

doi: 10.13241/j.cnki.pmb.2021.18.029

弹性髓内钉与接骨板内固定治疗儿童股骨干骨折的临床疗效对比研究*

胡 熙 毛 伟[△] 姜 飞 顾耘宇 宋志杰

(昆明市儿童医院创伤外科 云南昆明 650034)

摘要 目的:对比弹性髓内钉与接骨板内固定治疗儿童股骨干骨折的临床疗效。**方法:**本研究为回顾性研究,选取我院于2018年3月~2019年8月期间收治的儿童股骨干骨折患者98例,根据固定方式的不同将患儿分为A组($n=50$,接骨板内固定治疗)和B组($n=48$,弹性髓内钉治疗),观察两组优良率、术前/术后相关指标及并发症发生情况。**结果:**B组的优良率高于A组($P<0.05$)。B组手术时间、切口长度短于A组,术中出血量少于A组($P<0.05$)。B组骨折愈合时间、住院时间、手术至内固定拆除时间、取出内固定手术时间短于A组($P<0.05$)。两组患儿并发症发生率对比,差异无统计学意义($P>0.05$)。**结论:**相对于接骨板内固定治疗,弹性髓内钉治疗儿童股骨干骨折,疗效更好,可有效改善术中、术后指标,且不增加并发症的发生率。

关键词:弹性髓内钉;接骨板内固定;儿童;股骨干骨折;临床疗效;对比

中图分类号:R683 文献标识码:A 文章编号:1673-6273(2021)15-3533-05

Comparative Study on the Clinical Effect of Elastic Intramedullary Nail and Bone Plate Internal Fixation in the Treatment of Femoral Shaft Fractures in Children*

HU Xi, MAO Wei[△], JIANG Fei, GU Yun-yu, SONG Zhi-jie

(Department of Trauma Surgery, Kunming Children's Hospital, Kunming, Yunnan, 650034, China)

ABSTRACT Objective: To compare the clinical efficacy of elastic intramedullary nail and plate fixation in the treatment of femoral shaft fractures in children. **Methods:** This study was a retrospective study. 98 cases of children with femoral shaft fracture in our hospital from March 2018 to August 2019 were selected. According to the different fixation methods, the patients were divided into group A ($n=50$, bone plate internal fixation treatment) and group B ($n=48$, elastic intramedullary nail treatment). The excellent and good rate, pre-operative/postoperative related indicators and complications of the two groups were observed. **Results:** The excellent and good rate of group B was higher than that of group A, and the difference was statistically significant ($P<0.05$). The operation time, incision length of group B were shorter than those of group A, and intraoperative blood loss was less than that of group A ($P<0.05$). The fracture healing time, hospitalization time, operation to internal fixation removal time, removal of internal fixation operation time of group B were shorter than those of group A ($P<0.05$). There was no significant difference in the incidence of complications between the two groups ($P>0.05$). **Conclusion:** Compared with bone plate internal fixation, elastic intramedullary nail has better efficacy in the treatment of femoral shaft fractures in children, which can effectively improve the intraoperative and postoperative indicators, and do not increase the incidence of complications.

Key words: Elastic intramedullary nail; Bone plate internal fixation; Children; Femoral shaft fractures; Clinical efficacy; Comparison

Chinese Library Classification(CLC): R683 **Document code:** A

Article ID: 1673-6273(2021)18-3533-05

前言

股骨干骨折是指小转子下至股骨髁上之间的股骨骨折,儿童股骨干骨折在儿科创伤中较为常见,约占儿童骨折总数的1.6%,且男女比例约为2.75:1^[1-3]。一般情况下,股骨干不易骨折,当遭受车祸、高处跌落、挤压力性损伤时可引起股骨干骨折^[45]。儿童股骨干骨折的症状主要包括肿胀、压痛、短缩畸形,

因儿童依从性较差,保守治疗易出现骨折复位不理想,故其主要治疗方案为手术治疗,大多数预后良好^[67]。弹性髓内钉与接骨板内固定治疗均是治疗儿童股骨干骨折的常用方法,接骨板内固定固定牢固,可促进患儿早期功能锻炼,但也存在一些缺点,如切口较长、术中失血量多,手术风险相对较高等^[89]。弹性髓内钉内固定具有微创、骨折愈合快、并发症少等优势,其在成人骨折中获得了较好的疗效,但由于其不能良好的控制长度和

* 基金项目:云南省卫生科技计划资助项目(2016NS024)

作者简介:胡熙(1979-),男,本科,副主任医师,研究方向:儿童创伤外科,E-mail: hx19988580971@163.com

[△] 通讯作者:毛伟(1978-),男,本科,副主任医师,研究方向:儿童创伤外科,E-mail: 2905453283@qq.com

(收稿日期:2021-03-05 接受日期:2021-03-27)

旋转,在儿童骨折中的应用仍需进一步研究及大样本量的证实^[10,11]。本研究通过对比弹性髓内钉与接骨板内固定治疗儿童股骨干骨折的临床疗效,以期为临床治疗提供数据参考。

1 资料与方法

1.1 一般资料

本研究为回顾性研究,选取我院于2018年3月~2019年8月期间收治的儿童股骨干骨折患者98例,纳入标准:(1)年龄3~11岁;(2)经X线等影像学证实为股骨干骨折,骨折时间 ≤ 2 周;(3)耐受本次研究治疗方案者;(4)临床资料完整,均完成随访者。排除标准:(1)合并精神疾患,无法配合治疗者;(2)病理性骨折、粉碎性骨折患者;(3)开放骨折或多发骨折患者;(4)伴有免疫缺陷、感染者;(5)中途转其他治疗者。根据固定方式的不同将患者分为A组($n=50$,接骨板内固定治疗)和B组($n=48$,弹性髓内钉治疗),其中A组男童29例,女童21例,年龄3~10岁,平均 (5.68 ± 0.72) 岁;骨折时间2~14 d,平均 (8.26 ± 1.47) d;致伤原因:高空坠落13例,交通事故26例,挤压力性损伤11例;骨折部位:上段14例,中段30例,下段6例;骨折类型:斜形骨折17例,横形骨折24例,螺旋形骨折9例。B组男童26例,女童22例,年龄4~9岁,平均 (5.73 ± 0.81) 岁;骨折时间4~14 d,平均 (8.10 ± 2.03) d;致伤原因:高空坠落11例,交通事故25例,挤压力性损伤12例;骨折部位:上段15例,中段26例,下段7例;骨折类型:斜形骨折16例,横形骨折22例,螺旋形骨折10例。两组一般资料组间对比无统计学差异($P>0.05$),具有可比性。

1.2 方法

术前准备:两组患儿入院后行过腰石膏后托外固定,通过拍摄X线片测量股骨髓腔最窄处直径,计算弹性髓内钉、接骨板的直径,弹性钉直径为髓腔最窄处直径的40%。A组:接骨板内固定治疗,患儿采用硬外麻或静脉全麻,于股外侧作一切口,长约10~12 cm,钝性分离肌肉至股骨骨膜,逐层切开,通过旋转、牵引、克氏针、折顶撬拨等方法行骨折复位,C臂透视骨折复位满意后,选取长度适宜的接骨板,从切口导入至股骨上段,位置核实后,分别从股骨近端经皮打孔及股骨下段切口处拧入

锁定螺钉固定。术后1 d内使用抗生素预防感染,术后2 d根据患儿恢复情况进行膝关节、髋关节伸屈锻炼,待有骨痂生长后开始进行负重训练,骨折达到愈合标准后拆除接骨板。B组:弹性髓内钉内固定术治疗,取患肢股骨远端断端上方内外侧各做一切口,长约2~3 cm,于切口近端垂直开口钻入髓腔,髓内钉直径为填充髓腔最狭窄处直径的80%为佳。从外侧切口插入第一枚髓内钉,C臂下骨折闭合复位,推入髓内钉弧部顶端达骨折水平,使钉头部暂时不穿出骨折端,通过折顶、牵引、旋转、克氏针撬拨方法进行骨折复位;复位后再于内侧插入第二枚弹性髓内钉,钉尾露在皮质外0.5~1.0 cm,于髓内成“X”形的6点固定。术后1 d内均给予抗感染治疗,石膏固定3~4周,术后6~8周开始进行负重训练,骨折达到愈合标准后拆除弹性髓内钉。

1.3 观察指标

(1)采用门诊复查的形式对两组患儿进行为期9个月的随访。优:无疼痛畸形,膝关节完全伸直,可屈曲 120° ,下肢短缩 <1 cm。良:屈曲 $90^\circ \sim 120^\circ$,无畸形,膝关节完全伸直,下肢短缩 <2 cm。可:膝关节伸直 $<10^\circ$,畸形 $<10^\circ$,屈曲 $60^\circ \sim 90^\circ$,有轻微疼痛,下肢短缩 <3 cm。差:屈曲 $<60^\circ$,膝关节伸直 $>10^\circ$,畸形,持续重度疼痛,下肢短缩 >3 cm。优良率=优率+良率^[12]。(2)统计两组术中出血量、手术时间、切口长度情况。(3)统计两组术后恢复指标,包括骨折愈合时间、住院时间、手术至内固定拆除时间、取出内固定手术时间。(4)记录两组切口感染、骨折不愈合、畸形愈合、肢体不等长等并发症的发生情况。

1.4 统计学方法

采用SPSS24.0进行统计分析。计数资料以频数或百分数表示,采用 χ^2 检验。计量资料以均数 $\pm$ 标准差($\bar{x} \pm s$)表示,采用t检验。以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 两组疗效对比

B组的优良率为75.00%,高于A组的56.00%,差异有统计学意义($P<0.05$),详见表1;A、B两组术前、术后及取出内固定后图片,见图1,2。

表1 两组疗效对比[例(%)]

Table 1 Comparison of curative effect between the two groups [n(%)]

Groups	Excellent	Good	Can	Bad	Excellent and good rate
Group A($n=50$)	9(18.00)	19(38.00)	14(28.00)	8(16.00)	28(56.00)
Group B($n=48$)	14(29.17)	22(45.83)	8(16.67)	4(8.33)	36(75.00)
χ^2					3.902
P					0.048

2.2 两组手术相关指标对比

B组术中出血量少于A组,手术时间、切口长度短于A组,差异有统计学意义($P<0.05$),详见表2。

2.3 两组术后相关指标对比

B组骨折愈合时间、住院时间、手术至内固定拆除时间、取出内固定手术时间短于A组,差异有统计学意义($P<0.05$),详见表3。

2.4 两组并发症发生率对比

两组并发症发生率对比无统计学差异($P>0.05$),详见表4。

3 讨论

股骨是人体中最长的管状骨,股骨干包括股骨髁上2~5厘米至粗隆下2~5厘米的骨干^[13]。由于大腿的肌肉发达,股骨干骨折后多有错位及重叠,骨折远断端常向后成角,故易刺伤

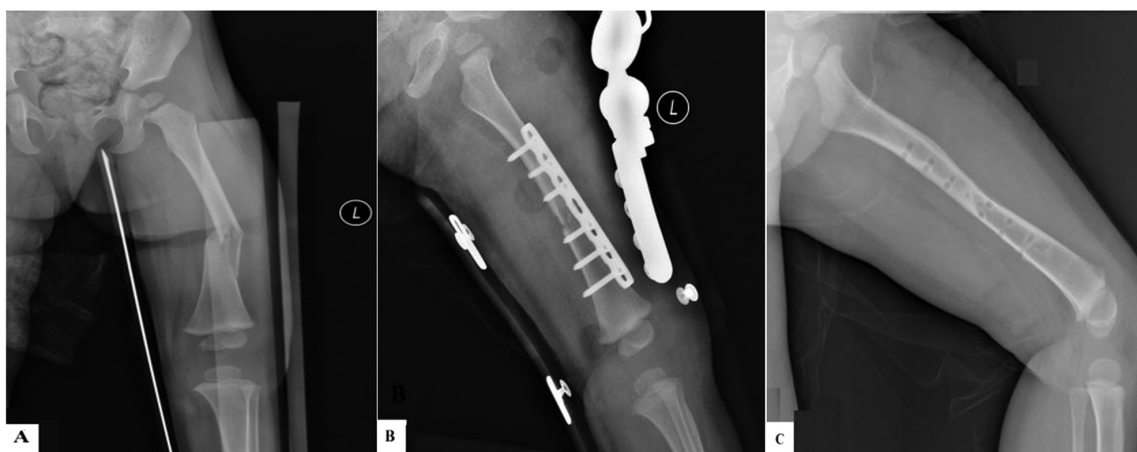


图 1 接骨板内固定治疗

Fig.1 Treatment of bone plate internal fixation

Note: female, 3 years old; A: preoperative X-ray film showed 1/3 fracture of the lower femur; B: postoperative X-ray film showed anatomical reduction on 1 day; C: postoperative internal fixation was taken out after 8 months to show fracture healing on 1 day.

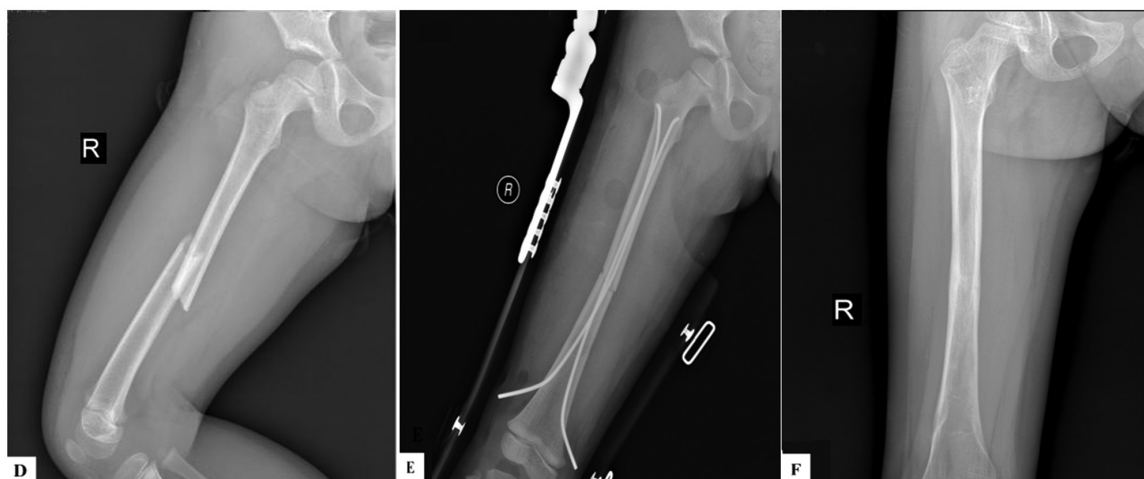


图 2 弹性髓内钉固定治疗

Fig.2 Treatment of elastic intramedullary nail fixation

Note: female, 5 years old; D: preoperative X-ray film showed fracture of middle femur; E: postoperative X-ray film showed functional reduction 2 days; F: postoperative internal fixation was taken out 6 months later, fracture healing 1 day.

表 2 两组手术相关指标情况对比($\bar{x} \pm s$)Table 2 Comparison of operation related indicators between the two groups($\bar{x} \pm s$)

Groups	Operation time(min)	Intraoperative blood loss(mL)	Incision length(cm)
Group A(n=50)	67.98± 4.55	98.56± 7.08	11.31± 1.25
Group B(n=48)	42.61± 3.04	32.53± 5.15	2.37± 0.12
t	32.318	52.615	49.323
P	0.000	0.000	0.000

表 3 两组术后相关指标对比($\bar{x} \pm s$)Table 3 Comparison of postoperative related indicators between the two groups($\bar{x} \pm s$)

Groups	Fracture healing tim (weeks)	Hospitalization time(d)	Operation to internal fixation removal time(d)	Removal of internal fixation operation time(min)
Group A(n=50)	27.56± 4.23	12.56± 3.64	258.46± 9.28	37.85± 3.16
Group B(n=48)	23.49± 2.74	10.98± 2.17	237.46± 8.32	25.13± 3.27
t	5.628	2.597	11.779	19.583
P	0.000	0.011	0.000	0.000

表 4 两组并发症发生率对比 [例(%)]

Table 4 Comparison of the incidence of complications between the two groups [n(%)]

Groups	Incision infection	Fracture nonunion	Malunion	Unequal length of limbs	Total incidence rate
Group A(n=50)	2(4.00)	1(2.00)	2(4.00)	1(2.00)	6(12.00)
Group B(n=48)	1(2.08)	1(2.08)	0(0.00)	1(2.08)	3(6.25)
χ^2					0.971
P					0.324

该处的腓动、静脉,出现疼痛、肿胀、肢体功能异常、血压下降、活动受限等症状,严重者会发生休克,危及患者性命^[14,15]。儿童由于年纪尚幼,保守治疗恢复缓慢,且患儿依从性差,故手术是其首选治疗方案。手术可帮助骨折患儿牢固固定伤处,早期进行功能训练,降低畸形愈合风险^[16]。由于股骨干解剖形态复杂,复位应达到以下要求:坚强固定达到早期功能锻炼的要求;恢复股骨远端力线,防患膝内外翻畸形^[17,18]。现临床涉及到股骨干骨折的治疗均在复位完整后采用内固定。接骨板内固定治疗固定牢靠,对骨面无压迫,可最大程度地减少固定侧骨质的血,但接骨板内固定的固定时间较长,术后疼痛明显,易发生膝关节功能障碍,患者恢复速度较慢^[19]。弹性髓内钉在国外被广泛地应用于治疗小儿四肢长管状骨骨折的治疗中,由于弹性髓内钉置入过程中无需扩髓及剥离骨膜,对骨折端血供影响小,符合生物力学,但弹性髓内钉治疗具有较为严格的适应症^[20]。两种内固定方式各有优势劣势,就此对比两种内固定方式的疗效。

本研究结果显示,相比接骨板内固定治疗,弹性髓内钉治疗优良率更高,切口小,手术时间短,术中出血量少,术后愈合快,能有效缩短住院时间,同时还能有效缩短手术至内固定拆除时间以及取出内固定手术时间,促进患者术后早期恢复,且不增加并发症发生率,疗效显著。弹性髓内钉生物相容性佳,具有较稳定的可塑性,固定过程中操作简单创伤小,置入过程中无需扩髓,无需剥离骨膜,有效缩短手术时间^[21,22]。同时弹性髓内钉置入过程中对骨折周围软组织及骨膜破坏较轻,能够减少术中出血量,促进患者术后恢复,缩短住院时间^[23,24]。弹性髓内钉在使用前预弯成高度为峡部直径3倍的弧形,在髓腔内通过钉头、弧顶、钉尾构成三点支撑产生弹性力矩,产生交叉应力,能有效维持骨折纵向轴线,在术后早期肢体主动活动或部分负重时,允许骨折端存在微动,有利于骨痂形成,促进骨愈合,增加骨折愈合强度^[25,26]。此外,与接骨板内固定相比,弹性髓内钉应力遮挡效应较小,除了利于骨痂形成外,在拆除内固定装置时,拆除弹性髓内钉也更有优势^[27,28]。接骨板内固定在打孔拆除螺钉过程中常因螺帽内软组织长入堵塞导致置入螺丝刀困难,且也时常出现拆除钢板的创口比植入钢板时还大,增加二次损伤及手术时间,而弹性髓内钉可避免上述困难,明显缩短取出内固定手术时间^[29,31]。值得注意的是,接骨板内固定适应证为长骨骨干简单骨折、粉碎性骨折,而弹性髓内钉虽具有诸多优势,但其在粉碎及不稳定骨折患儿中的应用仍颇受限制,术后早期需辅助支具外固定^[32,33]。本研究仍存在以下不足:病例数相对较少,非前瞻性随机对照试验,随访时间较短。接下来将联合多地区,加大病例样本量开展前瞻性研究,以期获取准确的数据指导临床治疗。

综上所述,弹性髓内钉治疗儿童股骨干骨折的疗效比接骨板内固定治疗更好,手术中对患儿的创伤更小,愈合更快,具有一定的临床推广价值,但在临床实际中应综合考虑患者的骨折类型、软组织条件及医生的经验等来选择合适的治疗方法。

参考文献(References)

- [1] 李兵兵, 王晓燕. 专家级青少年股骨外侧髓内钉内固定治疗大龄儿童股骨干骨折[J]. 中国骨与关节损伤杂志, 2019, 34(2): 155-156
- [2] von Heideken J, Thiblin I, Högborg U. The epidemiology of infant shaft fractures of femur or humerus by incidence, birth, accidents, and other causes[J]. BMC Musculoskelet Disord, 2020, 21(1): 840
- [3] 龙江涛, 白德明, 李杰, 等. 儿童股骨干骨折保守治疗早中期疗效分析[J]. 中国药物与临床, 2017, 17(4): 561-563
- [4] Lu Y, Wang Y, Song Z, et al. Treatment comparison of femoral shaft with femoral neck fracture: a meta-analysis [J]. J Orthop Surg Res, 2020, 15(1): 19
- [5] Agarwal-Harding KJ, Meara JG, Greenberg SL, et al. Estimating the global incidence of femoral fracture from road traffic collisions: a literature review[J]. J Bone Joint Surg Am, 2015, 97(6): e31
- [6] Neumann MV, Südkamp NP, Strohm PC. Management of femoral shaft fractures [J]. Acta Chir Orthop Traumatol Cech, 2015, 82(1): 22-32
- [7] Gao Y, Qiao NN, Zhang YH, et al. Application of fracture-sustaining reduction frame in closed reduction of femoral shaft fracture[J]. J Orthop Surg Res, 2019, 14(1): 147
- [8] Govindasamy R, Gnanasundaram R, Kasirajan S, et al. Elastic Stable Intramedullary Nailing of Femoral Shaft Fracture-Experience in 48 Children[J]. Arch Bone Jt Surg, 2018, 6(1): 39-46
- [9] 刘锋, 姜文凯, 路锐, 等. 弹性髓内钉与锁定加压接骨板治疗儿童股骨干骨折的近期临床疗效比较 [J]. 生物骨科材料与临床研究, 2016, 13(3): 76-78
- [10] Gadegone WM, Lokhande V. Screw Intramedullary Elastic Nail Fixation in Midshaft Clavicle Fractures: A Clinical Outcome in 36 Patients[J]. Indian J Orthop, 2018, 52(3): 322-327
- [11] Nørgaard SL, Riber SS, Danielsson FB, et al. Surgical approach for elastic stable intramedullary nail in pediatric radius shaft fracture: a systematic review[J]. J Pediatr Orthop B, 2018, 27(4): 309-314
- [12] 夏西尚, 方宣城, 邱新建, 等. 股骨大粗隆入钉点与梨状窝入钉点交锁髓内钉内固定治疗股骨干骨折的疗效对比研究[J]. 创伤外科杂志, 2020, 22(2): 129-132
- [13] 高建华, 邓江涛, 李秋明, 等. 交锁髓内钉与锁定加压钢板内固定对股骨干骨折患者膝关节功能及创伤相关指标的影响[J]. 现代生物医学进展, 2020, 20(16): 3100-3104
- [14] Rogers NB, Hartline BE, Achior TS, et al. Improving the Diagnosis of

- Ipsilateral Femoral Neck and Shaft Fractures: A New Imaging Protocol[J]. *J Bone Joint Surg Am*, 2020, 102(4): 309-314
- [15] Wu HH, Liu M, Challa ST, et al. Development of Squat-and-Smile Test as Proxy for Femoral Shaft Fracture-Healing in Patients in Dar es Salaam, Tanzania[J]. *J Bone Joint Surg Am*, 2019, 101(4): 353-359
- [16] Alam QS, Alam MT, Reza MS, et al. Evaluation of Outcome of Exchange Nailing with Autogenous Bone Graft for Treating Aseptic Nonunion of Femoral Shaft Fracture[J]. *Mymensingh Med J*, 2019, 28(2): 378-381
- [17] Tan L, Wang T, Li YH, et al. Patellar tendon ossification after retrograde intramedullary nailing for distal femoral shaft fracture: A case report and review of the literature[J]. *Medicine (Baltimore)*, 2017, 96(47): e8875
- [18] Jin YF, Xu HC, Shen ZH, et al. Comparing Augmentative Plating and Exchange Nailing for the Treatment of Nonunion of Femoral Shaft Fracture after Intramedullary Nailing: A Meta-analysis [J]. *Orthop Surg*, 2020, 12(1): 50-57
- [19] Koso RE, Terhove C, Steen RG, et al. Healing, nonunion, and re-operation after internal fixation of diaphyseal and distal femoral fractures: a systematic review and meta-analysis [J]. *Int Orthop*, 2018, 42(11): 2675-2683
- [20] Gautam VK, Ranade AS, Mone M, et al. A Novel Technique for the Removal of Elastic Intramedullary Nail in Pediatric Long Bones: A Technical Note[J]. *Cureus*, 2020, 12(8): e9717
- [21] Du M, Han J. Antegrade elastic stable intramedullary nail fixation for paediatric distal radius diaphyseal metaphyseal junction fractures: A new operative approach[J]. *Injury*, 2019, 50(2): 598-601
- [22] Li J, Ze R, Rai S, et al. Is elastic stable intramedullary nail a good choice for pathological fractures of the proximal femur due to simple bone cyst in pediatric population? [J]. *Medicine (Baltimore)*, 2020, 99(39): e22364
- [23] Corradi N, Caruso G, Martini I, et al. Rupture of an Intramedullary Elastic Bundle Nail Following Humeral Shaft Nonunion: A Case Report[J]. *J Long Term Eff Med Implants*, 2019, 29(1): 11-17
- [24] Wang W, Zheng X, Sun Z. Comparison of efficacy between internal fixation of minimally invasive elastic stable intramedullary nail and plate in the treatment of pediatric femoral shaft fracture[J]. *Pak J Med Sci*, 2019, 35(5): 1417-1421
- [25] Ramasubbu RA, Ramasubbu BM. Surgical stabilization for open tibial fractures in children: External fixation or elastic stable intramedullary nail - which method is optimal? [J]. *Indian J Orthop*, 2016, 50(5): 455-463
- [26] 姜海, 王磊, 李晓博, 等. 弹性髓内钉内固定治疗儿童股骨干骨折临床疗效观察[J]. *实用骨科杂志*, 2020, 26(3): 264-267
- [27] Li J, Rai S, Ze R, et al. The optimal choice for length unstable femoral shaft fracture in school-aged children: A comparative study of elastic stable intramedullary nail and submuscular plate[J]. *Medicine (Baltimore)*, 2020, 99(25): e20796
- [28] Griffin CM, Somerson JS. Elastic intramedullary nail treatment of adolescent perihardware radius and ulna refracture[J]. *BMJ Case Rep*, 2021, 14(1): e236098
- [29] Busch MT, Perkins CA, Nickel BT, et al. A Quartet of Elastic Stable Intramedullary Nails for More Challenging Pediatric Femur Fractures [J]. *J Pediatr Orthop*, 2019, 39(1): e12-e17
- [30] Frei B, Mayr J, de Bernardis G, et al. Elastic stabile intramedullary nailing (ESIN) of diaphyseal femur fractures in children and adolescents: A strobe-compliant study [J]. *Medicine (Baltimore)*, 2019, 98(14): e15085
- [31] Xu Y, Huang G, Niu C. Comparison of Elastic Intramedullary Nails and Locking Compression Plates on Oxidative Stress in Children with Distal Tibial Metaphyseal Fractures [J]. *J Coll Physicians Surg Pak*, 2019, 29(11): 1118-1120
- [32] 周岳来, 戴善和, 虞堂云, 等. 弹性髓内钉治疗儿童股骨干粉碎性骨折[J]. *实用骨科杂志*, 2014, 20(12): 1143-1144, 1145
- [33] 陈海龙, 周献伟, 郑九琴. 股骨干骨折锁定加压接骨板内固定失效3例原因分析[J]. *中国中医骨伤科杂志*, 2010, 18(4): 50-51
-
- (上接第 3514 页)
- [17] Zhang YJ, Li MP, Tang J, et al. Pharmacokinetic and Pharmacodynamic Responses to Clopidogrel: Evidences and Perspectives[J]. *Int J Environ Res Public Health*, 2017, 14(3): 301
- [18] Franchi F, Rollini F, Rivas Rios J, et al. Pharmacodynamic Effects of Switching From Ticagrelor to Clopidogrel in Patients With Coronary Artery Disease: Results of the SWAP-4 Study [J]. *Circulation*, 2018, 137(23): 2450-2462
- [19] Zhu J, Wu S, Hu S, et al. NLRP3 inflammasome expression in peripheral blood monocytes of coronary heart disease patients and its modulation by rosuvastatin[J]. *Mol Med Rep*, 2019, 20(2): 1826-1836
- [20] Yu P, Xiong T, Tenedero CB, et al. Rosuvastatin Reduces Aortic Sinus and Coronary Artery Atherosclerosis in SR-B1 (Scavenger Receptor Class B Type 1)/ApoE (Apolipoprotein E) Double Knockout Mice Independently of Plasma Cholesterol Lowering [J]. *Arterioscler Thromb Vasc Biol*, 2018, 38(1): 26-39
- [21] Perez-Calahorra S, Laclaustra M, Marco-Benedi V, et al. Comparative efficacy between atorvastatin and rosuvastatin in the prevention of cardiovascular disease recurrence [J]. *Lipids Health Dis*, 2019, 18(1): 216
- [22] Thondapu V, Kurihara O, Yonetsu T, et al. Comparison of Rosuvastatin Versus Atorvastatin for Coronary Plaque Stabilization [J]. *Am J Cardiol*, 2019, 123(10): 1565-1571
- [23] 张理科, 陈宇. 瑞舒伐他汀与阿托伐他汀治疗冠心病的疗效和安全性比较[J]. *中国药房*, 2016, 27(12): 1611-1613
- [24] 孙慧, 花继平. 美托洛尔联合心脉通胶囊对老年冠心病患者血脂、心功能及血液流变学的影响分析[J]. *中南医学科学杂志*, 2020, 48(1): 18-21
- [25] Liu D, Shen T, Ren C, et al. The effects of atorvastatin and rosuvastatin on exercise tolerance in patients with coronary heart disease[J]. *Expert Opin Drug Saf*, 2020, 19(9): 1203-1208
- [26] Lisyutenko NS, Morova NA, Tsekhanovich VN. Laboratory signs of activation of the hemostasis system in patients with coronary heart disease, who had coronary artery bypass surgery [J]. *Klin Lab Diagn*, 2018, 63(8): 500-505
- [27] Wu W, Liu R, Chen L, et al. Disequilibrium of Blood Coagulation and Fibrinolytic System in Patients With Coronary Artery Ectasia[J]. *Medicine (Baltimore)*, 2016, 95(8): e2779