Size-adjustable titanium plate for reconstruction of the sella turcica

Technical note

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A size-adjustable plate constructed of pure titanium is proposed for use in the reconstruction of the sella turcica. The plate is composed of two semicircular pieces that are connected by a hinge located at the top of the plate. Using an applicator, the plate is inserted into the sella turcica in a closed position. The same applicator is then used to open and secure the plate. The titanium causes minimal ferromagnetic artifacts on postoperative magnetic resonance imaging.

Preliminary findings indicate a possible clinical use for this plate in the reconstruction of the sella turcica when no suitable piece of bone is available.

KEY WORDS • size-adjustable titanium plate • sella turcica • reconstruction • transsphenoidal approach

RECONSTRUCTION of the sella turcica at the end of transsphenoidal surgery is generally performed using a piece of bony nasal septum. However, when a bone splint of adequate size is not available, materials such as hydroxyapatite or silicone are used. Unfortunately, various problems may arise when using these materials, such as difficulties involved in trimming and fitting, the possibility of tumorogenesis, foreign body granuloma, or autoimmune disease. To circumvent these problems, we have devised a size-adjustable sellar plate composed of pure titanium, a material widely used in neurosurgery, to reconstruct the sella turcica.

Materials and Methods

Titanium Plate

The plate is composed of pure titanium, which causes minimal ferromagnetic artifacts on magnetic resonance (MR) imaging studies. The plate is constructed using a pair of semicircular pieces that are hinged at the top (Fig. 1 left). The thickness of these pieces is 0.5 mm. Opening pressure for each plate is set between 400 and 800 gF. The plate may be opened or closed via a set of holes (one per plate) located approximately two thirds of the length from the top of each semicircular piece (Fig. 1 center). Notches on the straight-edged side of each plate allow a widely opened position profile (Fig. 1 right). Three model sizes with diameters of 10, 12, and 16 mm have been constructed to allow a proper fit for the various sizes of sellar openings.

Implantation Technique

At the end of transsphenoidal surgery, the plate is held by a special applicator and inserted into the sella turcica, which is filled with adipose tissue (Fig. 2 left). Placement of the plate is performed with the two semicircular pieces in the closed position to allow ease of insertion (Fig. 2 center). The plate is gradually widened by squeezing the applicator. The tip of the applicator is inserted into the notches and widened further to secure a better fit (Fig. 2 right). Fibrin glue may be applied to the plate to ensure proper fixation.
Clinical Application

With the approval of the ethics committee of Hiroshima University School of Medicine and after obtaining preoperative informed consent from each patient, plates were placed in three patients who harbored nonfunctioning pituitary adenomas (Fig. 3 upper left). In each case an adequate piece of bone was unavailable. No problems were encountered in postoperative fixation of the plate (Fig. 3 lower left) and no adverse effects, such as granulomatous tissue reaction, were observed after surgery. We did not observe any ferromagnetic artifact on postoperative coronal MR imaging (Fig. 3 upper right), but a minimal artifact was found on sagittal MR imaging (Fig. 3 lower right).

Discussion

Introduction of the endonasal endoscopic approach to transsphenoidal surgery appears to have led to more frequent use of nonosteal materials in sellar reconstruction. Titanium is a safe and incorruptible material that is widely used for implantation devices in the neurosurgical field. One defect associated with this material is the difficulty involved in onsite remodeling. We were able to overcome this problem by combining two titanium pieces into one plate. The opening pressure of the plate itself secures the plate to the sellar floor. The plate is composed of pure titanium to minimize ferromagnetic artifacts on MR imaging. The ferromagnetic artifact observed on sagittal MR imaging, which is caused by this plate, may not be negligible for evaluating residual tumor or tumor recurrence by using postoperative MR imaging in the case of a functioning adenoma. However, because the sella turcica is relatively small in cases involving functioning adenomas, the need to use nonosteal materials occurs less frequently. In addition, decreasing the thickness of the semicircular pieces will lessen this artifact. Consistency of opening and sliding pressures in this prototype is an area that should be improved through future development.
Titanium plate for sellar reconstruction

FIG. 3. Imaging studies obtained in a patient with a nonfunctioning pituitary adenoma in whom the sellar floor was reconstructed using the plate. The relatively large opening in the sellar floor, the intraoperatively observed cerebrospinal fluid leakage, and the unavailability of a sufficiently large vomer bone splint indicated use of the plate. Upper Left: Preoperative gadolinium-enhanced sagittal MR image. Lower Left: Postoperative lateral skull x-ray film demonstrating the plate affixed to the floor of the sella turcica. Upper Right: Postoperative gadolinium-enhanced coronal MR image in which no ferromagnetic artifact can be observed. Lower Right: Postoperative gadolinium-enhanced sagittal MR image revealing the plate with a minimal ferromagnetic artifact (arrow).

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References


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