

异体皮质骨板结合髂骨植骨辅助钢板治疗肱骨干骨折骨不连的短期临床疗效

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【摘要】 目的 探究肱骨外侧锁定钢板+自体髂骨植骨+皮质骨骨板辅助钢缆捆绑固定治疗肱骨干骨折骨不连的短期临床疗效。**方法** 回顾性收集本院骨创病区2016年9月至2020年9月间接诊的肱骨术后骨不连的23例患者。男性15例,女性8例;平均年龄22~65(40.6±3.8)岁。骨不连均采用肱骨外侧锁定钢板+自体髂骨植骨+皮质骨骨板辅助钢缆捆绑固定治疗。肩肘功能随访,使用肩关节Neer评分以及Mayo肘关节功能评分(MEPS)系统。**结果** 23例患者平均随访12~16(14.2±2.1)月。所有患者影像学表现均达到骨性愈合,且无肢体畸形改变;愈合时间平均为5~13(7.2±1.2)月。Neer肩关节功能在最后一次随访中的评分为72~96(84.5±8.2)分,优13例,良7例,中3例,优良率为86.9%;MEPS评分在最后一次随访中的评分为68~98(86.4±9.1)分,优15例,良6例,中2例,优良率为91.3%。**结论** 采用肱骨外侧锁定钢板+自体髂骨植骨+皮质骨骨板辅助钢缆捆绑固定治疗肱骨干骨折,可实现肱骨的初始机械稳定,也可达到远期生物稳定;自体松质骨可有效诱导成骨,钢板与骨板结合增加了肱骨断端稳定性,实现了力学与生物学双方面的骨骼重建,使骨折愈合的几率大大增加。

【关键词】 肱骨干骨折; 骨不连; 异体骨板; 植骨

Short-term clinical efficacy of allogeneic cortical bone plate combined with iliac bone graft as an auxiliary plate in the treatment of nonunion of humeral shaft fractures Zhao Qingbin, Yin Jian, Xiao Wei, Sun Jungang, Zhou Wenzheng. Department of Orthopedic Trauma, People's Hospital of Xinjiang Uygur Autonomous Region, Urumqi 830000, China

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【Abstract】 Objective To explore the short-term clinical effect of lateral locking plate of humerus+autologous iliac bone graft+cortical bone plate assisted by steel cable binding fixation in the treatment of nonunion of humeral fractures. **Methods** A retrospective analysis was conducted on 23 cases of postoperative nonunion of humeral fractures admitted from September 2016 to September 2020 in the bone trauma department of our hospital. 15 male patients and 8 female patients; The average age ranged from 22-65 (40.6±3.8) years. All cases of nonunion were treated with lateral locking plate of humerus, autologous iliac bone graft, and cortical bone plate assisted by steel cable binding and fixation. Shoulder and elbow function follow-up was conducted using the shoulder Neer score and the Mayo elbow function score (MEPS) system. **Results** 23 patients were followed up for an average of 12-16 (14.2±2.1) months. The imaging findings of all patients achieved bony union, and there were no abnormal changes in the limbs; The average healing time was 5-13 (7.2±1.2) months. In the last follow-up, the score of Neer's shoulder joint function was 72-96 (84.5±8.2) points, with 13 excellent, 7 good, and 3 moderate. The excellent and good rate was 86.9%; The MEPS score at the last follow-up ranged from 68-98 (86.4±9.1) points, with 15 excellent, 6 good, and 2 moderate. The excellent and good rate was 91.3%. **Conclusions** The treatment of nonunion of humeral fractures with lateral locking plate of humerus, autologous iliac bone graft, and cortical bone plate assisted by steel cable binding fixation can achieve initial mechanical stability and long-term biological stability of the humerus; Autologous cancellous bone can effectively induce bone formation. The combination of steel plate and bone plate in-

creases the stability of the broken end of the humerus, achieving both mechanical and biological bone reconstruction, and greatly increasing the probability of fracture healing.

【Key words】 Humeral fracture; Nonunion; Allogeneic bone plate; Bone graft

随着骨折内固定材料与技术的提升,肱骨骨折仍有2%~10%发生骨不连^[1-4]。外界因素中可致使骨不连的因素包括周围软组织的重度损害、开放骨块的复位、剥离过多的骨膜或碎骨块的过度游离等^[5-6]。而其自身因素包括肥胖、酗酒、吸烟等问题,也包括一些手术前无法纠正的因素,例如骨质疏松症、代谢以及内分泌异常^[7-9]。肱骨干骨不连的治疗目标包括良好的肘关节及肩关节功能,骨不连的治愈以及更快的功能康复时间。目前,相关文献中已证实,切开复位钢板内固定结合加松质骨局部移植,有较好的临床疗效^[10]。力学稳定以及通过植骨进行生物学刺激在治疗肱骨干骨不连的过程中尤为重要^[11-12]。髂骨是自体骨移植最常见的来源,髂骨植骨联合钢板内固定后,肱骨骨不连愈合率较高^[13-15]。但自体髂骨可用性有限,针对骨缺损及骨量减少的患者,我们采用自体髂骨植骨(骨不连断端结构植骨)+皮质骨板辅助钢缆捆扎固定治疗,并对这23例患者进行回顾性分析,探究其临床效果和手术可行性。

资料与方法

一、病例纳入与排除标准

病例纳入标准:①选取第一次使用固定方式为钢板固定的患者;②骨不连符合诊断标准;③年龄为19~70岁的患者。

病例排除标准:①病理性骨折,经首例手术确诊;②神经受损患者;③骨不连因感染引起;④上肢运动障碍严重的患者;⑤基础病较重者。

二、一般资料

术前X线片及CT的常规检查。检验学检测包括炎症因子及血常规检测(红细胞沉降率、C-反应蛋白、降钙素原以及血常规等),为明确有无感染,必要时需完善磁共振及骨扫描检查。

骨不连的诊断标准:术后9个月骨折没有愈合,同时连续3个月没有任何愈合迹象;临床表现断端出现疼痛,运动时加重。

首次骨折分型为:12A3型为7例,12A2型为6例,12A1型3例;12B2型3例,12B1型4例。

31例肱骨骨不连患者中,3例因金葡萄菌感染引

起骨不连而排除,2例因桡神经断裂肢体功能欠佳而排除,1例因严重基础疾病且不能耐受手术而排除,2例为脑梗后遗症致肢体偏瘫而排除,纳入研究的患者共23例,平均年龄为22~65(40.6±3.8)岁。有8名女性和15名男性。10例患者为左上肢,13例患者为右上肢。优势肢体治疗16例,非优势肢体治疗7例。患者骨不连手术与骨折初次手术的时间间隔平均为7~12(9.5±2.3)月。低能量损伤(13例),机动车辆人员事故(10例)。所有骨折均为闭合性骨折。六名患者(26.1%)是吸烟者。骨不连涉及3例(18.75%)肱骨干的近端三分之一,10例(62.5%)肱骨干的中三分之一,3例(18.75%)的肱骨干的远端三分之一。

此次研究已获得医学伦理委员会批准,手术前患者均签署肱骨骨不连翻修手术治疗知情同意书(伦理批号:KY2022072245)。

三、手术方法

手术旨在矫正患肢长度、成角畸形以及旋转畸形,并通过间接复位提供对骨折的充分固定,后外侧放置长钢板起桥接作用,外侧放置骨板提供支撑,同时营造有利于骨愈合的环境。1名高年资组长带领其团队共同完成手术治疗。术前抗菌素预防术中及术后感染发生,臂丛神经阻滞麻与全麻联合麻醉方式进行麻醉。初次手术及骨不连位置决定手术入路(其中16例前外侧入路,7例后方入路)

在手术中,骨折愈合的关键步骤是避免过度剥离软组织。寻找桡神经,找到后给予皮片保护。打开并探查骨折的骨不连部位(在3例患者中发现骨折断端软组织嵌插,3例断钉断板),并且在移除任何先前放置的钢板后确定了骨不连的部位,并进行了彻底的清创术。所有患者局部均送病理检查及一般细菌培养。骨不连部位周围除去所有的纤维和疤痕组织,包括整个假囊,直到在骨不连断端看到点状出血(辣椒征)。用钻头打开髓腔,用直尺测量骨缺损,以预期放置适当大小的自体髂骨。取合适大小髂骨,保留髂骨皮质,骨刀给予髂骨修整形状,使其能够紧密地插入整个骨折部位。骨折复位后选用肱骨远端外侧干骺端锁定钢板进行固定,翻修的钢板长度要足够长,上、下端保证3~4枚螺钉以维持稳定。皮质骨骨板置于外侧,捆绑带将骨板与肱骨捆

绑达到骨板与宿主骨紧密接触效果。然后在骨折线、骨板与股骨缝隙间植入剩余自体髂骨块,局部冲洗,留置引流管,将伤口分层关闭。

四、术后处理及疗效评价

术后切口引流均顺利拔除,术后当天再次给予抗生素一次,如后期伤口红肿,酌情给予抗生素预防感染。手术以后的定期复查,X线片为主要判断骨折愈合程度(必要时CT)。Neer及MEPS评分用来评估肩肘关节功能情况。

五、统计分析

采用SPSS 22.0(IBM,美国)统计软件进行数据录入及统计分析,计量资料采用Shapiro-Wilk检验是否符合正态分布,符合正态分布的计量资料,其中包括年龄、随访时间、愈合时间、Neer评分、MEPS评分,均采用 $\bar{x} \pm s$ 表示。检验水准 α 值取双侧0.05。

结 果

一、术中及术后结果

分泌物以及局部增生组织进行一般细菌培养、药敏实验以及病理检查均未见感染征象。手术时间为75~140 min,平均 (92 ± 13) min,术中出血量255~515 ml,平均 (395 ± 123) ml,术后引流量135~180 ml,平均 (160 ± 24) ml。

二、随访结果

23例患者均获得完整随访,随访率100%,随访时间为12~16月,平均 (14.2 ± 2.1) 月。23例患者骨

折不畸形改变,全部达到骨性愈合,愈合时间为5~13月,平均 (7.2 ± 1.2) 月。术后影像学可显示骨板与肱骨基本成为一体,2月左右骨板在体内开始骨重建,皮质外骨桥形成,影像学显示三个层面以上生成骨痂,达到骨性愈合。最后一次随访:Neer肩关节功能评分为72~96分,平均 (84.5 ± 8.2) 分,优13例,良7例,中3例,优良率为86.9%;MEPS评分为68~98分,平均 (86.4 ± 9.1) 分,优15例,良6例,中2例,优良率为91.3%。23例患者中没有螺钉及钢板松动、钢板断裂等发生。

三、并发症及康复结果

23例患者中以上肢功能减退以及桡神经的损害为主要并发症。3例患者围手术期出现了桡神经麻痹症状,主要表现为拇指和食指麻木,通过服用3个月的甲钴胺营养神经治疗,已完全康复。23例患者均无感染发生。在6名吸烟者中,均建议患者戒烟,4例患者成功戒烟,2例患者未戒烟,未发生并发症。术后制动6周,颈腕吊带常规固定,腕肘肩关节被动康复功能锻炼于术后3 d进行,患肢持重需待骨折愈合后再进行。典型病例见图1~12。

讨 论

一、肱骨骨不连治疗进展

目前,髓内针和钢板固定是治疗长骨干骨折不连接的主要手段,相关文献已证实两种方案的临床疗效^[16-19]。对于初次长骨干四肢骨折或者长骨干

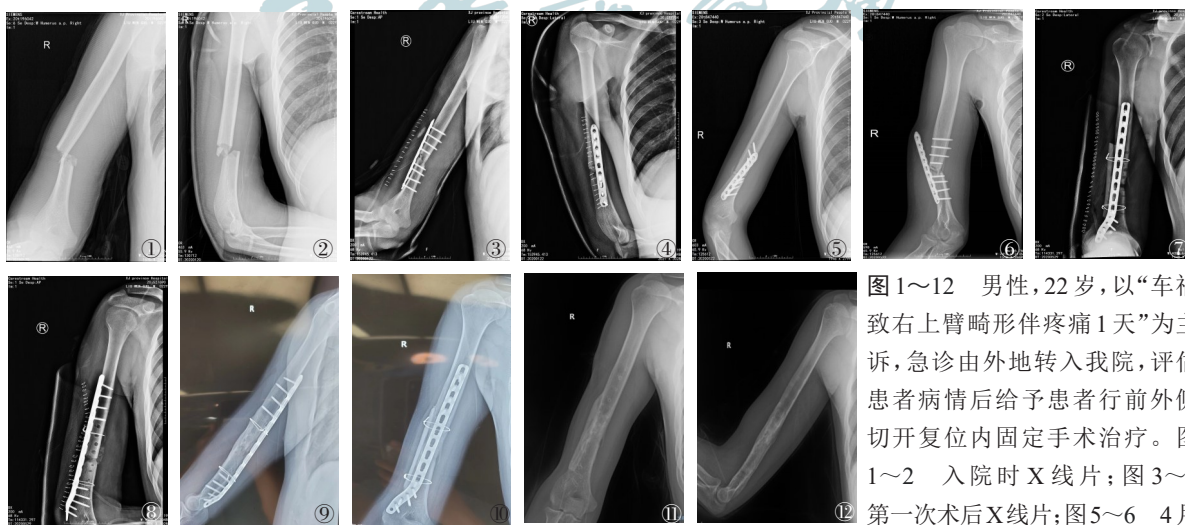


图1~12 男性,22岁,以“车祸致右上臂畸形伴疼痛1天”为主诉,急诊由外地转入我院,评估患者病情后给予患者行前外侧切开复位内固定手术治疗。图1~2 入院时X线片;图3~4 第一次术后X线片;图5~6 4月后患者摔倒后再次出现右上臂肿痛伴局部畸形改变,行X线片检查后考虑为:右侧肱骨骨折;右侧肱骨骨折术后螺钉断裂,于2019年6月再次给予患者右侧肱骨翻修手术;图7~8 翻修术后X线片;图9~10 翻修术后1年X线片;图11~12 内固定取出术后X线片

骨折的不愈合,交锁髓内钉的应用已被广大医生所接受^[20]。髓内针在肥大型骨不连的治疗中有较好的临床效果,其可通过粗于肱骨髓腔直径来增加肱骨断端的生物力学稳定性,并通过在断端植骨促进骨长入^[21-22]。但是,肱骨干骨不连使用髓内针的治愈率在40%至95.6%之间^[23-25]。由于本研究中的大多数患者存在骨质减少以及骨缺损的情况,因此难以通过髓内针实现良好的旋转控制并达到绝对稳定。此外,更换髓内针可能会增加肩袖损伤的风险,进而增加肩关节活动僵硬的风险,因此,针对本研究的患者,我们未选择髓内针固定进行治疗。

骨不连的治疗中,钢板仍占绝大多数,其中包括加压钢板结合自体腓骨、双钢板^[26-29]等。而研究也表明,为帮助骨折有效愈合,可术中自体与异体骨移植^[30]。钢板和松质骨移植物的联合使用可增加骨不连的愈合率,其既可以通过钢板实现刚性固定,又可以通过断端植骨、断端新鲜化改善骨折断端的成骨性。萎缩型骨不连存在断端骨量丢失,治疗时需通过植骨增加强度及增强断端成骨活性,同时需将断端死骨去除并进行新鲜化。Peters等^[31]研究表明,钢板固定联合自体骨移植的使用实现了较高的愈合率(平均愈合率为98%)。Feng等^[32]在对6例骨不连的患者治疗过程中得出结论,锁定加压钢板可以通过压缩骨节段和纠正畸形来实现较高的稳定性,自体髂骨植入可促进新血管形成以及成骨细胞的迁移,其可以营造有利于骨骼愈合的环境。

二、植骨在肱骨骨不连中的重要作用

目前植骨选择的“金标准”,仍是自体髂骨松质骨,其主要作用为诱导成骨作用强^[33-35]。但松质骨存在结构松散、坚强稳定性不足等缺点。异体骨板采用深低温方式保存(冷冻可达-70°),低温保存可降低骨板免疫活性,但其骨诱导活性以及机械性能未受影响,异体骨板结合钢板能维持骨折的初始机械稳定性,并可有效避免应力遮挡作用;骨板的弹性模量与宿主骨非常接近,使其可达到初始机械稳定与远期生物稳定共同实现的目的。但骨板与肱骨之间仍存在间隙,故我们的翻修患者均选择自体髂骨结合异体骨板,自体髂骨条、骨泥填塞在骨折断端、骨板与肱骨间,需要强调的是,异体骨板以及自体髂骨需与宿主骨密切接触,我们使用捆绑带将其紧密且稳定的固定在一起,从而达到骨板与宿主骨融为一体的最终目标。在髋关节翻修中,异体骨板已被广泛应用于股骨骨缺损的治疗中,Lim等^[36]回顾性分

析了28例髋关节翻修病例,自2004年至2014年平均随访时间为5.4±3.9年,结果显示,髋翻修中使用异体骨板可有效弥补股骨干缺损的情况,并取得了良好的临床结果及骨性愈合的影像学检查。Ding等^[37]同样对47例髋关节翻修的患者进行回顾性分析,其结果表明,异体骨板可有效降低应力遮挡,增加骨缺损区域的骨修复,并可有效改善髋关节翻修中的股骨骨量缺损。因此,我们借鉴了髋关节翻修中骨板应用的原理,将异体骨板结合自体髂骨移植应用在肱骨骨不连的治疗中。

三、本研究的依据及结果

本研究选择的对象多为骨量减少及骨缺损患者,此类患者使用皮质骨板,骨缺损可得到有效改善并极大提高骨折愈合几率,骨板、自身髂骨与肱骨的充分接触可最大的发挥自体骨的骨生产、骨传导及骨诱导的作用,从而限制肱骨局部应力遮挡对骨量的影响。Emerson等、Head等^[38-39]已证明,异体骨板可被破骨细胞,成骨细胞和血管侵入,并被宿主骨替代并保持生物活性,从而进一步进行适应性骨重构。Riviere等^[40]研究结果表明,异体皮质骨板改变了宿主骨骼的生物学环境,使宿主骨骼更好的应对压力及应力性遮挡。因此针对此类严重骨缺损及骨量丢失的患者,我科选择钢板+骨板治疗,本组患者的治疗结果令人满意,23例患者骨不连均达到骨性愈合,且无畸形改变;皮质外骨桥在末次随访时均已形成,实现了骨板与肱骨重塑,进而达到骨重建。证实此方法既增加了可实现初始机械稳定,又可实现的远期生物稳定的目的。

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