RESEARCH ARTICLE

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Sacroiliac Joint Variants: Insights from a Retrospective Computed Tomography Study

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Abstract

Objective: This study aimed to determine the prevalence and distribution of sacroiliac joint (SIJ) variants based on age and sex using computed tomography (CT) and to investigate their clinical relevance.

Methods: This retrospective study analyzed pelvic and abdominal CT scans from 200 patients aged 18 years and older, focusing on SIJ variants. Variants were evaluated by two radiologists, and their associations with age and gender were assessed.

Results: SIJ variants were observed in 107 patients (53.5%), with a mean age of 38.65±22.29 years. The most common variant was the iliosacral complex (44.9%), followed by the accessory SIJ (27.1%). A significant association was identified between variant types and age groups (p=0.005), whereas no significant relationship was found with gender.

Conclusion: SIJ variants are prevalent and exhibit age-related differences. Awareness of these variants is essential to avoid misdiagnosis and ensure proper clinical management.

Keywords: Sacroiliac joint variants, ileosacral complex, accessory sacroiliac joint, computed tomography, prevalence, age-related variants

Introduction

The sacroiliac joints (SIJs) are the largest axial joints in the human body and connect the axial skeleton to the pelvis. Due to their complex anatomical structure, they are one of the most challenging joints to assess using radiological imaging.[1,2]

With the widespread use of magnetic resonance imaging and particularly computed tomography (CT), significant advancements have been made in the diagnosis of SIJ disorders.[3] Understanding the normal anatomical structure of SIJs is essential for accurately identifying pathologies. SIJs exhibit a wide range of structural variations and may undergo certain anatomical changes.[4] Therefore, comprehensive radiological studies play a crucial role in distinguishing between normal and pathological appearances, providing significant benefits in the diagnosis of SIJs disorders.

Knowledge of the radiological morphology of the SIJ is crucial for the evaluation of spondyloarthropathic, such as ankylosing spondylitis, as well as degenerative conditions like osteoarthritis and processes arising from mechanical overloading. Additionally, this understanding is essential in surgical procedures, such as posterior pelvic fixation and both closed and open reductions.[5-8]

Numerous studies have identified the presence of an accessory sacroiliac joint (ASIJ) as the most common anatomical variant. The majority of these studies were conducted through direct observation of anatomical specimens.[9] A potential correlation between the presence of SIJ variations and factors such as sex and age has been suggested.[9] More recent studies have reported the normal anatomy of the SIJ using CT, direct radiography,[4] and cadaver specimens.[10,2]

Prassopoulos et al.[11], proposed a classification of six anatomical variants, reporting a prevalence of 36.3% in the Greek population. Demir et al.[3], reported a higher prevalence of 41.8% in the Turkish population.

However, debates regarding the origin of these variants persist; it remains unclear whether they are congenital or acquired later in life.[12] This study aimed to determine the types and prevalence of SIJ anatomical variants using Prassopoulos' classification via CT while also examining their associations with sex and age.

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Methods

This study was approved by the Non-interventional Clinical Research Ethics Committee of Erzincan Binali Yıldırım University (decision no: 2024-12/03, date: 12.09.2024). Informed consent was obtained from all patients prior to undergoing CT scans. Since the study was conducted retrospectively, no additional informed consent was required beyond what was initially obtained.

This retrospective, observational, cross-sectional, and descriptive study included consecutive pelvic and full abdominal CT scans performed at the Radiology Clinic of Iğdır State Hospital. All scans were acquired using a Siemens Emotion 16-slice CT scanner (Siemens Healthcare, Erlangen, Germany, 2007).

The sample size calculation was based on an expected moderate effect size of 0.5, significance level of 0.05, and power of 0.8. The inclusion of 200 patients was sufficient to detect statistically significant differences in SIJ variation.

Between 1 June 2024 and 1 July 2024, all CT scans performed at our hospital were reviewed in chronological order. The screening process was terminated after 200 patients met the inclusion and exclusion criteria.

The inclusion criteria were CT scans of patients older than 18 years with the SIJ fully visible. The indications for CT scan included acute abdominal pain and suspected intra-abdominal or pelvic pathologies, such as gastrointestinal, urological, or gynecological diseases. The exclusion criteria included conditions that could complicate the evaluation of variations, such as multiple traumas, spinal surgeries, and injuries.

Each CT scan was evaluated by two radiologists to determine the presence of anatomical variations. Assessments were conducted using bone-window view of the CT scans, focusing on the classification of variants. The evaluations were not blinded, and a consensus between the two radiologists was reached regarding the presence and type of variation, if any.

Statistical Analysis

All statistical analyses were performed using Statistical Package for the Social Sciences version 23 (IBM, Armonk, NY, USA). Descriptive statistics were reported as mean±standard deviation for normally distributed numerical variables and as median (minimum-maximum) for non-normally distributed data. Categorical variables are presented as numbers and percentages. Comparisons between groups with normally distributed data were made using the Student's t-test, while the Mann-Whitney U test was used for non-normally distributed data. The chi-square test was used to analyze categorical variables. A p value ≤0.05 was considered statistically significant.

Results

Between June 1, 2024 and July 1, 2024, CT scans were systematically reviewed in chronological order of acquisition, and a total of 200 patients were included in the screening process. Sacroiliac variants were detected in 107 patients (53.5%). Representative CT images of SIJ variants are shown in Figure 1.

The mean age of patients with sacroiliac variants was 38.65±22.29 years, ranging from 18 to 91 years. Of the 107 patients, 82 were male (76.6%) and 25 were female (23.4%). The distribution of patients by age showed that 40 patients (37.4%) were over 40 years old, while 67 patients (62.6%) were under 40 years old. The variants were primarily bilateral in 62 patients (57.9%), with 21 patients (19.6%) having variants on the right side and 4 patients (3.7%) on the left side.

Regarding the specific sacroiliac variants, the ileosacral complex was the most common, observed in 48 patients (44.9%), followed by the ASIJ in 29 patients (27.1%). The crescent iliac bony plate was identified in 15 patients (14.0%), ossification centers in 7 patients (6.5%), and both bipartite iliac bony plate and semicircular defect in 4 patients (3.7%) each. The distribution of SIJ variant types, demonstrating the predominance of the iliosacral complex as the most common variant, followed by the ASIJ, is illustrated in Figure 2 and summarized in Table 1.

The analysis revealed no significant relationship between gender and variant types (p=0.083). However, age and variant types showed a statistically significant relationship (p=0.005). Patients under 40 years old most commonly had the ileosacral complex (35 patients) and ossification centers (7 patients), whereas patients over 40 predominantly exhibited the ASIJ (18 patients). This relationship is visually demonstrated in Figure 3, in which age-based differences in variant types are clearly observed.

Discussion

This study revealed a high prevalence of SIJ variants (53.5%), which was within the upper range of previously reported values in the literature

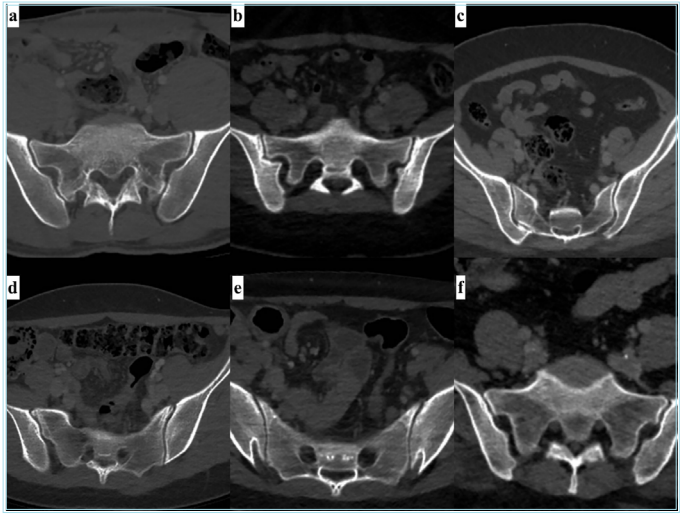

Figure 1. Representative computed tomography images of sacroiliac joint variants. (a) Accessory sacroiliac joint, (b) ileosacral complex, (c) crescent iliac bony plate, (d) ossification centers, (e) bipartite iliac bony plate, and (f) semicircular defect

Table 1. Distribution of sacroiliac joint variants

Sacroiliac variant	Number of patients (%)
Iliosacral complex	48 (44.9)
Accessory sacroiliac joint	29 (27.1)
Crescent iliac bone plate	15 (14.0)
Ossification centers	7 (6.5)
Semicircular defect	4 (3.7)
Bipartite intestinal bone plate	4 (3.7)

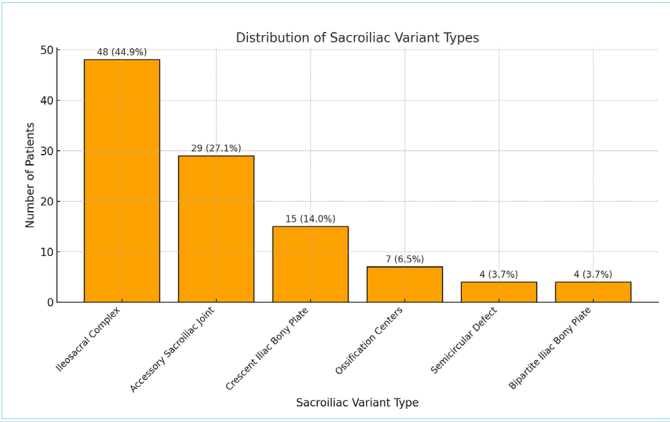

Figure 2. Distribution of sacroiliac variant types

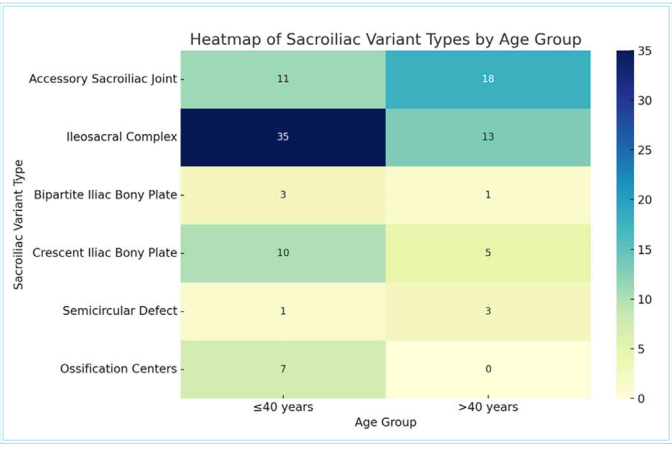

Figure 3. Heatmap of sacroiliac variant types according to age

(25.7-54.2%).[13] The most notable finding was the predominance of the iliosacral complex, particularly in younger patients, whereas the ASIJ was more frequently observed in older individuals. These findings suggest that SIJ variants may follow an age-related pattern, possibly influenced by cumulative mechanical stress or developmental changes. This highlights the importance of considering other factors, such as occupational- or lifestyle-related mechanical loads, as potential contributors to variant development.

The most common variant was the iliosacral complex 48 patients (44.9%), followed by the ASIJ 29 patients (27.1%). Similarly, Tok Umay and Korkmaz,[4] in their study involving 430 patients, also identified the iliosacral complex as the most prevalent variant. However, in many other studies, the ASIJ was reported as the most common variant.[3,9,11,14,15] The ASIJ is an additional joint within the ligamentous compartment, where the joint facets are covered by hyaline cartilage or fibrocartilage. The prevalence of this joint in individuals without SIJ disorders ranges from 4.5% to 26%.[3,4,9,11,14-18] This variant was observed to occur with equal frequency in both genders. Some studies have indicated that its prevalence increases with age and is more common in obese individuals and women who have had three or more childbirths.[3,9,11,17] In a study utilizing anatomical specimens, Trotter reported that accessory sacroiliac facets were more common among African women, attributing this to the cultural practice of carrying children on their backs wrapped in blankets.[19] In our study, the ASIJ was the most common variant in patients aged >40 years. This finding supports the hypothesis that ASIJ is not congenital but rather acquired over time due to factors such as mechanical stress.[20,21] In the younger population, the most common variant was the iliosacral complex. The ossification center variant, which is consistent with the literature, was not observed in the population over 40 years of age.[15]

No significant association was observed between gender and the variants in this study. Some previous studies have suggested that variants are more common in women.[9,3,18] Our results did not corroborate this finding.

It has been suggested that SIJ variants may be associated with past occupations or recreational activities, providing evidence for the theory of joint overuse. The fact that most variants were bilateral further supports the argument that mechanical stress may play a role in their development.[22] Changes caused by mechanical stress can result in radiographic images that mimic rheumatic diseases.[9,23]

Interpretation of the SIJ requires expertise. Although conditions such as low back pain and rheumatic diseases are primarily assessed using clinical criteria, imaging techniques play a crucial role in diagnosis, staging, and treatment monitoring. Anatomical variations can easily be mistaken for pathological findings, and accurate identification of these variants is essential for ensuring patient safety during surgical procedures. Due to the complex anatomy of the SIJ and the frequent occurrence of anatomical variants, misinterpretation of these findings is common.[20,24,25] Therefore, understanding normal variations is crucial for preventing the misinterpretation of pathological findings.[13]

Study Limitations

This study has several limitations. First, this was a retrospective study based on CT scans obtained from a single center, which may limit the generalizability of the findings to broader populations. Second, the sample size may not capture the full variability of SIJ anatomical variations across different ethnic and demographic groups. Additionally, the study did not include a follow-up period to assess the clinical implications of the detected variations, limiting the ability to evaluate long-term effects. Lastly, the lack of blinding in the radiological assessments could introduce potential bias, although a consensus between two experienced radiologists was reached for all cases.

Conclusion

This study highlighted the high prevalence of SIJ variants, particularly the iliosacral complex in younger patients and the accessory SIJ in older individuals. The significant occurrence of these variants underscores the importance of awareness in clinical practice to avoid misinterpretation during diagnosis and treatment.

Ethics

Ethics Committee Approval: This study was approved by the Non-interventional Clinical Research Ethics Committee of Erzincan Binali Yıldırım University (decision no: 2024-12/03, date: 12.09.2024).

Informed Consent: Informed consent was obtained from all patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.U.B., S.K., Concept: E.U.B., K.B.M., Design: E.U.B., K.B.M., Data Collection or Processing: E.U.B., K.B.M., Analysis or Interpretation: E.U.B., Literature Search: E.U.B., S.K., Writing: E.U.B.

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