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REVIEW

Literature review of the role of lateral internal sphincterotomy (LIS) when combined with excisional hemorrhoidectomy

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Abstract
Background and aim Pain following hemorrhoidectomy is a distressing sequel to the procedure. Various methods have been used to alleviate post-hemorrhoidectomy pain; among these methods is the lateral internal sphincterotomy (LIS). This review aimed to analyze all studies that evaluated the impact of LIS on the outcome of excisional hemorrhoidectomy.
Patients and methods Seventeen studies were included after organized search of the literature using electronic databases including PubMed/Medline and EMBASE. The studies included comprised 2180 patients with median age of 44 years. Variables selected for the review comprised patients' characteristics, postoperative pain assessment, analgesic consumption, and complications as fecal incontinence (FI), urinary retention, and anal stenosis.
Results Overall, 933 (42.7 %) patients underwent LIS. Almost all studies assessing postoperative pain reported lower pain scores and less need for postoperative analgesia among patients who underwent LIS in comparison with patients who did not have LIS. Eleven of 13 studies that assessed continence state postoperatively reported higher rates of FI among patients who had LIS with a median rate of 7.7 % versus 1.25 % for patients who did not have LIS. Incidence of urinary retention after LIS ranged from 0 to 60 %. Anal stenosis occurred in 0–14.5 % of patients who had LIS versus 0–36.4 % in patients without LIS.
Conclusion LIS effectively reduced postoperative pain and need for analgesics following excisional hemorrhoidectomy. LIS also managed to decrease incidence of postoperative urinary retention and anal stenosis significantly. The negative aspect of adding LIS to excisional hemorrhoidectomy was developing minor FI after surgery which was temporary in duration.

Keywords Lateral internal sphincterotomy · Hemorrhoidectomy · Excisional · Review

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Introduction

Hemorrhoids are one of the most common anorectal disorders with a prevalence reaching up to 36 % of the general population [1]. Around one third of patients with hemorrhoids try medical treatments, yet only 5–10 % of them respond to conservative measures; therefore, surgical therapy is considered the treatment of choice in these patients [2].

Excisional hemorrhoidectomy, whether open (Milligan-Morgan) or closed (Ferguson) hemorrhoidectomy, is known to be the most efficient treatment for grade III/IV hemorrhoids as it attains the lowest recurrence rate. However, excisional hemorrhoidectomy has some shortcomings such as the severe postoperative pain, and the relatively high complication rate [3].

Postoperative pain is the most dreaded sequel to hemorrhoidectomy and the main concern for patients with hemorrhoids. Fear of the anticipated post-hemorrhoidectomy pain often results in delaying the decision to undergo surgery. Post-hemorrhoidectomy pain can be attributed to various reasons such as the spasm of the internal anal sphincter (IAS) after exposure of its fibers, insertion of anal pack, damage of

nerve endings, mucosal injury, and suturing at the pedicle or below the dentate line [4, 5].

Since spasm of the IAS appeared to be the main cause of anal pain after hemorrhoidectomy [6], several methods have been devised to relieve postoperative pain including the use of metronidazole [7], local anesthetics infiltration [8], chemical sphincterotomy by application of glycerol trinitrate at the wound or injection of botulinum toxin into the IAS, and surgical internal sphincterotomy [4].

The hypothesis stating that combining lateral internal sphincterotomy (LIS) with excisional hemorrhoidectomy contributes to reduction of postoperative pain remains controversial. While some authors did not report significant reduction of postoperative pain after adding LIS to hemorrhoidectomy [9], other authors have stated tangible beneficial effects of adding LIS to open hemorrhoidectomy [10–12].

We conducted a thorough review of the literature searching for the role of LIS when combined with excisional hemorrhoidectomy, and the impact of this combination on postoperative pain, analgesic consumption, continence state, and complications to determine whether LIS should be combined routinely with excisional hemorrhoidectomy, or should be better abandoned.

Methods

After an organized literature search in the period of March 1988 to March 2014, we identified all randomized controlled trials (RCT) comparing hemorrhoidectomy combined with LIS as experimental group with hemorrhoidectomy alone, or combined with other interventions as chemical sphincterotomy. We also identified non-comparative cohort studies evaluating the role of LIS when added to hemorrhoidectomy.

Electronic databases used in the search process included: PubMed/Medline, and EMBASE. A parallel internet-based search was also conducted using "Google Scholar" service. The research key words "hemorrhoid*," "Milligan-Morgan," "Excisional," "pain," "internal sphincterotomy," "lateral sphincterotomy," and "chemical sphincterotomy" were used in combination with the medical subject headings "hemorrhoidectomy," and "sphincterotomy." Relevant articles mentioned in the references section of the initial publications were obtained, and the related articles were also screened to add any relevant publications to the results.

We excluded irrelevant articles, editorials, case reports, non-randomized trials, reviews, and meta-analyses. Studies with a sample size less than 20 patients, or follow-up duration less than 2 weeks, were also excluded. Duplicate reports were identified and excluded from the review. No language restrictions were applied. Articles that did not clearly report the aim, methodology, final results, and conclusion were excluded after second thorough revision by the reviewers.

We reviewed full texts of 18 articles, 17 of them were finally included in the current review. Summary of the included studies is shown in Table 1. Design and protocol of studies included are shown in Fig. 1.

The clinical outcome variables selected for this review included demographic data and characteristics of patients, postoperative pain assessment, analgesic consumption, length of hospital stay, and postoperative complications as: fecal incontinence (FI), urinary retention, anal stenosis, and rectal bleeding.

Results

1. Comparing the effect of LIS with the effect of anal stretch when combined with Milligan-Morgan hemorrhoidectomy:

   Asfar and colleagues [12] compared anal stretch (group 1) with LIS (group 2) with regard to their efficacy in reducing post-hemorrhoidectomy pain. The study included 258 patients (133 in group 1, and 125 in group 2).

   All patients of group 1 required narcotic analgesics in the first 24 h versus 18.4 % of patients in group 2 with significant p value < 0.01. Pain associated with first motion was severe in 96.2 % of group 1 patients as compared to 6.4 % of group 2 patients, also with significant p value < 0.01.

   Regarding postoperative morbidity, 39 % of group 1 patients complained of urinary retention versus 4 % of patients in group 2. More than half (57.3 %) of group 1 patients developed FI that persisted for more than 2 months as compared to 6.4 % of patients in group 2 who complained of postoperative fecal soiling for an average duration of 4.5 weeks. Overall, complication rate in group 1 was significantly higher than in group 2.
2. Comparing the effect of LIS with the effect of chemical sphincterotomy agents when combined with Milligan-Morgan hemorrhoidectomy:

   Two studies compared the effects of LIS and chemical sphincterotomy when added to Milligan-Morgan hemorrhoidectomy. In the first study [13] which included 60 patients (38 males), Amorotti and colleagues compared three groups: group A that underwent Milligan-Morgan hemorrhoidectomy plus chemical sphincterotomy using nitroglycerine 2 %, group B that underwent Milligan-Morgan hemorrhoidectomy plus LIS, and group C that underwent Milligan-Morgan hemorrhoidectomy alone.

   The authors used a subjective scale from 0 to 10 to measure postoperative pain. Mean pain scores in group A, group B, and group C were 5.8, 4.9, and 6.5,

Table 1 Studies included in the review and their protocol

Protocol of the study	Included studies	Year of publication
Comparing hemorrhoidectomy with anal dilatation with hemorrhoidectomy with LIS	Asfar et al. [12]	1988
Comparing three groups: hemorrhoidectomy alone, hemorrhoidectomy with chemical sphincterotomy, and hemorrhoidectomy with LIS	Amorotti et al. [13]	2003
Comparing hemorrhoidectomy with chemical sphincterotomy (topical diltiazem 2 %) with hemorrhoidectomy combined with LIS	Chauhan A et al. [14]	2007
Evaluating post-hemorrhoidectomy pain in patients who underwent hemorrhoidectomy with LIS	Mukadam P and Masu S [15]	2014
Comparing hemorrhoidectomy with LIS with hemorrhoidectomy alone (divided into two groups; first group treated by diosmin 500 mg and second treated by paracetamol 1000 mg)	De Lucaa et al. [16]	2012
	Mathai V et al. [17]	1996
	Galizia G et al. [10]	2000
	Khubchandani IT [9]	2002
	Taha S [18]	2003
	Kanellos et al. [19]	2005
	Hosseini et al. [20]	2007
	Junior et al. [21]	2007
	Diana et al. [22]	2009
	Abedidost et al. [23]	2011
	Das et al. [24]	2013
	Raza et al. [25]	2013
	Lu et al. [26]	2013

respectively. Overall, 10 patients had urinary retention, two had anal stenosis, both were from group C, and none of the patients in the study developed postoperative FI.

In the second study [14], Chauhan et al. divided 108 patients with grade III/IV hemorrhoids into two equal groups: group A that underwent Milligan-Morgan hemorrhoidectomy plus sphincterotomy with the use of a placebo cream, and group B that underwent hemorrhoidectomy plus topical application of diltiazem 2 % cream. Within the first 24 h postoperatively, the mean visual analogue scale (VAS) was comparable in both groups (6.69 versus 6.96) with non-significant p value of 0.11. Difference in mean VAS scores among the two groups remained non-significant up to the third postoperative day, afterwards VAS scores were significantly lower in group A. The mean number of analgesic tablets required by group A (10.54 + 1.15) was significantly lower than group B (15.40+ 1.73). Group A attained higher rate

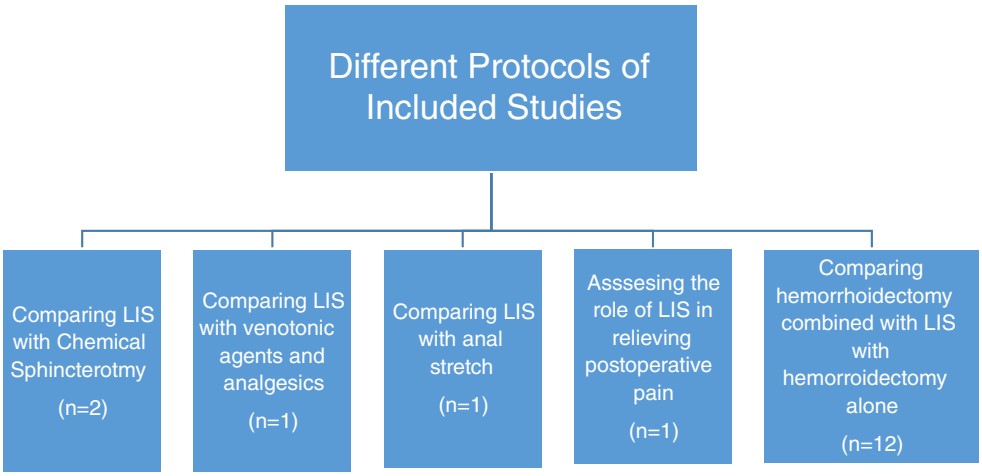

Fig. 1 Different protocols of the studies included

of postoperative complications than group B (11.5 versus 3 %); however, this difference was non-significant ($p = 0.48$). Flatus incontinence was noted in 5.7 % of group A patients, while none of group B patients complained of FI.

3. Evaluation of LIS as pain relieving method after open hemorrhoidectomy

   Mukadam P and Masu S [15] conducted an observational study on 20 patients with second or third degree hemorrhoids. The authors performed subcutaneous LIS at the left-sided raw area remaining after open hemorrhoidectomy.

   Injectable analgesics (diclofenac sodium 75 mg) were given at the first postoperative day followed by oral analgesics in the following days. Mean VAS at 24 h postoperatively was 4.4. Day-wise observation of postoperative pain revealed that in the first postoperative day all patients complained of pain which was described as severe by two (10 %) patients. Then, in the third postoperative day, 85 % of patients had mild to moderate pain whereas the remaining 15 % were free of pain. Finally, on the fifth postoperative day, half of patients were pain-free, and the other half had mild to moderate pain which was relieved by routine Sitz baths.

   Only one (5 %) patient developed urinary retention postoperatively, no significant postoperative hemorrhage was recorded. This study, as acknowledged by its authors, was limited by being extremely subjective, assessing the comfort level of patients with questionnaire. Also, no assessment of postoperative continence was done to judge the safety of LIS in this concern.

4. Comparing the effect of LIS with the effect of venotonic agents and paracetamol when combined with Milligan-Morgan hemorrhoidectomy:

   De Lucaa and colleagues [16] studied 90 patients who underwent Milligan-Morgan hemorrhoidectomy for grade III/VI hemorrhoids. Patients were subdivided into three groups, each comprised 30 patients. Group A included patients who underwent LIS, group B included patients treated with diosmin 500 mg capsules 4/day, and group C included patients treated with paracetamol 1000 mg when needed. Postoperative pain was evaluated using VAS ranging from 0 to 10.

   Mean VAS in the first 24 h after surgery were 3.66, 4.33, and 4.76 in group A, group B, and group C, respectively. Day-wise comparison of mean VAS scores showed superiority of group A in reducing postoperative pain as compared with the other two groups at the first, third, and ninth postoperative days. On the other hand, comparing group B with group C did not reveal any significant differences in terms of relief of postoperative pain.

   The authors concluded that the addition of LIS to hemorrhoidectomy is the only effective method that achieves satisfactory results in terms of reduction of VAS scores. However, the authors did not report the impact of LIS on continence state, or other potential complications as urinary retention or anal stenosis which is considered a limitation of their study.

5. Comparing hemorrhoidectomy combined with LIS with hemorrhoidectomy alone

   Twelve studies [9, 10, 16–26] compared Milligan-Morgan hemorrhoidectomy combined with LIS with Milligan-Morgan hemorrhoidectomy alone for patients with grade III/IV hemorrhoids. Only one study [9] assessed the effect of LIS when added to closed hemorrhoidectomy. LIS was performed in all studies on the left side of the wound. The demographic data and study parameters along with the results are listed in Tables 2, 3, and 4.

Analysis of results

Characteristics of patients and studies

Studies included in this review comprised a total of 2180 (1214 males, 966 females) patients with median age of 44 (range, 33–53) years. All patients had grade III/IV hemorrhoids; patients with thrombosed or infected hemorrhoids, or other anal pathology as anal fissure or fistula, were excluded from the studies.

All studies were randomized with different methods of randomization (Table 2), and all of them were comparative trials except one study [15] which aimed to evaluate the role of LIS individually when added to hemorrhoidectomy.

Surgical technique

All patients underwent Milligan-Morgan (open) hemorrhoidectomy except in one study [9] in which closed hemorrhoidectomy was used. Procedures were performed under spinal [9, 10, 15, 18, 21, 26], general [17, 19, 22–24], or local anesthesia [20]. Left LIS was done in 933 (42.7 %) patients with an average length of 0.8–1 cm.

Postoperative pain

Methods of assessment of postoperative pain within the first 24 h after surgery varied in the studies included (Figs. 2 and 3).

Fourteen studies used different pain scales, three of which used pain score of 0–3, seven used pain score of 0–10, and four studies used pain score of 0–100 (Fig. 2). Almost all the studies reported lower pain scores after addition of LIS, yet only seven studies [10, 13, 16, 22, 24–26] observed significant ($p < 0.05$) reduction of mean pain scores in patients who

Table 2 Demographic data and study parameters of 12 randomized controlled studies

Study	Study period	Randomization method	Total no/ patients with LIS	Mean age (years)	Male to female ratio	Type of analgesia	Pain assessment scale	Follow-up duration
Mathai V et al. [17]	March to Nov 1994	Sealed envelope	33/17	40	1.2:1	Oral ketoprofen/I.M pethidine	Linear analogue scale (0–100)	11 months
Galizia G et al. [10]	Sep 1995 to Dec 1996	Sealed envelope	42/22	30–50	Not mentioned	Oral nimesluide/I.M diclofenac	VAS	2 months
Khubchandani [9]	Dec 1999 to Sept 2001	Not mentioned	42/21	52	1.1:1	Oxycodone/acetaminophen	Pain assessment sheet	1 month
Taha S [18]	June 1998 to June 2001	Odd/even day numbers	200/100	–	4:1	I.M diclofenac sodium/I.M pethidine	Subjective, according to analgesic dose	1 month
Kanellos et al. [19]	1998–2003	Table of random numbers	78/39	50.9	1:1	Paracetamol plus codeine	Subjective, pain score (0–3)	1 month
Hosseini et al. [20]	Sept 2003 to Aug 2004	Blind person (nurse)	120/60	43.9	1.1	Not mentioned	VAS	2 weeks
Junior et al. [21]	May 2001 to June 2002	Surgeon preference	20/10	33.9	1:3	Diclofenac sodium, dipyrone and meperidine	Analgesic need and VAS	1.5 months
Diana et al. [22]	Jan 1980 to May 2007	Time-wise (before and after year 1995)	699/220	53	1.7:1	Ketorolac	VAS	6 months
Abedidost et al. [23]	2007–2008	Sample randomization	60/30	11–70	1.7:1	Not mentioned	VAS	2 weeks
Das et al. [24]	2011–2013	Chronological numbers of hospital admission	50/25	37	3.1:1	I.M tramadol HCL	Analgesic need	3 months
Raza et al. [25]	Nov 2006 to May 2011	Randomized sampling techniques	108/54	43	1.7:1	Not mentioned	VAS	1 month
Lu et al. [26]	Aug 2010 to Nov 2012	Not mentioned	192/96	48.5	1.04:1	Not mentioned	Pain score (0–3)	1 month

LIS lateral internal sphincterotomy, *VAS* visual analogue scale, *I.M* intramuscular

Table 3 Assessment of postoperative pain within 24 h in 12 RCTs

Study	Mean pain score in the hemorrhoidectomy group Score (total score)	Mean pain score in the hemorrhoidectomy + LIS group Score (total score)	*P*	Analgesic need in the hemorrhoidectomy group (no/total)	Analgesic need in the hemorrhoidectomy + LIS group (no/total)	*P*
Mathai V et al. [17]	30 (0–100)	20 (0–100)	0.3	1 /16 (6.25 %)	0/17 (0)	0.48
Galizia G et al. [10]	65 (0–100)	30 (0–100)	0.01	18/20 (90 %)	8/14 (57 %)	0.0004
Khubchandani [9]	29.4 (0–100)	26.6 (0–100)	0.290	Not mentioned	Not mentioned	–
Taha S [18]	25.1 (0–100)	23.5 (0–100)	0.12	21/100 (21 %)	3/100 (3 %))	0.0001
Kanellos et al. [19]	0.48 (0–3)	0.53 (0–3)	0.83	39/39 (100 %)	36/39 (92.3 %)	0.065
Hosseini et al. [20]	Not mentioned	Not mentioned	–	Not mentioned	Not mentioned	–
Junior et al. [21]	Not applicable	Not applicable	–	8/10 (80 %)	7/10 (70 %)	1
Diana et al. [22]	4.44 (0–10)	3.52 (0–10)	<0.0001	Not mentioned	Not mentioned	–
Abedidost et al. [23]	6.33 (0–10)	6 (0–10)	0.56	Not mentioned	Not mentioned	–
Das et al. [24]	2.32 (0–3)	1.6 (0–3)	<0.01	Not mentioned	Not mentioned	–
Raza et al. [25]	9.7 (0–10)	2.85 (0–10)	<0.0001	Not mentioned	Not mentioned	–
Lu et al. [26]	2.16 (0–3)	1.54 (0–3)	0.014	74/96 (77 %)	40/96 (41.6 %)	0.0001

LIS lateral internal sphincterotomy, *RCTs* randomized controlled trails

underwent LIS as compared with patients who did not have LIS.

Seven studies used percentage of patients requiring postoperative analgesia for assessment of pain (Table 3). All studies reported lower analgesic consumption after performing LIS with hemorrhoidectomy. However, only four studies [10, 12, 18, 26] found the percentage of patients who required analgesia after LIS to be significantly ($p < 0.05$) lower than the percentage of patients who did not undergo LIS. A median of 41.6 % (range, 0–92.3 %) of patients who underwent LIS required analgesia within the first 24 h, versus 80 % (range, 6.25–100 %) of patients who did not have LIS.

Both studies that compared chemical and surgical sphincterotomy [13, 14] concluded superiority of the surgical method in terms of pain relief after hemorrhoidectomy. This superiority is logical since chemical agents as glycerol trinitrate (GTN) 0.2 % lower the resting anal pressure by 20–30 % as compared to 26–58 % after surgical sphincterotomy [27]. It is also worthy to note that the effect of chemical agents proved to be only temporary and reversible.

Fecal incontinence

Eleven of 13 studies that assessed continence state after surgery reported higher incidences of FI after addition of LIS to hemorrhoidectomy. Nonetheless, no significant differences regarding postoperative FI between patients who had LIS and patients who did not were obtained (Table 4).

The median rate of patients who developed FI after hemorrhoidectomy with LIS was 7.7 % ranging from 0 to

Table 4 Postoperative complications of 12 randomized controlled studies

Study	FI in the hemorrhoidectomy group (no/total)	FI in the hemorrhoidectomy + LIS group (no/total)	*P*	Urine retention in the hemorrhoidectomy group (no/total)	Urine retention in the hemorrhoidectomy + LIS group (no/total)	*P*
Mathai V et al. [17]	0/16 (0)	2/17 (11.7 %)	0.48	0	0	–
Galizia G et al. [10]	0/20 (0)	1/21 (4.7 %)	1	10/22 (45 %)	2/20 (10 %)	0.006
Khubchandani [9]	4/18 (22.2 %)	11/21 (52.3 %)	0.156	Not assessed	Not assessed	–
Taha S [18]	Not assessed	Not assessed	–	14/100 (14 %)	2/100 (2 %)	<0.01
Kanellos et al. [19]	2/39 (5.1 %)	3/39 (7.7 %)	1	4/39 (10.2 %)	3/39 (7.7 %)	1
Hosseini et al. [20]	1/60 (1.6 %)	5/60 (8.3 %)	0.2	37/60 (61.6 %)	36/60 (60 %)	0.85
Junior et al. [21]	2/10 (20 %)	6/10 (60 %)	0.169	2/10 (20 %)	2/10 (20 %)	1
Diana et al. [22]	6/479 (1.25 %)	3/220 (1.3 %)	1	44/479 (0.1 %)	7/220 (3.1 %)	0.004
Abedidost et al. [23]	2/30 (6.6 %)	7/30 (23.3 %)	0.14	2/30 (6.6 %)	3/30 (10 %)	1
Das et al. [24]	0/25 (0)	3/25 (12 %)	0.234	1/25 (4 %)	8/25 (32 %)	<0.01
Raza et al. [25]	0/54 (0)	2/54 (3.7 %)	0.49	Not assessed	Not assessed	–
Lu et al. [26]	Not assessed	Not assessed	–	Not assessed	Not assessed	–

LIS lateral internal sphincterotomy, *FI* fecal incontinence

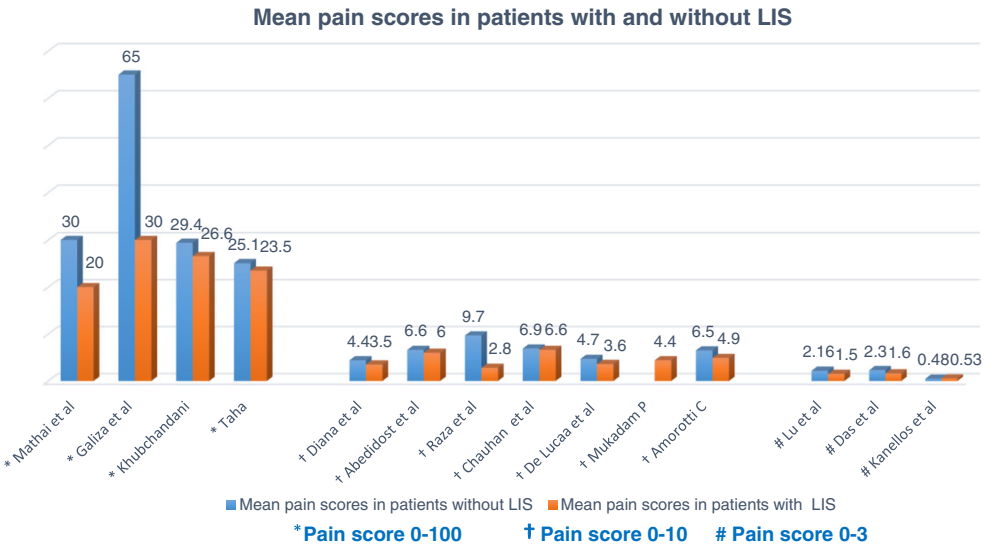

Fig. 2 Mean pain scores in patients with and without LIS

60 %, whereas the median rate of FI after hemorrhoidectomy without LIS was 1.25 % ranging from 0 to 57.3 %.

The highest incidence (57.3 %) of FI observed in the group that did not undergo LIS was reported by one study [12] that compared anal dilation with LIS. Anal stretch caused FI in more than half of the patients concordant with what Nielsen and colleagues [28] reported that sphincter injury occurs in more than 65 % of patients undergoing anal dilatation. On the other hand, LIS caused minor soiling in less than 10 % of patients. The results of this particular study render LIS more effective than anal stretch with regard to pain relief, and safer regarding continence state after surgery.

According to the studies included, FI that complicated LIS was of minor degree, ranging from flatus incontinence to fecal soiling, and temporary with minimum reported duration of 1 week and maximum of 1 year (Table 5).

Urinary retention

Nine studies assessed retention of urine after hemorrhoidectomy. Five of these studies [10, 12, 18–20] reported lower incidence of urinary retention in patients who underwent LIS, three [22–24] reported lower incidence of retention in patients who did not have LIS, whereas one study [21] reported equal rates of urinary retention in both groups (Table 4). The median rate of patients who developed urinary retention after adding LIS to hemorrhoidectomy was 7.7 % ranging from 0 to 60 %, whereas the median rate of retention after hemorrhoidectomy alone was 12 % ranging from 0 to 61.6 %.

Anal stenosis

Seven studies evaluated anal stenosis postoperatively. For patients who underwent hemorrhoidectomy combined with LIS,

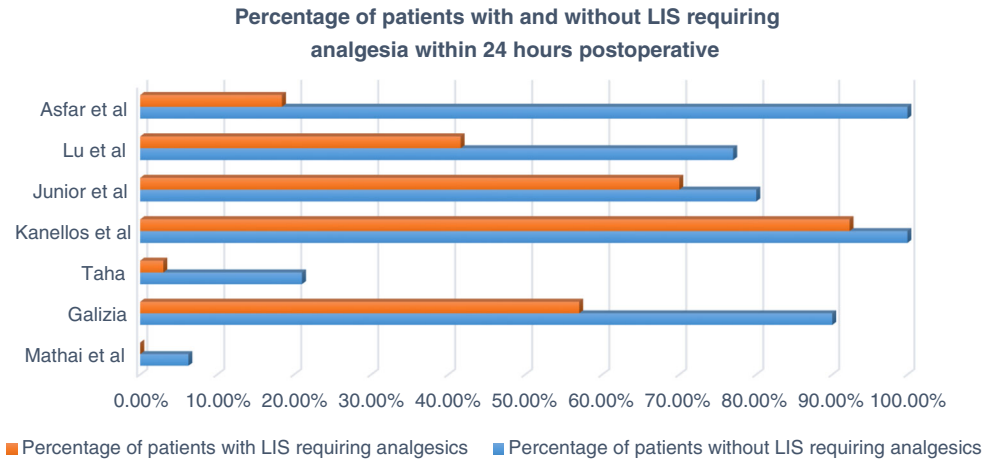

Fig. 3 Percentage of patients with and without LIS requiring analgesia within the first 24 h

Table 5 Degree and duration of FI in the studies evaluating FI after LIS

Study	Patients with FI/ total number	Degree of FI	Duration of FI
Mathai et al. [17]	2/17	Liquid stool	3 months–1 year
Junior et al. [21]	6/10	Gas and liquid stool	Average 6 months
Khubchandani [9]	11/21	Gas and liquid stool	Not mentioned
Hosseini et al. [20]	5/60	Gas and liquid stool	2–4 weeks
Galizia et al. [10]	1/21	Liquid and hard stool	3 months
Diana et al. [22]	3/220	Liquid stool	1–6 months
Das et al. [24]	3/25	Gas and liquid stool	1–2 weeks
Kanellos et al. [19]	3/39	Gas	Not mentioned
Abedidost et al. [23]	7/30	Gas and liquid stool	Not mentioned
Asfar et al. [12]	8/125	Liquid stool	Average 4.5 weeks
Raza et al. [25]	2/54	Gas	Not mentioned

LIS lateral internal sphincterotomy, *FI* fecal incontinence

only two studies [22, 26] reported anal stenosis in 0.45 and 14.5 % of patients. As for patients who underwent hemorrhoidectomy without LIS, five studies reported anal stenosis in 0.41–36.4 % of patients while two studies [17, 21] did not report postoperative anal stenosis.

Bleeding

Ten studies evaluated postoperative hemorrhage. For patients who underwent hemorrhoidectomy combined with LIS, six studies did not report the incidence of post-hemorrhoidectomy bleeding, and four studies [14, 19, 20, 22] reported significant bleeding in 0.9–55 % of patients. As for patients who underwent hemorrhoidectomy alone, only three studies [19, 20, 22] reported significant bleeding in 0.8–56.6 % of patients.

Anorectal manonmetry

Four studies investigated changes in anal pressures after LIS when added to excisional hemorrhoidectomy. Galizia et al. [10] stated that both resting and squeeze anal pressures remained unchanged in patients who did not have LIS. On the other hand, significant reduction in both resting and squeeze pressures by about 40 % was noted after LIS.

Mathai et al. [15] reported that the mean resting pressure (MRP) and maximum squeeze pressure decreased after adding LIS to hemorrhoidectomy, yet this reduction was not statistically significant.

Hosseini and colleagues [20] reported significant reduction of MRP in patients who underwent LIS. MRP in high pressure zone declined from 67.44 ± 24, 49.55 ± 22, and 22.55 ± 16 mmHg respectively to 46 ± 18, 21.77 ± 9 and 14 ± 6 mmHg after LIS. In patients who did not undergo LIS, pressures decreased slightly after hemorrhoidectomy. The authors also found that the mean squeeze pressure did not show any significant changes in both groups after surgery.

Junior and colleagues [21] noticed a significant difference between preoperative and postoperative anal pressures in patients undergoing hemorrhoidectomy combined with LIS. The authors classified patients who underwent hemorrhoidectomy with LIS as continent and incontinent based on fecal continence questionnaire conducted at 45 days postoperatively. Preoperative manometry results of continent and incontinent patients did not show any significant differences; therefore, it was difficult to determine patients with sphincter hypertonia, who would benefit from LIS, before surgery.

By comparing preoperative with postoperative anal pressures in both continent and incontinent patients, it was observed that incontinent patients with no social limitation had a statistically significant decrease in resting anal pressure after LIS. Interestingly, incontinent patients with social limitation showed a slight decrease in resting anal pressure after LIS. Shortening of high pressure zone was observed in symptomatic patients only; this implies the important role of the anatomic deformity caused by LIS in the onset of symptoms of FI.

Hospital stay

Five studies reported hospital stay after hemorrhoidectomy. The median duration of hospital stay was 1.5 (range, 1.3–3.2) days for patients who underwent LIS versus 2.3 (range, 1.3–5.2) days for patients who did not have LIS.

Follow-Up

Patients in the studies included were followed for a median duration of 1 month ranging from 2 weeks to 11 months.

Discussion

According to Johanson and Sonnenberg [29], ten million people in the USA complain of hemorrhoids and approximately one third of them have sought medical advice. Various treatment modalities were devised for management of hemorrhoids. These modalities include medical therapy with venotonics and bulking agents; outpatient procedures as injection sclerotherapy, electrocoagulation, cryotherapy, and rubber band ligation; and surgical treatment. Hemorrhoidectomy is indicated in severely prolapsed hemorrhoids, failure to improve after multiple trials of non-operative treatments, and hemorrhoids complicated by ulceration, fissure, fistula, large hypertrophied anal papilla, or extensive skin tags [30].

We reviewed 17 published trials reporting the effect of LIS when combined with excisional hemorrhoidectomy. The studies included were analyzed individually and collectively to reach a primary end point which is the impact of LIS on postoperative pain. Secondary end points comprised postoperative morbidities and hospital stay.

The most concerning issues encountered after hemorrhoidectomy are marked pain, retention of urine, bleeding, and anal stenosis. The most fearsome consequence of hemorrhoidectomy is postoperative pain which makes lots of patients opt to postpone surgical treatment. Spasm of the IAS was identified as the main cause of post-hemorrhoidectomy pain [31, 32]. The resultant anal wound after surgery exposes the IAS fibers and induces a reflex spasm of both IAS and the external anal sphincter. IAS spasm is usually temporary, yet a sustained spasm may lead to a vicious circle of increased anal pain and painful defecation ending eventually with an anal fissure [33].

Several methods were attempted to abolish the post-hemorrhoidectomy IAS spasm. Some investigators applied chemical agents as glycerol trinitrate (GTN) 0.2 % [34, 35], calcium channel blockers [36, 37], botulinum toxin [38], and trimebutine [39]. Other authors used surgical sphincterotomy [15] or anal dilatation [12]. The current review found LIS to be more effective and long lasting than chemical sphincterotomy, and more effective and safer than anal dilatation. Also, comparing hemorrhoidectomy with or without LIS highlights the value of LIS in reducing postoperative pain, patients' need for analgesia, incidence of urinary retention, and anal stenosis.

FI is a known complication after LIS, nonetheless the degree of incontinence is usually mild and temporary; however, it is still considered a morbidity and a cause of patients' distress and embarrassment. Incontinence is explained by the fact that LIS causes significant reduction in resting anal pressure which is mostly generated by IAS. Although IAS tone gradually increases within 1 year after surgery, resting anal pressure remains significantly lower than its baseline value before surgery [40].

Casillas and colleagues [41] reported temporary FI in 31 % of patients and persistent flatus incontinence in 30 % of patients who underwent LIS for chronic anal fissure. A meta-analysis [42] of 22 studies evaluating LIS in patients with chronic anal fissure reported flatus incontinence in 9 %, soiling in 6 %, incontinence to liquid stool in 0.6 %, and incontinence to solid stool in 0.8 % of patients. The median rate of FI in the present review (7.7 %) falls within the range of 6–9 % reported by the meta-analysis aforementioned.

Extent of internal sphincterotomy appears to influence the incidence of postoperative FI. A randomized controlled trial reported temporary FI in 10.8 % of patients who underwent traditional LIS up to dentate line versus 2.1 % of patients who had conservative LIS [43]. Moreover, Tjandra and colleagues [44] suggested that FI after a satisfactorily performed LIS is often associated with coexisting occult external or internal sphincter defects.

The current review revealed that 85 % of the studies included reported higher rates of FI after LIS compared to other comparators except anal dilatation. Median rate of FI after LIS is almost sevenfolds that in patients who did not have LIS. However, the degree of FI was mild, ranging from gas incontinence to minor soiling, lasting for few weeks with exception to one study in which FI lasted up to 1 year in a single patient.

Physiologic tests, as anorectal manometry, play an important role in evaluating patients after LIS. While three of four studies reported significant decrease in resting anal pressure after LIS, no significant changes were noted in mean squeeze pressure. Estimation of preoperative resting pressure would help determine patients with sphincter hypertonia who are likely to gain benefit from LIS. Since FI is usually associated with resting anal pressure <40 mmHg [20], anorectal manometry also helps detecting patients with diminished resting anal pressures who are more prone to developing FI after LIS. Although resting anal pressures normally decrease after LIS, only some patients develop symptomatic FI. According to one study in this review, patients who develop symptomatic FI show shortening of the high-pressure zone of the anal canal.

Retention of urine is a common squeal to hemorrhoidectomy with an average incidence of 15.2 %. It is usually attributed to the dysfunction of the detrusor muscle in response to pain, or to the distention of the anal canal or perineum [45]. Most of the studies in this review stated that LIS reduced the incidence of urinary retention after hemorrhoidectomy which makes sense as LIS significantly reduced the degree of postoperative pain that is the main contributing factor to retention as aforementioned. An added benefit of LIS, being able to decrease rates of retention after hemorrhoidectomy, that it could reduce the need for catheterization in the early postoperative period, hence reducing the incidence of catheter-related complications as urinary tract infection.

Anal stenosis is an uncommon, yet serious disabling complication of hemorrhoidectomy. Ninety percent of anal

stenosis is caused by excision of large areas of anoderm and rectal mucosa without sparing of adequate muco-cutaneous junctions in between, leading to scarring and progressive stenosis [46]. The majority of the studies reported no anal stenosis after LIS, conversely anal stenosis was frequently observed in patients who did not undergo LIS. It appears that LIS may have a preventive role against anal stenosis by minimizing the scarring and narrowing that occur after open hemorrhoidectomy. Since partial LIS is already considered an adequate management for patients with mild degree of anal stenosis, the prophylactic role of LIS against anal stenosis can be justified.

Bleeding after hemorrhoidectomy is common in the early postoperative period, mostly slight in amount and temporary after defecation. Patients who had LIS and patients who did not undergo LIS exhibited similar rates of significant postoperative bleeding. In light of this finding, we can conclude that LIS has no positive or negative effects on the incidence of post-hemorrhoidectomy bleeding.

Although hemorrhoidectomy is considered an ambulatory procedure [47], with patients usually being discharged in the same operative day, the present review reported long hospital stay ranging from 1 to 5 days. The reason of this prolonged hospitalization is probably attributed to the in-patient follow-up as the studies kept patients under observation for a longer time to carefully assess pain and analgesics requirements. It was notable that patients who underwent LIS stayed in hospital for shorter periods which can be explained that they had less postoperative pain and less analgesic requirement; therefore, they were discharged home earlier than patients who did not have LIS.

Limitations

An obvious limitation of the present review was the heterogeneity of the studies included and the usage of various pain assessment scales. Lack of important parameters in some studies such as evaluation of continence state, urinary retention, anal stenosis, and hospital stay length was another limitation that did not allow us to calculate the overall results of all studies. However, we overcame this obstacle by analyzing each parameter individually among the studies evaluating it and excluding studies that did not assess it. We summarized the results in the form of median and range as pooling of data was not appropriate owing to the heterogeneous nature of the studies.

Recommendations

Although LIS is considered a useful tool in decreasing post-hemorrhoidectomy pain, urinary retention, and anal stenosis, FI that may complicate LIS needs to be addressed properly. Factors that increase liability of FI after LIS can be summarized as: (1) traditional LIS up to dentate line, (2) presence of occult sphincter defect, (3) diminished preoperative resting anal pressure, and (4) shortening of high-pressure zone of the anal canal.

Hosseini and colleagues recommended performing LIS not as a routine procedure for patients with hemorrhoids, but only in patients with recurrent hemorrhoids, severe pain, prolonged constipation, and sphincter hypertonia.

Based on published literature, we advocate using conservative or limited sphincterotomy instead of the traditional one as it is deemed safer and more practical. We also recommend performing endorectal ultrasonography before adding LIS to excisional hemorrhoidectomy, especially in patients with history of previous anorectal operations, to exclude any occult sphincter defects which contribute to the development of postoperative FI. Measuring anal pressures before surgery by anorectal manometry would help excluding patients with sphincter hypotonia who are more likely to develop FI after LIS.

It is mandatory to have further studies evaluating continence state after combining LIS with hemorrhoidectomy in different cohorts of patients (e.g., males versus females, young age versus elderly, mild degree versus severe degree of hemorrhoids) as we believe that performing LIS with hemorrhoidectomy should be tailored to each patient according to pain threshold and tolerance, risk of FI, and severity of hemorrhoidal disease.

Conclusion

Lateral internal sphincterotomy effectively reduces postoperative pain and the need for analgesics following excisional hemorrhoidectomy. LIS also manages to decrease incidence of postoperative urinary retention and anal stenosis significantly. The negative aspect of adding LIS to excisional hemorrhoidectomy is developing fecal incontinence after surgery, which is usually minor in degree, temporary in duration, and can be avoided by proper selection of patients.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Loder PB, Kamm MA, Nicholls RJ, Phillips RK (1994) Haemorrhoids: pathology, pathophysiology and aetiology. Br J Surg 81:946–954
2. Arroyo A, Pérez F, Miranda E, Serrano P, Candela F, Lacueva J, Hernández H, Calpena R (2004) Open versus closed day-case hemorrhoidectomy: is there any difference? Results of a prospective randomised study. Int J Colorectal Dis 19:370–373
3. MacRae HM, McLeod RS (1995) Comparison of hemorrhoidal treatment modalities. A meta-analysis. Dis Colon Rectum 38: 687–694

4. Rahimi R, Abdollahi M (2012) A systematic review of the topical drugs for post- hemorrhoidectomy pain. Int J Pharmacol 8:628–637
5. Lohsiriwat D, Lohsiriwat V (2005) Outpatient hemorrhoidectomy under perianal anesthetics infiltration. J Med Assoc Thai 88:1821–1824
6. Wasvary HJ, Hain J, Mosed-Vogel M et al (2001) Randomized, prospective, double-blind, placebo-controlled trial of effect of nitroglycerin ointment on pain after hemorrhoidectomy. Dis Colon Rectum 44:1069–1073
7. Balfour L, Stoijkovic SG, Botterill ID et al (2002) A randomized, double blind trial of the effect of metronidazole on pain after closed hemorrhoidectomy. Dis Colon Rectum 45:1186–1190
8. Vinson-Bonnet B, Coltat JC, Fingerhut A et al (2002) Local infiltration with ropivacaine improves immediate postoperative pain control after hemorrhoidal surgery. Dis Colon Rectum 45:104–108
9. Khubchandani IT (2002) Internal sphincterotomy with hemorrhoidectomy does not relieve pain: a prospective, randomized study. Dis Colon Rectum 45:1452–1457
10. Galizia G, Lieto E, Castellano P et al (2000) Lateral internal sphincterotomy together with haemorrhoidectomy for treatment of haemorrhoids: a randomized prospective study. Eur J Surg 166: 223–228
11. Di Bella F, Estenne G (1990) Indications for internal, medioposterior with anoplasty or lateral sphincterotomy during hemorrhoidectomy: our experience. Minerva Chir 45:361–363
12. Asfar SK, Juma TH, Ala-Edeen T (1988) Hemorrhoidectomy and sphincterotomy. A prospective study comparing the effectiveness of anal stretch and sphincterotomy in reducing pain after hemorrhoidectomy. Dis Colon Rectum 31:181–185
13. Amorotti C, Mosca D, Trenti C, Pintaudi U (2003) Usefulness of lateral internal sphincterotomy combined with hemorrhoidectomy by the Milligan-Morgan's technique: results of a prospective randomized trial. Chir Ital 55(6):879–86
14. Chauhan A, Tiwari S, Mishra VK, Bhatia PK (2009) Comparison of internal sphincterotomy with topical diltiazem for post-hemorrhoidectomy pain relief, a prospective randomized trial. J Postgrad Med 55(1):22–6
15. Mukadam P, Masu S (2014) Internal sphincterotomy as a postoperative pain relieving method in patients operated for open hemorrhoidectomy. J Res Med Den Sci 2(1):55–58
16. De Lucaa S, Tomaselloa G, Damianoa, Palumboa V, Spinellia G, Giovialea M, Accardoc F et al (2012) The management of postoperative pain after hemorrhoidectomy: analysis of three methodics. Acta Med Mediterr 28:301
17. Mathai V, Ong BC, Ho YH (1996) Randomized controlled trial of lateral internal sphincterotomy with haemorrhoidectomy. Br J Surg 83(3):380–2
18. Taha S (2013) Routine internal sphincterotomy with hemorrhoidectomy for third and fourth degree hemorrhoids greatly improves the outcome. IJGE 1(4)
19. Kanellos I, Zacharakis E, Christoforidis E, Angelopoulos S, Kanellos D, Pramateftakis MG, Betsis D (2005) Usefulness of lateral internal sphincterotomy in reducing postoperative pain after open hemorrhoidectomy. World J Surg 29(4):464–8
20. Hosseini SV, Sharifi K, Ahmadfard A, Mosallaei M, Pourahmad S, Bolandparvaz S (2007) Role of internal sphincterotomy in the treatment of hemorrhoids: a randomized clinical trial. Arch Iran Med 10(4):504–8
21. Junior HM, Moreira J, Moreira H, Iguma C, Almeida A, de Magalhães C (2007) Open hemorrhoidectomy with associated lateral internal sphincterotomy for treatment of hemorrhoids: advantage or disadvantage? Rev Bras Colo Proctol 27(3):293–303
22. Diana G, Guercio G, Cudia B, Ricotta C (2009) Internal sphincterotomy reduces postoperative pain after Milligan Morgan hemorrhoidectomy. BMC Surg 9:16
23. Abedidost S, Poya M, Shafe SM (2011) The effect of internal sphincterotomy on post hemorrhoidectomy pain. Arak Med Univ J 14(56):58–63
24. Das DK, Choudhury UC, Lim ZS (2013) Effectiveness of internal sphincterotomy in reducing post open hemorrhoidectomy pain: a randomized comparative clinical study. Int J Collab Res Intern Med Public Health 5(6):428
25. Raza M, Khan A, Kamran R, Waqas K, Yusuf A (2013) Hemorrhoidectomy with and without lateral internal sphinterotomy. J Rawalpindi Med Coll 17(2):189–191
26. Lu M, Shi GY, Wang GQ, Wu Y, Liu Y, Wen H (2013) Milligan-Morgan hemorrhoidectomy with anal cushion suspension and partial internal sphincter resection for circumferential mixed hemorrhoids. World J Gastroenterol 19(30):5011–5015
27. McNamara MJ, Percy JP, Fielding IR (1990) A manometric study of anal fissure treated by subcutaneous lateral internal sphincterotomy. Ann Surg 211(2):235–8
28. Nielsen MB, Rasmussen OO, Pedersen JF et al (1993) Risk of sphincter damage and anal incontinence after anal dilatation for fissure-in-ano. An endosonographic study. Dis Colon Rectum 36: 677–680
29. Johanson JF, Sonnenberg A (1990) Prevalence of hemorrhoids and chronic constipation. An epidemiologic study. Gastroenterology 98:380–386
30. Nivatvongs S (2007) Hemorrhoids. In: Gordon P, Nivatvongs S (eds) Principles and practice of surgery for the colon, rectum, and anus. Informa Healthcare, New York, p 150
31. Ho YH, Tan M (1997) Ambulatory anorectal manometric findings in patients before and after haemorrhoidectom. Int J Colorectal Dis 12:296–297
32. Coskun A, Duzgun SA, Uzunkoy A, Bozer M, Aslan O, Canbeyli B (2001) Nitroderm TTS band application for pain after hemorrhoidectomy. Dis Colon Rectum 44(5):680–5
33. Eisenhammer S (1969) Proper principles and practices in the surgical management of hemorrhoids. Dis Colon Rectum 12(4):288–305
34. Elton C, Sen P, Montgomery AC (2001) Initial study to assess the effects of topical glyceryl trinitrate for pain after haemorrhoidectomy. Int J Surg Investig 2:353–357
35. Hwang DY, Yoon SG, Kim HS, Lee JK, Kim KY (2003) Effect of 0.2 percent glyceryl trinitrate ointment on wound healing after a hemorrhoidectomy: results of a randomized, prospective, doubleblind, placebo-controlled trial. Dis Colon Rectum 46:950–954
36. Amoli HA, Notash AY, Shahandashti FJ, Kenari AY, Ashraf H (2009) A randomized, prospective, double-blind, placebo-controlled trial of the effect of topical diltiazem on post-hemorrhoidectomy pain. Colorectal Dis 13(3):328–32
37. Perrotti P, Dominici P, Grossi E, Cerutti R, Antropoli C (2010) Topical nifedipine with lidocaine ointment versus active control for pain after hemorrhoidectomy: results of a multicentre, prospective, randomized, double-blind study. Can J Surg 53:17–24
38. Davies J, Duffy D, Boyt N, Aghahoseini A, Alexander D, Leveson S (2003) Botulinum toxin (botox) reduces pain after hemorrhoidectomy: results of a double-blind, randomized study. Dis Colon Rectum 46:1097–1102
39. Ho YH, Seow-Choen F, Low JY, Tan M, Leong AP (1997) Randomized controlled trial of trimebutine (anal sphincter relaxant) for pain after haemorrhoidectomy. Br J Surg 84(3):377–9
40. Ram E, Alper D, Stein G, Bramnik Z, Dreznik Z (2005) Internal anal sphincter function following lateral internal sphincterotomy for anal fissure: a long-term manometric study. Ann Surg 242(2):208–211
41. Casillas S, Hull TL, Zutshi M, Trzcinski R, Bast JF, Xu M (2005) Incontinence after a lateral internal sphincterotomy: are we underestimating it? Dis Colon Rectum 48(6):1193–9

42. Garg P, Garg M, Menon GR (2013) Long-term continence disturbance after lateral internal sphincterotomy for chronic anal fissure: a systematic review and meta-analysis. Colorectal Dis 15(3):e104–17. doi:10.1111/codi.12108
43. Elsebae MM (2007) A study of fecal incontinence in patients with chronic anal fissure: prospective, randomized, controlled trial of the extent of internal anal sphincter division during lateral sphincterotomy. World J Surg 31(10):2052–7
44. Tjandra JJ, Han WR, Ooi BS, Nagesh A, Thorne M (2001) Faecal incontinence after lateral internal sphincterotomy is often associated with coexisting occult sphincter defects: a study using endoanal ultrasonography. ANZ J Surg 71(10):598–602
45. Chik B, Law WL, Choi HK (2006) Urinary retention after hemorrhoidectomy: impact of stapled hemorrhoidectomy. Asian J Surg 29(4):233–7
46. Brisinda G (2000) How to treat hemorrhoids. Prevention is best; hemorrhoidectomy needs skilled operators. BMJ 321:582–583
47. Miles AJ, Dunkley AJ (2007) Day case hemorrhoidectomy. Colorectal Dis 9(6):532–5