada.

Pre-operative investigations included a full audiogram as well as CT scan of the temporal bone. All patients underwent a post-operative audiogram in order to evaluate the impact of the treatment on hearing. School performance, speech improvement and parental satisfaction were also studied. This component of the study was conducted via phone interviews with either parents or legal guardians. The interviewer could not be blinded to the patient's group. Hence we opted to have different researchers call the *surgery* group and the *BAHA* group to avoid bias by Pygmalion effect. To reduce bias, the phone interview was standardized to the following questions:

- a) Grade your general satisfaction from the management that your child had from 1–10, 1 being unsatisfied and 10 is complete satisfaction from the result.
- b) How did your child school performance change after his management: did he change from special school to normal school (yes/no), and should the child be in the same type of school, was there any noticed change in the grades (yes/no).
- c) Was there any improvement in his/her speech (yes/no).

Data evaluation was performed using spreadsheets in Microsoft Excel and unpaired *t*-test or Fisher exact test were applied.

## Results

A total of 30 patients were identified and included in the study. There were 21 males and 9 females, 19 with bilateral EACA, 12 of which underwent surgery and 7 *BAHA*, and 11 with unilateral EACA, 8 of which underwent surgery and 3 *BAHA*. Cases of unilateral atresia were mostly right sided (6 in *surgery* and 2 in *BAHA*). Patients in the *surgery* and the *BAHA* groups were on average 7.8 and 6.2 years of age respectively at time of surgery. EACA was associated with congenital anomalies in 73% of patients (Figure 1), microtia being the most frequent anomaly (59% of cases). While pre-operative CT scans demonstrated that patients had normal inner ear anatomy, other abnormalities were found including: decreased aeration of the mastoid air cells, decreased middle ear space, fused ossicles and abnormal anatomy of the facial nerve (Figure 2).

Pre- and post-operative audiograms were compared for air-bone gap (ABG) and speech reception threshold (SRT) (Figure 3). Closure of the air-bone gap (ABG) to 30 dB was seen in less than 50% in the surgery group. The *BAHA* group had closure of the ABG to less than 15 dB. Parental satisfaction was higher in *BAHA* group. Objective outcome measures also included operative complications. In the *surgery* group, canal stenosis and recurrent aural discharge affected 40% and 18% of patients respectively but facial nerve paralysis or sensorineural hearing loss were not encountered. On the other hand, the *BAHA* group suffered from skin infection (20%), skin irritation/itching (20%) and

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