

# Sacral ratio and fecal continence in children with anorectal malformations

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## OBJECTIVE

To evaluate the sacral ratio (SR) in patients with an anorectal malformation (ARM) and verify whether it has predictive value for fecal continence.

## PATIENT AND METHODS

From January 1990 to April 2002, 42 patients (aged 3–14 years) with an ARM and having already been operated on were reassessed and enrolled in the study. Patients with solid or paste-like stools but no soiling were deemed continent, those with similar stool and episodes of soiling partially continent, and those with no sphincter control, incontinent. The fecal continence was always analysed by

the same observer. Sacral radiographic images were reviewed and the SR calculated from anteroposterior and images in the lateral position. All images were obtained before surgery and analysed by the same observer, while a third analysed the results. Results were considered statistically significant at  $P < 0.001$ .

## RESULTS

Seventeen patients were deemed continent, seven partially continent and 18 incontinent; there was no significant difference in SR among the three groups. When fecal continence was analysed in relation to changes in the findings on computed tomography of the lumbosacral spine,

patients with sacral agenesis had a significantly higher frequency of fecal incontinence than the others, and all had a SR below 'normal'.

## CONCLUSION

Although the SR was different in patients with sacral agenesis it was no different in continent, partially continent or incontinent patients, and thus it is of no practical value in identifying patients likely to have fecal incontinence.

## KEYWORDS

anorectal anomaly, incontinence, sacral ratio, sacral abnormality, sacral agenesis

## INTRODUCTION

Anorectal malformations (ARMs) are known to be associated with further birth malformations and, among these, spinal and the genitourinary system disorders are the most common. Early identification of possible spinal chord dysraphism in patients with ARMs is important, considering that such association tends to worsen the child's prognosis for both urinary system function and achievement of fecal continence [1,2].

In 1995 Peña [3], claiming that the number of sacral vertebrae on plain radiographic imaging could not accurately predict which patients would be more likely to develop changes in the lower somatic innervation and consequently be more likely to become incontinent, proposed a new model to assess possible changes in the sacral spine. By using both the anteroposterior and the lateral view in plain spinal radiographs, he measured the sacrum and compared it to fixed hip-girdle variables. The value obtained, termed the sacral ratio (SR), could be used to predict which patients would be more likely to

develop incontinence, even if undergoing technically adequate surgery. The mean 'normal' SR was calculated as 0.74 for the anteroposterior view and 0.77 for the lateral view.

By analysing groups of normal patients and those with an ARM, Torre *et al.* [4] found a wide range of normal values for SR, and stated that patients should not be considered to have a true pathology unless the SR was  $< 0.52$  in either view. Also assessing normal patients and those with an ARM, Warne *et al.* [5] showed that different observers, by using radiographic images of the same patient, obtained different measures. They concluded that the SR would thus have limited value in distinguishing patients with sacral anomalies. Thus we assessed the SR in patients with an ARM and of an age that was suitable for analysing fecal continence.

## PATIENTS AND METHODS

From January 1990 to April 2002, 54 children with an ARM and being followed at the authors' institutions were invited to be

assessed (33 boys and 21 girls, aged 3–14 years); two declined, and 10 still had a colostomy and were excluded from the study. Thus 42 patients, all having the ARM corrected by the same surgical technique and by the same surgeon, were enrolled in the study.

Patients with solid or paste-like stool but with no soiling episodes were deemed continent, those with similar stool but accidental soiling episodes partially continent, and those with no sphincter control, incontinent.

To calculate the SR from plain lumbosacral spinal images in the anteroposterior view, a line is drawn joining the most superior points of both iliac crests, a second line joining the most inferior points of the sacro-ileac joints and a third parallel to the preceding lines across the most inferior point of the sacrum. The SR is then obtained by dividing the distance between the two baselines by the distance between the two upper lines. When the lateral view is used, three parallel lines are also drawn through the same points and the SR calculated using the same ratio [3]. Each

sacral radiograph was then defined as normal or abnormal by applying the Peña criteria, i.e. a normal SR of 0.74 and 0.77 [3].

To assess any correlation between the SR and anatomical spinal changes all patients had CT of the lumbosacral region, with axial slices 2 mm wide and at 5 mm increments. The number of sacral pieces, the morphology of the vertebral bodies, the posterior arc lamina, the vertebral channel and the presence or not of spinal dysraphism were analysed. The chi-square test was used to compare the SR and continence of the patients, and to assess the changes on CT and the level of continence. Differences were considered statistically significant at  $P < 0.001$ . The patients' continence was always assessed by the same observer, whereas all radiographic images were taken before surgery and assessed by a second observer, with a third analysing all the results.

## RESULTS

Of the 42 patients assessed, 17 were deemed continent, seven partially continent and 18 incontinent. As the SR could not be analysed from the anteroposterior view in all patients, only the results obtained from the lateral view were used.

There was no significant difference in the SR among the three groups, i.e. the number of incontinent patients did not differ whether the SR was higher or lower than 0.77 (Table 1). When the level of fecal continence was analysed for the changes on lumbosacral CT there was a significant difference, with patients with sacral agenesis being more likely to be incontinent; all patients with sacral agenesis had a SR of  $<0.77$  (Table 1).

## DISCUSSION

The main aim of managing patients with an ARM has been to construct an anal orifice that is suitable for the regular passage of feces and anatomically well positioned in relation to the sphincter system. The technical improvements in surgery have shown that some patients, although having appropriate surgery, fail to become fully continent. The disease involves more than simply having no anus, in some cases irreversibly compromising the entire innervation of the organs that rely on sacral spinal chord segments, consequently affecting urinary function and sometimes the locomotor system.

Group	Continent	Partially continent	Incontinent	Total
<b>SR</b>				
$<0.77$	4	4	8	16
$\geq 0.77$	13	3	10	26
Total	17	7	18	42
<b>CT findings</b>				
Normal	7	2	0	9
Dysraphism	7	1	6	14
Sacral agenesis	3	4	12	19
Total	17	7	18	42

TABLE 1

Comparison between the SR in the lateral position, or changes in spinal CT findings, and the level of continence of patients with an ARM

Predicting which patients would be more likely to have difficulties in developing fecal continence, Peña [3] introduced the SR, based on the fact that bone alterations would almost always be accompanied by changes in lumbosacral spine innervation. Thus, patients who had less space on a radiological view of the sacrum would be those most likely to have a neurological disorder capable of irretrievably compromising the operational capacity of the sphincter system.

As reported by earlier authors [4,5], in the present series there was no significant correlation between the level of continence and the SR and thus it is not possible to claim that patients with a SR less than 'normal' are more likely to develop incontinence, whereas those with sacral agenesis on CT were significantly more likely to have fecal incontinence. Curiously, all these patients had a SR of  $<0.77$ , showing that the value can be directly associated with lumbosacral spine disorders; however, it cannot be used to predict which patient will be more likely to develop fecal incontinence.

The ARMs are a broad spectrum of diseases that may or may not affect the innervation-dependent segments of the lumbosacral spine. Early recognition of patients at risk is important and should be an aim of all those who treat such children; any diagnostic means capable of safely predicting patients who are liable to develop disorders should be worthwhile. The SR was not useful for predicting which patients would have fecal incontinence and it was not completely reliable. The differences in SR in a larger sample than the present might confirm Peña's data [3], but as the data in Table 1 suggest, that there were significantly many incontinent patients with a normal SR makes it practically invalid as a marker. Thus the SR

should be interpreted cautiously and a close follow-up of all patients with ARM maintained.

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## CONFLICT OF INTEREST

None declared.

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Abbreviations: ARM, anorectal malformation; SR, sacral ratio