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THE ROLE OF HARMONIOUS DEVELOPMENT OF THE SACROCOCCYGEAL SPINE IN THE FUNCTIONING OF PELVIC ORGANS IN CHILDREN

РОЛЬ ГАРМОНІЙНОГО РОЗВИТКУ КРИЖОВО-КУПРИКОВОГО ВІДДІЛУ ХРЕБТА У ФУНКЦІОНУВАННІ ТАЗОВИХ ОРГАНІВ У ДІТЕЙ

Резюме. Порушення роботи тазових органів у дітей, зокрема формування хронічних закрепів, є однією з найпоширеніших дисфункцій шлунково-кишкового тракту в глобальному масштабі. За різними оцінками, до третини дітей віком 6-12 років стикаються з проявами тривалих порушень дефекації. Належне функціонування сечового міхура тісно пов'язане з його іннервацією, передусім із сакральним парасимпатичним центром. Тому будь-які аномалії формування або диспластичні зміни крижового сегмента хребта можуть призводити до розладів сечовипускання, одним із можливих проявів яких є міхурово-сечовідний рефлюкс.
Мета дослідження: проаналізувати показники сакрального індексу як у здорових дітей, так і у пацієнтів із хронічними порушеннями дефекації різного ґенезу та міхурово-сечовідним рефлюксом, з метою визначення прогностичної значущості цього параметра та частоти виявлення сакральної дисплазії залежно від патології.
Матеріал і методи. Робота виконувалася за дизайном «випадок-контроль». До дослідження включено 338 пацієнтів віком 3-14 років, які проходили стаціонарне обстеження та лікування у Вінницькій обласній дитячій клінічній лікарні у 2020-2024 роках. Усі діти, за наявності показань, обстежувалися рентгенологічно, за потреби – з контрастним підсиленням (іригографія, мікційна цистоуретерографія), із виконанням знімків у прямій та бічній проєкціях. У 40 пацієнтів не встановлено жодної патології, що дозволило сформувати контрольну групу. У 265 дітей зафіксовано рентгенологічні ознаки хронічних закрепів органічного походження (доліхосигма, доліхоколон, мегаколон тощо). У 33 пацієнтів виявлено міхурово-сечовідний рефлюкс I-III ступенів.
Результати. Попри провідну роль клінічного огляду та методів променевої діагностики у вивченні анатомії крижового відділу, розрахункові індекси розвитку крижово-куприкової ділянки можуть виступати додатковим інструментом діагностики та прогнозування перебігу патології тазових органів. Їх застосування сприяє обґрунтованому вибору консервативних підходів до лікування та формуванню показань для хірургічної корекції.
Висновок. Аналіз сакрального індексу у дітей з аноректальними аномаліями становить важливий компонент у визначенні прогнозу щодо можливості досягнення контрольованого кишкового пасажу, що має значення під час консультування батьків. Крім того, ідентифікація наслідків травматичного ушкодження куприка або варіантів його нормальної анатомічної будови є необхідним етапом перед розрахунком параметрів крижової кривизни, оскільки ці фактори впливають на загальну оцінку розвитку крижово-куприкового сегмента.
Ключові слова: діти, вроджені вади розвитку, міхурово-сечовідний рефлюкс, хронічні закрепи, сакральний індекс, крижова кривизна, діагностика, лікування.

Disorders of the functional state of the pelvic organs in children, particularly the development of chronic constipation (CC), are among the most common gastrointestinal tract disorders worldwide. According to statistical estimates, approximately one third of children aged 6-12 years report symptoms of this condition. Although organic causes of CC are relatively rare and usually diagnosed within the first months of life, their possibility must be considered when evaluating any case of constipation in childhood. CC most often develops during three key stages of growth: cessation of breastfeeding, toilet training, and school age. According to several researchers, about half of all CC cases are registered during the first year of life. Before puberty, the prevalence of constipation among boys and girls is approximately equal, whereas afterwards it is more common in females [1]. Anorectal malformations (ARM) belong to the most common congenital gastrointestinal anomalies, with a prevalence of 1:1500-1:5000 among newborns. They are characterized by significant variability in the level of involvement and may include defects of the muscular and neural structures of the sacrococcygeal region, as well as abnormalities of rectal and anal canal development [2]. Furthermore, ARM are frequently associated with cardiac, renal, skeletal, and spinal defects; 28% of children with constipation have concomitant anomalies [3]. Recent studies have demonstrated an association between ARM and neurogenic bladder dysfunction, abnormalities of the urinary system, including vesicoureteral reflux (VUR), which is diagnosed in approximately 2% of pediatric patients with this pathology [3, 4]. The functional state of the urinary bladder is determined by the quality of its innervation, particularly the activity of the sacral parasympathetic center S_2-S_4. Therefore, any developmental defects or dysplastic changes in the sacral spine may impair its function, one possible manifestation of which is VUR [5]. Spinal anomalies in general are the second most common group of congenital defects after cardiac malformations, with a prevalence of approximately 1:1000 newborns [6]. The process of vertebral segmentation begins in embryogenesis, when the paraxial mesoderm forms transverse partitions around day 21, dividing it into 42-44 somites. These later differentiate into the five main spinal regions. Ossification of the sacral vertebrae occurs with the participation of several primary and secondary centers and continues from birth to approximately 25 years of age, with final fusion of segments completed by 18 years. Therefore, assessment of such variants as lumbarization, sacralization, or synostosis of the first coccygeal and last sacral vertebrae is clinically important in childhood, since the caudal spine is the most vulnerable to segmentation disorders [7]. The clinical significance of the caudal spine is confirmed by caudal regression syndrome – a rare anomaly occurring with a prevalence of 1-2.5:100000 pregnancies or 1:60000 newborns and accompanied by profound developmental defects of the lower trunk. The pathology includes partial or complete absence of the lumbar or sacrococcygeal segments and is associated with abnormalities of the urogenital tract, gastrointestinal tract, and cardiopulmonary system [8, 9]. Its clinical manifestations were first described by Geoffroy Saint-Hilaire and Hohl in 1852, and it was recognized as a separate nosological entity by Duhamel in 1960 [9]. Additionally, the presence of caudal appendages – both true and pseudo-»tails» – results from impaired caudal regression during the sixth week of embryonic development and is often accompanied by spinal defects [10].

The aim of the study is to analyze sacral index values in healthy children and in patients with chronic defecation disorders of various etiologies and vesicoureteral reflux, in order to determine the prognostic significance of this parameter and the frequency of sacral dysplasia detection depending on the pathology.

Material and methods. The study was conducted according to a «case-control» design. A total of 338 children aged 3-14 years hospitalized at Vinnytsia regional pediatric hospital during 2020-2024 were included. All patients, when indicated, underwent radiographic examination, and when necessary – contrast studies (irrigography, voiding cystoureterography). Images were obtained in frontal and lateral projections. The control group consisted of 40 children without detected pathology. Radiologic signs of organic CC (dolichosigma, dolichocolon, megacolon, etc.) were identified in 265 patients. VUR grades I-III was diagnosed in 33 children. Patients with structural anomalies such as anorectal atresia, aganglionosis, or neurological disorders associated with spinal pathology (including scoliosis) were not included. Verification of CC was performed according to the Rome IV criteria for constipation in infants and children. Assessment of VUR severity was carried out according to the international Heikel–Parkkulainen classification (1966) and Campbell, Wein et al. (2007), which divides reflux severity into five grades based on cystoureterography [2]. The first objective of the study was to determine sacral index values in all three observation groups. The second was to compare the harmonious development of the sacral and sacrococcygeal segments by analyzing sacral curvature (SC).

Research results and their discussion. Modern imaging modalities, including CT and MRI, are widely used in studies of sacral anatomy and development. However, the primary and most accessible method remains plain radiography, the limitation of which is insufficient visualization clarity of the sacral segment, potentially complicating identification of minimal anomalies. The concept of the sacral index (SI) as a standardized criterion for evaluating sacral development was proposed by A. Peña in 1995. The researcher defined normative SI values: 0.74 in the frontal and 0.77 in the lateral projections [11]. Peña considered decreased sacral height a marker of increased risk of neurological disorders capable of causing sphincter dysfunction of the pelvic organs. The method includes drawing three parallel lines on a radiograph obtained with the patient lying supine with extended hip and knee joints: A – through the highest points of the iliac crests, B – through the lowest points of the posterior inferior iliac spines, C – through the sacrococcygeal junction. The sacral index is determined as the ratio of the length BC to AB (Fig. 1, 2).

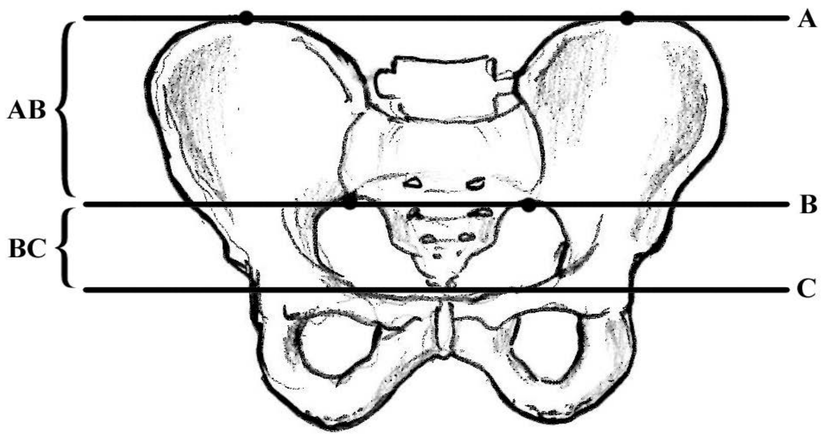

Fig. 1. Scheme for calculating the SI according to A. Pena

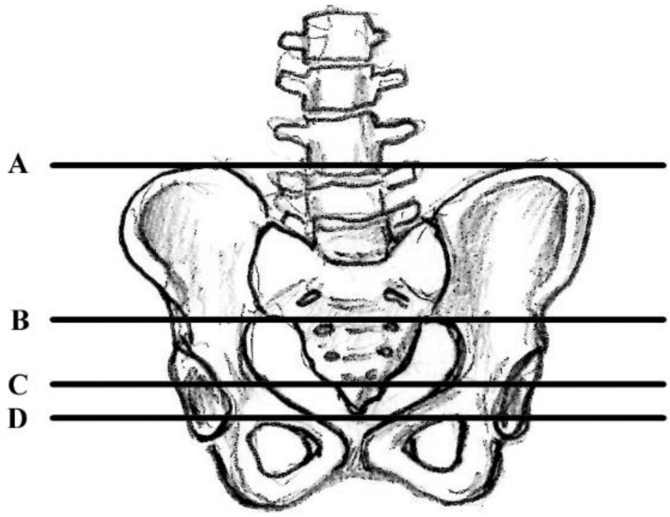

Fig. 2. A – line between the upper edges of the iliac wings on both sides; B – line between the lower edges of the sacroiliac joints on both sides; C – line drawn through the lower edge of the sacrum parallel to lines A and B; D – line drawn through the lower edge of the coccyx parallel to lines A, B, and C [15]

A. Kajbafzadeh et al. (2008) established that the mean values of the sacral index (SI) in healthy children are higher than in patients with vesicoureteral reflux (0.55) and defecation disorders (0.491). The authors also noted that the index remains stable under normal conditions regardless of age, whereas in the presence of pathology-particularly in children younger than 7 years – there was a tendency toward an increase in its value [12]. In the study by M. Torre et al. (2001), a possible age-related elevation of the SI in the lateral projection among healthy children and a decrease in this parameter in patients with anorectal malformations were demonstrated [13].

Since the more detailed investigation of the SI began, its use has expanded considerably: today this parameter is widely applied to predict defecation disorders, including constipation and fecal incontinence, as well as to assess the severity of anorectal anomalies in pediatric patients [14]. At the same time, in national pediatric practice the analysis of the SI is still presented only fragmentarily, which limits its use as a prognostic tool when planning the management of children with gastrointestinal and urinary tract pathology. To improve the objectivity of evaluating the development of the sacrococcygeal segment, a modified, more detailed variant of the sacral index has been proposed, which involves determining quantitative characteristics of the length of this spinal region.

According to this scheme, the researchers propose distinguishing the true sacral ratio (TSR), defined as TSR = BC/AB, and the sacrococcygeal ratio (SCR), which is calculated as SCR = (BC + CD)/AB. In the proposed concept, the authors emphasize the need to clearly differentiate the true sacral ratio (TSR), defined as SC = BC/AB, from the sacrococcygeal ratio (SCR), calculated using the formula SCC = (BC + CD)/AB. Unfortunately, apart from linear parameters, the SI does not account for the qualitative degree of sacral development, which may be represented by sacral curvature, normally exhibiting an anterior convexity [16, 17]. At the same time, the sacral developmental index does not encompass qualitative features of sacral formation, particularly its physiological curvature, which is typically ventrally directed [18, 19].

Sacral curvature under normal developmental conditions forms at an early stage of embryogenesis. However, in patients with ARM, a straightened or abnormally bent sacrum is often observed, which, according to several authors, reflects insufficient qualitative development of the bone – a feature that has not yet been adequately investigated [20, 21]. The ventral sacral bend is one of the primary embryonic curvatures established early in development [22]. The sacral segment maintains this curvature as it grows and as the vertebral bodies enlarge [23]. However, the dimensions of the sacrum may be reduced in the presence of severe anorectal malformations, confirming that complex ARM represent the consequence of early interruption of normal embryonic development [24]. Sacral curvature is established at the beginning of embryonic development, but in patients with anorectal malformations its straightening or atypical bending is frequently noted. Researchers indicate that such morphological variability may reflect incomplete sacral maturation, which has not yet been comprehensively studied [20, 21]. The ventral curvature of the sacrum is one of the primary embryonic bends [22] and is preserved during subsequent growth and formation of the vertebral bodies [23]. However, severe defects of anorectal development may be accompanied by a reduction in sacral size, indicating early arrest of normal embryogenesis and explaining the emergence of complex ARM [24].

One such developmental anomaly of the sacrum is sacral agenesis, which according to the Renshaw (1978) classification is divided into four types (Fig. 3) [25]. Among the anomalies of sacral formation, a special place is occupied by sacral agenesis, which according to the Renshaw (1978) classification is divided into four types (Fig. 3) [25].

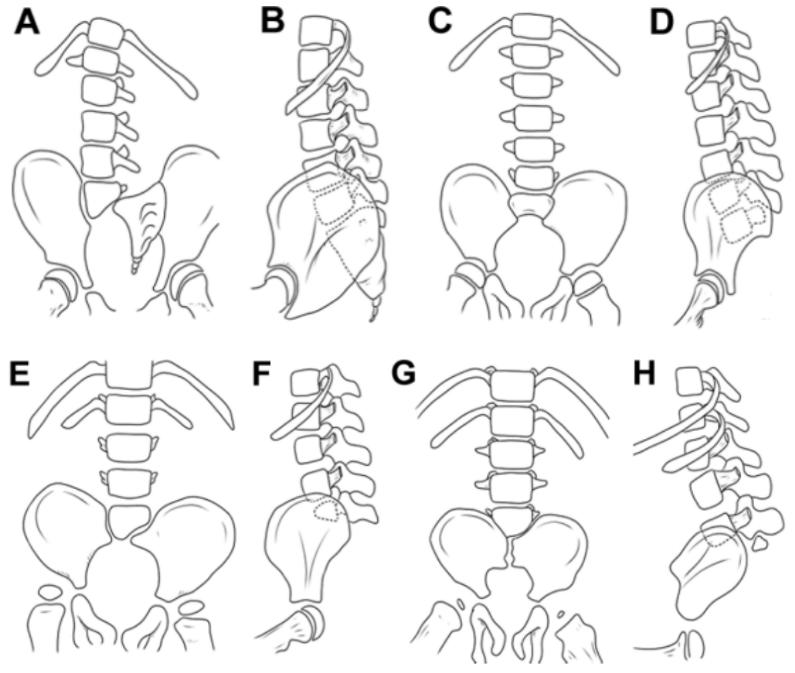

Fig. 3. Types of sacral agenesis according to Renshaw (1978): A–B = type I: partial or complete unilateral sacral agenesis; C–D = type II: partial sacral agenesis with a limited bilateral–symmetric defect and stable articulation of the iliac bone with a normal or hypoplastic first sacral vertebra; E–F = type III: variable lumbar and complete sacral agenesis in which the iliac bone articulates with the lateral aspects of the lowest vertebra; G–H = type IV: variable lumbar and complete sacral agenesis in which the caudal endplate of the lowest vertebra lies above the fused iliac bone or above the iliac amphiarthrosis (symphysis)

Often, so-called «sacral marks» of sacral agenesis are visually detectable on the skin of the lumbar region, and this condition is confirmed by radiological examination of the sacrococcygeal area. Chen Z. et al. (2021) proposed evaluating sacral development not only by the SI value but also by assessing sacral curvature (SC), assuming that sacral development may differ among various types of pathology and thus may serve as an indicator for predicting the course of a particular developmental anomaly [16]. The authors proposed determining SC as an index using their original scheme (Fig. 4).

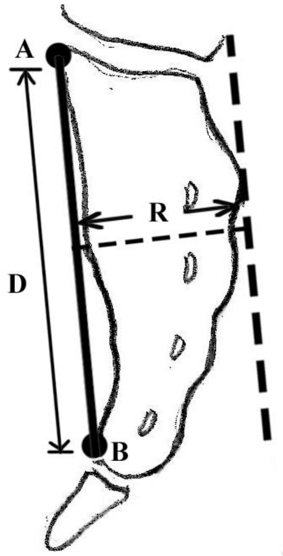

Fig. 4. Scheme for calculating SC according to Chen Z. et al. (2021). Point A – the hypothetical junction of the upper and ventral edges of S1 in the lateral projection; point B – the hypothetical junction of the lower and ventral edges of S5 or the last sacral vertebra. Distance D represents the distance between points A and B, and R denotes the vertical distance from the highest point of the dorsal sacral curvature to the AB line

Thus, SC represents the ratio of R to D on radiologic (MRI/CT, which provide superior visualization of anatomical details) images in the sagittal (lateral) plane: SC = R/D. Calculation of the SI for analytical comparison with the SC value was performed by the authors according to the classical scheme and the formula of M. Torre et al., 2021, which incorporates the linear length of the coccyx (Fig. 5) [13].

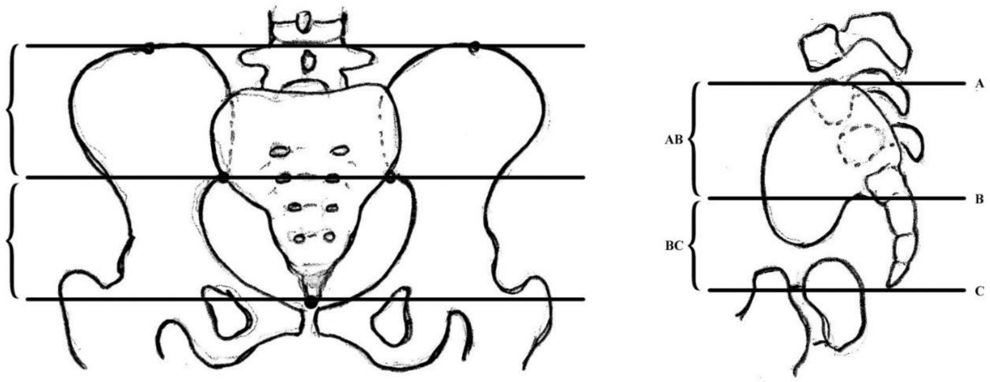

Fig. 5. Line A – line connecting the upper edges of the iliac wings on both sides; line B – connecting the lower edges of the sacroiliac joints; line C – drawn through the lower edge of the coccyx parallel to lines A and B

H. Ahmad et al. (2021) emphasize that determining the SI in the lateral pelvic projection is methodologically more reliable than in the anteroposterior view. In their assessment, the sacrum often appears artificially shortened in the frontal projection due to individual pelvic tilt and the reduced visible length of the lumbosacral segment [26]. Long-term clinical observations by M. Torre et al. (2021) demonstrated that SI tends to decrease with age [27]. However, S. A. Warne et al. (2003) noted that incomplete sacral ossification in infants makes SI interpretation significantly more difficult. They showed that parameters D and R increase with age, whereas SI and SC show no age dependency, since SC is not influenced by the degree of sacral ossification – unlike SI, which incorporates coccygeal length [28]. Researchers concluded that with higher ARM fistula levels, mean SI values significantly decrease (bladder: 0.57±0.12; urethral: 0.65±0.12; perineal: 0.73±0.12), while SC values increase in the opposite direction (perineal: 0.25±0.04; urethral: 0.22±0.04; bladder: 0.14±0.18). In a large cohort of over 400 healthy children, A. Kajbafzadeh et al. (2008) found that SI in ages 0-15 remained practically stable, with minimal non-significant increases between ages 7 and 15. The mean SI was 0.711 (range 0.36-1.333). In children with VUR and defecation disorders SI averaged ~0.55, and values below 0.4 were recommended as pathological.

In adolescents with pathological SI, a later increase was observed, suggesting maturation of the sacral region, possibly reflecting regression of VUR in some cases [12]. H. G. Nugraha and P. I. Miranti (2021) reported that SI incorporating coccygeal length averaged 0.55 in children with urinary tract pathology, 0.491 in constipation, and was lowest in Hirschsprung disease [29]. Multiple studies confirm that VUR exerts both local and systemic negative effects on child development, contributing to diverse functional disorders [30]. Long-term observations among patients with primary VUR and associated renal scarring and UTIs (even afebrile) show reductions in general growth parameters [31]. In a cross-sectional study by F. Ehsanipour et al. (2018) on 100 children under 15, sacral anomalies were significantly more frequent in the VUR group compared with controls [32]. Thus, SI should be regarded as an important prognostic marker in complicated VUR, and parents should be appropriately informed. J. Ahmadi et al. (2005) characterized SI as a predictor in anorectal malformations, highlighting that SI < 0.7 is pathological and correlates with defecation dysfunction. They emphasized that sacral morphology and SI are key prognostic factors for postoperative continence after ARM repair [32].

The coccyx is a triangular bone formed by fusion of 3-5 caudal vertebrae. It is anatomically important as an attachment site for multiple pelvic floor muscles [33]. To exclude pathological or post-traumatic coccygeal displacement, an orthopedic coccygodynia test is used, provoking pain via compression or traction of the distal spine [34]. The most common cause of coccydynia is trauma to the coccyx – first described by Simpson – resulting from external or internal forces [35, 36]. Such injuries are classified as flexion, compression, or extension types [37, 38].

The tilt test consists of two phases:

• Phase I – the patient sits upright on a firm surface.

• Phase II – the patient leans the trunk backward at ≥30°.

This angle is chosen because normally the coccyx moves 5-25° anteroposteriorly when sitting, returning to baseline upon trunk straightening. Mobility >25° or <5° is pathological and in ~70% corresponds to coccydynia associated with coccygeal abnormalities (dislocations, subluxations) [15]. Pain in Foye's point (sacrococcygeal junction) is considered a positive test [40].

Normal anterior coccygeal angulation varies considerably and is not always trauma-related, complicating diagnostic interpretation. According to the expanded Postacchini & Massobrio (1983) classification, coccygeal angulation includes six types:

I – gentle anterior curve with a caudally directed apex (~70°);

II – straight anterior bend, apex ~15°;

III – sharp forward angulation at CyI-CyII or CyII-CyIII (~5°);

IV – «subluxated» anterior shift at the sacrococcygeal joint or between first/second coccygeal segments (~10°);

V – retroversion (posterior rotation), sometimes with a dorsal spur;

VI – scoliotic variant with lateral deviation [41].

Mehdizadeh M. et al. (2013) found that some children with VUR confirmed by VCUG had decreased SI values. They proposed that sacral anomalies may contribute to voiding dysfunction, which in turn may play a role in VUR development [42].

Under normal physiology, defecation control relies on four mechanisms:

1. – Anal sensation – discrimination of stool type and consistency;

2. – Sphincter function – coordinated contraction and relaxation of internal/external sphincters;

3. – Rectosigmoid motility – effective transport enabling reservoir function;

4. – Reservoir (proprioceptive) function – rectal accommodation and reflex activation of voluntary sphincter contraction [43].

ARM arise from embryologic delay or arrest of pelvic musculature development, closely associated with sacral and spinal anomalies [44]. Poor pelvic muscle development limits defecation control. Based on this, O. Nash et al. (2020) proposed three SI categories:

• Group I – SI < 0.4 (low continence potential);

• Group II – 0.4-0.69 (intermediate likelihood);

• Group III – SI ≥ 0.7 (high continence potential).

SI in newborns may be misleading due to incomplete ossification, but becomes informative by 5-6 months. Lumbo-sacral MRI is recommended for SI < 0.6 to detect spinal anomalies, presacral masses, and caudal regression syndrome [45, 46].

Over the past two decades, multiple authors have viewed SI as a key sacral development index correlated with voiding and defecation dysfunctions [12]. Khalegh Nejad Tabari A. et al. (2005) suggested SI as a potential predictor of fecal continence in colorectal surgery [47, 48]. Yousefichaijan P. et al. (2013) stressed its use in predicting medical therapy success due to its association with VUR. A well-documented association exists between sacral agenesis and neurogenic bladder, voiding dysfunction, and secondary VUR due to the sacrum's proximity to distal ureters [5].

MRI is increasingly preferred for sacral assessment due to superior detail, especially for defining the caudal coccygeal boundary in children under 9 – an age at which coccygeal ossification is still incomplete [21].

Given existing inconsistencies in evaluating sacrococcygeal developmental harmony in children with pelvic dysfunction, we proposed – based on the SC model of Cheng Z. et al. (2021) – a modified method incorporating coccygeal length and morphology in the sagittal plane (Fig. 6).

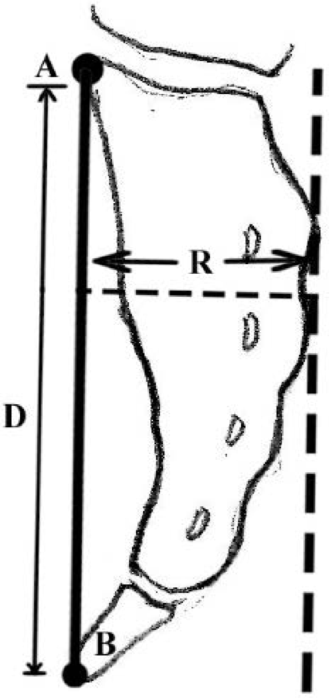

Fig. 6. Scheme for calculating the SCCI based on our own modification of the SC scheme according to Chen Z. et al. (2021). Point A is the hypothetical junction of the superior and ventral margins of S1 on the lateral projection; point B is the hypothetical distal edge of the last coccygeal vertebra. Distance D is the length between points A and B, and R denotes the vertical distance from the highest point of the dorsal sacral curvature to the AB line

The SC_CI value was calculated as the ratio of R (mm) to D (mm). This approach minimizes the influence of projection-related magnification or reduction factors that inevitably occur on every radiograph, thus ensuring correct comparison of the obtained results. A comparative analysis of sacral index (SI) values across study groups demonstrated characteristic trends in its variability. Both the true sacral ratio and the sacrococcygeal ratio showed a tendency toward lower values in patients of both groups compared with normal parameters – both in standard anteroposterior and lateral projections. Notably, in both projections, the lowest and statistically significant values of the true sacral ratio were observed in patients with vesicoureteral reflux. Specifically, in the anteroposterior projection this value was 0.61±0.02, and in the lateral projection – 0.47±0.02 ($p<0.05$), highlighting the importance of its reduction in this patient category.

The sacrococcygeal ratio in patients with VUR also demonstrated statistically significant minimal values in both projections, although they exceeded the true sacral ratio. In the anteroposterior projection its value reached 0.88±0.05, and in the lateral – 0.60±0.01 ($p<0.05$). Slightly higher values of this ratio may be explained by the fact that its formula includes an additional distance corresponding to the projected coccygeal length, which is absent in calculating the true sacral ratio. This accounts for the differences between these indices. When comparing sacral curvature coefficients in patients with chronic constipation of organic origin and those with vesicoureteral reflux, we identified a tendency toward progressive reduction in both projections. The lowest, statistically significant values of sacral curvature were registered in VUR patients-both when assessing the SC index and when considering the projected coccygeal length (SC_CI). The rate of coefficient reduction was more pronounced when using SCCI, likely due to inclusion of the additional coccygeal length parameter. Lower SC_CI values in both comparison groups indicate a stronger influence of coccygeal linear characteristics on this index compared with the SC index. Comparative analysis of SC and SC_CI components also showed a stable downward trend relative to physiological norms across all study groups. The most pronounced reduction was characteristic of patients with vesicoureteral reflux. The consistent trends of all analyzed indices support the objectivity of the applied sacral curvature assessment methodology, including our proposed modification. Therefore, the use of the updated SCCI coefficient, which incorporates the full sacrococcygeal distance (DK) and the corresponding vertical distance (RK), is supported by its consistency with data obtained in children with chronic constipation of organic origin. This demonstrates that SCCI accounts for all possible linear characteristics of related anatomical structures and their spatial relationships, including angular deviations.

Conclusion. Physical examination combined with radiological imaging remains a fundamental tool for assessing sacral structural harmony. At the same time, calculated indices of sacrococcygeal development can serve as additional diagnostic and prognostic criteria for pelvic organ disorders, as well as help predict the effectiveness of medical treatment and determine indications for surgical intervention. Evaluating SI in children with anorectal malformations is useful for surgical prognostication and informing parents about potential defecation control. It is also important to differentiate between post-traumatic coccygeal deformities and natural anatomical variants, as this significantly affects the accuracy of CI and SC calculations in each case. Considering the possibility of spontaneous regression of pathology, the use of individual sacral curvature indices (SC and/or SCCI) is advisable in the diagnostic algorithm for children with VUR. This provides objective digital documentation of developmental changes in the sacrococcygeal region during growth under dynamic observation.

Prospects for further research. Further research should focus on an in-depth analysis of the relationship between sacral index values, the degree of sacral dysplasia, and functional pelvic organ disorders in children of different age groups. Long-term prospective studies are warranted to assess the prognostic value of the sacral index in the course of chronic defecation disorders and vesicoureteral reflux. An important direction is the integration of radiographic morphometric parameters with clinical, neurophysiological, and ultrasound data to develop individualized diagnostic algorithms and to optimize treatment strategies and patient management.

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THE ROLE OF HARMONIOUS DEVELOPMENT OF THE SACROCOCCYGEAL SPINE IN THE FUNCTIONING OF PELVIC ORGANS IN CHILDREN

Abstract. Dysfunction of pelvic organs in children, particularly the development of chronic constipation, represents one of the most common gastrointestinal disorders globally. According to various estimates, up to one-third of children aged 6-12 years experience prolonged defecation disturbances. Proper bladder function is closely linked to its innervation, primarily via the sacral parasympathetic center. Therefore, any anomalies in the formation or dysplastic changes of the sacral spine segment can lead to urinary disorders, one potential manifestation of which is vesicoureteral reflux.
Aim of the study. To analyze sacral index values in healthy children and in patients with chronic defecation disorders of various etiologies and vesicoureteral reflux, in order to determine the prognostic significance of this parameter and the frequency of sacral dysplasia detection depending on the pathology.
Material and methods. The study was conducted as a case-control design. A total of 338 patients aged 3-14 years who underwent inpatient examination and treatment at the Vinnytsia Regional Children's Clinical Hospital from 2020 to 2024 were included. All children were radiologically examined as indicated, with contrast enhancement, when necessary (irrigography, voiding cystourethrography), with imaging performed in anteroposterior and lateral projections. Forty patients showed no pathology, forming the control group. Radiographic signs of chronic organic constipation (dolichosigma, dolichocolon, megacolon, etc.) were recorded in 265 children. Vesicoureteral reflux grades I-III were identified in 33 patients.
Discussion. Despite the leading role of clinical examination and imaging methods in studying sacral anatomy, calculated indices of sacrococcygeal development can serve as an additional tool for diagnosing and predicting

pelvic organ pathology. Their use facilitates a reasoned choice of conservative treatment approaches and the formulation of indications for surgical correction.
Conclusion. Analysis of the sacral index in children with anorectal anomalies is an important component in predicting the likelihood of achieving controlled bowel passage, which is essential when counseling parents. Furthermore, identifying the consequences of traumatic coccygeal injury or variants of normal anatomical structure is a necessary step before calculating sacral curvature parameters, as these factors influence the overall assessment of sacrococcygeal development.
Key words: children, congenital malformations, vesicoureteral reflux, chronic constipation, sacral index, sacral curvature, diagnosis, treatment.

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