INTRODUCTION
Fracture fragments in cases of comminuted facial bone fractures are sometimes difficult to fix to their normal positions using plates and screws. We experienced patients with comminuted fractures of the anterior wall of the frontal or maxillary sinus that were very difficult to fix using plates and screws. Placement of a drill hole in a small bone fragment usually caused an additional fracture in it. In addition, while dissecting the fracture site, small fragments were easily detached from soft tissue and dropped into the sinus cavity. Loss of several bone fragments eventually resulted in a big defect in the anterior wall of the frontal and/or maxillary sinus.

Cyanoacrylate (Dermabond®) was approved by the Food and Drug Administration for wound closure, and numerous studies have shown that this adhesion is useful for repair of uncomplicated lacerations in both children and adults. It has been demonstrated that this adhesion is effective in the closure of small skin incisions and lacerations. In this study, we determined whether OCA was effective in the fixation of fractured bone fragments and to evaluated the side effects of OCA.

CASES
This study was approved by the Institutional Review Board of our university hospital. Patients provided informed consent after complete explanation of our surgical treatment protocol. Between June and Aug of 2009, we used OCA (Dermabond®, Ethicon Inc, NJ, USA) to fix small fracture fragments. This study included 6 patients with facial bone fractures who were treated using OCA.

Three patients had a fracture of the anterior wall of the frontal sinus, two patients had a fracture of the anterior wall of the maxillary sinus and one patient had a supraorbital rim fracture. The patients with frontal sinus fracture had small and multiple fracture fragments that did not have a strong stability to retain the anterior wall shape and were not suitable to place a drill hole. We took out the bone fragment, identified the intact nasofrontal duct, and then applied small amount of OCA to the edges of the bone frag-
ments to fix the fragments to their normal position and we waited for several minutes to obtain the bony stability. We carefully used OCA so that it could not enter the sinus cavity. The operation was completed after subcutaneous and skin sutures. In the patients with maxillary sinus wall fracture, the depressed fracture fragments were reduced with a Freer elevator, but they were unstable and the fracture sites were too high to place a drill hole in the fragments, we used OCA to fix the fragments in the same way. We applied OCA to the edges of the bone fragments and attached them to their normal positions. We checked postoperative CT scan in average 13.2 months after surgery to see the bony alignment. In addition, we checked the complications related to OCA.

Of the 6 patients, 4 were male and 2 were female. The mean age of the patient was 32.6 years (range, 17–47 years). The mean follow-up period was 13.2 months (range, 5–18 months). The patients with a frontal sinus fracture showed a good alignment of fracture fragments on postoperative CT scans (Fig. 1), and the patients with a maxillary sinus fracture also showed a good alignment (Fig. 2). In addition, the patient with the supraorbital rim fracture showed a good alignment on postoperative CT scans (Fig. 3), the patient did not complain of any symptom or had external deformities. During the follow-up period, there was no significant side effects of OCA including infection or allergic reactions. The alignment of the fracture fragments was well maintained and there was no bone resorption with a 13-month follow-up. All patients were successfully treated and no cosmetic problems occurred after surgery (Table 1).

**DISCUSSION**

Only one small bone fragment can be removed in facial bone fractures without difficulty, but simultaneous removal of several small bone fragments frequently leaves a big bone defect during the dissection or reduction. Placing a drill hole in a small bone fragment is relatively difficult be-

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Follow up period</th>
<th>Postoperative result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal sinus anterior wall</td>
<td>6 months</td>
<td>Good</td>
</tr>
<tr>
<td>Frontal sinus anterior wall</td>
<td>5 months</td>
<td>Good</td>
</tr>
<tr>
<td>Frontal sinus anterior wall</td>
<td>16 months</td>
<td>Good</td>
</tr>
<tr>
<td>Maxillary sinus anterior wall</td>
<td>5 months</td>
<td>Good</td>
</tr>
<tr>
<td>Maxillary sinus anterior wall</td>
<td>16 months</td>
<td>Good</td>
</tr>
<tr>
<td>Supraorbital wall</td>
<td>18 months</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Table. Demographic and clinical characteristics of patients**

A  

**Fig. 1.** CT scans show a fracture of the anterior wall of the frontal sinus before (A) and 16 months after surgery using octyl-2-cyanoacrylate (OCA) (B). The bone alignment is good without bone absorption after surgery.

**Fig. 2.** CT scans show a fracture of the anterior wall of the maxillary sinus before (A) and 16 months after surgery using OCA (B). The bone alignment is relatively good after surgery.

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cause drilling pressure pushes the fragment into the sinus cavity or drilling itself causes an additional fracture in the fragment.

The traditional treatment of a displaced fracture of the anterior wall of the frontal sinus is open reduction and internal fixation with metal plates and screws, however, this procedure sometimes requires an additional procedure for the removal of the plates and screws. Although an absorbable plate does not need to be removed, it is bigger than a metal plate and a screw. Thus it is not suitable for fixation of small fracture fragments. Wiring is suitable for the fixation of small fragments, but the delicate procedure and long operation time are needed which may have the possibility of an additional bone fracture while drilling.

The use of OCA has been extensively studied primarily in plastic surgery, and oromaxillofacial surgery.\(^{5,9}\) The advantages of OCA are ease of use, decreased operation time and formation of a flexible water-resistant barrier.\(^{10}\) Shermak et al\(^{10}\) also found no significant differences in bone healing or biomechanical strength on assessing calvarial bone segments in a rabbit model after 8 weeks of fixation with either a microplate or cyanoacrylate adhesive. In animal model, cyanoacrylate-based adhesive can be used to fix a significantly greater bone grafts than the titanium screw.\(^{11}\) The substances of the cyanoacrylate family studied are: methyl (R=CH\(_3\)), ethyl (R=C\(_2\)H\(_5\)), butyl and iso-butyl (R=C\(_3\)H\(_7\)) and octyl (R=C\(_3\)H\(_7\)) cyanoacrylate.\(^{10}\) Some previous studies have demonstrated that bone fragments fixed with cyanoacrylate-based adhesive have better success, stability and new bone formation than those fixed with screws.\(^{12-14}\) Butyl-2-cyanoacrylate has been demonstrated to provide the greatest strength and least toxicity of the existing members of the cyanoacrylate family in prior experimental investigations.\(^{13}\) Although we achieved good postoperative results using OCA, we do not think that OCA can be an alternative to a plate or a screw in maxillofacial fractures, because it has weak adhesive strength and possible adverse effects such as foreign body reactions.\(^{10}\) OCA should be used only when plates and screws cannot be used and when fractures occur in the facial bone with low stability such as the anterior wall of the frontal or maxillary sinus.

In addition, we recommend that small amounts of adhesive should be used to fix bone fracture for the prevention of adverse effects such as foreign body reaction.

In conclusion, OCA fixation can be as an alternative method to repair comminuted fractures at the anterior wall of the frontal or maxillary wall when the fracture cannot be repaired using plates and screws. Further studies with a larger sample size are needed to confirm our results.

References

9. Rajimwale A, Golden BK, Oottomasathien S, Krishnamurthy M,