引文格式:孔祥斌,晏世刚,罗书科,苏鹏. 原发性闭角型青光眼患者虹膜生物学结构特点[J]. 眼科新进展,2015,35(3):254-257. doi:10.13389/j.cnki.rao.2015.0068

【应用研究】

原发性闭角型青光眼患者虹膜生物学结构特点△

孔祥斌 晏世刚 罗书科 苏鹏

作者简介:孔祥斌,男,1976年10月出生,江西九江人,博士。主要研究方向:眼科流行病学、青光眼。联系电话:13929994766;E-mail:kongxiangbin1976@gmail.com

About KONG Xiang-Bin: Male, born in October, 1976. Doctor degree. Tel: 13929994766; E-mail: kongxiangbin1976@gmail.com

收稿日期:2014-05-29
修回日期:2014-09-20
本文编辑:付中静
△基金项目:广东省自然科学基金资助(编号:S2012040007624);佛山市医学类科技攻关项目(编号:20121020081)
作者单位:528000 广东省佛山市,佛山市第二人民医院眼科中心
致谢:感谢中山大学中山眼科中心何光明教授提供ZAAP软件!
Received date: May 29, 2014
Accepted date: Sep 20, 2014
Foundation item: Natural Science Foundation of Guangdong Province (No: S2012040007624); Medical Science and Technology Project of Foshan (No: 20121020081)
From the *Department of Ophthalmology, the Second People's Hospital of Foshan, Foshan* 528000, *Guangdong Province, China*

Iris biometric characteristics of primary angle closure glaucoma

KONG Xiang-Bin, YAN Shi-Gang, LUO Shu-Ke, SU Peng

【Key words】 primary angle closure glaucoma; iris biometry; optical coherence tomography

【Abstract】 **Objective** To investigate iris biometric characteristics of primary angle closure glaucoma (PACG). **Methods** Anterior segment optical coherence tomography (AS-OCT) was used to obtain the anterior segment images of PACG and controls. The images were analyzed by Zhongshan angle analyze program (ZAAP); Iris biometry were compared between PACG and controls. **Results** Compared with controls, PACG patients had shallower anterior chamber depth, shorter axial length, thicker lens, narrower anterior open distance and anterior width, and the difference was significant (all $P<0.001$). IT750 of PACG was (0.48 ± 0.15) mm, the controls was (0.43 ± 0.18) mm, the difference was significant ($P<0.001$); IT2000 of PACG was (0.52 ± 0.14) mm, the controls was (0.47 ± 0.16) mm, the difference was significant ($P<0.001$); Iris area of PACG was (1.56 ± 0.28) mm^2, controls was (1.50 ± 0.28) mm^2, the difference was significant ($P<0.001$); Iris curvature distance of PACG was (0.31 ± 0.17) mm, the controls was (0.25 ± 0.12) mm, the difference was significant ($P<0.001$); Pupil diameter of PACG was (4.09 ± 1.71) mm, the controls was (4.48 ± 1.71) mm, the difference was significant ($P<0.001$). **Conclusion** Compared with control group, PACG patients have thicker iris, larger iris area and more iris curvatrue distance, iris biometries are associated with PACG.

【关键词】 原发性闭角型青光眼;虹膜生物学结构;光学相干断层扫描

【摘要】 **目的** 观察原发性闭角型青光眼(primary angle closure glaucoma, PACG)患者虹膜生物学结构特点。**方法** 采用眼前段光学相干断层扫描仪(anterior segment optical coherence tomography, AS-OCT),获取PACG组与对照组眼前段图像,采用中山房角分析软件(Zhongshan angle analyze program, ZAAP)对图片进行分析,对比PACG组与对照组虹膜结构参数的差异。**结果** PACG组患者前房浅、眼轴短、晶状体厚、房角窄及前房宽度小,与对照组相比差异均有显著统计学意义(均为$P<0.001$)。PACG组虹膜厚度IT750为(0.48 ± 0.15) mm,对照组为(0.43 ± 0.18) mm,PACG大于对照组;PACG组虹膜厚度IT2000为(0.52 ± 0.14) mm,对照组为(0.47 ± 0.16) mm;PACG组虹膜面积为(1.56 ± 0.28) mm^2,对照组为(1.50 ± 0.28) mm^2;PACG组虹膜弯曲距离为(0.31 ± 0.17) mm,对照组为(0.25 ± 0.12) mm;PACG组瞳孔直径(4.09 ± 1.71) mm,对照组为(4.48 ± 1.71) mm;两组间虹膜厚度、虹膜面积、虹膜弯曲距离、瞳孔直径差异均有显著统计学意义(均为$P<0.001$)。**结论** 与对照组相比,PACG患者虹膜厚、面积大、虹膜弯曲距离大,虹膜结构参数可能参与PACG发病。

青光眼是最常见的不可逆性致盲性眼病,根据我国流行病学调查显示,50岁以上中国人群中原发性闭角型青光眼(primary angle closure glaucoma, PACG)患病率为1.5%[1],而具备高危解剖因素的人群高达11.0%[2]。根据我们对2013年广东省佛山地区住院患者观察结果显示,PACG患者约占住院青光眼患者的60%,是目前我国最主要的青光眼类型。

目前PACG确切发病机制仍不十分清楚,以往研究认为,浅前房、短眼轴及厚晶状体等都是PACG发生的重要解剖因素[3-4];同时也有研究表明,女性是PACG发生的高危人群[5];晶状体年龄相关性增厚被认为是PACG发生的始动因素,而通过眼球解剖特点我们很清楚地看到,晶状体并不直接接触到小梁网;有学者对爱斯基摩人的随访数据表明[6],10 a内从解剖高危状态到真正出现PACG损害的比例只有10%,因此以往研究并不能完全解释PACG的发生机制。周边虹膜前粘连(peripheral anterior synechiae, PAS)是PACG发生最重要的病理过程,随着人们对PACG研究不断深入,作为PAS发生的直接参与者——虹膜已经被认为是PACG发生的最重要解剖结构,那么PACG患者虹膜结构参数有哪些特点?本

研究目的是观察 PACG 患者虹膜的生物学结构特点，从而为揭示 PACG 发生的虹膜相关机制提供依据。

1 资料与方法

1.1 一般资料与分组 本研究以佛山市第二人民医院眼科中心青光眼专科确诊的 PACG 患者为研究对象，其中 PACG 组患者共计 99 例(99 眼)；对照组为眼科中心白内障专科住院行白内障手术的老年性白内障患者，共纳入 103 例(103 眼)。

1.2 诊断标准、纳入标准 以临床上急性发作的 PACG 患者为研究对象，急性 PACG 的诊断标准[7]：(1)急性发作病程；(2)房角检查及 UBM 检查可见大于 180°房角狭窄；(3)伴有眼压升高；(4)有眼前段缺血改变，如青光眼斑、虹膜节段性萎缩。符合诊断标准后，以患者对侧眼为研究眼进行检查，根据研究计划，对侧眼必须符合以下标准：(1)房角镜静态下检查大于 180°功能小梁网不可见；(2)无 PAS；(3)眼压低于 21 mmHg(1 kPa = 7.5 mmHg)；(4)无眼前段缺血体征；(5)无青光眼视神经改变。符合以上标准列为 PACG 组。以同期白内障住院患者为对照组，对照组的纳入标准为：(1)房角镜静态下检查大于 180°功能小梁网可见；(2)无 PAS；(3)眼压低于 21 mmHg；(4)无眼前段缺血体征；(5)无青光眼视神经改变；(6)矫正视力大于 0.5。对照组排除标准：(1)有翼状胬肉、角膜炎等眼表疾病者；(2)有眼科手术病史，如角膜手术、白内障手术等病史；(3)既往诊断为青光眼患者。

1.3 检查项目及方法 采用标准对数视力表进行视力检查，视力低于 0.5 时根据电脑验光结果进行矫正；用电脑验光(Topcon RM 8000A，日本)仪进行验光，采用非接触气动眼压仪(Topcon，CT80A，日本)测量双眼眼压；进行双眼裂隙灯(BM-900，瑞士)及眼底检查(Volk 90D，美国)，记录眼前段及眼底检查结果；采用德国 Zeiss 眼前段光学相干断层扫描仪(anterior segment optical coherence tomography，AS-OCT)完成眼前段图像采集，根据 AS-OCT 操作要求，输入眼球屈光度数据，采用 Enhanced Anterion Segment Single 图像采集模式，为避免眼睑对研究结果的影响，本研究均取水平图像，图像达到研究要求后保存并导出，用中山房角分析软件(Zhongshan angle analyze program，ZAAP)[8]对图片进行分析和数据导出，AS-OCT 图像采集及 ZAAP 图像分析均由经过培训的专业人员完成(图 1)。AS-OCT 检查完成后点表面麻醉药物，完成 A 超检查，测量出眼轴长度及前房深度等结构参数，最后在暗室内完成裂隙灯及房角镜检查。

1.4 参数定义 等效球镜度数 =(球镜度数 + 柱镜度数)/2；眼轴长度指角膜前表面顶点至视网膜前表面的最长距离；前房深度指角膜前表面顶点至晶状体前表面之间的距离；前房宽度指 3 点至 9 点两巩膜突之间的直线距离；房角宽度指以巩膜突为圆心，500 μm 为半径做圆形，圆形与角膜内皮与虹膜前表面之间相交点的距离；IT750 指距离巩膜突 750 μm 处虹膜厚度；IT2000 指距离巩膜突 2000 μm 处虹膜厚度；虹膜最大厚度(iris thickness maximum，ITM)指采集图片中虹膜最大厚度；虹膜面积(iris area，I-Area)指左侧和右侧 I-Ared 的平均值；虹膜弯曲距离(iris curvature，I-Curv)指虹膜后表面最周边与瞳孔缘虹膜间连线，计算出虹膜弧度最大处顶点到该线的垂直距离；瞳孔直径(pupil diameter，PD)指获取图片中水平线与瞳孔缘相交点间的距离[9]。

Figure 1 AS-OCT image was analyzed by ZAAP ZAAP 软件分折 AS-OCT 图像

1.5 统计学方法 采用 Stata12.0 软件进行数据清理和统计分析，统计分析包括一般统计描述、t 检验、卡方检验，$P<0.05$ 为差异有统计学意义。

2 结果

2013 年我院青光眼专科共收治急性 PACG 患者共计 99 例，男 21 例，女 78 例，其中 37 例不符合或不能完成相关检查而被排除，共纳入 62 例 62 眼 PACG 患者；对照组 103 例中 33 例不符合或不能完成相关检查而排除，最终共纳入 70 例 70 眼。

与对照组相比，PACG 组女性比例大($P<0.05$)；在眼球生物结构参数上，PACG 组与对照组相比，两组等效球镜度数、眼轴长度、前房深度、晶状体厚度、前房宽度、房角宽度差异均有显著统计学意义(均为 $P<0.001$)；PACG 组与对照组眼压差异无统计学意义(均为 $P>0.05$，见表 1)。

研究结果显示，PACG 组虹膜结构参数 IT750 大于对照组，差异有显著统计学意义($P<0.001$)；两组虹膜结构参数 IT2000、I-Area、ITM、I-Curv、PD 差异均有显著统计学意义(均为 $P<0.001$，见表 2)。

3 讨论

选择合适的研究对象对于研究结果的可信度相当关键。大样本的流行病学研究是 PACG 最常见的研究方法，这类研究中，通常将 270°或更大范围功能小梁网不可见定义为窄房角，而对照组定义相反，需

表1 两组基本资料比较

Table 1 Comparison of baseline data between PACG group and control group

Baseline	PACG group	Control group	*P*
Age/year	63.6±13.4	72.0±10.7	0.020
Gender(female)	75.8%	68.6%	0.030
Spherical equivalent(φ/D)	0.75±2.15	−0.57±2.19	<0.001
Axial length(*l*/mm)	22.84±0.98	23.70±1.09	<0.001
Anterior chamber depth(*l*/mm)	2.57±0.18	3.29±0.30	<0.001
Len thickness(*l*/mm)	4.47±0.75	4.37±0.73	<0.001
Anterior chamber width(*l*/mm)	11.69±0.56	12.11±0.57	<0.001
Angle width(*l*/mm)	0.14±0.13	0.26±0.17	<0.001
IOP(*P*/mmHg)	14.20±2.50	14.40±2.50	0.350

表2 两组虹膜参数、PD比较

Table 2 Comparison of iris biometry and pupil diameter between PACG group and control group

Baseline	PACG group	Control group	*P*
IT750(*l*/mm)	0.48±0.15	0.43±0.18	<0.001
IT2000(*l*/mm)	0.52±0.14	0.47±0.16	0.004
ITM(*l*/mm)	0.64±0.13	0.60±0.15	0.030
I-Area(S/mm^2)	1.56±0.28	1.50±0.28	<0.001
I-Curv(*l*/mm)	0.31±0.17	0.25±0.12	<0.001
PD(*l*/mm)	4.09±1.71	4.48±1.71	<0.001

要重点指出的是,窄房角并不等于PACG,根据在格陵兰岛的纵向研究结果表明,10 a内仅10%高危房角发展为PACG[10];而Thomas等[11]对印度人群的纵向研究结果表明,5 a内22%可疑房角关闭(primary angle closure suspect,PACS)发展为原发性房角关闭(primary angle closure,PAC),28.5% PAC发展为PACG[12]。从以上数据我们可以看出,大部分PACS并不进展,因此我们如果以PACS为研究对象,将必然会导致研究结果假阳性率升高。而临床上的病例对照研究中,急性发作的闭角型青光眼多伴有眼前段缺血改变,早期虹膜水肿,后期虹膜萎缩,并不适合用于观察PACG与虹膜结构参数的关系。本研究选择单侧急性PACG患者,选择对侧未发作"正常眼"为研究对象,临床观察结果表明75% PACG患者对侧眼在5~10 a发生房角关闭[13],因此PACG患者对侧眼是真正意义上的"高危房角"。

本研究结果显示,PACG组女性患者占70%,大于对照组,表明女性是PACG的高危人群,这与以往研究结果相似[14-15]。本研究结果显示,PACG患者屈光度大于对照组,更偏向远视,这与以往研究结果相近[16-18];以往多项研究已经证实眼球解剖结构的异常是闭角型青光眼发病的主要因素,如浅前房、小角膜和厚晶状体等[4],我们的研究结果也得出相同的结论,PACG患者与对照组相比,前房浅、眼轴短、晶状体厚、房角宽度小等,与对照组相比,PACG前段更为"拥挤"。

本研究结果显示,PACG组IT750、IT2000及ITM均大于对照组,Wang等[9]在新加坡的研究结果也表明,高危房角患者周边虹膜厚度大于正常人群,从房角的解剖结构上我们可以看出,周边虹膜厚度必将导致房角宽度减少,从而更容易导致闭角型青光眼发作。Sihota等[19]对印度人群用UBM进行研究结果表明,急性发作PACG及慢性PACG患者虹膜厚度小于对侧临床前期PACG眼,与本研究结果相反,分析其主要原因是,研究对象为急性及慢性PACG患者眼压高,导致眼前段缺血,从而导致虹膜萎缩变性,因此虹膜厚度减小,横截面积减少。

本研究结果发现,PACG患者I-Curv大于对照组,与Wang等[9]研究结果一致;从本研究参数定义我们可以分析出,I-Curv越大,表示虹膜膨隆越明显,周边房角越窄;即本研究结果显示PACG虹膜膨隆大于对照组,分析其原因可能是PACG患者前房浅,晶状体虹膜隔前移,根据Mapstone公式[20-21],发现可导致虹膜瞳孔阻滞力增加,从而引起后房压力增加,进而引起虹膜膨隆,导致I-Curv增加。Wang等[22]研究结果表明,虹膜激光预防后,临床前期PACG眼I-Curv小于对照组,说明虹膜激光周边切除术可以显著改善I-Curv,从而可以预防高危房角急性发作。

本研究表明,PACG患者虹膜厚度、I-Area、I-Curv等与对照组有显著差异,根据房角解剖结构,PACG患者虹膜结构参数的改变趋势可导致房角变窄,从而可能导致PACG急性发作。有学者[9,22]研究表明虹膜结构参数,如虹膜厚度、I-Area、I-Curv是PACG发生的独立危险因素,可以用于PACG患者的筛查。

PACG是典型的年龄相关性眼病,本研究及以往研究[9,22]均证明虹膜结构参数与PACG密切相关,由于本研究及既往研究为病例对照研究或横断面研究,那么是否虹膜结构参数改变是导致PACG发作的主要原因呢?目前尚无法准确回答,需要进一步纵向数据去证实。

需要指出的是本研究为临床病例对照研究,对照组为住院白内障患者对侧眼,可能会对研究结果有一定影响;同时ZAAP软件分析时,34.5%研究对象因巩膜突无法确定而无法分析,可能对研究结果也有一定影响。

参考文献

1 He M, Foster PJ, Ge J, Huang W, Zheng Y, Friedman DS, *et al*. Prevalence and clinical characteristics of glaucoma in adult Chinese: a population-based study in Liwan District, Guangzhou [J]. *Invest Ophthalmol Vis Sci*, 2006, 47(7): 2782-2788.

2 He M, Foster PJ, Ge J, Huang W, Wang W, Friedman DS, *et al*. Gonioscopy in adult Chinese: the Liwan Eye Study [J]. *Invest Ophthalmol Vis Sci*, 2006, 47(11): 4772-4779.

3 Congdon NG, Youlin Q, Quigley H, Hung PT, Wang TH, Ho TC, *et al*. Biometry and primary angle-closure glaucoma among Chinese, white, and black populations [J]. *Ophthalmology*, 1997, 104(9): 1489-1495.

4 George R, Paul PG, Baskaran M, Ramesh SV, Raju P, Arvind H, *et al*. Ocular biometry in occludable angles and angle closure glaucoma: a population based survey [J]. *Br J Ophthalmol*, 2003, 87(4): 399-402.

5 Aung T, Nolan WP, Machin D, Seah SK, Baasanhu J, Khaw PT, *et*

al. Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations[J]. *Arch Ophthalmol*,2005,123(4):527-532.
6 Alsbirk PH. Anatomical risk factors in primary angle-closure glaucoma. A ten year follow up survey based on limbal and axial anterior chamber depths in a high risk population[J]. *Int Ophthalmol*,1992,16(4-5):265-272.
7 Foster PJ,Buhrmann R,Quigley HA,Johnson GJ. The definition and classification of glaucoma in prevalence surveys[J]. *Br J Ophthalmol*,2002,86(2):238-242.
8 Console JW,Sakata LW,Aung T,Friedman DS,He M. Quantitative analysis of anterior segment optical coherence tomography images:the Zhongshan Angle Assessment Program[J]. *Br J Ophthalmol*,2008,92(12):1612-1616.
9 Wang B,Sakata LM,Friedman DS,Chan YH,He M,Lavanya R,*et al*. Quantitative iris parameters and association with narrow angles[J]. *Ophthalmology*,2010,117(1):11-17.
10 Alsbirk PH. Anatomical risk factors of angle-Closure glaucoma. A 10-year study of limbal and axial anterior chamber depths in a risk population[J]. *Ugeskr Laeger*,1994,156(36):5117-5121.
11 Thomas R,George R,Parikh R,Muliyil J,Jacob A. Five year risk of progression of primary angle closure suspects to primary angle closure:a population based study[J]. *Br J Ophthalmol*,2003,87(4):450-454.
12 Thomas R,Parikh R,Muliyil J,Kumar RS. Five-year risk of progression of primary angle closure to primary angle closure glaucoma:a population-based study[J]. *Acta Ophthalmol Scand*,2003,81(5):480-485.
13 李美玉. 青光眼学[M]. 北京:人民卫生出版社,2004:314.
14 Lavanya R,Wong TY,Friedman DS,Aung T,Alfred T,Gao H,*et al*. Determinants of angle closure in older Singaporeans[J]. *Arch Ophthalmol*,2008,126(5):686-691.
15 Liang YD. Friedman DS,Zhou Q,Yang YH,Sun LP,Guo L,*et al*. Prevalence and characteristics of primary angle-closure diseases in a rural adult Chinese population:the Handan Eye Study[J]. *Invest Ophthalmol Vis Sci*,2011,52(12):8672-8679.
16 Sawaguchi S,Sakai H,Iwase A,Yamamoto T,Abe A,Tomita G,*et al*. Prevalence of primary angle closure and primary angle-closure glaucoma in a southwestern rural population of Japan:the Kumejima Study[J]. *Ophthalmology*,2012,119(6):1134-1142.
17 Devereux JG,Foster PJ,Baasanhu J,Uranchimeg D,Lee PS,Erdenbeleig T,*et al*. Anterior chamber depth measurement as a screening tool for primary angle-closure glaucoma in an East Asian population[J]. *Arch Ophthalmol*,2000,118(2):257-263.
18 Lavanya R,Foster PJ,Sakata LM,Friedman DS,Kashiwagi K,Wong KY,*et al*. Screening for narrow angles in the singapore population:evaluation of new noncontact screening methods[J]. *Ophthalmology*,2008,115(10):1720-1727.
19 Sihota R,Dada T,Gupta R,Lakshminarayan P,Pandey RM. Ultrasound biomicroscopy in the subtypes of primary angle closure glaucoma[J]. *J Glaucoma*,2005,14(5):387-391.
20 Mandell MA,Pavlin CJ,Weisbrod DJ,Simpson ER. Anterior chamber depth in plateau iris syndrome and pupillary block as measured by ultrasound biomicroscopy[J]. *Am J Ophthalmol*,2003,136(5):900-903.
21 Nonaka A,Iwawaki T,Kikuchi M,Fujihara M,Nishida A,Kurimoto Y. Quantitative evaluation of iris convexity in primary angle closure[J]. *Am J Ophthalmol*,2007,143(4):695-697.
22 Wang BS,Narayanaswamy A,Amerasinghe N,Zheng C,He M,Chan YH,*et al*. Increased iris thickness and association with primary angle closure glaucoma[J]. *Br J Ophthalmol*,2011,95(1):46-50.

(上接第 253 页)

参考文献

1 Wright KW. Pediatric Ophthalmology and Strabismus[M]. 2nd Edition. New York:Springer-Verlag New York Inc,2003:15771.
2 刘虎,赵堪兴,赵凤云,史学峰,钱学翰. 5-HT_(2c)受体在正常发育和斜视猫视皮层 17 区的表达[J]. 眼科新进展,2006,26(2):93-96.
3 Davis AR,Sloper JJ,Neveu MM,Hogg CR,Morgan MJ,Holder GE. Differential changes of magnocellular and parvocellular visual function in early- and late-onset strabismic amblyopia[J]. *Invest Ophthalmol Vis Sci*,2006,47(20):4836-4841.
4 Barnes GR,Li X,Thompson B,Singh KD,Dumoulin SO,Hess RF. Decreased gray matter concentration in the lateral geniculate nuclei in human amblyopes[J]. *Invest Ophthalmol Vis Sci*,2010,51(3):1432-1438.
5 Zhang Z,He X,Zhu J. Macular measurements using optical coherence tomography in healthy Chinese school age children[J]. *Invest Ophthalmol Vis Sci*,2011,52(9):6377-6383.
6 Cheng SC,Lam CS,Yap MK. Retinal thickness in myopic and non-myopic eyes[J]. *Ophthalmic Physiol Opt*,2010,30(6):776-784.
7 Al-Haddad CE,Mollayess GM,Cherfan CG,Jaafar DF,Bashshur ZF. Retinal nerve fibre layer and macular thickness in amblyopia as measured by spectral-domain optical coherence tomography[J]. *Br J Ophthalmol*,2011,95(12):1696-1699.
8 Ooto S,Hangai M,Sakamoto A. Three-dimensional profile of macular retinal thickness in normal Japanese eyes[J]. *Invest Ophthalmol Vis Sci*,2010,51(1):465-473.
9 Yalcin E,Balci O. Peripapillary retinal nerve fiber layer and foveal thickness in hypermetropic anisometropic amblyopia[J]. *Clin Ophthalmol*,2014,8(4):749-753.
10 Huynh SC,Samarawickrama C,Wang XY. Macular and nerve fiber layer thickness in amblyopia:the Sydney Childhood Eye Study[J]. *Ophthalmology*,2009,116(9):1604-1609.
11 Firat PG,Ozsoy E,Demirel S,Cumurcu T,Gunduz A. Evaluation of peripapillary retinal nerve fiber layer,macula and ganglion cell thickness in amblyopia using spectral optical coherence tomography[J]. *Int J Ophthalmol*,2013,6(1):90-94.
12 Lam DS,Leung KS,Mohamed S. Regional variations in the relationship between macular thickness measurements and myopia[J]. *Invest Ophthalmol Vis Sci*,2007,48(2):376-382.
13 Wu PC,Chen YJ,Chen CH. Assessment of macular retinal thickness and volume in normal eyes and highly myopic eyes with third-generation optical coherence tomography[J]. *Eye(Lond)*,2008,22(4):551-555.
14 Eriksson U,Alm A. Macular thickness decreases with age in normal eyes:a study on the macular thickness map protocol in the Stratus OCT[J]. *Br J Ophthalmol*,2009,93(11):1448-1452.
15 Leung CK,Chiu V,Weinreb RN. Evaluation of retinal nerve fiber layer progression in glaucoma:a comparison between spectral-domain and time-domain optical coherence tomography[J]. *Ophthalmology*,2011,118(8):1558-1562.
16 Knight OJ,Chang RT,Feuer WJ,Budenz DL. Comparison of retinal nerve fiber layer measurements using time domain and spectral domain optical coherent tomography[J]. *Ophthalmology*,2009,116(7):1271-1277.
17 Sung KR,Kim DY,Park SB,Kook MS. Comparison of retinal nerve fiber layer thickness measured by Cirrus HD and Stratus optical coherence tomography[J]. *Ophthalmology*,2009,116(7):1264-1270.
18 Sung KR,Kim DY,Park SB,Kook MS. Comparison of retinal nerve fiber layer thickness measured by Cirrus HD and Stratus optical coherence tomography[J]. *Ophthalmology*,2009,116(7):1264-1270.
19 Leite MT,Rao HL,Weinreb RN. Agreement among spectral-domain optical coherence tomography instruments for assessing retinal nerve fiber layer thickness[J]. *Am J Ophthalmol*,2011,151(1):85-92.
20 Park KA,Park DY,Oh SY. Analysis of spectral-domain optical coherence tomography measurements in amblyopia:a pilot study[J]. *Br J Ophthalmol*,2011,95(12):1700-1706.