Advances in Clinical Medicine 临床医学进展, **2026, 16(5), 125-130**
Published Online May 2026 in Hans. https://www.hanspub.org/journal/acm
https://doi.org/10.12677/acm.2026.1651797

复发性髌骨脱位中J征的发生机制与临床诊疗进展

付　平[1*]，林西贝[1]，李会榕[1]，方绍然[2]，陶　莹[2]，王建婷[3]

[1]昆明医科大学第二附属医院骨科，云南 昆明
[2]云南省滇东北中心医院创伤外科，云南 昭通
[3]四川省绵阳市江油市雁门镇中心卫生院，四川 江油

收稿日期：2026年3月30日；录用日期：2026年4月24日；发布日期：2026年5月7日

摘　要

复发性髌骨脱位(Recurrent Patellar Dislocation, RPD)中的J征是反映髌骨轨迹不良的直观动态体征，也是决定患者远期生活质量的关键预后因素之一。其发病机制并非单一软组织力学失衡，而是股骨滑车发育不良、高位髌骨、下肢三维旋转畸形及软组织张力失衡共同作用的结果。传统临床视触觉评估信度较低，目前广泛推荐基于多角度动态CT的三维影像学量化参数(如BOI、PTG等)进行精准评估。在手术策略抉择上，高度J征是内侧髌股韧带重建术(Medial Patellar Ligament Reconstruction Surgery, MPFLR)术后复发的高危因素。因此，临床需依托精准的影像学诊断，制定包含内侧髌胫韧带联合重建、下肢去旋转截骨及股骨滑车成形术在内的个性化联合手术方案，以彻底纠正解剖异常，改善患者预后。

关键词

复发性髌骨脱位，J征，滑车发育不良，放射评估，手术治疗

The Mechanism and Clinical Advances in Diagnosis and Treatment of the J-Sign in Recurrent Patellar Dislocation

Ping Fu[1*], Xibei Lin[1], Huirong Li[1], Shaoran Fang[2], Ying Tao[2], Jianting Wang[3]

[1]Department of Orthopedics, The Second Affiliated Hospital of Kunming Medical University, Kunming Yunnan
[2]Department of Trauma Surgery, Northeast Yunnan Central Hospital, Zhaotong Yunnan
[3]Jiangyou Yanmen Town Central Health Center, Jiangyou Sichuan

Received: March 30, 2026; accepted: April 24, 2026; published: May 7, 2026

*通讯作者。

文章引用: 付平, 林西贝, 李会榕, 方绍然, 陶莹, 王建婷. 复发性髌骨脱位中 J 征的发生机制与临床诊疗进展[J]. 临床医学进展, 2026, 16(5): 125-130. DOI: 10.12677/acm.2026.1651797

Abstract

The J-sign in recurrent patellar dislocation (RPD) is an intuitive dynamic sign reflecting patellar maltracking and a key prognostic factor determining patients' long-term quality of life. Its pathogenesis is not merely a result of soft tissue mechanical imbalance but a combined consequence of trochlear dysplasia, patella alta, three-dimensional rotational deformities of the lower extremity, and soft tissue tension imbalance. Traditional clinical visual and tactile assessments have low reliability. Currently, precise evaluation based on three-dimensional imaging quantitative parameters derived from multi-angle dynamic CT scans (such as BOI, PTG, etc.) is widely recommended. Regarding surgical strategy selection, a high-grade J-sign is a significant risk factor for recurrence after isolated medial patellar ligament reconstruction surgery (MPFLR). Therefore, clinical practice necessitates relying on precise imaging diagnosis to formulate personalized combined surgical plans, including combined medial patellotibial ligament reconstruction, lower extremity derotational osteotomy, and trochleoplasty, to thoroughly correct anatomical abnormalities and improve patient outcomes.

Keywords

Recurrent Patellar Dislocation, J-Sign, Trochlear Dysplasia, Radiological Assessment, Surgical Treatment

1. 引言

复发性髌骨脱位(Recurrent Patellar Dislocation，RPD)是一种受多重病理解剖因素影响的复杂骨科疾病，好发于青少年及运动水平活跃的年轻人群。在众多临床查体的指标中，J 征被公认为最直观能反映髌骨轨迹不良的动态体征。当患膝从完全伸直位向屈曲运动时，髌骨在伸直的终末期(通常为膝关节屈曲的 10˚至 30˚)突然脱离了股骨滑车沟的约束，向外侧发生的剧烈跳动，并且其运动轨迹在冠状面上呈现倒“J”形[1] [2]。

J 征绝对不是单纯的力学表象，而是直接决定患者远期生活质量的关键预后因子。Milinkovic 等[3]对 183 例 RPD 患者的前瞻性研究表明，高等级 J 征，尤其是严重度分级为 II 或 III 级与体重指数(BMI > 28 kg/m^2)是导致患者疾病特异性生活质量(BPII 2.0 评分)显著下降的独立影响因素。此外，Butnaru 等[4]指出，若全膝关节置换术(TKA)前患者存在 Wiberg III 型髌骨合并伸直终末期 J 征，即便不置换髌骨，术后膝前痛的发病率也会升高。这提示 J 征所代表的异常应力分布有长期的软骨破坏性，可能会加重患者膝关节骨关节退行性病变的进程。

2. 髌股不稳的分类系统

为了解决临床诊疗中出现的“影像学参数轻微异常，但患者脱位症状反而极为严重(即查体时评估患者出现的高度 J 征)”的现象，Frosch 和 Schmeling [5]提出来一套整合临床体征评估与影像学病理特征的髌股不稳五型分类系统。根据该系统中 J 征是 Type3 (髌骨不稳合并明确轨迹不良)的典型表现。该分型明确指出，Type3 的发生源于四个维度的病理因素叠加：(1) 软组织挛缩与失衡；(2) 高位髌骨；(3) 病理性的 TT-TG 距离；(4) 下肢旋转畸形。Frosch 分型的核心意义在于确立了治疗的界限，及对表现出明显 J 征

的 Type3 患者，常规的软组织修复是不足以防止髌骨术后再次脱位的发生，必须将治疗的方向由单独行内侧髌股韧带重建术转为对下肢力线尤其是膝关节骨性结构和下肢力线的评估。

3. J 征的三维解剖及生物力学机制

以往的研究仅仅将 J 征视为髌骨单纯的冠状面外移。然而随着影像学技术的发展，3D 重建技术的发展与普及，目前共识认为 J 征是膝关节骨性约束力缺失、动态软组织张力失衡及下肢三维力线紊乱的共同结果[6] [7]。

3.1. 股骨滑车发育不良

股骨滑车形态是髌骨在膝关节伸直末期脱出滑车沟的根本原因。北京积水潭医院刘心、冯华等人[8]的大样本研究指出，TT-TG 值增大和高位髌骨是 J 征的潜在风险。而 Hevesi 等[9]利用多因素回归模型进一步阐明，跳动型 J 征(Jumping J-sign)的主要驱动因素是严重滑车发育不良及滑车嵴的局部隆起高度(Trochlear bump height)。当股骨滑车外侧髁缺乏足够的骨性隆起作为屏障时，股内侧肌的张力完全无法对抗股外侧肌的牵拉，因此这类患者出现高度 J 征的风险更高。

3.2. 高位髌骨

高位髌骨使得髌骨在膝关节屈曲的早期使得髌骨无法及时进入股骨滑车沟内，并使髌骨在无骨性结构约束下停留的病理行程增加。Turkula 等[10]的回顾性研究证实，在实施胫骨结节远端化后，若 Caton-Deschamps 指数(CDI)持续 > 1.2，高达 83%的患者会残留 J 征。这表明恢复正常的髌骨高度是消除 J 征的前提条件。

3.3. 下肢力线的异常

下肢旋转力线的异常在 J 征的形成中有着放大骨性结构异常的作用。刘心等[11]对我国复发性髌骨脱位患者的 CT 测量所得数据证实，J 征阳性组患者的股骨前倾角(Femoral Anteversion, FAA)和胫骨外旋角均显著大于阴性组，过度内旋的股骨使得滑车沟在空间上相对内移，导致髌骨在伸直时受到的外侧牵拉矢量呈几何级数放大。张志军等[12]的研究进一步指出，随着 J 征临床分度的增加，患者的平均股骨前倾角呈显著递增趋势，这标志着高度 J 征本质上是下肢三维扭转畸形的极度恶化。

4. 影像学量化评估

4.1. 临床视触觉评估的信度低

传统的 J 征评估严重依赖医生的主观视觉及触觉。Smith 等[13]和 Hiemstra 等[14]的系统综述显示，常规视觉评估的评分者间信度(Inter-rater reliability)仅为“差至中等”即使在国际顶级髌股关节专家(IPSG)组成的评判团中，单纯依靠视觉判断 J 征偏移的毫米数的准确率也极不理想[15]。皮下脂肪的遮挡以及严重股骨滑车发育畸形所产生的视错觉，极易导致对真实轨迹偏移低估。虽然采用了“大”与“小/无”的二元分类法可在一定程度上提升信度[16]，或通过触觉－视觉联合诊断(Haptic-visual assessment)可将信度提升至 0.89 [17]，但这依旧无法满足精细截骨手术对“毫米级”测量的需求。

4.2. 膝关节 CT 扫描的评估参数

薛喆、刘心等[18] [19]确立了基于伸膝位轴向 CT 的中国人 J 征量化标准。研究证实，伸直位膝关节 CT 上显示的髌骨过度横向平移是 J 征阳性的最准确标志。其主要核心参数为：(1) 髌骨平分指数(Bisect Offset Index, BOI)：精确衡量髌骨中心偏离滑车最低点的比例。(2) 髌骨－滑车沟距离(Patellar-Trochlear-

Groove distance, PTG)：评估冠状面的绝对外移量。(3) 髌骨外侧倾斜角(Patellar Lateral Tilt Angle, PLTA)：评估髌骨在横截面上的异常旋转。

4.3. 多角度 CT 与 4D 运动学建模

静态扫描的局限性在于无法捕捉膝关节屈伸瞬间髌骨的非线性脱位。在 Tan 等[20]及 Li 等[21]近期的研究中表示，强烈推荐多角度动态运动学 CT (DKCT)。在上百例(140~150)的大型临床研究队列中，通过 0°、15°、30°等不同屈膝角度下采集的 CT 数据，可获得适合角及动态 TT-TG 距离的变化差值。这种多角度的 CT 影像学采集不仅客观的在二维平面上还原了三维空间中髌骨的活动幅度，更揭示了在静态 TT-TG 正常的情况下，软组织张力失衡导致的动态 TT-TG 增大[21]。Yuan 等[22]的 4D-CT 研究进一步补充说明了，J-征在空间中不仅包含横向平移，更伴随着显著的矢状面异常倾斜。

5. J 征的严重程度对个体化手术的指导

5.1. 孤立 MPFL 重建

内侧髌股韧带重建术(MPFLR)是稳定髌骨的基础，但面对高度 J 征，单纯的 MPFLR 则更容易引起重建术后的再次脱位。张志军、冯华等[23] [24]针对大量队列的研究深刻揭示，术前存在高度 J 征是导致术后短期临床评分(Kujala)下降及 MPFL 残余移植物松弛的最强独立危险因素。若是高级别 J 征存在的同时并发股骨隧道定位错位，这两者的恶性叠加将不可逆转地导致移植物在膝关节屈伸活动过程中受力极度不均，最终重建的韧带出现撕裂甚至是断裂[24]。Sappey-Marinier 等[25]对 211 例孤立 MPFLR 的随访同样证实，未被纠正的骨性异常(即高度 J 征及高位髌骨)导致了极高的远期脱位的复发率。

5.2. MPTL 重建

针对单纯 MPFLR 无法有效控制膝关节伸直终末期髌骨外移的缺点，重建内侧髌胫韧带则被逐渐关注。孙一嘉[26]的临床研究证实，对于 J 征阳性患者，实施内侧髌股韧带联合内侧髌胫韧带的双束重建，能够利用 MPTL 在屈曲膝关节早期(0°~30°)时限制髌骨外移的生物力学特性，显著提高髌骨在屈曲膝关节时早期稳定性。

5.3. 骨性手术的选择

当大样本多角度 CT 量化膝关节测量参数证实在极端的骨性力线偏移时，必须实施骨性手术。针对伴有高位髌骨及 TT-TG 明显增大的患者，Fulkerson 截骨术可通过胫骨结节的前内移位，同时纠正髌骨高位及过大的 TT-TG 距离[27]。Fulkerson 等[28]最新的 3D 术前规划提出，利用多角度 CT 测量入点－滑车沟角度(EP-TG)，能避免单纯二维 TT-TG 手术规划导致的髌骨在进入滑车沟时出现的“雪橇脱轨(skier/bobsled effect)”的碰撞效应，确保消除 J 征的精准截骨至毫米级。针对过度股骨前倾(FAA > 30°)诱发的高级别 J 征，Zhang [29]等证实，联合 DDFO 组在术后轨迹不良消除和功能恢复上具有压倒性优势。去旋转截骨从根本上纠正了下肢水平面的异常杠杆力。然而长时间的脱位导致的软组织永久形变可能即使实施了 DDFO，仍会有高度 J 征的患者残留极轻度的异常[30]。当高度 J 征的患者其主要是因为滑车沟的极度发育不良(Dejour B/D 型)时，常规的软组织和下肢力线矫正对其无任何效力。Carstensen 等[31]和 Camathias [32]等的相关研究表明，对于这类患者，其中包括了骨骼未成熟的青少年，实施股骨滑车加深成形术是重塑骨性轨道，彻底消除高级别 J 征的唯一手段。

6. 结语

目前对于复发性髌骨脱位诊疗中，J 征的评估已逐渐告别模糊的定性，向基于多维度影像学数字重构

的“精准医疗”迈步。本综述统合的中外文献一致表明：J 征的本质是滑车骨性约束的丢失、下肢水平面扭转(股骨前倾、胫骨旋转)以及髌骨周围软组织张力在伸直末期的失衡。面对伴有高度 J 征的复杂畸形，单一的 MPFLR 将不可避免的导致这类患者手术失败率升高。因此，临床医师必须熟练掌握膝关节 CT 指数，如 TT-TG、BOI、PLTA 及 PTG 的测量，并根据这些指数制定包含软组织重建、去旋转截骨及滑车成形术等的联合手术治疗方案。

参考文献

[1] Hadidi, O., Ellanti, P., Lincoln, M. and Hogan, N. (2018) The J-Sign in Patellar Maltracking. *BMJ Case Reports*, **2018**, bcr-2017-222887. https://doi.org/10.1136/bcr-2017-222887

[2] Rousseau-Saine, A., Nault, M. and Hiemstra, L.A. (2023) What Is the J-Sign and Why Is It Important? *Current Opinion in Pediatrics*, **35**, 97-101. https://doi.org/10.1097/mop.0000000000001193

[3] Milinkovic, D.D., Jovandic, I., Zimmermann, F. and Balcarek, P. (2022) The J-Sign and the Body Mass Index Determine the Disease-Specific Quality of Life in Patients with Lateral Patellar Instability. *Knee Surgery, Sports Traumatology, Arthroscopy*, **30**, 1672-1678. https://doi.org/10.1007/s00167-021-06705-6

[4] Butnaru, M., Sigonney, G., Müller, J.H., Senioris, A., Saffarini, M. and Courage, O. (2020) Wiberg Type III Patellae and J-Sign during Extension Compromise Outcomes of Total Knee Arthroplasty without Patellar Resurfacing. *The Knee*, **27**, 787-794. https://doi.org/10.1016/j.knee.2020.04.005

[5] Frosch, K.H. and Schmeling, A. (2016) A New Classification System of Patellar Instability and Patellar Maltracking. *Archives of Orthopaedic and Trauma Surgery*, **136**, 485-497. https://doi.org/10.1007/s00402-015-2381-9

[6] Sheehan, F.T., Derasari, A., Fine, K.M., Brindle, T.J. and Alter, K.E. (2010) Q-Angle and J-Sign: Indicative of Maltracking Subgroups in Patellofemoral Pain. *Clinical Orthopaedics & Related Research*, **468**, 266-275. https://doi.org/10.1007/s11999-009-0880-0

[7] Meena, G.L., Razak K, M. and S, G. (2017) Demystifying Tibial-Tuberosity Trochlear Groove Distance, the J-Sign and Trochlear Dysplasia: An Imaging Encomium. *Journal of Medical Diagnostic Methods*, **6**, Article 1000251. https://doi.org/10.4172/2168-9784.1000251

[8] 刘心, 张辉, 冯华. 复发性髌骨脱位 J 形征形成的风险因素分析[J]. 中国运动医学杂志, 2016, 35(2): 121-125.

[9] Hevesi, M., Cregar, W., Zavras, A., Trasolini, N., Yanke, A. and Dandu, N. (2022) Poster 233: The Presence of a Jumping J-Sign Is Driven Primarily by Trochlear Factors and Not Patella Alta or TT-TG Distance. *Orthopaedic Journal of Sports Medicine*, **10**. https://doi.org/10.1177/2325967121s00794

[10] Turkula, S., Schmiesing, A., Agel, J. and Arendt, E. (2021) Persistent J-Sign Following Distalization with Correction of Patellar Height: A Descriptive Study Reviewing Anatomic Factors (195). *Orthopaedic Journal of Sports Medicine*, **9**. https://doi.org/10.1177/2325967121s00306

[11] 刘心, 张辉, 冯华. 下肢旋转力线异常与髌骨轨迹 J 形征的相关性研究[J]. 骨科临床与研究杂志, 2018, 3(1): 12-15.

[12] 张志军, 张辉, 宋关阳, 等. 术前 J 形征分度对复发性髌骨脱位术后短期临床结果的影响[J]. 中国运动医学杂志, 2019, 38(11): 925-929.

[13] Smith, T.O., Clark, A., Neda, S., Arendt, E.A., Post, W.R., Grelsamer, R.P., *et al.* (2012) The Intra- and Inter-Observer Reliability of the Physical Examination Methods Used to Assess Patients with Patellofemoral Joint Instability. *The Knee*, **19**, 404-410. https://doi.org/10.1016/j.knee.2011.06.002

[14] Hiemstra, L.A., O'Brien, C.L., Lafave, M.R. and Kerslake, S. (2021) Common Physical Examination Tests for Patellofemoral Instability Demonstrate Weak Inter-Rater Reliability. *Arthroscopy, Sports Medicine, and Rehabilitation*, **3**, e673-e677. https://doi.org/10.1016/j.asmr.2021.01.004

[15] Best, M.J., Tanaka, M.J., Demehri, S. and Cosgarea, A.J. (2020) Accuracy and Reliability of the Visual Assessment of Patellar Tracking. *The American Journal of Sports Medicine*, **48**, 370-375. https://doi.org/10.1177/0363546519895246

[16] Walla, N., Moore, T., Harangody, S., Fitzpatrick, S., Flanigan, D.C., Duerr, R.A., *et al.* (2023) Qualitative Visual Assessment of the J-Sign Demonstrates High Inter-Rater Reliability. *Journal of ISAKOS*, **8**, 420-424. https://doi.org/10.1016/j.jisako.2023.07.006

[17] Zimmermann, F., Mandelka, E., Gierse, J., Grützner, P.A., Vetter, S.Y. and Balcarek, P. (2025) Haptic Visual and Superimposed Digital Imaging Analysis Improves the Interrater Reliability of J-Sign Assessment in Patients with Patellofemoral Instability: A Prospective Diagnostic Study. *Journal of Clinical Medicine*, **14**, Article 8559. https://doi.org/10.3390/jcm14238559

[18] Xue, Z., Song, G., Liu, X., Zhang, H., Wu, G., Qian, Y., *et al*. (2018) Excessive Lateral Patellar Translation on Axial Computed Tomography Indicates Positive Patellar J Sign. *Knee Surgery*, *Sports Traumatology*, *Arthroscopy*, **26**, 3620-3625. https://doi.org/10.1007/s00167-018-4897-3

[19] 薛喆, 宋关阳, 刘心, 等. 膝关节 J 形征在复发性髌骨脱位患者中的发病率、分度及放射学特征[J]. 中国运动医学杂志, 2017, 36(10): 843-846.

[20] Tan, S.H.S., Kwan, Y.T., Lee, J.Z.J., Yeo, L.K.P., Lim, A.K.S. and Hui, J.H. (2024) Patellar Tilt, Congruence Angle, and Tibial Tubercle-Trochlear Groove Distance Are Correlated with Positive J-Sign in Adolescents. *The Physician and Sportsmedicine*, **52**, 492-496. https://doi.org/10.1080/00913847.2024.2315012

[21] Li, J., Chen, Y., Yuan, M., Yang, H., Lv, F., Sheng, B., *et al*. (2025) Lateral Patellar Maltracking and Patellar Alta in the Absence of Increased $TT\text{-}TG_{dynamic}$ Distance in Isolated Patellofemoral Pain: A Dynamic Kinematic CT Study. *BMC Medical Imaging*, **25**, Article No. 446. https://doi.org/10.1186/s12880-025-01999-1

[22] Yuan, M., Chen, Y., Li, J., Yang, H., Yu, F. and Lv, F. (2025) Abnormal Patellar Sagittal Spatial Kinematics in Patients with Patellofemoral Pain: An *in Vivo* Dynamic CT Study. *Journal of Orthopaedic Surgery and Research*, **20**, Article No. 193. https://doi.org/10.1186/s13018-025-05610-9

[23] Zhang, Z., Zhang, H., Song, G., Zheng, T. and Feng, H. (2020) A Pre-Operative Grade 3 J-Sign Adversely Affects Short-Term Clinical Outcome and Is More Likely to Yield MPFL Residual Graft Laxity in Recurrent Patellar Dislocation. *Knee Surgery*, *Sports Traumatology*, *Arthroscopy*, **28**, 2147-2156. https://doi.org/10.1007/s00167-019-05736-4

[24] Zhang, Z., Song, G., Zheng, T., Ni, Q., Feng, H. and Zhang, H. (2021) The Presence of a Preoperative High-Grade J-Sign and Femoral Tunnel Malposition Are Associated with Residual Graft Laxity after MPFL Reconstruction. *Knee Surgery*, *Sports Traumatology*, *Arthroscopy*, **29**, 1183-1190. https://doi.org/10.1007/s00167-020-06140-z

[25] Sappey-Marinier, E., Sonnery-Cottet, B., O'Loughlin, P., Ouanezar, H., Reina Fernandes, L., Kouevidjin, B., *et al*. (2019) Clinical Outcomes and Predictive Factors for Failure with Isolated MPFL Reconstruction for Recurrent Patellar Instability: A Series of 211 Reconstructions with a Minimum Follow-Up of 3 Years. *The American Journal of Sports Medicine*, **47**, 1323-1330. https://doi.org/10.1177/0363546519838405

[26] 孙一嘉. 内侧髌股韧带联合髌胫韧带重建治疗"J"形征阳性复发性髌骨脱位的临床研究[D]: [硕士学位论文]. 合肥: 安徽医科大学, 2023.

[27] Edwards, A., Larson, E. and Albright, J. (2014) Correlation of Radiographic Patellofemoral Indices with Tibial Tubercle Transfer Distance in Fulkerson Osteotomy Procedures. *Iowa Orthopedic Journal*, **34**, 24-29.

[28] Fulkerson, J., Park, N., Manafzadeh, A.R., Glennon, A., Allen, C. and Sieberer, J.M. (2025) Three-Dimensional Tibial Tubercle Transfer Planning. *Video Journal of Sports Medicine*, **5**. https://doi.org/10.1177/26350254251342819

[29] Zhang, Z., Song, G., Li, Y., Zheng, T., Ni, Q., Feng, H., *et al*. (2021) Medial Patellofemoral Ligament Reconstruction with or without Derotational Distal Femoral Osteotomy in Treating Recurrent Patellar Dislocation with Increased Femoral Anteversion: A Retrospective Comparative Study. *The American Journal of Sports Medicine*, **49**, 200-206. https://doi.org/10.1177/0363546520968566

[30] Zhang, Z., Zhang, H., Song, G., Wang, X., Zhang, J., Zheng, T., *et al*. (2020) A High-Grade J Sign Is More Likely to Yield Higher Postoperative Patellar Laxity and Residual Maltracking in Patients with Recurrent Patellar Dislocation Treated with Derotational Distal Femoral Osteotomy. *The American Journal of Sports Medicine*, **48**, 117-127. https://doi.org/10.1177/0363546519884669

[31] Carstensen, S.E., Menzer, H.M. and Diduch, D.R. (2017) Patellar Instability: When Is Trochleoplasty Necessary? *Sports Medicine and Arthroscopy Review*, **25**, 92-99. https://doi.org/10.1097/jsa.0000000000000150

[32] Camathias, C., Studer, K., Kiapour, A., Rutz, E. and Vavken, P. (2016) Trochleoplasty as a Solitary Treatment for Recurrent Patellar Dislocation Results in Good Clinical Outcome in Adolescents. *The American Journal of Sports Medicine*, **44**, 2855-2863. https://doi.org/10.1177/0363546516652894