AO SPINE

Global Spine Journal
2023, Vol. 13(1) 140–148

DOI: 10.1177/21925682221993791
journals.sagepub.com/home/gsj
SAGE

Sacrococcygeal Morphologic and Morphometric Risk Factors for Idiopathic Coccydynia: A Magnetic Resonance Imaging Study

Ahmed Shams, MD[1], Osama Gamal, MD[1], and Mohamed Kamal Mesregah, MChOrth[1,2]

Abstract

Study Design: Retrospective case-control study.

Objectives: To evaluate the sacrococcygeal morphologic and morphometric features in idiopathic coccydynia using magnetic resonance imaging (MRI).

Methods: MRI scans from 60 patients with idiopathic coccydynia were compared with scans of 60 controls. Assessment of coccygeal morphology included coccygeal segmentation, coccygeal types, bony spicules, sacrococcygeal joint fusion, and intercoccygeal joint fusion and subluxation. Morphometric parameters included coccygeal straight and curved lengths, coccygeal curvature index, sacrococcygeal and intercoccygeal joint angles, sacral straight and curved lengths, sacral curvature index, sacral angle, sacrococcygeal straight and curved lengths, sacrococcygeal curvature index, and sacrococcygeal angle.

Results: The coccydynia group included 28 males and 32 females, with a mean age of 36.1 years. Type II coccyx and bony spicules were more common in coccydynia, $P = 0.003$ and 0.01, respectively. Sacrococcygeal joints were fused less commonly in coccydynia, $P = 0.02$. Intercoccygeal joint subluxation was more common in coccydynia, $P = 0.007$. The sacral angle was lower in coccydynia, $P = 0.01$. The sacrococcygeal curved length was higher in coccydynia, $P < 0.001$. The sacrococcygeal curvature index was lower coccydynia, $P < 0.001$. In females only, the coccygeal curvature index was lower in coccydynia patients, $P = 0.04$. In males only, the intercoccygeal angle was lower in coccydynia patients, $P = 0.02$.

Conclusions: Type II coccyx, bony spicules, intercoccygeal joint subluxation were more common, and sacrococcygeal joint fusion was less common in coccydynia patients. Sacral angle and sacrococcygeal curvature index were lower, while sacrococcygeal curved length was higher in coccydynia patients.

Level of Evidence: Level 3. Case-control study.

Keywords

idiopathic coccydynia, straight length, curved length, intercoccygeal angle, sacrococcygeal angle, MRI

Introduction

The coccyx is the lowermost triangular bone of the vertebral column distal to the sacrum, formed of 3 to 5 coccygeal vertebrae, which are anatomically lacking the posterior arch structures, including; the pedicles, laminae, and spinous processes.[1-3] It has an essential function in weight-bearing during sitting, particularly when leaning backward.[2,4]

The term coccydynia (coccygodynia) refers to pain in or around the coccyx that remains debated and undetermined.[1,5] Most commonly, it results from direct axial trauma to the tailbone, such as a fall.[4] Abnormal coccygeal mobility with postural changes, tumors, infections, or difficult childbirth, may explain the pain in some patients.[5-7] Yet, in around one-third of the patients, the cause is idiopathic.[8,9]

[1] Department of Orthopaedic Surgery, Faculty of Medicine, Menoufia University, Shebin El-Kom, Menoufia, Egypt
[2] Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

Corresponding Author:
Mohamed Kamal Mesregah, Department of Orthopaedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, CA 90033, USA.
Email: mohamed.mesregah@med.menofia.edu.eg

Data are lacking regarding the exact epidemiology; however, obesity and female gender are associated with a higher risk of developing coccydynia.[8] The higher incidence in women may also be attributed to different angles and shape of the pelvis compared to males, in addition to childbirth.[1,10]

Pain during sitting, which worsens by leaning partly backward or sitting on hard surfaces, is the typical presentation in coccydynia and tenderness is usually provoked on palpation.[2,11] Additionally, the coccyx can be grasped between the thumb and forefinger during rectal examination to evaluate the motility of the sacrococcygeal joint.[2,12]

Magnetic resonance imaging (MRI) is a valuable and useful tool to evaluate the anatomical and morphometric features of the sacrococcygeal region in coccydynia.[13] However, very few MRI studies have been conducted to evaluate the coccygeal morphology and morphometry and measure the sacrococcygeal parameters.[4,13]

Therefore, the current study was performed, aiming to evaluate the sacrococcygeal morphologic and morphometric features in patients with idiopathic coccydynia as compared to a control group using MRI and to evaluate the morphometric features among different coccygeal mobility types in patients with coccydynia categorized by dynamic X-rays.

Materials and Methods

Patient Selection

This study was conducted after approval from our University Institutional Review Board (MNF/2016/028). This retrospective case-control study included 120 participants. The coccydynia group included 60 patients who were diagnosed clinically with idiopathic coccydynia. The control group included 60 subjects without coccydynia who had undergone sacrococcygeal MRI for other non-orthopedic causes.

Inclusion criteria were patients $\geq$ 18 years with chronic idiopathic coccydynia lasting for $\geq$ 3 months. Exclusion criteria were the presence of associated sciatica, pilonidal sinus, previous local surgery, preceding trauma within less than 3 months, or coccydynia following labor.

MRI Scans and Dynamic Radiographs

MRI scans were obtained from February 2017 to April 2019 using Toshiba Excelart Vantage 1.5 Tesla MRI system. The sequence used was sagittal T2-weighted (TR 3500/TE120; slice thickness 5 mm). Scans were analyzed using Picture Archiving and Communication System (PACS), and measurements were performed by 2 experienced independent reviewers.

Additionally, 2 dynamic lateral X-rays were obtained from patients with coccydynia. One radiograph was a standing film taken after 10 minutes of standing. For the other radiograph, the patient was required to sit in the most painful position by slowly leaning backward from an upright posture until the usual pain was felt. Based on the lateral dynamic radiographs, coccydynia patients were divided into 4 mobility groups including: hypermobility (forward movement of more than 25°), subluxation (abnormal translational motion between 2 adjacent vertebrae), rigid (less than 5° forward or backward movement), normal mobility (forward movement between 5° to 25° or backward movement between 5° to 15°).[14]

Assessment of Coccygeal Morphology

Assessment of coccygeal morphology included analysis of coccygeal segmentation (number of coccygeal segments), in addition to coccygeal types based on Postacchini and Masobrio classification[15] including; type I, coccyx slightly curved forward with the apex directed downward; type II, coccyx with more forward curvature and the apex points forward; type III, coccyx sharply angulated forward; and type IV, coccyx with subluxation at the sacrococcygeal or first intercoccygeal joint, Figure 1. The assessment also included any bony spicule (a spur arising from the distal coccygeal vertebra), sacrococcygeal joint fusion (bone continuity between adjacent vertebrae), intercoccygeal joint fusion and intercoccygeal joint subluxation (abnormal translation between 2 adjacent coccygeal vertebrae at the level of intervertebral disc).

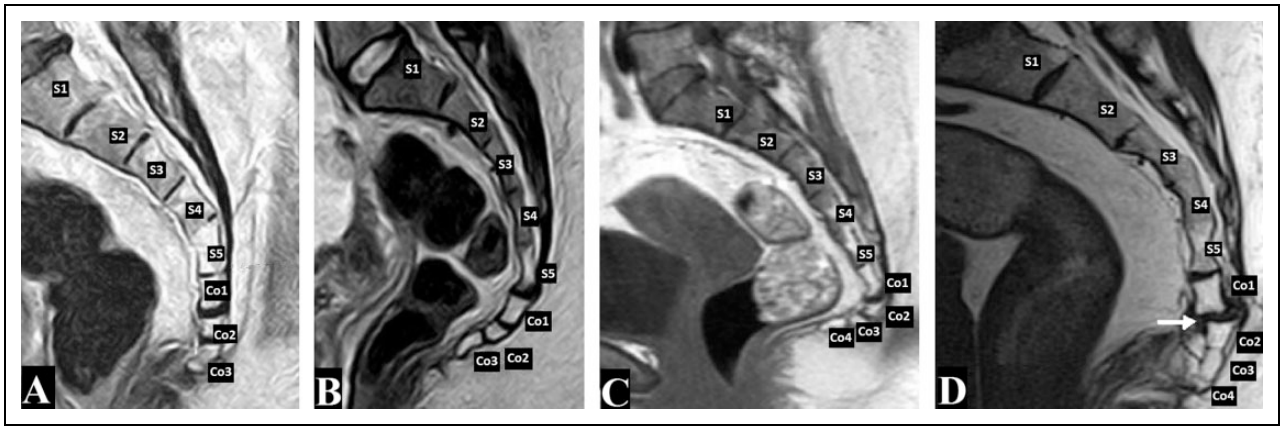

Figure 1. MRI of the sacrococcygeal region showing the coccygeal types: (A) Type I, (B) Type II, (C) Type III, (D) Type IV.

Table 1. Description of the Morphometric Parameters of the Coccyx and Sacrum.

Parameter	Description
Coccygeal straight length	Length of a straight line from the middle of the upper border of Co1 to the coccygeal tip, Figure 2A.
Coccygeal curved length	Average of the anterior and posterior curved coccygeal lengths measured from the upper border of Co1 to the coccygeal tip, Figure 2B.
Coccygeal curvature index	Coccygeal straight length divided by coccygeal curved length × 100.
Sacrococcygeal joint angle	Angle between lines intersecting the middle of S5 and Co1, Figure 2C.
Intercoccygeal angle	Angle between lines intersecting the middle of the Co1 and last coccygeal segment, Figure 2D.
Sacral straight length	Length of a straight line from the middle of the upper border of S1 to the middle of the inferior border of S5, Figure 3A.
Sacral curved length	Average of the anterior and posterior curved sacral lengths measured from the upper border of S1 to the inferior border of S5, Figure 3B.
Sacral curvature index	Sacral straight length divided by sacral curved length × 100.
Sacral angle	Angle between a straight line along the upper border of S1 and the true horizontal line, Figure 3C.
Sacrococcygeal straight length	Length of a straight line from the middle of the upper border of S1 to the coccygeal tip, Figure 3D.
Sacrococcygeal curved length	Average of the anterior and posterior curved sacrococcygeal lengths measured from the upper border of S1 to the coccygeal tip, Figure 3E.
Sacrococcygeal curvature index	Sacrococcygeal straight length divided by sacrococcygeal curved length × 100.
Sacrococcygeal angle	Angle between a line from the midpoint of the upper border of S1 to the midpoint of the upper border of Co1 and a line from the latter to the coccygeal tip, Figure 3F.

Assessment of Sacrococcygeal Morphometry

The measured sacrococcygeal morphometric parameters included the coccygeal straight and curved lengths, coccygeal curvature index, sacrococcygeal and intercoccygeal joint angles, sacral straight and curved lengths, sacral curvature index, sacral angle, sacrococcygeal straight and curved lengths, sacrococcygeal curvature index, and sacrococcygeal angle.[16,17] Table 1 and Figures 2 and 3 demonstrate the methods of measurement of these parameters.

Statistical Analysis

Data were statistically analyzed using IBM SPSS version 20.0 (Armonk, NY: IBM Corp). Descriptive statistics included number (n), percentage (%), mean ($\bar{x}$), and standard deviation (SD), and range. Qualitative data were reported as (n) and (%) and were analyzed using Fisher's exact or Chi-square test, when appropriate. Quantitative variables were reported as ($\bar{x}$) and (SD), and were compared using Student's t-test when comparing 2 groups and ANOVA test when comparing more than 2 groups. Measurements were repeated in a random sample of 20 subjects, 10 in each group, after an interval of 2 weeks to assess the inter-observer and intra-observer agreements for the morphometric parameters using kappa statistics. A *P*-value of less than 0.05 was considered statistically significant.

Results

Inter- and Intra-Observer Reliabilities

The mean kappa values for inter- and intra-observer reliabilities of the measured parameters were 0.82 ± 0.04 (range, 0.75-0.94), and 0.84 ± 0.03 (range, 0.76-0.94), respectively.

Patient Characteristics

The coccydynia group included 28 (46.7%) males and 32 (53.3%) females, with a mean age of 36.1 ± 6.9 (range, 20-49) years. The control group included 24 (40%) males and 36 (60%) females, with a mean age of 38.2 ± 7.2 (range, 19-51) years.

Morphology

In both groups, the most common number of coccygeal segments was 3 segments, 73.3% and 66.7% in the coccydynia and control groups, respectively, $P = 086$. The most common coccygeal type in the coccydynia group was type II (83.3%). In the control group, type II was the most common (40%), followed by type III (26.7%) and type I (23.3%), $P = 0.003$. Bony spicules were present more frequently (36.7%) in the coccydynia than the control groups (10%), $P = 0.01$. Sacrococcygeal joints were fused less commonly in the coccydynia as compared to the control groups, 40% and 86.7%, respectively, $P = 0.02$. There was no statistically significant difference between the 2 groups regarding the intercoccygeal joint fusions, $P = 0.24$. Intercoccygeal joint subluxation was more common in the coccydynia than the control groups, 43.3% and 10%, respectively, $P = 0.007$, Table 2.

Morphometry

The coccygeal straight and curved lengths did not differ between the 2 groups, $P = 0.06$ and 0.07, respectively. The coccygeal curvature index was lower in the coccydynia group (87.1 ± 4.2 cm) than the control group (88.6 ± 3.4 cm), $P = 0.04$. The sacrococcygeal joint angle did not differ between the 2 groups, $P = 0.33$. The intercoccygeal angle was lower in the coccydynia group (147.7 ± 19.5°) than the control

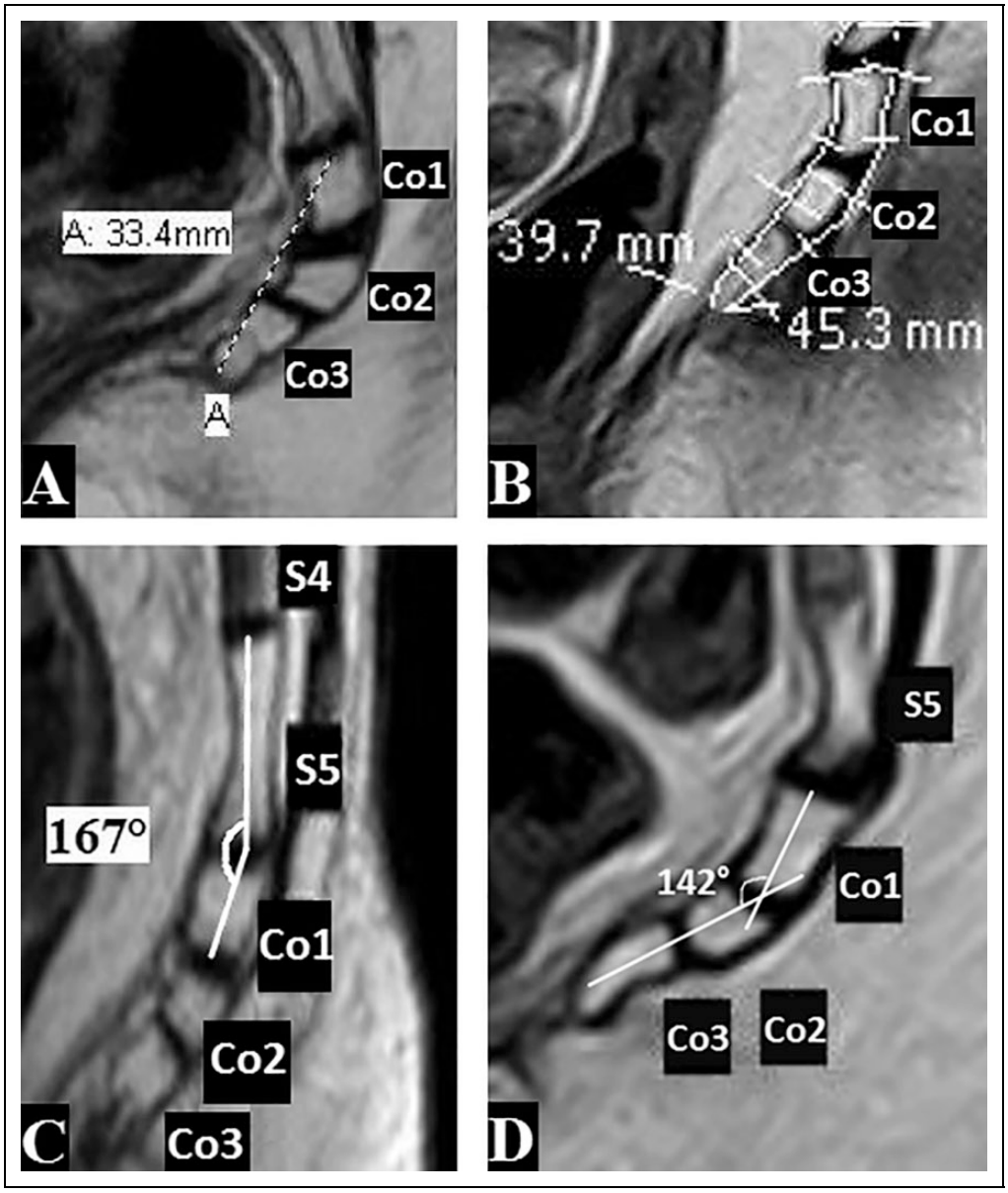

Figure 2. MRI of the sacrococcygeal region showing: (A) Coccygeal straight length: Length of a straight line from the middle of the upper border of Co1 to the coccygeal tip. (B) Coccygeal curved length: Average of the anterior and posterior curved coccygeal lengths measured from the upper border of Co1 to the coccygeal tip. (C) Sacrococcygeal joint angle: Angle between lines intersecting the middle of S5 and Co1. (D) Intercoccygeal angle: Angle between lines intersecting the middle of the Co1 and last coccygeal segment.

group (155.4 ± 7°), $P = 0.004$. The sacral straight and curved lengths and sacral curvature index did not differ between the 2 groups, $P = 0.07$, 0.15, and 0.06, respectively. The sacral angle was lower in the coccydynia group (38.7 ± 5.3°) than the control group (42.2 ± 5.3°), $P = 0.01$. The sacrococcygeal straight length did not differ between the 2 groups; however, the sacrococcygeal curved length was higher in the coccydynia group (15.6 ± 1.6 cm) than the control group (14.1 ± 0.8 cm), $P < 0.001$. The sacrococcygeal curvature index was lower in the coccydynia group (82.2 ± 4.8 cm) than the control group (87.3 ± 5.6 cm), $P < 0.001$. The sacrococcygeal angle did not differ between the 2 groups, $P = 0.77$, Table 2.

Subgroup Analysis

Gender subgroup analysis. In both sexes, type II coccyx was more common in the coccydynia than the control groups, $P = 0.01$ and 0.02, in males and females, respectively. Moreover, bony spicules were more common in the coccydynia than the control groups, $P = 0.04$ and 0.03, in males and females, respectively. Sacrococcygeal joints were fused less commonly in the coccydynia than control groups, $P = 0.01$ and 0.03, in males and females, respectively. Intercoccygeal joint subluxation was more common in the coccydynia than the control groups, $P = 0.02$ and 0.04, in males and females, respectively, Tables 3 and 4.

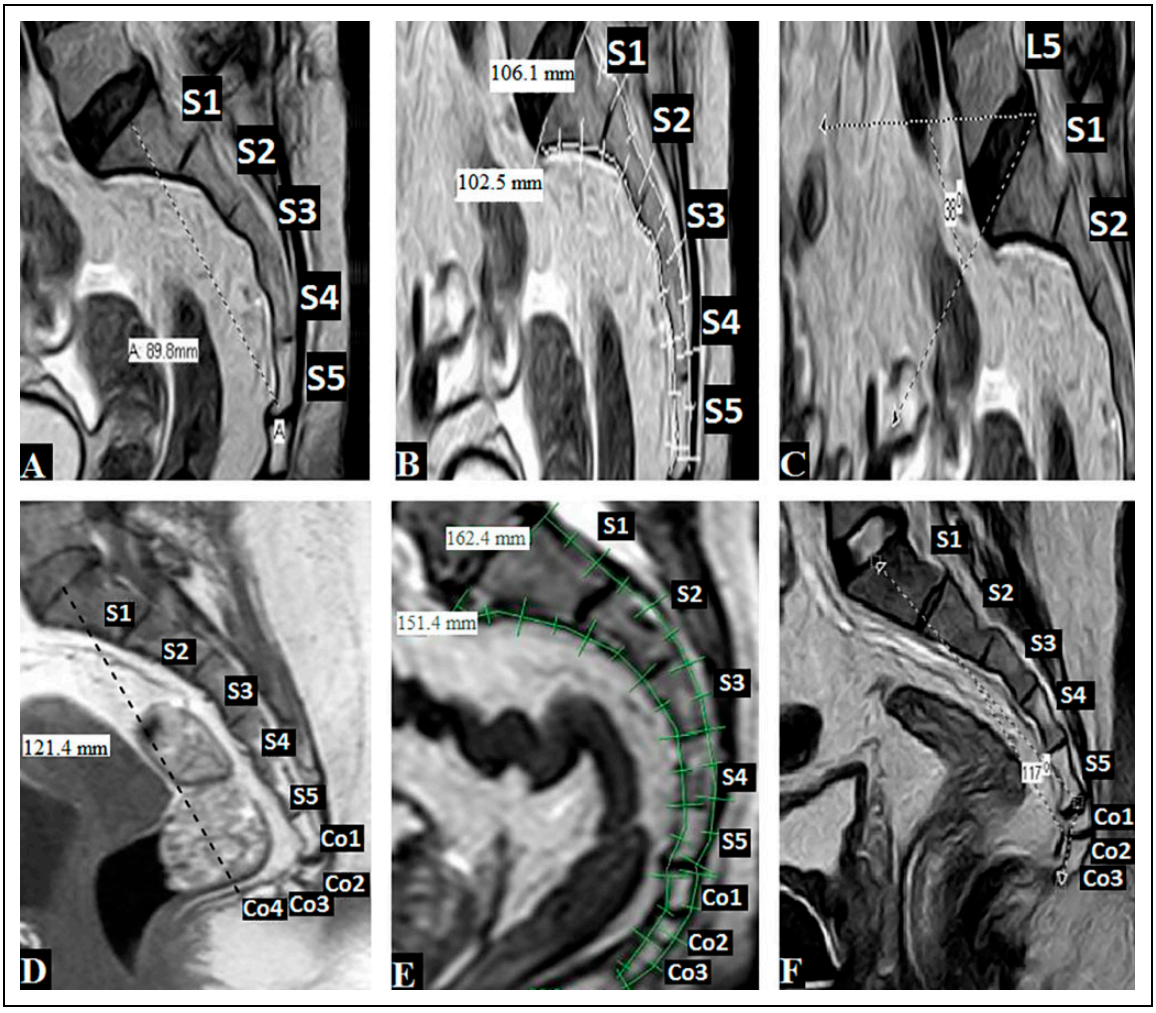

Figure 3. MRI of the sacrococcygeal region showing: (A) Sacral straight length: Length of a straight line from the middle of the upper border of S1 to the middle of the inferior border of S5. (B) Sacral curved length: Average of the anterior and posterior curved sacral lengths measured from the upper border of S1 to the inferior border of S5. (C) Sacral angle: Angle between a straight line along the upper border of S1 and the true horizontal line. (D) Sacrococcygeal straight length: Length of a straight line from the middle of the upper border of S1 to the coccygeal tip. (E) Sacrococcygeal curved length: Average of the anterior and posterior curved sacrococcygeal lengths measured from the upper border of S1 to the coccygeal tip. (F) Sacrococcygeal angle: Angle between a line from the midpoint of the upper border of S1 to the midpoint of the upper border of Co1 and a line from the latter to the coccygeal tip.

In both sexes, the sacral angle was significantly lower in coccydynia patients than in the controls, $P = 0.04$. The sacrococcygeal curved length of coccydynia patients was highly significantly higher than the controls, $P = 0.008$ and 0.002 in males and females, respectively. Moreover, the sacrococcygeal curvature index was significantly lower in coccydynia patients than the controls, $P = 0.01$ and 0.009 in males and females, respectively. In females only, the coccygeal curvature index was significantly lower in the coccydynia patients than the controls, $P = 0.04$. In males only, the intercoccygeal angle was significantly lower in the coccydynia than the control groups, $P = 0.02$, Tables 3 and 4.

Coccygeal mobility subgroup analysis. Out of the 60 coccydynia patients, there were 12 (20%) patients in the hypermobility group, 16 (26.7%) subluxation, 14 (23.3%) rigid, 18 (30%) normal mobility, categorized by the lateral dynamic radiography. There were no statistically significant differences regarding sacrococcygeal morphometry and morphometry between the coccygeal mobility subgroups, Table 5.

Discussion

The current study was a comprehensive comparison of sacrococcygeal morphology and morphometry in patients diagnosed with idiopathic coccydynia compared to healthy subjects, using MRI. Most of the previous studies focused on the etiology, diagnosis, radiologic classification, and management of coccydynia.[18-21]

In this study, type II coccyx, bony spicules, and intercoccygeal joint subluxation were significantly more common in the coccydynia patients, while the sacrococcygeal joint fusion was

Table 2. Comparison of Morphology and Morphometry of the Coccyx and Sacrum in Coccydynia and Control Groups.

Parameter	Coccydynia group (n = 60)		Control group (n = 60)		*P*-value
Morphology	**n**	**%**	**n**	**%**	
Coccygeal segments					0.86
2	2	3.3	0	0	
3	44	73.3	40	66.7	
4	12	20	20	33.3	
5	2	3.3	0	0	
Coccygeal types					0.003
Type I	2	3.3	14	23.3	
Type II	50	83.3	24	40	
Type III	4	6.7	16	26.7	
Type IV	4	6.7	6	10	
Bony spicule	22	36.7	6	10	0.01
Sacrococcygeal joint fusion	24	40	52	86.7	0.02
Intercoccygeal joint fusion					0.24
None	24	40	30	50	
Co1/2	4	6.7	0	0	
Co2/3	20	33.3	18	30	
Co3/4	6	10	6	10	
Co1/2/3	0	0	6	10	
Co2/3/4	4	6.7	0	0	
Co3/4/5	2	3.3	0	0	
Intercoccygeal joint subluxation	26	43.3	6	10	0.007
Morphometry	Mean ± SD		Mean ± SD		
Coccygeal straight length (cm)	3.2 ± 0.7		2.9 ± 0.3		0.06
Coccygeal curved length (cm)	3.6 ± 0.9		3.3 ± 0.3		0.07
Coccygeal curvature index	87.1 ± 4.2		88.6 ± 3.4		0.04
Sacrococcygeal joint angle (°)	164.1 ± 11.2		161.1 ± 10.9		0.33
Intercoccygeal angle (°)	147.7 ± 19.5		155.4 ± 7		0.004
Sacral straight length (cm)	10.8 ± 1		10.4 ± 0.6		0.07
Sacral curved length (cm)	11.7 ± 0.9		11.4 ± 0.8		0.15
Sacral curvature index	91.8 ± 2.8		90.5 ± 2.8		0.06
Sacral angle (°)	38.7 ± 5.3		42.2 ± 5.3		0.01
Sacrococcygeal straight length (cm)	12.7 ± 1.4		12.3 ± 0.9		0.26
Sacrococcygeal curved length (cm)	15.6 ± 1.6		14.1 ± 0.8		<0.001
Sacrococcygeal curvature index	82.2 ± 4.8		87.3 ± 5.6		<0.001
Sacrococcygeal angle (°)	114.8 ± 12.1		114 ± 9.5		0.77

Table 3. Comparison of Morphology and Morphometry of the Coccyx and Sacrum in Males With Coccydynia and Normal Males.

Parameter	Coccydynia males (n = 28)		Control males (n = 24)		*P*-value
Morphology	**n**	**%**	**`n**	**%**	
Coccygeal segments					0.11
2	2	7.1	0	0	
3	20	71.4	12	50	
4	4	14.3	12	50	
5	2	7.1	0	0	
Coccygeal types					0.01
Type I	2	7.1	4	16.7	
Type II	26	92.9	14	58.3	
Type III	0	0	6	25	
Type IV	0	0	0	0	
Bony spicule	8	28.6	2	8.3	0.04
Sacrococcygeal joint fusion	8	28.6	22	91.7	0.01
Intercoccygeal joint fusion					0.47
None	12	42.9	12	50	
Co1/2	2	7.1	0	0	
Co2/3	6	21.4	0	0	
Co3/4	4	14.3	6	25	
Co1/2/3	0	0	6	25	
Co2/3/4	2	7.1	0	0	
Co3/4/5	2	7.1	0	0	
Intercoccygeal joint subluxation	14	50	2	8.3	0.02
Morphometry	**Mean ± SD**		**Mean ± SD**		
Coccygeal straight length (cm)	3.2 ± 0.9		2.8 ± 0.3		0.11
Coccygeal curved length (cm)	3.6 ± 1		3.9 ± 0.4		0.13
Coccygeal curvature index	88 ± 4.1		88.3 ± 3.8		0.84
Sacrococcygeal joint angle (°)	167.5 ± 8.6		166.5 ± 7.6		0.74
Intercoccygeal angle (°)	150.4 ± 20.8		160 ± 5.1		0.02
Sacral straight length (cm)	11.2 ± 0.8		10.8 ± 0.4		0.13
Sacral curved length (cm)	12.2 ± 0.8		12.1 ± 0.6		0.65
Sacral curvature index	91.4 ± 1.8		89.7 ± 4.2		0.20
Sacral angle (°)	38 ± 5.1		42 ± 6.1		0.04
Sacrococcygeal straight length (cm)	13.3 ± 1.4		13 ± 0.4		0.42
Sacrococcygeal curved length (cm)	16.2 ± 1.6		14.7 ± 0.5		0.008
Sacrococcygeal curvature index	83.1 ± 4.9		88.2 ± 5.2		0.01
Sacrococcygeal angle (°)	117.5 ± 10.6		116 ± 5.4		0.64

significantly less common. The sacral angle and the sacrococcygeal curvature index were significantly lower in the coccydynia than in the control groups. On the other hand, the sacrococcygeal curved length was significantly higher in the coccydynia than in the control group. In females only, the coccygeal curvature index was significantly lower in the coccydynia patients as compared to controls, while in males only, the intercoccygeal angle was significantly lower in the coccydynia than the control groups. No statistically significant differences were found between coccygeal mobility subgroups in patients with coccydynia.

Postacchini and Massobrio[15] described a radiological classification of the coccyx based on coccygeal morphology. Our study confirmed that a similar number of coccygeal segments were present in patients with coccydynia and normal subjects; however, type II coccyx was more common in patients experiencing coccydynia, similar to findings in previous studies.[13,22]

Our study also demonstrated a significant prevalence of bony spicule in patients with coccydynia, which was noted in few previously published studies.[8,23]

Previous studies described the posterior intercoccygeal subluxation during sitting in patients with coccydynia, which was

Table 4. Comparison of Morphology and Morphometry of the Coccyx and Sacrum in Females With Coccydynia and Normal Females.

Parameter	Coccydynia females (n = 32)		Control females (n = 36)		*P*-value
Morphology	**n**	**%**	**`n**	**%**	
Coccygeal segments					0.92
2	0	0	0	0	
3	24	75	28	77.8	
4	8	25	8	22.2	
5	0	0	0	0	
Coccygeal types					0.02
Type I	0	0	10	27.8	
Type II	24	75	10	27.8	
Type III	4	12.5	10	27.8	
Type IV	4	12.5	6	16.7	
Bony spicule	14	43.8	4	11.1	0.03
Sacrococcygeal joint fusion	16	50	30	83.3	0.03
Intercoccygeal joint fusion					0.13
None	12	37.5	18	50	
Co1/2	2	6.3	0	0	
Co2/3	14	43.8	18	50	
Co3/4	2	6.3	0	0	
Co1/2/3	0	0	0	0	
Co2/3/4	2	6.3	0	0	
Co3/4/5	0	0	0	0	
Intercoccygeal joint subluxation	12	37.5	4	11.1	0.04
Morphometry	**Mean ± SD**		**Mean ± SD**		
Coccygeal straight length (cm)	3.1 ± 0.6		2.9 ± 0.3		0.14
Coccygeal curved length (cm)	3.6 ± 0.8		3.3 ± 0.34		0.58
Coccygeal curvature index	85.9 ± 4.9		88.9 ± 3.2		0.04
Sacrococcygeal joint angle (°)	161 ± 12.5		157.8 ± 11.2		0.45
Intercoccygeal angle (°)	145.3 ± 18.6		152.3 ± 6.4		0.06
Sacral straight length (cm)	10.4 ± 1.1		9.9 ± 0.5		0.09
Sacral curved length (cm)	11.3 ± 0.9		10.9 ± 0.5		0.16
Sacral curvature index	92.1 ± 3.5		91 ± 0.7		0.18
Sacral angle (°)	39.3 ± 5.7		43.6 ± 5.9		0.04
Sacrococcygeal straight length (cm)	12.2 ± 1.3		11.9 ± 0.9		0.53
Sacrococcygeal curved length (cm)	15.1 ± 1.4		13.7 ± 0.7		0.002
Sacrococcygeal curvature index	81.5 ± 4.8		86.7 ± 5.9		0.009
Sacrococcygeal angle (°)	112.4 ± 13.1		112.6 ± 11.4		0.95

confirmed in our study.[8,24] In Woon et al.[13] study, intercoccygeal joint subluxation was more significantly prevalent only in males with coccydynia but not in females. In contrast, in our study, it was significantly more common in both sexes.

The lower prevalence of sacrococcygeal joint fusion in patients with coccydynia reported in our study coincided with the results of Woon et al.,[13] using MRI in 107 patients with coccydynia. In contrast to our study, Postacchini and Massobrio[15] evaluated 51 patients with idiopathic coccydynia and found that 51% of patients showed fusion of the sacrococcygeal joint.

In Woon et al. study,[13] the sacral angle was significantly lower in the coccydynia than the control group in both sexes, and in females only, the coccygeal curvature index was significantly lower in the coccydynia patients, which coincided with our results. However, the sacrococcygeal angle was significantly higher in males with coccydynia than the controls, which disagreed with our results, in which the sacrococcygeal angle did not differ between the 2 groups. Moreover, in our study, the sacrococcygeal curved length was significantly higher in male and female patients with coccydynia in contrast to Woon et al.,[13] who did not find a statistically significant difference. Also, they did not report a statistically significant difference in both males and females regarding the sacrococcygeal curvature index, which was significantly lower in coccydynia patients in both genders in our study.[13]

Gupta et al.[4] performed MRI study to compare the sacrococcygeal and intercoccygeal angles in patients with coccydynia and normal subjects. They found no statistically significant difference in the sacrococcygeal angle in the coccydynia and control groups, which coincided with our study.[4] Similarly, interpretation of the intercoccygeal angle showed that the coccyx was significantly more curved forward in the coccydynia patients than the controls.[4]

Our study attempted to define possible links between static and dynamic coccygeal features and the development of idiopathic coccydynia.

Table 5. Comparison of Morphometry of the Coccyx and Sacrum in Different Coccygeal Mobility Groups in Patients With Coccydynia.

Parameter	Hypermobility (n = 12) Mean ± SD	Subluxation (n = 16) Mean ± SD	Rigid (n = 14) Mean ± SD	Normal (n = 18) Mean ± SD	*P*-value
Coccygeal straight length (cm)	3.3 ± 1.1	2.9 ± 0.8	2.9 ± 0.6	3.5 ± 0.4	0.31
Coccygeal curved length (cm)	3.8 ± 1.3	3.3 ± 0.9	3.4 ± 0.8	3.6 ± 0.4	0.32
Coccygeal curvature index	88.1 ± 5	87.4 ± 3.2	86.3 ± 6.1	88.2 ± 3.3	0.84
Sacrococcygeal joint angle (°)	169.8 ± 9.4	159.8 ± 8.8	163.5 ± 13.9	164.3 ± 12.1	0.45
Intercoccygeal angle (°)	139 ± 19.7	159.8 ± 11.7	147.1 ± 23.2	143.1 ± 19.5	0.19
Sacral straight length (cm)	11.4 ± 1.1	10.3 ± 1	11.1 ± 1	10.6 ± 1	0.17
Sacral curved length (cm)	12.1 ± 1	11.3 ± 1	11.9 ± 0.9	11.6 ± 1	0.45
Sacral curvature index	93.1 ± 2.1	90.5 ± 1.9	92.7 ± 2.3	91.5 ± 3.9	0.29
Sacral angle (°)	41.3 ± 4	37.2 ± 5.8	36.4 ± 5.1	40.1 ± 5.5	0.28
Sacrococcygeal straight length (cm)	13.4 ± 2	12.3 ± 1.1	12.5 ± 1.2	12.7 ± 1.5	0.58
Sacrococcygeal curved length (cm)	16.1 ± 2.4	15.1 ± 1.3	15.4 ± 1.6	15.8 ± 1.3	0.68
Sacrococcygeal curvature index	83.1 ± 1.2	81.6 ± 4.3	82.4 ± 2.9	82 ± 7.8	0.95
Sacrococcygeal angle (°)	111.8 ± 13.2	117.2 ± 8	116.1 ± 7.6	113.5 ± 17.4	0.84

Coccydynia is a symptom rather than a diagnosis with many potential causes, and one-third of cases are idiopathic.[9] It is fundamental to investigate the causes of coccydynia from different perspectives. This study revealed that some variations in morphological and morphometric features of the coccyx are associated with coccydynia. Solid knowledge of those features and their variations should help evaluate potential anatomical factors in the etiology of coccydynia and should help toward a diagnosis of idiopathic coccydynia. The study gives a better understanding of possible causes of idiopathic coccydynia and paves the way for further evaluation of its pathologies, potentially helping in management.

However, the limitations of this study include; its retrospective nature, the relatively low number of patients, and looking only for the radiological parameters that may predispose to coccydynia without correlation with the clinical risk factors.

Conclusion

Several radiological parameters have been defined to be correlated with coccydynia. As compared to normal subjects, type II coccyx, bony spicules, intercoccygeal joint subluxation were more prevalent, and the sacrococcygeal joint fusion was less common. The sacral angle and the sacrococcygeal curvature index were lower, while the sacrococcygeal curved length was higher in coccydynia patients compared to controls. The coccygeal curvature index was lower in coccydynia than control females, while the intercoccygeal angle was lower in coccydynia than control males. There were no significant morphometric differences among coccygeal mobility subgroups in patients with coccydynia.

Authors' Note

Approval of Ethical Review Committee has been obtained.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Mohamed Kamal Mesregah, MChOrth https://orcid.org/0000-0002-8047-9159

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