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股骨颈骨折粗细双螺钉内固定生物力学研究

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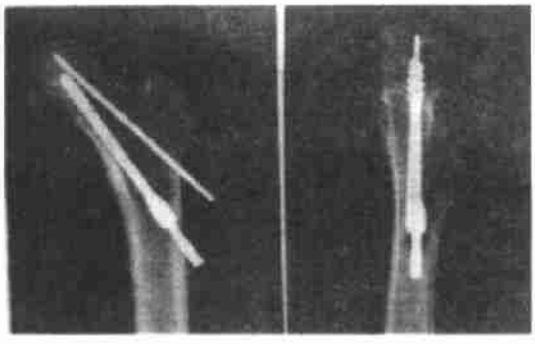
摘要　股骨颈骨折内固定方法繁多，本文采用一粗一细加压螺纹钉，采用先进电阻应变仪方法，对股骨颈的应力分布规律在中立、外展、内收不同位置上施加 50kg 荷载压力，通过电阻应变计测定一粗一细两钉所承受拉、压应力优于其它内固定形式。

关键词　股骨颈骨折　生物力学

股骨颈骨折内固定方法很多。1974 年 Tronzo 列举文献中曾用股骨颈骨折的内固定器材共有 76 种之多，本试验采用一粗一细加螺纹钉在不同体位的应力状态，为临床推广使用进行论证。

实验方法

1. 粗钉头部带有螺纹，钉尾配以垫圈与弹簧一束。细钉亦呈粗螺纹型（见图）。钉尾呈三角形，供配把手拧入。钉全长 85～125mm，三种规格。粗钉直径 8mm，细钉 5mm。



2. 电阻应变仪测试法

选择正常股骨二副（四个）。粗钉选择于股骨颈内下方贴近骨皮质，钉与股骨干成 130°～135°，在大转子下方 2.5cm 捻入，钉贯入至头部软骨下 0.5cm，以螺纹部应超过骨折线处，起到加压作用，使骨折部紧密对合。细钉位置选择在股骨颈外上方，贴近骨皮质捻入，捻紧加压。股骨颈分锯断和不锯断二种状态，在确定骨折处的位置，把该位置的螺纹略锉平，粘贴 BX120－0.5AA 电阻片，然后将螺纹钉拧入钉洞，使电阻片的平面位置在上部，在一些空隙间浇入常温固化的环氧树脂，以模拟实际结构的紧密配合作用，股骨干完全固定在钢板上，当调整钢板倾斜位置时，加力架的垂直荷载将变成为内收、外展的各种荷载，实验在 0.3T 加力架上进行，使用 ES－0.3T 测力计和 J－X3 型静态电阻应变仪进行测试。机械测试使用百分表布置在股骨头的垂直下方或上方测定在各级荷载下股骨头的垂直移量。电测法做中立、外展、内收不同位置上，在施加 50kg 荷载压力，通过电阻应变计测定一粗一细加压螺纹钉所承受的拉、压位移情况。$kg/cm^2 = 100KPa$。

实验数据：（1）模型中立位：垂直荷载 50kg，股骨头的垂直位移 0.72mm，上行钉应力 $78.4kg/cm^2$。下行钉应力 $86.3kg/cm^2$。（2）模型外展 10 度：垂直荷载 50kg，股骨头的垂直位

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移 0.61mm。上行钉应力 69.5kg/cm²。下行钉应力 57.9kg/cm²。(3) 模型外展 20 度：垂直荷载 50kg，股骨头的垂直位移 0.58mm。上行钉应力 55.6kg/cm²。下行钉应力 50.5kg/cm²。(4) 模型外展 30 度：垂直荷载 50kg，股骨头的垂直位移 0.51mm。上行钉应力 50.3kg/cm²。下行钉应力 40.1kg/cm²。(5) 模型内收 10 度：垂直荷载 50kg，股骨头的垂直位移 0.84mm。上行钉应力 81.4kg/cm²。下行钉应力 87.4kg/cm²。(6) 模型内收 20 度：垂直荷载 50kg，股骨头的垂直位移 0.93mm。上行钉应力 93.1kg/cm²。下行钉应力 89.6kg/cm²。(7) 模型内收 30 度：垂直荷载 50kg，股骨头的垂直位移 1.15mm 上行钉应力 98.8kg/cm²。下行钉应力 90.4kg/cm²。

经实验测试，钉的弹性模量 E = 1800000kg/cm² 根据 $\sigma=E\cdot\varepsilon$ 公式，ε 为电测实验的实测应变量，可以计算出应力。

实验结果

1. 从中立位到外展 30°，在垂直荷载相同的条件下，上行细钉的拉应力从 78.4kg/cm² 减小到 50.41kg/cm²；而粗钉的压应力从 86.3kg/cm² 减小到 40.1kg/cm²。当改在内收位时，上行细钉的张应力增大到 98.8kg/cm²，下行粗钉的压应力亦增大到 90.4kg/cm²。

2. 从外展位 10°～30°时上行细钉张应力渐变小，而在内收位 30°时张应力剪应力最大，起到明显抗拉、剪力作用。下行粗钉从中立位逐渐外展到 30°时，压应力变小，此处位置骨折部较为稳定。当内收角度增大时，骨折部出现分离力、剪应力增大，故垂直位移从 0.72mm 增大 1.15mm。下行粗钉起到防止股骨头在股骨距上旋转有约束作用。

3. 一粗一细二根加压螺纹钉在股骨头下 0.5cm 颈内空间交叉，符合正常股骨上段张应力与压应力骨小梁的布局，起到三角桁架作用。二者协同起到抗剪力和抗扭转力的作用，因此对固定 Garden Ⅲ Ⅳ 型股骨颈骨折起到良好固定效果。

讨　论

对股骨颈骨折的治疗，原则上都是无损伤性良好复位，坚实可靠的内固定。多年习惯使用三翼钉为首选内固定器材，临床实践中发现对股骨颈骨折移位较多者，失败率几乎达到 50%，我们在骨折标本上做模拟步行的实验，也证实三翼钉远不及一粗一细空心加压螺纹钉的固定效果。

在使用一粗一细加压螺纹钉固定有移位股骨颈骨折，由于更接近股骨颈的生物力学原理。从临床中显示，股骨颈有移位的骨折经内固定后，克服运动中肌肉的收缩消极因素。

股骨颈的承载，主要在股骨距。以粗加压钉贴近股骨颈内下方靠骨皮质处进钉，穿过骨折线牢固地扣紧骨折断端，主导稳定作用。低角度进行增加了抗剪力，又不减少骨折部的整个加压力；低角度进钉所丧失的部分加压力由细加压钉弥补。细钉选择股骨颈外上方，贴近骨皮质捻入加压固定，更于粗钉联合固定的协同制约作用。

在临床中观察到经以上内固定，早期卧床即开始有节律髋关节运动，不仅未发现退针，更能使骨折断端紧密嵌入。在运动时，股骨颈将承受弯曲力矩，其上皮质骨产生拉张应力（细钉固定）。臀中肌收缩时乃产生挤压应力，以中和或抵消拉张应力。所以肌肉的收缩能使股骨颈承受较大的负荷。

总之，一粗一细加压螺纹钉汇集了其它内固定的经皮内固定快速简便，固定确切牢固的优点。力学实验证实，不需要再用更多的内固定针。

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Abstract of Original Articles

Treatment of Acute Fascial Compartment Syndrome

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The delayed treatment of the acute fascial compartment syndrome can produce disability of the limbs and even dangerous to the life. The conservative treatment can be applied to the moderate—mild patients, such as closely observing the patient's condition, immobilizing and elevating the illed limb, and applying 20% mannitol for dehydration, as early as possible. As there is no effect in the conservative treatment and the syndrome is serious, you must be not delay to apply the surgical operation. The only effective method is thorough decompression and excision of the necrotic tissue. The selective decompression, primary open reduction and internal fixation, and relief skin grafting are feasible.

Key Words Fascial compartment syndrome Close observation Decompression Mannitol

(Original article on page 3)

Evaluation of Treatment on Spine Fracture Combined with Paraplegia with Self—made Frame for Internal Fixation

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After analysis of the therapeutic effect of thoracic and lumbar fracture and dislocation combined with spinal cord injury in 12 cases with self—made internal fixation frame, it was considered that the structure of frame has an unique characteristics of biomechanism: the ability of its anti rotation and anti—lateral bending are better than Harrington's rod, "∩" formed rod, and Luque rod, but its longitudinal oppening force is less than that of Harrington's rod and Dick's fixator. It is much firmer due to its multiple segmental fixation, and more suitable for thoracic and lumbar vertebral fracture and dislocation without or with I°—II° vertebral compression, and instability of lower lumbar vertebrae. The advantages and drawbacks of the frame structure were evaluated.

Key Words Structure of frame Internal fixation Injury of spine and spinal cord

(Original article on page 6)

Two Factors Analysis about the Influence of Repairing Approaches for Bone Trauma on Serum Copper

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Experimental defect of rabbit's mandible was created and repaired with three different approaches. Serum copper was detected by atomic absorption spectrophotometry to explore the metabolism of trace element copper during the repair of defect. The results indicated that the changes of serum copper are different due to different approaches. There are statistical significance in the changes of the different time—points in different approaches. It was suggested that there is significance in supplement of copper in adequate amount, while zinc is supplied in clinic.

Key Words Bone trauma Repairing approach Repairing time Serum copper Two facters analysis

(Original article on page 8)

Biomechanical Studies on Internal Fixation with One Thick and One Thin Lag Screws for Femoral Neck Fracture

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There are various kinds of internal fixation for femoral neck fracture. One thick and one thin lag screws were drilled into femoral neck and the biomechanical properties were studied in this work. After applying 50 kg of loading in abduction, adduction and natural position, the distributions of stresses in femoral neck were measured with advanced resistance strainometer. The results indicated that the tensile stress and compressive stress beared by such two screws are superior to that by other forms of fixation.

Key Words Fracture of femoral neck Internal fixation Biomechanics