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对侧皮质锁定螺钉与锁定螺钉治疗股骨远端骨折疗效比较 *

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摘要 目的:比较对侧皮质锁定螺钉与锁定螺钉治疗股骨远端骨折的临床疗效。**方法:**回顾性分析自 2013 年 5 月至 2016 年 8 月诊治的 52 例股骨远端骨折患者,采用对侧皮质锁定螺钉 +NCB 接骨板内固定治疗 26 例(A 组:对侧皮质锁定组),采用锁定螺钉 +NCB 接骨板内固定治疗 26 例(B 组:锁定螺钉组)。记录两组手术出血量和手术时间、切口长度、内固定治疗后骨折愈合时间、内固定治疗后完全负重时间、内固定治疗后并发症发生率等,在每个随访节点对每位患者进行患肢的正侧位 X 线平片检查,末次随访时对患肢进行膝关节功能评分,采用美国特种外科医院膝关节评分标准评定患肢功能。骨折愈合的定义为活动时骨折处无痛且在骨折正侧位 X 线平片上可见到断端骨皮质骨痂连接。术后并发症包括:关节僵硬、内固定断裂、骨不连以及感染等。**结果:**本研究 52 例骨折均获得至少 12 个月的随访。两组在手术相关指标及切口愈合等方面均无明显差异(P 均＞0.05)。在骨折愈合以及完全负重时间方面,A 组均显著短于 B 组(P 均 <0.05)。末次随访时 52 例患者患肢膝关节功能:A 组:优 18 例,良 5 例,差 4 例,优良率 88.5%;B 组:优 15 例,良 6 例,中 4 例,差 1 例,优良率 80.8%。两组对比 A 组优良率显著高于 B 组(P<0.05)。两组并发症对比无明显差异:A 组发生骨不连 2 例,骨折内固定断裂 2 例。B 组发生骨不连 3 例,畸形愈合 2 例。**结论:**与传统锁定螺钉相比,对侧皮质锁定螺钉在骨折愈合时间、完全负重时间、术后患肢功能优良率方面具有优势,但在并发症发生率方面没有明显差异。对侧皮质锁定螺钉的治疗指征及自身强度还有待大样本、多中心的临床研究进一步明确。

关键词:股骨远端骨折;对侧皮质锁定;Motionloc;骨折愈合

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Comparison of Far Cortical Locking Screws and Locking Screws in the Treatment of Distal Femoral Fractures*

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ABSTRACT Objective: To compare the difference of clinical effects of far cortical locking screws versus locking screws in the treatment of distal femoral fractures. **Methods:** Retrospective analysis of May 2013 to August 2016 since the diagnosis and treatment of 52 patients with distal femoral fractures which using far cortical locking screws+NCB plate fixation in 26 cases (group A: locking group in far cortical), using locking screws +NCB plate fixation in 26 cases (group B: locking screw group). Records of two groups of surgical bleeding and operation time, incision length, internal fixation after fracture healing time, full weight bearing time after fixation and internal fixation for the treatment of complications, follow-up in each node of each patient were lateral limb X-ray examination, knee joint function score of the the limb at the end of the follow-up, using the hospital for Special Surgery knee limb function evaluation standard for evaluation. The fracture healing was defined as the painless fracture at the active site, and the bony union of the fractured cortical bone could be seen on the X-ray film of the fracture side. Postoperative complications included joint stiffness, fracture of internal fixation, nonunion and infection. **Results:** In this study, 52 cases of fractures were followed up for at least 12 months. There was no significant difference between the two groups in the operation related indexes and wound healing (P>0.05). In fracture healing and full weight-bearing time, A group was significantly shorter than that of B group (P<0.05). At the last follow-up, 52 patients had knee joint function: group A: excellent in 18 cases, good in 5 cases, poor in 4 cases, the excellent and good rate was 88.5%; group B: excellent in 15 cases, good in 6 cases, moderate in 4 cases, poor in 1 cases, the excellent and good rate was 80.8%. The excellent and good rate of the A group was significantly higher than that of the group B (P<0.05). There was no significant difference between the two groups in complications: 2 cases of nonunion and 2 cases of fracture internal fixation breakage in group A. In group B, nonunion occurred in 3 cases and malunion in 2 cases. **Conclusions:** Compared with the traditional locking screws, the far cortical locking screws has advantages in fracture healing time, full weight-bearing time, postoperative limb function of the excellent and good rate, but the rate of complications occurred in no significant difference.

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前言

股骨远端骨折约占股骨骨折的6%[1]。通常发生在由车祸、高处坠落等高能量损伤的年轻人,或因摔倒等低能量损伤伴骨质疏松的老年人。在引入锁定接骨板内固定治疗股骨远端骨折后,由于其可以微创置入、具有减少软组织剥离和骨折区域血供破坏等优点,在临床中被广泛应用[2]。但是使用锁定接骨板治疗股骨远端骨折后骨折的延迟愈合及不愈合率并没有明显提高。2005年之后的6篇文献[3-8]报道显示其临床效果也许并不优于其他内固定方式:骨折不愈合率为9%～20%(平均15.7%),内固定失败率为0～13%(6%)。有学者认为,锁定螺钉系统存在刚度较高、钢板近侧应力较集中等问题[9],针对于此,Bottlang等在2005年美国矫形研究协会年会上首次提出FCL(Far Cortical Locking)概念,由此设计出首款FCL螺钉:MotionLoc螺钉[10,11]。该特殊螺钉的螺杆远端有螺纹,用来把持远端皮质,中段带倒置螺纹,便于螺钉取出,近端较细且不带有螺纹,不把持近端皮质,钉尾光滑无螺纹,便于轴向微动,靠尾帽与钢板进行锁定而且螺杆具有弹性,螺钉锁定后钢板与骨面也有间隙,受力后螺钉可以弯曲,因此在骨折断端远近测皮质可以产生对称的微动。本文回顾性分析了我院创伤骨科自2013年5月至2016年8月,收治的52例行锁定螺钉或Motionloc螺钉内固定治疗的股骨远端骨折患者资料,分析比较两种螺钉的疗效及术后并发症情况,现报道如下。

1 资料与方法

1.1 一般资料

纳入标准:(1)AO/OTA分型中的33A型和33C型股骨远端骨折;(2)采用锁定接骨板内固定治疗的患者;(3)年龄＞18岁;(4)2周内的新鲜闭合性损伤;(5)单侧损伤;(6)术后随访≥12个月;排除标准:(1)AO/OTA分型中33B型股骨远端骨折;(2)采用保守治疗或髓内钉、外固定支架等其他治疗方式的患者;(3)年龄＜18岁;(4)病理性骨折患者。共52例患者纳入研究,一般资料具体见表1。其中男18例,女34例;年龄30～87岁(平均66.5岁);AO/OTA骨折分型:33A型20例、33C型32例;致伤原因:车祸伤18例、摔伤25例、高处坠落伤9例。将所有研究对象按照内固定方案分为两组,两组各26例,A组行Motionloc螺钉+NCB(Non-Contact Bridging)桥接锁定接骨板内固定,B组行传统锁定螺钉+NCB桥接锁定接骨板内固定。两组患者在性别、年龄、AO分型、致伤原因等方面比较,差异无统计学意义(P＞0.05),具有可比性。

表1 两组患者基本资料

Table 1 Basic data of two groups of patients

Groups	Gender| n		Age| years	AO/OTA type| n		Injury mechanism| n		
	M	F		33A	33C	Motor vehicle crash	Ground level fall	Fall from height
Group A	10	16	67.0± 14.9	12	14	7	15	4
Group B	8	18	66.0± 16.1	8	18	11	10	5
P	>0.05		>0.05	>0.05		>0.05		

1.2 治疗方法

常规采用标准股骨远端外侧入路、股骨远端外侧髌旁入路,复位骨折,必要时另行内侧纵形切开辅助复位固定,随后放置锁定接骨板固定。均使用捷迈公司NCB(Non-Contact Bridging)桥接锁定接骨板进行固定。Motionloc的使用方法依据Bottlang等和捷迈公司的建议进行固定:1.MotionLoc的使用区域为骨干处。2.骨折线一侧全部使用MotionLoc,或全部不用。

A组:实施NCB+Motionloc螺钉内固定治疗。手术方式:沿股骨外侧髁中点向近端切开,沿股骨轴线作长约3-5 cm切口,直视下行股骨髁关节面复位,克氏针临时固定。然后牵引复位股骨远端骨折,恢复股骨长度,用骨膜剥离器对骨与肌肉间隙进行分离,插入NCB钢板。通过NCB配套外接瞄准器,跨过骨折区,在近端经皮置入Motionloc螺钉予以固定。

B组:手术方法同A组,但是将近端固定螺钉改为普通锁定螺钉。

1.3 术后随访及疗效评价

分别于术后4、12、24、48周及必要时复查膝关节正、侧位X线片,末次随访时采用美国特种外科医院膝关节评分标准评定患膝功能:优:≥85分,良:70-84分,中:60-69分,差:≤59分。

主要观察指标:治疗相关指标:手术出血量、手术时间和切口长度等。内固定治疗后骨折愈合时间;内固定治疗后完全负重时间;内固定治疗后并发症发生率;术后并发症包括关节僵硬、内固定断裂、骨不连以及感染等。

骨折愈合评估标准:包括局部无压痛,无纵向叩击痛;局部无异常活动;X射线片显示骨折线模糊,有连续性骨痂通过骨折线等[12,13]。

1.4 统计学方法

应用SPSS 19.0统计软件进行分析,计量资料以均数± 标准差($\bar{x}$± s)表示,两组间及组内比较采用两独立样本t检验或配对t检验,计数资料以例数或率表示,两组比较采用x^2检验。P＜0.05为差异有统计学意义。

2 结果

2.1 统计结果

两组 52 例患者均获得至少 12 个月的随访,均进入结果分析,未出现失随访病例。

两组治疗相关指标比较:两组在手术相关指标(术中出血量、手术时间、切口长度)及切口愈合等方面均无明显差异(P均>0.05)。具体结果如表 2 所示。

在骨折愈合及完全负重时间方面,A 组均显著短于 B 组(P均<0.05)。具体结果如表 3 所示。

末次随访时 52 例患者按美国特种外科医院评分标准评定患膝功能:A 组:优 18 例,良 5 例,差 4 例,优良率 88.5%;B 组:优 15 例,良 6 例,中 4 例,差 1 例,优良率 80.8%。两组对比 A 组优良率显著高于 B 组(P<0.05)。具体如表 4 所示。

共 9 例 (17.3%) 患者发生术后相关并发症: 骨不连 5 例(9.6%),畸形愈合 2 例(3.8%),内固定物断裂 2 例(3.8%)。其中 A 组发生骨不连 2 例,骨折内固定断裂 2 例。B 组发生骨不连 3 例,畸形愈合 2 例。

表 2 两组患者治疗相关指标比较($\bar{x}\pm$ s,n=26)

Table 2 Comparison of treatment related indicators between the two groups ($\bar{x}\pm$ s, n=26)

Groups	Intraoperative blood loss /mL	Operation time /min	Incision length /cm	Incision healing grade/n		
				A	B	C
A	117.2± 4.1	82± 2	4.5± 0.8	26	0	0
B	116.4± 5.1	81± 3	4.6± 0.9	26	0	0
P	>0.05	>0.05	>0.05			

表 3 两组患者内固定治疗后骨折愈合时间和完全负重时间比较($\bar{x}\pm$ s,n=26,周)

Table 3 Comparison of patients after internal fixation treatment of fracture healing time and full weight-bearing time between the two groups($\bar{x}\pm$ s, n=26, weeks)

Groups	Fracture healing time	Full weight-bearing time
A	14.4± 4.1	12.6± 2.3
B	16.8± 3.1	14.5± 3.4
P	<0.05	<0.05

表 4 两组患者末次随访时膝关节功能评分比较

Table 4 Comparison of the knee function scores of the two groups at the last follow-up

Groups	Excellent	Good	Moderate	Poor	The excellent and good rate(%)
A	18	5	0	4	88.5
B	15	6	4	1	80.8
P					P<0.05

2.2 典型病例

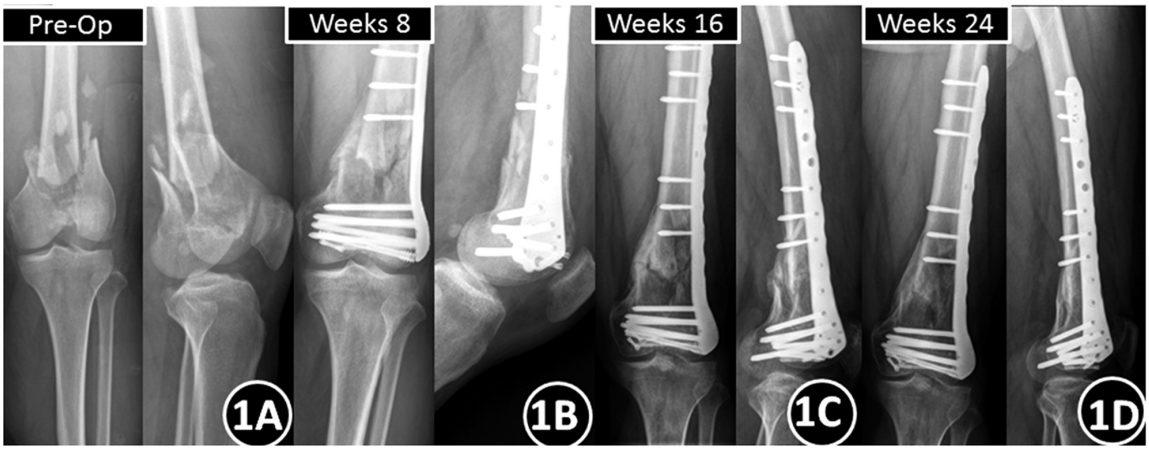

图 1 44 岁男性,车祸致左股骨远端骨折,AO 分型:33C 型

Fig.1 44 year old man with left lateral distal femoral fracture caused by car accident, AO classification: 33C

Note: 1A: preoperative picture of left knee joint: anterior-posterior and lateral position X-ray films: 33C; 1B: using 6 Motionloc screws, 8 weeks after operation, anterior-posterior and lateral position X-ray films showed obvious callus growth, the patient can walk independently, full weight-bearing; 1C: 16 weeks after operation, the X-ray showed visible callus growth significantly, cortical bone are connected; 1D: 24 weeks after operation, X-ray films showed fracture healing.

图 2 54 岁男性，高处坠落致右股骨远端骨折，AO 分型：33C 型

Fig.2 54 year old man with right lateral distal femoral fracture caused by Fall from height, AO classification: 33C

Note: 2A: preoperative picture of right knee joint: anterior-posterior and lateral position X-ray films: 33C; 2B: 2 days after operation, 5 Motionloc screws were used, the femoral line was restored and the articular surface was well restored; 2C: 16 weeks after operation, the X-ray showed visible callus growth significantly, cortical bone are connected.

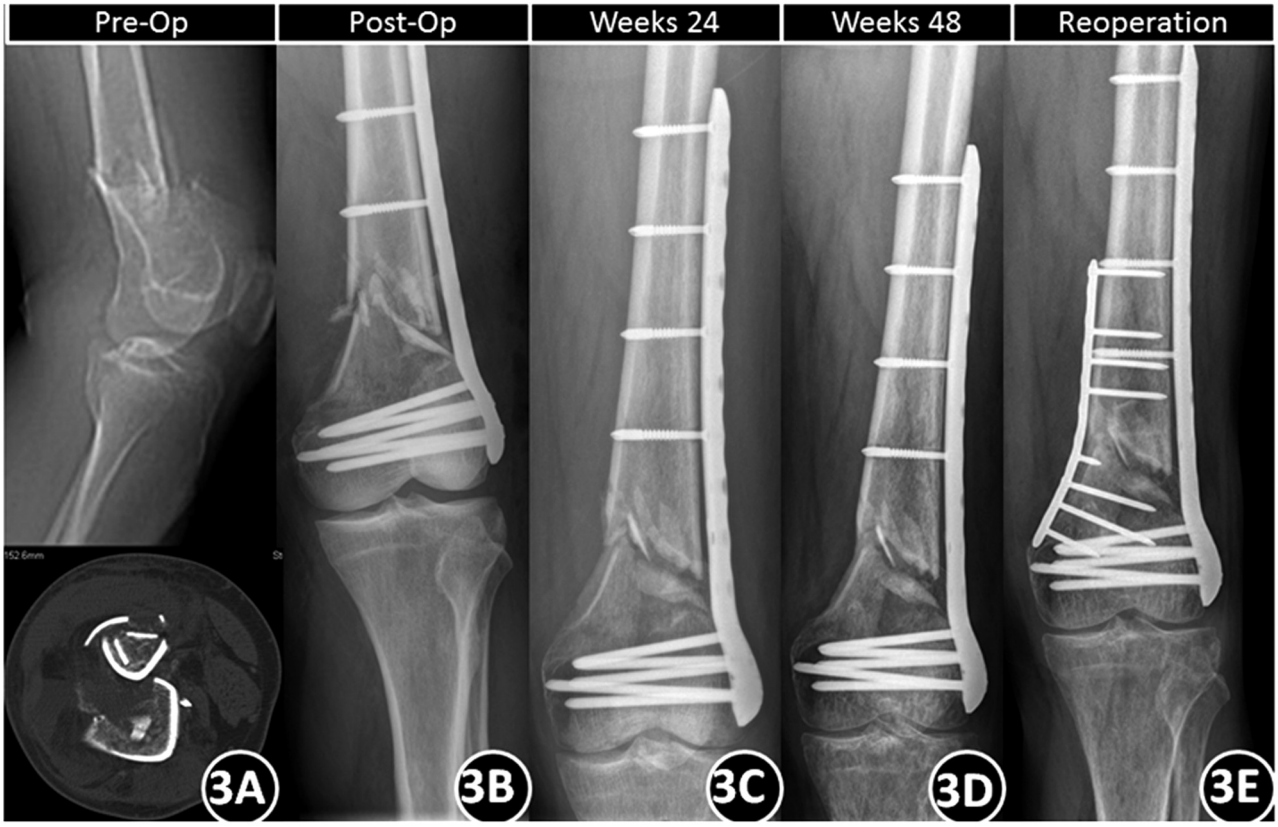

图 3 63 岁男性，车祸致股骨远端骨折，33A 型，使用 NCB+Motionloc 固定，随访 48 周，未见骨痂生长，再次入院后行切开复位内固定 + 植骨术

Fig.3 63 year old man with distal femoral fracture caused by car accident, AO classification: 33A，NCB+Motionloc was used for 48 weeks, no callus growth was found, and then open reduction, internal fixation and bone grafting were performed again

Note: 3A: preoperative picture of left knee joint: X-ray films: 33A;3B: 2 days after operation, 4 Motionloc screws were used, the femoral line was restored and the articular surface was well restored; 3C: 24 weeks after the operation, the fracture was not healed; 3D: 48 weeks after the operation, X-ray showed nonunion; 3E: After admission, autogenous iliac bone graft and medial femoral plate fixation were performed.

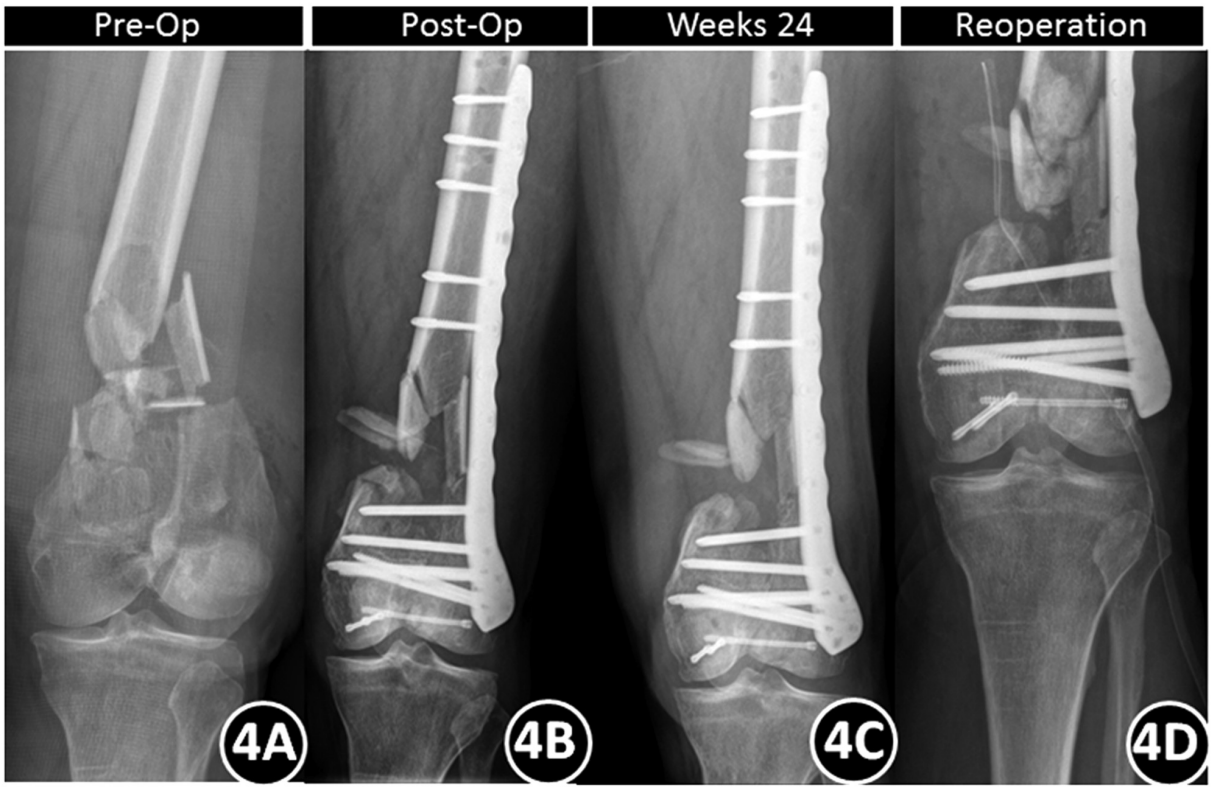

图 4 82 岁男性，摔伤致股骨远端骨折，33A 型，使用 NCB+Motionloc 固定，随访 24 周，未见骨痂生长，再次入院后行人工骨植骨术

Fig.4 82 year old man with distal femoral fracture caused by Ground level fall, AO classification: 33C, NCB+Motionloc was used for 24 weeks, no callus growth was found, and then reoperation with artificial bone grafting

Note: 4A: preoperative picture of left knee joint: X-ray films: 33C; 4B: 2 days after operation, 5 Motionloc screws were used, the femoral line was restored and the articular surface was well restored. However, there are massive bone defects; 4C: 24 weeks after the operation, X-ray showed nonunion;4D: reoperation with artificial bone grafting.

3 讨论

近年来，随着现代交通和建筑业的高速发展，股骨远端骨折逐年增多。按损伤机制可分为高能量损伤和低能量损伤，高能量损伤多见于交通伤和坠落伤，多为复杂的关节内粉碎骨折；而低能量损伤主要发生在合并骨质疏松症的老年患者，由于骨质疏松，螺钉对骨皮质把持力不足，易出现固定松动。这两种损伤均对骨折的治疗产生巨大挑战。目前广泛采用的内固定接骨术是为了达到两个看似矛盾的目的：在为骨折断端提供可靠的稳定性的同时又不会对骨折断端的自然愈合产生生物学和生物力学方面的影响[14]。尽管现代的锁定钢板已经可以最大限度的保护骨的血运，但是其自身固有的刚度仍然会对骨痂的形成造成影响，这种影响不利于骨折的二期愈合[15-20]。使用传统锁定钢板固定骨折断端，对侧皮质部位形成的骨痂要比靠近钢板侧皮质部位形成的骨痂多，其原因可能是骨折断端对侧皮质部位的微动要大于靠近钢板侧的皮质部位[21]。Lujan 等通过一项临床回顾性研究发现：传统锁定钢板治疗股骨远端骨折会抑制骨折断端骨痂的形成并且使骨痂的分布不均匀，靠近钢板侧的皮质骨痂形成明显要少。因此 Lujan 等认为当今锁定钢板固定系统的缺点：1.刚度较高，容易出现应力遮挡。2.骨折块间微动较少。3.骨痂形成少，骨痂形成不均匀。以上原因均不利于骨折的 2 期愈合[15]。为了减少锁定钢板系统的刚度，许多学者进行了不同的尝试。Stoffel 等在 2003 年发表的一项生物力学研究中报道：他们建议在靠近骨折断端的钢板远近端各少用 1 颗螺钉，从而增加钢板的跨度，即增加桥接距离，以此降低系统刚度。他们研究发现，省去 2 枚螺钉可以减少 45%的系统刚度[22]。

但是，这种做法最明显的缺点就是，增加钢板工作跨度以后，仅仅是钢板对侧皮质的微动明显增加了，钢板近侧皮质的微动并没有明显增加。另外，骨折断端处的水平剪切活动增加是轴向活动增加的 3 倍。水平剪切活动并不利于骨折的愈合[23-26]。

最近的一项关于桥接跨度的研究也提示，桥接跨度越长约容易增加水平微动，而轴向微动的增加并不明显。在分析了 66 例股骨远端骨折采用锁定钢板内固定治疗的患者之后，Elkins 等发现骨折断端的水平剪切活动会抑制骨痂的生长。这种增加桥接跨度来动力化钢板的方法存在明显弊端：减弱固定系统的强度，导致远侧和近侧皮质轴向微动的不平衡，增加额外的水平剪切活动。以上均不利于骨折的愈合[27]。

Bottlang 等在 2005 年美国矫形研究协会年会上首次提出 FCL 概念，即对侧皮质锁定技术。由此设计出首款 FCL 螺钉：Motionloc 螺钉[10,11]。Bottlang 等通过相关的生物力学实验和动物实验证明，Motionloc 螺钉和传统锁定螺钉相比，在保持同样内固定强度的同时，Motionloc 系统可以减少 84%的系统刚度。同时，与传统锁定系统相比，Motionloc 具有骨痂生成多，骨痂分布均匀等特点。最主要的，FCL 在固定骨折断端时，螺钉可以

尽可能的靠近骨折断端,不用额外增加钢板的桥接跨度,从而可以避免产生额外的水平剪切活动。Bottlang 等也对 Motionloc 进行了临床应用研究，他们利用 Motionloc 治疗了 33 例股骨远端骨折的患者,通过至少 1 年的随访,获得了较为满意的疗效[28]。

Julia 等通过力学实验,系统的比较了 4 种使内固定系统动态化的方法,发现非锁定螺钉固定并不能减少内固定物的刚度和骨折断端间的活动度,长跨度钢板内固定只会大幅增加系统的水平剪切活动而不是轴向活动，而 FCL 螺钉固定组则可以增加系统的轴向微动而不会增加水平剪切活动[29]。

需要注意的是，尽管 FCL 相对于传统锁定螺钉能够显著降低系统刚度,但其刚度仍然远高于外固定支架。但外固定架置于体外,给患者生活带来不便,且愈合时间相对较长,容易出现钉道的感染和渗出,随着髓内钉和锁定钢板等新型内置物的推广应用,目前外固定架仅用于开放性骨折的临时固定。本次研究结果显示,A 组患者在内固定治疗后骨折愈合时间和完全负重时间均显著短于对照组,术后患肢功能总优良率显著高于对照组,但是并发症发生率两组比较没有明显差异。以上结果提示,较之现有的锁定螺钉系统,使用对侧皮质锁定螺钉治疗股骨远端骨折患者可以获得更快的骨折愈合时间和更早的完全负重,患者的术后恢复时间更短。需要注意到的是,本研究中使用 Motionloc 固定出现了 2 例术后骨不连患者(图 3、图 4)。分析其原因可能是因为锁定钢板固定系统虽然可以最大程度减少对软组织和骨折血运的损伤,促进骨折愈合,但是如果患者出现部分骨折端明显缺损的时候,治疗过程中未予以基本纠正便进行固定,则反而会导致骨折愈合延迟等情况的出现。其次,使用 FCL 进行固定,骨折断端处为桥接区域,在桥接锁定系统本身就有轴向微动的前提下,FCL 为其提供了更大的轴向活动度,这种活动度如果在轴向上如果大于 4 mm,则会影响固定系统的稳定性,抑制骨痂的生成[30]。

因此,对于以上两例骨不连患者,再次入院后分别予以辅助内侧钢板固定增加稳定性以及骨缺损处植入同种异体骨治疗后均获得了愈合。但是,本研究受到研究时间以及样本容量等因素的限制,并没有对术后相关并发症的出现原因进行更深入全面的分析。因此,本研究还存在一些缺陷和不足,还需要在今后的研究中予以不断完善。

总体来讲,FCL 技术临床应用尚属初期阶段，总体上应用病例较少,观察时间较短,能否在长期临床实践中表现出与其生物力学和动物实验相似的效果,有待多中心、更大样本量的临床随机对照试验研究验证。以上,我们主要从 Motionloc 结构本身和手术技术等方面分析对比了它和锁定螺钉系统的临床治疗效果差异，取得了较为理想的结果。我们希望对于使用 Motionloc 的指征有一个更明确的规范，在更为具体的使用方法上也有指南能够产生。

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