·临床研究·

骨盆 Teepee 像的影像解剖研究

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【摘要】 **目的**:研究骨盆 Teepee 像主体结构的影像解剖,包括其方位走行及影像解剖构成。**方法**:对 2013 年 6 月至 2014 年 6 月进行骨盆 CT 检查的成人检查结果进行筛选,排除骨骼畸形及由肿瘤、创伤等所导致骨盆骨性破坏的患者。将所筛选出的 9 例全骨盆 2.0 mm 层厚轴向 CT 扫描图像作为研究对象,其中男 7 例,女 2 例;年龄(41.2±10.3)岁。应用 Mimics 10.01 对 9 例无病损全骨盆 2.0 mm 层厚轴向扫描数据进行三维重建。将重建出的骨盆三维图像进行透明化处理后向髋臼闭孔斜位及骨盆出口位逐渐旋转,直至髋臼上方区域出现标准的"圆锥形帐篷"(即 Teepee)样外观。此时的图像即骨盆 Teepee 像,"圆锥形帐篷"即此投照像的主体。沿主体的边缘进行剪切,对主体及其以外的骨盆结构同时显示,然后研究其于整个骨盆内的方位走行及影像解剖构成。**结果**:骨盆 Teepee 像所示主体起自髂前下棘后外侧骨皮质,经尾端、前方、外侧到头端、后方、内侧的指向,止于髂后上棘及髂后下棘之间的骨皮质。其由一顶、一底及两缘围成。其顶由髂骨的内板(形成其内缘)及外板(形成其外缘)的骨皮质相交形成,其底由坐骨大切迹形成。其内侧、下部、后方总包括小部分骶髂关节及所对应的骶骨侧骨质。**结论**:骨盆 Teepee 像的主体为丰富的骨性结构,除其内下方小部分区域外可作为容纳某些类型骨盆、髋臼骨折固定物的安全区域。骨盆 Teepee 像可用于指导固定物的安全置入。

【关键词】 骨盆;　髋臼;　骨折;　骨折固定术,内;　X 线;　体层摄影术,螺旋计算机
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Radiographic anatomical analysis of the pelvic Teepee view　*CAI Hong-min, CHENG Chuan-de*, WU Xue-jian, WANG Wu-chao, TANG Jin-cheng, CHANG Shou-ya, DUAN Wei-feng, and LI Wu-yin. *Department of Pelvic Surgery, Luoyang Orthopaedic Hospital of Henan Province, Luoyang* 471002, *Henan, China*

ABSTRACT　**Objectives**: To research radiographic anatomy of the main structure of the pelvic Teepee view, including its azimuth direction and view anatomy structure. **Methods**: From June 2013 to June 2014 adult pelvic CT examination results were filtered, excluding skeletal deformities and pelvic osseous destruction caused by tumors, trauma, etc. The data of 2.0 mm contiguous CT scan of 9 adults´ intact pelves was selected and input into Mimics 10.01 involving 7 males and 2 females with an average age of (41.2±10.3) years old. Utilizing the software, the 3D CT reconstructions of the pelves were completed. Setting the transparency being high, the pelvic 3D reconstructions were manipulated from the pelvic anteroposterior view to the combined obturator oblique outlet view and fine-tuned till the regular Teepee-or teardrop-shaped appearance emerges. Cutting tools of the software were at the moment applied to separate the "Teepee" from the main pelvis for each reconstruction. Then the "Teepee" and the rest (main) part of the pelvis were displayed in different color to facilitate the analysis on the Teepee, iliac-oblique, and anteroposterior views. **Results**: The "Teepee" started from the posterolateral aspect of the anterior inferior iliac spine and finished at the cortex between the posterior superior iliac spine and the posterior inferior iliac spine in a direction of being from caudal-anterior-lateral to cranial-posterior-medial. The radiographic anatomical composition of the "Teepee" contained one tip, one base, and two aspects. With the inner and outer iliac tables being the inner and outer aspects of the "Teepee", the tip is consequently formed by their intersection. The base is imaged from the cortex of the greater sciatic notch. The medial-inferior-posterior portion of the "Teepee" contains a small part of sacroiliac joint and its corresponding side of bone of the sacrum. **Conclusions**: The "Teepee" is a zone of ample osseous structures of the pelvis, aside from a small medial-inferior-posterior portion, the main zone of which can be accepted as a safe osseous zone for the anchor of implants stabilizing certain pelvic and acetabular fracture patterns. The Teepee view can be utilized as guidance for the safe percutaneous insertion of such implants.

KEYWORDS　Pelvis;　Acetabulum;　Fractures;　Fracture fixation, internal;　X-rays;　Tomography, spiral computed
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随着创伤骨科医师意识的提高、医学影像科学的进步、闭合复位技术的发展,治疗骨盆、髋臼骨折传统的切开复位内固定术正逐步为经皮微创螺钉内

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固定术作出让步，使得后者逐渐流行并成为常用的治疗手段[1-7]。不同类型的经皮螺钉置入术依赖特定的两个甚至多个平面的透视像来确保所置入螺钉的安全。如 LC-II 螺钉[可用于治疗骨盆后环新月形骨折（OTA-61B2.3）及髋臼高位前柱骨折（OTA-62A3.2）]和髂前下棘(anterior inferior iliac spine, AIIS)骨盆外固定架［可用于 OTA-61B1.1 型骨盆骨折的终极治疗及 OTA-61C 型骨盆骨折的辅助治疗等］Schanz 钉的安全置入有赖于 Teepee 像及髂骨斜位像。目前，教科书及文献资料对 Teepee 像的论述极为匮乏且主要集中在其成像方法、适应证方面[7-9]，而对其解剖构成则鲜有提及。本文旨在通过医学影像处理软件对骨盆 Teepee 像进行影像解剖研究。

1　资料与方法

1.1　研究对象

对 2013 年 6 月至 2014 年 6 月于我院进行骨盆 CT 检查的成人检查结果进行筛选。排除骨骼畸形及由肿瘤、创伤等所导致骨盆骨性破坏的检查结果。共筛选出 9 例全骨盆 2.0 mm 层厚轴向 CT 扫描图像作为研究对象，男 7 例，女 2 例；年龄(41.2±10.3)岁。

1.2　研究方法

将所筛选出的 CT 扫描的数据导入 MIMICS 10.0(Materialize 公司)。通过该软件对所有研究对象进行三维重建。将重建出的骨盆三维图像进行透明化处理后自骨盆正位向髋臼闭孔斜位及骨盆出口位(combined obturator oblique outlet view, COOO)[9-10]逐渐旋转并进行微调，直至髋臼上方区域出现标准的“圆锥形帐篷”，即 Teepee 样外观[7-9]。此时的图像即骨盆 Teepee 像，“圆锥形帐篷”则为此投照像的主体(图 1)。沿主体的边缘进行剪切，同时显示主体及其以外的骨盆结构。

1.3　观察指标与方法

结合三维(骨盆 Teepee 像、髂骨斜位及正位像)及平扫图像，观察其于整个骨盆内的方位走行及影像解剖构成

2　结果

2.1　骨盆 Teepee 像所示主体的方位走行

主体起自 AIIS 后方、外侧骨皮质(图 2a)，止于髂后上棘(posterior superior iliac spine, PSIS)及髂后下棘(posterior inferior iliac spine, PIIS)之间的骨皮质(图 2b)，其内侧、后方、下部总包括小部分骶髂关节(sacroiliac joint, SIJ) 及所对应的骶骨侧骨质（图 2b)。于标准解剖位(骨盆正位)上其由尾端、前方、外侧指向头端、后方、内侧(图 2c)。

2.2　Teepee 像所示主体的影像解剖构成

主体在 Teepee 像上呈“圆锥形帐篷”或“水滴”样外观，由一顶、一底及两缘围成(图 2d)。其顶由髂骨的内板(形成其内缘)及外板(形成其外缘)的骨皮质相交形成，其底由坐骨大切迹形成。其内侧、下部、后方总包括小部分 SIJ 及所对应的骶骨侧骨质（图 2d)。在髂骨斜位像上，其顶受限于髂窝的最低点，其底位于髋臼顶的头端受限于坐骨大切迹(图 2e)。在骨盆轴向 CT 平扫像上，其为自前向后位于髋臼、坐骨大切迹顶部的丰厚的骨性区域，其内侧、后方总包括小部分 SIJ 及所对应的骶骨侧骨质(图 2f)。

图 1　骨盆三维 CT 重建 Teepee 像(43 岁男性)。位于左侧髋臼顶部的“圆锥形帐篷”或“水滴”清晰可见，其为 Teepee 像的主体结构

Fig.1　A pelvic Teepee view manipulated from a 3D pelvic CT reconstruction of a 43-year-old male. The Teepee-or teardrop-shaped radiographic landmark locates above the left acetabulum and can be clearly visualized, which is the main structure of the Teepee view

3　讨论

临床实践中，骨科医师逐渐认识到广泛的软组织(包括骨膜)剥离、骨折局部血肿的清除干扰了骨折愈合的生物学环境进而减缓了骨折愈合过程，并且增加了并发症(如感染等)的发生率，因而逐渐发展出了“足够的剥离和稳定”(just enough dissection and stabilization)[7]的治疗原则。该原则驱动了骨科创伤关怀(orthopaedic trauma care)的演进，其中包括闭合复位技术的不断提高及经皮螺钉内固定技术的不断完善，使得骨盆、髋臼骨折的治疗有了更好的备选方案。经皮螺钉内固定术多在透视监视下进行。不同类型的骨折需要不同的置钉方式；而不同的置钉方式则依赖不同的透视像。用于治疗特定类型的骨盆、髋臼骨折(如 OTA-61B1.1/B2.3/C、62A3.2 等)的 LC-Ⅱ螺钉及髂前下棘外固定架的 Schanz 钉的经皮置入需要在 Teepee 像及髋臼髂骨斜位像的监视下完成。目前，教科书及文献资料对 Teepee 像的论述极为匮乏且主要集中在其成像方法、适应证(应用)方面[7-9,11]，而对其解剖构成则未有论述。事实上，

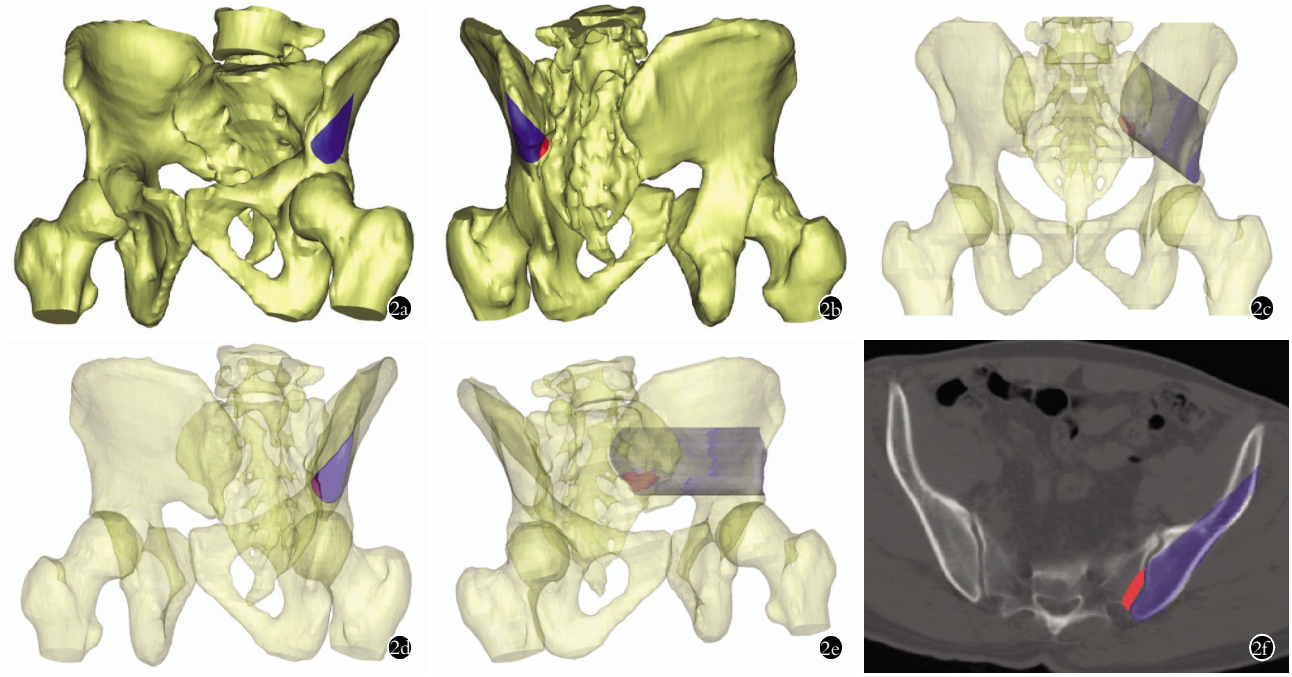

图 2　骨盆 Teepee 像主体结构在骨盆内的方位走行及其影像解剖构成(45 岁男性)　**2a.** 骨盆 Teepee 像(前后)显示主体(蓝色区域)的前方起点　**2b.** 骨盆 Teepee 像(后前)显示主体(蓝色及红色区域)的后方止点　**2c.** 骨盆正位像显示主体(蓝色及红色区域)的走行方向　**2d.** 骨盆 Teepee 像显示主体的解剖构成　**2e.** 髂骨斜位像显示主体(蓝色及红色区域)的头端及尾端界限　**2f.** 骨盆轴向 CT 平扫像显示主体(蓝色及红色区域)的解剖构成

Fig. 2　The location, orientation, and radiographic anatomical composition of the main structure of the pelvic Teepee view (all views are derived from a 45-year-old male)　**2a.** A 3D pelvic Teepee view (anteroposterior) demonstrated the anterior reflection of the "Teepee" (blue zone)　**2b.** A 3D pelvic Teepee view (posteroanterior) demonstrated the posterior reflection of the "Teepee" (blue and red zone)　**2c.** A transparent 3D anteroposterior pelvic view demonstrated the orientation of the "Teepee"(blue and red zone)　**2d.** A transparent 3D pelvic Teepee view demonstrated the radiographic anatomical composition of the "Teepee"(blue and red zone)　**2e.** A transparent 3D iliac-oblique view demonstrated the cranial-caudal confines of the "Teepee" (blue and red zone)　**2f.** An axial pelvic CT scan demonstrated the radiographic anatomical composition of the "Teepee"(blue and red zone)

术者对影像解剖的熟知和掌握是成功、安全地实施经皮螺钉内固定的基石[12-18]。

3.1　Teepee 像的影像解剖

Teepee 像主体呈现规则“圆锥形帐篷”或“水滴”样外观，头端尖细而尾端宽钝，特点鲜明而易于识别。其主体起自 AIIS 后外侧骨皮质，经尾端、前方、外侧到头端、后方、内侧的指向，止于 PSIS 及 PIIS 间骨皮质。除前后方骨皮质界限外，主体顶端受限于髂窝(骨盆骨性结构中最为薄弱的解剖区域，多为单层骨皮质且老年人此部多形成缺损[19])，底部受限于坐骨大切迹，内外侧界限为髂骨内外板；上述皮质界限经 X 线投射显像为平滑高密度闭合结构。主体内部为以上骨性界限所包绕的骨性区域，包括相对致密的髋臼顶部骨松质[10,20-22](前部)、坐骨支撑柱(sciatic buttress, SB)骨松质(中部)[19]及 PSIS 和 PIIS 间 SIJ 髂骨侧骨松质(后部)；需要注意的是，除了上述后部构成外，其后部内下方总包括小部分 SIJ 及所对应骶骨侧骨质，是内置物需要避开的区域；经 X 线投射后，上述结构在 Teepee 像上显示为高密度封闭界限内的相对低密度区域。

3.2　Teepee 像的意义

治疗骨盆、髋臼骨折的经皮螺钉内固定术的安全性依赖于可完全容纳螺钉的骨性区域即骨性通道(osseous pathway, OP)[10]。施行此类手术的理想状态是螺钉 OP 的放射可视化。学者们为该可视化付出努力并取得成果[1,23-25]。如骶髂螺钉平向 OP 在标准骶骨侧位像上的可视化[1-2]，斜向 OP 在骶椎体侧块轴位像[1,24]及变异骶骨侧位像[1,25]上的可视化。而 Teepee 像的意义则在于实现了 LC-Ⅱ螺钉及髂前下棘骨盆外固定架 Schanz 钉 OP 的可视化进而为确定内置物的起点及安全性提供可靠的依据。内置物的起点及位于骨内的部分完全位于 Teepee 像所示主体内部(且避开其内下部区域)提示内置物未突破骨性界限从而确保了手术的安全性；尽管内置物突破此像主体并非确切预示内置物一定会突破骨皮质，但其必然激起术者对内置物安全性的疑虑且需要借助除髂骨斜位外的其他透视像(如髂骨入口位)来寻找内置物安全性的(并非确切的)证据(此无疑增加

了手术时间、透视操作、射线暴露等)。

3.3 Teepee 像的应用

术中透视以髋臼顶部区域为投照中心,将 X 线自骨盆正位向 COOO 转变并微调至髋臼顶部出现标准的“圆锥形帐篷”或“水滴”样外观即停止而获得 Teepee 像。如上所述,其“帐篷”或“水滴”样主体实为自 AIIS、跨髋臼顶部、经 SB 及 SIJ 后外侧止于 PSIS 及 PIIS 的丰富的较为致密的骨性区域,可锚定用于治疗经此部骨折 (如 OTA-61B1.1/B2.3/C、62A3.2 等)的内置物,如 LC-II 螺钉及外固定架 Schanz 钉。

Teepee 像的主体为丰富的骨性结构, 除其内下方小部分区域外可作为容纳某些类型骨盆、髋臼骨折固定物的安全区域。Teepee 像可用于指导固定物的安全置入。

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