坚硬接骨板固定后局部骨质疏松的骨组织形态计量学的实验研究

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摘要 本实验通过骨组织形态计量学的方法，对家兔完整胫骨坚硬接骨板内固定后局部骨组织的变化进行了研究，实验家兔随机分为 1、2、3、4 组和空白对照组，固定时间为 6.8.10 和 12 周。对不脱钙骨组织切片在纵切面和横切面上进行普通光和莹光分析测量。结果发现：坚硬接骨板内固定后六周时固定段骨即出现骨质疏松，发生在哈佛氏系统的骨丢失，10 周后骨内膜表面出现骨吸收、骨髓腔增大，两个表面的骨重建单位的负平衡使固定段皮质骨疏松变薄，特别是在钢板下。

关键词 内固定 骨质疏松 骨重建

坚硬接骨板在骨与关节损伤中的应用非常广泛，但其对局部骨力学环境的影响也越来越被人们所重视，Uhthoff 等认为用弹性模量高的材料制成加压钢板进行内固定，可产生应力遮挡(Stress Shielding)或应力保护(Stress Protection)效应[1]，使钢板固定段骨缺少应力刺激导致局部骨质疏松，去除钢板后在此薄弱处易发生再骨折[2]。本组实验对家兔完整胫骨坚硬接骨板内固定后局部骨组织进行了骨组织形态计量学的研究，现报告如下。

材料与方法

实验用家兔，雌雄不限，平均体重在 2.5～2.6kg，钢板用天津产 5×3×1cmm E=210GPa 5 孔直不锈钢板。

家兔随机分为 1、2、3、4 组和空白对照组，每组各 8 只动物，用标准饲料喂养。手术方式为右侧胫骨中段钢板内固定术，严格无菌操作，自胫骨结节下 1cm 前外侧，做长约 4cm 的纵切口，切开皮肤，从胫前肌内侧间隙进入，切开并剥离外侧骨膜，将钢板固定在距胫骨结节下 1cm 处的前外侧面，拧四颗螺丝钉，使螺钉尾部平钢板后再拧一螺距，缝合切口。空白对照组行假手术，术后分笼标准饲料喂养。1、2、3、4 组钢板固定时间分别为 6、8、10 和 12 周，各组动物在处死前两周进行四环素双标记。

标本制备为原切口进入取出钢板，分别截取钢板固定段胫骨，并保留骨周围部分软组织，钢板固定段胫骨的近心端为纵切面标本，拟分析钢板固定后两侧皮质骨变化；远心端为横切面标本，从横切面上分析钢板下及其周围的皮质骨变化。将取下的标本用 Millonias 溶液固定三天，上行脱水，甲基丙烯酸甲酯及磷苯甲酸二丁酯包埋成块，用 Reichart-Jung 切片机将近心段沿纵轴，远心段沿垂直于纵轴方向做不脱钙骨不连续切片，厚 5μm 及 10μm，前者用甲苯胺兰染色，进行普通光分析，后者进行莹光分析。

骨组织形态计量学分析，采用 Opton-ⅡRs 多功能显微镜和 Mophomat-10 半自动图像分析系统测量骨组织切片，相对骨体积的测量是用目格法，测量参数为：

1. 纵切面(Longitidinal Section)：平均皮质骨壁厚度(mm)(Mean Wall Thickness of the cortex，MWTc)；胫骨直径(mm)(Diameter of the Tibial，D_T)；胫骨髓腔直径(mm)(Diameter of the Tibial Marrow Cavity，D_{MC})；内膜表面骨矿化速率(μm/D)(Minaralization Rate of the Endosteal Surface，MRe)

2. 横切面(Cross-Section)：皮质骨截面积(mm^2)(Cross-Section Area of the Cortical Bone，Ac)；皮质骨相对体积(%)(Cortical Bone Volume，CBV)；哈佛氏系统表面骨矿化速率(μm/D)(Minaralization Rate of the Haversian System Surface，MRh)。

所测参数值均采用 Primer 软件进行方差分析 F 检验和两两比较 q 检验。

结 果

1. 坚硬钢板内固定后各组在不同时期骨组织形态计量学参数值纵切面标本上的测量结果(见表 1)。从表中可看出，皮质骨壁厚度(MWTc)随固定时间的延长，逐渐变薄；髓腔直径(D MC)在胫骨外径(D_T)不变的情况下也随固定时间的延长在增大；骨内膜矿化速率(MRe)空白对照组较钢板固定组为大。

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2. 坚硬钢板内固定后各组在不同时期骨组织形态计量学参数值横切面标本上的测量结果。(见表 2)

表 1　　Group 5　N=8　Mean±SD

	空白组	1 组	2 组	3 组	4 组	P
MWTc(mm)	1.14±0.05	1.6±0.35	1.29±0.29	1.07±0.12	1.06±0.08	<0.001
D_T(mm)	6.8±1.1	6.4±0.8	6.6±0.2	6.3±0.7	6.9±0.7	>0.05
D_{MC}(mm)	4.3±0.08	2.5±0.8	4.3±0.6	4.6±0.6	4.9±0.5	<0.001
MRe(μm/D)	0.4±0.07	0.3±0.1	0.19±0.04	0.24±0.06	0.25±0.07	<0.01

表 2　　Group 5　N=8　Mean±SD

	空白组	1 组	2 组	3 组	4 组	P
Ac(mm2)	kl37.7±1.78	59.4±11.6	51.9±3.5	34±6.5	32±10.6	<0.001
CBV(%)	0.96±0.04	0.9±0.02	0.88±0.01	0.84±0.05	0.8±0.07	<0.01
MRh(μm/D)	0.22±0.04	0.12±0.02	0.1±0.02	0.15±0.02	0.17±0.03	<0.01

在横切面上，横截面积(Ac)随固定时间的延长在减小；相对骨体积(CBV)在 1 组 6 周同时即小于空白对照组，并也随固定时间的延长而减小。哈佛氏系统骨矿化速率(MRh)空白组高于各组但 4 组 12 周时又高于 1、2 组。

讨　论

Tonino 等认为接骨板越坚硬，对局部骨的影响越大，坚硬的接骨板吸收了骨的正常生理应力，从而使钢板固定段应力刺激减少，导致局部骨质疏松[3]。本实验发现坚硬钢板固定后六周的皮质骨壁厚度和截面积较空白组增加，这是由于钢板刺激所引起周围骨痂增多，这和 CaO 的实验模型相同。而皮质骨相对体积却减小，皮质内孔隙增多，尤其是在钢板下。所以说坚硬钢板固定后的早期骨丢失，是发生在皮质内的哈佛氏系统，特别是钢板下哈佛氏系统重建单位的负平衡，造成了钢板下的骨质疏松，在八周时这种表现更为明显，皮质内孔隙增多、增大，表明哈佛氏系统骨表面骨吸收增加。CaO 等认为完整胫骨用不锈钢板固定，早期为骨内膜的吸收，使骨皮质变薄[4]。从我们的动物模型中得出，早期是作用于皮质内的哈佛氏系统，皮质骨内呈多孔样改变，10 和 12 周时，髓腔扩大，骨皮质变薄，皮质内的孔隙加大，尤以钢板下骨为重，从四环素荧光标记得出，内膜骨表面矿化速率降低，说明成骨细胞的分泌功能下降。皮质内哈佛氏系统和骨内膜表面骨重建过程的负平衡使皮质内孔隙加大，皮质骨壁变薄，在本实验中这种表现在 12 周里是进行性的。我们还发现哈佛氏系统的骨矿化速率随着钢板固定时间的延长是增快的，这可能是哈佛氏系统表面在 10 和 12 周时发生高转换率性骨丢失。

参考文献

1. Vhthoff HR. et al. The advatages of titanium alloy over stainless steel plate for the internal fixation of fractures. J Bone Joint Surg(Br) 1981;63:427
2. Woo Sl-Y,et al. Lees rigid internal tixation plate:Histeological perspectives and new concepts. J Orthop Res 1984;110:413－9.
3. Tonino AJ,et al. Protection from strees in bone and its effects J Bone and Joint Surg 1976;58B:107－13.
4. Chao EYS,et al. The effet of rigidity of fracture healing in external fixation. Clin Orthop 1989;241:24－31

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Abstract of Original Articles

Influence of Bu Yang Huan Wu Tang(BYHWT)on clamp injured rat sciatic nerve axoplasm transportation

Shi Guan-tong, Li Yi-kai, Shi Yin-yu. Affiliated Shuguang Hospital, Shanghai University of TCM (200021)

Horseradish peroxidase tetrograde labeling method was selected to demonstrate changes of quantity of HRP labelled neurone cytoplasm of L4-5 spinal cord and ganglion. The results indicated that BYHWT can accelerate transportation of rat sciatic nerve axoplasm. Fourty eight hours after introduction of HRP, number of labelled cytoplasm of the neuron in BYHWT group is prominently more ($P<0.05$) than that of the control group, those of the rest few groups were similar ($P>0.05$) in number. It suggests that the prescription can accerelate transportation of axoplasm of clamped nerve. It is related with improvement of local micro-circulation. It may be one of the mechanism in promoting regeneration of peripheral nerve injury in clinic and experiment.

Key words Sciatic nerve Transportation of axoplasm Bu Yang Huan Wu Tang

(*Original artide on page* 3)

Anatomical study of upper cervical spine and atlantcepistrophic derangement *Zhou Wei, Jiang Weizhuang, Zhang Yongdong, Li Xing, Institute of Orthopaedics and Traumatology, China Academy of TCM* (100700)

Via observation and analysis of upper cervical vertebrae of three cadavers, we consider; 1) Axis is the stress centre of upper cervical spine, commonly atlantoepistrophic derangement is lateral or rotatory deviation; 2) compression and irritation of posterior branches of upper three cervical nerves are the main causes of cervicogenic headache; and 3) strain of vertebral artery between transverse process of atlas and axis is one of the cause of cervicogenic dizziness.

Key words Atlantoepistrophic derangement Cervical nerve Vertebral artery

(*Original artide on page* 5)

Experimental study on local osteoporosis secondary to rigid plate internal fixation with bone histomorphometry *Wu Yu-shi, Lou Si-quan, Dang Geng-ding, Staff and worker Hospital, Baotou Steel and Iron Company, Internal Mongolian* (014010)

Through bone histomorphometrical method, local bone changes of rabbit intact tibia after rigid plate internal fixation was studied. Experimental rabbits were divided into 1, 2, 3, 4 and blank control groups in random, with fixation time in 6, 8, 10 and 12 weeks respectively. Histomorphometrical and tetracycline fluorescence measurement were undertaken in non-decalcified bone tissue sections longitudinally and transversely. The results revealed that there was osteoporosis appeared at 6 weeks in rigid fixating segment. Bone lossing happened at Haver's system, bone absorption revealed after 10weeks on endosteal surface and enlargement of bone marrow. Osteoporosis and thinning of the cortex on fixating segment, especially under steel plate happened due to negative balance of remodeling process of the two surface of the bone.

Key words Internal fixation Osteoporosis Bone remodeling

(*Original article on page* 7)

Clinical study on lumbar fect joint syndrome *Li Zhenyu, et al. Affiliated Hospital of Gansu College of TCM* (730000)

Clinical study of pathogenesis, diagnosis and mechanism of manipulative therapy in 124 patients suffered with lumbar facet joint syndrome. The results indicated that the onset of lumbar facet joint syndrome was happended mostly at 25-45 years of age, and they were found mostly at lower segment. Oblique X-ray film and CT scanning is in significance rather than A-P and lateral view film. The manipulative result is evident, rate of excellent and good was 95%. The pathological change was mainly embedding of synovial membrance, but subluxation of joint or interferance of joint capsule due to proliferation and stimulating the nerve