Case Report

Intra-Operative Navigation for Orbital Reconstruction to Correct Diplopia and Enophthalmos with Endoscopic Assisted Technique: First Case Report in Thailand

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Background and Objective: In an orbital fracture involving diplopia, enophthalmos is a major problem to be corrected because of soft tissue swelling and limited incision, which causes inaccurate restoration of orbital anatomy and reestablishing orbital volume. Pre-operative computerized planning combined with intra-operative navigation and endoscopy are used to create the accurate anatomical orbital position and effectively correct the posttraumatic diplopia and enophthalmos. Case Report: An 18-year-old Thai male with diplopia and enophthalmos presented a posttraumatic left orbital fracture two months prior. Three-dimensional CT scan of the facial bone confirmed the fracture. The patient required surgical treatment for correction of the orbital fracture. The intra-operative navigator and endoscopy-assisted technique were used. Pre- and post-operative pictures were compared, indicated the successful correction of enophthalmos and clinical correction of diplopia. Conclusion: Intra-operative navigator combined with endoscopy-assisted technique were a new surgical procedure that could correct the orbital deformity problem involving enophthalmos and diplopia more effective.

Keywords: Intra-operative navigator, Endoscopy-assisted technique, Enophthalmos, Diplopia, Orbital fraction

The problem of diplopia and enophthalmos in posttraumatic orbital fracture is difficult to accurately correct by conventional technique(1). Using stereolithographic models and computerize assisted navigation to evaluate the posttraumatic orbital bone position is a new technique for planning and positioning the normal orbital bone(2-4). Endoscopy is used to identify the deep bone defect and optic nerve. By these techniques we could accurately correct the orbital volume and bone position, so we could correct the diplopia and enophthalmos effectively, the first successful case in Thailand.

Case Report: An 18-year-old Thai male presented as left orbital fracture with diplopia and enophthalmos two months after a motorcycle injury. Written informed consent was given. The patient’s orbital anatomy was assessed in 3-dimensional computed tomography (3-D CT) using 1.2 mm thick slices of the bony part of the skull. The 3-D computer scanner was used to measure the orbital volume, defined as all content posterior to the orbital rim, not including the optic canal. There were 22.448 cm³ in left orbit and 20.623 cm³ in right side. The degree of enophthalmos was the distance level of eye globe projection measured from the native intraocular lens to the imaginary line connecting the edges of the orbital rim; the left orbital was 2 mm enophthalmos and none on the right. The visual activity test was 20/20, 20/20. Pre-operative computer planning was used to virtually correct the mirror image (i-plan) of the uninjured anatomically corrected side superimposed on the traumatic side. An intraoperative navigator was used to assess the accuracy of the restored orbital anatomy in various points on the virtual image. The external orbit frame was reduced to proper anatomical position and was fixed with 1.5 mm titanium plates and screws. The internal orbital bony medial wall and floor defect were corrected by autogenous calvarial bone graft. The depth of the orbital edge of the bone defect was visualized by endoscopy to prevent injury to the optic nerve and to determine the condition of the bone edge replacing the bone graft to correct the defect. Pre- and post-operative
pictures were compared the corrected enophthalmos, facial a symmetry, and the diplopia were clinically corrected.

Results

The intra-operative navigator and endoscopy-assisted technique was used successfully treat orbital fracture and accurately correct diplopia and enophthalmos. The patient’s vision returned to normal, and the diplopia and enophthalmos were completely corrected using pre- and post-operative pictures, orbital volume, and degree of enophthalmos. The right orbital volume was equal in pre- and post-operative The left post-operative orbit volume was 20.705 cm³. The eye globe projections were at the same level on both sides. The native intraocular lens of left globe was higher than the imaginary line connecting the edges of the orbital rim, no enophthalmos.

Discussion

The conventional technique in orbital reconstruction(1) involves difficulty in accurately adjusting the orbital volume and returning the bony position to normal or equal to the normal orbit side because of soft tissue swelling and small incision. Surgeons cannot see the orbits bone position, the eye globes, and eye globe projection together, so they cannot accurately estimate the symmetry due to the swelling of soft tissue in the orbital cavity. As a result, many cases of diplopia and enophthalmos cannot be accurately corrected. However, using pre-operative computer planning and intra-operative navigator
assisted\(^\text{(2-4)}\) technique when performing endoscopy to see the defected, bony edge position, and suitable position for replacing bone graft\(^\text{(5,6)}\), the authors can accurately correct the orbital volume and proceed to correct the diplopia more effectively than the conventional technique.

Pre-operative computer planning and intra-operative navigation are a useful guide for precisely adjusting the anatomy position of bone and function of vision\(^\text{(7,8)}\). The complicated posttraumatic deformities of maxillofacial bone especially the orbitozygomatic bone is very difficult to accurately restored\(^\text{(9)}\). Therefore, computer-assisted surgery usefully guides the intra-operation to restore proper form and function\(^\text{(9,10)}\). This patient was treated by 3-DCT using 1.2 mm thick slices, pre-operative computer planning (stereolithrographic models) and intra-operative navigator\(^\text{(11)}\). Patient underwent reconstruction with adequate restoration of form and function and required an autogenous calvarial bone graft to replace the bone defect at the median wall and floor of the orbit\(^\text{(5,12,13)}\). The defect was extremely deep so endoscopy was used to measure the deep edge of the defect to determine the position to place the bone graft in the most suitable position. Then, 1.5 mm diameter titanium plates and screws were used to fix the fracture site. The bone graft and plate position was confirmed, and the orbital volume or globe projection was checked during the operation time by intra-operative navigation guiding point-by-point with mirror image planning. The goals of treatment were re-establishing the bony position, normalizing the bony position and orbital volume, and correcting enophthalmos and diplopia\(^\text{(11,14)}\) including improvement of facial esthetics.

**Conclusion**

Pre-operative computer planning and intra-operative navigator was useful for orbital reconstruction. The patient received more accurate reconstruction especially regarding to enophthalmos and diplopia, because the process provided accurate volume equal in both orbits to correct both problems. Pre-operative computer planning and intra-operative navigator could appropriately solve all the associated problems of soft tissue swelling. The previous operation technique presented the problems of intra-operative accuracy of the orbital volume, globe projection, and orbital bony position. By this technique, we can accurately
map the orbital reconstruction virtually. Therefore, using this technique, we can correct the orbital deformities including enophthalmos and diplopia more effectively.

What is already known on this topic?
Using the previous technique in an orbital fracture involving diplopia with enophthalmos problems cannot effectively correct the problem due to the limited exposure and soft tissue swelling. It results in inaccurate restoration of orbital anatomical and eye globe position.

What this study adds?
Pre-operative computer planning with intra-operative navigation and endoscopy can be used to create the accurate anatomical orbital position and effectively correct the post-traumatic diplopia and enophthalmos.

What are the implications for public health practice?
Public health practice about post-traumatic diplopia and enophthalmos correction can be improved by using pre-operative computer planning with intra-operative navigation and endoscopy. This technique can improve the patient’s quality of life if we can effectively correct the diplopia in only one operation.

Potential conflicts of interest
None.

References
การผ่าตัดกระดูกบกตาแตกเพื่อมองRATION ที่มียุทธการคัดกรองที่ดีและ enophthalmos โดยใช้ระบบนำทาง (navigator) ตรวจ discrepanกระดูกบกตาแผลผ่าศูษ์ที่ผ่าตัดดังกล่าวในผู้ป่วยกระดูกบกตาคิดวิธีทำงาน

เล็ก ภูมิหลัง

ผู้มีส่วนและวัตถุประสงค์: ผู้ป่วยกระดูกบกตาแตกจากอุบัติเหตุที่มีปัญหาการคัดกรองที่ดีและ enophthalmos มีจังหวะมาก การผ่าตัดรักษาในโรงพยาบาลสุขนิสิตจะมีปัญหา, bone graft เสี่ยงกระดูกที่แตกหรือไม่วิจารณา ได้ถูกจัดให้นักวิจารณ์อยู่ในกลุ่มผู้ป่วยผู้ดี เหล่านี้มีที่มาจากผู้ป่วยที่มีวิธีการผ่าตัดที่ดีผ่านระบบการตรวจผ่านระบบการผ่าตัดที่มีระบบการตรวจแล้ว ได้รับประโยชน์มาก ระบบการตรวจที่แตกหรือไม่ได้ถูกจัดให้ผู้ป่วยที่มีวิธีการผ่าตัดที่ดีผ่านระบบการตรวจผ่านระบบการตรวจ ได้รับประโยชน์มาก

การผ่าตัดกระดูกบกตาแตกเพื่อมองRATION ที่มียุทธการคัดกรองที่ดีและ enophthalmos โดยใช้ระบบนำทาง (navigator) ตรวจ discrepanกระดูกบกตาแผลผ่าศูษ์ที่ผ่าตัดดังกล่าวในผู้ป่วยกระดูกบกตาคิดวิธีทำงาน

รายงานผู้ป่วย: ผู้ป่วยชาย อายุ 18 ปี มาด้วยอาการมองภาพซ่อนแผลผ่าศูษ์ที่มีปัญหาการคัดกรองที่ดีและ enophthalmos โดยใช้ระบบนำทาง (navigator) ตรวจ discrepanกระดูกบกตาแผลผ่าศูษ์ที่ผ่าตัดดังกล่าวในผู้ป่วยกระดูกบกตาคิดวิธีทำงาน

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