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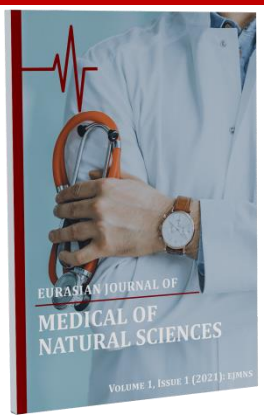

MODERN ACHIEVEMENTS IN SURGICAL TREATMENT OF CONGENITAL ATRESIA OF THE EXTERNAL AUDITORY CANAL (LITERATURE REVIEW)

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ABSTRACT

Congenital atresia of the external auditory canal has become the subject of serious discussions in the literature, since it is associated with serious aesthetic and functional problems that are difficult to cope with. Obtaining stable results of correction of congenital atresia of the external auditory canal remains a difficult task in otology. Complications such as stenosis, drainage, and hearing impairment can be minimized if well-established concepts and methods are followed.

Introduction. The first surgical attempts to eliminate congenital ear atresia were made in the middle of the XIX century. A.A. Thomson (1845) published an article in which he reported on his experience of three patients operated on by other surgeons for congenital ear atresia. In the first two cases, the operation was terminated after incision of the skin and soft tissues when encountering a dense bone wall. In the third case, despite the fact that the surgeon managed to preserve the recognizable external auditory canal, it was soon re-closed. Thomson concluded that the complete closure of the bony part of the auditory canal is an insurmountable obstacle to surgical removal and that the externally visible malformation indicates the presence of other defects in deeper parts of the ear [1]. In 1882, W. Kiesselbach [2,3] performed the first deep surgery on a six-month-old child with congenital ear atresia. Unfortunately, the operation ended with facial nerve paralysis. The most popular operation in the early 19th century was the opening of the antrum, aditus and the laying of a skin flap (often 10 days later during the second stage operation). The middle ear cavity was rarely penetrated, and hearing improvement was minimal.

F. Bezold and F. Siebenmann in 1908 described a surgical procedure in which the antrum was opened from the mastoid process and a wide channel was made, lining the mastoid process cavity with grafts [4].

In the same year, Alexander presented a case where a mastoidectomy was performed and skin flaps were produced from the posterior part of the wound. He concluded that in case of unilateral atresia, surgery is recommended only in the presence of otitis media or mastoiditis on the affected side [5].

In the case of a bilateral problem, H. Marx proposed surgery only if the deafness was pronounced and the inner parts of the ear (especially the labyrinth) were healthy [6].

In 1914, J.R. Page reviewed eight cases, including one of his own. The usual surgical procedure involved opening the mastoid process and removing cells all the way to the tympanic cavity. He created a hole in the auricle, then closed the mastoid process and placed a skin flap into the wound of the mastoid process through the created external auditory canal. Five out of eight cases showed hearing improvement with this procedure [7].

In the 1930s, a common surgical procedure was to make a small hole in the atretic plate and close this area with a skin graft. Surgeons usually avoided large holes because they believed that this could expose the middle ear cavity to the risk of scar tissue and fibrosis.

In 1925 J. Beck investigated the psychological side of the problem. He found that the attitude and response of patients to their deformities were better after surgery, as a result of which they had a passage and an auditory canal constructed, although their hearing did not significantly improve [8].

Although atresia of the external auditory canal was described several years ago, its surgical treatment began to develop only from the late 1940s, 1950s.

In 1947, G.L. Pattee [9] described the technique of reconstruction of the auditory canal and mobilization of the stirrup in congenital atresia of the auditory canal. This was done by endaural incision with mastoidectomy. He removed the anvil and the hammer, leaving a movable stirrup. Split-thickness skin was used to align the cavity. No attempts were made to reconstruct the bones, and the results were similar to fenestration surgery.

In the same year, 1947, M. Ombredanne [10] reported on his results of correction of congenital atresia using fenestration of the horizontal semicircular canal.

The methods described by H. Wullstein [11] and F. Zollner [12] were adopted by many surgeons in their attempts to operate on ear atresia, and eventually the bones became structures that needed to be preserved rather than removed. Howard House [13] in 1953 and L. Ruedi [14] in 1954 presented their experience of using G.L. Patee surgical technique. However, the last author admitted that the long-term hearing results were disappointing. In 1957, Y. Meurman [15] presented his series of 74 operated patients, most of whom had unilateral atresia. It was the largest series ever presented up to that time.

In 1960, R.J. Bellucci [16,17] used the methods of Wullstein and Zollner, trying to preserve the architecture of the middle ear. However, in cases of unilateral atresia, the result was questionable.

E.L. Derlacki [18] in 1968 was one of the first surgeons to support the role of cytomographic radiology in the preoperative assessment of patients with congenital ear atresia. He usually used a thin full-layered skin flap as a substitute for the eardrum and a split skin flap for the orifice. However, he managed to achieve a very good hearing result only in 25% of cases; he also had problems with secretions from about one third of the operated ears. These were probably the reasons that prompted him to suggest surgery only in bilateral cases.

In 1967, A.A. Scheer [19] and then J. A. Crabtree [20] in 1968 also made various attempts at ossiculoplasty.

It is clear that the aesthetic result and the opening of the closed auditory canal eventually became one of the two surgical goals, since an acceptable functional (auditory) result was added to the surgical planning.

In 1969, N.W. Gill [21] published his work on 83 operated ears, which is still considered one of the landmark articles on congenital ear atresia. According to Gill, for bilateral diseases, one ear should be operated on as early as possible if surgical correction is indicated for a specific type of deformity. Certain criteria must be met before performing surgery, including an X-ray demonstration of the presence of an inner ear and an audiometric demonstration of good bone conduction. As for the optimal age for surgery, Gill suggested that it depends on whether the deformity was unilateral or bilateral. He preferred to operate on a child between the ages of 12 and 18 months in bilateral cases. In unilateral cases, he advocated surgery, ideally after puberty, but since this interfered with education and training, he concluded that it was better for the patient to operate between the ages of 4 and 6 years. In analyzing its results, Gill reported acceptable results in a significant proportion of its patients. By 1971, his series had increased to 113 operated ears in 95 patients [22].

B.H. Colman (1971, 1974) [23,24] presented his surgical series of 184 cases over this decade. Half of these patients had bilateral atresia. However, postoperative results were excellent in patients with a narrow external auditory canal, fixed bones and deformed stirrup. In more serious cases, the results were much worse.

R.A. Jahrsdoerfer [25] published an article in 1978 in which he presented his experience of surgical correction of congenital ear atresia. He classified malformations as "minor" when they are limited to the middle ear, and "major", referring to all cases of atresia and stenosis of the external auditory canal. Surgical correction attempts were made on 20 ears in 18 patients. Jahrsdoerfer usually preferred front-end accesses, and his methods became very popular over time. He often used a fascia graft in combination with a skin graft through the central opening. The results were satisfactory. However, he stated that surgery in unilateral cases should be performed only in correctly selected patients. With regard to bilateral cases, he suggested that functional criteria should be applied, since hearing is very important. Regarding the optimal age for surgery, Jahrsdoerfer stated that in cases of bilateral atresia, a bone conduction hearing aid should be installed as early as the third month of life, regardless of the age preferences of the surgeon. On the contrary, in unilateral cases, he suggested that the operation should not be performed until the child was old enough to decide on his own.

Modern imaging techniques, especially high-resolution computed tomography (CT), developed in the 1980s, have provided surgeons with precise anatomical details of the middle and inner ear and mastoid process. This improved preoperative planning and led to better functional and aesthetic results in the majority of operated patients. Since 1980, several improvements have been made in channeloplasty, tympanoplasty and ossiculoplasty for congenital ear atresia, and various surgeons have reported large series of surgical interventions. Both aesthetic and functional results are considered important and achievable, artificial auricles are currently close to perfection, and plastic surgery has evolved significantly with acceptable results. However, difficulties and complications remain a concern.

According to T.B. Molonya and A. De la Cruz, with forward access, up to 79% success can be achieved and transmastoidal access 60% success, respectively. They proposed a modified front access, which was considered the synodural angle as the main reference point. This method combines the advantages of early identification of surgical landmarks with good anatomical and functional results of anterior access. In addition, the authors suggest performing ossiculoplasty with prostheses, after complete or partial removal of the atretic plate. In them, stenosis of the formed external auditory canal occurred more often with transmastoid access [26,27].

In 1989, H.F. Schuknecht [28], one of the leading modern otologists, presented his experience in surgical correction of 69 ears with congenital atresia of the external auditory canal. In five of the 62 ears, the operation resulted in temporary paralysis of the facial nerve, and in another five ears, the operation was discontinued due to significant anatomical malformations that occurred during the operation. Nevertheless, 30% of patients who underwent canaloplasty and 8% of patients who underwent mastoidectomy with stapedopexia received excellent hearing results in the postoperative period.

Schuknecht also divided patients with congenital atresia into three groups depending on the severity of pathological changes and proposed three surgical treatment methods, respectively:

(1) fenestration of the lateral semicircular canal;

(2) Channeloplasty;

(3) Type III tympanoplasty.

In all these cases, the mastoid process is opened to provide access to the auditory bones and the cavity of the middle ear, which creates a risk of formation of a cavity in the postoperative period (operated ear disease).

In 1992, R.A. Jahrsdoerfer [29] created a classification system for congenital ear atresia based on high-resolution computed tomography of the temporal bone. Parameters such as the presence of a stirrup, the condition of the oval and round windows and the cavity of the middle ear, facial nerve, maleusal complex, pneumatization of the mastoid process, anvil-stapes connection and the appearance of the outer ear were evaluated. Each parameter within the normal range was given one point, except for the presence of a stirrup, for which two points were given. According to R.A. Jahrsdoerfer, the score obtained (out of a maximum of 10 available points) expresses the possibility of satisfactory postoperative results. However, its classification is mostly functional, as it gives only one point to the appearance of the outer ear. It is now obvious that plastic surgeons, like ENT surgeons, have different and sometimes conflicting priorities.

In 1993, L. Shih and J.A. Crabtree [30] examined 39 surgical cases of congenital ear atresia for complications and long-term results. They proposed the expansion of the narrow external auditory canal by systematic drilling, lifting of the skin of the canal to ensure adequate examination of the conducting mechanism and, if necessary, reconstruction of the auditory ossicles with autogenous tissues or prosthetic materials. In more serious cases, they suggested more extensive postauricular access, removal of the atretic plate and reconstruction of the auditory ossicles with suitable materials (autogenous grafts or prosthetic materials). The two most common complications were external auditory canal

stenosis and chronic infections with recurrent otorrhea. The incidence of stenosis in primary cases was 33%, and infection appeared in 31%. The use of a split skin flap instead of a full-layered one was associated with fewer complications.

In 1994, Chang et al. [31] presented a modified anterior access and reposition of the auricle using a z-plastic incision. The atretic plate was removed and tympanoplasty was performed. The posterior-lower part of the new external auditory canal is covered with a periosteal flap with a lower base. The most common postoperative complication was stenosis of the external auditory canal.

In 1998, P.R. Lambert [32] presented a retrospective study of 55 patients (59 ears) who underwent surgery for congenital ear atresia for 11 years. He used an anterior surgical approach under continuous monitoring of the facial nerve. An external canal was created and the surrounding bone was removed from the chain of auditory ossicles, so that the latter was focused on the new external auditory canal. A fascia graft was used to create an eardrum. Finally, the external canal was lined with a split skin graft overlapping the fascia graft. Revision surgery was necessary in about a third of the patients. The main complications that occurred, according to Lambert, were facial nerve paralysis (1.5% of patients) and significant hearing loss (3%).B 1995 r.

De la Cruz et al. [33] reported their results in a series of 92 ears operated on for congenital ear atresia using a mastoid process. In all primary cases, atresioplasty with a split skin flap was performed. In the case of revision surgery, atresioplasty was performed, and the decision to use a skin graft was decided depending on the specific situation. The most common complications were stenosis of the external auditory canal (10% of primary cases and 4% of revisions) and lateralization of the eardrum (9% of primary cases and 15% of revisions).

De la Cruz and K.B. Teufert [34] presented their enlarged surgical series in 2003. The total number of operated atretic ears in this series was 116. The main complications were stenosis of the soft tissues of the external auditory canal (in 8% of primary cases and 3.4% of revisions) and bone chain refixation (in 11.5% of primary cases and 6.9% of revisions).

As the surgical methods used gradually improved and various modifications and materials were used, De la Cruz and K.B. Teufert presented an article in 2004 in which they tried to compare the results and the incidence of complications in cases of ear atresia operated before 1994 (36 cases) and during the period after 1994 (80 cases) [35]. The reason for this, according to the authors, was that all modifications used in practice, such as the use of an argon laser, thinner split skin grafts and the use of Silastic and Merocel wicks plates in the external auditory canal were performed at their institute as a routine procedure by 1994. As for the main complications, they reported that the most common were soft tissue stenosis and bone growth of the external auditory canal (in 3.8% of cases). new and 13.9% of old cases) and bone chain refixation (in 3.8% of new and 25% of old cases).

Ralf Siegert [36] also made a significant contribution to the combined reconstruction of congenital ear atresia and severe microtia by proposing a combination of plastic surgery of the auricle and functional surgery of the middle ear. This surgical procedure consists of three main stages. During the first operation, autogenous cartilage is extracted, the frame of the auricle is manufactured and implanted. The eardrum and the external auditory canal are also

made in advance and placed in a subcutaneous pocket. During the second operation, the new frame of the auricle is lifted, and this procedure is combined with an operation for atresia using a combined eardrum and an external auditory canal. Finally, during the last operation, the shell cavity is deepened, the external auditory canal is opened and closed with a skin graft. Restenosis of the external auditory canal was not observed in the Siegert series. The aesthetic result of the reconstructed auricle was also very satisfactory.

Conclusion. Surgery for congenital atresia of the external auditory canal remains one of the most difficult operations in otology. Thanks to advances in imaging techniques, the surgical microscope and surgical techniques, more and more otologists are reporting improved surgical results. Despite this, a wide range of abnormal changes in the structures of the middle ear, the proximity of vital formations and the possibility of their atypical location, as well as the absence in some cases of important anatomical landmarks, in patients with congenital atresia of the external auditory canal complicates surgical treatment and increases the risk of postoperative complications in children. Therefore, surgical treatment, namely the use of gentle methods for the formation of the external auditory canal and the restoration of the sound-conducting apparatus in children remains relevant.

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