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· 综述 ·

鼻眶筛并发颧骨骨折伴发症解剖研究现状

马莉[1,2],高瞻[1,2],李鹏起[2],倪前伟[2]
1. 石河子大学 医学院, 新疆 石河子 832099
2. 新疆军区总医院 颌面外科, 新疆 乌鲁木齐 830099

摘要:鼻眶筛(naso-orbito-ethmoid, NOE)位于面中部多块骨的交汇处,结构复杂,其单独骨折的概率很低,常并发面部其他骨折,其中最常并发颧骨骨折。NOE 并发颧骨骨折的病因多为高能量的钝性损伤,故常伴随多种面部其他损伤,由于 NOE 区及颧骨均邻近眼眶,故 NOE 并发颧骨骨折时可出现大量眼部伴发症,轻度伴发症的发病率较高,严重伴发症的发病率低。以 NOE 区骨折为主的并发骨折的伴发症以内眦间距过宽等靠近内侧的组织损伤为主,以颧骨骨折为主的并发骨折的伴发症以眼球运动受限等靠近外侧的组织损伤为主,NOE 区及颧骨骨折均较严重的并发骨折多伴发失明、颅脑损伤等严重伴发症。NOE 并发颧骨骨折的主要机制是能量从撞击点沿着面中部的垂直和水平支柱向面中部支柱向周围传播,能量随着传播距离的增加逐渐衰减,在能量传播过程中,鼻窦可通过变形和骨折吸收部分能量从而对颅脑和眼球有一定的保护作用。

关键词:鼻眶筛骨折;颧骨骨折;解剖;并发症;机制
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Current status of anatomical research on nasal orbital ethmoid and concurrent zygomatic bone fracture complications

MA Li[1,2], GAO Zhan[1,2], LI Pengqi[2], NI Qianwei[2]
1. Shihezi University School of Medicine, Shihezi 832099, Xinjiang, China
2. Department of Oral and Maxillofacial Surgery, General Hospital of Xinjiang Military Command, Wulumuqi 830099, Xinjiang, China

Abstract: The naso-orbito-ethmoid (NOE) is located at the intersection of multiple bones in the middle of the face. Its structure is complex and the probability of its fracture alone is very low. It often co-occurs with other facial fractures, most commonly zygomatic bone fractures. The cause of NOE concurrent with zygomatic bone fractures is often high-energy blunt trauma, so it often accompany various other facial injuries. Since the NOE area and the zygomatic bone are adjacent to the orbit, a large number of ocular complications can occur when NOE co-occurs with zygomatic bone fractures. The incidence of mild complications is relatively high, while the incidence of severe complications is low. The complications of concurrent fractures that involve mainly the NOE area are mainly tissue injuries close to the medial side, such as an excessive medial canthal distance. The complications of concurrent fractures mainly involving zygomatic bone are mainly tissue injuries close to the lateral side, such as limited eye movement. Concurrent fractures in both the NOE area and the zygomatic bone are often accompanied by serious complications such as blindness and cranial injury. The main mechanism of NOE concurrent with zygomatic bone fractures is that the energy from the impact point spreads along the vertical and horizontal pillars of the middle part of the face to the surrounding areas of the middle pillar, and the energy gradually attenuates with increasing propagation distance. During the energy propagation process, the sinuses can absorb some energy through deformation and fracture, thus providing a certain protective effect on the skull and eyeball.

Key words: Naso-orbito-ethmoid fracture; Zygomatic bone fracture; Anatomy; Complications; Mechanism

鼻眶筛(naso-orbito-ethmoid, NOE)骨折并发颧骨骨折(下文用“并发骨折”代替“NOE 骨折并发颧骨骨折”)发病率约为面中部骨折的 30%[1],易发生多种严重伴发症[2],还可出现心理健康问题,严

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通信作者:高瞻。E-mail:gaozhan1970@163.com

重影响患者的生活质量[3]。本文将从解剖结构来分析并发骨折的伴发症的研究现状及并发骨折的发病机制,以期对临床中易发生、易忽略的并发骨折的伴发症早期关注、早诊早治,还可了解并发骨折的机制研究现状,从而为面中部创伤防护提供思路。

1 解剖结构

1.1 基本结构

NOE 复合体是由鼻骨、额骨鼻突、上颌骨额突、筛骨、泪骨和蝶骨组成的面中部复杂复合体[4],其以筛状板为上界,内侧眶壁为外侧界,鼻腔为下界,蝶窦为后界[5]。内眦韧带(medial canthal tendon,MCT)是 NOE 复合体主要结构之一,由眼轮匝肌的肌纤维和来自颧骨区域的肌腱组成,分为前后两肢[6]。MCT 在维持睑裂的形状和位置方面起着重要作用[5]。颧骨包括一个主体和 4 个骨突延伸,由颧骨体与颧骨额突、颧骨蝶突、颧骨颞突和颧骨上颌突构成,是重要功能单元的交汇处[7]。颧骨参与形成眶外侧壁和眶下壁,咬肌是附于颧骨上的重要肌肉[8]。

结构支撑:面中部依靠水平和垂直的支柱结构维持面部的形态和功能。垂直支柱是面中部的主要支柱,包括鼻上颌、颧上颌和翼上颌,水平支柱辅助垂直支柱,包括额骨、上颌骨和颧骨[9]。Varghese 等[10]的研究发现,对面部组织施加一定的力时,应力沿着垂直和水平支柱传播,且垂直支柱比水平支柱能承受更大的应力。

1.2 鼻窦对颅脑的防护作用

Pajic 等[11]发现在头面部外伤中,鼻旁窦通过自身变形和骨折分散能量从而对颅脑、眼球具有重要保护作用,且鼻窦发育越充分,对颅脑的保护作用越强。但是 Celiker 等[12]的研究发现,额窦体积越大,对额叶脑组织的保护作用越弱。可以确定,鼻窦对颅脑和眼球有一定的保护作用。出现上述相反观点是因为随着鼻窦体积的逐渐增大,鼻窦对颅脑的防护作用呈现先增强后减弱的趋势。随着鼻窦的发育,变形和骨折吸收的能量越多,对颅脑和眼球的保护作用逐渐提升;当达到一定程度时,随着鼻窦体积的增加,骨质相对变少,吸收的能量也相对变少,从而对颅脑和眼球的保护作用逐渐减弱。

2 并发症

2.1 NOE 骨折并发症

NOE 骨折常伴发一些继发性损伤。NOE 骨折引起的鼻骨骨折出现鼻尖上翘,鼻背凹陷及其引起的鞍状鼻[13]等表现;NOE 骨折引起的鼻软骨骨折破坏软骨膜,引起鼻中隔血肿,可出现软骨膜脓肿形成、鼻中隔软骨坏死[14];鼻泪管损伤是 NOE 骨折的常见并发症,溢泪是鼻泪管损伤最常见的表现[15];NOE 骨折还可通过引起鼻泪管和泪囊损伤继发泪囊炎甚至慢性脑膜炎[16],NOE 骨折引发鼻泪管阻塞可继发黏液囊肿,囊肿感染后可演变为黏膜膨出[3]。NOE 骨折引起的筛骨(眶板)骨折可出现眶周瘀斑、眼眶血肿、球后血肿,严重时可因损伤视神经而出现失明[17-18],筛骨板骨折容易引起底层硬脑膜撕裂,使脑脊液漏到鼻旁窦和鼻腔,从而继发脑炎、脑膜炎[19-20];筛状板移位时可损伤嗅神经从而导致嗅觉丧失[5];NOE 区的重要结构 MCT 断裂时可出现内眦间距变宽、睑裂变小等面部畸形[21-23];NOE 骨折时造成眶缘骨折卡压下直肌,进而出现眼肌麻痹、眼睑下垂等眼运动障碍[24];NOE 区骨折引起的眶周骨折可挤压眶内容物,出现角膜擦伤、前房积血、视网膜脱落和眼球破裂等眼部损伤[5];NOE 骨折若伴发颅底骨折,可出现颅内出血、脑脊液漏等重大创伤,严重影响患者预后,早期诊断 NOE 骨折是否伴有颅底骨折对患者早期治疗、改善生活质量息息相关。Simon 等[25]认为出现眶周淤血高度预测颅底骨折,因为颅底骨折时常伴有眶周瘀血的表现,但眶周骨折等其他损伤也可出现眶周淤血[26-27],眶周淤血并不是颅底骨折的特有表现,故出现眶周淤血可高度怀疑颅底骨折。NOE 骨折最常见的颅脑损伤是颅腔积气,其次是弥漫性轴索损伤。还可有硬膜外出血、硬膜下出血等[28]。NOE 骨折还可出现眼球突出、复视、骨组织感染等伴发症[29]。

2.2 颧骨骨折并发症

由于颧骨与颞骨、眼眶、蝶骨等相邻,颧骨骨折时常伴发周围组织损伤。颧骨可因咬肌的作用向外移位导致眼眶体积增加,眼眶体积增加可出现眼球内陷,若颧骨向内侧移位时则出现眼球突出[30]。当颧骨向内侧移位时,很可能累及眶尖,可出现眶上裂综合征[31]。若骨折线累及眶下孔,可导致眶下神经区感觉异常,其发生率从 10%~65%不等[32]。如果侵及下颌骨冠突,则可出现牙关紧闭[33]。颧骨骨折也可因骨折端压迫颞肌而继发三叉神经痛[34]。颧弓极易损伤,因其紧邻面神经,其损伤后可出现面神经麻痹[35]。约一半的颧骨骨折患者有阻塞性睡眠呼吸暂停[36],我们猜测出现此现象的原因为中面骨折容易影响气道的通畅性,目前尚未找到论文支持我们的猜测。颧骨骨折还可出现结膜下出血、前房积血、视网膜出血、球后出血、创伤性瞳孔散大等眼部损伤表现[37]。颧骨骨折引起的球后出血是最严

重的并发症之一,可导致失明,少于 5%的患者可能出现失明[38],引起失明最常见的面部骨折是颧骨骨折[39]。此外,颧骨骨折还可伴发中枢神经系统疾病、颅骨损伤、癫痫、听力障碍和创伤后应激障碍等并发症并可长期存在[40]。

2.3　NOE 并发颧骨骨折并发症

NOE 区和颧骨邻近眼部,故并发骨折常出现一些眼科并发症。轻度并发症包括眶周水肿、眼睑撕裂、眶周瘀斑和结膜下出血。中度并发症包括眼球突出、眼球运动受限、复视、远视、远眦、轻度视力丧失和瞳孔散大。严重并发症包括水肿、前房积血、晶状体穿孔、角膜擦伤、视网膜脱落、球后出血、创伤性视神经病变和失明[41]。当累及眶尖时,视神经可能受损,导致单侧失明。当眶上裂受累,可出现眶上裂综合征[24]。当额凹陷、蝶筛凹陷或口鼻口复合体受累,可阻塞鼻窦引流[20]。最常见的轻微并发症是复视,其次是蜂窝织炎。最常见的畸形是眼内陷。常见的术后畸形包括眼眶增大、眼球内陷等[42]。还有一些并发症相对少见,如鼻道梗阻、眼内陷、鼻泪管梗阻、眼球突出和外伤性远眦。漏诊可能导致修复不充分,导致各种后遗症,如鼻塞、眼球内陷、鼻气道阻塞和畸形,甚至失明[1]。

研究表明,并发骨折的并发症发生率远高于颧骨骨折[2,42]。颧骨、NOE、颧骨并发 NOE 骨折均可出现眼科并发症。三者均是轻度并发症较多,结膜下出血最常见,眼睑撕裂伤最少见;NOE 骨折的眶周水肿发病明显高于颧骨骨折;中度并发症中 NOE 骨折多见内眦间距过宽、眼球突出、眼球内陷、轻度视力丧失,最常见的是内眦间距过宽;颧骨骨折则以眼球运动受限为主,重度并发症均少见,三者均以角膜擦伤多见[41]。

3　发病机制

3.1　临床发病率

NOE 骨折常与颧骨复合体、上颌骨和眼眶壁等部位的骨折同时存在[2,43],在诊疗过程中极易被忽略。NOE 骨折最常合并颧骨骨折。Nissen 等[1]在一项回顾性研究中发现 NOE 骨折并发颧骨骨折概率约 30%。Buchanan 等[42]同样在一项回顾性研究中发现颧骨骨折的患者中合并 NOE 骨折的概率为 30%。但是,也有研究表明,颧骨骨折并发 NOE 骨折的概率约为 10%[44]。研究结果的不同与样本量大小、研究对象不同、诊断技术的发展及致伤机制的差异有关。Nissen 等[1]研究样本量较大,研究结果相对更准确;此外,研究结果还与患者的致伤原因有关,并发骨折常由钝器伤所致,钝器伤患者占比较多的医院则更容易出现并发骨折;同时,技术的发展对诊断的概率有较大影响,随着技术的进展,对骨折诊断的精确性更高,从而减少漏诊率和误诊率,得出更准确的并发骨折的概率。

3.2　力的传导机制

NOE 并发颧骨骨折的主要机制是能量的吸收和传播。NOE 并发颧骨骨折通常由高能量的钝性损伤引起,高速撞击面中部大多位置时,能量先集中在撞击部位,撞击部位骨折前可吸收部分能量,剩余能量沿着周围骨组织辐射状传播,随着传播距离的增加,能量逐渐衰减;同一撞击部位,撞击速度越大,颅颌面接收到的能量值越高,骨折越严重,能量传播的越远。颧骨是面中部前外侧最突出的骨骼,且对面中部组织有支撑作用,在高速撞击下,其在骨折之前能吸收一定量的能量[45]。如果撞击的能量值超过引起颧骨所能吸收的最大能量值,能量则会分散到邻近的骨骼上,引起眶下缘、上颌骨外侧、颧蝶骨缝线和颧弓的骨折。剩余的能量会造成进一步的创伤。最常见的是剩余能量向内侧延伸至上颌骨额突,从而向鼻骨和眶内壁传播,鼻骨再传向深处的筛窦,从而导致同侧 NOE 骨折[42,46];若是鼻骨受到高能量撞击,先出现鼻骨骨折,剩余能量迅速通过上颌骨额突传导至眼眶底部、颧骨,引起颧骨骨折,此外,能量还可通过鼻中隔软骨传导至筛骨垂直板、直至整个筛骨,引起 NOE 骨折[47]。眼眶骨折最常合并颧骨骨折,其次是 NOE 骨折[48],故两者骨折均常合并眼部并发症,而颧骨复合体构成了眼眶的外侧壁和眼眶底壁,眼眶外侧壁损伤时容易侵犯到下颌骨,下颌骨冠突损伤时容易出现牙关紧闭;眼眶底壁骨折时由于骨的回弹速度快于眼内软组织,故容易发生内直肌或下直肌的卡压,故颧骨骨折容易伴发眼球运动受限[5];NOE 复合体构成了眼眶内侧壁,与 MCT 邻近,故常伴发内眦间距过宽。

4　小结与展望

并发骨折的发病率较高,约为面中部骨折的 30%,该区域结构复杂,产生的并发症多且严重,严重影响患者的生活质量,并发骨折的主要力学机制是能量沿着面部力学支柱的吸收和传播。且各文献对于各个并发症的发病率没有统一的意见。可通过机制研究发现该区域所能承受的最大的能量值,从而进行特定部位的创伤防护;研究并发骨折的生物力学机制可发现面中部的薄弱点及容易损伤的结构,从而对面中部的薄弱点进行特定部位的创伤防

护,对容易损伤的结构进行早期关注,从而达到及早诊治、防止进一步的发展。人工智能的发展为伴发症的早期诊断提供了新的思路,可利用人工智能对面部组织进行三维重建,进而确定面部组织的损伤情况,从而早诊治,防治并发症进一步进展;但目前仍存在人们对人工智能的接受程度不高,临床医生对人工智能的基本原理认识有所缺乏,人工智能的技术仍不是很成熟等问题[49-50];对于并发骨折的机制,目前最常用有限元分析法进行研究,有限元分析法通过数值模拟技术建立人体有限元创伤模型,可反复模拟面部不同创伤情况,但有限元模型与人体真实数据仍存在一定差距,且单一有限元模型不能代表整体人群数据情况。以后的研究可致力于创建更接近真实更具有代表性的人体三维模型,从而对创伤所致的面中部骨折生物力学机制及伴发组织损伤进行更深入的了解,为面中部骨创伤防护及早诊早治提供理论依据。

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