Functional and Aesthetic Restoration of Medial Canthal Region Following Naso-Orbito-Ethmoidal (NOE) Traumatic Telecanthus

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ABSTRACT

Background: Injuries to the nasoorbitoethmoidal (NOE) complex involve functional and aesthetic aspects. The close anatomical relationship among the medial canthus, eyelids, and nasolacrimal drainage system presents a challenge to the reconstructive surgeon in treatment of post NOE traumatic telecanthus. Correction of the deformity requires adequate dissection and mobilization of the medial canthal tendon, subperiosteal exposure of the medial orbit, precise identification of the correct anatomical location for tendon placement, and secure fixation of the tendon to bone. Many techniques were described to reconstruct the medial canthal ligament and repair of telecanthus deformity.

Patients: The study included 13 patients (11 males and 2 females) who have had Telecanthus following a variable period of NOE fracture.

Methods: The technique of medial canthoplasty consisted of reattachment of the anterior and posterior limbs of the medial canthal tendon by 2 separate wires. The two wires were passed through a single transnasal hole drilled superior and posterior to the lacrimal fossa and secured at the contralateral side over a 6-holes titanium mesh.

Results: Over a period of 2-years, and with an average follow-up period of 12 months, the authors reported good functional and aesthetic results based on the measurement of pre- and postoperative intercanthal distance.

Conclusion: (1) Drilling one hole instead of two prevents weakening of the bone segments, (2) Twisting the wires on metal plates instead of the bone results in a more secure fixation, and (3) Proper anatomical reposition of the medial canthal tendon superior and posterior to the anterior lacrimal crest results in restoration of functional and aesthetic properties of the medial canthal region.

INTRODUCTION

The medial canthal tendon is a complex anatomical structure arising from the medial margin of the upper and lower tarsi and the orbicularis oculi. It inserts in a tripartite fashion into the region of the lacrimal crests at the medial orbit [1]. The normal bony insertion of the medial canthal tendon may be disrupted after trauma. Failure to reattach the medial canthal tendon results in medial canthal dystopia [2].

Injuries to the nasoorbitoethmoidal complex involve functional and aesthetic aspects [3]. The close anatomical relationship among the medial canthus, eyelids, and nasolacrimal drainage system presents a challenge to the reconstructive surgeon. Medial canthal injuries can be broadly divided into two categories: Degloving injuries and injuries associated with bony disruption (nasoethmoidal fractures) [4]. Although nasoethmoidal fractures may also have a degloving component, reduction and fixation of bony fragments should occur before soft-tissue reconstruction. Soft-tissue degloving injuries, by definition, do not include bony disruption. They result from shearing forces and avulsion of soft tissue along the medial canthus, typically transmitted from the brow or forehead across the medial canthus to the lower eyelid/cheek complex [5,6].

Correction of the deformity requires adequate dissection and mobilization of the medial canthal tendon, subperiosteal exposure of the medial orbit, precise identification of the correct anatomical location for tendon placement, and secure fixation of the tendon to bone. Multiple techniques have been described [9-15]. Transnasal wiring [9-11] is the most commonly used technique in most centers, but the procedure is technically difficult. It necessitates wide exposure sufficient to allow transverse passage of a wire through a bony fenestration deep within the orbit, and entails dissection of the contralateral orbit. Other techniques are ipsilateral techniques and include the nylon anchor [12] the stainless steel screw [13], the cantilevered miniplate [14,15], and the Mitek mini-GII anchor [16].

In this study, the authors restore the anterior and posterior limbs of the medial canthal tendon using a single hole transnasal wiring fixed along a contralateral 6-holes titanium mesh. Furthermore, drilling was performed posterosuperior to the lacrimal crest to ensure the proper reattachment of the medial canthal tendon into its original insertion and restoration of the normal shape and function.
PATIENTS AND METHODS

The study included 13 patients (11 males and 2 females) who had been presented at the Department of Plastic Surgery, Ain Shams University, Cairo, Egypt, over a period of 2 years with post NOE traumatic telecanthus. The age of patients at the time of presentation ranged from 11 to 39 years with a mean age of 23.5 years. The cause of injury included motor vehicle accident (5 patients), bicycle accident (3 patients), and interpersonal violence (5 patients). The average duration from the onset of injury to the clinical presentation ranged from 8 months to 4.5 years with an average of 3.2 years. All patients had surgical intervention following trauma in the form of open reduction and internal fixation. The period of follow-up ranged from 6 to 12 months with an average of 9 months.

Clinical picture at time of presentation included (1) a vertically or obliquely oriented scar extending from the forehead and crossing the eyebrow, medial canthus and cheek area, (2) naso-orbito-ethmoidal fracture with bony displacement, (3) telecanthus, and (4) eyelid ptosis with or without lacrimal system injury. Radiological studies included pre- and postoperative Coronal and axial CT scan and three dimensional axial tomography.

All patients underwent clinical examination for telecanthus, including the distance (in millimeters) between the facial midline and the medial canthus which was compared with the same measurement on the contralateral uninvolved side. Examination also included canthal position, eye movement, levator function, and patency of nasolacrimal system. Standard preoperative and postoperative photographs were reviewed (Table 1).

Table (1): Patients’ characteristics and clinical pictures.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yr) and sex</th>
<th>Side</th>
<th>Clinical picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24 male</td>
<td>Left</td>
<td>Telecanthus and old NOE fracture orbital floor fracture, enophthalmos, and lower lids ectropion.</td>
</tr>
<tr>
<td>2</td>
<td>31 male</td>
<td>Right</td>
<td>Telecanthus and old NOE fracture with displaced lateral nasal bone.</td>
</tr>
<tr>
<td>3</td>
<td>21 male</td>
<td>Left</td>
<td>Telecanthus and old NOE fracture with crooked nose.</td>
</tr>
<tr>
<td>4</td>
<td>15 male</td>
<td>Left</td>
<td>Telecanthus, old NOE and zygomaticomaxillary complex fracture, ptosis and dystopia.</td>
</tr>
<tr>
<td>5</td>
<td>27 male</td>
<td>Bilateral</td>
<td>Telecanthus (bilateral) after bilateral NOE fracture type (III) and right canalicul injury.</td>
</tr>
<tr>
<td>6</td>
<td>39 male</td>
<td>Right</td>
<td>Telecanthus, old NOE, ptosis and right frontozygomatic fracture.</td>
</tr>
<tr>
<td>7</td>
<td>29 female</td>
<td>Left</td>
<td>Telecanthus, old NOE with crooked nose and scar on the dorsum of the nose.</td>
</tr>
<tr>
<td>8</td>
<td>26 male</td>
<td>Left</td>
<td>Telecanthus, old NOE, orbital floor fracture, lower lid ectropion and lagophthalmos.</td>
</tr>
<tr>
<td>9</td>
<td>19 male</td>
<td>Right</td>
<td>Telecanthus, old NOE fracture, and orbital floor fracture.</td>
</tr>
<tr>
<td>10</td>
<td>18 male</td>
<td>Right</td>
<td>Telecanthus, old NOE fracture, deviated nose, canalicul injury and lagophthalmos.</td>
</tr>
<tr>
<td>11</td>
<td>11 female</td>
<td>Bilateral</td>
<td>Telecanthus, old NOE fracture, fracture of orbital floor, right enophthalmos, and right lower lid ectropion.</td>
</tr>
<tr>
<td>12</td>
<td>20 male</td>
<td>Right</td>
<td>Telecanthus, old NOE fracture with orbital rim and orbital wall fractures.</td>
</tr>
<tr>
<td>13</td>
<td>27 male</td>
<td>Left</td>
<td>Telecanthus, old NOE fracture, ptosis and enophthalmos.</td>
</tr>
</tbody>
</table>

Surgical technique:

All patients were operated upon while under general anesthesia with oral endotracheal tube. One gram third generation cephalosporin was given at the induction of anesthesia.

The existed scar was removed by simple elliptical excision, then dissecting the underlying soft tissue of the medial canthal region to reach the lateral nasal bones, medial orbital wall, and medial part of the orbital rim and floor. Lower eyelid and
upper buccal sulcus incision were used to repair
the old NOE fracture. A lower eyelid incision is
used to expose the inferior orbital rim fractures
and explore the internal orbit. The upper buccal
sulcus incision was used to reduce and stabilize
fractures of the nasomaxillary buttress and piriform.
In 11 cases, there was an old displaced fracture of
lateral nasal bone along with displaced fracture of
the nasal process of frontal bone and/or frontal
process of maxilla. In 9 cases, the medial canthal
tendon was completely avulsed and displaced
without any attached bone fragment.

One of the objectives of old nasoorbitoethmoidal
fracture treatment is to restore normal orbital
volume and shape in order to maintain globe posi-
tion and function. The internal orbit was routinely
explored if missing defects were identified on the
CT scan. Defects of the orbital floor were recon-
structed with titanium mesh while displaced frac-
tures of inferior orbital rim were reduced through
the lower eyelid incision and fixed with orbital
plate. The authors could custom the titanium plate
to fit and reconstruct each individual orbital floor
defect with no any reported infections or extrusions.

Medial canthoplasty:

In all unilateral cases, the disrupted medial
canthus from its bony insertion, and a vertically
or obliquely oriented scar extending from the
forehead and traversing the medial canthal region
were constant findings. Exposure was done through
the existing scar while breaking it at the medial
canthus during closure. A curved vertical incision
was made a few mm in front of the medial canthus
of the uninjured side. In bilateral cases, a coronal
approach was used instead. Dissection of the medial
orbital wall was carried out in a subperiosteal
plane. It was confined to a limited area in the
anterior one third of the uninjured medial orbital
wall enough to accommodate a mesh plate. A single
hole was drilled posterior and superior to the
lacrimal crest. This hole was widened at the injured
side to accommodate the bulkiness of the canthal
tendon and sutures at the time of tightening and
to allow for overcorrection. The owl was passed
from the uninjured side to reach the contralateral
posterior and superior aspect of the lacrimal crest
while protecting the globe with a malleable (Fig.
1A). Both superficial and deep leaflets of the medial
canthal tendons were grabbed separately with wire
sutures, passed transnasally with the aid of the owl
to the uninjured side, and fixed over a mesh plate
(Figs. 1B,2). In children, non-absorbable sutures
were used instead. Dacrocystorhinostomy was
performed when indicated. Subcutaneous closure
of the wounds was done prior to tightening of the
wires and resuspension of the medial canthal ten-
don. A tie-over bolster dressing was applied over
the medial canthal region for a few days to mini-
mize postoperative edema at the medial canthal
region. This method is intended to easily pass a
pair of bent wire strings transnasally through one
drill hole and to securely fix them over a reduced
titanium mesh.

RESULTS

The results of a total of 13 patients were studied
(Figs. 3-6). With an average follow-up period of
9 months, restoration of the medial canthal tendon
was achieved in all patients. Pre- and 6 months
postoperative measurements of the canthal-midline
distance in comparison to the measurement of the
contralateral uninvolved side are shown in Table
(2).

Most of the patients had fractures extended
beyond the NOE complex, including 5 patients
with orbital floor and rim fractures treated by bone
graft in 2 patients while titanium mesh was applied
in 3 patients. Displaced fracture of lateral nasal
bones in 4 patients (2 patients had crooked nose)
and they were treated by open reduction and rigid
internal fixation. Reduction and rigid fixation was
performed to a patient with frontozygomatic frac-
ture and another patient with zygomaticomaxillary
buttress fracture.

Probing and irrigation with stent placement
was performed on 2 patients with canalicular injury
which resulted in resolving the tearing problem,
and Dacrocystorhinostomy was performed to another
2 patients. Eyelid Ptosis was reported in 2 patients
with poor preoperative levator function. Levator
advancement was performed with marked improve-
ment of levator function at 6 months postopera-
tively.

Reconstruction of the orbital floor with resto-
ration of the orbital volume greatly repositioned
the globe with resolving the appearance of enoph-
thalmos in 3 patients (Fig. 6A,B).

Statistics:

Analysis of the mean values between variables
and study of the paired t-test revealed that the
difference between the postoperative mean value
of midline-canthal distance (15.53±SD 3mm) com-
pared with the preoperative mean value of midline
canal distance (19.03±SD 3mm) was statistically
significant (p<0.05). Meanwhile, the difference
between the mean postoperative distance and the
midline-canthal distance at the uninvolved side
was not statistically significant (p>0.05).
Table (2): The pre- and postoperative measurements of midline to canthal distance (in mm) and compared to the distance of the uninvolved side.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Side</th>
<th>Preoperative Midline to canthal distance “in mm”</th>
<th>Postoperative Midline to canthal distance “in mm”</th>
<th>Uninvolved side Midline to canthal distance “in mm”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>17</td>
<td>15.5</td>
<td>15.5</td>
</tr>
<tr>
<td>2</td>
<td>Right</td>
<td>17.5</td>
<td>16</td>
<td>15.5</td>
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<tr>
<td>3</td>
<td>Left</td>
<td>19</td>
<td>16.5</td>
<td>16.5</td>
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<td>4</td>
<td>Left</td>
<td>18.5</td>
<td>14.5</td>
<td>14.5</td>
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<tr>
<td>5</td>
<td>Bilateral</td>
<td>Rt. 17.5</td>
<td>Rt. 15.5</td>
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<tr>
<td></td>
<td></td>
<td>Lt. 16.5</td>
<td>Lt. 15.5</td>
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<tr>
<td>6</td>
<td>Right</td>
<td>21.5</td>
<td>16</td>
<td>15.5</td>
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<td>7</td>
<td>Left</td>
<td>21</td>
<td>15.5</td>
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<td>8</td>
<td>Left</td>
<td>20</td>
<td>15.5</td>
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<tr>
<td>9</td>
<td>Right</td>
<td>19.5</td>
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<td>10</td>
<td>Right</td>
<td>18</td>
<td>15.5</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Bilateral</td>
<td>Rt. 19.5</td>
<td>Rt. 14.5</td>
<td>–</td>
</tr>
<tr>
<td>11</td>
<td>Left</td>
<td>18.5</td>
<td>Lt. 14.5</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>Right</td>
<td>20.5</td>
<td>16.5</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>Left</td>
<td>21</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Mean 19.03±3 SD 15.53±3 SD 15.23±3 SD

Fig. (1): Technique of transnasal wiring: A. The owl being passed from the other side posterosuperior to the lacrimal crest while protecting the globe with a malleable. B. The medial canthal tendon is found, grabbed with a wire suture and passed to the other side. DCR was also performed (white tube in the depth of field).

Fig. (2): Front and oblique views of 3D computed tomographic scan show the titanium plate applied anterior to lacrimal crest of the contralateral side to hold the paired wires holding the anterior and posterior limbs of the medial canthal tendon. The ends of the two wires were twisted and secured into a 6 holes titanium mesh.
Fig. (3): A. 24-year-old male with old left NOE fracture and telecanthus. B. 1 year post reconstruction.

Fig. (4): A. 21-year-old male (shown in Fig. 1) with old left NOE fracture & telecanthus. B. One month post-operative result.
Fig. (5): A. 15-year-old male with telecanthus, ptosis & dystopia that resulted from an old left NOE fracture and zygomaticomaxillary complex fracture. B. 18 months post refraction and fixation, unilateral medial canthopexy, DCR and scar revision.

Fig. (6): A. 27-year-old male with bilateral NOE fracture type (III) and telecanthus following a blow to the central midface region. B. 6 months following ORIF, split calvarial bone grafts, and transnasal canthopexy restoring his pre-accident shape. C. D- Lateral views of the same patient demonstrating the backward displacement of the nasal root.
DISCUSSION

Functional and Aesthetic deformity that results from inadequate naso-orbito-ethmoidal fracture treatment is well described by Clair et al. [17] and Converse and Smith [9]. Secondary management of NOE injuries were managed by open techniques that addressed the medial canthal tendon, orbital, and nasal bone malposition and lacrimal obstruction [18-20]. The evolution improving the results was open reduction interfragmental wiring which was first utilized in compound fractures but was later extended to closed injuries by Dingman and Natvig [21], Dingman et al. [22], and Stranc [11].

Transnasal reduction of the canthal tendon bearing bone fragment is the most important step in restoring the intercanthal distance. Lateral displacement of the frontal process of the maxilla is responsible for the increased intercanthal distance especially if when transnasal wiring is performed anterior to the canthal insertion resulting in telecanthus [9,10]. The intercanthal distance is properly preserved by performing transnasal reduction of the medial orbital rims through drill holes placed posterior and superior to the lacrimal fossa [9,10,23]. In this series, treatment of telecanthus and medial canthoplasty was a secondary procedure after a period of NOE fracture. The proper management did not only depend on the repositioning of the medial canthal tendon into its anatomical insertion, but also depended on the reduction of the displaced frontal process of maxilla, medial orbital wall, and reconstruction of the orbital rim and floor.

The pitfall of the standard technique of transnasal wiring is the double drilling through the lacrimal and nasal bones which may subject the bones for further fragmentation and subsequent displacement and relapse of the telecanthus [9-11]. In the present study, single hole was performed, the two wires holding the anterior and posterior limbs of the medial canthal tendon was passed through it and secured on a titanium plate fixed on the contralateral medial orbital rim.

In conclusion, the main advantages of the described method may be summarized as follows: (1): One hole is drilled instead of two, greatly facilitates the operation; (2) The folded wires are passed easily through a plastic tube that is placed transnasally during drilling; (3) Drilling one hole instead of two prevents weakening of the bone segments; and (4) Twisting the wires on metal plates instead of the bone results in a more secure fixation.

Disclosures: The authors have no conflicts of interest or financial ties to disclose.

REFERENCES


