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Surgical Concepts for Reconstruction of the Auricle

History and Current State of the Art

Alexander Berghaus, MD, Frank Toplak, MD

• **We compiled and evaluated the world literature on auricular reconstruction, for a total of over 400 publications, more than 200 authors, and over 3,300 reported cases. We found that partial reconstructions were already performed as early as 600 BC; total reconstructions were still considered impracticable in 1830. But since 1891, more than 40 different cartilaginous, osseous, and alloplastic frame materials have been described. Only eight of these were still being applied in the last decade, with autogenous costal cartilage and silicone as the leading substances. Results of the operation can be improved by special surgical manipulations, eg, the "fan-flap" technique. Taking into consideration the complication rate, the number of individual interventions, and the stability of the results, we devised a special point system that makes possible a limited assessment of the different surgical techniques.**

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The two major problems in reconstruction of the auricle are as old as the history of this operation, and they have so far lost nothing of their importance. These problems are—as stated by Eduard Zeis[1] as early as 1838—the provision of a suitable supporting frame and its coverage by skin. As an optimal solution has not yet been found, the search continues for the best frame material and the most suitable surgical technique. As this is a relatively rare operation, the experience gained with it is mainly described in scattered individual representations, thus making it difficult to obtain a comprehensive overview.

We compiled all published reports dealing with reconstruction of the auricle in an attempt to provide an overview of all known implants, transplants, and surgical techniques that have been used. In addition, we tried to establish objective criteria for weighing the pros and cons of different surgical techniques on the basis of information given in the literature; we did this by recording all complications mentioned in the cases reported and by simultaneously listing all individual operations necessary for correction. Finally, we wanted to answer the question of whether the preference of a certain material or surgical technique can be derived from the available literature.

The completeness of the literature collection was not limited by the number of sources (>400) or their age; reliable reports on complete auricular reconstructions date from the second half of the 19th century at the earliest, a time from which it is still relatively easy to obtain references. On the other hand, it would have involved a disproportionate amount of effort to procure or translate some studies, mainly from East Bloc countries or east Asia. Approximately ten publications were thus excluded.

The thoroughly compiled sources date from pre-Christian times[2] (600 BC in India) to 1984. As the search for literature was not regionally restricted, we cannot claim our study to be complete; the investigation is, however, continuously under way. We registered 205 authors, 404 publications, 3,346 cases of reconstructed auricles, and 42 different types of frame materials. From the mass of data and findings, only some individual aspects can be mentioned herein. It is interesting from the historical point of view that even famous surgeons, such as Dieffenbach,[3] Nelaton and Ombre-

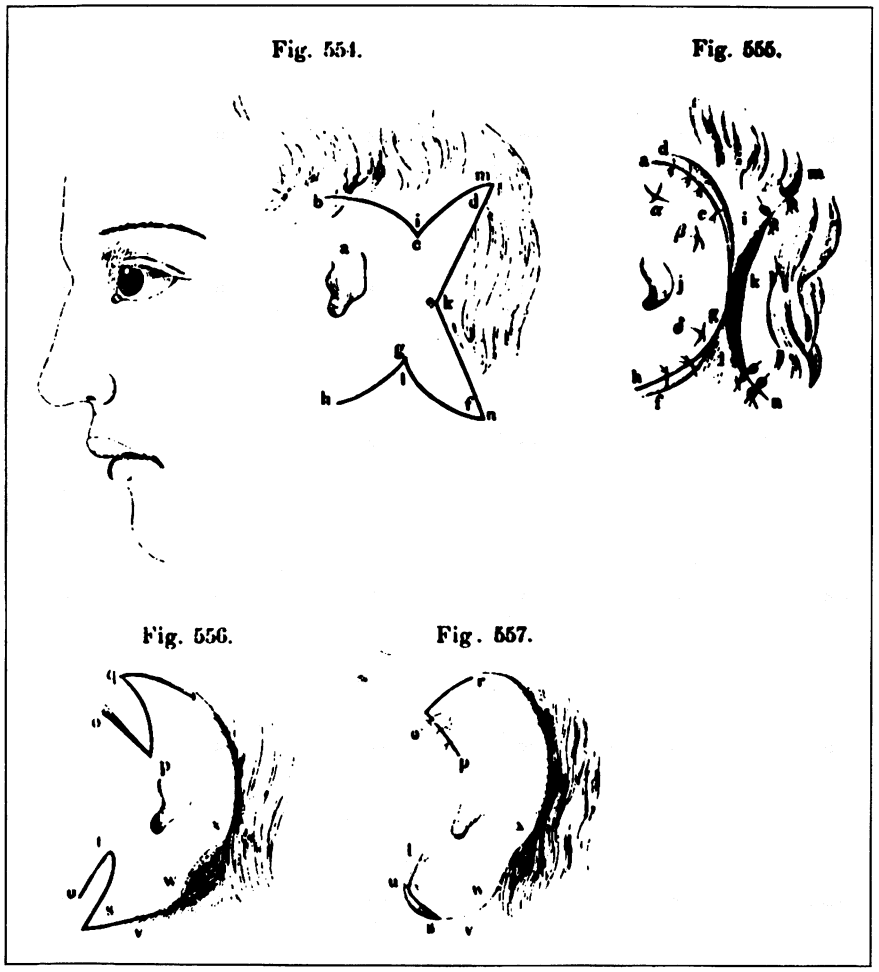


Fig 1.—Theoretical proposal for auricular reconstruction in 1870 (from von Szymanowski[6]).

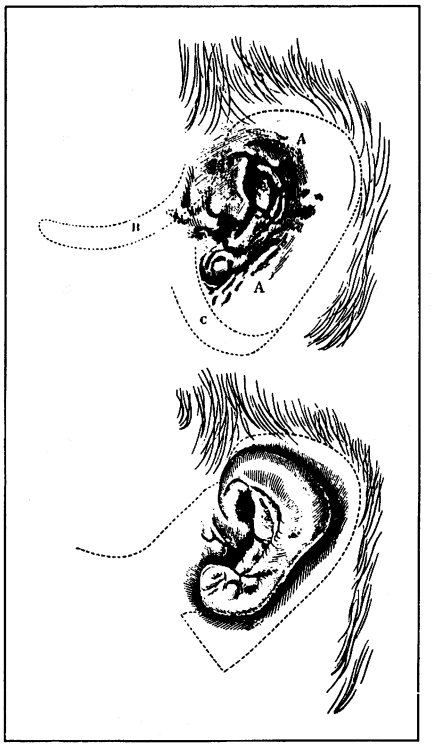


Fig 2.—Technique of Kuhnt in 1890 with figures prepared by his assistant (from Schanz[8]).

danne,[4] and Fritze and Reich,[5] considered *total* reconstruction of an auricle to be impracticable for a long time—until the end of the 19th century—whereas *partial* reconstructions are reported to have already been carried out in ancient India and Alexandria and, later, Italy.

Apart from the merely theoretical proposal for the reconstruction of an auricle without a supporting frame, never carried out by von Szymanowski,[6] who gave the first description in 1870 (Fig 1), and the inappropriate attempt to improve this technique by subcutaneous injections of petroleum jelly (Vaseline) by von Hacker[7] in 1901, we found that the first reports on total surgical reconstruction of an auricle were the following. Kuhnt, and his assistant, Schanz,[8] in Jena, Germany, in 1890, used the ipsilateral auricular cartilage rudiment (Fig 2). Randall,[9] in Philadelphia in 1893, used a frame of fresh rabbit cartilage (Fig 3). Körte,[10] in 1905 at the municipal hospital *Am Urban* in Berlin, used (inspired by König from Altona, Germany) a "wedge-shaped part of full thickness" from the healthy ear, which would be called "composite graft" today, together with the mastoid skin of the affected side and a free skin transplant for the operation. Lexer[11,12] and Eitner[13] are among the dozen of Körte's followers who have adopted this technique. The last reports on it were presented by Gabka[14] in 1972, Gorney et al[15] in 1971, and Gorney,[16] who carried out a systematic analysis of the applicable parts of the nonaffected ear (Fig 4).

FRAME MATERIALS

Although isolated attempts have been made again and again to reconstruct an auricle without a supporting frame, eg, Beck[17] in 1925, De River[18] in 1927, and, most recently, Sarig et al[19] in 1982, attention was focused on the search for optimal supporting material during the following half century. At the same time, the demands for aesthetic results continued to grow. Later, in 1944, Suraci[20] suggested the following seven criteria that must be met in reconstruction of the auricle: (1) correct size, (2) appearance identical to that of the contralateral ear, (3) identical ear-head angles, (4) identical levels of the ears, (5) durability of the results in terms of size and shape, (6) selection of adequate supporting and soft tissue for precise molding, and (7) the color of the skin has to correspond to that of the contralateral ear.

Autogenous costal cartilage, which later became the most widely applied material, was used very early. In 1908, Schmieden[21] at the Royal Surgical University Clinic, Berlin, used this material to form an ear under the abdominal skin and then moved it to the defect area using a "plastic migrating pedicle flap" (Fig 5). According to our investigations, Gillies,[22] in 1920, was the first to recon-

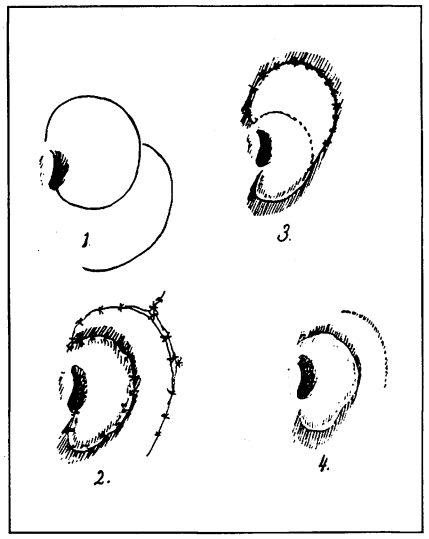


Fig 3.—Surgical procedure with fresh rabbit cartilage transplant in 1893 (from Randall[9]).

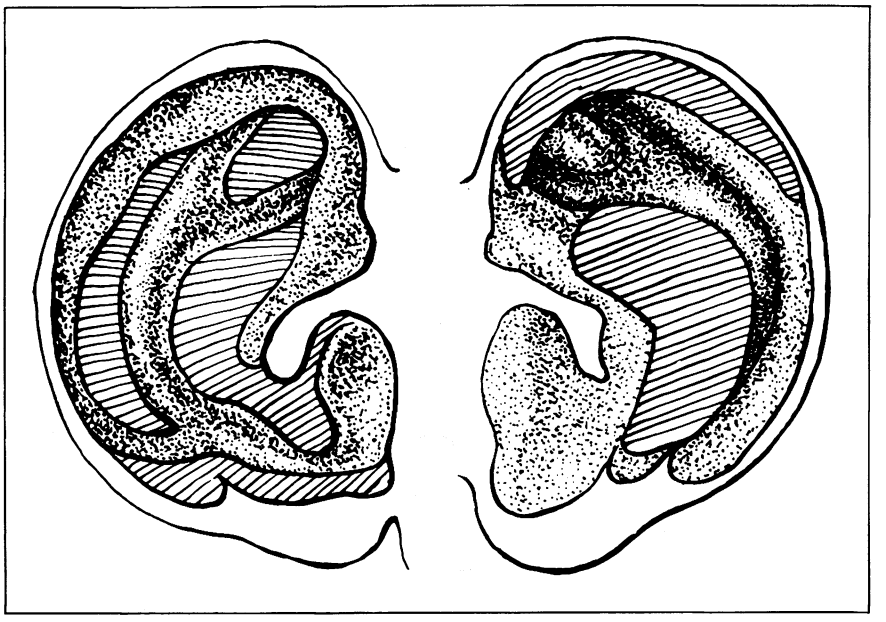


Fig 4.—Applicable parts of nonaffected ear cartilage, with frontal view on left side and rear view on right (from Gorney[16]).

struct an auricle with autogenous costal cartilage in Anglo-American countries.

Of a total of more than 40 surgical techniques distinguishable by the material used for the supporting structure (Table 1), some are mentioned here briefly as follows: autogenous tibial bone,[23] iliac bone,[24] mastoid bone,[24-26] autogenous nasoseptal cartilage,[27] maternal auricular cartilage,[24,28] allogenous conserved auricular cartilage,[29,30] allogenous costal cartilage,[31-33] autogenous diced cartilage[34-37] (Fig 6), allogenous diced cartilage,[37-39] ox cartilage,[40] calf cartilage,[41] and allogenous meniscus.[42-44] In addition to allogenous meniscus, Pitanguy, in 1958, also used autogenous meniscus. The above-mentioned materials have also been combined with each other and with other materials.

In view of the disadvantages for the patient that result from taking autogenous material, eg, additional surgical areas and risk of bending or resorption, scientists have always tried to find uncomplicated materials for implantation that are easily obtained without interventions in the patient and well tolerated at the same time. As Tanzer[45] stated in 1963, the ideal supporting framework consists of anorganic material that can be preoperatively formed, then sterilized and applied.

This resulted in the use of ivory, for example[46,47] (Fig 7), and in the early search for a suitable alloplastic material on the other hand. Thus, the observed resorption, even of autogenous costal cartilage, caused Ombredanne[48] and others to use acrylic material and later polyethylene instead of autogenous material (Table 2). The following alloplastic materials have been used: caoutchouc,[49] tantalum wire,[50,51] acrylic glass[52-54] (Fig 8), polyethylene,[55] x-ray film,[51] polyamide,[56] silicone[57,58] (Fig 9), Teflon,[59] and porous polyethylene.[60,61]

We were able to differentiate 42 cartilaginous, osseous, alloplastic, and combined frame materials; the classification provides for a subdivision into autogenous, allogenous, and xenogenous types based on origin, since different behavior in the implant bed can be assumed in each case. It was problematic to classify the use of the microtic auricular-cartilage rudiment (always autogenous). Some surgeons reject the use of this cartilage, others consider its use valuable, and a third group does not mention it when describing the intervention. Finally, its specification as an independent material combined with others always appeared useful in cases in which the author emphasized the processing of this rudiment in a particular manner as an operative principle.

RECONSTRUCTION PROCEDURES

According to the information we compiled, only eight of more than 40 separate procedures were still being applied internationally within the last ten years. They are (in the order of the number of cases reported in the literature) as follows: autogenous costal cartilage, silicone, allogenous diced cartilage, allogenous costal cartilage, autogenous cartilage combinations, autogenous mastoid bone, allogenous auricular cartilage, and porous polyethylene.

Autogenous Costal Cartilage

Although the general view is that autogenous cartilage cannot be regarded as an optimal implant material in some respects, it has been applied far more frequently than seven other frame materials in the last ten years. While the development of additional risks (eg, pleural ruptures or thoracic deformities) and scars are obvious disadvantages, numerous surgeons disregard or underestimate the danger of partial or complete resorption of autogenous costal cartilage. Incomplete data in the publications render it impossible to determine the

Fig 5.—Auricular reconstruction with autogenous costal cartilage and "plastic migrating pedicle flap" in 1908 (from Schmieden[21]).

Table 1.—Supporting Frame Materials Used for Auricular Reconstruction

- Cartilage
  - Autogenous
    - Contralateral auricular
    - Costal
    - Diced
    - Septonasal
    - Meniscus
  - Allogenous
    - Fresh auricular
    - Conserved auricular
    - Fresh costal
    - Conserved costal
    - Diced
    - Septonasal
    - Meniscus
  - Xenogenous
    - Rabbit
    - Ox
    - Calf
- Autogenous bone
  - Tibial
  - Iliac
  - Mastoid
- Ivory
- Combinations
  - Autogenous ipsilateral auricular/costal cartilage
  - Autogenous contralateral auricular costal cartilage
  - Autogenous costal cartilage/bone
  - Autogenous auricular cartilage/ivory
  - Autogenous auricular cartilage/acrylics
  - Autogenous auricular cartilage/polyethylene
  - Autogenous costal cartilage/polyethylene
- Alloplastic materials
  - Petroleum jelly (Vaseline)
  - Caoutchouc
- Metals
  - Silver wire
  - Tantalum wire
  - Steel wire
- Synthetic materials
  - Acrylic glass
  - Acrylics, soft
  - Polyethylene, massive
  - Polyethylene, porous
  - Polyamide (Supramide, Nylon), massive
  - Polyamide (Nylon), porous
  - Polyamide (Nylon), fiber
  - Polyester x-ray film
  - Polyester fiber
  - Polytetrafluoroethylene (Teflon)
  - Silicone (Silastic, Etheron)

precise percentage of resorption related to the total number of ears (1,592) with autogenous costal cartilage as the implant material. It is nevertheless noteworthy that 13 (19%) of 69 authors report on "resorption" in their group of patients (Table 3). This number is increased by an additional 14 authors, if—as appears justifiable—the "spreading" and "shrinking" of the new auricle that they describe is interpreted as resorption. If these are included, as many as 39% (27/67) of all surgeons with published results on autogenous costal cartilage as the supporting structure would have observed this unfortunate complication. One can only speculate as to how many of the remaining authors observed a resorption but did not report it. Other not uncommon phenomena are skin necroses and frame protrusions, which were described by 20 (29%) of the 69 authors. Thus, unproblematic healing cannot be taken for granted with costal cartilage, even though it is an autogenous material.

Silicone

The possibility of complications is even greater with silicone frames, which have more recently been ranging second in their frequency of application (we found reports of over 679 ears reconstructed with this material). Of 15 authors, 12 (80%) had to remove the silicone frames for various reasons. Nine (60%) of the authors observed spontaneous skin perforations, and seven (47%) an infection (compared with 9% [6/69] with autogenous costal cartilage); again it was not possible to determine the percentages in relation to the total number of ears that were operated on (Table 3).

Other Materials

The other six current frame materials are used much less often, judging from the literature references that mention them. The materials listed under items 3 through 8 in Table 4, taken together, were used in operations on about 400 ears.

The application of allogenous costal

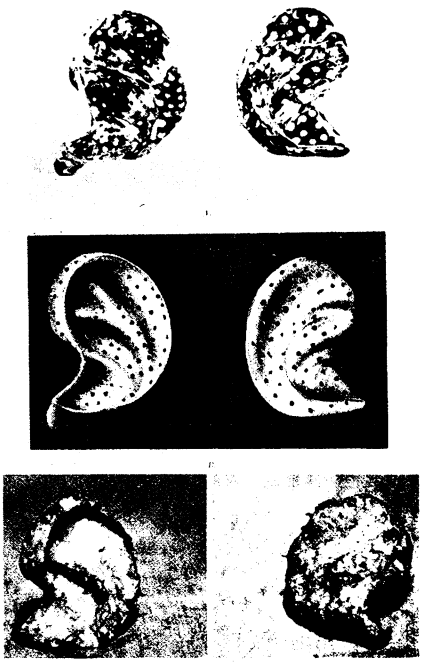


Fig 6.—Precast diced cartilage graft (bottom) on its removal from metal form (top) in 1944. Drawing of metal form shown at center (from Young[35]).

cartilage has so far been reported by 15 authors (as with silicone) but only once in the last ten years (in 1980).[33] On closer consideration, however, this material cannot be recommended, because resorption has been observed with striking frequency (by some authors in as many as 100% of all cases).

It is surprising that comparatively fewer resorptions were described with *diced* allogenous costal cartilage, which was implanted by Limberg in 1961[37] and others with a "cartilage injection." Of the three Russian authors concerned, Yarchuk[62] mentions an "absorption" in 33 of 100 cases, but Limberg[37] (41 cases) and Aleksandrov[39] (one case) apparently did not observe this complication.

It appears that somewhat more favorable results can be achieved than with autogenous costal cartilage alone by combining autogenous auricular cartilage from the healthy contralateral side with costal cartilage. Walter,[63] particularly, achieved favorable results with this material. This cannot be judged with certainty, however, because of the small number of cases (72 cases from three authors) and the altogether limited data published on

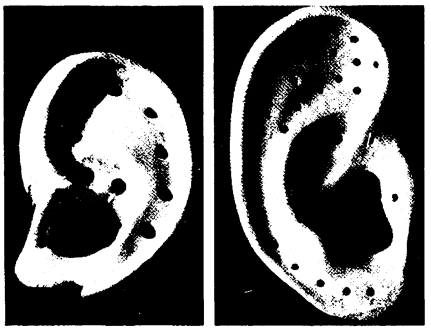


Fig 7.—Ivory framework in 1931 (from Joseph[47]).

the postoperative course. Unfavorable, in any case, are the three to four additional operating areas in the patient.

There are still more uncertainties in connection with autogenous mastoid bone, which was suggested by Gillies[24] in 1937 and adopted as a frame material by Cotin et al[25] in 1978. Apparently, resorptions and deformities develop, but the small number of cases and limited data of the authors do not permit a well-founded assessment.

Allogenous conserved auricular cartilage was reported to be used as frame material in 1983 by Campbell[30] but in only one patient whose long-term course is not known. It is interesting, however, that Kruchinskii[64] had previously (1973) reported only one frame removal over a period of four years in 32 ears constructed of this material. As early as 1940, Kirkham[29] also assessed the allogenous auricular-cartilage frame quite favorably.

ATTEMPT AT A NUMERICAL ASSESSMENT

Is it now possible to somehow objectively compare the results of all the authors considered? This project certainly involves some problems, for example, the nonuniform nomenclature in specifying complications and the frequent lack of data in the publications. Nevertheless, we have attempted to assign a mathematically determined point value to each of the different reports, taking into consideration the objectively positive and objectively negative aspects of the surgical procedures. Based on the

Table 2.—Surgeons Who Changed Frame Materials

Surgeon	Year	Frame Material
Gillies	1920	Autogenous costal cartilage
	1937	Autogenous bone
	1937	Allogenous auricular cartilage
	1951	Xenogenous cartilage
Pierce	1930	Autogenous costal cartilage
	1938	Allogenous costal cartilage
	1962	Polyethylene
Ombredanne	1944	Autogenous costal cartilage
	1951	Acrylics
	1958	Polyethylene
Bäckdahl	1939	Allogenous auricular cartilage
	1946	Rustproof steel wire
	1948	X-ray film
	1949	Autogenous costal cartilage
	1950	Xenogenous cartilage

briefly and appropriately formulated demands made by Sanvenero-Rosselli[65,66] to achieve "the best result within the shortest period of time with as few interventions as possible," a long postoperative observation period with maintenance of the surgical results is assessed as positive by our calculation procedure. The following phenomena, on the other hand, appear to be negative: many separate surgical sessions, additional operating areas outside the ear region, and, of course, the postoperative complications, comprising early and late complications. For example, it is possible that an early postoperative suppuration may at first heal without loss of the entire ear but that, years later, the same ear may nevertheless end up as a failure through rejection of the implant or shrinking of the cartilage.

The total number of ears reconstructed by one author using a particular technique is considered by specifying the complications as a percentage of all reconstructions. To avoid putting disproportionate emphasis on the early complications, which do not necessarily result in a loss of the new auricle, their percentage is only assessed as one tenth in each case, while the percentage of late complica-

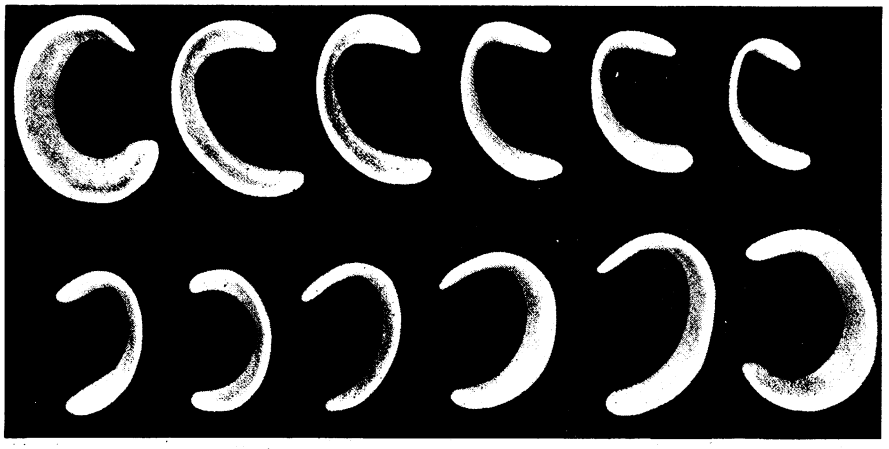


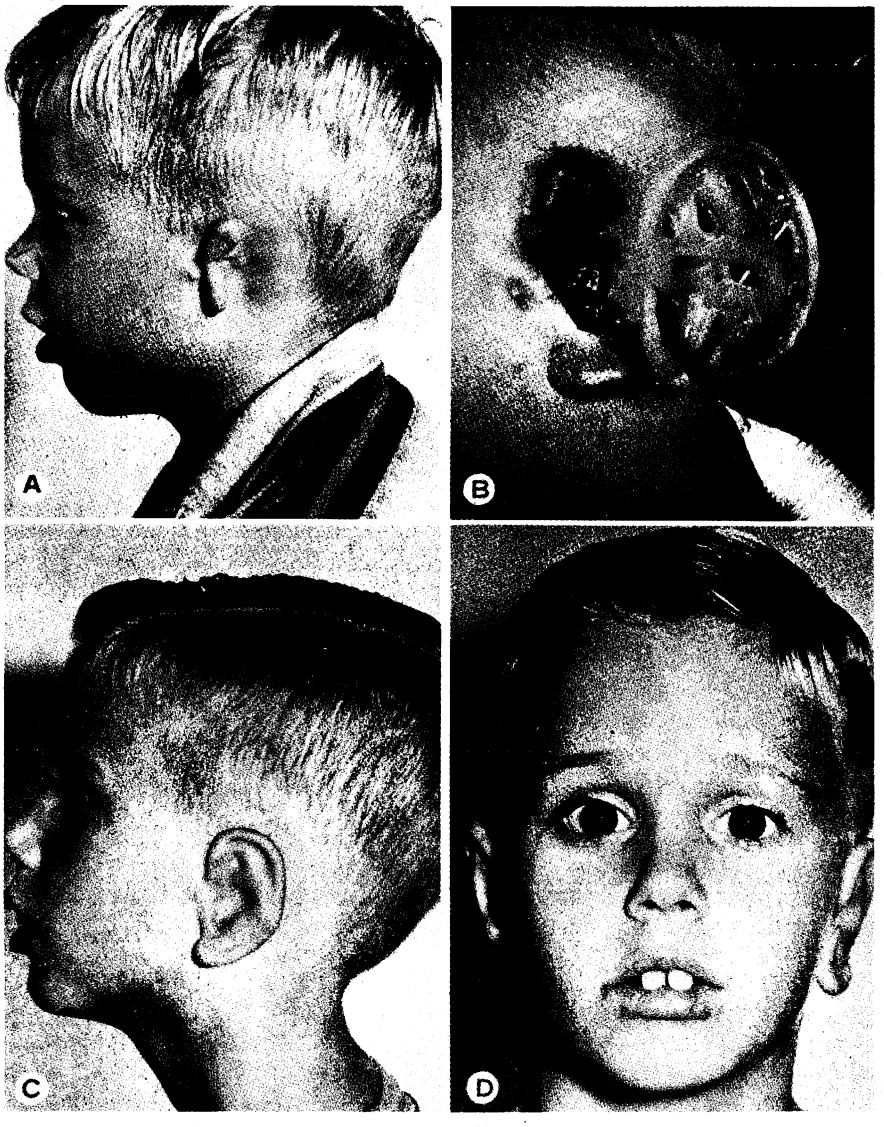
Fig 8.—Collection of acrylic supports in 1961 (from Matthews[53]).

Table 3.—Complications of Autogenous Costal Cartilage and Silicone Most Frequently Mentioned in the Analyzed Publications*

Complications	No. (%) of Authors
Autogenous costal cartilage	
Skin necrosis and frame protrusion	20/69 (29)
Bending, spreading, and shrinking	14/69 (20)
Cartilage resorption	13/69 (19)
Pleural rupture	7/69 (10)
Infection	6/69 (9)
Silicone	
Frame removal	12/15 (80)
Frame protrusion	9/15 (60)
Infection	7/15 (47)

*The frequency of complications in relation to the number of ears that were operated on could not be evaluated due to incomplete data.

Fig 9.—Auricular reconstruction with silicone framework in 1966 (from Cronin[57]).



tions (eg, resorption), which can signify the failure of the operation, is entered into the calculation undivided. If authors did not mention in later publications the development of complications in previously reported cases, we assumed that the long-term results were good.

The mode of calculation used for the point value that we determined for the individual procedures is illustrated in the examples of authors A and B in Table 5. The individual points are totaled after assessment. A value around 0 speaks favorably for the surgical technique, while increasingly negative values—particularly around −100—are considered unfavorable. In principle, our calculating methods are also conceivable, eg, forming a quotient, but the relations should remain the same. It becomes clear anyhow that this assessment can only be carried out if the results are published by the authors with sufficient transparency. The gaps found in the reports that we assessed are in part considerable. Of current interest is the evaluation of techniques of the last ten years, as shown in Table 5.

Influence of Surgical Technique on Results

Apart from the implanted material, the surgical technique can also exert an influence on the long-term result; it is possible to demonstrate this impressively by using as an example the "fan-flap" technique (the term alludes to the fan shape of the fascia

Table 4.—Assessment of Current Auricular Reconstruction Procedures in the Literature

Frame Material	Publication Period*	Total No. of Authors (Assessed)†	Total No. of Cases (Assessed)†	Mean Value‡
1. Autogenous costal cartilage	1908-1983	69 (32)	1,590 (1,238)	−22.6
2. Silicone	1966-1984	15 (12)	679 (412)	−46.3
3. Allogenous costal cartilage particles	1958-1975	3 (2)	142 (141)	−10.5
4. Allogenous costal cartilage	1939-1980	15 (10)	104 (86)	−64.0
5. Autogenous cartilage combination: contralateral auricular cartilage and costal cartilage	1963-1983	5 (3)	77 (72)	0
6. Autogenous bone (mastoid)	1937-1983	3 (2)	51 (51)	−52.5
7. Allogenous auricular cartilage (conserved)	1940-1983	4 (2)	40 (34)	−4.8
8. Porous polyethylene	1981-1984	2 (2)	5 (5)	−0.8
9. Autogenous costal cartilage	...	2 (2)	44 (44)	−0.6
10. Silicone	...	4 (4)	250 (250)	+1.7
11. Allogenous costal cartilage	...	1 (1)	8 (8)	−101.0
12. Porous polyethylene	...	1 (1)	2 (2)	−2.5

*Items 9 through 12 included the application of the "fan-flap" technique; all appeared in the literature after 1976.

†Parenthetical values indicate the number of authors and cases that we evaluated on the basis of sufficient data, using our point system.

‡Determined from the total of individual values for each author.

Table 5.—Two Assessment Examples

Assessment Criteria	Author A: Autogenous Costal Cartilage	Author B: Silicone
Observation period of years	+8.0	+5.0
Operation sessions	−4.0	−4.0
Operating areas outside the ear region	−3.0	−1.0
Percentage of early complications (X0.1)	−16.0	−5.6
Percentage of late complications	−95.0	−9.0
Total Points	**−110.0**	**−14.6**

flap). This procedure, which, in its essential aspects, had already been described and applied by Herrmann and Zühlke[54] in 1964 as "perichondrization" of the supporting frame, became generally well known in the modified form published independently by Fox and Edgerton[67] in 1976. The procedure is based on the principle that coverage with pericranium[54] or vascularized temporal fascia[67] provides an implant or transplant with a vital protective coat, which not only reduces the danger of skin perforations and necroses but also permits a frame thus coated to be covered with a free-skin transplant in one session (Fig 10). Brent and Byrd[68] developed the fan-flap technique in detail in 1983 by utilizing the healthy contralateral temporal fascia as a free flap and connecting it, such as in burn injuries, to the affected side by microvascular anastomosis. Although Dufourmentel,[69] in 1958, had already utilized the temporal vessels covered with a skin transplant for reconstruction of the auricle, the vessels only served as a protection for the helix margin of the implant.

The enthusiasm recognizable in the reports of those authors who apply the fan-flap technique can be objectively explained by our assessment system. If the point values are compared when the same frame material is used with and without application of the fan-flap technique, a marked improvement of the results obtained with autogenous costal cartilage and silicone can be achieved by the use of a covering composed of temporal fascia (Table 4, items 9 and 10). However, this hope must be expressed with caution, particularly for autogenous costal cartilage, since reports by only two authors with 44 fan-flap operations could be evaluated. The calculation for silicone frames is more reliable, because this technique was reported by four authors with 250 cases, which can better be compared with 12 authors and 412 cases without application of the fan flap. Ohmori[70] and Ohmori and Sekiguchi,[58] who have had experience with both methods, have observed only very few frame protrusions since they started using temporal fascia. For their results, we calculated a point value of −14.6 from the publication in 1974 reporting 116 cases without application of the temporal fascia[70]; later, in 1984, Ohmori and Sekiguchi[58] achieved a mean value of +0.6 with 156 reconstructed ears using the fan-flap technique. This observation is also supported by our experience[71] with the fan-flap technique in combination with a frame of porous polyethylene, although our cases are limited in relation to the number of cases discussed herein.

The fact that our assessment system shows no improvement for allogenous costal cartilage with the fan-flap technique is most probably due to the strong resorptive tendency of the material rather than to the technique. If the feared frame protrusions do not again occur with alloplastic implants, application of the fan-flap technique would for the first time render a modern synthetic material clearly superior to the cartilage frame.

Assessment of Our Results

The great advantage of an alloplastic frame compared with that of autogenous costal cartilage lies—above all, for the patient—in the fact that it obviates the removal of autogenous cartilage, which has its own surgical risks and scars. Due to the high failure rate (especially without the fan flap) and the known risk of infection associated with silicone

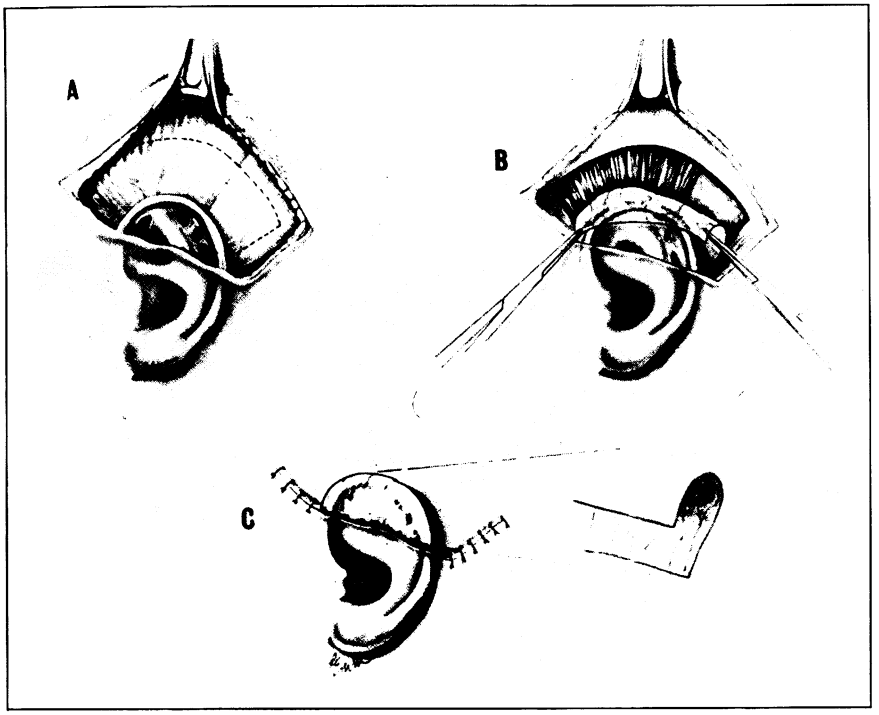


Fig 10.—Principle of "fan-flap" technique in 1976 (from Fox and Edgerton[67]).

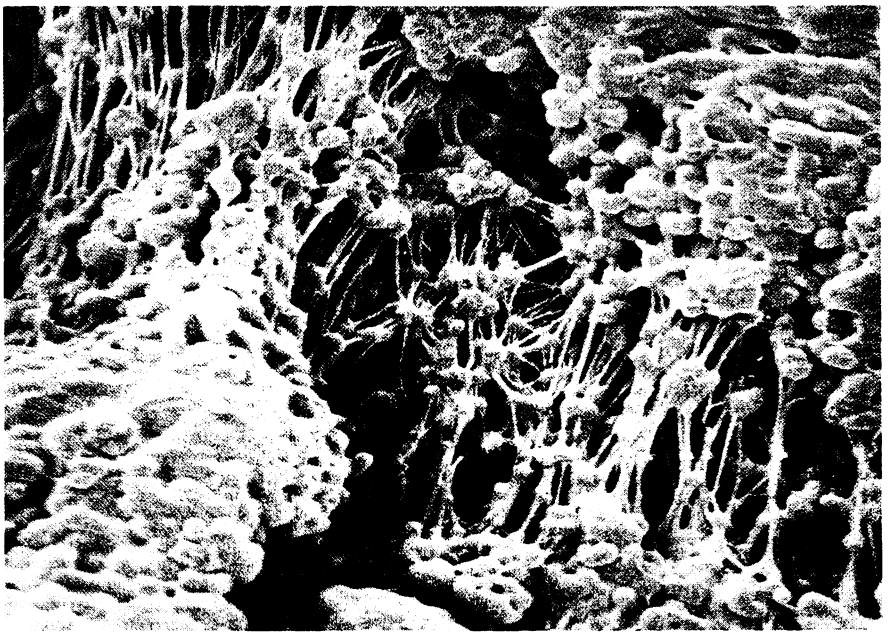


Fig 11.—Scanning electron photomicrograph of porous high-density polyethylene (×100).

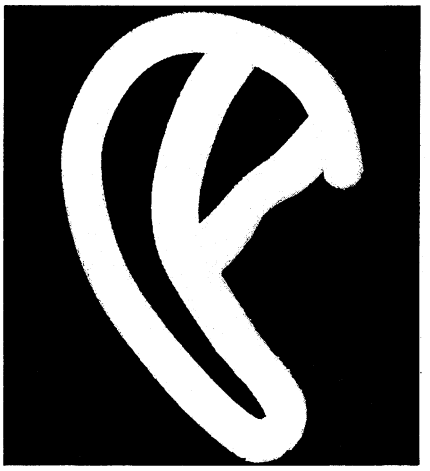


Fig 12.—Framework of porous polyethylene, as designed by Berghaus (unpublished data, August 1983).

Fig 13.—Normal postauricular sulcus three years after perichondritis with destruction of large portion of cartilage and implantation of porous polyethylene support.

frames, however, silicone did not seem optimal. In searching for a tissue-compatible and stable alloplastic frame with low susceptibility to infection, Berghaus et al,[61] in comparative animal experiments with four materials, found porous high-density polyethylene to be particularly suitable (Fig 11).

Since report of these experiments in 1983, Berghaus (unpublished data, August 1983), has used this easily pliable material to develop rounded implants in which the synthetic mass is reduced to a minimum (Fig 12). As already shown by preliminary experimental studies, the adaptation of the skin to the frame is very good and increases continually with time, so that a marked relief formation is achieved. The implants permit a total auricular reconstruction and can also be cut down to achieve a partial one.

Important for the stability of the result is coverage with a fan flap, which we prepare as described by Brent and Byrd[68] and supplement by a postoperative suction drainage according to Cronin.[57] Skin coverage is performed with a thick split-skin flap.

We first used a still rather crudely formed porous high-density polyethylene frame in 1982 in a case of auricular cartilage loss due to abscess-

Fig 14.—Patient with microtia before (left) and 1½ years after (right) reconstruction with rather simple arched clasp made of porous high-density polyethylene.

Fig 15.—Left, Patient with microtia preoperatively. Right, Same patient nine months after reconstruction using porous polyethylene framework. Patient does not desire further corrections.

forming perichondritis.[71] The result has remained satisfactory as of this writing (Fig 13).

The further developed, more delicate frames have so far been used five times for total auricular reconstructions (Figs 14 and 15). Postoperative skin shrinkage with small suture dehiscences and protruding synthetic material had made early corrections necessary in two early cases in which the implants were slightly shortened and again covered with small compound or split-skin transplants.

It is noteworthy that no appreciable complications occurred in a postoperative observation period of between six months and three years. A point value of −2.5 was calculated for our own results.

CONCLUSION

Due to the great number of procedures reported, it is impossible to discuss in detail the various types of incisions and flap techniques. In addition to roll and distant flaps, bilobate as well as transposition-rotation flaps have been applied, and, above all, split-skin and compound flaps from diverse donor sites have been used. Besides the fan flap discussed herein, particular mention should be made of the "Esser inlay"[72] and the "scalp roll."[73]

Other special procedures were the "valise-handle technique" of "tunnel procedure" of Tanzer[74] and the "skin expansion" and "expansile framework" performed temporarily by Brent,[75] who after 1976 preferred a modified framework from that used by Tanzer.[74] This is probably today's most used type of autogenous rib cartilage framework for auricular reconstruction.

The numerical assessment system that we have suggested for better comparison of the various procedures can only function properly when the data in the publications are always complete and up to date, which means that the system is dependent on ideal conditions. Since these are never given, the calculations for an overview can only be of an orienting character. On the other hand, since each surgeon's own current data are always accessible, we believe that our point system may be a valuable aid for the individual surgeon in assessing his or her total results.

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