

· 临床研究 ·

后外单侧入路椎体次全切融合钉棒固定治疗 胸腰椎爆裂性骨折

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【摘要】 目的: 探讨后外单侧入路椎体次全切融合钉棒固定与侧前方入路椎体次全切植骨融合钉板固定治疗胸腰椎爆裂性骨折的临床疗效。**方法:** 回顾性分析 2008 年 1 月至 2014 年 5 月行手术减压、融合、内固定的 36 例胸腰椎爆裂性骨折患者。后路组 16 例, 其中男 13 例, 女 3 例; 年龄 37~62 岁; 坠落伤 9 例, 车祸伤 3 例, 重物砸伤 4 例; 损伤节段: T₁₂ 2 例, L₁ 5 例, L₂ 7 例, L₃ 2 例; ASIA 分级: A 级 3 例, B 级 2 例, C 级 2 例, D 级 5 例, E 级 4 例; 伤后距手术时间 5~15 d。侧前方组 20 例, 其中男 15 例, 女 5 例; 年龄 27~62 岁; 坠落伤 12 例, 车祸伤 4 例, 重物砸伤 4 例; 损伤节段: T₁₂ 2 例, L₁ 7 例, L₂ 9 例, L₃ 2 例; ASIA 分级: A 级 4 例, B 级 2 例, C 级 4 例, D 级 6 例, E 级 4 例; 伤后距手术时间 4~12 d。观察两组的手术时间、术中出血量和术后引流量, 并对其神经功能 ASIA 等级变化、临床疗效、胸腰椎前凸角改善度数、骨性融合等进行比较。**结果:** 所有患者获到随访, 时间 12~24 个月, 平均 (15.8±3.3) 个月。后路组和侧前方组手术时间、术中出血量和术后引流量差异均无统计学意义 ($P>0.05$)。末次随访两组 ASIA 分级与术前比较差异有统计学意义 ($P<0.01$), 表明两组术后神经功能均获得不同程度的恢复。两组 JOA 评分末次随访与术前比较差异有统计学意义 ($P<0.01$), 表明两组均获得较好临床疗效。两组间 ASIA 分级结果、JOA 评分、RIS 临床疗效无差异。两组均获得融合。胸腰椎前凸角改善度数两组间比较差异无统计学意义, 两组相对术后较术前差异均有统计学意义, 表明两种入路均能有效恢复脊柱序列。**结论:** 对胸腰椎爆裂性骨折只需椎管前方减压和前中柱重建的病例, 可根据术者对术式的熟练程度及患者的病情来选择, 但对椎管前后均需减压、三柱重建而需前后联合入路的病例, 后外单侧入路椎体次全切融合钉棒固定明显缩短了手术时间, 减少了手术的创伤, 值得临床推广。

【关键词】 胸椎; 腰椎; 脊柱骨折; 脊柱融合术

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Clinical studies of pedicle screw-rod fixation of thoracolumbar burst fractures through posterior unilateral approach after vertebrae corpectomy fusion HUA Yong-jun, WANG Ren-yan*, GUO Zhi-hui, SHU Cun-hong, and LI Chao-hua. *The Orthopedics and Traumatology Hospital of TCM of Fuyang City, Fuyang 311400, Zhejiang, China

ABSTRACT Objective: To compare the clinical curative effect of thoracolumbar burst fracture treated by the posterior unilateral approach corpectomy fusion screw-rod fixation and anterior corpectomy bone fusion screw plate fixation. **Methods:** From January 2008 to May 2014, 36 cases of thoracolumbar burst fracture underwent operation of decompression, fusion, and internal fixation was retrospective analyzed. Among them, 16 patients were treated through posterior approach as posterior group, including 13 males and 3 females aged from 37 to 62 years old; 9 cases caused by falling injury, 3 cases by traffic accident injury, 4 cases by heavy aboved; the injury segment was on T₁₂ in 2 cases, L₁ in 5 cases, L₂ in 7 cases, L₃ in 2 cases; according ASIA grade, 3 cases were grade A, 2 cases were grade B, 2 cases were grade C, 5 cases were grade D, 4 cases were grade E; the time between injury and operation ranged from 5 to 15 days. Other 20 patients were treated through anterior-lateral approach as anterior-lateral group, including 15 males and 5 females with age from 27 to 62 years old; 12 cases caused by falling injury, 4 cases by traffic accident injury, 4 cases by heavy aboved; the injury segment was on T₁₂ in 2 cases, L₁ in 7 cases, L₂ in 9 cases, L₃ in 2 cases; for ASIA grade: 4 cases were grade A, 2 cases were grade B, 4 cases were grade C, 6 cases were grade D, 4 cases were grade E; the time between injury and operation ranged from 4 to 12 days. The operation time, bleeding during operation and postoperative drainage volume were observed in two groups, and the changes of nerve function of ASIA grade, clinical efficacy, improved degree of thoracic and lumbar lordosis, and bony fusion were compared between two groups.

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Results: All patients were followed up from 12 to 24 months with an average of (15.8±3.3) months. The operation time, bleeding during operation, and postoperative drainage volume had no significant different between two groups ($P>0.05$). As compared with preoperative, ASIA grade of two groups at last follow-up had statistically significantly different ($P<0.01$), the neural function of two groups after operation was recovered for different extent. The JOA score of two groups was compared between last follow-up and preoperative, the difference had statistically significant ($P<0.01$), the two groups showed good clinical effect. The clinical results of ASIA grade, JOA score and RIS had no significant differences between two groups. All patients of two groups were obtained fusion. Thoracic and lumbar lordosis angle improvement degree had no significant difference between two groups, it had significant difference had statistical significance compared with preoperative, the two approaches could effectively restore the spinal sequence. **Conclusion:** For patients with thoracolumbar burst fracture just treated by anterior decompression and reconstruction of anterior column, according to the degree of operation performer's skill proficiency and the patient's condition to choose, but for patients must performed the spinal canal decompression anterior and posterior, the three column reconstruction to required anterior-posterior approach, the posterior unilateral approach corpectomy fusion screw-rod fixation obviously shorten operation time, reduce the operation wound, it is worth the clinical promotion

KEYWORDS Thoracic vertebrae; Lumbar vertebrae; Spinal fractures; Spinal fusion

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胸腰椎爆裂性骨折累及前中柱或三柱损伤,其中约 20%患者还伴有不同程度的神经功能损害^[1],需手术治疗。因神经、脊髓压迫常来自椎管前方,且前中柱是脊柱稳定的基础,故常需解除椎管前方的压迫和前中柱的重建。笔者 2008 年 1 月至 2014 年 5 月采用后外单侧入路椎体次全切融合钉棒固定和侧前路减压融合钉板固定治疗胸腰椎爆裂性骨折 36 例,进行两组对照研究,报告如下。

1 资料和方法

1.1 纳入标准

Denis 分型^[2]为爆裂性伴或不伴有脊髓损伤的胸腰椎骨折,并有椎管前方占位 $\geq 50\%$;或脊柱后凸畸形 $>20\%$;或椎体高度丢失 $\geq 50\%$;或椎管内有翻转骨块预计无法间接复位者。尤其是伴有后柱损伤,包括椎板内陷性骨折、关节突关节骨折脱位、后部韧带复合体损伤、椎弓根骨折及相邻椎间盘损伤等。

1.2 排除标准

相邻多椎体爆裂性胸腰椎骨折者;严重心肺肝肾等功能障碍无法耐受手术者;精神疾病等无法良好配合治疗者;切口部位感染者。

1.3 一般资料

本组 36 例,胸腰椎 Denis 分型均为爆裂性骨

折,手术均由同一组医师完成。后路组 16 例,采用经后路椎体次全切植骨融合椎弓根钉内固定治疗,脊髓神经功能损伤情况按美国脊髓损伤协会(American Spinal Cord Injury Association, ASIA)脊髓神经功能障碍分级^[3]:A 级 3 例,B 级 2 例,C 级 2 例,D 级 5 例,E 级 4 例。侧前方组 20 例,采用侧前方入路椎体次全切植骨融合钉板内固定术,脊髓神经功能障碍 ASIA 分级^[3]:A 级 4 例,B 级 2 例,C 级 4 例,D 级 6 例,E 级 4 例。两组术前均行 X 线 CT 检查确定椎管内碎骨块的占位情况,部分病例行 MRI 检查,以更好了解后方韧带复合体损伤情况。两组患者术前年龄、性别、伤后手术时间、受伤原因及部位等经统计学处理,差异无统计学意义($P>0.05$),见表 1。

1.4 治疗方法

1.4.1 手术方法 后路组:全麻成功后患者俯卧位,腹部悬空。C 形臂 X 线定位后,骨折椎体为中心,取后正中线切口,固定侧采用肌间隙入路,减压侧剥离骶脊肌至关节突外缘,在伤椎上下椎弓根内植入 4 枚椎弓根钉。固定侧安装纵向连接杆并撑开伤椎固定。切除减压侧椎板及伤椎上下椎间隙对应上下关节突。切断伤椎横突,并将伤椎侧方软组织剥离直至椎体前方用霍夫曼拉钩牵开。切除椎弓根,注意保

表 1 两组爆裂性骨折患者的术前临床资料比较

Tab.1 Comparison of preoperative clinical data of patients with thoracolumbar burst fracture between two groups

组别	性别(例)		年龄($\bar{x}\pm s$,岁)	受伤原因(例)			损伤节段(例)				伤后手术时间($\bar{x}\pm s$,d)
	男	女		坠落	车祸	砸伤	T ₁₂	L ₁	L ₂	L ₃	
后路组	13	3	45.375±7.615	9	3	4	2	5	7	2	8.250±2.910
侧前方组	15	5	42.100±9.994	12	4	4	2	7	9	2	7.550±2.012
检验值			$t=1.082$			$\chi^2=0.128$				$\chi^2=0.140$	$t=0.852$
P 值	0.709		0.287	0.938			0.987				0.400

表 2 两组爆裂性骨折患者临床观察结果

Tab.2 Comparison of clinical observation results of patients thoracolumbar burst fracture between two groups

组别	例数	围手术观察($\bar{x}\pm s$)			疗效评定(例)			胸腰椎前凸角改善度数($\bar{x}\pm s, ^\circ$)	
		手术时间(min)	出血量(ml)	引流量(ml)	优	良	中	术前/术后 1 周	术后/末次随访
后路组	16	182.188±19.405	1700.625±533.522	175.938±120.613	12	1	3	16.688±6.322	0.375±0.500
侧前方组	20	173.500±21.831	1479.000±195.311	138.750±61.363	15	2	3	13.275±5.422	0.475±0.499
检验值	-	$t=1.246$	$t=1.579$	$t=1.201$	$Z=1.242$			$t=1.743$	$t=-0.597$
P 值	-	0.221	0.132	0.238	0.214			0.090	0.555

护椎弓根下方出口神经根,完整暴露椎体侧方。用骨刀、带齿髓核钳行伤椎椎体次全切减压,并用刮匙刮除上位椎体下、下位椎体上终板软骨。术中透视脊柱是否恢复正常序列,如已恢复,则测量上下椎体间高度并剪取相应钛网。再次在固定侧撑开伤椎使其过撑并固定。钛网用减压中获得的自体骨填塞,经脊髓外侧斜向置入上下椎体间,并调整位置。透视正位像钛网位于中轴线,侧位像位于椎体中后 2/3 处。固定侧松开连接杆使其自然加压固定,减压侧安装连接杆及横杆。固定侧伤椎及上下邻椎横突背侧去皮质,行横突间植骨。减压侧留置引流管 1 条,逐层关闭切口。对于伤椎下半部椎体完整及椎间盘未损伤者,只行伤椎上半部椎体及相邻椎间盘切除植骨。

侧前方组:采用传统侧前方 L₁-L₃ 行腹膜后、T₁₂ 行腹膜后胸膜外入路,椎体次全切减压、钛网植骨融合钉板固定,如伴有严重后柱损伤者行前后联合入路减压融合固定。

1.4.2 术后处理 术中、术后均用抗生素预防感染,术后中药活血化瘀、清热解毒之剂内服。术后 1 周内行胸腰椎 X 线摄片。术后第 2 天行下肢康复训练,10 d 后行飞燕式腰背肌功能锻炼,1 个月后进行胸腰段支具保护下离床活动或坐轮椅活动。

1.5 观察项目与方法

(1)围手术期记录手术时间、术中出血量和术后引流量。(2)临床观察术前、末次随访时神经功能 ASIA 等级。术前和末次随访(≥ 12 个月)最终临床疗效,采用腰痛疾患 JOA(日本矫形外科协会)评分法^[4]进行评价,同时根据 JOA 评分好转率(rate of the improved JOA score, RIS)判定疗效[RIS=(术后评分-术前评分)/(29-术前评分) $\times 100\%$]; $>75\%$ 为优,50%~74%为良,25%~49%为中, $<25\%$ 为差。(3)影像学 X 线侧位片测量术前与随访伤椎矢状位 Cobb 角改善度。骨性融合判断,术后 6 个月以上随访时根据有无进行性后凸、内固定松动、钉-骨界面及钛网-骨界面有无透亮线等指标综合判定。

1.6 统计学处理

采用 SPSS 17.0 统计软件对两组资料进行统计

学分析,计数资料用卡方检验,配对计量资料采用 t 检验,等级资料采用秩和检验,以 $P<0.05$ 为差异有统计学意义。

2 结果

36 例均获得随访,时间 12~24 个月,平均(15.8±3.3)个月。两组术后切口均 I 期愈合,未见神经症状加重。侧前方行腹膜后胸膜外入路 1 例术后发现医源性损伤胸膜引发血气胸,行胸腔闭式引流而愈。术中后路组发现 3 例骨折片刺破腹侧硬膜脑脊液漏,无法直接修补,术中用明胶海绵填塞后尽量严密缝合肌肉和筋膜,术后头低脚高,24 h 后拔出引流。

2.1 围手术观察项目

围手术观察结果见表 2。两组手术时间、术中出血量和术后引流量差异均无统计学意义($P>0.05$)。

表 3 两组爆裂性骨折患者脊髓损伤 ASIA 分级(例)

Tab.3 Comparison of ASIA grade for spinal cord injury of patients thoracolumbar burst fracture between two groups

组别	例数	脊髓损伤 ASIA 分级				
		A 级	B 级	C 级	D 级	E 级
后路组	术前	3	2	2	5	4
	末次随访	3	0	1	2	10
侧前路组	术前	4	2	4	6	4
	末次随访	4	1	0	2	13

注:ASIA 分级两组间比较:术前 $Z=0.971, P=0.331$; 末次随访 $Z=1.052, P=0.293$ 。同组内术前后比较:后路组 $Z=2.327, P=0.020$;侧前方组 $Z=3.025, P=0.002$

Note: ASIA grading were compared between two groups: preoperative $Z=0.971, P=0.331$; the last follow-up $Z=1.052 P=0.293$; comparison of preoperative and postoperative within same group: in posterior group, $Z=2.327, P=0.020$; in anterolateral group, $Z=3.025, P=0.002$

2.2 两组影像学及临床疗效观察结果

两组影像学观察结果见表 2,36 例均获得融合。胸腰椎前凸角改善度数两组间比较差异无统计学意义($P>0.05$)。两组术后较术前差异均有统计学意义($P<0.01$),表明两种入路均能有效恢复脊柱序列。

表 4 两组爆裂性骨折患者手术前及末次随访 JOA 评分结果($\bar{x}\pm s$, 分)

Tab.4 Comparison of JOA score result of preoperative and final follow-up of patients thoracolumbar burst fracture between two groups($\bar{x}\pm s$, score)

组别	例数	时间	主观症状			体征			日常动作	膀胱功能	总分
			腰痛	下肢痛	步行能力	直腿抬高试验	感觉	肌力			
后路组	16	术前	3.000±	0	0	2.000±	0.813±	0.688±	0.813±	-3.750±	3.5635±.
			0.000			0.000	0.834	0.873	0.834	2.569	033
		末次随访	2.875±	3.000±	2.250±	2.000±	1.438±	1.375±	13.000±	-1.500±	24.438±
侧前方组	20	术前	3.000±	0	0	2.000±	0.900±	0.600±	1.200±	-3.900±	3.800±
			0.000			0.000	0.718	0.821	0.894	2.404	4.584
		末次随访	2.850±	3.000±	2.250±	2.000±	1.400±	1.400±	13.000±	-1.650±	24.550±
			0.366	0.000	1.333	0.000	0.883	0.883	1.777	2.661	6.970

注:JOA 总分两组间比较:术前 $t=-0.148, P=0.883$;末次随访 $t=-0.048, P=0.962$ 。同组内术前后比较:后路组 $t=-14.827, P=0.000$;侧前方组 $t=16.399, P=0.000$

Note: JOA scores were compared between two groups: preoperative $t=-0.148, P=0.883$;the last follow-up $t=-0.048, P=0.962$. comparison of preoperative and postoperative within same group: in posterior group, $t=-14.827, P=0.000$; in anterolateral group, $t=16.399, P=0.000$

ASIA 分级结果见表 3,两组末次随访与术前比较差异有统计学意义($P<0.01$),术后神经功能均获得不同程度的恢复。JOA 评分结果见表 4,两组末次随访与术前比较差异有统计学意义($P<0.01$),两组均获得较好临床疗效。ASIA 分级结果、JOA 评分、RIS 两组间比较差异无统计学意义($P>0.05$),表明两组间临床疗效无差异。典型病例影像学资料见图 1。

3 讨论

3.1 后外单侧入路椎体次全切融合钉棒固定优势

严重胸腰椎爆裂性骨折常破坏脊柱前中柱或三柱的稳定性,致椎体后缘骨块突入椎管和(或)椎板内陷,造成脊髓或神经的损伤。手术的目的是恢复脊柱正常序列,解除脊髓或神经的压迫,重建脊柱的稳定性。而对入路的选择,有学者认为脊柱载荷分享评分^[5]为 6 分或以下时,骨折椎体有部分负载能力,可行后路手术;7 分或以上时应行前路手术支撑植骨固定;7 分或以上并有脊椎移位时需行前后联合入路植骨固定。Eno 等^[6]强调前中柱是脊柱稳定的基础,它承担脊柱 70%~80%的轴向负荷。对于脊柱载荷分享评分 7 分或以上的脊柱骨折,目前,前中柱的重建常采用侧前方入路。但侧前路手术操作复杂,所涉及的胸、腹腔重要结构、器官多,有损伤胸腹膜、输尿管、乳糜管、甚至大血管的风险^[7]。且前路对伴有后柱损伤如椎板内陷性骨折、关节突关节骨折脱位等,常需联合后路减压、融合固定,明显延长了手术时间、增加了手术创伤。

后路手术是治疗胸腰椎骨折的传统术式^[8],对于前中柱或三柱均需重建的脊柱损伤,是否能用后路单一切口恢复脊柱正常序列,解除脊髓或神经的

压迫,重建稳定性? 1985 年 Thomasen^[9]提出使用经椎弓根截骨矫形术治疗强直性脊柱炎后凸畸形。笔者在此技术基础上进行改良,术中通过后侧入路,仅切除椎管占位严重或内陷侧椎板、椎弓根及伤椎上下椎间隙的关节突,即可处理后柱损伤问题。咬断横突,剥离椎体侧方的肌肉,暴露椎体侧方及上下椎间隙,可以从容地从侧方用骨刀、髓核钳、刮匙进行椎管彻底减压、椎体次全切和伤椎上下邻椎终板的处理。而对于伤椎下半部椎体完整及椎间盘未损伤者,只行伤椎上半部椎体及相邻椎间盘切除融合,保留了相邻的运动节段。前中柱用填充松质骨的钛网重建、对侧行横突间植骨结合后路钉棒固定,从而真正做到一个切口进行三柱的重建和固定。虽然牺牲了一侧椎板、上或和下关节突关节,但通过术中放置横向连接杆,使两侧钉棒连接紧固,从而整个内固定装置形如一个框架,实现真正的三柱坚强固定,同时生物力学试验亦证明了其力学的稳定性^[10],促进植骨愈合。后侧入路,在未减压侧行肌间隙入路钉棒固定,避免了对椎旁软组织的广泛剥离,从而减少术中出血、术后肌粘连肌萎缩,较快的疼痛缓解有利于患者尽早进行功能锻炼,同时也减少后遗腰背疼痛的发生^[11]。此术式因不进入胸腔和腹膜后,避免了胸腹腔组织的损伤和并发症,尤其适合胸腰椎爆裂性骨折伴有胸腹损伤者。

3.2 手术操作技巧和注意事项

(1) 术中椎弓根螺钉需准确无误,力争一次植入。若多次预置通道,必然使椎弓根螺钉的把持力下降,从而影响植骨融合。(2) 伤椎椎管因骨块严重占位而狭窄,减压前先在固定侧用连接棒撑开伤椎并



图 1 患者,男,40岁,高处坠落伤致 L₂ 爆裂骨折 **1a,1b**。L₂ 骨折术前正侧位片,骨折段向后成角 20° **1c,1d**。术前横断面及矢状位 CT, L₂ 三柱损伤,椎管明显占位 **1e,1f**。术后 15 个月侧位 X 线片,骨折段前凸 4°, 动力位片 Cobb 角无改变 **1g,1h,1i,1j**。术后 15 个月随访, L₂ CT 重建(侧位和正位)、横断面及矢状位片,显示植骨融合,椎管完全减压

Fig.1 A 40-year-old male patient with vertebra burst fractures of L₂ caused by falling **1a,1b**. Postoperative AP and lateral X-rays showed L₂ fracture, fracture segment backward into the angle of 20° **1c,1d**. Preoperative cross section and sagittal CT showed L₂ three column injury with spinal canal occupying lesion **1e,1f**. At 15 months after operation, lateral X-rays showed 4° of fracture segment lordosis angle, dynamic radiographs without changes of Cobb angle **1g,1h,1i,1j**. At 15 months after operation, CT reconstruction (AP and lateral) on cross section and sagittal showed interbody fusion, complete decompression of spinal canal

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固定使椎管内骨块部分复位而使椎管扩大, 在行椎体后壁减压前先分离硬膜和黄韧带, 从而降低硬膜、神经或脊髓医源性损伤的概率。(3)充分切除椎间盘组织及邻椎终板软骨, 以利于融合, 但不要损伤终板, 以免引起钛网下沉。(4)伤椎的切除以减压彻底及钛网位置摆放合适为准, 不必过多地切除, 保留钛网前方和侧方的骨质与钛网贴合, 有利于提供侧方血供和融合界面。(5)钛网过长术中置入困难, 过短不利于恢复脊柱正常序列或钛网与终板接触不紧密易导致松动。笔者在剪取钛网前先透视脊柱侧位片,

观察伤椎是否恢复正常高度及正常序列, 若均已恢复, 此时再测量剪取钛网。(6)钛网的放置是术中的难点, 操作不慎易引起神经的损伤。因术中已切除了椎间盘, 故可再次使其过撑, 为钛网的置入预存一定的空间。钛网从神经根上方斜向置入骨窗与下方椎体终板贴合, 然后用血管钳通过神经根腋下骨窗把持住钛网远端, 再向下前敲击钛网近端, 使其放置于准确位置。(7)减压时的出血是术中的另一难点, 出血来自椎管静脉丛和减压时伤椎的渗血。笔者的经验首先使用自血回输机, 其次减压前先用神经剥

离子分离硬膜腹侧组织,以减少对硬膜外静脉丛的干扰,对明显充盈的硬膜外静脉丛及伴随神经根行走的静脉用双极电凝处理,再采用麻醉药控制性降压,使血压保持在 90/60 mmHg 以上,既能减少出血又不会造成脊髓损伤。(8)对于腹侧硬脊膜破裂无法修补的,术中采用明胶海绵填塞后严密缝合切口,减少硬膜外死腔。术后头低脚高位,切口外加压包扎。24 h 后即可拔管,未见不良后果。

本研究显示后外单侧入路椎体次全切融合钉棒固定与侧前方入路椎体重建钉板固定在围手术期各项指标、临床疗效、融合率方面差异无统计学意义,说明了对胸腰椎爆裂性骨折只需椎管前方减压和前中柱重建的病例,可根据术者对术式的熟练程度及患者的病情来选择,但与椎管前后方均需减压、三柱重建而需前后联合入路的病例比较,后外单侧入路椎体次全切融合钉棒固定明显缩短了手术时间,减少了手术的创伤,值得临床推广。但是本术式技术要求较高,只有经过长期专业训练的脊柱外科医生才能完成此手术,体现其术式的优越性。

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