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Surgical Versus Prosthetic Reconstruction of Microtia: The Case for Prosthetic Reconstruction

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The auricular prosthesis and the autogenous reconstruction must ultimately be judged on their ability to free the patient from the stigmatization of their condition. Excellent esthetic results are key in providing patients with the confidence that their correction will go undetected. There are other technical and psychological issues that impact prostheses success in particular, but the wide variability in esthetic quality available historically and around the world today might still be unnecessarily complicating if not biasing the treatment selection process. The thrust of this article is to provide current advantages and future potential of prostheses, along with demonstration of esthetic results that are possible with ear prostheses. The hope is that readers will come away more enlightened, more optimistic, and more confident in sharing information on prostheses with colleagues, parents, or patients. This might be helpful to those patients with an ambiguous prognosis who, for lack of knowledge, might otherwise undergo fruitless attempts at autogenous reconstruction.

Surgeons and others involved in the decision-making process with parents of children with microtia are encouraged to become familiar with the important references. The criteria for treatment selection between surgical and prosthetic approaches are well-developed and supported in Wilkes and Thorne.[1,2] However, the question for the patient or parent will always remain prior to treatment; what will the final result really look like? This article is written from the point of view of a medical artist/anaplastologist that has practiced full time for 25 years creating and providing silicone auricular, nasal, and orbital prostheses. The initial 4 years were in hospital-based positions and the last 21 years have been in private practice in collaboration with university implant teams in Dallas, Texas. This article suggests that the prosthetic option has historically been poorly represented, even misrepresented for various reasons, and that more should be published in the future to give a more complete picture of the prosthetic option to help with this decision of treatment selection. It is hoped that the author's experience, not as plastic surgeon, implant surgeon, or prosthodontist, but as the silicone ear specialist of 25 years, will add a different perspective to help guide future decisions.

Treatment options for children with absence or other malformation of the pinna remain; no treatment, autogenous reconstruction, or prosthetic reconstruction. The literature provides guidance in the area of selection criteria for choosing between autogenous and prosthetic reconstruction[1-3] and several team studies help to add quantity and experiential insight to the information pool on this topic.[4-6] Some of the articles have been coauthored by the autogenous surgical and prosthetic representatives at large centers that can evaluate patients, make a recommendation on the preferred treatment, and offer treatment of either kind at the center. The situation where a patient would receive the very best results for either treatment type from the same institution is rather unusual in the author's experience. The idea of offering such comprehensive excellence under one roof is attractive, but parents should feel free to consult independent anaplastologists as well. As a private anaplastologist based 21 years in Dallas, the author has enjoyed the professional enrichment of close collaboration and cross-referring of patients with maxillofacial surgeons and prosthodontists at Baylor College of Dentistry, Medical City Dallas, and the University of Texas Southwestern Medical Center. Some anaplastologists would agree that this experience of professional autonomy has invested them more deeply in their patient and thereby elevated final prosthetic results and long-term care.

The general opinion gleaned from the main references seems to be that autogenous reconstruction is the preferred method, if there exists a reasonable

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chance for an esthetically acceptable result. What is judged to be esthetically acceptable is a question worthy of much more study, both for surgical and prosthetic results. There seems to be general agreement that surgical results are improving because of the refinement of the techniques pioneered by Tanzer and further refined by truly gifted and experienced specialists like Brent, Firmin, Nagata, and very few others around the world. Many surgical outcomes are characterized as "suboptimal" or "not entirely successful" indicating results continue to be unpredictable.

On the other hand, prosthetic results are also improving in terms of stability, anatomical accuracy, and esthetics. With over 2 decades of experience in craniofacial implantology in the United States, and the continual refinement of implant techniques to retain ear prostheses, patients now enjoy predictable and repeatable attachment of the prosthesis with the promise of even more stable, secure, and sophisticated designs to come. The application of advanced digital technologies plays an increasingly important role in planning and guiding endosseous implant placement for bone-anchored prostheses as well as in several phases of ear prosthesis fabrication where anatomical fit and bilateral symmetric accuracy approach perfection. Perhaps as important has been the profound maturing of the field of anaplastology; specifically, facial prosthetics, in which truly dedicated artist/clinicians have provided as their specialty esthetic silicone auricular prostheses that often eclipse those from nonspecialized dental labs where they are treated as incidental or ancillary services. The "professionalization" of anaplastology and the dedicated specialization in silicone ear and facial prosthetics in particular has raised the bar considerably over the last two decades. In view of these developments and the collaboration between anaplastologist, implant surgeon and other team members, the prosthetic option should be considered equally with autogenous reconstruction in borderline cases.

The Anaplastologist's Opinion

In the author's opinion, children with microtia should be provided the best chance to have their ears successfully surgically reconstructed, which means they should be evaluated and treated only by the best in the specialty. The author recognizes the major articles on the criteria used in treatment selection. In general, the articles discourage attempts at surgical reconstruction for the child with a more profound deformity or with certain complicating factors such as low hairline, unavailability of suitable soft tissue, etc. As an anaplastologist, the author would generally agree with the major articles. As a nonsurgeon and nonstudent of long-term autogenous sequelae, the author must defer to the selection criteria posed in the major articles. However, in the author's 25 years of creating ear prostheses, many have been for patients with hemifacial microsomia, Goldenhar syndrome, etc, who presented with histories of repeated unsuccessful attempts at reconstruction. Given that there is some component of cases of unremitting family pressure to reconstruct even in light of the surgeon's caution, so there must be a component of overzealousness or other motivation that prompts some surgeons to operate. There also is very likely a component of experienced pediatricians and others who have steadfastly eschewed the idea of a prosthesis based, probably in part, on long-term patient dissatisfaction with adhesives and/or very poor esthetic results or unfamiliarity with the recent advances in the ear prosthesis option. The author believes that, generally, patients with microtia should be evaluated by only the very best dedicated ear reconstructive surgeons. The present level of prosthetic outcome success must become more visible so that selection criteria are based on accurate offerings for each treatment type. In particular, it is incumbent on anaplastologists specializing in ear (and facial) prostheses to present and publish the results of their university or private practice experience.

Patients must be referred only to surgeons such as Brent, Nagata, or the handful of similarly successful ear reconstructive surgeons worldwide, who, with their great experience, would be more likely to predict the outcome as well as most likely to provide a successful result. It is crucial that the initial attempt be in the hands of one of the few experts. Perhaps these individuals would be less likely to undertake cases with poor prognoses for the sake of gaining more experience. Also of concern in the author's experience is the notion that patients should be directed to major "centers" where they can make their treatment selection and obtain successful results utilizing either the surgical option or the prosthetic option within the center. As with referral to an expert ear reconstructive surgeon where location and hospital affiliation are secondary, so too should be the mode of referral to the expert anaplastologist or team that includes a highly regarded anaplastologist.

The anaplastologist, like the reconstructive surgeon, is charged with the formidable task of restoring the delicate beauty of the human ear. Differently trained and equipped, perhaps, both specialists are responsible for constructing the ear to the best of their ability and turning the patient toward the mirror, and in doing this, altering the way the patients feel about themselves and their presentation to the world. However, anaplastologists as a group, unlike surgeons, have definitely not contributed significantly to the literature to offer up a true representation of what is possible prosthetically. Whether this is due to anaplastologists' less scholarly educational preparation or simply the fact that the design and fabrication process leaves little time to write, it is unfortunate that significant practice experiences have gone unpublished. The point here is that much of what has been published in periodicals or texts on facial prosthetics is outdated, depicts technical or clinical solutions of narrow application, or it presents a random prosthetic result often selected and published by someone other than the anaplastologist who performed the result. In short, serious facial prosthetists in private practice or in universities who possess the right blend of training, talent, and time to put the treatment in its best light still have not taken, or been given, as the case may be, the opportunities to show results the way world-class reconstructive surgeons have, for instance.

Noteworthy exceptions to this can be seen in a compilation by Branemark, the pioneer of osseointegration, in which solid prosthetic results from anaplastologists around the world are seen.[7] In a text written by Thomas, he shows a comprehensive command of silicone facial prosthetics.[8] However, even these sources are 8 or 10 years old. The author's opinion is that, aside from a few exceptions, the literature projects an incomplete if not inaccurate picture of what patients should expect in a prosthesis.

Admittedly, even now, a continuum of ear prosthetic results exists worldwide, from crudely formed masses of inferior materials slathered with color all the way to inspired renditions so accurate and lifelike that duplication is dishearteningly unlikely (with increased focus and resources for prostheses, hopefully we will see the adoption of sophisticated manufacturing processes so patients can anticipate a lifetime of consistent duplication of the perfect match). Much of what is seen in publication falls somewhere in the middle of this continuum. Ear prostheses seen in publication sometimes appear off balance slightly in opacity-translucence, off in hue (wrong color), off in value (too dark or light), or off in chroma (too dull or intense), and anatomical form appears carved rather than organic and fleshy, as though the process was hurried. Margins may be easily detected. Historically, such shortcomings might have been acceptable in view of the unavailability of specialized staff and infrequency of facial patients. Conversely, some major centers overwhelm even the facial specialist so that compromises are made to accommodate the volume of patients.

The prosthetics option will eventually provide a more accurate picture and better alternative in borderline cases. This will happen when the facial prosthetics professionals who have created their ideal practice environment begin to publish and present the results of their work more seriously. Like ear reconstructive specialists, there are very few anaplastologists worldwide who practice silicone facial and auricular prosthetics as their core competency. However, unlike autogenous successes, prosthetic successes occupy a relatively low profile. Some of the most impressive prosthetics results worldwide come from anaplastologists working in private settings, which might mean that they are off the radar of important referral networks and implant teams that they should be a part of.

Surgical Problems

In all of the important references it is agreed that the surgical reconstruction of the human ear is an extremely complex procedure. It is "in the upper echelons of reconstructive surgical procedures," states Walton.[9] He continues, "Optimal results can only be achieved through dedicated study and experience." This message that autogenous ear reconstruction should be left to the talented and dedicated few reverberates throughout the literature. And this is particularly true because the incidence of microtia/anotia patients is relatively small; 1:5,000 according to Brent.[10] It is clear that authors, most of whom are surgeons, make this point loud and clear repeatedly, and with good reason. Complications at the ear reconstruction site include exposure of the cartilage framework due to skin flap necrosis.[9] This can be devastating to the reconstruction if not managed carefully. If the framework cannot be salvaged it must be removed and the operation considered a failure. Long-term complications include the significant resorption of the cartilage framework, which may or may not respond well to additional cartilage grafting to restore the lost contour. There is always the chance that if the cause for the resorption is not understood and corrected appropriately, this destructive process will reoccur. Finally, resorption of the framework at the site of synchondrosis can result in notching of the framework, requiring reintervention.[11]

These complications may lead to a severely compromised result. But even in the absence of complications, the entire restoration might not achieve the elevation from the head to gain the approval of surgeon and patient (Figs 1, 2). Walton states, "All authors agree that maximum relief of the construct is essential for the highest quality of reconstruction."[9] If the reconstructed ear does not display normal elevation and reasonable definition, observers will likely detect it, especially during a face-to-face encounter where both ears will be seen. Additionally, Thorne concedes that a suboptimal result might be uncorrect-

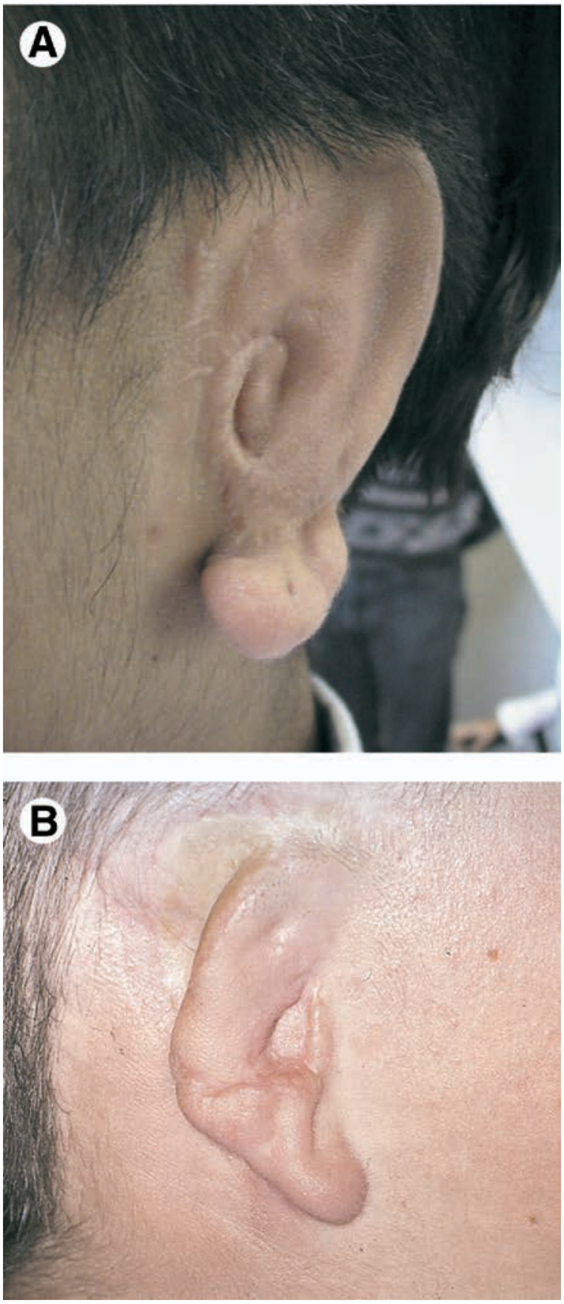

FIGURE 1. *A, B,* Results of repeated autogenous reconstruction.

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able.[2] The poor autogenous or prosthetic subpar result will attract attention or require some degree of coverage or shadowing with hair or hat to minimize detection. These patients (Figs 1, 2) preferred to "wipe the slate clean" and wear a prosthetic ear to achieve the balance and beauty of a normal-looking ear.

Autogenous reconstruction also requires a sizeable piece of rib cartilage for the ear sculpture, leaving a compromised rib structure and a soft tissue deficit in the donor site. Although the ideal age for children to have ear reconstruction is generally agreed to be about 6 years, Ohara reported that 64% of children under age 10 years had chest wall deformity compared with only 20% of older children.[12] The emotional toll of parents and patients in failed attempts and the trauma and disfigurement to the donor site, although not precluding the autogenous option, certainly must be considered a disadvantage of this option. The presence of a long-lasting scar is yet another reminder of the child's imperfection, and will likely invite more questioning from peers during athletic or summertime activities. To the child, it may become an additional reminder of the parent and other's focus on the microtic ear.

Also of concern is the degree to which the reconstructed ear will grow to keep pace with the contralateral ear. Aguilar points out, in his reconstructive technique article, that studies in this area are seriously lacking.[13] He also cites that Brent addressed this issue, reporting on 76 patients operated on between ages 5 and 10 years.[14] The report describes the majority of cases growing on pace with, or a few millimeters larger than, the contralateral ear, with only 10% lagging several millimeters behind. Aguilar states that more such studies are indicated and the area is ripe for further research.

Then there is the question of long-term integrity of the reconstructed ear. Will the reconstructed ear continue a trend in maturation into middle and old age that reflects that of the contralateral ear? The large studies of Brent[14] and others report on the maintenance of the ear shape over 10 to 15 years, which would measure the result when many in the group are still relatively young, perhaps 16 to 30 years old. In Tanzer's comments after Brent's article,[14] he observed some indications of loss of form after a longer period. Fukuda made a similar observation in his very long-term study.[15] Perhaps more time will be needed to measure long-term integrity of the reconstructions by Brent, Nagata, and others. We cannot diminish the efforts and spectacular results of the best ear reconstructions. However, the achievement of bilateral symmetry is an area where we will see an advantage of the prosthetic option, particularly for those who choose to wear very short hairstyles.

The obvious advantage of using one's own tissue for permanent reconstruction along with greater refinement of techniques by experts seen in recent decades is still offset somewhat by the uncertainty of the actual results obtained by individual surgeons. Most surgeons do not have the experience to duplicate the results of large specialized studies like those of Brent, Firmin, Nagata, etc, and the failed attempts are likely to compromise if not eliminate any future chances for truly successful reconstruction.

Prosthesis as "Backup" if Autogenous Fails

There is some logic to the notion that because a prosthesis can always be provided, why not try to reconstruct the ear surgically first. This is a reasonable thought if a child presents with microtia, anotia, or other correctable condition in the view of an expert ear reconstructive surgeon. Of concern would be the tendency to use the prosthesis option as a backup or secondary choice when in fact it should be the primary choice to save a child unnecessary prolonged physical and emotional pain. The failed autogenous reconstruction experience or, for that matter, any result that still draws immediate attention to the patients head, cannot be easily dismissed. In the wake of a poor result, the parents and patient will anticipate a waiting period to either accept and live with the result and the child's continued social torment, the decision to undergo another attempt with less chance for success, the decision to start the process again with another surgeon, or the difficult decision to excise the construct to prepare the area for a prosthesis. In any event, surgical ear reconstruction is accompanied by trauma in multiple sites, possibly over several years, considerable pain especially from cartilage harvest sites, possible need for adjunctive procedures such as tissue expanders with other possible complications further delaying the outcome, and, of course, the extended focus on the ear during a crucial period of a child's psychosocial development.

Anaplastology: An Additional Asset for the Prosthetic Option

The American Anaplastology Association is a group of individuals with international representation that is specifically dedicated to improving facial prosthetics. Their focus on the challenge of lifelike soft tissue prosthetics promises to further advance the results and value of prosthetic reconstruction. Individuals who have specialized in silicone facial prosthetics have practiced in different settings using many different titles, including facial prosthetist, maxillofacial prosthetist, head and neck prosthetist, and even medical sculptor. More recently, many individuals have used the title of anaplastologist. Anaplastology is a relatively new term, defined in medical dictionaries as: Application of prosthetic materials for construction and/or reconstruction of a missing body part (from the Greek *ana*, again, and *plastos*, formed).[16] The field of anaplastology and the anaplastologist have come into existence largely because of increased focus and dedication to the unique challenge of creating silicone facial prostheses. The American Ana-

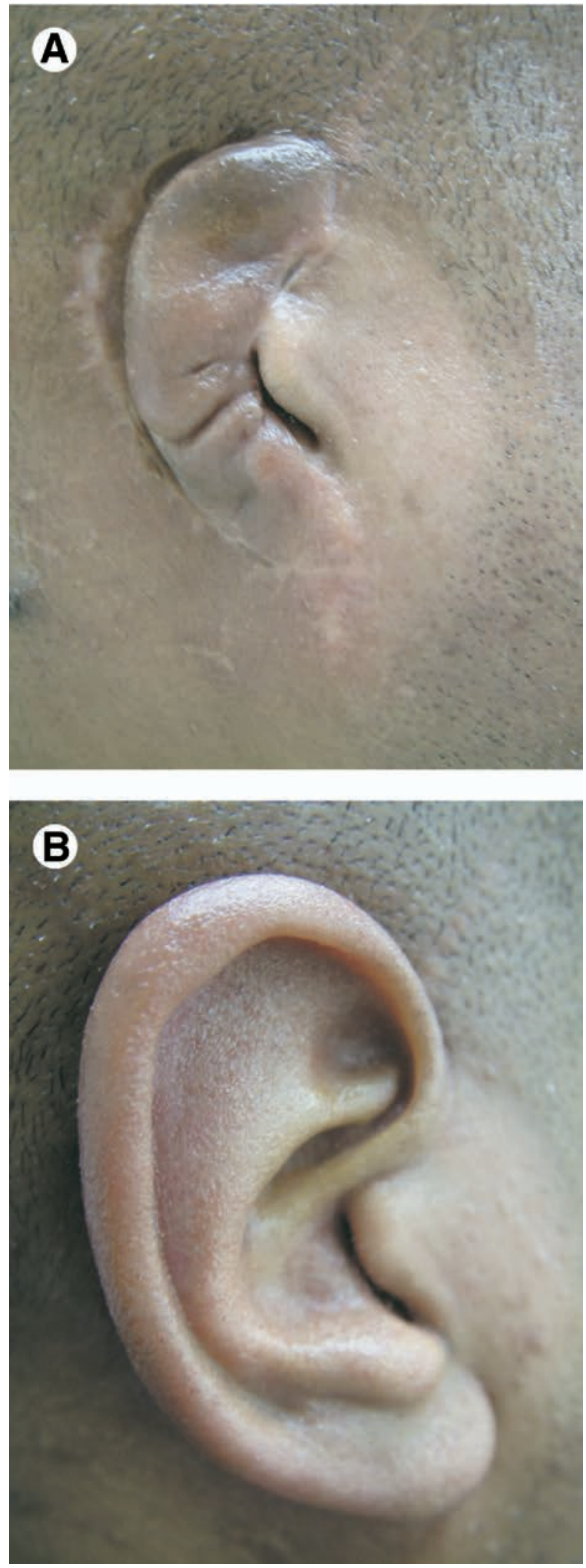

FIGURE 2. *A*, Right autogenous reconstruction. *B*, Implant-retained prosthesis replaces autogenous construct.

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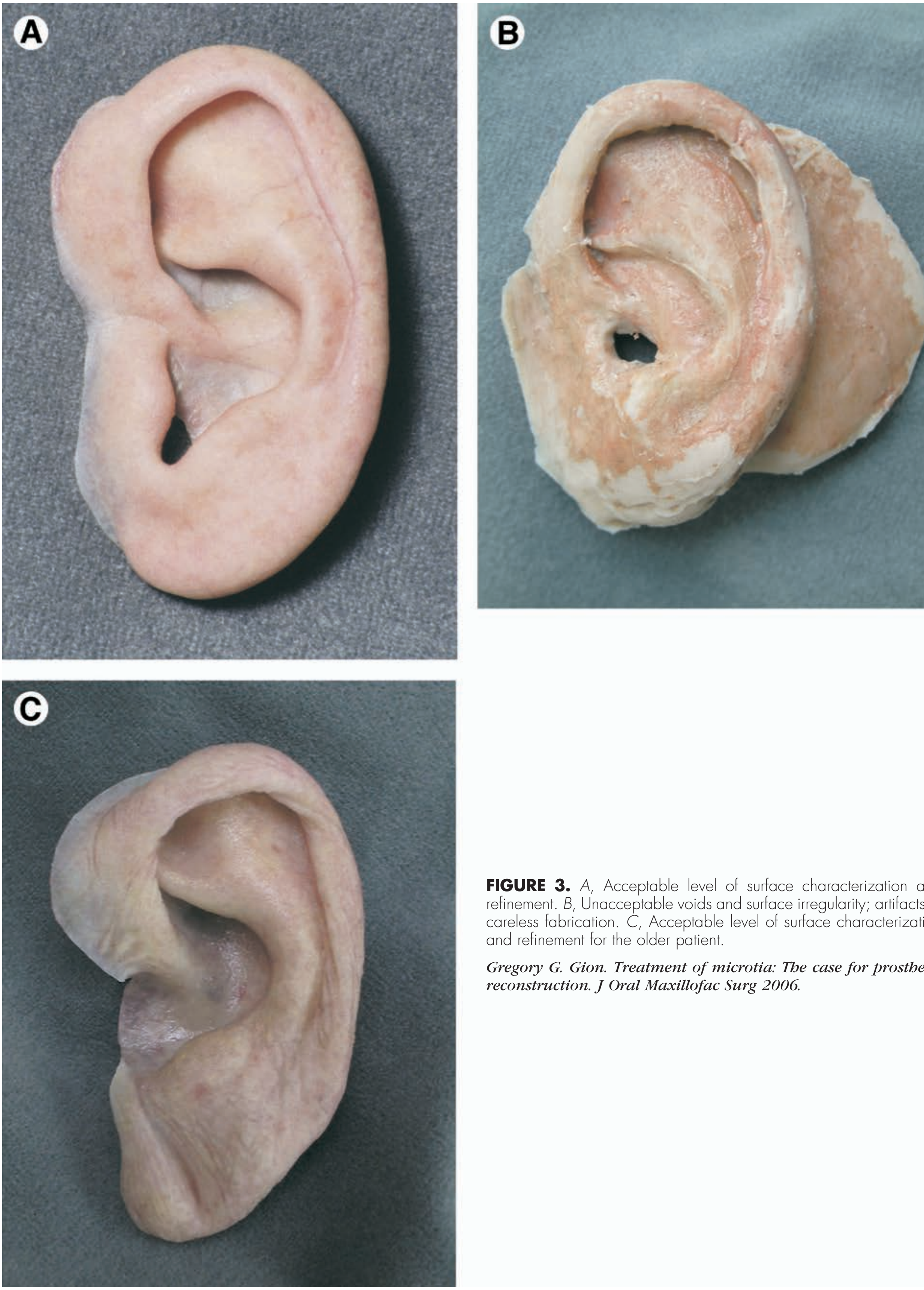

FIGURE 3. *A*, Acceptable level of surface characterization and refinement. *B*, Unacceptable voids and surface irregularity; artifacts of careless fabrication. *C*, Acceptable level of surface characterization and refinement for the older patient.

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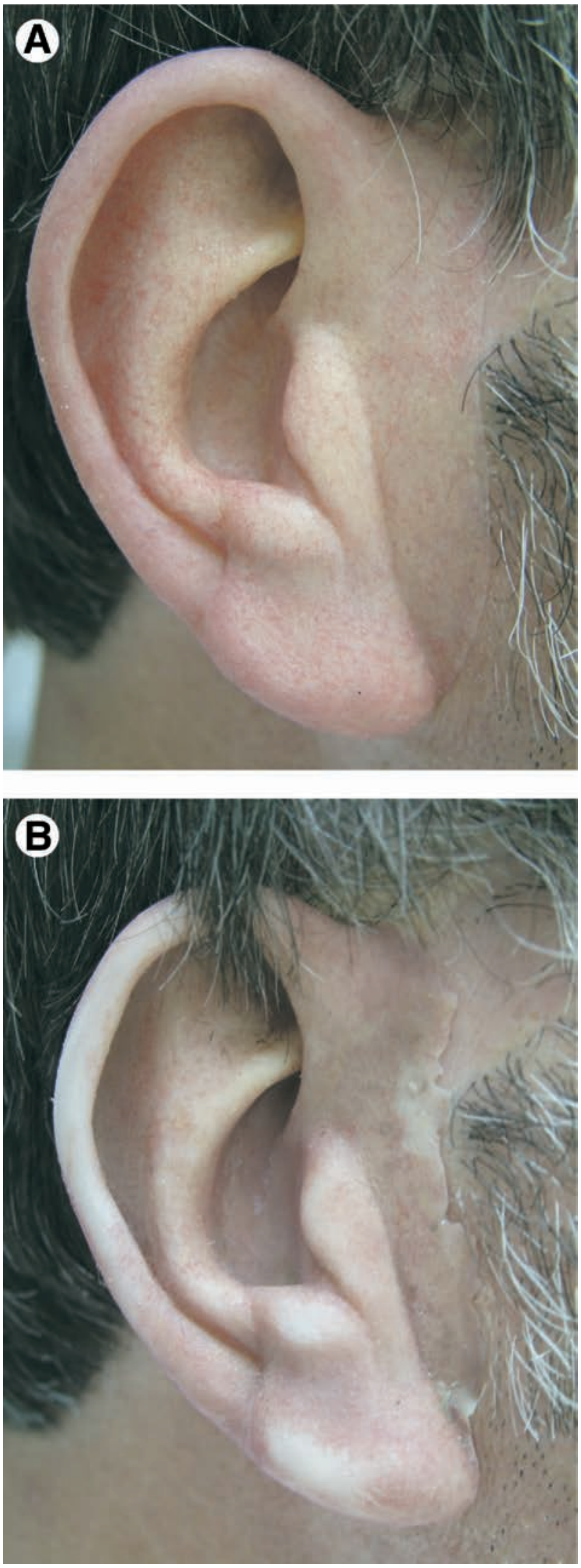

plastology Association, begun by Dr Walter Spohn at Stanford, had its first annual meeting in 1986. In 1987, the Association of Biomedical Sculptors begun by Dennis Lee at the University of Michigan in the late 1970s/early 1980s was essentially absorbed by the American Anaplastology Association (AAA) to continue their dedication to the specialty. The AAA has enjoyed solid international participation every year since 1986.

The current members have diverse educational backgrounds including medicine, dentistry, dental technology, materials research, medical art/illustration, and fine art, to name a few. There are also members who originate from the fields of ocular prosthetics or limb prosthetics/orthotics. Although the diversity of education and training experiences provides fertile ground for new ideas and information exchange, membership in the AAA or using the title of anaplastologist does not in any way indicate an individual's actual training or competence in providing auricular or other facial prostheses. The Board for Certification in Clinical Anaplastology (BCCA) has begun the process of developing criteria to identify an individual's knowledge of basic materials and principles in the provision of anaplastology services. A grandfathering phase has identified subject matter experts who are assisting with test development. The BCCA is a member of the National Organization for Competency Assurance (NOCA) and is pursuing accreditation through the National Commission for Certifying Agencies (NCCA). These developments underscore an international effort to define this specialization and to promote a significantly higher level of prosthetic result.

Facial Prosthetist Selection

The success of implant-retained facial prostheses has prompted the formation of teams with the goal of providing comprehensive centers for maxillofacial prosthetic rehabilitation. Within large medical institutions or dental schools, these teams often form around the reputations of attending surgeons and prosthodontists. Some teams have recruited a dedicated anaplastologist or retained a proven independent facial prosthetist to assure that their patient receives the maximum prosthetic outcome. Others

FIGURE 4. *A*, Replacement prosthesis with patient preference for heavier margins to withstand adhesive regimen. *B*, Opacification/surface wear indicate daily use of and reliance on prosthesis well beyond recommended replacement interval.

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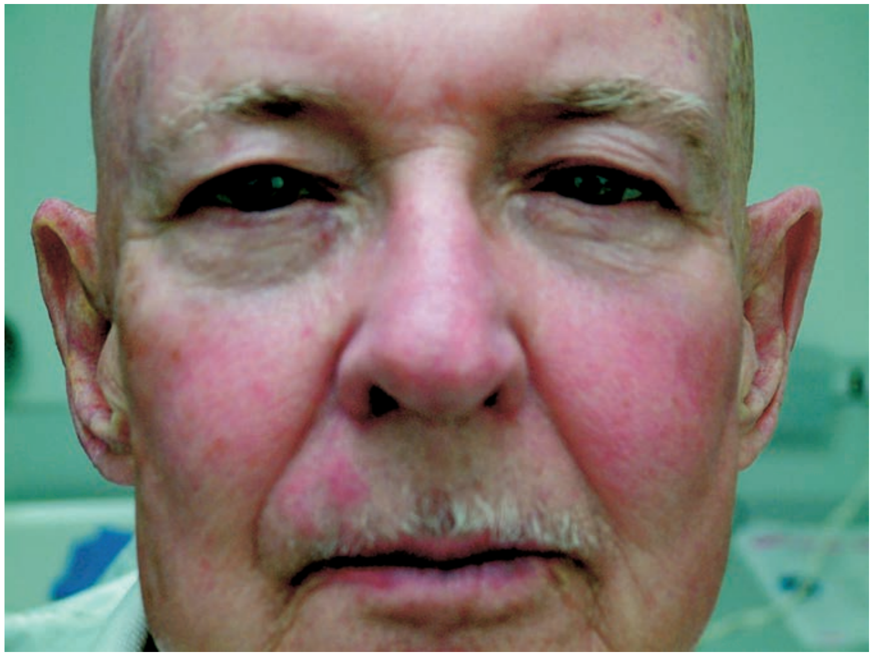

FIGURE 5. Right auricular prosthesis provides balanced unremarkable silhouette.

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enlist existing lab staff for the task, assigning them a title such a medical artist. The latter approach may provide savings for departments and it may help inflate the profile of the program. However, it does not serve the patient, institution, or the legitimate medical art-trained anaplastologist, and is not encouraged. When patients are weighing the merits of autogenous versus prosthetic reconstruction, they should have access to full-time facial prosthetic specialists just as they should have access to dedicated ear reconstructive specialists. Patients should be referred to facial prosthetists who can show, through close-up photographs, many excellent and varied types of prosthetic ear results. Providers should be experienced not just to provide conventional adhesive- or implant-retained prostheses, but also more complex designs to exploit opportunities for anatomical or mechanical attachment. The author agrees with the plastic surgeon Walton who states, "The weak link in this technology (the prosthetic option) lies in the quality of the prosthesis itself, the life-like appearance of which is wholly dependent on the artistry and skill of the anaplastologist"[9] (Fig 3). The importance of this relationship with an expert anaplastologist is restated by the plastic surgeon Somers of Belgium.[5]

The provider of ear prostheses must possess a blend of training and talent as well as a willingness to devote the time needed to render a result that achieves true visual integration (VI). VI occurs when the prosthesis convinces the eye that it is vital, normal, and contiguous with surrounding anatomy. VI is difficult to achieve consistently, but no less important than the requirement of functional integration (FI). FI occurs when a patient accepts a safe, secure, and manageable prosthesis, integrating it into the self image and daily life. The author advocates the use of VI and FI or similar language to frame the equal importance and measurement of these criteria.

Advantages of Prostheses

Attempts have been made to measure facial prostheses,[17,18] and some studies have reported on overall patient satisfaction with maxillofacial prostheses.[19] However, in general, studies are vague and inconclusive for the purpose of developing treatment selection protocol. What is reliable is the fact that many men, women, and children have successfully and happily worn ear prostheses for many years, many of them returning every few years over the course of decades for replacement prostheses as they wear out. A 48-year-old patient (Fig 4) has used an adhesive-retained prosthesis for many years after several surgeries during childhood to reconstruct. The author has provided this patient with prostheses since 1993. The patient opted to leave the surgical remnant of the lobule to reside beneath the prosthesis. This photograph showing the wear characteristics of a 5-year period of daily use illustrates patients' reliance on a prosthesis and its integration into their daily life. More frequent repair, retinting, or replacement of the prosthesis is recommended, but this mail carrier now with

children of his own will have the prerogative to acquire improved prostheses as he wishes. Although these photos typify adhesive-related degradation of silicone prostheses, they also hint at the even greater longevity and ease of use of implant-retained versions. They also give testament to patient usage and long-term satisfaction with prostheses. Check-up and refurbishing every 1 or 2 years preserves margin esthetics and visual integration of the prosthesis.

Symmetry

Symmetry in particular is an important element, especially for those anticipating wearing a short hairstyle not only as a child but also throughout their adult life. In a normal social encounter, an auricular discrepancy will likely be detected, drawing focus away from the human interaction and toward the dissimilarity of the ears. This point is very pronounced in those with short hair styles and protruding ears (Fig 5). The success of osseointegration makes the use and acceptance of the prosthesis even more dramatic. With prosthetic accuracy and ease of use increasing, the long-term studies will become more important in measuring how closely the autogenous reconstruction matches the contralateral ear after 20, 30, or more years when the patient reaches the age of 40, 60, or 80 years.

Patients apparently are very concerned about symmetry, based on the author's experience with requests to improve upon the results of unsuccessful autogenous reconstructions. In these cases, patients have autogenous structure that approximated the general size of the contralateral ear, but they seek a prosthetic ear to cover and mask their reconstructive result (Fig 6). This would suggest that even having their own ear formed of their own body is less than satisfactory, and that having a removable prosthetic ear that projects the natural esthetic beauty of normal anatomy is worth the daily regimen of prosthesis usage. It may be that this combination of basic autogenous structure and overlying prosthetic surface is worth the added cost and trouble of care and maintenance because it makes the patients feel that they have their own ear, and the prosthetic "sleeve" or "overlay" may be more easily accepted as an enhancement—an option to improve esthetics, not the correction of a gross defect. In some of these situations

FIGURE 6. *A*, Patient with left autogenous reconstruction. *B*, Patient using sleeve-type prosthesis to achieve a more normal appearance of superior auricular anatomy.

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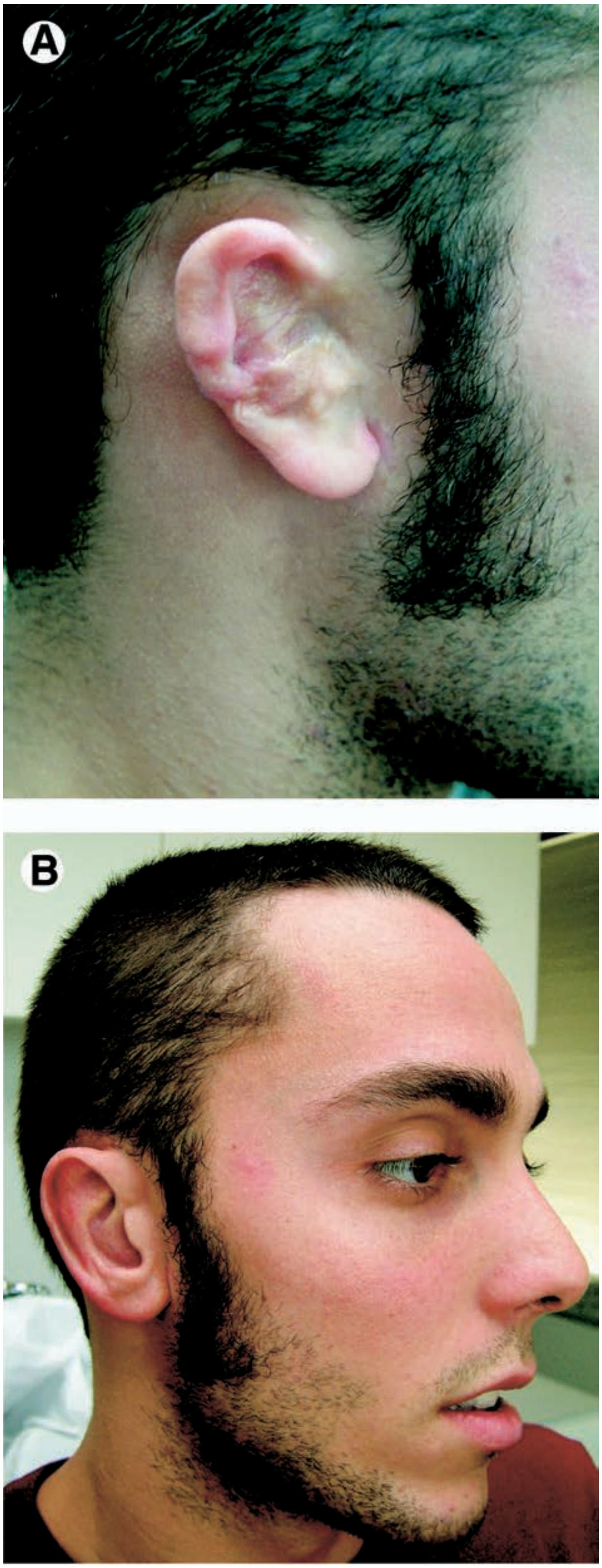

FIGURE 7. *A*, Patient with right autogenous reconstruction. *B*, Patient using an adhesive-free sleeve type prosthesis and subsequent replacements.

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the patient does benefit by the retentive effect of the existing ear, as it allows the prosthetic ear to slip over it like a glove, reducing or eliminating reliance on adhesive (Fig 7).

The importance of symmetry cannot be minimized. In the author's experience, patients almost without fail judge the prosthesis first on symmetry. Even when patients verbally acknowledge the need for compromise of desired prosthesis shape due to existing anatomy, implant abutments, etc, they continue to focus on and point out minute discrepancies in bilateral symmetry to the anaplastologist. This is common and a constant indication of the importance of symmetry. The author has accomplished symmetry by sculpting in wax a mirrored rendition, usually by studying a plaster cast made from an impression of the contralateral ear. However, the use of digital technologies such as 3-dimensional scanners/printers now adds to the speed, accuracy, and patient confidence in prosthetic replacement therapy. After 25 years of sculpting ears from a lump of softened wax, we now use a Roland MDX-15 3-dimensional scanner/printer in office to accomplish near-perfect initial bilateral symmetry. Adaptation to the defect contours and final surface detailing still require some effort, but less so. The explosion of digital applications not only promises to improve morphological accuracy, it promises to transfer the saved time in sculpting hours and potentially in color quantification to the next challenge of achieving a highly accurate and systematized reproducible skin appearance in the prosthesis.

Prosthetic restoration, unlike autogenous reconstruction, is almost immediate. In cases where a patient wants to know what a prosthetic result can offer without osseointegration, the prosthesis can be created and attached in 3 days. Waiting and worries of whether the correct surgeon has been selected, timing of the surgeries, school absences, pain, complications, and follow-ups are not present with the prosthetic option. Children utilizing a bone-anchored auricular prosthesis may require only a single surgery followed by integration time and prosthesis fabrication time—a total period lasting as little as 12 weeks at which time they have their "ear" and may begin integrating it into their life. Despite having knowledge of and access to the best ear reconstructive surgeons, some parents select osseointegration over the uncertainty and prolongation of autogenous reconstruction. A 6-year-old child (Fig 8) was evaluated and the parents were encouraged to consult excellent ear reconstructive surgeons. After this, the parents selected prosthetic reconstruction and the child received implants and a completed prosthesis prior to first grade. Upon returning home after his first day he expressed some regret that he received no extra attention—no classmates detected his prosthetic ear.

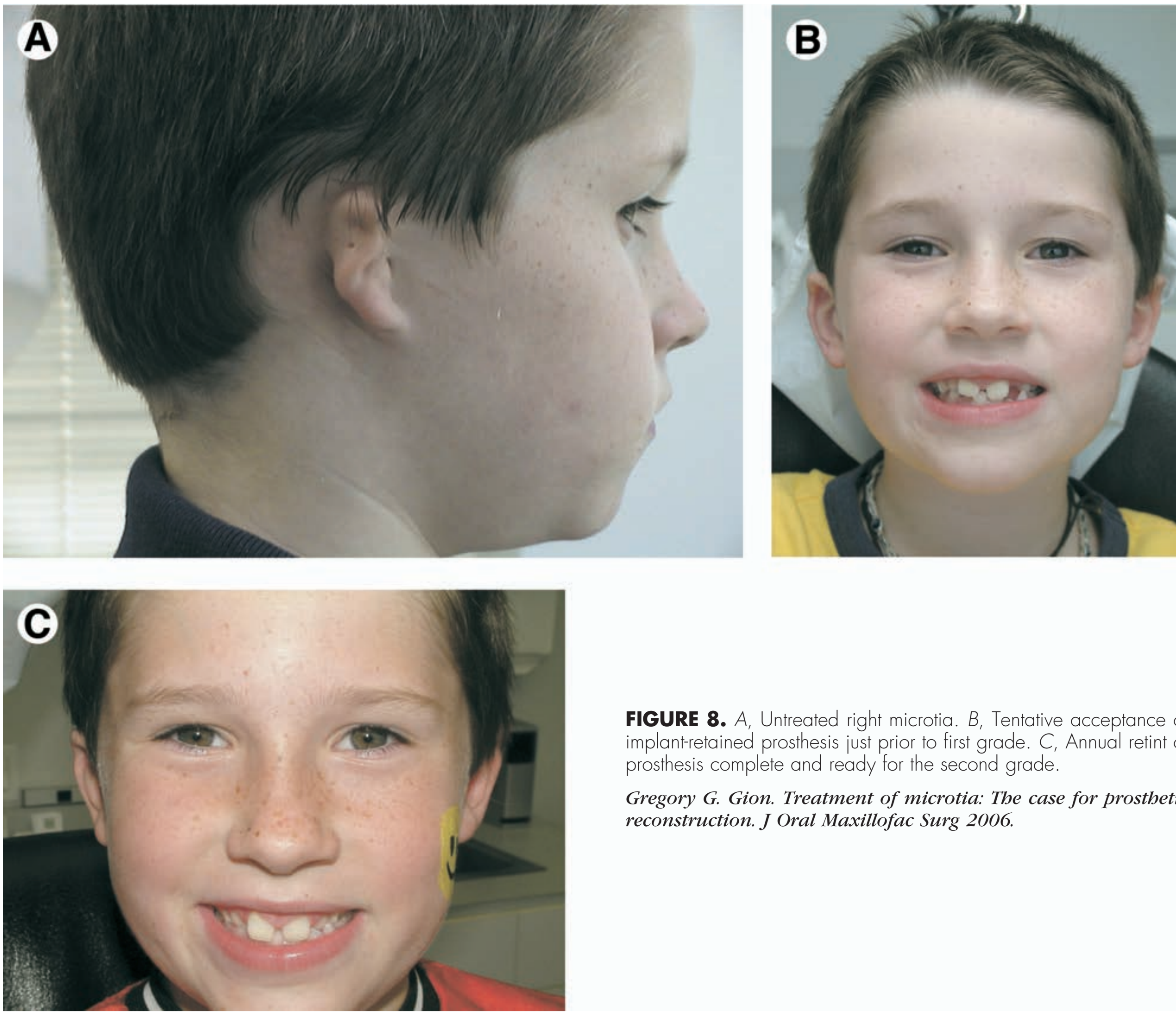

FIGURE 8. *A*, Untreated right microtia. *B*, Tentative acceptance of implant-retained prosthesis just prior to first grade. *C*, Annual retint of prosthesis complete and ready for the second grade.

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Nearly 1 year later, the child returned to the office for retinting of his prosthesis in preparation for the start of second grade. In a long-term study of quality and safety of osseointegration-supported ears, it is reported that many of the patients accepted the prosthesis as their own.[20] Studies of children's and parents' questionnaires report improved quality of life.[6]

There is also a high success rate for implants placed in the mastoid. During the years 1994 to 2004, our implant success rate has been 100%. Of a total of 92 implants placed in the mastoid by Dr. Douglas Sinn, the maxillofacial surgeon at the University of Texas Southwestern Medical Center, during these years for ear prostheses created by the author we are not aware of any failures. Other advantages include, of course, no trauma of repeated surgeries associated with the reconstructed site and rib cartilage harvest site.

There has been justified concern that the placement of implants will preclude future attempts at surgical reconstruction in "ideal" microtic ears. The author is much more comfortable and prefers that well-situated microtic tissue be left alone to reside beneath the prosthesis (Fig 9). The presence of the remnant lobule, if well positioned under the prosthesis, actually produces a snugger fit and more esthetic margin with less chance for exposed scarring, contracture, etc. In cases where 2 or 3 implants are placed into the mastoid, future reconstruction may not be precluded. In some cases the prosthesis is designed to blend into the remnant lobule, not cover it. This can have the advantage of maintaining the important visual continuity in color and texture between the cheek and the ear lobe. In grade 1 and grade 2 microtia, excision for a prosthesis should not occur, generally. In some scenarios involving grade 2 or 3 microtias, some patients and parents having difficulty with their decision might benefit from having a prosthesis even with a compromised shape. It allows them to understand how existing tissue compromises the prosthesis, it allows accurate assessment of

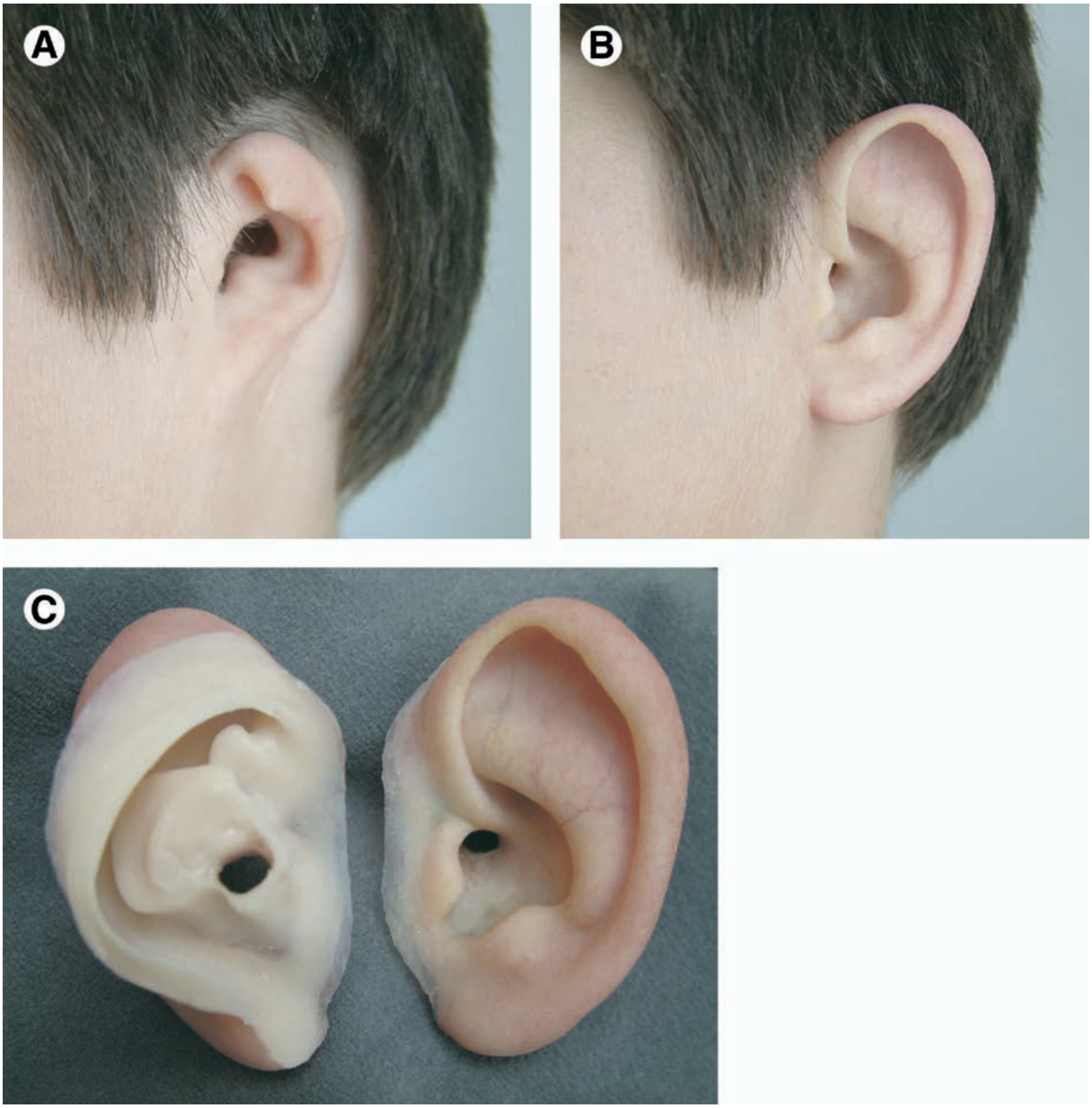

FIGURE 9. *A*, Untreated left microtia. *B*, Sleeve or slip-on type prosthesis in situ. *C*, Sleeve prosthesis and duplicate.

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achievable esthetics in terms of color match, etc, and it introduces the reality of daily application and removal of a prosthesis. This can be helpful before deciding to excise the remnant for osseointegration and eliminating an opportunity for later reconstruction (Figs 9A-C).

The general advantage of the prosthesis is the potential to present normal appearance and be undetectable. In real-life situations where people have an opportunity to study one another's ears such as crowded elevators, grocery lines, etc, small deviations may be detected, so prostheses must be nuanced and formulated to appear natural in different lighting conditions (Figs 10A-C). Subtle coloration, convincing simulation of anatomy, and tightly fitting margins should be present in the prosthesis. Unlike the trend in autogenous reconstruction where the chance for happiness and success diminish with repeated attempts, prosthetic results will likely improve, as will subsequent versions of the ear as technique is refined or a more talented/experienced anaplastologist is used. There should be no evidence that the ear form began as a clay sculpting or wax carving. Contours should be smooth, rounded, and undulating, connoting softness, especially in the child's ear (Fig 11). There should be a slight vibrancy to mimic flushing. The

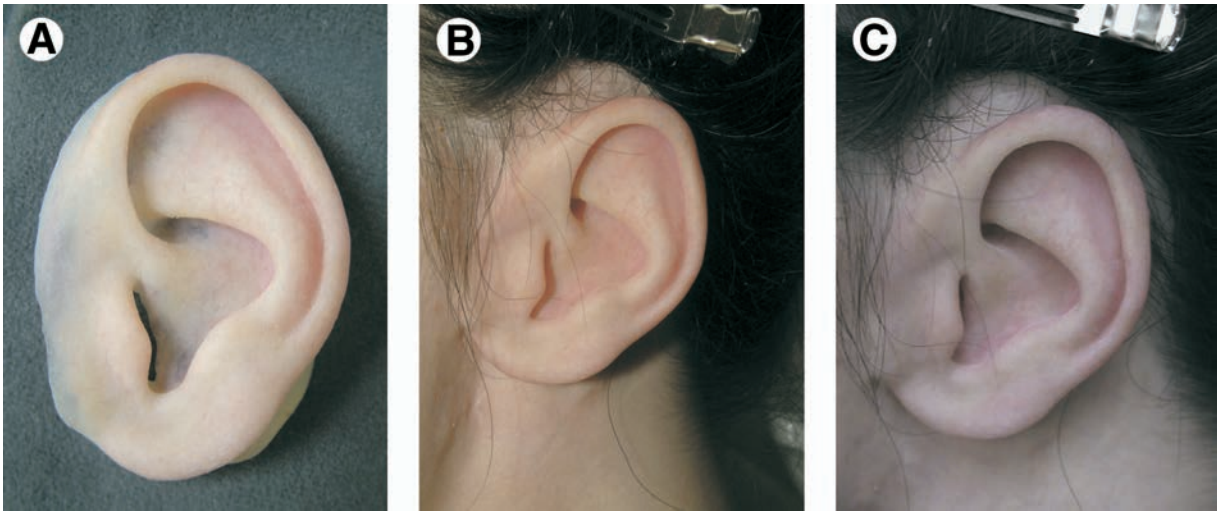

FIGURE 10. *A*, Prosthesis under MacBeth daylight spectrum fixtures and north light (Fuji image). *B*, Prosthesis in situ (flash photo). *C*, Prosthesis in situ under daylight spectrum fixtures and north light (Sony image).

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beauty of the prosthesis option is that it can always offer a future of continual improvement toward visual perfection. There is a certainty of lifetime symmetry in the patient's presentation to the world at the discretion of the patient. There are an infinite number of opportunities to renew the ear, improve upon it with emerging technologies, and change it to more closely mimic the natural aging of the contralateral ear. There is always hope for the patient to improve their situation rather than resignation with the result of a single surgical effort.

Disadvantages of Prostheses

The most significant disadvantage of an auricular prosthesis is the fact that it is not part of the person. It is an appliance that must be removed regularly, cleaned and maintained, and replaced every few years. Some prosthetic designs feature an unesthetic gap in the posterior of the prosthesis used as a means to ventilate the peri-implant tissues. However, we have provided auricular prostheses with no venting or no visible vent designs since 1994 without incident. On the question of security of the attachment, this is an area of significant personal frustration in view of the overall elegance, beauty, and effectiveness of a carefully created prosthesis. Efforts to incorporate other mechanisms to create stronger attachment are to be commended,[21] although a definitive foolproof mechanism has yet to be invented. The standard arrangement featuring the bar splint is difficult to clean under, can become loose or get bent, and still provides no absolute measure of security. With the right force applied, the prosthesis can still become dislodged without warning. The clips need to be adjusted, and they must be housed in an acrylic substructure that sometimes results in significant compromise to the prosthesis' contour. The freestanding abutment and magnet approach offers easier cleaning, no substructure, and less required force to attach and remove the prosthesis.[22] The use of the largest magnets in conjunction with multidurometer silicone prostheses and techniques described in Thomas[22] significantly improves retention to match or exceed that of bar-clip designs. In a recent version we combine these techniques with strategic placement of very soft compliant silicones to dampen typical dislodging forces. Even with a linear arrangement of abutments the method resists breakaway from anterior and posterior applied forces (Fig 12).

On the Horizon

It is the author's belief that the natural evolution of continued experimentation will feature a locking element of some type that will provide absolute retention for the prosthesis, once engaged. This would mean that the silicone prosthesis would deform completely under stress to the point of rupture of the material before the prosthesis would be released. This alone would have a dramatic effect on patient confidence and acceptance of a prosthesis. Other designs might feature softer materials or pivoting sections in the prosthesis as means to absorb otherwise dislodging forces. A viscoelastic silicone gel or like material might provide a more intimate interface, acting as a tissue conditioner, secondary retention, and obviating the need for air vents. In any event, the solutions are exciting to anticipate because they will offer our patients a whole new level of confidence and satisfaction with their prostheses. The solu-

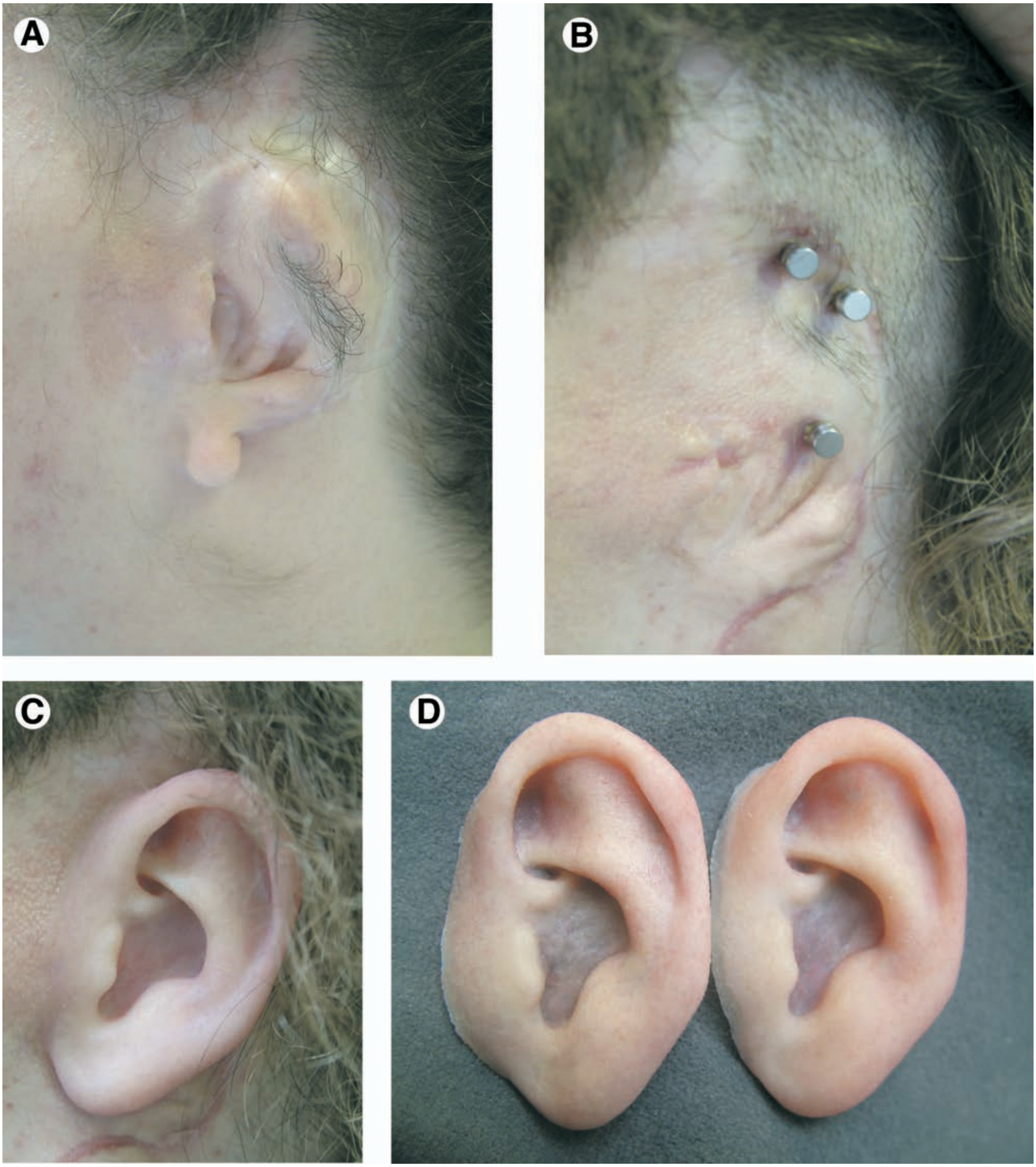

FIGURE 11. *A*, Left autogenous reconstruction. *B*, Construct excised and cranial implants placed. *C*, Left auricular prosthesis in situ. *D*, Prosthesis and duplicate.

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tions to these mechanical problems are unfortunately a function of institutional research initiative and individual practitioner's inventiveness and their respective resources. Auricular prostheses, like other extraoral prostheses, provide little economic or professional incentive for study compared with intraoral prosthetics, for instance. However, the increased interest and collaboration to solve such problems promise that long-established lines between disciplines will blur. The role of the anaplastologist will assume heightened interest and

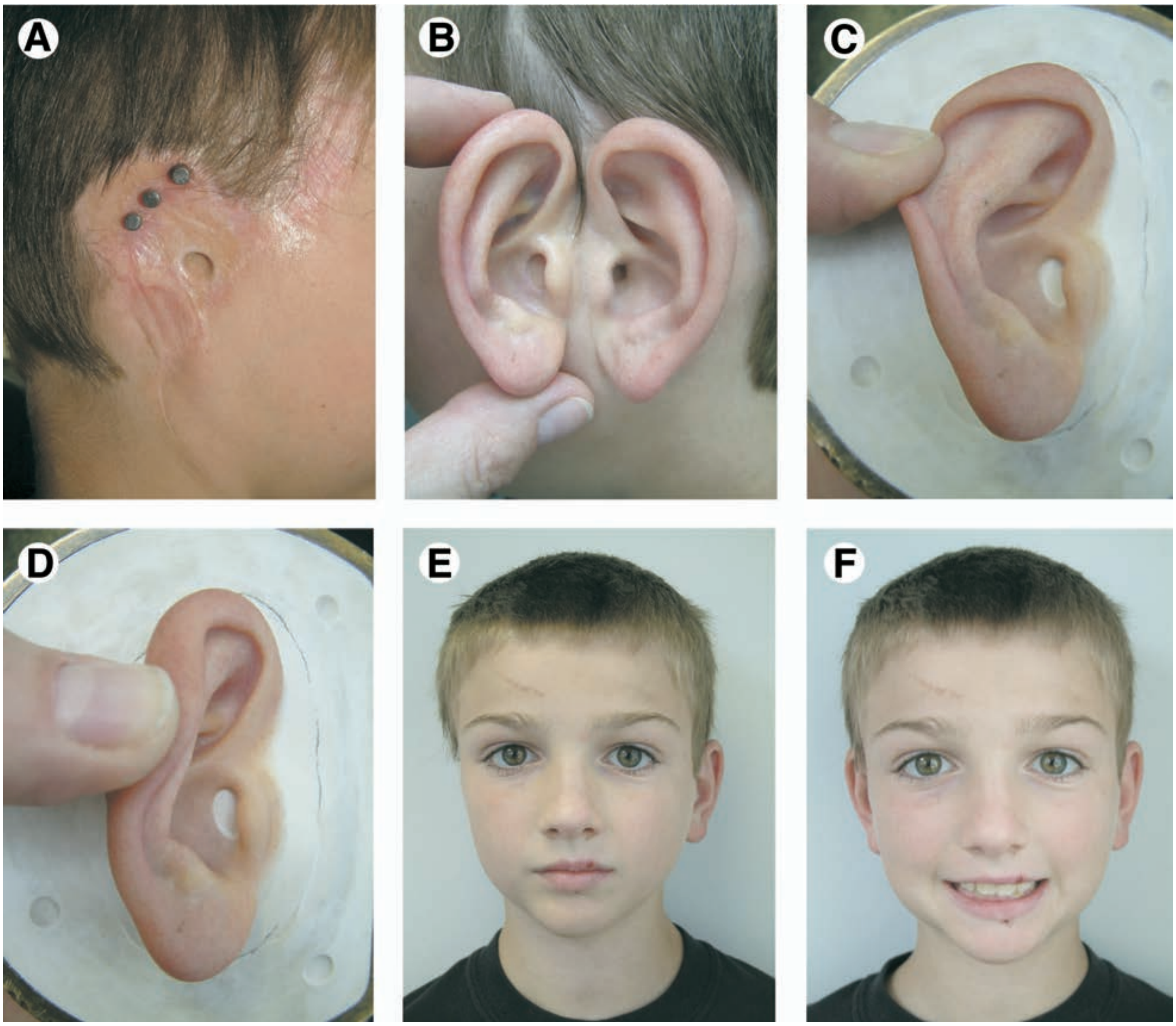

FIGURE 12. *A*, Linear implant arrangement. *B*, Progress check of extrinsic color application. *C,D*, On-mold check of resistance to typical displacement forces. *E,F*, Patient before and after attachment of implant-retained prosthesis.

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greater scrutiny due to the need for competency in digital technologies, artistic skill, and patient management. The added attention will likely inspire anaplastologists to achieve even greater esthetic results for their patients.

The prosthetics option has gained far greater merit in the last decade because of the pioneering work of P.I. Branemark. Branemark's hope was that a prosthesis should not be detectable at a distance of 1 meter or greater (personal communication). Branemark also expressed that anaplastology, or the quality of the prosthesis, was the limiting factor in the area of craniofacial osseointegration rehabilitation (personal communication). The prosthesis option seems to be regarded more highly and selected more often in Europe. Some European studies support overall satisfaction with the prosthetic option.[5,20] The author believes strongly that the prosthetics option in the United States may still be given less serious consideration because of the widely varying quality in prostheses. There is no apparent method to predict which type of provider credential or practice setting will yield even acceptable results. Unlike the professional school preparation and specialty certification necessary for anyone to reconstruct an ear or place implant fixtures, there is not a universally accepted level of preparation to create and provide a prosthetic ear. However, in the author's 25-year experience, there is now a palpable interest in the professionalization of clinical anaplastology (Board for Certification in Clinical Anaplastology). The solidification of anaplastology has fostered professional identity and practice dynamics. Anaplastologists now are key to prosthetic osseointegration success, which has inspired even greater creativity and contribution to the field. This translates to increased patient satisfaction with their prosthesis and improved likelihood that they will maintain the needed long-term relationship with their specialists.

There is the natural tendency for the anaplastologist to put the prosthesis option in the best possible light. However, the intent has been to give proper and needed exposure to the high points and potential of the option and not misguide the patient, family, or specialist toward the wrong choice of treatment. The inherent shortcomings of any prosthetic device are painfully obvious especially to the creator, and the author wholeheartedly agrees with Thorne,[2] that a good autogenous reconstruction is more desirable than any prosthetic result. It is only hoped that future results will become more predictable and treatment selection easier as specialists hone their skills and learn from each other. Robert Kelton, PhD, offers suggestions for health care professionals working with patients with craniofacial conditions.[23]

Convey to parents of affected newborns as much optimism about their child's future as you can muster: As Strauss (1999)[23] makes clear, the attitude you communicate to parents is likely to have a profound impact on the life of the affected family.

Support a team approach to treatment: It offers the best hope for efficient, effective patient care. Furthermore, patients are likely to find the team approach reassuring and as a result may participate more actively and constructively in their own care.

Encourage parents to treat their affected child as normally as possible: A child with facial anomalies will usually respond as well as any other child to a high standard of conduct and achievement.

Remain sensitive to the pain stigma causes, and encourage parents to do all that is medically and financially feasible to repair stigmatizing facial differences. At the same time, remind parents not to believe every medical claim they hear, even when those claims originate with your well-meaning colleagues.

Encourage patients to seek out others with similar anomalies, because people facing similar adversities have much to teach one another.

Maintain a sense of humor. It will encourage parents and patients to do likewise.

Collectively, these strategies will contribute significantly to healthy adaptation to craniofacial conditions, and at the same time, may increase the satisfaction you derive from your efforts.

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