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·综述·

眼眶减压术后新发复视的研究进展

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[摘　要] 甲状腺相关眼病(thyroid-associated ophthalmopathy,TAO)，又称Graves眼病，是与甲状腺疾病密切相关的一种器官特异性自身免疫性疾病。眼球突出是TAO的主要临床表现之一，也是临床上多数患者就诊的原因。眼球突出一方面会影响美观，另一方面可因眼睑闭合不全导致暴露性角膜炎或因眼眶压力增大导致压迫性视神经病变。眼眶减压术用于重度TAO已有过百年历史，从最早经外眦皮肤切开的传统外部切口入路进行骨性眼眶减压及脂肪减压到内镜下经鼻入路眼眶减压术，其安全性和有效性均已得到肯定。术后复视是眼眶减压术常见的并发症。近年来，随着眼眶减压术的发展，其越来越多地用于美容目的以矫正眼球突出。然而术后的新发复视仍然是困扰众多相关眼科医疗工作者的难题。近年来，多项研究对术后新发复视的相关因素进行了探讨，并由此对眼眶减压术进行改良，在对术后新发复视的减少方面取得不同程度的进展。该文对眼眶减压术后新发复视的研究进展进行综述，旨在促进专科医生更精准地开展TAO的手术，进而提高手术患者术后的生活质量及手术满意度。

[关键词] 甲状腺相关眼病；眼眶减压术；复视

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Research progress on new diplopia after orbital decompression

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电子全文

Abstract Thyroid-associated ophthalmopathy (TAO), known as Graves'orbitopathy, is an organ specific autoimmune disease closely related to thyroid diseases. Exophthalmos is one of the main clinical manifestations of thyroid related ophthalmopathy and is also the reason for most patients seeking medical attention in clinical practice.Eyeball protrusion can affect aesthetics on the one hand, and on the other hand, it can lead to exposed keratitis due to incomplete closure of the eyelids or compressive optic neuropathy due to increased orbital pressure.Orbital decompression has been used to treat severe TAO that threatens vision for over 100 years, and its safety and effectiveness have been confirmed.However, postoperative new diplopia remains a challenge for many ophthalmic medical workers.In recent years, many studies have explored the relevant factors of postoperative new diplopia, and improved the surgery, achieving varying degrees of progress in reducing postoperative new diplopia.This article reviews the research progress of new diplopia after orbital decompression, aiming to promote more accurate surgery for thyroid related eye diseases by specialized doctors.

Keywords thyroid-associated ophthalmopathy; TAO; orbital decompression; diplopia

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甲状腺相关眼病(thyroid-associated ophthalmopathy, TAO)，是一种与甲状腺疾病尤其是自身免疫性甲状腺疾病密切相关的器官特异性自身免疫性疾病，位居成人眼眶疾病发病率首位[1]。TAO患者典型的眼部症状包括眼睑退缩、眼球突出、眶周水肿、斜视、复视等，严重者可能因眼睑闭合不全出现暴露性角膜炎和(或)因眼眶压力的增大而导致压迫性视神经病变，二者都具有致盲性。其中眼球突出多表现于双眼，是临床上多数患者就诊的原因。眼眶减压术用于治疗重度TAO已有过百年历史。从最早Dollinger报道的从外眦皮肤切开的传统外部切口入路进行骨性眼眶减压及脂肪减压，到1990年Kennedy首创内镜下经鼻入路眼眶减压术，眼眶减压术在不断地发展和完善。近年来，仅用于减少眼球突出度的美容性眼眶减压术的占比越来越高，且在不同的随访报道中显示其治疗TAO患者眼球突出的安全性及有效性[2-7]。眼眶减压术是通过去除眼眶骨壁和(或)减少眶内脂肪从而矫正失衡的骨性眼眶容积-眼眶软组织体积关系的方式治疗TAO性眼球突出。其去除不同的眶壁及不同数目的眶壁对眼球突出具有不同的贡献：据回顾性研究，仅外侧壁、内壁、下-内壁、外-内壁、三壁减压可使眼球突出回缩分别为：2~3 mm、2~4 mm、4~6 mm、4~5 mm及8 mm，四壁减压甚至可以实现12~14 mm的回缩[8-9]。在Cheng等[3]的报道中，平均切除眼眶脂肪体积 4.4 mL，眼球突出度减少 4.1 mm。(见表 1)脂肪减压常与骨性减压联合以取得更好的治疗效果[5,10]，外-内壁减压联合脂肪减压可以达到三壁减压的眼球回缩效果[11]。术后复视是眼眶减压术常见的并发症，在各报道中，眼眶减压术后出现的新发复视率可达38%(脂肪减压术)、51%(骨性减压术)左右[12]。眼眶减压术后新发复视的产生与眼眶结构和功能的改变以及减压的术式有关，现将近年相关研究进展综述报道如下。

1 眶减压术后与新发复视有关的眼眶结构和功能变化

1.1 眼球丧失前内侧骨膜和眶骨的支撑

骨性眼眶下内侧的Strut结构，又称筛-上颌骨支撑结构。其前部由厚的上颌骨组成，可为眼眶下缘提供

表1 不同类型眼眶减压术后眼球回缩量

Table 1 The amount of eyeball retraction after different types of orbital decompression surgery

眶减压类型		眼球回退量 /mm
骨性减压	外侧壁	2~3
	内壁	2~4
	下-内壁	4~6
	外 - 内壁	4~5
	下 - 内 - 外壁	8
	四壁	12~14
脂肪减压		每切除 4.4 mL 脂肪，眼球回缩 4.1 mm

支撑，中部由筛骨和眶底薄的上颌骨交界处形成，后方由筛窦和腭骨的眶突交界处形成。前部Strut结构不仅为眼球提供了重要的骨性支撑，还为支持眼球的前部眶周韧带提供了骨性附着点[13]。眼眶减压术中有意或无意去除Strut结构可导致严重的垂直复视和日落综合征[14]。

1.2 Pulley结构改变

眼外肌Pulley是由胶原纤维、弹性纤维和平滑肌形成并包绕在眼外肌周围的环状结构，其主要功能是改变眼外肌肌力的作用方向[15]。Pulley结构与眼眶壁相连，直肌从Zinn环起始向前穿过Pulley后附着于巩膜。其作为眼外肌的功能性起点，在眼球运动时与眼眶位置通常固定，在维持空间关系、限制偏移和抵抗位移上起到至关重要的作用，从而使眼球在运动期间位置协调[16]。Pulley结构不稳定与眼球转动时明显增加的眼球移位有关，其异常与许多类型斜视的发生相关[17]。有研究指出，球后脂肪能起到旋转眼的轴承作用，使眼直肌腹保持在适当的位置，而这种脂肪由结缔组织片包裹[18]。目前缺乏眼眶减压术后Pulley结构改变的研究报道。

1.3 肿胀的眼外肌与收缩力的变化

眼眶减压术会加重已纤维化眼外肌的收缩力，使眼球转位加重[19]。有研究者发现，术后内斜视的患者会出现内直肌增厚而非移位，并且收缩力有所增加[20]。通过电子计算机断层扫描(computed tomography, CT)对眼外肌的测量，发现眼眶减压术后早期，眼外肌体积有一定的增加，而术后20周时眼外肌体积缩小[21]。Hu等[22]的研究发现，眼眶减压术后内直肌体积比术前增加了27%，外直肌、上直肌/上睑提肌复合体、下直肌和上斜肌在术后则未见明显的体积增加。Gupta等[23]发现，平衡减压术(深外壁联合内壁减压)后，外直肌的宽度比内直肌的宽度增加得更多。关于术后眼外肌体积增大的原因，许多学者有不同的看法，如术后炎症反应致使的眼外肌增厚、眼眶压力突然改变导致肌肉在高渗状态下扩张、静脉充血以及术前相对处于拉伸状态的肌腹在术后得到放松等[23-26]。

1.4 眼外肌的移位

减压手术后，眼外肌移位到相邻的鼻窦会导致或加剧肌肉的失衡。去除内壁后，内直肌可在眶尖附近以锐角进入筛窦[27]，这种肌肉路径的离心位移可使肌力增加从而导致术后复视。内直肌向筛窦位移的程度与外展范围呈负相关，与水平复视的严重程度直接相关[28]。术后水平复视常归因于内直肌的异常，下壁减压术后下直肌脱垂到上颌窦可导致垂直凝视受限[28]。

1.5 TAO术后再激活

TAO的发病机制尚未完全明确，免疫、遗传、环境等因素均可能与其有关。研究表明，细胞免疫反应可产生不同细胞因子，同时辅助活化体液免疫反应，体液免疫反应产生的自身抗体攻击免疫眼眶成纤维细胞。眼眶成纤维细胞可分泌炎症细胞因子和透明质酸等，导致眶脂肪体积的增大及眼外肌的肥大。在体液免疫方面，自身抗原促甲状腺激素受体(thyroid stimulating hormone receptor,TSHR)及胰岛素样生长因子-1受体(insulin-like growth factor-1 receptor,IGF-1R)均可通过介导相关的信号转导通路使透明质酸大量分泌。环境中的危险因素，如吸烟、甲状腺功能异常、硒元素的缺乏、较高的压力或应激水平可增强细胞免疫效应或激活眼眶成纤维细胞从而导致TAO[30-34]。TAO的经典病程是持续6~24个月的活跃炎症期，随后则是慢性纤维化阶段，但也有TAO在一段时期的静止后重新激活[35]。Baldeschi等[36]报告的康复性骨眼眶减压术后TAO重新激活现象的发生率为1.3%(3/239)，Woo等[37]报告了7.6%(7/92)患者在骨性减压联合脂肪减压术约36周后发生TAO的重新激活，该报道指出吸烟及术前限制性肌病的程度或与TAO的再激活有关。

1.6 术后粘连与瘢痕形成

眼眶减压术后眼外肌周围的粘连和瘢痕的形成、眼外肌以外的眶内组织粘连也可能是术后新发复视的原因之一[20,38-41]，患者通常需要在减压术后的第一天进行眼球运动以防止这种情况的发生[42]。Golan等[43]的研究中，尽管术后没有在高分辨率磁共振成像(magnetic resonance imaging,MRI)上找到局灶性的瘢痕带，但随后的手术中却能在原来的手术区域找到瘢痕带。眼眶脂肪似乎在术后粘连中发挥着一定的作用，有研究者认为经睑入路可能会破坏更多的眼眶脂肪室从而引起眼外肌更多的粘连及纤维化[41]，而将保留的一些眶脂肪轻挤到脂肪去除完毕的部位则可以减少眼外肌与眶周之间的粘连及消除无效腔[44]。也有研究者认为沿内直肌保留骨膜瓣可以防止其在筛窦与骨骼裸露的表面黏附[45]。此外，术中对神经及软组织损伤也与眼眶减压术后新发复视有关[46-48]。

2 术后新发复视率较低的眼眶减压术式

目前，深外侧壁减压术及平衡减压术被认为是术后新发复视率较低的术式。

2.1 深外壁减压术

1911年Dollinger首次描述了去除外侧壁的眶减压，随后Goldberg等提出了对外侧壁的更进一步的减压，称为深外侧壁减压[49-50]。深外壁由蝶骨的大部分组成，此区域的减压包括泪腺窝、蝶骨门框和眶下裂盆。深外壁减压去除的骨性结构几乎位于肌锥的后方，外直肌在外侧壁减压后疝入骨缺损处所引起的肌锥移位也不如内直肌的移位大[51]。与内侧壁减压及平衡减压术相比，深外壁减压后的新发复视率更低[11,50, 52-54]。Baldeschie 等[49]报告，深外壁新发复视的发生率为13%，并能在4~6个月内自发消退。深外壁减压术后可能会出现眶周肌与颞肌附着导致的咀嚼时的振动视[55]，在颞肌内侧留下一层薄骨则可减轻这种症状[51]。由于进行性颞肌和皮下脂肪的萎缩，术后可能出现颞骨空洞，保留一定的眶缘可以减少其发生，同时也可以通过脂肪移植来纠正[56]。与手术相关的并发症还有颞部感觉的改变、脑脊液漏、持续性三叉神经过敏等[51-52]。

2.2 平衡减压术

平衡减压术是对眼眶内壁及外壁行骨性减压手术，于1989年由Leone等[57]首次报道。Shepard等[58]的研究表明，平衡减压可减少眼球移位及复视的发生概率。该手术方式是使用内镜或经肉眼方法实现内侧壁减压术，而外侧壁的入路则是在眶周皮肤皱纹处做一个大约1.5 cm的外眦切口，暴露眶外侧壁的眶缘后，使用电锯进行上下水平截骨术或保留眶缘，通过磨除眶外侧壁骨质以及去除蝶骨髓质间隙来进一步扩大眼眶体积[26, 59-60]。有学者从发际线入路使用内镜对眼眶进行外壁及内壁的减压手术，以尽可能地减少面部手术瘢痕[61]。平衡减压可使眼眶组织均衡地向左右释放，这可以避免因单壁减压或不对称眶壁切除引起的眼外肌运动不平衡及复视。平衡减压术后的新发复视率在0~53%[36, 62-66]，其中Shepard[58]等报道的美容性或暴露性角膜炎的患者没有出现新发复视，Baril等[63]报道TAO压迫性视神经病变的患者术后新发复视率为52.94%(18/34)。平衡减压的并发症除复视外还包含了眶内壁及眶外壁减压的一系列并发症，如蝶腭动脉分支受损所致的严重术后出血[41]、误伤硬脑膜所致的硬膜外血肿或脑脊液漏[67]、术后眶周肌与颞肌附着导致的与咀嚼相关的振动视[55]、术后太阳穴痛及“咔嗒”感等[68]。

3 降低眶减压术后新发复视率的措施

许多学者试图通过改良手术细节来降低眼眶减压术后的新发复视率(表2)。

表2 能减少新发复视发生率的手术方式或技巧及其新发复视率

Table 2 Surgical methods or techniques that can reduce the incidence of new diplopia and their incidence of new diplopia

减少新发复视发生率的手术方式或技巧	新发复视率 /%
深外壁减压术	13
平衡减压术	0~53
保留眼眶Strut结构	0~16
保留眶周带	0~11.8
保留前眶周部	0

3.1 保留眼眶Strut结构

保留上颌-筛窦交界处的骨支柱，即Strut结构，可以减少肌锥和眼眶结缔组织向上颌窦和筛窦移位[69-73]。此术式首先在1992年由Goldberg在经结膜入路的眶减压中提出，随后Wright等将其转化为内镜入路的技术[74-75]。保留这样一个1.5~2.0 cm的三角形支柱结构有一定的技术难度，手术常因为Strut结构的意外断裂而复杂化[69, 76]。Bleier等[70]提出内镜下保留Strut结构的可靠方法，报道中100%的病例可保留Strut结构。其手术方式为在上颌窦造口、蝶骨切开和完整的筛窦切除后，暴露眶底的下内侧支柱与眶下神经之间的骨性眶底，使用标准的额窦咬合器械扩大截骨边界。在内侧和下方完成截骨并保留下内侧的Strut结构。未保留Strut结构的传统下内侧眼眶减压后，4.5%的病例眼球和肌锥向内、向下移位[77]。在Paridaens等[78]和 Bailey 等[79]的研究中，经结膜下内壁减压联合外壁减压后新发复视率为1.8%~12.5%，他们都认为保留Strut结构使得复视率降低。一项回顾性研究表明，保留Strut结构的内镜眶减压术新发复视率为16%(1/6)，术后复视消退率为36%(4/11)[64]。据Wright等[69]研究，保留双侧Strut结构患者术后复视的发生率

为0(0/6)，尽管一些研究认为Strut结构的保留并不会影响减压的充分性，但仍有另一些研究表明保留Strut结构会造成术后眼球内陷不理想、眼睑闭合欠佳，尤其在眶内软组织广泛纤维化的患者中[48, 80-82]。

3.2 保留眶周带

行内壁骨性减压后内直肌可向筛窦移位，这会使眼外肌失衡进而导致复视[28, 83]。Metson和Samaha[29]提出沿内直肌保留前后骨膜作为吊带以稳定内直肌并防止其脱垂，脂肪仍可以在眶周带的上方和下方进入筛窦和上颌窦中，并且不会干扰内镜经鼻进入眶底，该研究中新发复视率为0。其手术方式为内镜经鼻入路完全暴露眶筋膜后在接近内直肌上下边缘的两个相隔约10 mm的水平切口上切开，切口起于蝶骨前表面延伸至上颌线。上、下切口分别平行于筛顶及眶底。从后向前切以防止突出的眶脂肪阻碍手术视野。保留眶周带的眼眶减压在多项研究中显示出较低的术后复视率(0~11.8%)[61, 84-85]。然而保留眶周带是否会限制眼球突出度的减少仍待讨论，Mainville等的研究表明保留眶周带会减少减压手术对减少眼球突出度的效益[77]。Jimenez-Chobillon等[84]对比Metson和Schaefer等的报道后认为保留眶周带并不会严重限制眼球突出度的减少。Vaidya等[86]的研究表明，在平衡减压术中沿内直肌保留骨膜瓣不会使术后双眼单视视野及偏斜角发生改变，眶周带的保留可能无法防止内直肌的移位，但与传统的纵向Ⅰ型骨膜瓣不同，上述研究中所制作的骨膜瓣为U形，其限制内直肌移位能力可能较低[45]。

3.3 保留前眶周部

眼眶结缔组织间隔在前部眼眶中分布最为广泛和复杂，连接眼外肌并将其连接到眼眶壁[17]。保留前眶周部可能有助于支撑眶内容物从而降低复视率。有研究将内壁减压骨窗的位置后移，发现比传统中前部骨窗减压更少的眼位偏斜程度[87]，靠后且面积小的骨窗可避免眼外肌的过度移位。去除的骨窗过前可使前内侧骨膜和眶骨的支撑丧失，这可能会导致眼球和肌肉锥体向内移动。Seiff等[88]研究中保留了眶前部10~15 mm，而未保留Strut结构，新发复视率为0(0/9)。

4 结语

术后新发复视是眼眶减压术后，尤其是美容性眶减压术后需要面对的头号难题。本文在总结引起术后新发复视相关因素的基础上提出了解决方法。首先，眼眶减压术应尽可能选择在静止期进行，并避免术后眼眶炎症再复发；其次，通过保留具有重要支持和限制作用的眶骨和筋膜来预防眼球和眼外肌向扩大的一侧眶腔过度移位和粘连；第三，尽量抽取肌锥内脂肪，适当保留前部眶周脂肪。对于眶减压术前已存在复视的患者，术后原有复视的进展本文未进行论述，但笔者认为可遵循以下手术方案设计原则来减轻：避免在肥大的眼外肌一侧进行骨壁减压，而选择在其对侧进行骨壁减压；对于两条以上眼外肌肥大者，选择平衡减压术或深外壁减压术。只有不断探索、进一步优化手术技巧才能预防新发复视，提高患者的术后生活质量。

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