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TECHNICAL NOTE

High and low take-off external prolapse phenotypes can be characterised preoperatively on defaecation proctography

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Abstract

Background External rectal prolapse is poorly understood, with controversy surrounding the ideal surgical approach. Anecdotal mentions of high and low take-off in the literature hint at different pathological phenotypes of prolapse. However there has been no effort to define and characterise these terms, or to discuss how take-off might relate to the underlying pathophysiology of prolapse. We aimed to determine if defaecation proctography (DPG) could reliably characterise high and low take-off prolapse.

Methods The study was a retrospective analysis of prospectively collected data. A total of 88 patients with external rectal prolapse were investigated with a defaecating proctogram as part of their routine evaluation between January 2004 and December 2017. Prolapse take-off was determined by the level of origin on proctography. The rectosigmoid junction position at rest and caudal mobility during straining were also determined, relative to sacrococcygeal bony segmental level.

Results Take-off was characterised in all 88 patients (median age 64 years old, 92% female), of which 53 (60%) had high take-off and 35 (40%) low take-off prolapse. There was significantly greater rectosigmoid junction caudal mobility (median descent 9 vs 5 cm, $p=0.001$, respectively) and a trend to significantly lower resting rectosigmoid position (median sacral level S4 vs S3, $p=0.08$, respectively) in the high take-off group compared to low take-off.

Conclusion In this first formalised description and definition of take-off in the literature, we have shown that defaecating proctogram can satisfactorily identify, discriminate between and characterise two distinct external prolapse phenotypes. We propose two distinct causal pathways to external rectal prolapse, connective tissue failure and levator ani factors. Take-off should be a consideration as a prognostic in clinical practice and research trials.

Keywords Rectal prolapse · Take-off · Proctography

Background

External rectal prolapse is an embarrassing and debilitating condition whose nature is poorly understood. Whilst surgery is the only definitive treatment, the optimal surgical procedure remains debatable, with Cochrane reviews and randomised controlled trials failing to show definitive superiority of an abdominal over a perineal approach [1–3]. Recurrence rates remain stubbornly high, and are shown to be greater in well-designed studies compared to the many single-centre cohort papers in the literature, where follow-up may be truncated [1, 2].

Currently the operation offered to patients is necessarily less often based on features of the prolapse itself, but rather based on patient comorbidity along with surgeon preference and training [4]. Such foundations are not tolerated in cancer and inflammatory bowel disease surgery, and neither should they be in rectal prolapse.

There are anecdotal mentions in the literature of "take-off" as a natural feature of rectal prolapse [5–8]. Take-off is understood to be the physical origin or lead point of a prolapse, with a loose distinction made between "high" and "low" take-off. To date, there has been little published that attempts to define these terms or explain how take-off might relate more broadly to the aetiology of rectal prolapse and its subsequent treatment [6–9]. However, understanding the nature and significance of the distinction in take-off may

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generate prognostic data that could helpfully influence decision-making. This would enable surgeons to choose a more suitable procedure, one that is tailored to and targets a specific anatomical pathology, with the view to ultimately help reduce stubbornly high recurrence rates [7]. Understanding the nature of take-off may also shine a light onto the aetiology of rectal prolapse, which is currently poorly researched and understood. If there are indeed two distinct prolapse phenotypes, this raises the possibility of potentially two distinct causal pathways into external prolapse.

Prolapse take-off can be determined by clinical examination as an outpatient, or at examination under anaesthetic (EUA). However, the clinic setting is suboptimal because of physical and psychological constraints, while assessment at EUA is inconvenient and too late in the pathway from a surgical strategy and consent perspective. Physical examination also has the disadvantage of being unable to characterise take-off in cases of internal rectal prolapse.

Most surgeons regard defaecation proctography (DPG) as superfluous in the evaluation of many cases of external rectal prolapse, but if take-off could be determined at DPG, after clinic and before prolapse surgery, it could prove useful for overcoming the drawbacks of physical examination in clinic or at EUA. The aim of this paper is to determine whether DPG can adequately characterise two possible phenotypes, high and low take-off prolapse.

Methods

All patients who were referred to the Oxford University Hospitals Trust with an external rectal prolapse between January 2007 and December 2017 were investigated with a fluoroscopic DPG as part of their routine evaluation. Patients who were unable to have a DPG (i.e. frailty) were excluded from the study. After appropriate ethical approval, our study was registered as service evaluation with Oxford University Hospitals NHS Trust.

Dynamic DPG was performed with small bowel and rectal opacification per protocol as described previously [10]. Images were acquired at rest, squeeze and straining evacuation. All proctograms were performed and reported by a standard specialist radiology team. Images were co-reviewed and agreed by two colorectal surgeons. Grade of full-thickness rectal prolapse was scored according to the Oxford Prolapse Grade [11].

A high take-off prolapse was defined by a lead point of the prolapse developing in the upper half of the rectum during the straining phase, while a low take-off prolapse originated in the lower half. The presence and grade of rectocoele were noted: grade 1, <2 cm = normal; grade 2, 2–4 cm; grade 3, >4 cm. The presence or absence of an enterocoele was determined when herniation of small bowel (or sigmoid colon) was seen caudally beyond the upper limit of the rectovaginal septum (i.e. bulging into the lumen of the vagina). Perineal elevation, descent and total movement of the anorectal junction were measured between squeeze and rest, rest and maximal strain, and squeeze and maximal strain, respectively, with the lower ischial tuberosity as a reference. Excessive perineal descent was considered as more than 30 mm descent at rest or straining [12–14].

Two further novel and previously unpublished DPG metrics were coined in this study—rectosigmoid junction (RSJ) position at rest and RSJ caudal descent during straining. RSJ position at rest was determined relative to the sacral and coccygeal bony segmental level. The RSJ caudal descent was calculated by measuring the distance the RSJ travelled (in centimetres) from its resting position to its most caudal position during straining.

Statistical analysis was performed using R (v4.2.3, www.r-project.org). Non-parametric continuous data were analysed using the Mann–Whitney *U* test for comparing two variables and the Kruskal Wallis test for more than two variables. Categorical data were analysed using the chi-squared test. A p value of <0.05 was taken to be significant.

Results

Take-off was characterised in all 88 patients who had had a DPG (Table 1). The median age of the cohort was 64 years, with no significant difference between high and low take-off. The large majority of patients (92%) were women.

Take-off vs RSJ mobility

Of the study cohort of 88 patients, 53 (60%) were identified as having high take-off prolapse, while 35 patients (40%)

Table 1 Take-off vs age vs RSJ mobility

	Total cohort	HTO	LTO	*p* value
Number (%)	88	53 (60)	35 (40)	
Gender (%)				
Female	81	51	30	0.07
Male	7	2	5	
Median age (IQR)	64 (50–72)	63 (53–69)	67 (46–72)	0.95
Median resting RSJ position—sacral level (IQR)	4 (3–4)	4 (3–5)	3 (3–4)	0.08
Median RSJ descent during straining—centimetres (IQR)	8 (5–12)	9 (6–12)	5 (3.5–8.5)	0.001

HTO high take off, *LTO* how take off, *IQR* interquartile range

Table 2 Absence or presence of enterocoele and rectocoele

	HTO	LTO	*p* value
Number (%)	53 (60)	35 (40)	
Enterocoele			
Present	34 (64)	18 (51)	0.23
Absent	19 (36)	17 (49)	
Rectocoele			
Grade 1 (< 2 cm)	35 (66)	32 (91)	
Grade 2 (2–4 cm)	17 (32)	3 (9)	0.01
Grade 3 (> 4 cm)	1 (2)	0 (0)	

had low take-off prolapse (Table 1). There was significantly greater RSJ caudal mobility in the high take-off group compared to low take-off (median descent 9 vs 5 cm, respectively, $p = 0.001$), and a non-significant trend to a lower resting RSJ position in the high take-off cohort compared to low take-off (median sacral level S4 vs S3, respectively, $p = 0.08$).

Take-off vs enterocoele vs rectocoele

In the high take-off group, there were significantly more grade 2 and 3 rectocoeles identified on DPG compared to patients with low take-off prolapse (18 vs 3, $p < 0.01$) (Table 2). While there was a trend towards an enterocoele more likely being present in high take-off prolapse, this was not significant ($p = 0.23$).

Discussion

While prolapse "take-off" has previously been mentioned in the literature [6–8], to our knowledge this is the first paper to define high and low take-off prolapse, characterise two rectal prolapse phenotypes and reveal that DPG satisfactorily discriminates between the two. High and low take-off prolapse can be visualised radiologically on standard barium defaecation proctography, by colorectal surgeons with an interest and experience in pelvic floor disorders, without necessarily involving a radiologist unfamiliar with the concept.

A high take-off prolapse appears readily visible in the proximal rectum, with an intussusceptum originating, developing and eventually invaginating into the distal rectum (the intussuscipiens) to create a rectal intussusception (Fig. 1). A low take-off prolapse on the other hand is a distinct and different radiological entity, with the distal rectum visualised as the lead point with its subsequent effacement and protrusion via the anus (Fig. 2). It appears as a short intussusception, or in some cases a minimal intussusception, and may instead be more analogous to a "hernia" of the pelvic floor

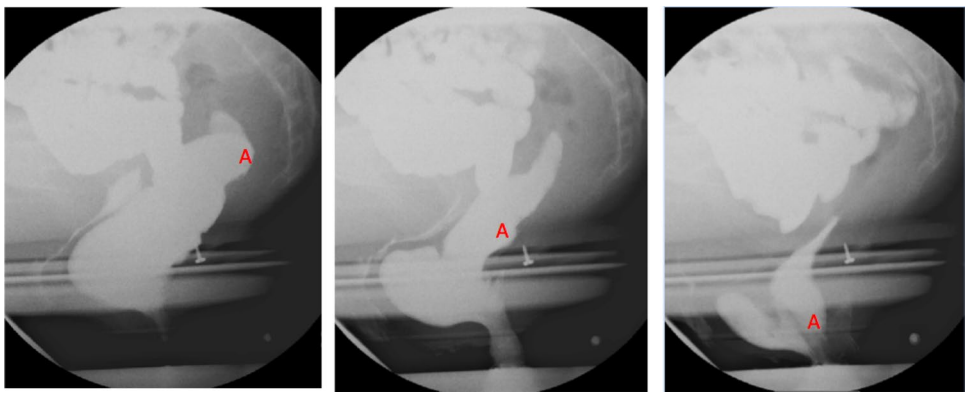

Fig. 1 Defaecating proctogram demonstrating a high take-off prolapse with the lead point (marked with 'A') originating in the upper rectum before intussuscepting and resulting in an external rectal prolapse

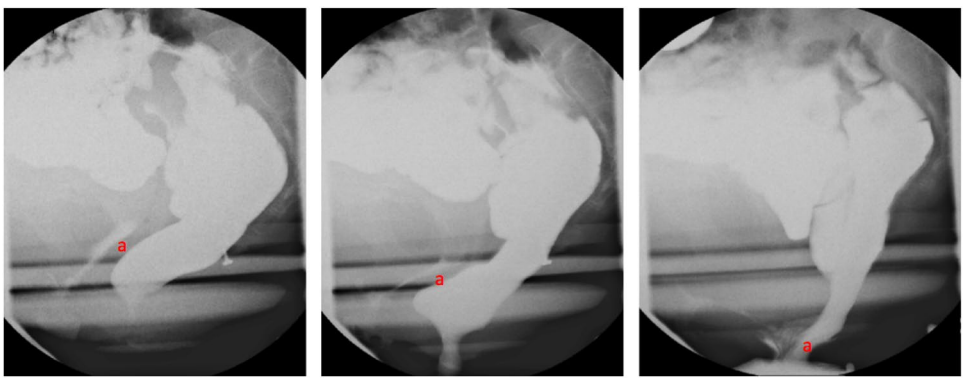

Fig. 2 This proctogram demonstrates a low take-off prolapse with the distal rectum acting as the lead point (a), resulting in a short intussusceptum and its subsequent effacement

[15]. Further study may help to define any real distinction between a small rectal intussusception and a rectal hernia in this low take-off phenotype.

We also found that DPG allowed determination of a novel and potentially valuable radiological metric of interest, that of the rectosigmoid junction (RSJ) position both at rest and on straining, relative to the bony sacral and coccygeal segments. This metric has not been described previously but it may provide insight into the integrity of the supportive pararectal connective tissues relevant to colorectal surgeons, where previous uro-gynaecological studies have relied more on MRI characterisation of the integrity of the cardinal and uterosacral ligaments [16, 17], ligaments which may be less relevant in rectal prolapse. In high take-off (compared to low) prolapse, we found significantly more caudal descent of the RSJ during straining and there was a clear trend to lower RSJ position at rest. This suggests abnormal mobility of the upper rectum, including the RSJ, and would be explained by loss or impairment of the supportive connective tissue that usually maintains the RSJ in its normal anatomical position. It is possible that the fundamental loss of support is in the connective tissue of the recto-sacral fascia [17], and anatomical and intraoperative descriptions of prolapse comment on the lack of sacral support for the posterior mesorectum, and describe the slide of the rectum and thus RSJ to lie on or just above the pelvic floor.

Combining the findings of a hypermobile RSJ in high take-off prolapse, and the lack of ageing and parity as an explanatory cause in young nulliparous women with external rectal prolapse, we therefore speculate and propose that high take-off prolapse phenotype is caused by failure of the upper rectal ligamentous supports including the recto-sacral fascia, leading to a lax and hypermobile rectum and RSJ. A genetic connective tissue abnormality may underlie high take-off prolapse phenotype.

While parity and aging have long been linked to rectal prolapse these factors cannot account for the development of prolapse in nulliparous women and men who make up to 30% of the prolapse cohort [18–20]. Therefore, defects and abnormalities in connective tissue likely play a larger role in the pathophysiology of prolapse than first thought. Indeed, there is a growing body of work exploring the association between collagen-associated disorders and rectal prolapse [21–24]. We found a higher incidence of rectocoele in the high take-off group, and rectocoeles have been described as a not uncommon occurrence in normal women, i.e. those without an obstetric history. Rectocoeles (rather than uterine prolapse and cystocoeles) have also been found to be associated with nulliparity in a large perineal ultrasound study [25].

Though the cause of low take-off prolapse is not immediately clear, it might be secondary to failure of the pelvic floor rather than failure of the other ligamentous supports. It is well established that vaginal delivery (especially forceps-assisted) is associated with an expanded levator hiatus and subsequent risk of pelvic organ prolapse (POP) [17, 26]. Furthermore failure to close a levator defect at the time of POP repair is associated with increased rates of recurrence in all compartments [27, 28]. A similar phenomenon may be occurring in rectal prolapse surgery. Failure to address the levator defect for a low take-off prolapse may account for disappointing recurrence rates.

From a surgical strategy perspective, a high take-off prolapse would not unreasonably be thought to be best managed by an abdominal approach. This would allow the surgeon to obtain support below and above the origin of the intussusception, a goal unlikely to be achieved via a perineal approach. Equally a low take-off prolapse would be more difficult to get below from an abdominal approach, if there is a low and small intussusception. Therefore, perhaps a low take-off prolapse should be best managed by a perineal approach, potentially allowing simultaneous levator reconstruction if necessary. This remains open to conjecture and might be a fruitful area for future research. Certainly, it appears that a combined prolapse-levator perineal approach can reduce recurrence in both Altemeier [29] and Delorme's procedure [30, 31].

It becomes clear that exploring these distinctions in prolapse anatomy and phenotype provides a potential explanation for the stubbornly high and poorly explained recurrence rates in both abdominal and perineal approaches. If patients are assigned to an approach without regard to the natural phenotype, it is not unreasonable to speculate that recurrence might be higher as a result.

Given the retrospective nature of the study, one limitation is the paucity of information we have on patients who did not undergo defaecography as part of their workup for rectal prolapse. It would have been useful to know how many patients did not have a DPG and the exact reason for its omission.

Nevertheless, in this first description of prolapse take-off in the literature we have identified that DPG can satisfactorily identify, discriminate between and characterise two distinct phenotypes of external rectal prolapse. On the basis of the radiological appearances, we propose both two prolapse phenotypes and therefore possibly two distinct causal pathways to external rectal prolapse. We hypothesise that high take-off prolapse and RSJ hypermobility is secondary to connective tissue failure of the upper rectal ligamentous support. The casual pathway to low-take off prolapse is less clear but might be related to lower ligamentous support or levator ani factors. DPG should become more standard in the evaluation of external rectal prolapse where feasible. This would allow take-off phenotype to be determined preoperatively and deployed as a potentially important prognostic factor when choosing a surgical approach. Future studies

are required to further characterise these two pathways in terms of causal hypothesis, selection for surgical treatment and correlation with surgical outcomes.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest No authors have financial or non-financial interests to disclose that are directly or indirectly related to the work submitted for publication. The manuscript has not been published previously, nor is it under consideration elsewhere. There are no potential conflicts of interest.

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