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ORIGINAL ARTICLE

VIDEO-ASSISTED AND CT NAVIGATED REPOSITION OF AN ORBITAL BLOW-OUT FRACTURE

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Summary

One possible use of CT navigated surgery in Otorinolaryngology includes traumatology of the facial skeleton.

CT navigation enables a surgeon to assess the range and quality of reposition and fixation of a fracture, in our case the fracture of the orbital floor, using a navigated tube. We proceed from pre-operative CT of the paranasal sinuses images to navigation with 1,5-2,0 mm incisions and subsequent registration. Formerly, we used mainly transantral approach at our department, while currently we prefer subciliar approach with the use of absorbable materials (PDS or PMR splint).

We use a rigid endoscope for infraorbital nerve decompression and delicate removal of free bone fragments from the maxillary sinus. We applied this procedure in 2 patients. We verified the range of decompression, degree of reposition of the orbital blow-out fracture, and placement of PMR splint and titanium grid using video navigation.

Key words: orbital blow-out fractures; otorinolaryngology; CT navigation; video-assisted and CT navigated surgery

INTRODUCTION

A concept of hydraulic, orbital blow-out fractures was mentioned for the first time in the world literature in Smithe and Regan´s work in 1957 (11).

Symptoms of these fractures include edema, hematoma and emphysema of lids as well as the orbit, neuropathy (most often hypesthesia) of the infraorbital nerve. As to the time following after the injury, exophthalmos, normal position of the eyeball and also enophthalmos may be observed. Motility limitation and diplopia mostly caused by myogenous and mechanical lesions are the most important symptoms. Traumatic changes affect the inferior rectus muscle, the inferior oblique muscle and the medial rectus muscle.

The symptoms may be present in various combinations, however, fracture manifestations may be even very poor. We assess the presence of the orbital blow-out fracture, its size and seriousness from CT images (coronary and sagittal sections). As long as

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a patient is asymptomatic or symptoms are disappearing fast (excluding the entrapped muscle) and late diplopias do not occur, we treat the fracture conservatively. In other cases, we conduct a surgical revision (7).

We focused on a benefit of endoscopically assisted and CT navigated reposition of the orbital blow-out fracture with removing free bone fragments from the maxillary sinus and providing decompression of the infraorbital nerve in case it is com-pressed by bone fragments.

Series of patients

Two patients were indicated to a video-assisted and CT navigated surgery of the orbital blow-out fracture.

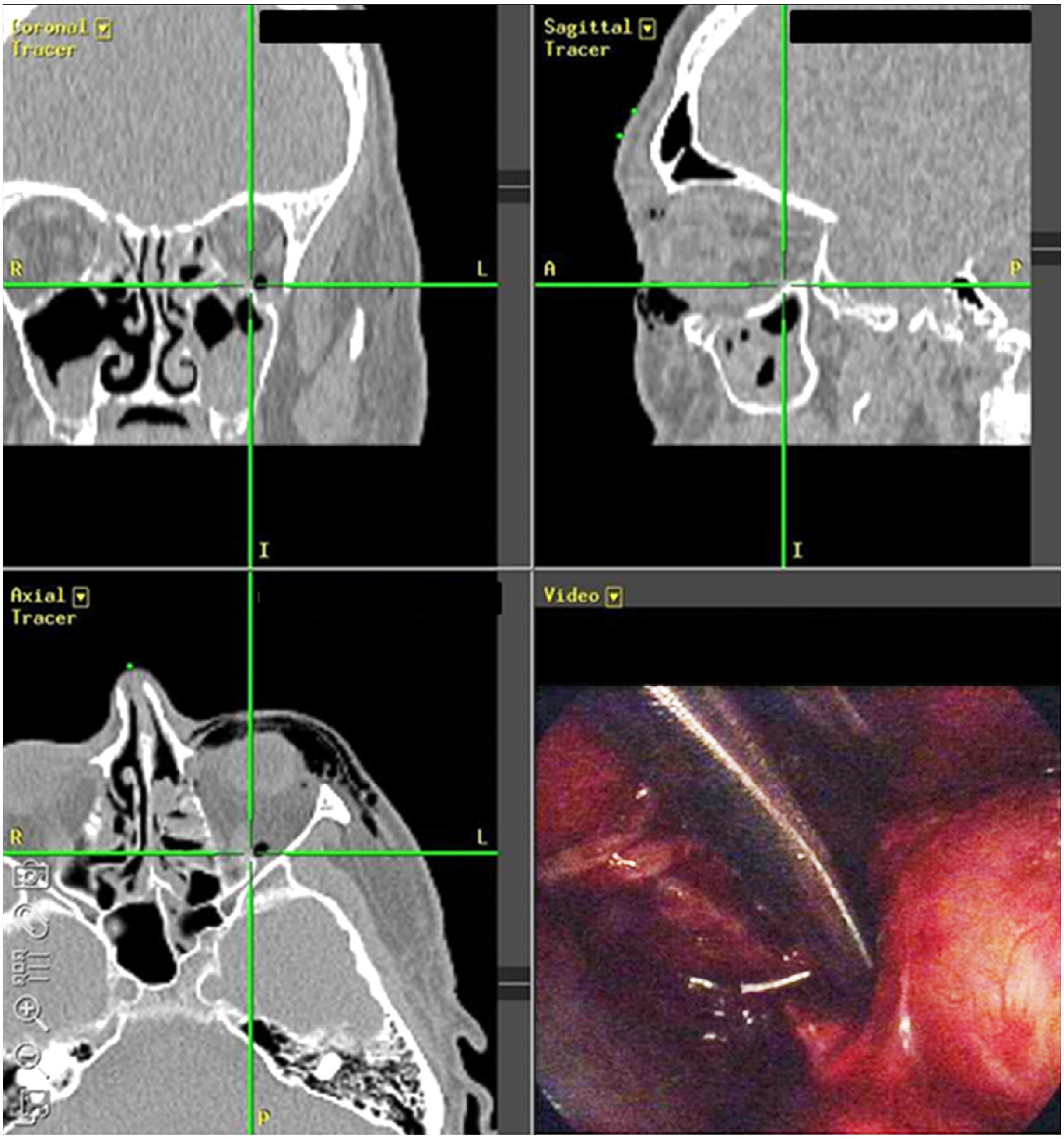

Figure 1. Verification of the right mobilisation and fixation of the orbital blow-out fracture (subciliar approach)

The first case was a man, in whom we performed a revision surgery 30 years after primary insufficient coverage of the orbital blow-out fracture with a bone disc and a subsequent reoperation and removal of mucosa from the maxillary sinus. (Caldwell – Luc).

After many years of asymptomatic period, the increase of exophthalmos of the left eye, reduced motility of the eyeball, intermittent vision defect, and expression up to permanent diplopia appeared continuously. Endoscopically we confirmed an expansion arising from the maxillary sinus, which corresponded with the expansive mucocele of the left maxillary sinus with osteolysis on CT and MR images, closely related to the inferior and internal rectus muscles and the optic nerve.

The surgery was performed in two stages. After endoscopic supraturbinal antrostomy and wide marsupialization of a cyst, we let the orbital floor spontaneously strengthen by scarring. Exophthalmos and lateroposition of the left eyeball disappeared in the operated patient. Eye motility was almost completely restored and diplopia in the direct line disappeared. Expressive diplopia was revealed in other directions above 10 degrees of gaze. Nevertheless, the patient was satisfied with the result and he could work at the computer more comfortably.

After half a year and the patient´s consent, we carried out a revision of the orbital floor from subciliar access using CT navigation under endoscopic control. We released the eyeball and the infraorbital nerve from the scars so that it could not be compressed after supporting the defect of the orbital floor. With respect to the range of the defect, we reconstructed the orbital floor with a titanium grate, the right position of which we verified with a CT navigated probe and we used endoscopy from transorbital and transantral approaches.

The second patient had a comminutive orbital blow-out fracture with posttraumatic limited function of the inferior rectus and infraorbital nerve hypesthesia caused by bone fragments compression. Fracture lines revision was performed from subciliar approach. Under endoscopic control, we removed free bone fragments and hematoma from the max-illary sinus, performed infraorbital nerve decompression in a proper extent and then a reposition of the orbital blow-out fracture itself bridged with a thermoplastic resorbable PolyMax Rapid (PMR) splint with CT navigation.

We verified the extent of mobilisation, the degree of reposition of the orbital blow-out fracture and insertion of the PMR splint or the titanium grate by videonavigation. (Fig. 1, Fig. 2, Fig. 3)

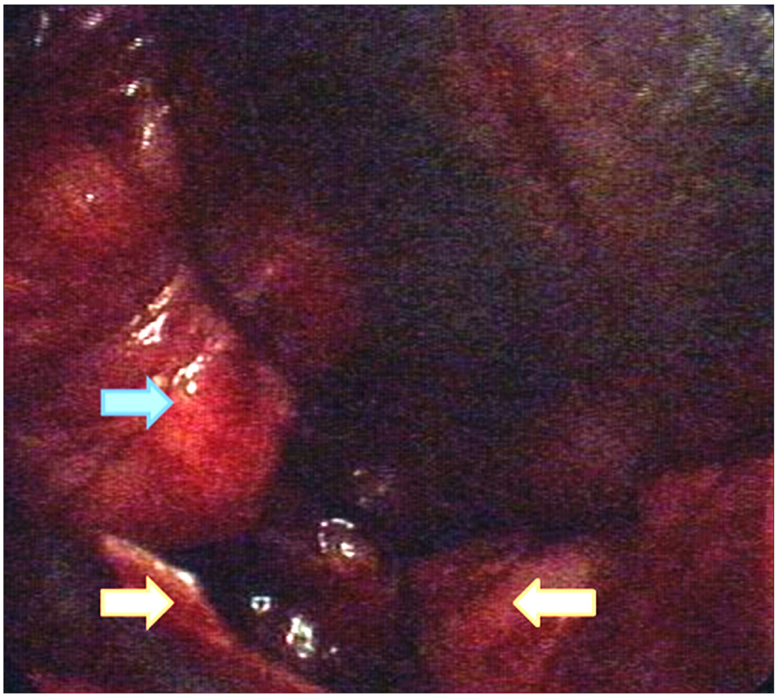

Figure 2. Videoendoscopic reposition of the orbital blow-out fracture, White arrows: The orbital floor, Blue arrow: The periorbit

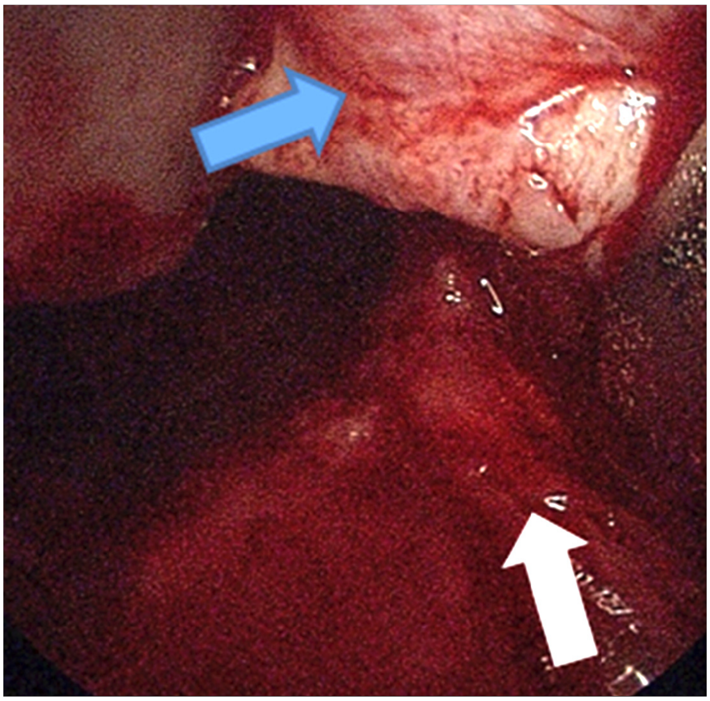

Figure 3. Decompression of the infraorbital nerve, White arrow: The released infraorbital nerve, Blue arrow: The periorbit

RESULTS

In the patient with the repeated revision surgery, we were able to separate the maxillary sinus mucosa with the scar and the released infraorbital nerve from the periorbit using the direct endoscopic control accompanied with CT navigation. We were able to reinforce this space with the titanium grate after determination of firm rims of the orbital floor defect. We changed the location and position of the eyeball by retaining a full motility and reducing diplopia. We most likely eliminated possibilities of recre-ating the mucocele with compressive manifestations on surroundings or development of inflammatory complications after the separation of the maxillary sinus epithelium from the soft parts of the eyeball (including the infraorbital nerve release) and retaining the controllable maxillary sinus (performed by supraturbinal antrostomy).

Diplopia occured only at 20 degrees which brought additional improvement to the patient´s health state.

In the patient with primary surgery of the comminutive orbital blow-out fracture, we confirmed a benefit of using endoscopy for determination of the extent of fracture, removal of free bone fragments from the maxillary sinus and release of the infraorbital nerve compressed by bone fragments in the canal of the same name. After the surgery, physiological functions were restored, diplopia disappeared and sensation of innervated area came back.

DISCUSSION

Many authors from our and foreign countries deal with proper timing and surgical technique in orbital blow-out fractures. Exclusively, the group of authors Voldřich and Cigánek point out an importance of visual assessment of the whole surgical site (2, 14,15).

Harris, in conformity with most surgeons (2,4, 5,6,9,13,14,15), recommends surgery in such defects of the orbital floor where clinically significant enophthalmos or persistent and not diminishing diplopia within 14 days after the injury is likely expected.

Kwon et al. classify orbital blow-out fractures in their two works as anterior, posterior and anteroposterior. They recommend a transorbital or combined approach in the anterior median of the orbital floor and in the „trap-door“ type of fractures with the pinched inferior rectus muscle. Then, a transantral or again combined approach (8) in fractures in the posterior median.

Beumer, Pham and Schramm (1,10,11) recommend the use of CT navigation in maxillofacial skeleton fractures in order to minimize posttraumatic enophthalmos and to reach better facial symmetry. Moreover, Collyer and Schramm (3,11) emphasize its great benefit in secondary reconstructions of the orbit.

Voldřich (14,15), Cigánek et al. (2) present a series of patients in which 87 – 90 % operated patients were without diplopia. They used entirely the transantral approach with mobilization of ruptured part of the orbital floor under the direct visual or endoscopic control. They stress the need to remove free bone fragments from the maxillary sinus, pathologically changed mucosa and potential release of the infraorbital nerve from the fractured line and to verify free passive eyeball motility immediately after conducted reposition at the end of the operation.

CONCLUSION

We presented benefits of CT navigation in repositions of the orbital blow-out fractures in a single article (7). In this paper, we focused on advantages of the use of endoscopy. The main advantage of the use of videoendoscopically navigated surgery in indicated cases is to remove free bone fragments from the maxillary sinus, to aspirate hematoma and prevent maxillary sinus inflammation development which is hard to solve. Another advantage is to gently conduct elevation of marginal fragments, to release the infraorbital nerve from the fractured line and to eliminate or prevent development of hypoesthesia (paresthesia) in this area.

We obtained a perfect view of both the inferior orbit and the state of the maxillary sinus and thus resolved mentioned above pathological findings using video-assisted and CT navigated surgery.

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