

临床论著

胸腰段爆裂骨折后凸畸形不同测量方法比较

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【摘要】目的:比较常用胸腰段骨折侧位 X 线片不同测量方法测量后凸角度的可信度及可重复性。**方法:**40 例胸腰段爆裂骨折患者的侧位 X 线片, 让 3 位脊柱外科医师应用 6 种测量方法测量后凸角度, (1) 伤椎头侧邻近椎体上终板和尾侧邻近椎体下终板平行线的垂线夹角; (2) 伤椎下终板和头侧邻近椎体上终板平行线的垂线夹角; (3) 伤椎头侧和尾侧邻近椎体后壁平行线的垂线夹角; (4) 伤椎头侧邻近椎体下终板和尾侧邻近椎体上终板平行线的垂线夹角; (5) 伤椎上终板和下终板平行线的垂线夹角; (6) 后凸比率, 即伤椎头侧邻近椎体前下缘至尾侧邻近椎体前上缘距离(a)/伤椎头侧邻近椎体后下缘至尾侧邻近椎体后上缘距离(b)。以 3 周为间隔分别独自测量两次后凸角度, 对测量结果进行统计学分析。**结果:**方法 1 组内相关系数高度一致($r=0.84\sim0.95$), 其次是方法 4($r=0.75\sim0.90$)。各种测量方法三位测量医师所得结果组内一致性(重复测量 5° 以内变化)为 76%~98.5%, 方法 1 显示较好的一致性(92.4%~98.5%)。配对检验显示, 不同观察者之间, 组间可信度相关系数为 0.53~0.90, 方法 1 显示最高组间可信度相关系数(0.85, 范围 0.75~0.92), 其次是方法 4(0.81, 范围 0.71~0.89)。**结论:**测量伤椎头侧椎体上终板和尾侧椎体下终板平行线的垂线夹角作为骨折椎体后凸角具有最佳组内和组间可信度。

【关键词】 胸腰段; 爆裂骨折; 后凸; X 线片

doi:10.3969/j.issn.1004-406X.2009.03.09

中图分类号: R683.2, R682.3, R814.4 文献标识码: A 文章编号: 1004-406X(2009)-03-0212-05

Comparison of various measurements for thoracolumbar kyphosis after burst fracture/ZHAO Dong, DENG Shucan, SUN Zhiming, et al//Chinese Journal of Spine and Spinal Cord, 2009, 19(3): 212~215, 226

【Abstract】 Objective: To compare the various measurements of lateral view X-rays for thoracolumbar burst fracture and determine their reliability and repetitiveness of measuring the kyphosis. **Method:** To determine the angle of kyphosis, forty lateral radiographs of thoracic and lumbar burst fractures from the department of spinal surgery in Tianjin hospital were measured by three spine surgeons, using 6 different measurement methods. (1) measuring the included angle formed by two vertical lines perpendicular to the lines parallel to the superior endplate of the vertebral body, one above the injured vertebra and to the inferior endplate of the vertebral body, one below the injured vertebra; (2) measuring the included angle formed by two vertical lines perpendicular to the lines parallel to the superior endplate of the above vertebral body and to the inferior endplate of the fractured vertebral body; (3) measuring the included angle by the two vertical lines perpendicular to the lines parallel to the posterior wall of the vertebral body above and below the injured vertebra; (4) measuring the included angle by two vertical lines perpendicular to the lines parallel to the inferior endplate of the above vertebra and the superior endplate of the below vertebra; (5) measuring the included angle by two vertical lines perpendicular to the lines parallel to the superior endplate and the inferior endplate of the injured vertebra; (6) kyphosis ratio, distance from the anterior margin of inferior endplate of the vertebrae above the injured vertebra to the anterior margin of superior endplate of the vertebra below the injured vertebra (a)/distance from the posterior margin of inferior endplate of the vertebra above the injured vertebra to the posterior margin of superior endplate of the vertebra below the injured vertebra (b). All radiographs were measured for kyphosis angle two times at an interval of 3 weeks. The results were studied statistically. **Result:** Method 1 had a higher consistency of correlation coefficient within the group ($r=0.84\sim0.95$), and method 4 was

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the next ($r=0.75-0.90$). The measurement agreement (the changes within 5° by repeated measuring) by three observers ranged from 76.0% to 98.5% for all methods, but method 1 showed the best agreement (92.4%–98.5%). Paired comparison indicated the reliability correlation varied considerably from 0.53 to 0.90 among the observers. Method 1 showed the highest reliability coefficient 0.85 (range, 0.75–0.92) in the groups, followed by method 4, reliability coefficient was 0.81 (range, 0.71–0.89). **Conclusion:** Method 1 showed the best reliability of the measurement performed by one or different observers.

【Key words】 Thoracolumbar; Burst fracture; Kyphosis; Radiographic parameters

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精确、可靠地测量脊柱 X 线片对于胸腰段骨折治疗非常重要。侧位片显示的损伤局部后凸程度,例如后凸 Cobb 角 $>30^\circ$, 常为手术指征之一^[1]; 另外, 矢状位序列亦是此类患者后期随访重点关注的内容之一。文献报道^[2,3], 胸腰段骨折矢状位畸形的测量内容包括 Cobb 角、Gardener 节段性畸形、矢状位指数以及椎体滑脱、椎体压缩程度等。尽管国外有很多文献报道了胸腰段骨折后凸畸形不同测量方法的可信度和可重复性研究^[1,4,5], 但国内一直未见有类似报道。本研究由 3 位经专门培训的脊柱外科医师应用 6 种不同测量方法^[1,4,6] 对 40 例胸腰段骨折患者的侧位 X 线片进行测量, 以评估不同测量方法的测量者间和测量者内差异性。

1 资料与方法

选择天津医院脊柱外科病房收治的 40 例胸腰段爆裂骨折标准侧位 X 线片 (卧位)。入选条件: T10~L2 单节段骨折, 成像清晰, 以伤椎为投影

中心。所有 X 线片由一位不参与任何测量的医师编码。三位脊柱外科医师, 接受 6 种测量方法专门训练。所有测量人员不知道患者具体病史、诊断等相关资料, 独立完成对每一张 X 线片的测量。所有画线在另一位医师测量前全部擦拭干净。测量完成后, 重新编码所有 X 线片, 3 周后由此 3 位医师重新测量。6 种测量方法包括 (图 1): 方法 1, 伤椎头侧邻近椎体上终板和尾侧邻近椎体下终板平行线的垂线所成夹角; 方法 2, Gardener 节段性畸形, 伤椎下终板和头侧邻近椎体上终板平行线的垂线所成夹角; 方法 3, 伤椎头侧和尾侧邻近椎体后壁平行线的垂线所成夹角; 方法 4, 伤椎头侧邻近椎体下终板和尾侧邻近椎体上终板平行线的垂线所成夹角; 方法 5, 伤椎上终板和下终板平行线的垂线所成夹角; 方法 6, 后凸比率, 即伤椎头侧邻近椎体前下缘至尾侧邻近椎体前上缘距离 (a) / 伤椎头侧邻近椎体后下缘至尾侧邻近椎体后上缘距离 (b)。

所有数据用 SPSS 10.0 软件进行分析。方差

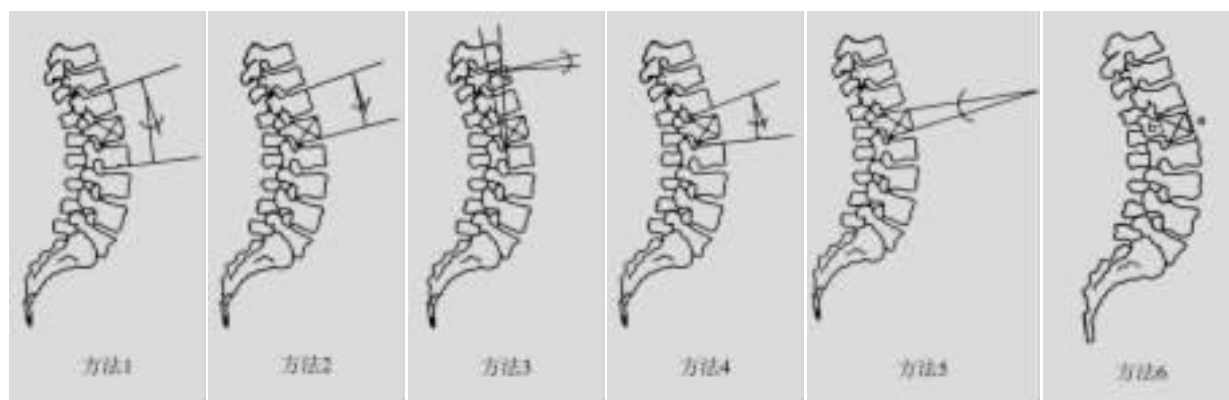


图 1 6 种测量方法图示 方法 1, 伤椎头侧邻近椎体上终板和尾侧邻近椎体下终板平行线的垂线所成夹角; 方法 2, Gardener 节段性畸形, 伤椎下终板和头侧邻近椎体上终板平行线的垂线所成夹角; 方法 3, 伤椎头侧和尾侧邻近椎体后壁平行线的垂线所成夹角; 方法 4, 伤椎头侧邻近椎体下终板和尾侧邻近椎体上终板平行线的垂线所成夹角; 方法 5, 伤椎上终板和下终板平行线的垂线所成夹角; 方法 6, 后凸比率, 伤椎头侧邻近椎体前下缘至尾侧邻近椎体前上缘距离 (a) / 伤椎头侧邻近椎体后下缘至尾侧邻近椎体后上缘距离 (b)

分析(ANOVA)重复测量所得结果,分别评估测量者内和测量者间可信度(相关系数 r)。测量者内可信度评估同一测量者应用同一种方法多次测量结果的可重复性。测量者间可信度评估不同测量者应用同一测量方法对同一对象所得结果的可重复性。

2 结果

2.1 测量者内可信度

比较 6 种不同测量方法,结果显示不同测量医师所得结果的可重复性差异很大(表 1)。不同方法测量者内相关系数(r)结果显示:测量者 1 为 0.55~0.95,测量者 2 为 0.72~0.90,测量者 3 为 0.67~0.85。组内相关系数最一致的是测量方法 1 所得结果($r=0.84\sim0.95$),随后依次是方法 4>方法 6>方法 5>方法 2>方法 3。

2.2 测量者内一致性

以 5°为误差允许范围(方法 6 以 5mm 为测量误差允许范围),3 位测量者运用不同测量方法所得测量结果一致百分比从 76.0%~98.5%不等(表 2)。结果同样显示,所有 6 种测量方法中,不同测量者应用测量方法 1 在不同时间点对同一张 X 线片所测结果一致性最高(98.5%,98.2%和 92.4%),随后依次是方法 4>方法 6>方法 5>方法 2>方法 3。

2.3 测量者间可信度

运用每种测量方法的组内相关系数,配对比较不同测量者所得结果差异见表 3。结果显示,不同测量者运用方法 1 所得结果差异最小,可信度最佳, $r=0.85$, $CI=0.75\sim0.92$;随后依次是方法 4>方法 6>方法 5>方法 2>方法 3。

2.4 不同误差允许范围测量结果一致性

按照不同误差允许范围,配对比较不同测量者运用同一种测量方法所得结果的一致性。也就是说,不同测量者应用同一种方法对同一对象在一定误差允许范围内测量结果的一致性。以 2°、5°为误差允许范围时,方法 1 所得结果一致性最好,方法 3 最差(表 4)。

3 讨论

迄今为止,骨折后凸畸形只是被简单地定义为一个角度,关于如何测量这个角度目前还无统一标准。确定一种可信的、可重复的测量方法对于

表 1 不同测量方法不同测量者测量结果的可信度组内相关系数

	测量者 1	测量者 2	测量者 3
方法 1	0.95(0.90~0.98)	0.90(0.80~0.97)	0.84(0.73~0.92)
方法 2	0.66(0.52~0.77)	0.75(0.61~0.83)	0.67(0.50~0.83)
方法 3	0.55(0.42~0.67)	0.72(0.57~0.80)	0.70(0.59~0.82)
方法 4	0.90(0.80~0.95)	0.82(0.70~0.90)	0.75(0.56~0.89)
方法 5	0.80(0.75~0.89)	0.72(0.56~0.87)	0.85(0.73~0.94)
方法 6	0.89(0.83~0.95)	0.80(0.67~0.86)	0.74(0.58~0.83)

表 2 以 5°为误差允许范围同一测量者不同时间点所测结果一致百分比 (%)

	测量者 1	测量者 2	测量者 3
方法 1	98.5(92.3~99.9)	98.2(92.0~99.9)	92.4(87.8~95.5)
方法 2	78.9(68.4~88.9)	80.5(70.1~92.0)	84.0(76.8~91.0)
方法 3	76.0(70.7~83.2)	79.2(71.5~89.5)	83.0(75.9~90.5)
方法 4	97.0(89.9~98.4)	97.0(89.9~98.4)	82.3(71.5~91.4)
方法 5	89.0(79.3~97.3)	90.2(82.5~96.7)	86.6(80.0~93.9)
方法 6	91.0(84.0~96.8)	91.0(84.0~96.8)	85.1(79.5~90.4)

注:* 以 5mm 为测量误差允许范围

表 3 运用不同测量方法组内相关系数计算测量者间可信度

	全部测量者	1:2°	1:3°	2:3°
方法 1	0.85 (0.75~0.92)	0.84 (0.68~0.96)	0.89 (0.84~0.96)	0.76 (0.66~0.82)
方法 2	0.67 (0.54~0.80)	0.66 (0.55~0.77)	0.68 (0.44~0.84)	0.70 (0.61~0.78)
方法 3	0.58 (0.43~0.73)	0.61 (0.47~0.80)	0.53 (0.42~0.69)	0.55 (0.40~0.73)
方法 4	0.81 (0.71~0.89)	0.90 (0.83~0.94)	0.77 (0.68~0.87)	0.74 (0.60~0.87)
方法 5	0.70 (0.57~0.83)	0.74 (0.63~0.87)	0.68 (0.54~0.78)	0.66 (0.52~0.82)
方法 6	0.71 (0.61~0.81)	0.72 (0.60~0.81)	0.70 (0.66~0.77)	0.69 (0.57~0.79)

注:* 不同测量者两两配对

表 4 不同误差允许范围不同测量者间测量结果一致百分比 (%)

	误差 ≤ 2°	误差 ≤ 5°
方法 1	78.0(72.4~83.7)	92.0(80.6~99.1)
方法 2	53.5(35.8~71.0)	75.1(46.7~98.9)
方法 3	47.1(31.1~46.2)	74.6(62.4~99.4)
方法 4	64.0 (57.3~76.7)	85.5(70.4~99.0)
方法 5	58.0(50.0~66.1)	80.7(65.1~96.9)
方法 6	63.7(53.3~79.0)	80.5(62.2~98.7)

注:* 以 2mm 或 5mm 为测量误差允许范围

联性。

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(收稿日期: 2008-10-30 末次修回日期: 2009-01-09)

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(本文编辑 李伟霞)

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其结果造成一定影响。但是, 考虑到其相对稳定性以及目前任何一种测量方法的内在缺点, 应用这两种方法有助于提高可信度的同时保证不同研究的可比性。

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(收稿日期: 2008-09-10 修回日期: 2008-10-27)

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(本文编辑 彭向峰)