DOI:10.3969/j.issn.1005-202X.2016.09.014

医学影像物理

PET/CT增强在鼻咽癌头颈部淋巴结转移的应用价值

张晓辉[1,2],王淑侠[3],徐卫平[3],王思云[3],曹贤东[4]
1.南方医科大学,广东 广州 510515;2.肇庆市第一人民医院核医学科,广东 肇庆 526000;3.广东省人民医院核医学科,广东 广州 510080;4.肇庆市第一人民医院信息科,广东 肇庆 526000

【摘 要】**目的:**研究PET/CT同机CT增强一站式扫描对鼻咽癌患者头颈部淋巴结转移的检测价值。**方法:**对61例确诊鼻咽癌患者行PET/CT同机CT对比剂增强一站式扫描,分析PET图像、CT图像和PET/CT增强图像对淋巴结检测的特点,分成3组数据,对比各组对颈部淋巴结转移诊断的差异。**结果:**61例患者共发现213个病灶,其中CT组发现阳性病灶137个,阴性病灶76个,灵敏度83.8%,特异性86.4%;PET组发现阳性病灶156个,阴性病灶57个,灵敏度95.5%,特异性86.2%;PET/CT增强组发现阳性病灶153个,阴性病灶60个,灵敏度99.3%,特异性98.3%。**结论:**PET/CT增强扫描在鼻咽癌头颈部淋巴结转移的诊断中,无论是对淋巴结的检出,还是在良恶性判断方面都有重要的应用价值。

【关键词】鼻咽癌;淋巴结转移;正电子显像;X线体层摄影术
【中图分类号】R739.6;R816.95 【文献标志码】A 【文章编号】1005-202X(2016)09-0939-05

Application value of enhanced PET/CT in scanning for cephalic and cervical lymph node metastasis of nasopharyngeal carcinoma

ZHANG Xiao-hui[1,2], WANG Shu-xia[3], XU Wei-ping[3], WANG Si-yun[3], CAO Xian-dong[4]
1. Southern Medical University, Guangzhou 510515, China; 2. Department of Nuclear Medicine, Zhaoqing First People's Hospital, Zhaoqing 526000, China; 3. Department of Nuclear Medicine, Guangdong General Hospital, Guangzhou 510080, China; 4. Department of Information, Zhaoqing First People's Hospital, Zhaoqing 526000, China

Abstract: Objective To study on the application value of positron emission tomography (PET)/CT fusion scanning in the detection of cephalic and cervical lymph node metastasis of nasopharyngeal carcinoma. **Methods** The PET/CT fusion scanning with contrast medium was conducted for 61 patients diagnosed as nasopharyngeal carcinoma. The characteristics of PET images, CT images and enhanced PET/CT scanner fusion images for the detection of lymph node were analyzed and divided into 3 groups of data. The differences of the diagnosis of cephalic and cervical lymph node metastasis were compared between the 3 groups. **Results** Totally, 213 lesions were found in 61 patients. In CT group, 137 positive lesions and 76 negative lesions were found, with a sensitivity of 83.8% and a specificity of 86.4%. In PET group, 156 positive lesions and 57 negative lesions were found, with a sensitivity of 95.5% and a specificity of 86.2%. In enhanced PET/CT group, 153 positive lesions and 60 negative lesions were found, with a sensitivity of 99.3% and a specificity of 98.3%. **Conclusion** Enhanced PET/CT scanning has important application value in the diagnosis of cephalic and cervical lymph node metastasis of nasopharyngeal carcinoma, no matter for the detection of lymph node or the judgment of benign and malignant tumor.

Key words: nasopharyngeal carcinoma; lymph node metastasis; positron emission tomography; X-ray CT

前 言

鼻咽癌是我国华南地区常见的头颈部恶性肿瘤,广东更是高发地区,淋巴结转移发生率较高,尤以头颈部淋巴结转移发生率高[1]。目前鼻咽癌的治疗方法为三维适形调强放疗,可在治疗靶区内准确和精确地对病灶进行照射,以减少对正常组织的损伤,故对头颈部及其淋巴结转移的靶区设定尤为重要。PET/CT可以同时反映解剖图像与肿瘤代谢分子功能图像,提高靶区的准确性。本研究通过PET/CT增强图像与单独PET图像和单独CT增强检查图像

【收稿日期】2016-05-24
【作者简介】张晓辉,女,副主任医师,E-mail:48555775@qq.com
【通信作者】王淑侠,女,博士,主任医师,硕士生导师,研究方向:PET/CT分子影像诊断,E-mail:wang_shuxia2002@aliyun.com

比较，探讨PET/CT增强一站式扫描在鼻咽癌头颈部淋巴节转移诊断中的临床应用价值。

1 材料与方法

1.1 临床资料

收集2009年1月至2016年3月经病理组织学检查诊断为鼻咽癌并头颈部淋巴结转移的患者61例，在放疗前行PET/CT增强检查。其中男性42人，女性19人，年龄22~84岁，中位年龄50岁。其中低分化鳞癌3例，未分化多角癌58例。

1.2 仪器与方法

PET/CT为德国Siemens Biograph Sensation 16，采用39环LSO（硅酸镥）闪烁晶体，CT为16层高性能UFC™（超高速陶瓷）CT检测器。^{18}F-FDG为本中心的回旋加速器生产，放化纯度>95%。对比剂非离子型增强检查，禁食4 h以上，注射前测血糖（微量法），静脉注射^{18}F-2-脱氧葡萄糖（FDG），暗光、静息60 min以上，3D PET/CT采集（Biograph16，120 keV，50 mAs）。顺序及范围：会阴部→颅底（2 min/床位）+头部。深吸气末屏气状态下行胸部（肺窗1、5 mm及纵隔窗1、5 mm重建）、腹部（1、5 mm重建）、盆腔（1、5 mm重建）、头部（2、5 mm重建）CT增强扫描。

1.3 判断方法

CT图像和PET图像由高年资CT专业医生和核医学专业医生分别阅图，PET/CT增强图像CT专业医生和核医学专业共同阅图。

1.3.1 CT组淋巴结转移诊断标准

（1）横断面图像上淋巴结最小径>10 mm，重点区域8 mm，中-明显强化，淋巴结中心坏死，淋巴结边界模糊不清，包膜外侵；（2）咽旁淋巴结转移判断标准：淋巴结最小径≥6 mm，中心坏死，环形强化[2]。

1.3.2 PET组淋巴结转移诊断标准

SUV≥2.5。

1.3.3 PET/CT增强组淋巴结转移诊断标准[3]

（1）淋巴结最小径≥8 mm，SUV≥2.5，中度-明显均匀强化。（2）淋巴结最小径≤8 mm，SUV<2.5，淋巴结明显不均匀强化，边界模糊。（3）咽旁淋巴结转移判断标准：淋巴结最小径≥6 mm，中心坏死，环形强化或SUV≥2.5。

1.4 统计学方法

采用SPSS19.0软件对数据进行统计分析，各组阳性率、特异性比较采用χ^2检验，P<0.05为有统计学差异。

2 结 果

61例鼻咽癌患者共检出淋巴结213个，其中转移淋巴结153个，良性淋巴结60个，淋巴结大小介于5~45 mm。PET共检出156个阳性病灶（真阳性142个），57个阴性病灶（真阴性50个）；CT共检出137个阳性病灶（真阳性129个），57个阴性病灶（真阴性51个）；PET/CT增强共检出153个阳性病灶（真阳性152），60个阴性病灶（真阴性59个）。各组灵敏度、特异度、阳性预测值和阴性预测值比较见表1。阳性结果典型图像见图1~3。

表1 各组诊断效能比较

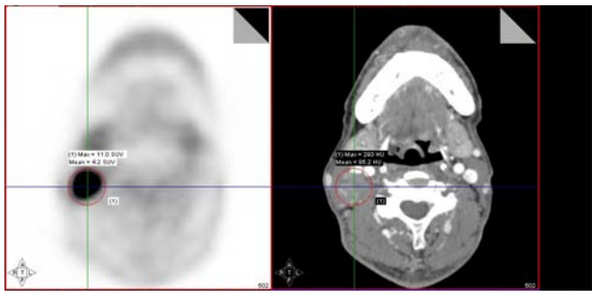
Tab.1 Comparison of diagnostic efficiency in 3 groups

Group	Sensitivity/%	Specificity/%	Positive prediction value/%	Negative prediction value/%
PET/CT	99.3	98.3	99.3	98.3
CT	83.8	86.4	84.3	85.0
PET	95.5	86.2	96.7	83.3
CT *vs* PET (χ^2 /*P* value)	11.425/0.001	0.001/0.971	12.100/0.001	0.063/0.803
CT *vs* PET/CT (χ^2 /*P* value)	24.033/0.000	6.018/0.014	23.043/0.000	6.982/0.008
PET *vs* PET/CT (χ^2 /*P* value)	4.541/0.033	6.155/0.013	3.622/0.057	8.107/0.004

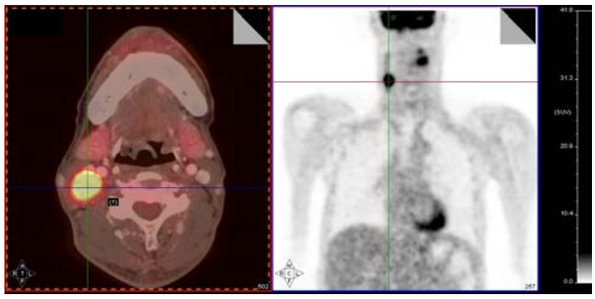
PET: Positron emission tomography

3 讨 论

鼻咽癌患者在首诊中70%~80%出现颈部淋巴结肿大[4]，转移淋巴结发生部位与原发肿瘤的淋巴引流区域相关，鼻咽癌转移淋巴结多为双侧发生，常见于颈静脉链周围淋巴结[5]。判断淋巴结是否为转移性肿大，对于患者的分期、放射治疗靶区的建立和预后评价非常重要。目前常用的检查方法为增强CT、增强MRI及PET/CT常规扫描，CT或MRI检查显示的淋巴结大小、形态、是否有中央坏死以及是否呈簇分布等形态学特征[6]。有文献报道PET/CT在鼻咽癌颈淋巴结转移的诊断及颅底骨质破坏的诊断敏感性及



1a　　1b

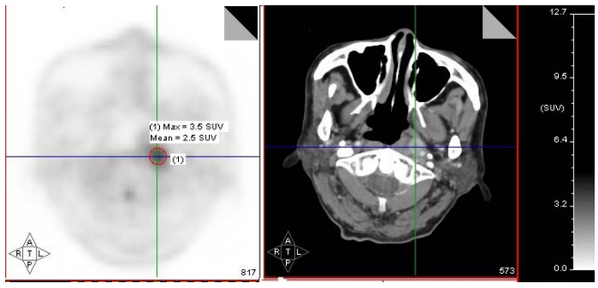


1c　　1d

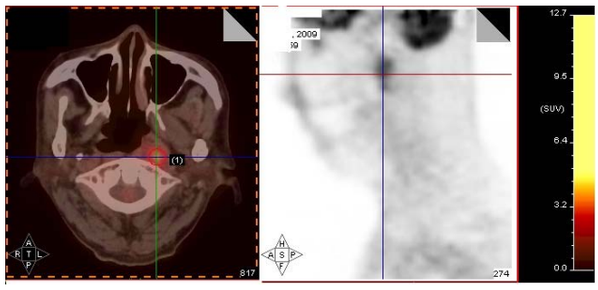
FDG: Fluorodeoxyglucose. Fig.1a & fig.1d were the axial and coronal PET scanning images of the cervical lymph node of right II zone, showing FDG uptake increase of this lymph node, FDG SUV_{max}: 11.0. Fig.1b was the enhanced CT image of this lymph node, showing the enhanced lymph node with the mean CT value of 85.2 HU. Fig.1c was the fusion of fig.1a and fig.1b, showing the enhancement and FDG uptake increase of this lymph node.

图1　右II区颈部淋巴结转移灶

Fig.1　Cervical metastatic cancer of right II zone



2a　　2b



2c　　2d

Fig.2a and fig.2d were the axial and sagittal PET scanning images of left- parapharyngeal lymph node metastasis, showing FDG uptake increase , FDG SUV_{max}: 3.5. Fig.2b was the enhanced CT image of this lymph node, showing the enhanced lymph node. Fig.2c was the fusion of fig.2a and fig.2b, showing the enhancement and FDG uptake increase of this lymph node.

图2　左咽旁淋巴结转移

Fig.2　Left−parapharyngeal lymph node metastasis

特异性都高于CT及MRI[7-9]。

PET/CT常规扫描中CT可以提供良好的解剖定位，但对于颈部复杂的解剖结构，CT平扫淋巴结与颈部血管及小肌肉横断面的形态、密度难以区别，通过注射对比剂增强后可把颈部淋巴结与颈部血管、神经及小肌肉区分出来，而且可以观察淋巴结内部结构，节内有无坏死[10]。PET/CT是目前公认的头部和颈部癌症分期和治疗评估的一个重要诊断技术手段。^{18}F-FDG PET/CT用于检测小淋巴结比CT或MRI具有更高的灵敏度[11-12]。然而，^{18}F-FDG并不是特异性癌细胞显像剂，炎性或生理摄取容易造成假阳性。本研究中PET/CT增强组和PET组及CT组在诊断淋巴结转移的特异性、灵敏度及阴性预测值方面均有明显差异，但阳性预测值与PET组差别不显著。PET显像中8例假阳性，其中6例淋巴结为炎性肿大，2例为肌肉生理性摄取，其中5例被PET/CT增强诊断为阴性结果，尤其在增强后肌肉血管及淋巴组织显影更为清晰。^{18}F-FDG显像中，囊性淋巴结转移常常被漏诊，PET组出现假阴性7例，原因可能为囊性淋巴结转移或肿瘤细胞增殖不高。因此，PET/CT增强对坏死或囊性淋巴结转移诊断准确性更高，PET/CT增强一站式扫描对功能和解剖信息的整合，显著提高病灶定位和定性。PET/CT增强一站式扫描对鼻咽癌颈部淋巴结转移的判断可提供更多诊断依据[13]。有文献报道增强扫描PET/CT在非小细胞肺癌中治疗评价对原位复发和局部转移的诊断准确性均明显高于非增强PET/CT和增强CT[14]。Tan等[15]报道多层增强CT对食管癌的淋巴结转移诊断中假阴性率高，而FDG PET/CT显像在区分假阴性转移淋巴结是很有价值的，所以FDG PET/CT与增强CT的组合可以明显提高食管癌淋巴结转移分期的准确性。

综上所述，PET/CT增强一站式检查对鼻咽癌放疗前颈部淋巴结转移无论是灵敏度、特异性还是准确性均比普通CT增强及PET显像明显提高。基于PET/CT增强一站式扫描，充分利用PET/CT信息，并增加对比剂增强CT，而不是仅根据^{18}F-FDG PET代谢信息或单纯的解剖形态学诊断进行鼻咽癌患者的鼻咽病灶、淋巴结和其它远处脏器的转移诊断和临

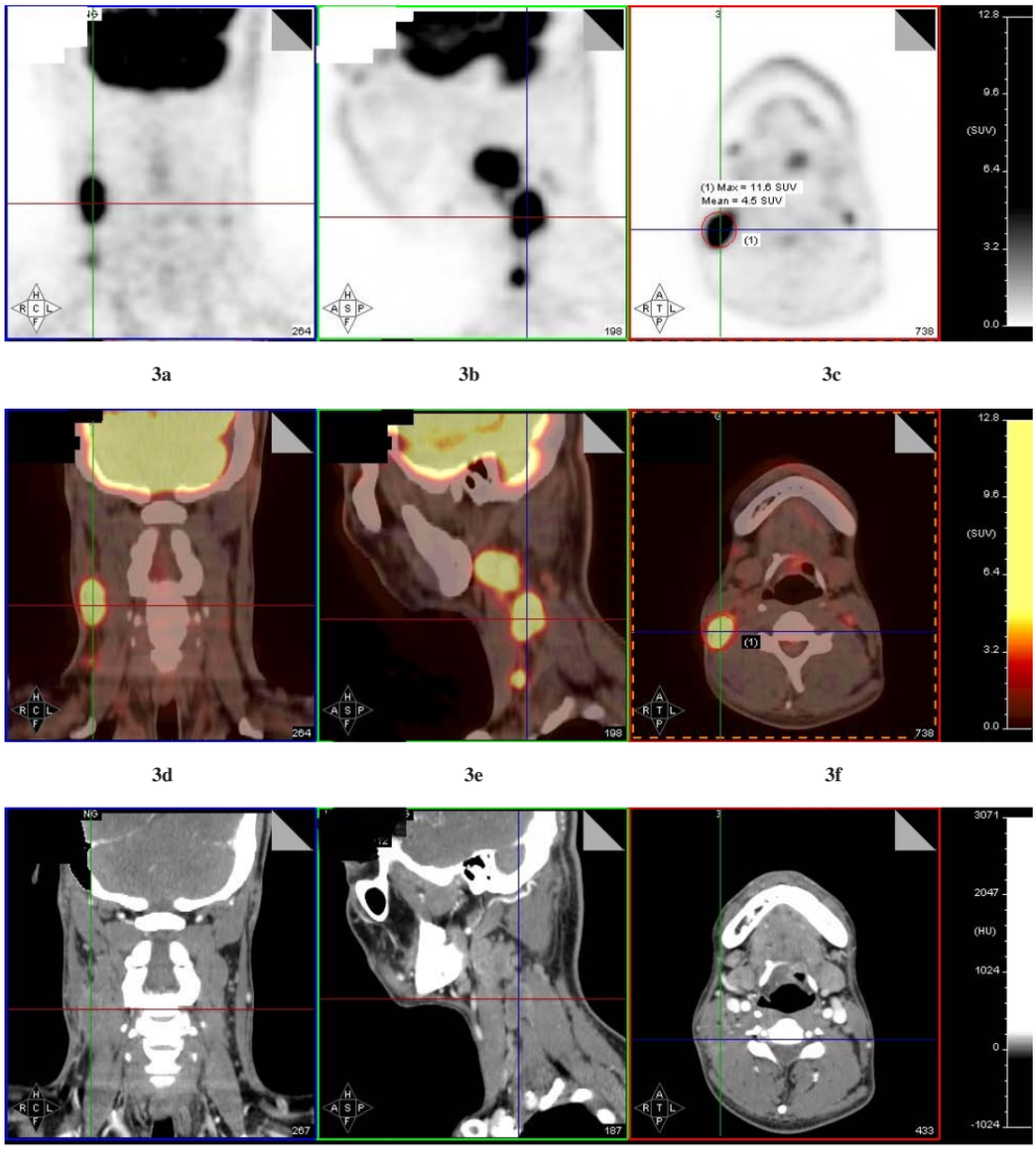


Fig.3a-fig.3c were the coronal, sagittal and axial PET scanning images of lymph node of left-cervical V zone, showing FDG uptake increase, SUV_{max}: 4.2. Fig.3g-fig.3I were the coronal, sagittal and axial enhanced CT scanning images of this lymph node, which also showed the FDG uptake increase and lymph node enhancement of cervical lymph node. Fig.3d- fig.3f were respecively the fusion of fig.3a-fig.3c and fig.3g-fig.3I, showing the enhancement and FDG uptake increase of this lymph node.

图3 左颈V区淋巴结转移

Fig.3 Lymph node metastasis of left-cervical V zone

床分期[16]，其结果更全面、准确，所以PET/CT增强一站式检查在鼻咽癌头颈部淋巴结转移的诊断中，无论是对淋巴结的检出，还是对良恶性的判断都有重要的应用价值。

【参考文献】

[1] CHAN A T. Nasopharyngeal carcinoma[J]. Ann Oncol, 2010, 21(Suppl 7): 308-312.

[2] VAN DEN BREKEL M W, STEl H V, CASTELIJNS J A, et a1. Cervical lymph node metastasis: assessment of radiologic criteria[J]. Radiology, 1990, 177: 379-384.

[3] 唐玲珑, 马骏, 陈勇, 等. MRI/CT和PET/CT检查对鼻咽癌咽后淋巴结转移的诊断价值[J]. 癌症, 2007, 26(7): 737-741.
TANG L L, MA J, CHEN Y, et a1. The values of MRI, CT, and PET/CT in detecting retropharyngeal lymph node metastasis of nasopharyngeal carcinoma[J]. Chinese Journal of Cancer, 2007, 26(7): 737-741.

[4] FLEMING I, COPPER J, HENSON D, et a1. American joint committee on cancer: AJCC cancer staging manual[M]. 5th ed. Philadelphia: Lippincott-Raven, 1997.

[5] 罗德红, 周纯武, 姚雪松, 等. 鼻咽癌颈部淋巴结转移的CT表现[J]. 临床放射学杂志, 2007, 26(12): 1199-1203.
LUO D H, ZHOU C W, YAO X S, et a1. The CT manifestations of the cervical lymph node metastasis of the nasopharyngeal carcinoma[J]. Journal of Clinical Radiology, 2007, 26(12): 1199-1203.

[6] 胡秀全, 肖巍魏, 沈关驻, 等. 疗前^{18}F-FDG PET/CT对鼻咽癌颈部散在小淋巴结的临床诊断价值[J]. 中华临床医师杂志:电子版, 2012, 6(6): 1425-1429.
HU X Q, XIAO W W, SHEN G Z, et a1. Clinical value of pretreatment ^{18}F- FDG PET/CT for small cervical lymph node in nasopharyngeal carcinoma patients[J]. Chinese Journal of Clinicians: Electronic Edition, 2012, 6(6): 1425-1429.

[7] ADAMS S, BAUM R P, STUCKENSEN T, et a1. Prospective comparison of ^{18}F-FDG PET-CT with conventional imaging modalities (CT, MRI, US) in lymph node staging of head and neck cancer [J]. Eur J Nucl Med, 1998, 25(9): 1255-1260.

[8] LIM T C, CHUA M L, CHIA G S, et a1. Comparison of MRI, CT and ^{18}F- FDG- PET/CT for the detection of intracranial disease extension in nasopharyngeal carcinoma[J]. Head Neck Oncol, 2012, 4(2): 49.

[9] 王淑侠, 唐安戊, 乔穗宪, 等. FDG-PET在鼻咽癌诊断、疗效监测及转移灶判定中的临床应用[J]. 中国临床医学影像杂志, 2002, 13(9): 392-394.
WANG S X, TANG A M, QIAO H X, et a1. Clinical utility of FDG-PET in diagnoising and detecting residue/recurrence/metastasis of nasopharyngeal carcinomas[J]. Journal of China Clinic Medical Imagine, 2002, 13(9): 392-394.

[10] 范文焱, 孙敬武. 增强CT对头颈部恶性肿瘤颈淋巴结转移的诊断价值[J]. 中华临床保健杂志, 2006, 9(3): 236-237.
FAN W Y, SUN J W. Valuation of enhanced CT on the cervical lymph node metastasis of head and neck neoplasms[J]. Chinese Journal of Clinical Health Care, 2006, 9(3): 236-237.

[11] 林勤, 李夷民, 周原, 等. ^{18}F-FDG PET/CT在鼻咽癌颈部淋巴结转移分期中的作用[J]. 中华核医学与分子影像杂志, 2012, 32(6): 418-421.
LIN Q, LI Y M, ZHOU Y, et a1. The value of 18F-FDG PET/CT in N staging nasopharyngeal carcinoma patients[J] .Chinese Journal of Nuclear Medicine and Molecular Imagine, 2012, 32(6): 418-421.

[12] LAI V, KHONG P L. Updates on MR imaging and 18F-FDG PET/CT imaging in nasopharyngeal carcinoma[J]. Oral Oncol, 2014, 50(6): 539-48.

[13] KUHN F P, HÜLLNER M, MADER C E, et a1. Contrast-enhanced PET/MR imaging versus contrast-enhanced PET/CT in head and neck cancer: How much MR information is needed[J]. Nucl Med, 2014, 55(4): 551-558.

[14] SUENAGA Y, KITAJIMA K, ISHIHARA T, et a1. FDG-PET/contrast-enhanced CT as a post-treatment tool in head and neck squamous cell carcinoma comparison with FDG-PET/non-contrast-enhanced CT and contrast-enhanced CT[J]. Eur Radiol, 2016, 26(4): 1018-1030.

[15] TAN R, YAO S Z, HUANG Z Q, et a1. Combination FDG PET/CT of and contrast-enhanced MSCT in detecting lymph node metastasis of esophageal cancer[J]. Asian Pac J Cancer Prev, 2014, 15(18): 7719-7724.

[16] 林晓平, 赵充, 陈明远, 等. ^{18}F-FDG PET/CT在鼻咽癌诊断及分期中的临床价值[J]. 癌症, 2008, 27(9): 974-978.
LIN X P, ZHAO C, CHEN M Y, et a1. Role of ^{18}F-FDG PET/CT in diagnosis and staging of nasopharyngeal carcinoma [J]. Chinese Journal of Cancer, 2008, 27(9): 974-978.

(编辑:黄开颜)

(上接932页)

[4] 谭小义, 耿彬, 张波, 等. 股骨髁间窝的形态学测量及临床意义研究进展[J]. 中国矫形外科杂志, 2015, 23(13): 1191-1194.
TAN X Y, GENG B, ZHANG B, et al. Research progress of morphology measurement and clinical significance of femoral intercondylar notch [J]. Orthopedic Journal of China, 2015, 23 (13): 1191-1194.

[5] 王守海, 郑奎宏, 谢雁. 髁间窝后前位DR诊断膝关节骨性关节炎价值研究[J]. 人民军医, 2011, 54(6): 496-497.
WANG S H, ZHENG K H, XIE Y. Intercondylar fossa posteroanterior DR diagnosis value of knee joint osteroarthritis[J]. People's Military Surgeon, 2011, 54(6): 496-497.

[6] SUTTON K M, BULLOK J M. Anterior cruciate ligament rupture: difference between males and females [J]. J Am Acad Orthop Surg, 2013, 12(1): 41-50.

[7] WANG J H, KIM J G, AHN J G, et al. Is femoral tunnel length correlated with the intercondylar notch and femoral condyle geometry after double-bundle anterior cruciate ligament reconstruction using the transportal technique? An *in vivo* computed tomography analysis[J]. Arthroscopy, 2012, 28(8): 1094-1103.

[8] HOTEYA K, KATO Y, MOTOJIMA S, et al. Association between intercondylar notch narrowing and bilateral anterior cruciate ligament injuries in athletes[J]. Arch Orthop Trauma Surg, 2011, 131(3): 371-376.

[9] SWAMI V G, MABEE M, HUI C, et al. Three-dimensional intercondylar notch volume in a skeletally immature pediatric population: a magnetic resonance imaging-based anatomic comparison of knees with tore and intact anterior cruciate ligaments[J]. Arthroscopy, 2013, 29(12): 1954-1962.

[10] MILJKO M, GRLE M, KOZUL S. Intercondylar notch width and inner angle of lateral femoral condyle as the risk factors for anterior cruciate ligament injury in female handball players in Herzegovina[J]. Coll Antropol, 2012, 36(1): 195-200.

[11] PEAT G, THOMAS E, DUNCAN R, et al. Clinical classification criteria for knee osteoarthritis: performance in the general population and primary care[J]. Ann Rheum Dis, 2006, 65(10): 1363-1367.

[12] ZENG C, GAO S G, WEI J. The influence of the intercondylar notch dimensions on injury of the anterior cruciate ligament: a meta-analysis[J]. Knee Surg Sports Traumatol Arthrosc, 2013, 21 (4): 804-815.

[13] SHEPSTONE L, ROGERS J, KIRWAN J R, et al. Shape of intercondylar notch of the human femur: a comparison of osteoarthritic and non-osteoarthritic bones from a skeletal sample[J]. Ann Rheum Dis, 2001, 60(10): 968-973.

[14] AJUIED A, WONG F, SMITH C, et al. Anterior cruciate ligament injury and radiologic progression of knee osteoarthritis: a systematic review and meta-analysis[J]. Am J Sports Med, 2014, 42(9): 2242-2252.

[15] CHAPPLE C M, NICHOLSON H, BAXTER G D. Patient characteristics that predict progression of knee osteoarthritis: a systematic review of prognostic studies [J]. Arthritis Care Res (Hoboken), 2011, 63(8): 1115-1125.

[16] YUSUF E, KORTEKASS M C, WATT I. Do knee abnormalities visualized on MRI explain knee pain in knee osteoarthritic? A systematic review[J]. Ann Rheum Dis, 2011, 70(1): 60-70.

(编辑:陈丽霞)