Clinical Study

Comparative Orbital Volumes between a Single Incisional Approach and a Double Incisional Approach in Patients with Combined Blowout Fracture

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Purpose. Blowout fracture characterized by concurrent floor and medial wall fractures is a rare entity. We compared surgical outcomes between a single approach and a double approach in patients with orbital fracture by measuring the postoperative orbital volume.

Methods. We confirmed that 21 (8.5%) of a total of 246 patients with orbital fractures had fractures of the medial wall and floor through a retrospective chart review. Of these, 10 patients underwent the single approach and the remaining 11 patients had the double approach. We performed a statistical analysis of changes between the preoperative and postoperative orbital volumes at a 6-month follow-up.

Results. Compared with the contralateral, nonaffected side, the orbital volume was 115.3 (±6.09)% preoperatively and 106.5 (±6.15)% postoperatively in the single approach group and 118.2 (±11.16)% preoperatively and 108.6 (±13.96)% postoperatively in the double approach. These results indicated that there was a significant difference between the preoperative and postoperative orbital volumes in each group (P < 0.05). However there was no significant difference between the single approach and the double approach (P > 0.05). Conclusions. Our results showed that there were no significant differences in surgical outcomes between the two modalities. The treatment modality may be selected based on the surgeons’ preference, as well as the fracture type.

1. Purpose

Blowout fractures most commonly occur in the medial wall or floor of the orbital wall. Repair should be performed in cases of extraocular muscle entrapment, diplopia, globe malposition, and significant orbital volume expansion [1–5]. Cases of blowout fracture involving both the medial wall and the floor are rare and the suitable surgical approaches are debatable [6].

The surgical approach according to the fracture sites of the floor is via subciliary, transconjunctival, or subtarsal incision [7]. Additionally, the approach for the medial wall fractures is via the transcaruncular [8, 9], Lynch incision [10], or endonasal approach [11, 12]. Alternatively, by the extension of the subciliary or transconjunctival incision of the floor or transcaruncular incision to the medial side, a single incision can be made to achieve reduction of both floor and medial wall fractures [13].

A double approach is useful to secure the visualization of the entire fracture in each site of fracture. There is a high possibility that the insertion site for the inferior oblique muscle might be preserved. This leads to the remote possibility that the postoperative diplopia might occur but may prolong the operation time. The single approach has the advantage of a single incision for the reduction of 2 fracture sites. This approach shortens the operation time but may not be useful to secure a visual field. This may lead to incomplete reduction and the inaccurate placement of the implant.

We compared surgical outcomes between a single approach and a double approach in patients with orbital fracture and measured the postoperative orbital volume.
We performed a comparative analysis of the degree of the recovery of the orbital volume.

2. Method

Seoul St. Mary’s Hospital Institutional Review Board approved the current study. A retrospective chart review during the period from January, 2009, to December, 2013, confirmed that 21 (8.5%) of a total of 246 patients with orbital fractures had fractures of the medial wall and floor. All patients sustained an injury due to trauma, and they presented with no notable findings in the eye balls. Patients who underwent surgery within 2 weeks of the onset of injury were enrolled in the current study. Furthermore, we excluded patients with inferomedial fracture where there was a connection between the medial and floor fractures due to the concurrent fractures of inferomedial strut, the ethmoid-maxillary junction (Figure 1). Of the 21 patients, 11 underwent a double approach via a transcaruncular and a subciliary incision and the remaining 10 had a single approach via a subciliary incision. The single incisional approach was used during the initial 3 years from 2009 to 2011. From 2012, double incisional approach was used to obtain more wide surgical field. All the surgical procedures were performed by a single surgeon (D.Y.O.). Porous polyethylene (PPE) was used in the placement of the implant.

We evaluated the operation time. We also analyzed the postoperative complications such as visual acuity, diplopia, extraocular muscle limitation, vertical globe position, and hertel exophthalmometry. We performed a CT scan 6 months postoperatively. We completed the treatment after a 12-month follow-up in patients who did not show an eventful postoperative course.

2.1. Surgical Technique. All patients underwent surgical procedure under general anesthesia. The patients underwent forced duction test preoperatively as an evaluation of globe restriction. The floor was opened via a subciliary incision in the single approach. A periosteum incision line was extended to the inferomedial strut, if at least it was possible to obtain a closer visual identification of the medial wall. Once the operative field was sufficiently secured, sufficient reduction of the soft tissue at sites of the floor fracture was achieved. For better visualization of medial wall, the patients were tilted head down and turned his/her head to the opposite direction from injured orbit. An exposure to frontoethmoidal suture is also possible. We confirmed the medial wall fracture and achieved a sufficient reduction of the soft tissue. We subsequently inserted porous polyethylene (PPE) of 1 mm thickness. Similar to the wrap-around technique described by Nunery et al. [14], a single layer of PPE was used to cover the defects in the floor and on the medial wall. Moreover, we ensured that the implants were sufficiently placed in the anterior, lateral, and posterior margins of the fracture (Figure 2).

A subciliary incision was made for the reduction of the floor, as described above, followed by a transcaruncular incision, in the double approach. With the minimal dissection of the inferomedial strut, efforts were made not to detach the insertion sites of the inferior oblique muscle. In contrast, in case of double-approach, two separate implants were used for reconstruction. Each implant was placed in the fracture sites on the medial wall and floor. Moreover, we ensured that the implants were sufficiently placed in the anterior, lateral, and posterior margins of the fracture (Figure 3). We also examined the proportion of the postoperative diplopia, as compared with a single approach.

We performed a forced duction test postoperatively, after the implantation, to determine whether there were restrictions to the globe mobility.

2.2. The Measurement of the Orbital Volume. We measured the orbital volume, as previously described in the literature [15–18], Changes between the preoperative and postoperative orbital volumes were analyzed by CT scan imaging. CT scans of all patients were taken 6 month postoperatively. Even
Figure 2: Single incisional approach. (a) A 27-year-old male patient was injured by a baseball on his left orbit wall. (b) A single approach was done via a subciliary incision. (c) A single layer of the porous polyethylene was used to cover the defects in the floor and on the medial wall, similar to the wrap-around technique described by Nunery et al.

Figure 3: Double incisional approach. (a) A 36-year-old male patient was injured by a fist injury. (b) A double approach was done via subciliary incision and transcaruncular incision. (c) Each implant (porous polyethylene) was placed in the fracture sites on the medial wall and floor.

though PPE is a nonradiopaque material, it is visualized easily through adjusting CT density. The orbital volume at surgical sites was measured using Centricity Radiology RA 600 Clinical v8.0 (GE Medical System, WI, USA). The volume was obtained by measuring the surface of the orbital margin drawn on a 3 mm thickness coronal section image. The origin of the orbital margin began from a point where the entire margin of the orbital cavity could be seen on cross section to the point where the margins converged. A single observer who measured the orbital volume blinded to the technique used measured the orbital volume twice and then averaged the results to reduce measurement errors. We calculated the mean of both preoperative and postoperative values of the orbital volume assuming that there was no significant difference in the preoperative and postoperative orbital volume on the contralateral, nonaffected side. This served as the control group. Moreover, we also confirmed the degree of the difference in the orbital volume as compared with the affected side. We analyzed the decrease between preoperative and postoperative orbital volumes by a single approach and a double approach with the one sample $t$-test. Additionally, we also used the independent $t$-test to compare the postoperative orbital volume between the 2 groups. Statistical analysis was performed by the SPSS version 13.0 software (SPSS Inc., Chicago, IL, USA).

3. Result

21 (8.5%) of a total of 246 patients with orbital fractures had fractures of the medial wall and floor. 40 (16.3%) patients with fractures that included inferomedial strut were excluded from this study. A single approach was performed in 9 men and 1 woman. A double approach was performed in 9 men and 2 women. Average follow-up duration was 1 year 2 months.

Postoperative outcomes were summarized in Table 1. The mean operation time was 1 hour and 9 minutes in the single approach group and 1 hour and 48 minutes in the double approach group. The postoperative visual acuity was normal in all surgical patients. There was no postoperative extraocular muscle limitation. The vertical globe position was
and postoperative orbital volumes in each group (there was a significant difference between the preoperative

We demonstrated that both methods were effective in reducing the increased orbital volume due to the fracture. Our results also showed that there were no significant differences in surgical outcomes, except for the temporary occurrence of diplopia between the 2 modalities.

We concluded from our results that both surgical modalities were effective for the treatment of patients with fractures
Table 2: Orbital volume, single approach.

| Patient number | Preoperative volume increase (%) | Postoperative volume increase (%) | Difference (pre. − post.) |
|----------------|----------------------------------|-----------------------------------|--------------------------|
|                | \[(\text{preoperative injured orbit volume} / \text{noninjured orbit volume}) \times 100\] | \[(\text{postoperative injured orbit volume} / \text{noninjured orbit volume}) \times 100\] |                          |
| 1              | 107                              | 96                                | 11                       |
| 2              | 115                              | 102                               | 13                       |
| 3              | 117                              | 108                               | 9                        |
| 4              | 108                              | 106                               | 2                        |
| 5              | 118                              | 115                               | 3                        |
| 6              | 119                              | 111                               | 8                        |
| 7              | 113                              | 99                                | 14                       |
| 8              | 128                              | 114                               | 14                       |
| 9              | 117                              | 106                               | 11                       |
| 10             | 111                              | 108                               | 3                        |
| Average        | 115.3                            | 106.5                             | 8.8                      |

Table 3: Orbital volume, double approach.

| Patient number | Preoperative volume increase (%) | Postoperative volume increase (%) | Difference (pre. − post.) |
|----------------|----------------------------------|-----------------------------------|--------------------------|
|                | \[(\text{preoperative injured orbit volume} / \text{noninjured orbit volume}) \times 100\] | \[(\text{postoperative injured orbit volume} / \text{noninjured orbit volume}) \times 100\] |                          |
| 1              | 126                              | 119                               | 7                        |
| 2              | 135                              | 125                               | 10                       |
| 3              | 110                              | 102                               | 8                        |
| 4              | 122                              | 109                               | 13                       |
| 5              | 132                              | 132                               | 0                        |
| 6              | 116                              | 101                               | 15                       |
| 7              | 125                              | 122                               | 3                        |
| 8              | 98                               | 87                                | 11                       |
| 9              | 114                              | 102                               | 12                       |
| 10             | 116                              | 100                               | 16                       |
| 11             | 106                              | 96                                | 10                       |
| Average        | 118.2                            | 108.6                             | 9.5                      |

of the orbit wall and medial wall and furthermore the surgical treatment can be selected based on the surgeons’ preference, as well as the fracture type.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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