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Parturition Pit: The Bony Imprint of Vaginal Birth

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Abstract

Purpose—To retrospectively evaluate for pits along the dorsum of the pubic body in females and compare the presence/absence of these pits to vaginal birth data.

Materials and Methods—We retrospectively reviewed females with vaginal birth data who underwent pelvic CT. The presence of pits along the dorsum of the pubic body, pit grade (0 = not present; 1 = faintly imperceptible; 2 = present; 3 = prominent), and the presence of osteitis condensans ilii, preauricular sulcus, and sacroiliac joint vacuum phenomenon were assessed on imaging. Musculoskeletal radiologists who were blinded to the birth data evaluated the CTs. 48 males were also evaluated for the presence of pits.

Results—482 female patients underwent CT pelvis and 171 were excluded due to lack of vaginal birth data. Of the 311 study patients, 262 had prior vaginal birth(s) and 194 had pits on CT. Only 7 of the 49 patients without prior vaginal birth had pits. There was a statistically significant association between vaginal birth and presence of pits ($p < 0.0001$). Patients with more prominent pits (grades 2/3) had a greater number of vaginal births. As vaginal deliveries increased, the odds

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Conflict of Interest

The authors declare that they have no conflict of interest.

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of having parturition pits greatly increased, adjusting for age and race at CT ($p<0.0001$). No males had pits.

Conclusion—Our study indicates that parturition pits are associated prior vaginal birth and should be considered a characteristic of the female pelvis. The lytic appearance of prominent pits on imaging can simulate disease and create a diagnostic dilemma for interpreting radiologists.

Keywords

Parturition pit; Pregnancy; Vaginal birth; Pubic symphysis

Introduction

Articles describing skeletal indicators of biological sex and childbirth have been reported in the radiologic and anthropologic literature. The preauricular sulcus and osteitis condensans ilii have both been described in the radiologic literature as distinct characteristics of the female pelvis [1–4]. Localized smooth walled depressions on the dorsal surface of the pubic body adjacent to the symphysis or “parturition pits” have been described in the anthropologic literature as a characteristic of the female pelvis [5], although not discussed in the radiology literature. Because the pubic bones separate to allow an infant to pass through the birth canal, the ligaments connecting the pubic bones must stretch (Figure 1). It has been proposed that these ligaments tear and bleed at their attachment sites, later causing bony remodeling and grooves on the dorsum of the pubic bones [6]. Identifying the sex of an individual is important in a forensic setting as well as for archaeological research.

Parturition pits, when present, are readily identified on pelvic radiographs and computed tomography (CT) imaging as well-defined, smooth depressions along the dorsal aspect of the pubic body (not subchondral cyst-like changes) (Figures 2 and 3). Radiologists may encounter these parasymphyseal lytic lesions on imaging and incorrectly diagnose them as degenerative arthrosis or metastatic disease in a patient with history of primary malignancy, creating a diagnostic dilemma for referring clinicians and interpreting radiologists. Therefore, evaluating the significance of parturition pits is clinically important, as they are benign/nonaggressive and not a true lytic aggressive lesion or some other pathology about the pubic symphysis. We hypothesize that parturition pits are related to traumatic changes such as micro- and macro-tears and bleeding during pregnancy, labor and childbirth. Assessing for the presence of parturition pits in the female pelvis on imaging and correlating this information with pregnancy data has not been described in the radiologic literature.

Materials and Methods

In this IRB-approved, HIPAA-compliant study, 505 female patients were identified during data collection for a separate musculoskeletal imaging research project assessing for pelvic floor symptoms in patients undergoing Hologic Discovery W Dual-Energy X-ray Absorptiometry (DEXA) scan for osteoporosis evaluation. Patients participating in this study were required to complete a questionnaire about pelvic floor symptomatology and vaginal birth history. Patients reported vaginal birth as follows: 0 = no prior vaginal birth, 1 = 1 vaginal birth, and 2 = greater than or equal to 2 vaginal births. Of these 505 patients, 482

had prior CT pelvis exams at the time of questionnaire completion. 171 of these 482 patients were excluded secondary to lack of vaginal birth data (the patient either chose not to report this information on the survey and left this portion blank).

In the remaining 311 female patients with vaginal birth data and pelvic CT images, two board-certified, musculoskeletal fellowship-trained radiologists assessed for the presence/absence of parturition pits, assessed laterality of the pits (unilateral versus bilateral), and graded the pits on pelvic CT images. The two radiologists were blinded to the vaginal delivery data. The parturition pits were graded by the musculoskeletal radiologists as follows: 1) grade 0 = not present; 2) 1 = present but faintly perceptible; 3) grade 2 = definitely present; 4) grade 3 = prominent (Figure 4). The presence of preauricular sulci, osteitis condensans ilii, and sacroiliac joint vacuum phenomenon were also assessed, all findings previously discussed as characteristics of the female pelvis in the radiology literature [1–4]. This information was then compared to patient vaginal delivery data to assess for a correlation with parturition pits and prior vaginal delivery. CT studies were performed at 5-mm intervals using a variety of scanners including General Electric 4, 16, and 64 detector-row scanners and Philips 16, 40, and 64 detector row scanners. We also evaluated for parturition pits in 48 male patients, which were randomly selected within the study period.

Statistical Analysis

A biostatistician investigator who was not involved in data collection or parturition pit grading performed the statistical analysis. Agreement between radiologists was assessed with the Kappa agreement statistic. Data summaries are provided as mean and standard deviation (SD) for continuous variables, and frequency and percentage for categorical variables. Correlations were assessed using Pearson's correlation coefficient; chi-square and Fisher's exact tests were used to examine between group distributional differences. Multivariable logistic regression modeling was used to estimate the association between the number of vaginal deliveries and the presence of pits controlling for race and age at CT.

Results

505 female patients were screened during data collection assessing for pelvic floor symptoms in patients undergoing DEXA scan for osteoporosis evaluation. 482 of these patients had both prior CT pelvis exams and completion of a pelvic floor symptomatology and vaginal birth questionnaire. 171 of these 482 patients were excluded secondary to lack of vaginal birth data.

Of the 311 study patients (age range: 25–102 years; mean age: 66 years), 262 patients (84%) reported a history of prior vaginal birth(s) and 205 (78.2%) had 2 or more vaginal births. 194 of the 262 patients (74%) had parturition pits on CT. Only 7 of the 49 patients (14%) without prior vaginal birth had evidence of parturition pits (Figure 5).

There was a statistically significant association between vaginal birth and presence of pits ($p < 0.0001$) both before and after adjusting for race and age at CT (Table 1). Of the female patient population, 217 were Caucasian, 90 were African-American, 2 were Asian, 1 was

Hispanic and 1 was multiracial. The strength of the correlation between pit grade and vaginal delivery was different between races, more prominent in the non-white population. Among non-white subjects, higher vaginal delivery was inversely correlated with pit grade ($Rho = -0.2544$, $p = 0.0036$). Among white subjects, higher vaginal delivery was not correlated with pit grade ($Rho = 0.1243$, $p = 0.1571$). Patients with grade 2 or 3 pits had a greater number of vaginal pregnancies, although not statistically significant ($p < 0.885$). As vaginal deliveries increased, the odds of having parturition pits greatly increased, adjusting for age and race at CT ($p < 0.0001$). To estimate the odds of presence of pits, we included the number of vaginal deliveries, race, and age at CT into a logistic regression model. There was also a strong association between vaginal birth and presence of pits among patients who had a CT over the age of 50. Patients with identified pits were on average approximately 4 years older than patients without (67 years vs 63 years of age, $p < 0.01$). The two readers had fair agreement for presence of pits (Kappa = 0.31, $p < 0.01$), laterality (Kappa = 0.29, $p < 0.01$), and grade (Kappa = 0.36, $p < 0.01$).

When evaluating patients for previously described radiologic skeletal indicators of the female pelvis, the distribution of preauricular sulci was not statistically different among patients with prior vaginal birth (Vd- = 19[38.8%] vs Vd+ = 112[43.08]; $p = 0.5762$). The distributions of osteitis condensans ilii (Vd- = 6[12.2%] vs Vd+ = 37[14.2%]; $p = 0.7126$) and sacroiliac joint vacuum phenomenon (Vd- = 17[34.7%] vs Vd+ = 118[45.4%]; $p = 0.1164$) were similar between vaginal birth and non-vaginal birth women.

48 male patients were also evaluated on CT imaging for the presence of parturition pits (age range: 22–81 years; mean age: 51.5 years) and none of the male patients had pits. Of these patients, 39 were Caucasian, 7 were African-American, 1 was Middle Eastern, and 1 was Hispanic.

Discussion

The methods by which human remains are sexed involve qualitative and quantitative measurements. The pelvis has the reputation of having the highest success for sex determination due to the wider pelvic inlet for childbirth [5]. Dorsal pubic pitting has been reported in the anthropology literature as evidence of pregnancy or parturition. These bony changes on the human pelvis were originally attributed to the stresses of pregnancy such that these “scars” are left as evidence of labor [5]. However, several studies contradict this hypothesis. Some studies claim that there is no statistically significant relationship between the dorsal pitting and parity status [7–8]. Other studies found a correlation in younger women [9]. Suchey et al. found a statistical association between the number of full-term pregnancies and the degree of dorsal pitting; however, the correlation was not strong [10]. In addition, a relationship between the presence of these dorsal symphyseal pits and age has also been found [10–11].

In radiology, these pits may be encountered on routine pelvic imaging. Radiologists may incorrectly diagnose these pits as subchondral cysts related to degenerative arthrosis in these patients. Alternatively, the lytic appearance of prominent pits on imaging can simulate disease in patients with known primary malignancy.

Limitations of our study include its small number of patients without prior vaginal birth. 84% of our patients have a history of prior vaginal delivery. Although our primary outcome was to assess the effect of vaginal delivery on skeletal changes, we do not have prior pregnancy data that did not result in vaginal birth (miscarriage, termination, and/or cesarean section). Therefore, some of our patients could have theoretically been pregnant or had a cesarean section at some point in time and we would not have this information. Although the musculoskeletal radiologists were blinded to the pregnancy data, they were not blinded to the male or female sex, as the pelvic organs were visible on CT. Other limitations include its retrospective nature and the inability to evaluate causation between the development of parturition pits and vaginal delivery. None of the patients had pre-childbirth imaging to assess for the interval development of parturition pits after subsequent delivery.

Our results propose that parturition pits should be considered a characteristic of the female pelvis, given its presence in our study population and lack of pits in the male study patients. Given that there was a statistically significant association between vaginal birth and presence of pits and the odds of having parturition pits greatly increased as vaginal deliveries increased, our findings suggest that the pits are related to vaginal birth. The lytic appearance of prominent pits on imaging can simulate disease and create a diagnostic dilemma for interpreting radiologists. Therefore, knowledge of this finding has important clinical implications.

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Figure 1.

7.5-month pregnant patient presented to the ED after MVA with pubic symphyseal widening without symphyseal pain or tenderness on exam. Symphyseal widening is normal in late pregnancy and at delivery, related to pregnancy hormones.

Figure 2.
37 year-old female with lytic lesions adjacent to the pubic symphysis bilaterally, consistent with parturition pits. Notice the lack of joint space narrowing, osteophyte formation, and subchondral sclerosis to suggest degenerative osteoarthritis.

Figure 3.
21 year-old female with hip fracture-dislocation and incidental pits along the dorsal aspect of the pubic bone, consistent with parturition pits.

A.

D. **Figure 4.**

Examples of grading of parturition pits on CT imaging. A. Grade 0 = No pits present; B. Grade 1 = Pits present but faintly imperceptible; C. Grade 2 = Pits definitely present; D. Grade 3 = Prominent parturition pits.

Figure 5. Organizational chart demonstrating the study patients who underwent pelvic CT, vaginal birth data, and parturition pit grading.

Table I

No Vaginal Delivery vs Vaginal Delivery Patient Characteristics by Age, Race, and Parturition Pit Grading.

	Vd- n=49	Vd+ n=262	P-value
Age, mean (SD)	59.8 (11.6)	67.4 (10.8)	<0.0001
Age >50, n (%)	40 (81.6)	247 (94.6)	0.0043
Race White, n (%)	38 (77.5)	179 (68.3)	0.1966
Race Non-White, n (%)	11 (22.5)	83 (31.7)	
Pits Yes, n (%)	7 (14.3)	194 (74.1)	<0.0001
Pits, Grade 1	3 (42.9)	118 (60.8)	0.5244
Pits, Grade 2	4 (57.1)	71 (36.6)	
Pits, Grade 3	0 (0.0)	5 (2.6)	

Vd- = No prior vaginal delivery. Vd+ = Prior vaginal delivery.