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数字技术联合髓芯减压人工骨植入治疗早中期股骨头坏死*

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摘要 目的: 回顾性分析在早中期股骨头坏死患者中,使用数字技术结合髓芯减压、人工骨植骨的临床疗效。**方法:** 选取 2013.01-2017.01 符合纳入及排除标准的共计 21 名股骨头早中期患者。所有的股骨头坏死患者均统一按照国际股循环研究会标准,评定为 ARCO I 期或者 II 期。所有纳入患者均采用数字技术进行相关的术前准备,导板制作。然后术中行髓芯减压,死骨刮出,人工骨植骨术。术后通过视觉模拟评分和髋关节 Harris 评分系统对患者的疼痛和功能进行判定。**结果:** 所有患者均接受至少半年的随访。患者在术后 3 个月及 6 月的 Harris 功能评分较术前具有显著的改善($P<0.05$)。21 例患者中,优:12 例,良:7 例,尚可:2 例。优良率为 90.5%。股骨头保存率为 100%。患者在术后 1 月、3 月及 6 月的 VAS 疼痛评分较术前具有显著的降低($P<0.05$)。**结论:** 与传统技术相比,使用数字技术结合髓芯减压,人工骨植骨在轻中度股骨头坏死患者的治疗中可显著改善功能,减轻疼痛,具有较明显的优势。

关键词: 股骨头坏死;髓芯减压;保存关节手术

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Digital Technology with Decompression and Bone Graft for the Treatment of the Early and Middle Stage Osteonecrosis of the Femoral Head*

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ABSTRACT Objective: Objective the outcome of the digital technology with decompression and bone graft for the treatment of the early and middle stage osteonecrosis of the femoral head. **Methods:** Retrospective analysis of 2013.01 to 2017.01 since the diagnosis and treatment of 21 patients with the early and middle stage osteonecrosis of the femoral head. The necrosis stage was divided into the Association Research Circulation Osseous (ARCO) I stage and II stage. All patients were accepting digital technology to have the preoperative preparation and guide production. Then the patients received core decompression, sequestrum erasion, impaction of artificial bone filling particles. Hip Harris Score (HHS) was used to evaluate the postoperative improvement of the hip function and the Visual Analogue Scale (VAS) to assess the intensity of pain. **Results:** In this study, 21 cases were followed up for at least 6 months. HHS were significantly increased when compared before surgery in the 3th month and 6th month after the treatment ($P<0.05$). The excellent function was obtained in 12 hips, good function in 7 hips, and fair function in 2 hips, the good rate was 90.5%, the survival rate of the femoral head was 100%. VAS 2 were significantly reduced when compared before surgery in the 3th month and 6th month after the treatment ($P<0.05$). **Conclusions:** Compared with the traditional treatment, the digital technology with decompression and bone graft for the treatment of the early and middle stage osteonecrosis of the femoral head has advantages in induce process of injury repair in the femoral head, promoting the function of hip joint, and play a very good prevention and treatment role for hip pain fracture healing time.

Key words: Femur head necrosis; Core decompression; Joint Salvaging Surgery

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前言

股骨头坏死^[1](Osteonecrosis of the Femoral Head, ONFH)是一类好发于中青年,主要表现为髋关节疼痛,功能障碍的复杂、难治性的可致残疾病。其病因及发病机制目前尚未得到明确^[2]。

主要考虑为酗酒及服用激素过度等从而导致的股骨头的供血出现严重困难乃至中断^[3]。继而出现股骨头发生结构性改变,出现囊性改变、软骨下骨折等问题。股骨头坏死的早期诊断和治疗尤为重要。若未得到早期诊治,待病情发展至晚期,股骨头已经出现严重的间隙狭窄及骨性关节炎后,则只能接受人工髋关

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节置换^[4]。继而出现翻修等严重问题^[5]。

目前对于前中期的股骨头坏死患者来讲,在其治疗中尚未发现一种行之有效的药物,药物治疗目前只是处于辅助作用^[6]。目前,被广泛承认和认可的治疗早中期股骨头坏死的外科治疗方法就是髓芯钻孔减压术,即通过降低坏死区域的压力来进行股骨头的修复^[7]。但单纯的进行减压仍然会出现骨不愈合,股骨颈骨折等诸多问题^[8]。因此,人们开始在进行减压之后,进行各种植骨来解决这些问题^[9]。例如,给予人工骨植骨^[10],带血管蒂的自体髂骨或者腓骨植骨^[11],骨形态发生蛋白移植术^[12]等等。

但这些方法仍然有其自身的缺陷和不足。一个显著的问题便是仅仅通过术中的透视尚不能准确的进行坏死区域的确定乃至进行精确的减压^[13]。往往创伤较大,手术时间较长,却不能靶向的到达坏死灶,继而真正有效的对坏死灶进行减压和植骨^[14]。针对这一问题,我们将数字技术引入到股骨头手术的治疗中,透过在术前对患者进行精确的三维重建,坏死区域确定。在术前便规划好要进行减压的通道并进行导板的制作。通过这一技术,我们显著的降低了术中的操作时间及并发症并收到了良好的治疗效果。本文回顾性分析了本院创伤骨科自 2013 年 1 月至 2017 年 1 月,用此种方法治疗的共计 21 例股骨头早中期患者,分析此种方法的治疗效果,现报道如下。

1 资料与方法

1.1 一般资料

对 2013.01 至 2017.01 按照相应纳入及排除标准筛选后,共纳入 21 名患者。所有纳入患者均由同一主任医师主刀进行手术治疗。患者一般性资料分布如下:性别分布:男性为 14 例,女性为 7 例;年龄分布:17-65 岁,平均为 38.6 ± 12.8 岁。随访时间:最长为 56 个月,最短为 6 个月,平均为 22.8 ± 8.7 月。所有纳入患者的股骨头坏死分期按照 ARCO 标准判定,均为 I 期或者 II 期。

1.2 治疗方法

1.2.1 纳入标准 1) 患者有明显的髋关节的疼痛、受限等症状,结合患者的体征及影像学资料,可以确诊的诊断股骨头坏死;2) ARCO 标准判定,均为 I 期或者 II 期。3) 患者有明确的手术适应症并行数字技术下髓芯减压人工骨植骨者^[15]。

1.2.2 排除标准 1) 患者有既往手术及外科有创处理者;2) 双侧股骨头坏死者;3) 合并有肿瘤,严重椎间盘突出,结核,严重的骨质疏松症甚至骨折及其他严重全身性疾病者;4) 有血液系统疾病或严重的精神异常者等^[15]。

1.2.3 治疗方法 患者在术前常规行患侧的 X 片及髋关节的 CT 容积扫描。将 CT 扫描数据刻盘后导入 minics research 软件。进行图像的模拟及重建。按照重建后的图像,以坏死区域作为靶点,以大粗隆棘作为标志物进行减压通道的设计。并计算相应的长度和宽度。设计好通道后,以大粗隆棘及周围骨质为基本点进行相应导板的设计。导板通道的内径恰好为减压钻头的外径。然后将相关数据导入 3D matic research 软件。通过 3D 打印机将导板打印。

患者在术中采用侧卧位,常规全身麻醉满意后,消毒铺单。选择髋部外侧切口,以大粗隆顶点为顶点,向远端行一长约 3 厘米长的切口,以此切开皮肤,皮下组织及筋膜,将阔筋膜张肌纵行劈开,暴露股骨近端。充分止血后,使用骨剥对股骨近端进行暴露。注意尽量保护后侧的骨膜及血运,以免影响到血供。充分暴露完毕后。将已消毒完毕的导板放置于预固定的位置。沿通道将导针打入股骨颈中。C 型臂透视,见效果满意后。拔除导针,使用减压钻直接按照预先设计的长度沿通道置入股骨颈中,进行扩髓减压,必要时可使用铰刀。使用刮匙沿着通道进行充分的死骨刮除。充分冲洗后,将人工骨和 BMP 的混合物沿通道置入刮除区域。用顶棒进行充分压实。再次 C 型臂透视无误后,大量生理盐水冲洗,放置负压引流管引流,逐层缝合切口。无菌辅料包扎。术闭。

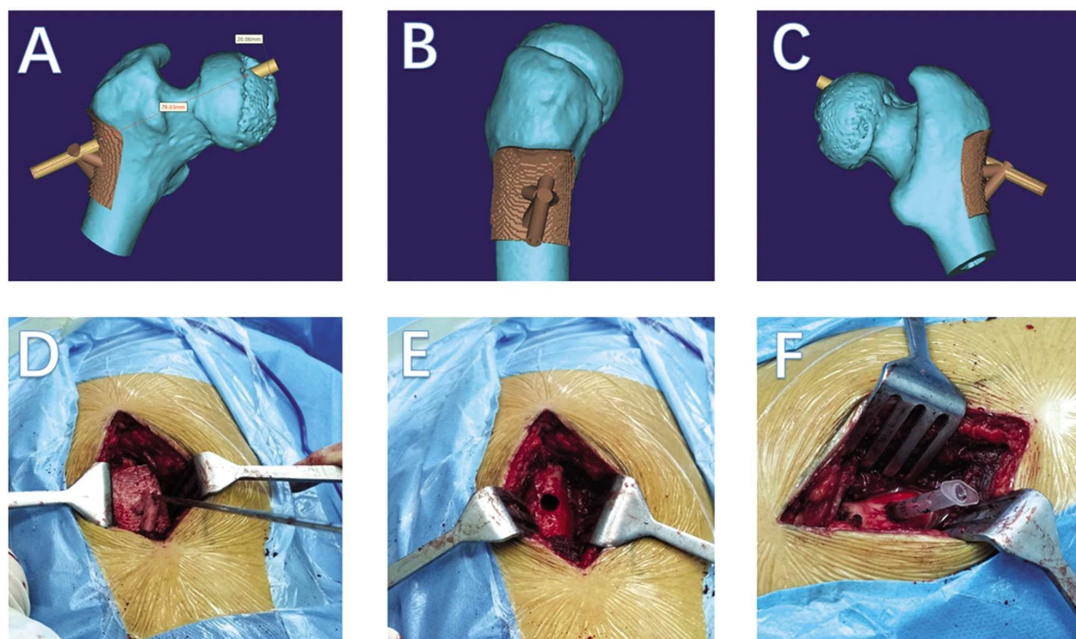


图 1 典型病例。A-c 为术前 3D 打印及模板设计;D 为术中减压;E 为术中视野;F 为术中植骨图片

Fig. 1 A Typical case. A-B: The Preoperative imaging pictures of 3D and formwork design; D: Intraoperative decompression picture; E: Intraoperative pictures; F: herniated nucleus pulposus F: The picture of bone grafting

1.3 术后随访及疗效评价

所有患者均在术前及术后 24 h 内按照相关要求进行了抗生素的使用。根据引流液的多少,引流管于术后 48 h 内进行拔除。如无意外情况,于术后 14D 给予切口的拆线。两组患者在术后 1 月、3 月及 6 月进行 VAS 和 Harris 评分的测定。并在复查时,行相关的 CT 及平片检查。患者术后第二天即可在床上行适度的功能锻炼。3 月后可拄拐行部分负重。半年后可下地负重训练。

Harris^[16]评分主要根据患者的髋关节功能情况进行测定。分数越高代表功能越好。满分为 100 分。可根据分数将其分为"优""良""尚可""差"。股骨头的保存率为前三者的总目除以总的数目*100%。同时采用 CT 及核磁共振来评估股骨头的缺血及修复情况。一般情况下,将新发的大于 3 mm 的塌陷作为影像学手术失败的诊断标准。VAS^[17]评分按照疼痛的程度,由患者进行自我评定。10 分最高,代表最痛。0 分代表完全无痛。

1.4 统计学方法

应用 SPSS 19.0 统计软件进行分析,计量资料以均数 $\pm$ 标准差($\bar{x} \pm s$)表示,计数资料以例数或率表示。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 统计结果

所有患者(21 例)均获得至少 6 个月的电话、邮件或者门诊随访,所有的会诊结果均有效且纳入结果分析,未发现失访病例。

2.2 患者手术前后的髋关节 VAS 疼痛评分的比较

结果显示,所有患者(21 例)在经过治疗后的第 1 月、3 月及 6 月的患髋关节的 VAS 评分较手术前有显著性的统计学差异,均较手术前有显著的降低($P < 0.05$),见表 1。

表 1 患者治疗前后疼痛评分的比较($\bar{x} \pm s$)

Table 1 Comparison of the VAS scores of patients before and after therapy ($\bar{x} \pm s$)

Group	Case	VAS	P
Reoperation	21	6.65 $\pm$ 1.23	
1 months after surgery	21	3.82 $\pm$ 1.19	<0.05*
3 months after surgery	21	2.13 $\pm$ 0.89	<0.05*
6 months after surgery	21	1.98 $\pm$ 0.75	<0.05*

Note: * compared with preoperation.

2.3 患者手术前后的髋关节 Harris 功能评分的比较

结果显示,所有患者(21 例)在经过治疗后的第 1 月、3 月及

6 月的患髋关节的 Harris 功能评分较手术前有显著性的统计学差异,均较手术前有显著的改善($P < 0.05$),见表 3。

表 2 患者治疗前后 Harris 功能评分的比较($\bar{x} \pm s$)

Table 2 Comparison of the Harris scores of patients before and after therapy ($\bar{x} \pm s$)

Group	Case	VAS	P
Reoperation	21	60.65 $\pm$ 10.23	
1 months after surgery	21	83.78 $\pm$ 8.75	<0.05*
3 months after surgery	21	88.47 $\pm$ 8.42	<0.05*
6 months after surgery	21	90.03 $\pm$ 7.41	<0.05*

Note: * compared with preoperation.

2.4 患者手术前后的临床结果分析

结果显示,在所有 21 例经治疗后的患者中,根据最后一次随访结果显示:优 12 髋,良 7 髋,尚可 2 髋,差 0 髋,髋关节 Harris 评分优良率为 90.5%(图 2),股骨头保存率为 100%,无 1 髋行 THA。所有 21 例患者中除 1 例出现皮肤浅层感染,经换药治愈后,未见其他并发症。

3 讨论

股骨头坏死是指由于各种原因所导致的股骨头内的血供出现损害甚至中断,继而出现相应骨及骨髓细胞的坏死,经自身修复、结构改变之后最终出现骨质塌陷、功能障碍的疾病^[18]。尽管酗酒和服用激素类药物已被广泛认为是股骨头坏死的重要病因,但股骨头坏死的发病机制目前仍不明确^[19]。酒精性股

骨头坏死目前被认为是最为主要的致股骨头坏死原因^[20]。比较公认的发病机制是由于大量饮酒后,可带来超氧化歧化酶等物质的活性异常,从而导致脂类物质的代谢紊乱,继而出现股骨头内的供血障碍及脂肪变性坏死^[21]。激素类致股骨头坏死的发病机制是,大量激素可导致股骨头内微血管的损伤,继而出现股骨头细胞的凋亡^[22]。股骨头坏死发生之后,前期治疗主要为非手术治疗,后期治疗可大体分为保髋治疗和关节置换两大类^[23]。对于年轻人及坏死轻、中期的患者来讲,关节置换由于翻修,创伤较大、花费较高等原因,并不是一类合适的治疗方法,人们正在积极的探索安全、有效、经济的保髋方法^[24]。

股骨头坏死的治疗,在轻度时首要考虑非手术治疗。主要是通过减少负重和对抗,同时使用相关药物来进行综合治疗。药物主要使用抗凝、抗血小板凝集的前列地尔等药物和抗骨质

疏松的唑来膦酸等药物^[25]。关节置换治疗主要是针对股骨头坏死晚期患者,已经出现严重的关节塌陷和功能障碍者。通过截骨,去除坏死骨质,安装人工假体等来提高患者关节功能。该方法能短期有效的提高患者的关节功能和生活质量^[26]。但该方法花费高,创伤大,容易出现并发症。最重要的是,对于年轻患者来讲,人工假体的翻修问题可以说是灾难性的^[27]。

保髋治疗的目的是通过各种方法,对股骨头坏死的状况进行阻碍甚至逆转。目前最为常见的方法是以髓芯减压为基础的各种骨质及材料的置入术^[28]。首先通过髓芯减压,对股骨头的负重坏死区域进行减压,减轻血管压力,促进血液循环,然后进行植骨(可复合各种成骨因子和材料),启动骨的修复和愈合过程,通过骨再生和爬行来对股骨头坏死起到治疗作用。此方法的疗效目前已得到广泛的认同并在临床上得到证实^[29]。

但此种方法的一个重要问题在于,在手术过程中很难精确地完成基础操作 - 对坏死区域进行精准和充分的减压。如果减压范围和深度不够,坏死区域得不到有效的改善和纠正,如果减压范围过大,由于股骨颈特有的解剖学特点,很容易出现股骨颈骨折、粗隆间骨折等严重并发症^[30]。因此,需要找到一种新的辅助方法来对坏死区域进行靶向定位和减压,从而为后续过程打下良好基础。

随着科学技术的发展,特别是计算机软硬件及数字技术的不断进步,数字技术与医学完美的结合起来。通过将各种数字技术输入计算机,首先通过软件技术进行处理,然后通过硬件进行打印,最终应用于临床患者的方法目前已经开始应用于临床。首先,对患者进行 X 线、CT 及 MRI 的检查,然后将各种数据导入到计算机的特有软件中,可以让我们直观的对坏死及病变的区域进行立体、三维的观察,特别是通过三维重建以后,还可以对整体的结构及与周围重要组织、血管的关系加以明确。然后在计算机中,利用强大的软件功能,将手术目的和手术步骤进行模拟和观测,以找到最为合适的角度和方法。然后将设计好的模型通过导板进行进一步的设计,通过 3D 打印机进行打印,消毒。这样在术中就可以准确的找到坏死的区域,通过设计好的管道进行减压和处理。在填充材料中,我们使用的是人工骨材料,因为人工骨相对于其他材料,更为安全、经济、方便,再加上骨诱导材料(BMP),能够达到很好的填充和植骨的目的^[31]。

本次实验证实,我们采用数字技术,将临床骨科数据与三维重建及快速成型技术进行结合,然后通过计算机软件进行规划、设计,最终将导板通过成型技术打印、消毒、应用对于中、初期股骨头坏死能够起到很好的治疗作用。且手术时间少,创伤小,并发症少。在临床中可以进一步的进行推广。当然此方法目前仍尚属初期阶段,本次实验纳入的病例较少,随访时间较短,也不是多中心研究。因此,相关实验结果有待多中心、更大样本量的临床随机试验研究验证。

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