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Reconstruction of Pterional Key Hole Using Three-dimensional Titanium Plate: Technical Note

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ABSTRACT

Patients who have undergone pterional craniotomy sometimes complain about postoperative cosmetic impairment in the frontotemporal area. This problem occurs as a result of inappropriate repair or no repair of the pterional key hole. The authors have developed an intraoperative hand-made three-dimensional titanium plate, and as a result of using this plate the postoperative cosmetic appearance was satisfactory.

Key words: *Aneurysm, Pterional approach, Cosmetic appearance*

In recent years, with the advancement of microsurgical techniques in neurosurgery, the outcome of patients with ruptured and un-ruptured aneurysms has improved. However, a cosmetic problem for those who undergo craniotomy still often exists. For the operation of intracranial aneurysms, a pterional approach is commonly selected and this method needs a burr hole at the pterion. This burr hole can be visible as a dent or recessed area in the skin in the postoperative period. This deformity at the front-temporal region makes patients unhappy, even after successful treatment of the aneurysms. For the purpose of solving this problem, the authors developed the idea of utilizing a titanium plate which is bent in three steps to completely cover the key hole. This plate was originally developed by Codman Corporation for the purpose of covering surgical holes in the calvaria which has a flat or slightly bent surface. This is the first report of this plate being used for covering the pterional key hole. By using this method, an excellent cosmetic appearance was achieved.

TECHNIQUE

The patient lies in the supine position with the head secured in a Mayfield head holder. The head is turned to the opposite side at a 30- to 40-degree angle, depending on the location of the lesion. An arcuate skin inscion is made along the hairline and the temporal muscle is incised by monopolar cautery along the same line as the skin incision. Then, the skin-galea-muscle flap is reflected until the superior orbital rim and the frontal process of zygomatic bone are exposed. With a high-speed bone drill three burr holes are made. They are made in the temporal fossa just behind the starting point of the superior temporal line of the frontal bone (pterional key hole), in the temporal fossa just along the superior temporal line 3 to 4 cm posteriorly from the key hole and in the temporal fossa just anterior from the start of the cutting line in the temporal muscle. With the dura adherent tightly to the bone, one more burr hole is made slightly lateral to the midline of the superior orbital margin. The bone flap is detached mostly by a side-cutting craniotome with the basal part attached to the sphenoid ridge fractured manually prior to lifting the flap. The lateral sphenoid ridge and vertical bone on both sides are drilled off until the bony exposure is parallel to the frontal skull base. The dura is opened with a curvilinear incision and the surface of the brain is exposed. The operating microscope is introduced after this procedure. After the successful clipping of the aneurysm, the dura is closed and the free bone flap is placed in its original position. Then using two or three titanium plates (BIOPLATE™, Codman), the flap is tightly fixed to the margin of the craniotomy in order to minimize any gap. Then, a key hole covering plate is made using pincers to bend the round shaped plate (BIO-

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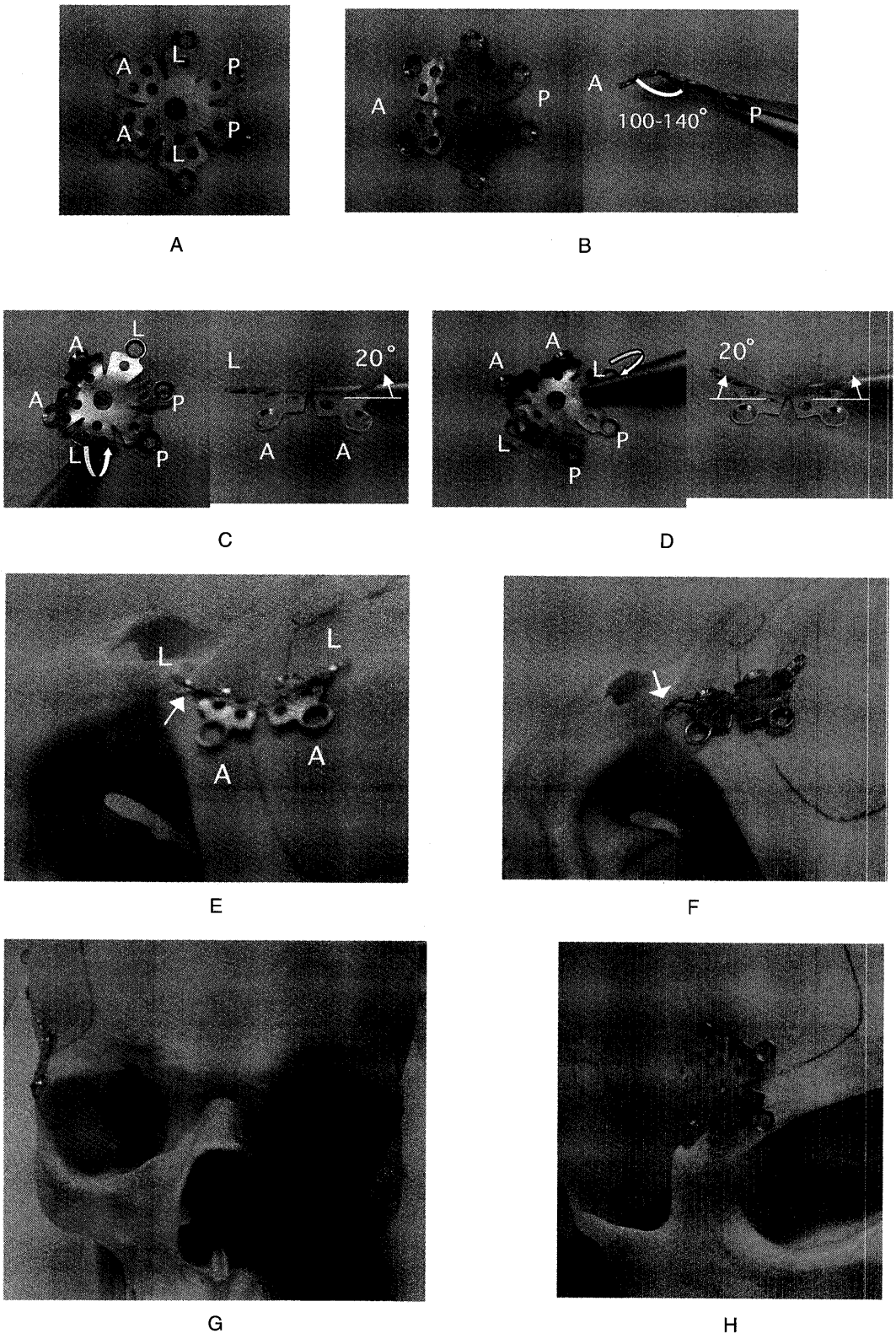

Fig. 1

A: Upper view of the titanium plate (BIOPLATE™, Codman, Burr hole cover 81–2047). A: anterior wing, L: lateral wing, P: posterior wing.

B: The anterior wings are bent. Left: Upper view. Right: Lateral view.

C: One side of the lateral wing is bent to around 20 degrees. Left: Upper view. Right: Anterior view.

D: The other side of the lateral wing is also bent smoothly to make a concave shape. Left: Upper view. Right: Anterior view.

E: The inferior side of the lateral wing protrudes from the margin of the lateral orbita.

F: The far lateral side of the lateral wing is bent in order not to protrude.

G, H: The plate fits to the pterion and completely covers it.

Fig. 2
Upper: Seventy seven-year-old female, ruptured right middle cerebral aneurysm case. Lower: Sixty five-year-old female, ruptured left internal carotid artery aneurysm. Both photographs were taken about 1.5 months postoperatively and cosmetic appearance was satisfactory in each case.

PLATE™, Codman, Burr hole cover 81–2047). This type of titanium plate has six wings: two anterior wings, two lateral wings and two posterior wings. The process of making this plate is composed of three steps, as follows: First, an arcuata just covering the base of the superior temporal line must be made. This arcuata should be made by bending the lateral side of the two anterior wings to an angle of 100–140 degrees depending on each patient. Second, the two lateral wings are bent up to match the concavity of the pterion. These bend angles are usually around 20 degrees. Third, the plate is placed over the pterion so that the anterior wings are on the superior orbital rim and frontal bone and the posterior wings are on the temporal fossa. When this plate is placed this way, the inferior side of the lateral wing will usually protrude from the lateral orbital rim, so the far lateral side of this lateral wing should be bent to fit its plane. This hand-made plate is fixed by three or four screws (Fig. 1).

After fixation of the bone flap, primary suture of the temporal fascia including muscle and skin flap is performed.

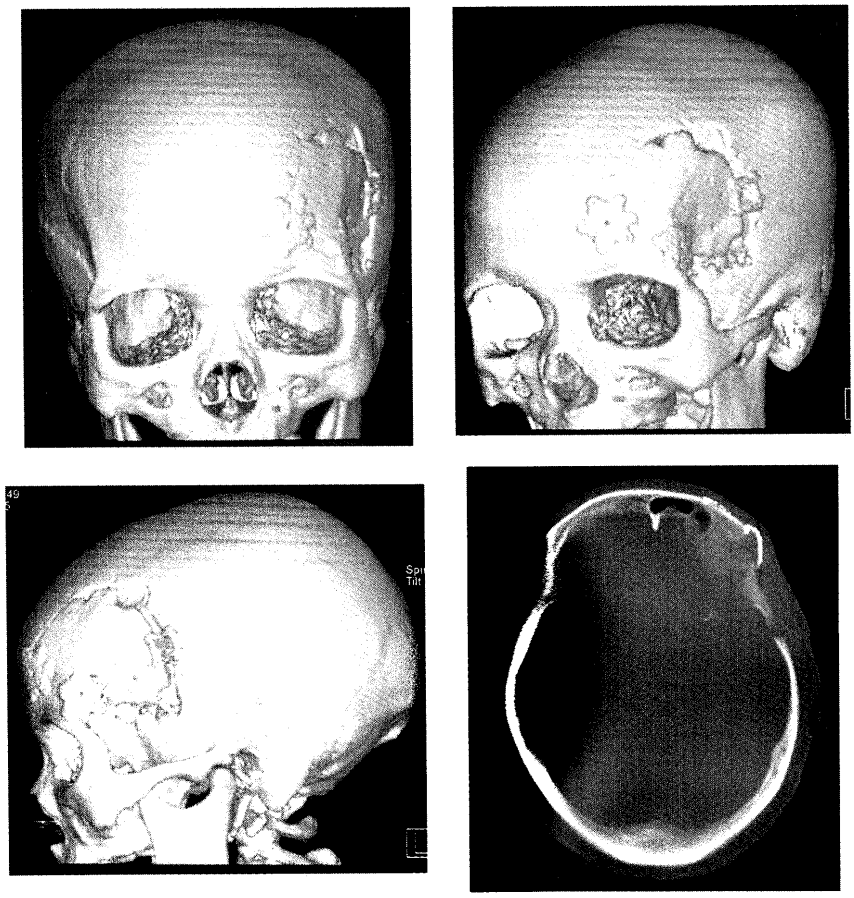

Fig. 3. Three dimensional computed tomography (CT).
This case is the same as figure 2, below. The burr hole at the frontal region inside the hairline is not covered because this burr hole was used for ventricular drainage. This CT was taken 4 months after the operation and no deformity of the soft tissue around the left temple was noted (lower right, CT bone image).

RESULTS

The author has used this technique since 2003 in 50 patients. No surgical complication such as infection, omission of the screws or floating of the plate occurred. Postoperative photographs (Fig. 2) showed that the front-temporal region was not depressed nor deformed which indicated the usefulness of covering the pterional key hole. Postoperative three-dimensional computerized tomography revealed the smooth surface of the cranial bone around the frontal area below the hairline with the pterional key hole plate preventing any deformity (Fig. 3). From a cosmetic view point, younger patients tended to show a better result. This is thought to be due to the influence of the thickness of the skin, fat and temporal muscle.

DISCUSSION

Patients who have undergone craniotomy sometimes complain about cosmetic impairment. Especially in cases of a pterional approach, a key-hole at the pterion is needed and owing to the bone defect around this area, denting or deformity often occurs at the temple. This impaired appearance makes patients unhappy even after a successful operation. With the advent of the malleable titanium plate[1,4], the problem of a free bone flap fixed with sutures tending to cause a depression postoperatively is solved. Dents caused by burr holes on the flat surface (i.e. frontal bone, parietal bone) can also be disguised by covering them with a circular titanium plate. However, a dent around the pterion still often occurs owing to the inappropriate repair of the key-hole, because this region is characterized by a complex curvature. Kang[2] reported a technique of pterional craniotomy without a key hole to avoid this problem and this resulted in a good cosmetic appearance. However, this method is not a standard technique and is not recommended for surgeons who are not experienced. Recently, hydroxyapatite[5] and alumina ceramics[3] have been developed to cover the burr hole sites. However, the structure around the pterion is so complicated that these burr hole buttons do not usually fit it smoothly. Our method, which covers the pterional key hole with an intraoperative hand-made titanium plate, made the postoperative appearance satisfactory. The reason is as follows. The curvature and the angle of the linear temporalis near the pterion is so variable in patients, that a tailor-made method is necessary in its reconstruction. In addition, another cause of the depression around the pterion is postoperative temporal muscle atrophy. Therefore, in our cases, where postoperative muscle atrophy was anticipated (i.e. the deep temporal artery was coagulated or the temporal muscle was extensively coagulated intraoperatively), the posterior wings are intentionally bent up from the surface of the temporal fossa (Fig. 4). By doing this, a dent can be avoided, even after temporal muscle atrophy occurs.

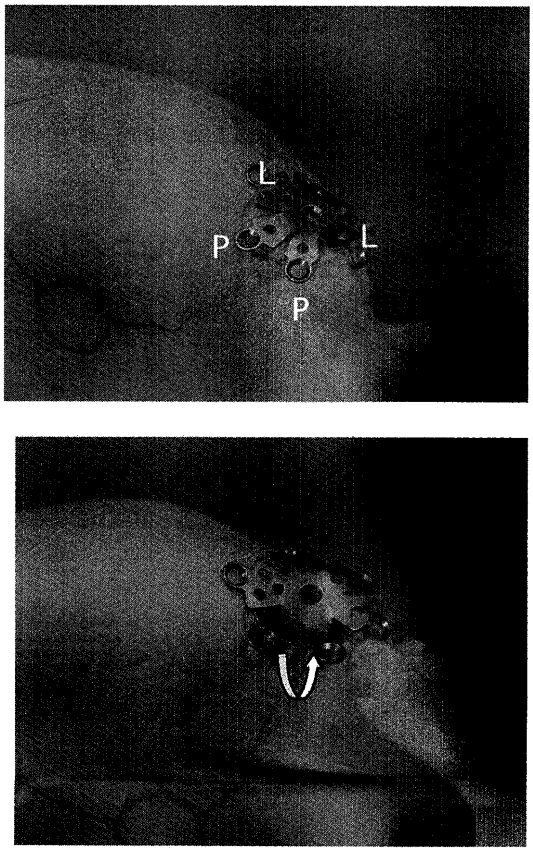

Fig. 4. In cases where temporal muscle atrophy is anticipated, the posterior wings are intentionally bent up.

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