

Osteopathic Manipulative Treatment in Management of Acute Orbital Compartment Syndrome

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Hypothesis

Functional venous drainage plays a critical role in the healing process of orbit pathology. Somatic dysfunctions result in mechanical dysfunction of the inherent venous pump and in obstruction of venous drainage pathways, interfering with healing and predisposing to complications.

Introduction

This case discusses how osteopathic manipulative treatment (OMT) promotes orbital drainage in a patient with acute orbital compartment syndrome (AOCS).

AOCS is an ophthalmologic emergency and a rare complication of orbital trauma^{1,2,3}. Progressive visual impairment is caused by increased intra-orbital pressure impairing perfusion of relevant neurovascular and neurosensory structures^{1,4}. Untreated, irreversible vision loss can occur in as little as 90 minutes^{1,2,3}. The risk of permanent vision loss in these patients is 44-52%³.

Surgical decompression within 2 hours of trauma is generally recommended^{1,2,3}. While surgical decompression protects the globe, it has little impact on reducing the retro-orbital bleeding and swelling that contributes to AOCS. Inconsistent outcomes and complication rates post-operatively are noted in current literature^{1,2,3,4}. One case even documented spontaneous recovery of vision with no intervention¹.

Orbital drainage is not currently considered in the management of orbital trauma. No literature exists on the use of OMT in AOCS.

Methods

A patient with AOCS was admitted to the trauma inpatient service and the Osteopathic Manipulative Medicine (OMM) service was consulted. OMT was performed daily based on osteopathic structural exam (OSE) findings. AC and HE performed the first OSE and OMT. AC performed the 2nd and 3rd OSE and OMT. Subjective and objective findings were documented in the patient's medical record and retrospectively reviewed.

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Case Description

HPI: A 50 year-old male presented after blunt trauma to bilateral orbits with chief complaint of severe bilateral eye pain and swelling, left worse than right, and decreased visual acuity bilaterally.

CT Brain and Maxillofacial: Extensive left periorbital hematoma with retro-orbital blood and edema, oblong shape of the globe with possible lens disruptions, non-displaced right nasal bone fracture with 2mm depression.

Review of Systems: Vision complaints (see Table 2), otherwise unremarkable

Medical History: Human immunodeficiency virus, hepatitis B

Surgical History: None

Social History: Employed, 15 pack-year smoking history, polysubstance abuse

Physical Exam: See Table 2 for pertinent eye exam findings

Assessment: 50 year-old male with left eye AOCS and severe somatic dysfunction in cranium and along orbital venous drainage pathway.

Plan: 1. Surgical and medical management by ophthalmology and primary teams
2. Initiate trial of OMT to assist in recovery

Osteopathic Structural Exam on Hospital Day (HD) #1

Head: L orbit warmth and bogginess with poor amplitude of primary respiratory motion, L sphenobasilar symphysis (SBS) lateral strain, L SBS torsion, sphenoid interosseous strain, L temporal bone internally rotated, occipital extension, L dural strain through tentorium cerebelli, OAES_LR_R

Cervical: R sternocleidomastoid (SCM) spasm, R middle and R anterior scalene spasm, anterior cervical fascial strain, AAR_L, C3-7ESR_L

Thoracic: T1-2FSR_L, T11-12ESR_R **Lumbar:** L5ESR_L **Sacrum:** R on L

Pelvis: R innominate posterior **L.E.:** R hip external rotation

U.E.: R clavicle superior with dysfunction at acromioclavicular and sternoclavicular joint, R supraclavicular bogginess, R humeral head internally rotated, R shoulder protracted

Ribs: R rib 1 inhaled, R ribs 2-10 inhaled, R ribs 11-12 exhaled

Abdomen: L hemidiaphragm inhaled, R hemidiaphragm exhaled with R crus tension

Table 1. Significant OSE throughout hospital course

	HD#1	HD#2	HD#3
Significant OSE Findings	See Above	T1FSR _R and T2-4FSR _L with associated warmth & bogginess	Resolution of cranial, cervical and thoracic dysfunction

Treatment Course

The patient received daily OMT for 3 days and was discharged the afternoon of day 3 with intact vision bilaterally. Treatment was based on the principles of balanced membranous tension (BMT), balanced ligamentous tension (BLT) and myofascial release (MFR). Goals of treatment were to reduce traumatic strains and somatic dysfunction severity, promote drainage of the eye and head, and palliate pain.

Table 2. Evolution of eye exam findings during hospital course

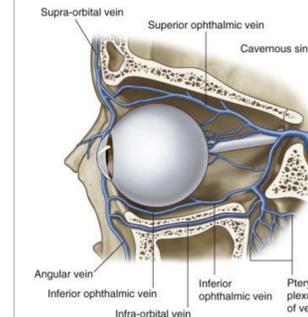
	OD: Right OS: Left OU: Bilateral	HD#0, before OMT		HD#1, 4 hrs after OMT		HD#2, 4 hrs after OMT		HD#3, 2 hrs after OMT	
		OD	OS	OD	OS	OD	OS	OD	OS
Subjective		10/10 Pain, +Swelling, +Light perception	10/10 Pain, +Swelling, No light perception	4/10 Pain, +Blurry vision	6/10 Pain, +Swelling, No light perception	Normal Vision	+Light perception	Normal Vision OU	
Eye Exam	Periorbital Edema	2+	4+++	1+	3+	1+	1.5+	trace	1+
	Extra-ocular Motions	Restricted OU		Restricted OU		Intact	Restricted	Intact OU	
	Lid Motion	Restricted OU		Restricted OU		Intact	Upper Lid Mobility	Intact OU	
	Pupil	2-3mm	Nonreactive +RAPD*	1-2mm	2mm fixed	1-2mm	1.5-2mm fixed	1-2mm	1.5-2mm reactive
	Visual Acuity	20/70	<20/200	20/40	20/150	20/30	20/50	20/40	20/40

*RAPD: relative afferent pupillary defect.

Discussion

As William G. Sutherland, DO astutely noted, the eye is a very vascular organ⁵. While arterial supply is generally adequate, "restriction of the flow of venous blood, from that vascular organ, the eyeball, could result from a little blow⁵." Somatic dysfunction impedes orbital drainage in two important ways.

1. Inherent motion of the cranial bones is crucial for proper venous drainage from the cranium.



- Venous sinuses are inelastic, lack smooth muscle, and do not benefit from typical "peripheral pumps" that move venous blood throughout the body.
- 7 bones form the orbit—a design for motion crucial to drainage of orbital veins. "Look into the cone-shaped [orbit] and see two outstanding fissures—the superior and inferior orbital fissures—and ask if there is not evidence of the provision for mechanical changes resulting from motion⁵."
- Sphenoid and temporal bone motion is necessary for venous flow through the cavernous and petrosal sinuses to their exit at the jugular foramen.
- This patient had significantly reduced inherent motion in all these areas, indicating reduced effectiveness of this critical venous pump.

Image 1. Lateral view of ophthalmic veins of eye. Reprinted from Gray's Anatomy for Students, 3rd ed.



2. Somatic dysfunction may obstruct venous drainage from the orbit at vulnerable points along its course. As "in the case of glaucoma, one may reason that the accumulation of fluid points to a condition somewhere back along the intracranial membranous wall of the cavernous sinus, or in the walls of the petrosal sinus, to a membranous restriction affecting the venous return, and back of that, the possibility of a cranial lesion as an etiological factor⁵."

Image 2. Superior view of cavernous sinus and petrosal sinuses and their relationship to the dura mater. Red arrow: Superior petrosal sinus; Orange: Inferior petrosal sinus; Green: Cavernous sinus. Reprinted from Pernkopf Atlas of Topographical and Applied Human Anatomy: Volume 1: Head and Neck.

Table 3. Areas of orbital venous obstruction

Venous Course	Anatomic Relationship	Patient's Somatic Dysfunction
Ophthalmic veins → Cavernous sinus	Exits through superior orbital fissure, a narrow space between greater and lesser wings of sphenoid	Sphenoid intraosseous strain crowds this opening, increasing local tension and reducing drainage
Cavernous sinus → Superior & inferior petrosal sinus → Internal jugular vein	Tentorium cerebelli forms walls of the cavernous sinus and superior petrosal sinus	Dural strain impacts drainage from cavernous and petrosal sinuses
	Inferior petrosal vein runs in the petrosal articulation	Internally rotated temporal bone crowds the petrosal articulation. Strain at petrosal tip reduces drainage of cavernous sinus into petrosal sinuses
Internal jugular vein → Heart	Exits cranium through jugular foramen, formed by articulation of temporal and occipital bones	Occiput and temporal bone dysfunction obstructs drainage at jugular foramen
	Internal jugular vein courses under the SCM, behind the clavicle, through the thoracic inlet	Rib 1, clavicle, and SCM dysfunction impacts thoracic inlet. Supraclavicular bogginess is evidence of obstruction

Improvement in somatic dysfunctions correlated with bilateral return of extra-ocular and eyelid motion, return of pupil reactivity, return of visual acuity, and improvement in associated periorbital soft tissue edema.

While this case report enabled an in-depth study of orbital drainage, conclusions of causation are limited due to sample size and documented variability in the natural progression of AOCS. However, we feel the impressive response and recovery in this case warrants further study to corroborate OSE findings in patients with AOCS and to determine correlation between OMT and patient outcomes.

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