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Computerised tomography in the management of imperforate anus patients following rectoplasty

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Abstract. Eighteen patients with surgically corrected high (supralevator) anorectal anomalies were scanned by computerised tomography (CT) to assess the state of development of the anorectal sphincter muscle complex (SMC) and the position of the neorectum in relation to the SMC. These CT findings were compared with the patients' assessed grade of faecal continence/incontinence. While continence levels did not always correlate closely with CT findings, the presence of a deficient SMC or an eccentric position of the neorectum within it, or both, was more frequent in patients with continence problems. For severe incontinence, CT scanning gave helpful indications for or against secondary rectoplasty.

Key words: Anorectal anomalies–Rectoplasty–Postoperative results – Radiology – Computerised tomography

Introduction

Although most patients eventually achieve a socially acceptable level of faecal continence following rectoplasty for high (supralevator) anorectal anomalies, a few suffer such gross incontinence as to warrant further investigation and reoperation. It is already recognised that in the initial assessment of neonates with high anorectal anomalies, computerised tomography (CT) can help in demonstrating the site and development of the pelvic musculature as well as the site and placement of the rectal pouch [5, 7, 8]. However, in the assessment of post-rectoplasty incontinence and in weighing the indications for secondary rectoplasty, CT of the anorectal sphincteric muscle complex (SMC) has a potential to help decision-making that has received scant attention thus far.

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To facilitate the rational management of post-rectoplasty patients with varying degrees of faecal incontinence, CT scans were used in a series of 18 patients with high (supralevator) anorectal anomalies to assess the development of the SMC and determine whether or not the surgical placement of the neorectum within the SMC was satisfactory.

Patients and methods

The clinical records, continence status, and CT findings were reviewed for 18 patients (15 males, 3 females) with supralevator anorectal anomalies who had undergone rectoplasty between 1969 and 1985 and had subsequently had CT pelvic scans. In all these patients anorectoplasty had been performed at least 2 years before CT scanning. The scans were performed in both axial and coronal planes by a technique previously described [9], in which the conventional axial views best demonstrate the levator sling and its relation to neorectal placement and the coronal views give a better estimate of the bulk of the SMC.

The continence level of each patient was assessed using a slightly modified Wingspread clinical method [16], dividing patients into groups: "clean", "smearing", "intermittent soiling", "constant soiling", and "colostomy". "Smearing" was taken to mean minor leakage of rectal contents only; "intermittent soiling" was major leakage requiring change of undergarments less than three times a week; and "constant soiling" similar major leakage three or more times a week. Three of the 18 patients had required reestablishment of colostomies for faecal incontinence, and were grouped as a separate category not included in the original Wingspread scheme. Of the remaining 15 patients, 4 were clean with or without therapy; 2 had smearing without therapy; 6 had intermittent soiling; and 3 had constant soiling requiring a daily rectal washout to maintain anal cleanliness.

CT findings were grouped according to the development of the SMC and the placement of the neorectum within the SMC [7]. In the absence of sufficient criteria of what constituted "normal" CT appearances of the SMC, we simply graded SMC development as "adequate" or "deficient" according to whether a substantial or attenuated SMC mass was demonstrated. The placement of the rectum within the SMC was judged as to whether the position of the rectal lumen within the SMC was predominantly centric or eccentric. A large catheter within the rectal lumen was sometimes helpful in this assessment, but was not always needed.

Patients were initially selected for CT scanning if faecal continence was poor, but as the study progressed we included children with more satisfactory levels of faecal continence in order to compare their sphincteric development and rectal placement. This series is therefore non-re-

Table 1. Anorectal anomalies in the 18 patients studied (Male 15, Female 3)

Specific anomaly	Number of patients
Recto-prostatic fistula	9
Ano-rectal agenesis	5
Recto-bulbar fistula	1
Recto-vestibular fistula	2
Cloaca, high type	1

Table 2. Type of rectoplasty employed

Type of rectoplasty	Number of patients
Abdomino-perineal (Rehbein) [12]	9
Sacro-perineal (Stephens) [15]	4
Posterior sagittal anorectoplasty (Pena) [2]	3
Sacro-abdomino-perineal endorectal rectoplasty (Kiesewetter) [6]	1
Transposition	1

Table 3. Development of sphincteric muscle complex (SMC) as assessed by CT scanning in 18 patients

SMC development	No. of patients
Well-developed	10
Recto-prostatic fistula	4
Ano-rectal agenesis	3
Recto-bulbar fistula	1
Recto-vestibular fistula	1
Cloaca	1
Hypoplastic	8
Recto-prostatic fistula	5
Ano-rectal agenesis	2
Recto-vestibular fistula	1

Table 4. Placement of the neorectum on CT scanning in 18 patients

Enlocation of neorectum within SMC		Number of patients
Rectum Central		13
AP (Rehbein)	5	
PSARP (Pena)	3	
SP (Stephens)	3	
SAP (Kiesewetter)	1	
Transposition	1	
Rectum eccentric		5
AP (Rehbein)	4	
SP (Stephens)	1	

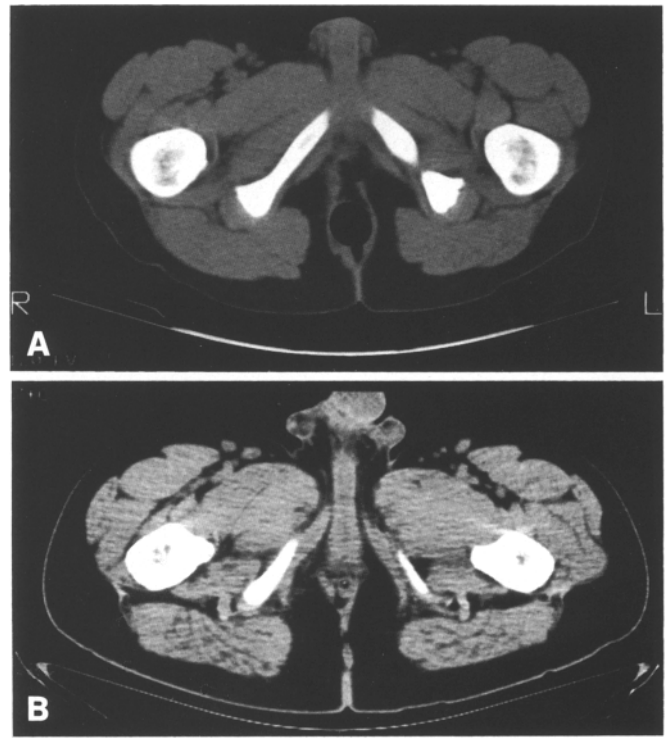

Fig. 1. An example of adequacy (**A**) and deficiency (**B**) of the sphincter muscle complex (SMC) on postoperative CT scanning

Fig. 2. Postoperative CT scan demonstrating eccentric placement of the pulled-through neorectum. The SMC is well-developed in this case.

presentative of the overall hospital experience of high anorectal anomalies, either with respect to the relative frequencies of the indicidual anomalies ancountered (Table 1) or to the various types of rectoplasty employed (Table 2).

Results

From the relatively small numbers of individual anomalies scanned, no obvious correlation can be drawn between the degree of development of the SMC and the specific anomalies encountered (Table 3) or the type of rectoplasty employed (Table 4).

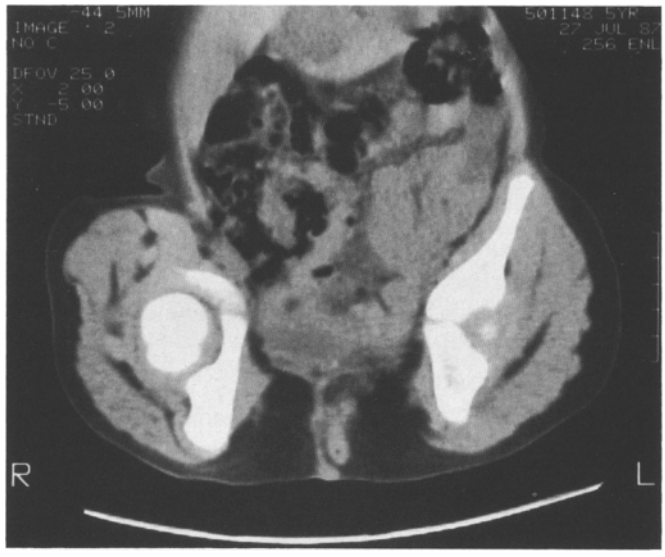

Fig. 3. A combination of SMC deficiency and eccentric neorectal placement is shown in this patient's postoperative CT scan

The SMC was adequate or well developed (Fig. 1 A) in 9 patients and deficient (Fig. 1 B) in 9. The position of the neorectum was eccentric (Fig. 2) in 5 patients, 4 of whom also had hypoplastic musculature (Fig. 3). Eccentricity in placement of the neorectum occurred in 4 of the 9 Rehbein procedures and in 1 of the 4 Stephens operations.

In Table 5, these results are correlated to the continence status of the patients. Four patients were clinically clean with adequate development of the SMC and with a centrally placed rectum. Of 2 patients who smeared, 1 had no abnormal CT findings and the other had a deficient SMC. Of the 6 patients with intermittent soiling, 3 had sacral or spinal abnormalities and 2 of these 3 were demonstrated to have both SMC deficiency and eccentric rectal placement.

Of 6 patients with gross incontinence (3 in the constantly soiling group and 3 after re-establishment of colostomy) only 1 had an adequate SMC, but with an eccentric neorectum plus a spinal abnormality, while the 5 others all had SMC deficiency, 3 also having an eccentric neorectum. In addition, 4 of the 6 had either sacral anomalies or spina bifida occulta (SBO).

Of the 9 patients with SMC deficiency, 5 had associated spinal abnormalities and 5 had eccentric placement of the neorectum within the SMC, suggesting that either SMC deficiency or spinal/sacral abnormalities, or both, may predispose to unsatisfactory surgical enlocation of the neorectum within the SMC.

Table 5. Continence results assessed by modified[a] Wingspread method and correlated to the CT findings

Continence category	Sex	Initial operation	SMC	Neorectal placement within SMC: CT findings	Spinal abnormality
1. Clean					
	F	PSARP	Adequate	Central	-
	M	PSARP	Adequate	"	-
	M	PSARP	Adequate	"	-
	M	APR	Adequate	"	-
2. Smearing					
	M	SP	Adequate	"	-
	M	APR	Deficient	"	-
3. Intermittent soiling	M	APR	Adequate	"	-
	M	APR	Adequate	"	-
	F	SP	Adequate	"	S4 hemivertebrae
	M	APR	Deficient	Eccentric to L	-
	M	SP	Deficient	Eccentric to L	S2 hemivertebrae
	M	APR	Deficient	Eccentric to R	SBO
4. Constant soiling	M	APR	Adequate	Eccentric to L	S2 hemivertebrae
	M	KIE	Deficient	Central	SBO
	M	SP	Deficient	Central	Total sacral agenesis
5. Colostomy					
	M[b]	APR	Deficient	Central	-
	F	TR	Deficient	Central	-
	M	APR	Deficient	Eccentric to R	SBO

Abbreviations: APR = Rehbein rectoplasty, KIE = Kiesewetter rectoplasty, PSARP = Posterior sagittal anorectoplasty, SP = Sacroperineal rectoplasty, SBO = Spina bifida occulta, TR = Anal transposition

[a] "Colostomy" was not a category in the original Wingspread method

[b] Colostomy closed following CT, with continence improved to category 2

Table 6. How did CT scans help in management?

Eccentric rectum, SMC adequate	2
Revision rectoplasty	1
Revision recommended: patient refused	1
Eccentric rectum, SMC deficient	5
Revision recommended: patient undecided	1
Revision rectoplasty failed: permanent colostomy	1
Bowel washout regime (Sacral agenesis, 2)	3
Rectum central, SMC deficient	5
Good continence	1
Closure of colostomy with improved continence	1
Revision contraindicated (all with spinal abnormalities)	3

Discussion

Incontinence following rectoplasty for high (supralevator) anorectal anomalies remains a problem [13, 14]. Investigations may be undertaken to demonstrate surgically correctable causes for faecal incontinence, which most commonly are unsatisfactory enlocation of the neorectum within, or iatrogenic damage to, the levator complex [14]. Such investigations may range from digital examination of the rectal sling, which is imprecise, to the newest imaging modality, magnetic resonance imaging (MRI) [1, 11]. We have chosen to use the CT scanner because it is cheaper, more readily available, and associated with few patient monitoring problems. The MRI scanner permits better resolution of soft tissues than CT, although the latter is still preferred for examination of the pelvis [1].

The hypoplastic SMC

The puborectalis and other muscles important for the control of defaecation are known to be hypoplastic in patients with high (supralevator) anorectal anomalies [5, 7, 15] and severe sacral vertebral deficiencies [15]. In a postoperative population, however, the perceived muscle deficiency may be due not only to congenital hypoplasia or sacral neural deficiency, but to surgical trauma. Although the sphincters may be torn by surgery, the sacral nerve branches (S3,4) supplying the levator complex are placed well laterally to any near-midline pull-through operation and are unlikely to be damaged during surgery. In view of this, the finding of a deficient SMC (9 out of 18 patients in this study) in a patient with faecal incontinence is most probably developmental rather than acquired, and unlikely to justify secondary rectoplasty. Such patients could, perhaps, warrant sphincter-strengthening operations such as gracilis transplant levatorplasty [3, 10, 14], but such operations lie outside our experience.

The eccentric rectum ("missed SMC")

For optimal continence, the importance of central placement of the neorectum within the SMC has long been recognised [15] and the finding of an eccentrically placed rectum could, perhaps, be regarded as a prime indication for secondary rectoplasty. In 5 patients in this study an eccentric neorectum was associated with moderate to severe faecal incontinence: 1 of these 5 had an adequate SMC, but with sacral hemivertebrae; the other 4 had SMC deficiency, and in 3 of these 4 patients severe sacral anomalies or SBO were also present. It is unlikely that such patients would be helped by further surgery, except perhaps a terminal colostomy, so that CT scanning can provide helpful contra-indications, as well as indications, for secondary rectoplasty.

Can the "good" CT predict "good" continence?

Unfortunately, as we have shown, the presence of an adequate SMC and centrally located rectum plus the absence of sacral/spinal abnormalities were not always accompanied by satisfactory anorectal continence. Two patients soiled intermittently even though no muscular, rectal, or spinal abnormalities were found. In these cases it is likely that other neuropathological or functional factors were to blame, such as the many described by Holschneider, Schärli, and others [4, 13]. In general, though, an absence of abnormalities on the CT scan in our patients was associated with socially acceptable continence.

How did CT help in the management of our patients?

Finally, it must be asked how CT scans helped in the management of this group of patients. Six patients were either completely clean or suffered only smearing, and no further surgery was contemplated even though SMC deficiency was noted in 1 of these patients (Table 6).

Of the 6 patients with intermittent soiling, 3 had no abnormal CT scan findings while 3 had a combination of deficient musculature and eccentric rectal placement. One of these 3 patients, who had no recognised spinal abnormalities, subsequently underwent a revision posterior sagittal anorectoplasty (PSARP), but with no obvious improvement in his continence level.

All 3 patients with constant soiling had severe spinal anomalies, and 2 had a combination of deficient musculature and eccentric neorectum. One with adequate development of the SMC but with an eccentrically located neorectum subsequently had a revision PSARP with improvement in his level of continence from constant soiling even with washouts to clean with the aid of washouts.

Of the 3 patients who had colostomies prior to the study, 1 with satisfactory enlocation of the neorectum within a relatively poorly developed SMC had his colostomy closed with satisfactory continence subsequently. For another patient with markedly deficient musculature and ectopia vesicae, no further corrective surgery is planned. One of the patients with combined SMC deficiency and an eccentric neorectum had a revision PSARP following the CT scan, but this revision failed to achieve any gain in anorectal control and he has been reconciled to a permanent colostomy. Taken alone, there-

fore, the CT finding of an eccentrically placed neorectum is an unacceptable indication for secondary rectoplasty.

Other methods for visualising pelvic structures.

MRI is an alternative investigation [1] in planning the surgery of patients with anorectal anomalies, and has an advantage in its ability to demonstrate abnormalities such as tethered spinal cord or neoplasms of the spinal canal [1]. Because of its ready availability and ease of use, however, the CT scanner is the radiological investigation of choice in the assessment of severe faecal incontinence after surgical repair of a supralevator anorectal anomaly. It is anticipated that as MRI and CT are more frequently used in the assessment of patients for revision surgery, more instances of such hitherto "hidden" anomalies will be detected and may explain some of the apparently poor results in patients with successful enlocation of the neorectum within the SMC.

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References

1. Anderson RE (1989) Magnetic resonance imaging versus computed tomography – which one? Postgrad Med 85: 79–87
2. deVries PA, Pena A (1982) Posterior sagittal anorectoplasty. J Pediatr Surg 17: 638–643
3. Hartl M (1972) A modified technique of gracilis plastie. Paediatr U Paedol [Suppl 2]: 99–107
4. Holschneider AM (1976) The problem of anorectal continence. Prog Pediatr Surg 9: 85–114
5. Ikawa H, Yokoyama J, Sanbonmatsu T, Hagane K, Endo M, Katsumata K, Kohda E (1985) The use of computerised tomography to evaluate anorectal anomalies. J Pediatr Surg 20: 640–644
6. Kiesewetter WB (1967) Imperforate anus. II. The rationale and technique of the sacro-abdomino-perineal operation. J Pediatr Surg 2: 106
7. Kohda E, Fujioka M, Ikawa H, Yokoyama J (1985) Congenital anorectal anomaly: CT evaluation. Radiology 157: 349–352
8. Leighton DM, de Campo M (1989) CT invertograms. Pediatr Radiol 19: 176–178
9. Leighton DM, de Campo M (1989) Uses of direct coronal pelvic CT. Australas Radiol 33: 157–159
10. Pickrell KL, Georziade N, Crawford H (1952) Construction of a rectal sphincter and restoration of anal continence by transplanting the gracilis muscle. Ann Surg 35: 853–862
11. Pringle KC, Sato Y, Soper RT (1987) Magnetic resonance imaging as an adjunct to planning an anorectal pull-through. J Pediatr Surg 22: 571–574
12. Rehbein F (1959) Operation for anal and rectal atresia with recto-urethral fistula. Chirurgie 30: 417
13. Schärli AF (1984) Analysis of anal incontinence. Prog Pediatr Surg 17: 93–104
14. Smith ED (1988) In: Stephens FD, Smith ED, Paul NW (eds) Anorectal malformations in children: update 1988. Liss, New York, pp
15. Stephens FD, Smith ED (1971) anorectal malformations in children. Year Book Medical, Chicago, pp
16. Stephens FD, Smith ED (1986) Classification, identification, and assessment of anorectal anomalies. Pediatr Surg Int 1: 200–205