

Using of Octyl-2-Cyanoacrylate in Total Ear Reconstruction: Avoidance of Suturing and Suction

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ABSTRACT

Total ear reconstruction is considered to be one of the challenging procedures in reconstructive surgery. Creation and maintenance of convolutions of the reconstructed auricle represent a challenge. This study was conducted on 13 patients (8 males, 5 females), their age ranged from 14 to 35 years old. All patients were classified as classic type microtia. In this study the cartilage was harvested as one block and all features have been sculpted. Helix and antihelix were further augmented by adding diced cartilage. These pieces were fixed by Octyl-2-Cyanoacrylates glue. This was a better alternative than sutures as regards duration of procedure, cutting through the cartilage, edge sharpness and cartilage memory. The overlying skin flap was adhered to the depressed features of the implanted framework to obliterate any dead space by using Octyl-2-Cyanoacrylates glue. This guarantees maintenance of shape and convolutions. It also negates the need for suction or use of bolsters. Results were satisfactory to patients and surgeons.

INTRODUCTION

Auricular reconstruction poses one of the most difficult challenges in reconstructive surgery of the head and neck. This is due to the unique architectural topography of the external ear. A successful outcome should reach proper characteristics of normal ear which include size, location, orientation and anatomical landmarks. The recreation of multiple concavities and convexities in a cartilaginous framework with an adherent overlying skin represent a tough goal for every plastic surgeon. Many trials had been made in order to reach a more precise and detailed framework using alloplastic materials as medpore [1], silicone and homologous cartilage [2]. The use of these materials proved to be of far more complications than the use of autologous cartilage [3]. Authors had been using wire suture, nylon sutures in order to reach a detailed framework utilizing pits and pieces of cartilages. Wire sutures had a high rate of complication mainly extrusion [4]. Now in common practice nylon sutures is being used to gather pits and pieces of

cartilage to conform a framework but yet still such a method is difficult to attain smooth curves and detailed convolutions. It is also considered as time consuming and tedious procedure.

An alternative method of bonding cartilage to create a detailed framework is octyl 2-cyanoacrylate tissue glue (OCA). Cyanoacrylates (CAs) were not widely adopted for medical use until recently because of concerns regarding tissue toxicity. The newer, longer chain CA, octyl-2-cyanoacrylate, now has been approved for multiple uses in the United States and has achieved widespread acceptance by the medical and lay communities [5]. Toxic effects in cell culture of a new long-chained octyl-2-cyanoacrylate tissue adhesive were compared with those of short-chained ethyl-2- and butyl-2-cyanoacrylates. Histomorphologically With electron microscopy, studies were done showed no disadvantages of use octyl-2-cyanoacrylate as regards tissue regeneration and histotoxicity [6]. Octyl-2-cyanoacrylate has been used in closure of skin wounds. It is an excellent alternative to suture closure. Many studies proved that this product is superior to skin closure by sutures [7-12].

There are other uses of cyanoacrylates rather than skin. OCA has been used in treatment of oral ulcerations [13]. Higher chained alkyl cyanoacrylates have potential to function efficiently as space filling, hydrophobic, viscoelastic, biocompatible, and rapidly polymerizing bone adhesives. They may be useful in applications where a void has to be filled, such as replacement of the intervertebral disc [14]. It was used in middle ear surgery [15,16,17]. They are used in embolization of vessels with embolic materials in hepatic metastasis and in management of acute variceal bleeding. However, it is not approved to be used endoscopically by FDA [18]. They are also used as sealants in bronchial fistula [19]. They are used in brain surgery [20].

PATIENTS AND METHODS

Total ear reconstruction was planned for 13 patients. Two needed bilateral ear reconstruction. Age ranged between 14 and 35 year old. They were 8 males and 5 females. All had congenital classic microtia; two were diagnosed as Treacher Collin's syndrome. Auricles were examined as regards cartilage remnants, ear lobule, presence of external auditory meatus, mastoid skin condition, size and location of the other normal auricle.

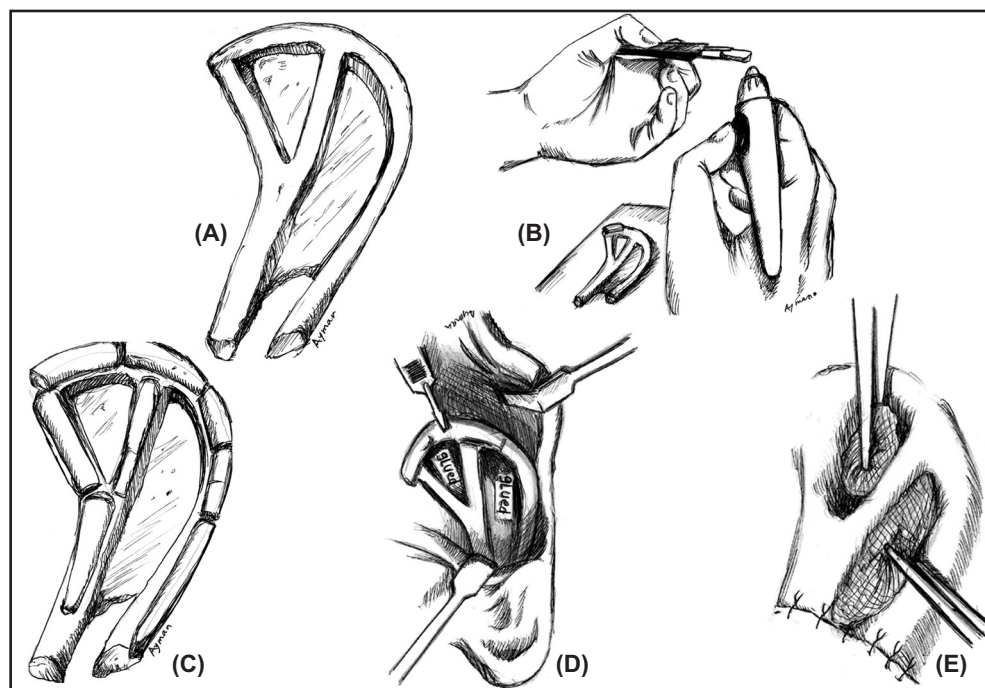
Technique:

10cm long full thickness costochondral cartilage is harvested from the contralateral six, seven and eighth costal cartilage. Carving of en block cartilage was done using a model imitated from the normal auricle. In case of bilateral microtia model was done as an imitation from normal person; auricle with the same age, sex and built. If the ear lobule is present the cartilage is sculpted to create the whole auricle; scapha, concha, helix, antihelix, superior and inferior crura. If the ear lobule is absent it is sculpted with the rest of the auricle frame as one block using the syncitium. Augmentation of the helix and antihelix using diced cartilage using Octyl-2- Cyanoacrylate. The glue (DERM-ABOND) from Johnson and Johnson Company is

applied on selected points Fig. (1D). This was done to assure fixation without covering the whole surface. It is better to test the adhesion by shaking the cartilage after waiting 10 seconds. The cartilage is put into kidney shape bowel containing saline and antibiotic. A subcutaneous pocket has been created after removal of cartilage remnants and making use of the rest of the available local flaps. The pocket is been created about 25% wider and longer than the contained auricular cartilaginous frame to allow the draping of skin over the carved framework to imitate the natural convolutions and depressions of the normal auricle. Octyl-2- Cyanoacrylate has been applied to the deepest points of the fossae of the carved framework which will be inserted into the pocket. Pressure is maintained for 30 seconds over the skin at the deepest points of the fossae using fingers or soaked cotton gauze. This is done to allow adhesion between the under-surface of the skin pocket and the frame Fig. (1A-E). No suction is needed. Soaked cotton was applied on to the convolutions then the usual dressing was applied.

Follow-up was done at one week, one month and 6 months postoperatively. Sutures were removed after one week. Dressing was removed after 2 weeks.

Fig. (1): Technique using octyl-2-cyanoacrylate in total ear reconstruction. (A) Cartilaginous framework after carving, (B) Demabond used to glue pieces of cartilage to framework, (C) Final framework before application (D) Framework with applied glue in depressed area while applied under skin flap (E) light pressure applied on skin using wet gauze.



RESULTS

There were no signs of inflammation or infection. Vascularity of skin flap was not affected. Edema resolved after one week. The reconstructed

ear was aesthetically accepted. Shape was definite with all the features were well defined. The convolutions were maintained. Results were long lasting. Results were satisfactory to both patients and surgeon Fig. (2A-E).



Fig. (2-A): Preoperative picture of RT side classic microtia.



Fig. (2-B): X-ray film showing marking of proposed cartilaginous framework.

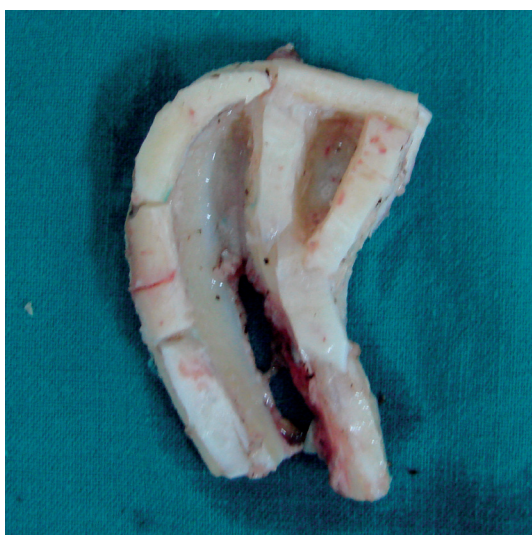


Fig. (2-C): Cartilaginous framework with pits and pieces joined by (OCA).



Fig. (2-D): Immediate postoperative picture showing areas of depressions and adherent skin to cartilage by using (OCA).



Fig. (2-E): Picture showing results after 2 months with satisfactory convolutions and accepted shape.

DISCUSSION

The appearance and symmetry of the auricle is crucial for the restoring facial aesthetics. Microbial is a malformation of the auricle ranging from a small one with minor deformity to one with major deformity which may be associated with middle and inner ear anomalies. Ear reconstruction was first referred in the "surhruta samhita" which suggested a cheek flap for repair of ear lobe. Gilles 1920 was the first to burry carved costal cartilage under mastoid skin and separated it with a cervical flap. Later the work introduced by Tanzer 1959 where he used autologus cartilages in auricular reconstruction constitutes one of the most important

work that introduced the current techniques [21]. The use of alloplastic materials as silicone and medpore was attempted in order to reach a more detailed framework with better cosmetic results. The rate of complications mainly extrusion had greatly minimized their use. Tissue engineering had been used in an attempt to create a three dimensional framework from autogenous cartilage. Insufficient replication of chondrocytes hinders formation of a firm framework which had limited its use. It can not resist the pressure caused by the two dimensional, taught, inelastic and restrictive skin cover [22]. Sculpted autogenous rib cartilage remains the most reliable material that produces acceptable result with the least complications. The goal is to get a detailed cartilaginous framework with exaggerated helical rim and detailed antihelical complex. This can be achieved by carving only. Carving is an artistic and meticulous procedure. Costal cartilage dimensions are detrimental for the reconstructed framework. Too much thinning of the cartilage during carving may let the used sutures to cut through the cartilage. Insufficient carving ends up to failure to reach an exaggerated helical rim and detailed antihelical complex. This one piece of cartilage with the restrictive power of tight skin will make the reconstructed auricle ill-defined one. The idea of adding pits and pieces of cartilages to augment all possible details of framework would give good result. This necessitates the use of too many stitches baring in mind the difficulty to approximate the pits and pieces of cartilage in different angles and maintain it. In this study octyl-2-cyanoacrylate was used to stick these pieces to the cartilaginous framework. It augments and forms a smooth, well defined helix and antihelix. The adversities of use of nylon sutures were avoided. It was performed in few minutes. The material is inexpensive. Memory cartilage of longer pieces is not anticipated to be a problem with this glue as it has the ability to get over.

Success of achieving good cosmetic result with well-defined appearance of helical rim and antihelical complex depends mainly on keeping the skin adherent to cartilage as long as possible. Prevention of hematoma is mandatory. This had been possible by using suction drain yet, it should be removed after several days for fear of infection. The drain represents a burden on the patient and the medical staff to take care of. Use of bolster sutures had been advocated by [23], yet problems with blood supply of skin can not be excluded. Application of octyl-2-cyanoacrylate beneath the skin flap at certain points representing the created concavities guaranteed reflection of all the features and the

longevity of the surgical outcome. There were no signs of inflammation. Vascularity of the flap was not affected. This may indicate that this type of glue is inadvertent and may be applicable in interior surgical uses. Food and Drug Administration approved its use in 1998 [24]. It was formulated to correct some of the deficiencies of the shorter-chain cyanoacrylate derivatives. As an 8-carbon alkyl derivative, this polymer should be less reactive than the shorter-chain derivatives. The slower degradation of the octyl derivatives may result in lower concentrations of the cyanoacrylate polymer by-products in surrounding tissues, resulting in less inflammation. Additionally, plasticizers are added to produce a more pliable and tissue-compatible product that flexes with the skin and remains inherent for longer periods of time. The 3-dimensional breaking strength of 2-octyl cyanoacrylate is 3 times that of butyl-2-cyanoacrylate [25,26].

Conclusion:

Total ear reconstruction is a real challenge. Octyl-2-cyanoacrylate may be a good alternative to sutures in cartilage remodeling; however, other histological studies are recommended.

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