

1~15岁单侧髋关节发育不良患儿坐骨厚度演变探讨

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摘要 目的 探讨1~15岁未经治疗的单侧髋关节发育不良(DDH)患儿坐骨骨性厚度的自然演变过程及相关因素。**方法** 回顾性分析符合标准的329例单侧脱位未经治疗的1~15岁DDH患儿,在CT冠状面和轴面对坐骨进行取点连线分区,两侧Y型软骨中心连线为H线,两侧坐骨最下缘连线为b线,两连线中间部分被a线平分,由患侧至健侧,坐骨厚度冠状位定义为CL1-CL4,轴位定义为AL1-AL4。测量双侧不同截面、不同分区坐骨厚度、髌板厚度、髌骨厚度、股骨头髌商等,并进行相互比较和相关性分析。**结果** 冠状位坐骨厚度CL1-CL4在1~10岁时随着年龄的增长逐渐增加,在11~15岁时坐骨厚度逐渐降低,骨性坐骨厚度CL1-CL4的范围为2.1~16.7 mm、3.3~18.9 mm、2.4~13.6 mm和3.0~14.9 mm。轴位坐骨厚度AL1-AL4在1~13岁时随着年龄的增长逐渐增加,13岁时达到顶峰。骨性坐骨厚度AL1-AL4的范围为4.6~20.4 mm、2.5~17.2 mm、3.4~16.3 mm和2.4~14.2 mm。1~15岁各年龄段不同截面和不同区域患侧坐骨厚度均大于对侧,差异有统计学意义($P < 0.05$)。患侧冠状位髌板宽度、轴位髌板宽度、髌骨厚度等大于对侧,差异有统计学意义($P < 0.05$),髌商小于对侧,差异有统计学意义($P < 0.05$)。冠状位和轴位髋关节中心区域的差异大于边缘区。冠状位和轴位坐骨厚度与年龄呈中度正相关($r = 0.413 \sim 0.570, P < 0.05$),和脱位程度基本无相关性($r = 0.024 \sim 0.073, P > 0.05$)。坐骨厚度和同侧相应的髌板厚度、冠状位髌骨厚度等呈正相关($r = 0.427 \sim 0.681, P < 0.05$),坐骨厚度和髌商呈一般强度负相关($r = 0.130 \sim 0.241, P < 0.05$)。**结论** 1~10岁单侧DDH患儿坐骨厚度的发育随着年龄的增长逐渐增加,11~15岁以后增速逐渐下降。相同年龄患侧坐骨厚度大于对侧,在冠状位和轴位,髋关节中心区域的差异大于边缘区。坐骨厚度和髌臼软骨指数、髌板厚度、冠状面髌骨厚度等指标同步演变。

关键词 发育性髋关节脱位;CT;坐骨;厚度;演变;儿童

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髋关节发育不良(developmental dysplasia of the hip, DDH)是儿童骨科常见的复杂髋关节疾病谱。根据目前的研究,髋关节发育不良的主要病理改变股骨头变小呈橄榄样、前倾增加、颈干角增大、股骨头塌陷坏死,髌臼外上方的软骨、孟唇等的形变,包括髌臼前倾、孟唇增厚内翻或外翻、髌臼指数增大、眉弓硬化等^[1-6]。目前,对于髋关节的主要受力区髌骨的研究较多,而对于坐骨的形态及其病理改变缺乏研究^[7]。

在儿童生长发育过程中,坐骨增厚的主要形式是软骨化骨,其厚度和形态随年龄逐渐向成人髋关节演变^[8]。而在DDH患儿中,其演变过程并不明确。DDH患儿患侧坐骨厚度及形态和对侧并不完全相同,部分坐骨髌臼内壁处呈现“凸形”,占据髋关节空间,增加了复位后再脱位及股骨头的撞击磨损可能^[9-11]。因此,该研究拟通过测量CT不同截面、不同部位坐骨厚度,比较单侧DDH患儿两侧坐骨厚度的演变规律及其增厚的相关因素。

1 材料与方法

1.1 一般资料 回顾性收集2015年1月—2022年7月安徽医科大学附属省儿童医院骨科接受治疗的DDH患儿资料,并进行门诊病例检索。纳入标准:①单侧发病患儿,包括全脱位、半脱位、髌臼发育不良;②包含CT检查;③年龄0~14周岁。排除标准:①神经肌肉性疾病所致髌脱位、畸形性髌脱位、外伤性髌脱位等;②双侧脱位患儿;③影像学资料不清晰或临床记录不完善;④行CT检查前有Pavlik吊带治疗、闭合复位或其他治疗等病史。

根据以上纳入排除标准,共收集329例DDH患儿,男女比例为66:263,左侧:右侧为223:106。患儿年龄为1~15岁,平均3.81岁。由于患儿年龄跨度较大,且主要是低年龄儿,本研究采用目前常用的国际髋关节脱位程度标准(international hip dysplasia institute, IHDI)进行分度^[12], I度0例, II度86例, III度69例, IV度174例。

1.2 研究方法 所有纳入研究的373例患儿,在接受任何形式的治疗前行CT检查。低年龄无法配合

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患儿(<4岁)检查前30 min使用水合氯醛经肛门灌肠镇静(25 mg/kg)。所有患儿检查时仰卧于检查台,双腿与肩等宽,轻度内旋约15°,处于镇静状态下患儿使用被褥维持肢体位置。所有测量数据均通过医院的CT图像存档和通信系统(Picture Archiving and Communication System, PACS)进行测量。由于儿童期髋关节处于整体发育阶段,增厚的坐骨和髌骨厚度、髌板厚度、脱位程度、股骨头髌商等都可能具有相关性,本研究测量髌骨厚度、髌板厚度和髌商等指标,判断和坐骨厚度演变的相关性。共有两名观察者进行测量,连续变量取平均值,分类变量若有差异以年资最高者为准。CT重建层厚1 mm,并应用工作站进行MPR多平面重组,将测量部位调整至最佳位置进行测量。

1.3 测量方法

1.3.1 冠状面坐骨厚度测量 在冠状位上,以正常侧髋臼为参考系,轴位Y型软骨坐骨耻骨支最大截面为参考截面,测量冠状位髋关节截面指标。两侧Y型软骨中心连线为H线,两侧坐骨最下缘连线为b线,两连线中间部分被a线平分,分为两部分,从下往上分为1区和2区,1区代表髋臼边缘区域,2区代表髋臼中心区域,不同区域中心以P点表示。在两区等分线中心上垂直于坐骨内板测量坐骨厚度,由脱位侧到对侧依次为厚度CL1、CL2、CL3、CL4,测量方法如图1所示。



图1 磁共振测量时髋关节冠状面和矢状面分区示意图

注:做坐骨最下缘连线b和两髋臼中心H线,将两连线中间部分二等分,从下往上分为1区和2区。在两区中心测量坐骨厚度,患侧为CL1和CL2,对侧为CL3和CL4。

1.3.2 轴面坐骨厚度测量 同样,在轴位上,以正常侧髋臼为参考系,冠状位Y型软骨坐骨髌骨支最大截面为参考截面,测量轴位髋关节截面指标。做两髋臼软骨中心连线H和两髋臼软骨后缘关节边缘连线a,做一条平分线b将两者中间区域平分为1

区和2区,1区代表髋臼边缘区域,2区代表髋臼中心区域,测量过1区和2区中心Q点垂直髋臼坐骨内板垂线,分别为厚度AL1、AL2、AL3、AL4。测量方法见图2。同样在该截面测量轴位髌板宽度,见图3。

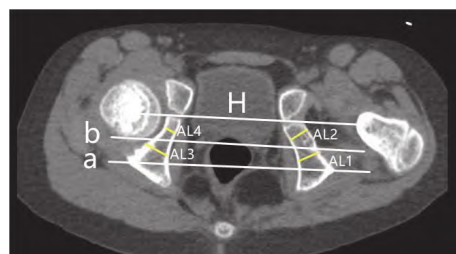


图2 CT测量髋关节冠状面示意图

注:轴面上,做两髋臼软骨中心连线H和两髋臼软骨坐骨和后方孟唇结合部连线a,做一条平分线b将两者中间区域平分为1区和2区,测量1、2区中心垂直髋臼坐骨内板垂线距离。

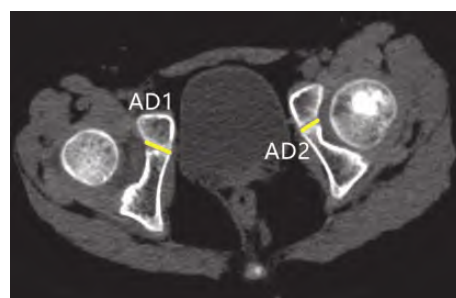


图3 CT测量髋关节轴面髌板厚度示意图

注:轴面上,选取AD1为患侧髌板厚度,由髋臼髌板外侧缘至骨盆侧内侧缘,AD2为同样测量方法测量对侧。

1.3.3 冠状面相关指标比值测量 在轴面耻骨坐骨髌骨厚度最大处相对应的冠状面上测量髌骨厚度,定义Y型软骨髋臼处最外缘为点A,髋臼骨性最外缘为点B,点M为点A和点B弧形中点。过A点做髌骨内板垂线,髌骨厚度为IL1,过髋臼弧形中点M点做内板垂线,为IL2,同样方法测量对侧。CD1为患侧髌板厚度,由髋臼髌板外侧缘至骨盆侧内侧缘,CD2为同样测量方法测量对侧。髌商测量方法:股骨头骨髌板厚度为d,高度为h, h/d即为股骨头骨髌商。测量方法见图4。

1.4 统计学处理 采用SPSS 24.0版(IBM Corp, Armonk, New York, USA)进行统计学分析。连续型变量均以均数±标准差表示($Mean \pm SD$),配对样本t检验比较脱位侧和对侧不同截面坐骨厚度、髌板厚度、髌骨厚度的差异。Pearson、Spearman相关因素分析坐骨厚度和相应髌板厚度、侧别、性别、IHD



图4 CT测量时髋关节冠状位髌骨厚、髌板宽度、髌商示意图

注:右侧髋关节为定义示意图,定义Y型软骨髌臼处最外缘为点A,髌臼骨性最外缘为点B,点M为点A和点B弧形中点。左侧髋关节为测量示意图,过A点做髌骨内板垂线,髌骨厚度为IL1,过髌臼弧形中点M点做内板垂线,为IL2,同样方法测量对侧。同样在该图上测量髌板厚度、髌商等。

不同脱位程度、轴位坐骨形态、髌商、轴位坐骨厚度、冠状位髌骨厚度等的相关性^[13]。P < 0.05 表示差异有统计学意义。相关系数结果如下:0.8 ~ 1.0,极强相关;0.6 ~ 0.8,强相关;0.4 ~ 0.6,中等程度相关;0.2 ~ 0.4,弱相关;0 ~ 0.2,极弱相关或无相关。

2 结果

2.1 冠状位不同部位坐骨厚度、髌板厚度、髌商等CT测量结果 根据以上纳入排除标准,共收集329例DDH患儿,年龄1 ~ 15岁,平均3.81岁,其中学龄前儿童占71%,青少年60例(≥10岁)。半脱位患儿86例。患儿冠状位和轴位坐骨厚度、髌骨厚度、髌板厚度、髌商等见表1、2。根据配对样本t检

表1 冠状位坐骨厚度 CL、髌板厚度 CD、h/d 及患健侧比值

年龄 (岁)	n	冠状位坐骨宽度测量结果 (Mean ± SD)											
		CL1	CL2	CL3	CL4	CD1	CD2	h/d1	h/d2	CL1/CL3	CL2/CL4	CD1/CD2	(h/d)1/ (h/d)2
1	21	5.50 ± 1.07	7.05 ± 1.83	5.31 ± 0.47	6.07 ± 0.93	7.6 ± 1.63	6.05 ± 1.10	5.71 ± 1.18	4.96 ± 0.86	1.05 ± 0.16	1.19 ± 0.37	1.27 ± 0.28	1.17 ± 0.27
		6.67 ± 1.41	8.0 ± 1.27	5.73 ± 0.89	6.46 ± 1.03	9.05 ± 1.38	7.08 ± 1.06	7.24 ± 1.07	6.29 ± 0.92	1.17 ± 0.22	1.27 ± 0.26	1.29 ± 0.23	1.16 ± 0.16
2	34	7.71 ± 1.33	9.14 ± 1.77	6.36 ± 1.22	7.40 ± 1.31	9.41 ± 1.16	8.22 ± 3.48	7.98 ± 0.92	6.89 ± 1.05	1.26 ± 0.34	1.28 ± 0.35	1.24 ± 0.30	1.17 ± 0.16
		6.64 ± 1.92	8.34 ± 2.37	5.85 ± 1.11	7.03 ± 1.53	10.15 ± 1.69	7.63 ± 1.56	8.15 ± 1.52	6.67 ± 0.97	1.15 ± 0.33	1.24 ± 0.48	1.39 ± 0.42	1.24 ± 0.24
3	88	11.98 ± 0.9	6.14 ± 0.76	11.4 ± 1.54	6.07 ± 0.71	14.12 ± 1.4	6.6 ± 0.71	12.74 ± 2.07	6.24 ± 0.7	1.16 ± 0.32	1.02 ± 0.13	1.12 ± 0.11	1.06 ± 0.11
		7.71 ± 1.93	9.4 ± 2.36	6.59 ± 1.89	7.77 ± 1.94	10.45 ± 1.95	8.71 ± 1.69	8.29 ± 1.30	7.97 ± 1.39	1.23 ± 0.32	1.24 ± 0.29	1.29 ± 0.29	1.12 ± 0.23
4	20	7.28 ± 1.21	9.66 ± 0.88	5.88 ± 0.78	6.72 ± 0.69	11.11 ± 1.49	9.14 ± 1.02	9.01 ± 1.39	7.92 ± 0.89	1.24 ± 0.19	1.44 ± 0.17	1.27 ± 0.29	1.17 ± 0.23
		9.66 ± 0.6	11.39 ± 1.12	7.95 ± 1.07	8.16 ± 1.91	13.17 ± 2.28	9.61 ± 1.76	10.54 ± 0.46	8.99 ± 1.24	1.23 ± 0.11	1.48 ± 0.45	1.39 ± 0.21	1.19 ± 0.16
5	30	10.01 ± 2.2	11.77 ± 4.05	6.69 ± 2.82	8.17 ± 2.94	13.58 ± 3.19	9.53 ± 1.47	10.69 ± 1.33	8.32 ± 1.31	1.53 ± 0.61	1.53 ± 0.46	1.26 ± 0.23	1.15 ± 0.12
		10.74 ± 3.04	13.09 ± 2.54	8.37 ± 1.69	9.76 ± 1.73	13.66 ± 2.25	11.31 ± 1.65	11.06 ± 1.95	9.81 ± 1.61	1.27 ± 0.25	1.37 ± 0.32	1.22 ± 0.21	1.13 ± 0.11
6	24	10.21 ± 1.68	10.94 ± 2.78	7.56 ± 2.48	7.26 ± 2.55	13.92 ± 3.32	10.26 ± 2.1	10.85 ± 2.59	8.29 ± 1.02	1.51 ± 0.72	1.69 ± 0.73	1.37 ± 0.23	1.32 ± 0.29
		9.93 ± 3.19	12.13 ± 3.44	7.47 ± 2.67	7.91 ± 3.33	14.55 ± 3.85	10.05 ± 2.61	12.31 ± 1.89	9.53 ± 2.21	1.38 ± 0.38	1.70 ± 0.61	1.49 ± 0.37	1.33 ± 0.24
7	18	9.52 ± 1.53	10.89 ± 1.59	7.19 ± 2.46	7.94 ± 2	13.3 ± 2.12	10.58 ± 2.68	8.20 ± 2.57	10.37 ± 3.91	1.42 ± 0.36	1.46 ± 0.43	1.32 ± 0.35	0.97 ± 0.58
		7.54 ± 2.02	9.61 ± 2.83	6.47 ± 1.79	6.33 ± 1.53	12.25 ± 1.42	9.55 ± 0.74	9.32 ± 0.85	6.99 ± 1.61	1.17 ± 0.13	1.56 ± 0.51	1.29 ± 0.22	1.44 ± 0.52
8	13	8.31 ± 2.89	8.47 ± 4.06	6.04 ± 1.56	6.21 ± 1.99	9.89 ± 4.68	8.13 ± 2.3	9.06 ± 2.34	6.93 ± 2.86	1.36 ± 0.26	1.38 ± 0.49	1.17 ± 0.2	1.44 ± 0.47
		10.74 ± 3.04	13.09 ± 2.54	8.37 ± 1.69	9.76 ± 1.73	13.66 ± 2.25	11.31 ± 1.65	11.06 ± 1.95	9.81 ± 1.61	1.27 ± 0.25	1.37 ± 0.32	1.22 ± 0.21	1.13 ± 0.11

表2 轴位坐骨厚度 AL、髌骨厚度 CI 及左右侧比值

年龄 (岁)	n	轴位坐骨厚度 AL、髌骨厚度 CI (Mean ± SD)											
		AL1	AL2	AL3	AL4	CI1	CI2	CI3	CI4	AL1/AL3	AL2/AL4	CI1/CI3	CI2/CI4
1	21	7.52 ± 0.98	5.88 ± 1.06	6.79 ± 1.17	5.18 ± 0.85	6.82 ± 1.27	8.59 ± 1.84	6.20 ± 1.30	8.19 ± 1.69	1.13 ± 0.23	1.17 ± 0.27	1.12 ± 0.21	1.06 ± 0.16
		8.93 ± 1.27	7.56 ± 1.30	7.89 ± 1.49	6.19 ± 1.07	7.01 ± 0.93	9.08 ± 1.33	7.92 ± 1.28	9.67 ± 1.59	1.16 ± 0.21	1.25 ± 0.24	1.15 ± 0.25	1.08 ± 0.21
2	34	10.77 ± 1.48	7.75 ± 1.40	9.18 ± 1.63	6.19 ± 1.17	9.32 ± 1.20	15.39 ± 11.58	10.92 ± 8.24	10.25 ± 1.59	1.20 ± 0.24	1.29 ± 0.33	1.15 ± 0.19	1.15 ± 0.18
		10.32 ± 2.00	7.79 ± 1.43	9.37 ± 1.48	6.14 ± 1.32	9.58 ± 2.28	12.17 ± 2.23	8.02 ± 1.09	10.35 ± 0.62	1.11 ± 0.22	1.29 ± 0.25	1.21 ± 0.26	1.18 ± 0.22
3	88	10.24 ± 1.77	7.22 ± 2.09	9.28 ± 1.48	5.61 ± 2.24	9.68 ± 1.41	12.55 ± 1.71	8.31 ± 1.69	11.43 ± 3.29	1.15 ± 0.38	1.47 ± 0.64	1.23 ± 0.34	1.16 ± 0.25
		11.31 ± 1.68	7.7 ± 1.33	9.95 ± 1.49	5.59 ± 1.43	10.62 ± 1.37	13.13 ± 1.79	8.97 ± 1.66	10.97 ± 1.49	1.16 ± 0.23	1.45 ± 0.37	1.22 ± 0.28	1.22 ± 0.26
4	20	11.50 ± 1.71	8.79 ± 1.50	10.26 ± 1.37	5.55 ± 1.30	11.57 ± 2.01	13.52 ± 2.01	9.2 ± 1.29	12.09 ± 0.79	1.12 ± 0.05	1.66 ± 0.41	1.27 ± 0.24	1.12 ± 0.14
		12.06 ± 1.17	9.29 ± 0.81	9.61 ± 2.29	5.48 ± 1.32	13.22 ± 2.31	15.41 ± 2.88	10.02 ± 1.53	12.82 ± 1.54	1.31 ± 0.28	1.79 ± 0.45	1.32 ± 0.15	1.19 ± 0.09
5	30	13.33 ± 2.81	9.71 ± 2.47	10.68 ± 3.57	5.88 ± 2.56	13.53 ± 2.69	17.15 ± 3.55	10.77 ± 1.42	15.73 ± 2.71	1.43 ± 0.69	1.88 ± 0.74	1.26 ± 0.22	1.09 ± 0.15
		13.45 ± 2.75	10.17 ± 2.41	11.46 ± 2.55	6.95 ± 1.69	12.8 ± 1.57	17.22 ± 2.08	11.3 ± 1.55	16.8 ± 1.51	1.19 ± 0.18	1.51 ± 0.32	1.14 ± 0.08	1.03 ± 0.12
6	24	13.46 ± 2.37	8.98 ± 2.75	10.2 ± 2.41	5.47 ± 1.57	12.72 ± 1.56	17.61 ± 2.12	10.51 ± 1.19	13.86 ± 2.48	1.36 ± 0.28	1.69 ± 0.45	1.21 ± 0.11	1.29 ± 0.21
		13.64 ± 4.59	10.74 ± 1.76	11.48 ± 2.42	6.86 ± 3.57	14.81 ± 3.08	18.89 ± 3.39	10.77 ± 2.48	15.09 ± 3.08	1.17 ± 0.26	1.91 ± 0.84	1.41 ± 0.32	1.26 ± 0.13
7	18	12.07 ± 1.63	10.53 ± 3.23	8.03 ± 3.49	6.85 ± 2.34	14.29 ± 1.21	18.95 ± 2.59	12.84 ± 2.98	16.89 ± 2.91	1.78 ± 0.78	1.56 ± 0.48	1.15 ± 0.18	1.13 ± 0.08
		13.69 ± 1.49	6.83 ± 1.41	10.21 ± 1.58	5.19 ± 2.20	13.02 ± 1.05	18.94 ± 1.86	10.59 ± 1.21	16.61 ± 1.98	1.37 ± 0.29	1.43 ± 0.38	1.24 ± 0.23	1.14 ± 0.09
8	13	11.72 ± 3.35	8.42 ± 2.56	8.3 ± 2.94	4.99 ± 1.67	11.15 ± 3.95	16.22 ± 3.91	9.12 ± 3.18	14.2 ± 2.69	1.44 ± 0.28	1.82 ± 0.72	1.28 ± 0.39	1.14 ± 0.14

验结果,相同年龄不同截面和不同区域患侧坐骨厚度均大于对侧,1~15岁各年龄段差异均有统计学意义($P < 0.05$)。患侧冠状位髌板宽度、轴位髌板宽度、髌骨厚度等大于对侧,差异有统计学意义($P < 0.05$),髌商小于对侧,差异有统计学意义($P < 0.05$),患侧髌骨形变和股骨头形变程度均大于对侧。

2.2 不同截面、部位坐骨厚度及相同区域坐骨厚度比值等结果折线图演变规律 冠状位 CL1-CL4 在 1~10 岁时随着年龄的增长,坐骨厚度逐渐增加,意味着骨性坐骨厚度随年龄增长而增加,10 岁时达到顶峰。在 11~15 岁坐骨厚度逐渐降低,整个演变过程骨性坐骨厚度 CL1-CL4 的范围为 2.1~16.7 mm、3.3~18.9 mm、2.4~13.6 mm 和 3.0~14.9 mm。轴位 AL1-AL4 呈现类似的演变过程,在 1~13 岁

时,随着年龄的增长,坐骨厚度逐渐增加,坐骨厚度随年龄增长而增加,13 岁时达到顶峰。在 13~15 岁时,坐骨厚度稍微下降,整个演变过程坐骨厚度 AL1-AL4 的范围为 4.6~20.4 mm、2.5~17.2 mm、3.4~16.3 mm 和 2.4~14.2 mm。CL1/CL2、CL3/CL4、AL1/AL2、AL3/AL4 平均值均大于 1(1.21~1.42),且在 9 岁之前呈现增加的趋势,说明 1~9 岁不同部位双侧坐骨厚度差异逐渐增加,10~15 岁差异减小,但双侧差异有统计学意义。同时可见无论冠状位还是轴位,髌关节中心区域的差异大于边缘区。

2.3 坐骨厚度和髌板厚度、髌骨厚度、髌商、脱位程度等的相关性 在坐骨厚度和年龄、脱位程度的 Spearman 相关性检验结果中,无论是冠状位还是轴位,坐骨厚度和年龄基本呈中度正相关,和脱位程度

基本没有相关性。具体相关系数 r 和 P 值见表 3。

表 3 不同部位坐骨厚度和脱位程度 Spearman 相关性检验结果

坐骨部位	年龄		脱位程度	
	r 值	P 值	r 值	P 值
CL1	0.471	0.001	-0.024	0.645
CL3	0.413	0.001	0.053	0.310
AL1	0.570	0.001	-0.073	0.126
AL3	0.421	0.001	-0.058	0.160

在患侧坐骨厚度和髌板厚度 CD、髌商 h/d、冠状位髌骨厚度 IL 等 Pearson 相关性检验中,不同部位、不同截面坐骨厚度和同侧相应的髌板厚度、冠状位髌骨厚度等呈正相关,且和髌板宽度有较强相关性。坐骨厚度和髌商呈一般强度负相关,差异有统计学意义,具体相关系数 r 和 P 值见表 4。

3 讨论

临床上,X 线可以观察到 DDH 患儿坐骨增厚的现象,CT 上不同年龄患儿可见坐骨增厚程度和部位不同,且可能影响着复位方式和复位质量,甚至引起远期的髋关节撞击及骨性关节炎^[6,14]。在患儿生长发育过程中,坐骨增厚属于软骨化骨过程,在 CT 上测量坐骨的骨性部分发育过程,虽然不像 MRI 上包含软骨成分,但揭示了整个坐骨骨性部分发育演变过程,对早期明确坐骨厚度转归及是否需要手术干预具有重要意义^[15-16]。

本研究冠状位坐骨和髌骨的发育在 1~10 岁时快速发育,后发育逐渐下降,具有同步性。目前学者们对髌臼髌骨部分发育的研究较多,DDH 髌骨的病变 Kim 分区的 2-3 区,此处为站立行走时髋关节受力最大区,因此髋关节病变和受力程度明显相关^[7]。本研究结果显示,坐骨增厚冠状位上在 1 区和 2 区,轴位上主要在中央区 2 区。虽然一定年龄内患侧轴位上 2 区先增大后减小,随着发育过程加大髌臼窝容积,但始终落后于对侧。Lu et al^[17]对髋关节髌臼的前倾在 MRI 上进行了研究,正常髌臼前倾在 0~2 岁时快速发育,2~9 岁时基本不发育,且

DDH 患儿髌臼前倾大于正常患儿。本研究结果是在 1~10 岁时,患儿的髌骨厚度和坐骨厚度,均和对侧同步发育,10 岁以后基本保持恒定,说明髋关节的发育在一定的年龄内持续发育,而进入青春期后髋关节软骨化骨基本不再增加。

由于髌板厚度和坐骨厚度有关,本研究中患侧髌板厚度、对侧髌板厚度均随着年龄逐渐增加,且在 10 岁时到达顶峰,之后又逐渐下降。这和 Lu et al^[17]研究类似,10 岁可能是髋关节发育的一个节点,此时 Y 形软骨骨化基本结束,软骨本身不再增殖。也有学者对青春期 DDH 髌臼覆盖情况进行研究,结果在 12 岁以后,髌臼前倾逐渐减小,这也可能和髌臼边缘软骨骨化有关^[18-19]。同样,轴位髌板厚度 12 岁之前差异有统计学意义,之后双侧差异无统计学意义,这也和 Y 形软骨本身的发育有关。

在坐骨厚度的研究中,无论是 1 区还是 2 区,坐骨厚度均随着年龄增加而增加。在患儿生长发育的青春期之前,双侧同一部位的坐骨厚度差异逐渐增大,可能和 DDH 患儿坐骨软骨的增殖和凋亡紊乱有关,这需要进一步的基础实验研究进行验证。坐骨增厚在冠状位和轴位上主要是 2 区中心区增厚,这可能和脱位后缺少头臼相互刺激或和髌板的距离有关。

本研究冠状位和轴位坐骨厚度和年龄呈中度或较强正相关,而冠状位和脱位程度并不相关。冠状位上,无论脱位程度如何,一旦坐骨失去了股骨头的刺激,其发育过程可能就和股骨头是否和髌臼接触无关。而在轴位上,坐骨厚度和脱位程度有中度负相关性,脱位程度越低,坐骨厚度越大。髋关节坐骨类似曲面的球形,髌板增宽可能也会影响着坐骨增厚,坐骨增厚和髌臼指数、髌臼软骨指数一样,可能也是髋关节发育不良指标之一。而不同坐骨厚度和髌商呈一般强度负相关,说明髌商越小,坐骨厚度越大,也即坐骨增厚和股骨头发育不良具有相关性。同样,对侧的统计结果和患侧类似,DDH 患儿各种指标发育不良的始动因素可能具有同源性。

本研究有一定的局限性。首先,样本量不够大,

表 4 患侧不同部位坐骨厚度和髌板宽度、髌商等因素的相关性检验结果

坐骨部位	CD1		AD1		IL		h/d	
	r 值	P 值	r 值	P 值	r 值	P 值	r 值	P 值
CL1	0.638	0.001	0.586	0.001	0.638	0.001	-0.130	0.013
CL2	0.595	0.001	0.427	0.001	0.766	0.001	-0.082	0.118
AL1	0.681	0.001	0.644	0.001	0.678	0.001	-0.241	0.001
AL2	0.521	0.001	0.497	0.001	0.597	0.001	-0.180	0.001

且患儿年龄分布不符合正态性,学龄前儿童较多,且半脱位患儿多为大龄儿,可能会导致结果的偏倚。在以后的诊疗中,会进一步加入新的同质患儿,尤其是学龄期和青春期儿童。其次,本研究测量数据没有进行组间、组内一致性比较,仅由两名临床医师完成,是否具有可重复性并不确定。最后,由于患儿体位因素或 CT 扫描层面因素,测量时的标准截面可能并不相同,导致偏倚。

总之,1~15岁单侧 DDH 患儿,1~10岁时冠状位 1 区和 2 区坐骨厚度随着年龄增长而匀速增加,11~15岁以后增速逐渐下降,无论冠状位还是轴位,双侧髋关节中心区域的差异性大于边缘区。坐骨厚度和髌板厚度、冠状面髌骨厚度等呈正相关性,和髌商呈负相关性。单侧脱位 DDH 患儿髋关节坐骨、髌骨和股骨头不同空间部位的演变具有同时性,均为 1~10岁时快速发育,11~15岁时发育缓慢。

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Evolution of ischial thickness in unilateral developmental dysplasia of the hip in 1-15 years old children

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Abstract Objective To investigate the natural evolution of the sciatic bone thickness in pediatric untreated uni-

lateral developmental dysplasia of the hip (DDH) aged 1 – 15 years. **Methods** 329 cases of DDH children aged 1 – 15 years with unilateral dislocation were retrospectively recorded. The connection lines were defined on the coronal plane or axial plane of CT. The connection lines of the Y-shaped cartilage center on both sides were line H, the connection lines of the lowest edge of the ischia on both sides were line b, and the middle part of the two lines were divided into Zone 1 and Zone 2. Zone 1 represented the marginal area, and Zone 2 represented the central area. The thickness of ischium, epiphyseal plate, iliac bone thickness and epiphyseal quotient of femoral head on both sides were measured and compared. **Results** In coronal CL1-CL4, the ischial thickness gradually increased with age from 1 to 10 years old, and decreased from 11 to 15 years old. The range of ischial thickness of CL1-CL4 was 2.1 – 16.7 mm, 3.3 – 18.9 mm, 2.4 – 13.6 mm and 3.0 – 14.9 mm, respectively. The width of the epiphyseal plate in coronal position, the width of the epiphyseal plate in axial position, and the thickness of the iliac bone in the affected side were greater than those in the opposite side and had statistical differences. In the correlation test of ischial thickness with age and degree of dislocation, the thickness of ischial bone in coronal and axial positions was moderately correlated with age ($r=0.413-0.570$, $P<0.05$), and had no correlation with the degree of dislocation ($r=0.024-0.073$, $P>0.05$). In the correlation tests of ischial thickness and epiphyseal thickness CD, epiphyseal quotient, coronal iliac thickness IL on the affected side, the thickness of ischial bone in different parts and sections were positive ($r=0.427-0.681$, $P<0.05$), and the thickness of ischial bone was negatively correlated with the epiphyseal quotient ($r=0.130-0.241$, $P<0.05$). **Conclusion** The ischial thickness in coronal zone 1 and zone 2 of 1 – 10 years old children with unilateral DDH increased at a stable rate with age, and the growth rate decreased gradually in 11 – 15 years old. The thickness of ischia on the affected side in different sections and areas were greater than that on the opposite side. The difference in the central area of the hip joint was greater than that in the marginal area. The thickness of ischia was positively correlated with acetabular cartilage index, epiphyseal plate thickness, and coronal iliac bone thickness.

Key words developmental dysplasia of the hip; computed tomography; ischial; length; evolution; children

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cultured *in vitro* and to establish a prediction model for the purity of peripheral blood NK cells. **Methods** The peripheral blood of 93 healthy donors was collected, the purity of NK cells was detected by flow cytometry after *in vitro* culture, and the clinical physical examination indicators of the donors were collected. 77 cases were randomly selected as the training set, and the remaining 16 cases were used as the test set. Pearson's correlation test was used to analyze the indexes related to the purity of NK cells, and multivariate regression analysis was used to establish a model for predicting the purity of NK cells. We analyzed the correlation between model predicted purity and actual purity and the area under the receiver operating characteristic curve (ROC) of the model. **Results** The indicators correlated with the purity of NK cells were age, triiodothyronine (T3), red blood cell distribution width (RDW), red blood cell volume distribution width standard deviation (RDW-SD), creatinine (Cr), lymphocyte percentage (LY%), glucose (Glu), percentage of eosinophils (EOS%), number of eosinophils (EOS) and platelet volume distribution width (PDW). For regression model, NK index was $-164.557 + 2.544 \text{ RDW-SD} + 3.730 \text{ PDW} + 4.389 \text{ Glu} + 10.237 \text{ T3}$ ($R^2 = 0.494$, $P < 0.05$). In the test set, the coefficient of determination (*R-Square*) between the predicted value and the true value of the NK index model was 0.725, P was 0.001, and the area under the ROC curve of the NK index model in the training set and test set was 0.815 and 0.938. **Conclusion** The NK index model can better predict the purity of peripheral blood-derived NK cells cultured *in vitro*, and provide theoretical guidance for the subsequent formulation of clinical NK cells reinfusion treatment plans.

Key words NK cells; red cell distribution width; peripheral blood; immunocytotherapy; predictive index