CLINICAL STUDY ON CARTILAGE FORMATION IN AUTOGENOUS PERICHONDRIAL TRANSPLANTATION IN PLASTIC SURGERY

YU MARUYAMA

Department of Plastic and Reconstructive Surgery, School of Medicine, Keio University, Tokyo, Japan

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ABSTRACT

The author has used for perichondrial grafting in various clinical cases classified as follows:
1) Loss of the auricles.
2) Nasal deformity.
3) Eye lid reconstruction.
4) Temporomandibular joint ankylosis.

In this clinical series, the chondrogenic activity apparently exists over a wide age spectrum, the amount and regularity of cartilage produced by any type of perichondrial graft is influenced by age and seems to be due to the vascularization to the perichondrium.

INTRODUCTION

Cartilage is the specialized dense connective tissue, the dominant tissue in most of the embryonic skeleton, and is an important factor in the growth of many bones.

In the adult, cartilage provides a surface for bony joints, and structural support for the ears, nose, respiratory tract, and anterior chest cages.1

In the field of plastic surgery, cartilage is an invaluably important material in reconstruction of microtia, defect of the nose, bony joint ankylosis, funnel chest, tracheal defect, and some other flexible supportable frame-works.

In their publication in 1972, Skoog2 demonstrated that the perichondrium could be used to produce new cartilage.3-8 On the basis of the author's experimental studies of the perichondrial regeneration in rabbits for over a year, the possibilities of free perichondrial and perichondrocutaneous graft7,9 or their
flaps\textsuperscript{10} seem to be almost unlimited and invaluable for use in plastic surgical practice.

1. LOSS OF THE AURICLE

The external ear is an easily traumatized organ of the face, and the loss of the ear is frequently attended in the out-patient clinic.

In general, since aquined auricular defects and their nature are various. The choice of the operative procedure to reconstruct them is limited to the surgeon's imagination.\textsuperscript{11}

The author have used the regenerated perichondrium resulting in the formation of cartilage instead of cartilage grafting.\textsuperscript{12}

Case 1

A 15-year-old male who experienced a loss of superior auricular defect in an accident, was brought to our institute. (Fig. 1)

The defect of the ear was repaired with both of anterior and posterior perichondrial flaps. By the tunnel method, the flaps were placed under the subcutaneous area of the mastoid region. Three months later, skin and underlying cartilage formed by the perichondrium were separated and the defect behind the ear was covered by a full thickness skin graft. (Fig. 2)

Case 2

A 34-year-old male experienced a loss of the middle third of the auricle
Fig. 3 A: Schema of the defect. B: Anterior perichondrial flap is raised in the shape of the defect. C: Both perichondrial flaps are sutured to each other and then to the end of the cartilage. D: Embedded by the tunnel procedure. E: In the second stage, the auricle is separated and full thickness skin grafting applied.

Fig. 4 A biopsy revealed the proliferation of the cartilage. (Case 1-1)
following a traffic accident. (Fig. 5)

Both anterior and posterior perichondrial flaps were used for flexible framework, and the skin defect was covered by an advanced retroauricular inferior based skin flap. (Fig. 6)

NOTE

In author’s experimental study in the rabbits, a perichondrial flap with good vascular supply brought about a more reliable formation of cartilage than free perichondrial grafting.

The thickness of newly formed cartilage was found to be almost the same as the original in the follow up study of both cases.

2. APPLICATION TO NASAL DEFORMITY

The nose consists of covering tissues, bony framework and cartilagenous structure, and is the most prominent and characteristic feature of the face. So often seen, are noses injured, congenitally malformed, or affected by benign and malignant tumours.

The author have used perichondrocutaneous grafting in some cases to reconstruct defects of the nose.

Case 1

A 29-year-old male, had a giant neurofibromas of the nose, once, a surgical attempt was made by another hospital with only slight improvement of his nose. He could not breath through his right nostril. (Fig. 8)
The operation was done with an incision just lateral to the tumour. The tumour was severed and a part of so damaged and prolapsed ala cartilage was excised. Postoperatively the patient did well except for remaining defect of the right ala. (Fig. 9)

Three months after the first operation, perichondrocutaneous grafting from the right posterior side of the ear was applied to his nose, and took well. (Fig. 10)

Case 2

A 22-year-old male, had a severe cleft lip deformity with especially downward concaved nasal floor due to past primary straight line closure, and to hypoplasia of the left side of his maxilla. (Fig. 12)

The operative procedure for the upper lip was not specific except that the orbicularis muscle layer was overlapped and rearranged to exaggerate the philtral dimple and the column on cleft side.15

In the nasal floor, special attention was paid to supply as much nasal lining as possible around the piriform margin, though there still left 10×5 mm
raw surface area, then a perichondrocutaneous composite grafting to resurface the inner naval lining was applied. (Fig. 13)

Over 7 cases of patients with cleft-lip-nose were treated with this procedure
and have gained good results.

NOTE

Blent⁹ described that cartilage production from a perichondro cutaneous graft is not uniformly predictable and it seems that a take of the composite unit offers more substantial and supportive than full thickness skin graft, but generated cartilage is not influenced by the donor site contours, and can be made into desirable shapes.

In authors' experimental study¹³ in rabbits the perichondrocutaneous vascular pedicle flap can offer more reliable results than the free graft.

3. EYELID RECONSTRUCTION

In certain cases of eyelid reconstruction in ectropion, facial palsy, and in socket plasty, perichondrial and perichondrocutaneous grafting could be applied.
Case 1

A 13-year-old female, presented with congenital ptosis of the left eyelid. Examination of the patient revealed multiple neurofibromata and café-au-lait spot on the trunk and multiple hyperpigmentation in the axilla and in the left upper lid.

The patient stated that these areas of hyperpigmentation and neurofibromata had appeared three years previously, and gradually increased in number and size.

Other history and physical examinations were essentially negative.

She could not open her left eye, though she has normal vision in both eyes. At another hospital an attempt that skin grafting from the lower abdomen to the forehead and excision of the tumour of the upper lid were performed previously. (Fig. 14)

The operation revealed that the tarsus of her upper lid was severely damaged, and it was removed together with the tumour. The defect after tarsal resection was filled with the perichondrium, and the levator shortening procedure\cite{16,17} also applied. (Fig. 15)

Fig. 14 Congenital ptosis of the left upper lid. Hyperpigmentation and neurofibroma on the lid gradually increased. Case 1–3.
Case 2

A 24-year-old female had been using a left artificial eye resulting from an traffic accident. For 6 months, the artificial eye has easily fallen out of her socket. Carefull examination of her socket revealed shallowness of her lower lid sac. Her shallow socket was repaired with a perichondrocutaneous graft.

NOTE

Zbylski reported the correction of lower lid ptosis in the enophtalmic orbit with an autogenous ear cartilage graft with tolerable result.

In such that cases and in the case of lower lid ectropion, the perichondrium graft could also be applied.

4. TEMPOROMANDIBULAR JOINT ANKYLOSIS

The purpose of surgical treatment of temporomandibular joint ankylosis is to produce non-union. After resection of ankylosed area, various kinds of materials have been interposed with tolerable results.

However, with perichondrial grafts new and more physical joints can be produced rather than the crude non union or pseudoarthrosis.

Nine cases of temporomandibular joint ankylosis were treated by the use of free perichondrial grafts with favorable results. Up to 3 years follow-ups of the first case, the patient can open his mouth to 4 cm, and radiograph demonstrates an apparent new joint space.

A punched biopsy, of course, revealed the production of newly formed cartilage.

A case of bilateral temporomandibular joint ankylosis is shown in figure 16-18.

Illustrated case

A 35-year-old male had been unable to fully open his mouth these 3 years. The etiology was thought to be due to a previous intra-articular fracture of temporomandibular joints in a traffic accident.

The maximum vertical mouth opening, between the upper and lower incisors, was only 5 mm. (Fig. 16)

Through periauricular incision, the hypertrophied upper part of mandibular ramus was sectioned at the level of the base of the cranium to mobilize the mandible, and the cranial side of the osteotomy was performed in the center of simulate the glenoid fossa.
Fig. 16  The occlusion and the amount of opening before the arthroplasty. (Illustrated case-4)

Fig. 17  The sheet of the perichondrium was placed over the new joint surface. (Illustrated case-4)

Fig. 18  Maximum opening, one year after the operation. (Illustrated case-4)
The sheet of perichondrium taken from his right 7th and 8th costal cartilages was placed over the created new joint surface of both sides. (Fig. 17) One year after the operation, he can open his mouth up to 35 mm without difficulty. (Fig. 18)

DISCUSSION

The production of neocartilage by autogenous perichondrium separated from its underlying cartilage was documented by Lester in 1959, however it seems that its clinical potential went unrecognized.

In 1972 Skoog, Ohlsen and Sohn reported that new cartilage formation was induced from the traumatized perichondrium in their pilot study.

Their findings stimulated them to investigate intensely the chondrogenic potential of perichondrium as a free graft, especially for tracheal and auricular reconstruction.

They stressed on the existence of blood clot under the grafted autogenous perichondrium.

In our clinical series, we did not apply any blood clot under the perichondrium, however the newly formed cartilage was found under the surface of perichondrium in most of the cases.

In addition, authors' laboratory findings reveal smooth and reliable cartilage formation seemed to be dependent upon the vascularization of the perichondrium itself and not dependent upon the existence of blood clot under surface of the perichondrium.

Although the chondrogenic activity apparently exist over a wide age spectrum, the amount and regularity of cartilage produced by any type of perichondrial graft is probably influenced by age, and it was also observed that cartilage production is greater in younger individuals.

More information is needed about how to predict and control neochondrogenesis.

SUMMARY

Autogenous perichondrial transplantation uniquely provides the formation of cartilage.

Various applications of this graft in plastic and reconstructive surgery are presented.

The possibilities with perichondrial and perichondrocutaneous free graft, on their flap seem to be invaluable and almost unlimited.
REFERENCES