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Review

A systematic review and meta-analysis evaluating the effectiveness of lightweight mesh against heavyweight mesh in influencing the incidence of chronic groin pain following laparoscopic inguinal hernia repair

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KEYWORDS:
Inguinal hernia;
Laparoscopic repair;
Lightweight mesh;
Heavyweight mesh;
Chronic groin pain

Abstract

BACKGROUND: A systematic analysis was conducted of randomized controlled trials (RCTs) comparing lightweight mesh (LWM) with heavyweight mesh in laparoscopic inguinal hernia repair.

METHODS: Data extracted from the included RCTs were analyzed according to the principles of meta-analysis.

RESULTS: Eleven RCTs encompassing 2,189 patients were analyzed. In a fixed-effects model, operating time, postoperative pain, and recurrence rate were statistically similar between LWM and heavyweight mesh. LWM was associated with fewer perioperative complications and a reduced risk for developing chronic groin pain. There was also a reduced risk for developing other groin symptoms, such as foreign body sensations, but it was not statistically significant.

CONCLUSIONS: The use of LWM for laparoscopic inguinal hernia repair is not associated with an increased risk for hernia recurrence. LWM reduces the incidence of chronic groin pain, groin stiffness, and foreign body sensations. Therefore, LWM may routinely be used in laparoscopic inguinal hernia repair. However, high-quality RCTs with longer follow-up periods are required to validate these findings.

Open and laparoscopic inguinal hernia repair (LIHR) with mesh has become a gold-standard surgical procedure for an estimated 16% of symptomatic groin hernias in general surgical patients.[1–7] Approximately 20 million laparoscopic and open inguinal hernias are repaired each year worldwide, >17,000 operations in Sweden, >12,000 in Finland, >80,000 in England, and >800,000 in the United States.[8–11] The most frequently used biomaterial in all types of hernia repair is polypropylene. Heavyweight polymers of polypropylene offer maximum mechanical stability at the hernial defect, resulting in stiff and nonflexible scar formation, to ensure a resilient hernia repair once mesh biomaterial is incorporated in the surrounding tissue of abdominal wall. However, it produces a segment of abdominal wall with an excessive tensile strength that is not adapted to local

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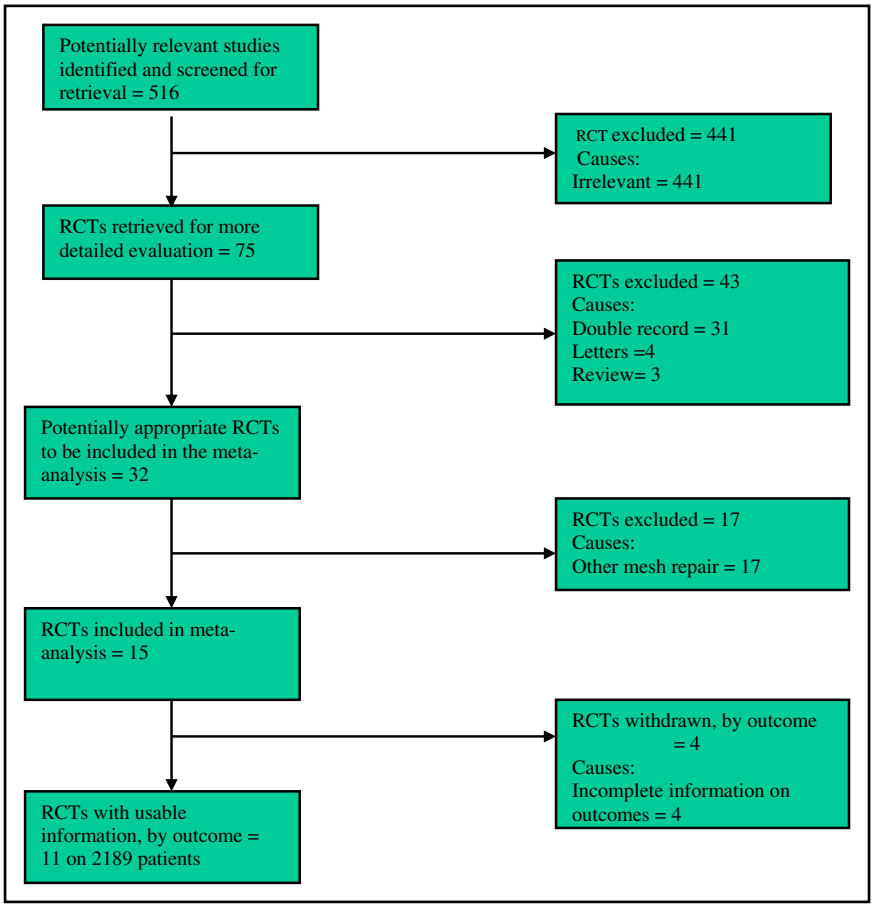

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart showing trial selection methodology.

tissue, leading to stiffness and foreign body sensations in the groin. Polymers of the biomaterial used to construct a surgical mesh are considered physically and chemically inert, nonimmunogenic, and nontoxic, but they can still locally trigger an extensive inflammatory adverse reaction, called a "foreign body reaction."[12,13] If this reaction is too strong and unremitting, especially when combined with hazards of bioincompatibility and mismatched tensile strength of the mesh, it is considered to play a key role in the development of chronic groin pain.[14,15] Additionally, because mesh biomaterial is directly in contact with vas deferens and testicular vessels during LIHR, this widespread regional fibrosis could lead to dysfunction of these structures, resulting in fertility problems and testicular pain.[16,17] In view of the fact that inflammatory reaction to the biomaterial of heavyweight mesh (HWM) correlates with the weight of the mesh (the amount of polymer, expressed as grams per square meter) and the pore size of the material inserted, the concept of lightweight mesh (LWM) was developed to minimize the content of nonabsorbable foreign material with a pore size $>$ 1 mm.[18] Increased biocompatibility and reduced incidence of chronic groin pain have already been reported after the insertion of old and new generations of LWM, such as lightweight polypropylene, polypropylene-polyglactin, β-D-glucan, titanium-coated polypropylene, and polypropylene-poliglecaprone.[19–23] The objective of this meta-analysis was to systematically analyze randomized controlled trials (RCTs) of the use of LWM versus HWM in patients undergoing LIHR by both transabdominal preperitoneal and total extraperitoneal approach.

Methods

Identification of trials

RCTs (irrespective of language, country of origin, hospital of origin, blinding, sample size, or publication status) that compared the use of LWM versus HWM in LIHR were included in this review. The Cochrane Colorectal Cancer Group Controlled Trials Register, the Cochrane Central Register of Controlled Trials in the Cochrane Library, MEDLINE, Embase, and the Science Citation Index Expanded were searched for articles published up to June 2011, using the Medical Subject Headings "inguinal hernia" and "groin hernia." Equivalent free-text search terms such as "inguinal hernia repair," "laparoscopic repair," "total extraperitoneal," and "trans-abdominal pre-peritoneal repair" were used in combination with "lightweight mesh" and "heavyweight mesh," "polypropylene mesh," "composite mesh," "partially absorbable mesh," "titanium coated mesh," "polyglactin mesh," "poliglecaprone mesh,"

Table 1 Characteristics of included trials

Trial	Year	Country	Patients	Age (y), median (range) or mean ± SD	Gender	Duration of follow-up (mo)	Hernia details	Primary*/ secondary outcomes*
Agarwal et al[32]	2009	India			Mixed group of male and female patients	16 (6–25)	Bilateral primary inguinal hernia	Postoperative pain* Groin complaints† Recurrence† Sexual dysfunction†
LWM			25					
HWM			25	62.68 (32–85)				
Bittner et al[33]	2011	Germany			Mixed group of male and female patients	12	Unilateral primary, recurrent inguinal, and femoral hernia	Chronic groin pain* Groin complaints† Daily activity† Analgesia used†
LWM			150	53.5 ± 14.5				
HWM			150	52.4 ± 15.7				
Bittner et al[34]	2006	Germany			Mixed group of male and female patients	12	Unilateral primary, recurrent inguinal or femoral hernia	Chronic groin pain* Groin complaints† Daily activity† Analgesia used†
LWM			450	59.1 ± 13.9				
HWM			150	57.2 ± 13.4				
Bringman et al[35]	2005	Sweden and Finland			All male patients	2	Bilateral primary or recurrent inguinal hernia	Quick recovery* Postoperative pain* Recurrence† HR-QOL† Chronic groin pain†
LWM			69	55 ± 11				
HWM			70	55 ± 12				
Champault et al[36]	2007	France			All male patients	24	Unilateral primary inguinal hernia	Recurrence* Chronic groin pain†
LWM			57	54 (18–84)				
HWM			80					
Chowbey et al[37]	2010	India			Mixed group of male and female patients	12	Unilateral primary, recurrent inguinal or femoral hernia	Postoperative pain* Recurrence† Chronic groin pain† Seroma† Complications† Testicular pain†
LWM			191	53.4 (18–83)				
HWM			211	52.8 (20–92)				
Chui et al[38]	2010	Hong Kong			Mixed group of male and female patients	12	Bilateral primary inguinal and femoral hernia	Postoperative pain* Recurrence† Chronic groin pain† Seroma† Complications† Testicular pain†
LWM			50					
HWM			50	61.6 (25–84)				
Heikkinen et al[39]	2006	Sweden			All male patients	2	Recurrent, unilateral inguinal hernia	Postoperative pain* HR-QOL* Time to work† Complications†
LWM			68	60 ± 12				
HWM			69	59 ± 13				
Langenbach et al[40]	2006	Germany			All male patients	3	Primary inguinal hernia	Postoperative pain* HR-QOL* Time to work† Sexual dysfunction† Incapacity to work† Testicular changes† Complications†
LWM			30	63.5				
HWM			60	65.4				
Langenbach et al[41]	2008	Germany			All male patients	60	Primary inguinal hernia	HR-QOL* Sexual dysfunction† Recurrence† Chronic groin pain†
LWM			58	62.3				
HWM			117	63.2				
Peeters et al[42]	2010	Belgium			All male patients	12	Primary unilateral and bilateral inguinal hernia	Male fertility check* Complications† Time to work† HR-QOL† Recurrence† Chronic groin pain†
LWM			39	43.5 (34.5–47.5)				
HWM			20	34.5 (28.5–47)				

HR-QOL = health-related quality of life; HWM = heavyweight mesh; LWM = lightweight mesh.
*indicates primary endpoint.
†indicates secondary endpoint.

Table 2 Treatment protocol adopted in included trials

Trial	LWM group	HWM group
Agarwal et al[32]	• 12 × 15 cm polypropylene mesh • Weight: lightweight • TEP approach • Mesh fixation technique not reported	• 12 × 15 cm polypropylene mesh • Weight: standard heavyweight • TEP approach • Mesh fixation technique not reported
Bittner et al[33]	• 10 × 15 cm titanium-coated polypropylene mesh • Weight 16 g/m^2 • TAPP approach • Mesh fixed with sutures • Pore size > 1 mm	• 10 × 15 cm polypropylene mesh • Weight 90 g/m^2 • TAPP approach • Mesh fixed with sutures • Pore size 1.2 mm
Bittner et al[34]	• Size 10 × 15 cm • Polypropylene: weight 55 g/m^2, pore size 0.75 mm in 150 patients • Polypropylene-poliglecaprone mesh • Weight 28 g/m^2, pore size 3–4 mm in 150 patients • Titanium-coated polypropylene: weight 35 g/m^2, pore size > 1 mm in 150 patients • TAPP approach • Mesh fixed with fibrin glue	• 10 × 15 cm polypropylene mesh • Weight 90 g/m^2 • TAPP approach • Pore size 1.2 mm • Mesh fixed with fibrin glue
Bringman et al[35]	• 12 × 15 cm polypropylene-Polyglactin mesh (VYPRO II) • Weight: lightweight • TEP approach • Mesh fixed with tacker	• 12 × 15 cm polypropylene mesh • Weight: heavyweight • TEP approach • Mesh fixed with tacker
Champault et al[36]	• 7.5 × 15 cm polypropylene–β-D-glucan • Weight 50 g/m^2 • TEP approach • Mesh fixation technique not reported	• 7.5 × 15 cm polypropylene mesh • Weight 105 g/m^2 • TEP approach • Mesh fixation technique not reported
Chowbey et al[37]	• 12 × 15 cm polypropylene-poliglecaprone mesh • Weight 28 g/m^2 • Pore size 3–4 mm • TEP approach • Mesh fixed with tacker	• 2 × 15 cm polypropylene mesh • Weight 105 g/m^2 • Pore size 0.8–1 mm • TEP approach • Mesh fixed with tacker
Chui et al[38]	• Polypropylene-polyvinylidene fluoride • Weight 60 g/m^2 • Pore size 2.0 mm • TEP approach • Mesh not fixed	• Polypropylene mesh • Pore size 0.44 mm • Weight: heavyweight (>50 g/m^2) • TEP approach • Mesh not fixed
Heikkinen et al[39]	• 12 × 15-cm polypropylene-polyglactin mesh (VYPRO II) • TEP approach • Mesh fixed with staples	• 12 × 15 cm polypropylene mesh • TEP approach • Mesh fixed with staples
Langenbach et al[40]	• Polypropylene-polyglactin mesh • TAPP approach • Mesh fixed with staples • Pore size 2–5 mm • Size 15 × 12 cm • Weight 54.6 g/m^2 • Mesh fixed with staples	• Polypropylene double-filament mesh in 30 patients with pore size 1–1.6 mm and 108 g/m^2 • Polypropylene multifilament mesh in 30 patients with pore size 0.8–1 mm and 116 g/m^2 • Size 15 × 12 cm • TAPP approach • Mesh fixed with staples

Table 2 (*continued*)

Trial	LWM group	HWM group
Langenbach et al[41]	• Polypropylene-polyglactin mesh • TAPP approach • Mesh fixed with staples • Pore size 2–5 mm • Size: 15 × 10 cm • Weight 35 g/m^2 • Mesh fixed with staples	• Polypropylene double-filament mesh in 60 patients with pore size 1–1.6 mm and 108 g/m^2 • Polypropylene multifilament mesh in 60 patients with pore size 0.8–1 mm and 116 g/m^2 • Size 15 × 10 cm • TAPP approach • Mesh fixed with staples
Peeters et al[42]	• Polypropylene-polyglactin mesh in 20 patients with pore size 4 mm and 30 g/m^2 • TiMesh in 19 patients with pore size >1 mm and 35 g/m^2 • Size 15 × 13 cm • TEP approach • Mesh fixed with staples in a few cases	• Polypropylene mesh in 20 patients with pore size 1 mm and 95 g/m^2 • Size 15 × 13 cm • TEP approach • Mesh fixed with staples in a few cases

HWM = heavyweight mesh; LWM = lightweight mesh; TAPP = transabdominal preperitoneal; TEP = total extraperitoneal.

"Prolene mesh," and "VYPRO II mesh." A filter for identifying RCTs recommended by the Cochrane Collaboration[24] was used to filter out nonrandomized studies in MEDLINE and Embase. The reference lists of the included articles were searched to identify additional studies.

Data extraction

Two authors independently identified the RCTs for inclusion and exclusion and extracted the data. The accuracy of the extracted data was further confirmed by a third author. There were no discrepancies in the selection of the trials or in data extraction between the reviewers, except in the case of recording the severity of pain according to the measurement scales and timing of the recorded data. All reviewers agreed that blinding was impossible to achieve in case of the operating surgeon. However, there was disagreement with regard to whether the trials should be classified as having a high or low risk for bias on the basis of 4 parameters: randomization technique, power calculations, blinding, and intention-to-treat analysis. It was agreed that the lack of an adequate randomization technique and an intention-to-treat analysis would result in a trial's being classified as having a high risk for bias. In case of any unclear or missing information, the reviewers obtained data by contacting the authors of the published RCTs to avoid bias related to missing data.

Statistical analysis

The software package RevMan version 5.0 (Cochrane Collaboration, Copenhagen, Denmark) was used for the statistical analysis to achieve a combined outcome. Risk ratios (RR) with 95% confidence intervals (CIs) were calculated for the binary data, and mean differences (MDs) with 95% CIs were calculated for continuous data. A random-effects model[25] and a fixed-effect model[26] were used to calculate the combined outcomes of both binary and continuous variables. In cases of heterogeneity, only the results of the random-effects model were reported. Heterogeneity was explored using chi-square tests, with significance set at $P < .05$, and was quantified[24] using I^2, with a

Table 3 Quality assessment of included trials

Trial	Randomization technique	Power calculations	Blinding	Intention-to-treat analysis	Concealment
Agarwal et al[32]	Blind envelope system	Not reported	Yes	Not reported	Yes
Bittner et al[33]	Computer generated	Yes	Yes	Yes	Yes
Bittner et al[34]	Computer generated	Yes	Yes	Yes	Yes
Bringman et al[35]	Computer generated	No	Yes	Yes	Yes
Champault et al[36]	Computer generated	Yes	Yes	Yes	Yes
Chowbey et al[37]	Computer generated	Not reported	Not reported	Not reported	Yes
Chui et al[38]	Computer generated	Not reported	Yes	Not reported	Yes
Heikkinen et al[39]	Computer generated	Yes	Yes	Yes	Yes
Langenbach et al[40]	Computer generated	Not reported	Yes	Not reported	Yes
Langenbach et al[41]	Blind envelope system	Not reported	Yes	Not reported	Yes
Peeters et al[42]	Computer generated	Not reported	Not reported	Yes	Yes

Lightweight mesh compared to heavyweight mesh for laparoscopic inguinal hernia repair

Patient or population: patients with laparoscopic inguinal hernia repair
Settings: outpatient as well inpatient
Intervention: Lightweight mesh
Comparison: heavyweight mesh

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk Heavyweight mesh	Corresponding risk Lightweight mesh				
Operation time Mean difference Follow-up: 2-60 months		The mean operation time in the intervention groups was **1.08 lower** (3.29 lower to 1.13 higher)		748 (6 studies)	⊕⊕⊖⊖ **low**	
Postoperative pain Risk ratio-number of reported patients Follow-up: mean 12 months	**Study population**		**RR 0.81** (0.49 to 1.33)	900 (2 studies)	⊕⊕⊕⊖ **moderate**	
	87 per 1000	**70 per 1000** (42 to 115)				
	Moderate					
	87 per 1000	**70 per 1000** (43 to 116)				
Postoperative pain Mean difference reported as intensity of pain Follow-up: 12-25 months		The mean postoperative pain in the intervention groups was **0.09 lower** (0.18 lower to 0 higher)		552 (3 studies)	⊕⊕⊖⊖ **low**	
Post-operative complications Risk ratio Follow-up: 2-60 months	**Study population**		**RR 0.76** (0.59 to 0.99)	1902 (8 studies)	⊕⊕⊕⊖ **moderate**	
	155 per 1000	**118 per 1000** (91 to 153)				
	Moderate					
	127 per 1000	**97 per 1000** (75 to 126)				
Time to return to work Mean difference Follow-up: 12-25 months		The mean time to return to work in the intervention groups was **0.92 lower** (1.59 to 0.25 lower)		943 (5 studies)	⊕⊕⊖⊖ **low**	
Recurrence Risk ratio Follow-up: 12-60 months	**Study population**		**RR 2.56** (0.77 to 8.49)	1262 (7 studies)	⊕⊕⊕⊖ **moderate**	
	6 per 1000	**15 per 1000** (5 to 50)				
	Moderate					
	0 per 1000	**0 per 1000** (0 to 0)				
Chronic groin pain Risk ratio Follow-up: 12-60 months	**Study population**		**RR 0.48** (0.31 to 0.75)	1792 (7 studies)	⊕⊕⊕⊖ **moderate**	
	65 per 1000	**31 per 1000** (20 to 49)				
	Moderate					
	80 per 1000	**38 per 1000** (25 to 60)				
Other symptoms Risk ratio Follow-up: 2-25 months	**Study population**		**RR 0.81** (0.46 to 1.41)	1678 (6 studies)	⊕⊕⊕⊖ **moderate**	
	38 per 1000	**31 per 1000** (17 to 54)				
	Moderate					
	35 per 1000	**28 per 1000** (16 to 49)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

Figure 2 Summary and strength of the evidence from trials analyzed in GradePro. Operation time was reported by 6 trials.[35,37,38,40–42] Postoperative pain was reported as number of patients in 2 trials.[33,34] Postoperative pain was reported as pain score in 3 trials.[32,37,38] Postoperative complications were reported in 8 trials.[33–35,37,39–42] Time to return to work was reported in 5 trials.[35,37,39–41] Recurrence was reported in 7 trials.[32,33,35–37,41,42] Chronic groin pain was reported in 7 trials.[33–37,41,42] Other symptoms were reported in 6 trials.[33–38]

maximum value of 30% identifying low heterogeneity.[27] The Mantel-Haenszel method was used for the calculation of RRs under the fixed-effect and random-effects models.[28] In a sensitivity analysis, .5 was added to each cell frequency for trials in which no event occurred in either the treatment or control group, according to the method recommended by Deeks et al.[29] If the standard deviation was not available, it was calculated according to the guidelines provided by the Cochrane Collaboration.[24] This process involved assumptions that both groups had the same variance, which might not have been true; variance was either estimated from the range or from the *P* value. The estimate of the difference between both techniques was pooled, depending on the effect weights in results determined by each trial's estimated variance. A forest plot was used for graphical display of the results. The square around the estimate stands for the accuracy of the estimation (sample size), and the horizontal line represents the 95% CI. The methodologic quality of the included RCTs was initially assessed using the published guidelines of Jadad et al[30] and Chalmers et al.[31] On the basis of the

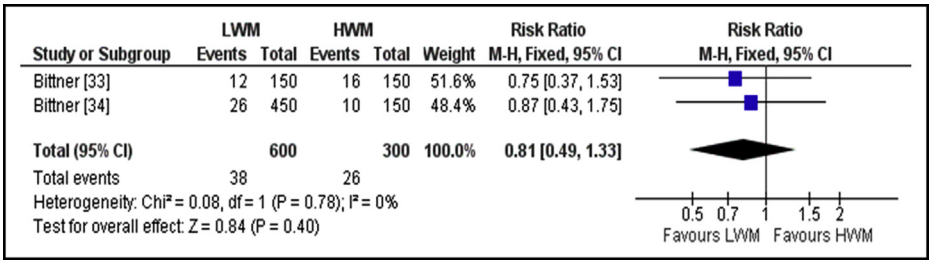

Figure 3 Postoperative pain (reported as number of patients). M-H = Mantel-Haenszel.

quality of the included RCTs, the strength and the summary of the evidence was further evaluated using GradePro (Cochrane Collaboration).

Results

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart to explain the literature search strategy and trial selection is shown in Fig. 1. Eleven RCTs[32–42] encompassing 2,189 patients were analyzed systematically to achieve a summated outcome. There were 1,187 patients in the LWM group and 1,002 patients in the HWM group. The characteristics of included RCTs are provided in Table 1. The salient features and treatment protocols adopted in the included RCTs are given in Table 2.

Methodologic quality of included studies

According the published guidelines of Jadad et al[30] and Chalmers et al,[31] all trials were of moderately good quality (Table 3). On the basis of the quality of the included RCTs, the strength and summary of the evidence analyzed in GradePro is shown in Fig. 2. Two included trials[32,38] reported the use of LWM on 1 side and HWM on the other side in patients undergoing bilateral LIHR. We analyzed these as an individual patient undergoing unilateral LIHR to obtain a balanced combined outcome.

Operation time

Six RCTs[35,37,38,40–42] reported and contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 8.00, $df = 5$, $P = .16$, $I^2 = 38\%$). In the fixed-effects model (MD, −1.08; 95% CI, −3.29 to 1.13; $z = .96$; $P = .34$), operating time for LIHR was statistically similar after the use of either LWM or HWM.

Postoperative pain

Two RCTs[35,36] reported the number of patients with severe postoperative pain as assessed using a visual analogue scale. There was no heterogeneity among trials (chi-square = .08, $df = 1$, $P = .78$, $I^2 = 0\%$). In the fixed-effects model (RR, .81; 95% CI, .49 to 1.33; $z = .84$; $P = .40$; Fig. 3), postoperative pain in the LWM group and the HWM group was statistically comparable. Three RCTs[32,37,38] reported postoperative pain scores after LIHR. There was significant heterogeneity (chi-square = 80.09, $df = 2$, $P < .00001$, $I^2 = 98\%$) among RCTs. Therefore, in the random-effects model (MD, −.09; 95% CI, −.18 to −.00; $z = 2.05$; $P < .04$; Fig. 4), the postoperative pain score was lower in the LWM group.

Perioperative complications

Eight RCTs[33–35,37,39–42] contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 4.38, $df = 7$, $P = .74$, $I^2 = 0\%$). In the fixed-effects model (RR, .76; 95% CI, .59 to .99; $z = 2.04$; $P < .04$; Fig. 5), the risk for developing perioperative complications was statistically greater after the use of HWM in LIHR.

Return to work

Five RCTs[35,37,39–41] contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 6.23, $df = 4$, $P = .18$, $I^2 = 36\%$). In the fixed-effects model (MD, −.92; 95% CI, −1.59 to −.25; $z = 2.70$; $P < .007$; Fig. 6), the time taken to return

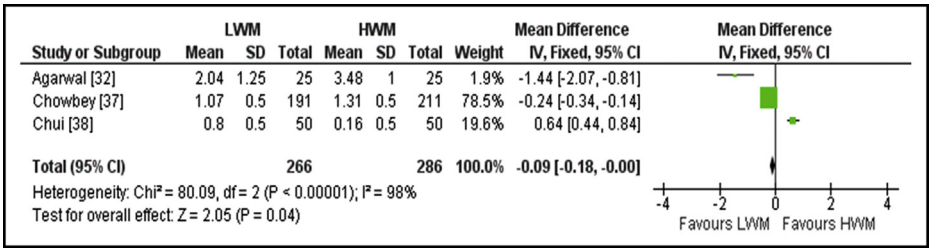

Figure 4 Postoperative pain (reported as pain score). IV = Inverse Variance.

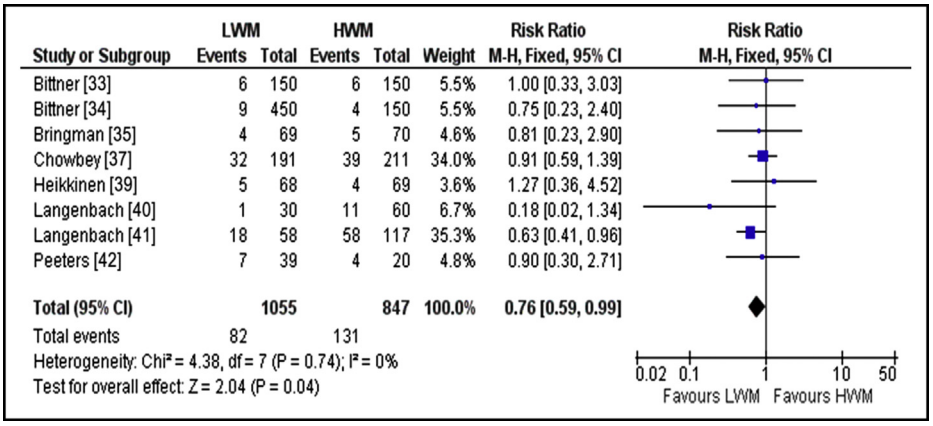

Figure 5 Perioperative complications. M-H = Mantel-Haenszel.

to work by the patients in LWM group was statistically shorter than the time taken by the patients in HWM group.

Recurrence

Eight RCTs[32–37,41,42] contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 2.12, $df = 4$, $P = .71$, $I^2 = 0\%$). In the fixed-effects model (RR, 2.01; 95% CI, .71 to 5.67; $z = 1.32$; $P = .19$; Fig. 7), the risk for hernia recurrence after the use of LWM and HWM in LIHR was not statistically different.

Chronic groin pain

Seven RCTs[33–37,41,42] contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 3.24, $df = 6$, $P = .78$, $I^2 = 0\%$). In the fixed-effects model (RR, .48; 95% CI, .31 to .75; $z = 3.27$; $P < .001$; Fig. 8), the risk for developing chronic groin pain was statistically greater after the use of HWM compared with LWM.

Other symptoms (groin discomfort, sensory impairment, hard feelings, point tenderness, and foreign body sensations)

Other symptoms were assessed using various scales, such as an independent doctor's judgement,[32] visual analogue scales ranging from 1 to 100),[33,34] the SF-36 Health Survey,[35] a visual analogue scale ranging from 1 to 10),[36] and subjective complaints and physical examination[37,38] of the groin. Six RCTs[33–38] contributed to the combined calculation of this variable. There was no heterogeneity among trials (chi-square = 3.77, $df = 5$, $P = .58$, $I^2 = 0\%$). In the fixed-effects model (RR, .81; 95% CI, .46 to 1.41; $z = .76$; $P = .45$; Fig. 9), the risk for developing other groin symptoms was lower with the use of LWM, but it was not statistically significant.

Comments

Circumventing chronic groin pain after LIHR should be the prime goal for hernia surgeons, bearing in mind that groin pain after herniorrhaphy is becoming a common reason for litigation against operating surgeons.[43] Various surgical measures aiming to reduce the risk for developing chronic groin pain are mainly focused on preventing damage to regional nerves.[43,44] However, the use of LWM in LIHR has been proven to reduce the incidence of chronic groin pain by inducing minimal foreign body reaction due to the presence of lower percentage of reactive biomaterial[32,33,37,38] in woven mesh. Hernia surgeons are exploring every possible avenue to further refine mesh biomaterial to achieve the lowest possible rate of chronic groin pain without compromising the vigor of the mesh in inguinal hernia repair. This concept of LWM has led to the development of a new generation of meshes, such as titanium-coated

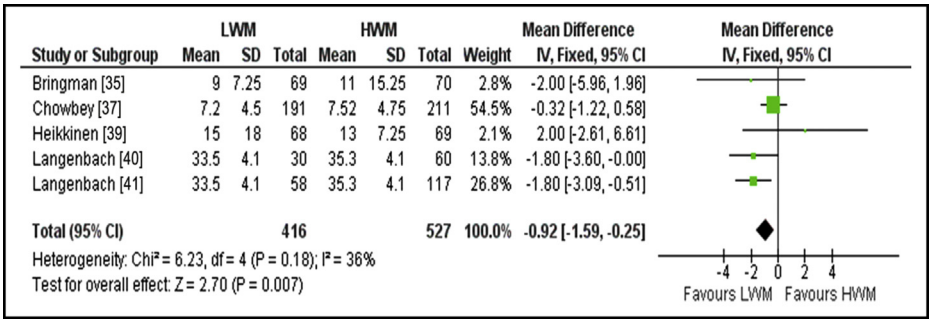

Figure 6 Time to return to work. IV = Inverse Variance.

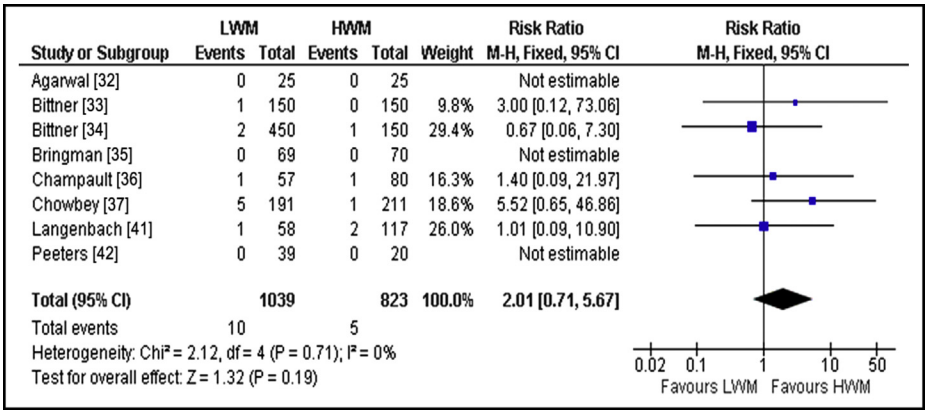

Figure 7 Recurrence. M-H = Mantel-Haenszel.

polypropylene mesh and the combination of polypropylene with poliglecaprone, with very encouraging reported results after LIHR.[33,37,38] Reducing the biomaterial load from 35 to 16 g/m^2 has been reported to improve the biocompatibility of extralightweight mesh, thus improving clinical outcomes by reducing the incidence of chronic groin pain to a rare event.[23] Detailed exploration of the role of various mesh fixation techniques responsible for the development of chronic groin pain after LIHR is outside the scope of this review. However, contributions of tacker, suture, fibrin glue, and other mesh fixation techniques in the etiology of the development of chronic groin pain can be quantified only by comparing them with a no-fixation approach to reach an acceptable and validated conclusion. One of the confounding variables in the included trials of this review is the use of various mesh fixation techniques, which may be considered a potential source of sample contamination in recording the pain score.

A previously published meta-analysis[45] concluded that no difference existed between LWM and HWM in terms of short-term effectiveness. There may be many reasons for this conflicting conclusion. That review was performed by analyzing 6 RCTs of LIHR and 4 RCTs of open inguinal hernia repair. LIHR has been found to cause less postoperative pain compared with OIHR.[5,6] The site of incision and type of tissue dissection are entirely different. We believe that meta-analyzing both procedures together may not generate a reliable conclusion. In addition, LWM, in the form of VYPRO II (Ethicon Endo-Surgery, Blue Ash, OH), was compared with polypropylene, whereas our meta-analysis included all types of LWM, including new-generation meshes, such as β-D-glucan, titanium-coated polypropylene, and polypropylene-poliglecaprone. However, in the previous review,[45] LWM was found to be associated with a reduced feeling of foreign body sensations in the groin, consistent with our results.

We are fully aware of the fact that there were several limitations to this review. First, there were significant differences in inclusion (eg, sex differences, different sizes of hernias, the inclusion of recurrent hernias, and an age range from 25 to 85 years) and exclusion criteria among included RCTs. We acknowledge that a potential confounder in this study is the particularly broad inclusion criteria, which can strongly influence the ability to detect real differences in the primary and secondary outcomes.

Second, varying degrees of differences also existed among trials concerning the definitions of chronic groin pain, other symptoms, and measurement scales for postoperative pain. There is an urgent need for an internationally accepted pain measurement tool for homogenous assessment of postoperative and chronic groin pain in patients undergoing inguinal hernia surgery. The approach of addressing chronic groin pain in a very standardized patient population using an agreed-upon standardized rigorous technique has already been reported and should be considered for future randomized trials.[46–48]

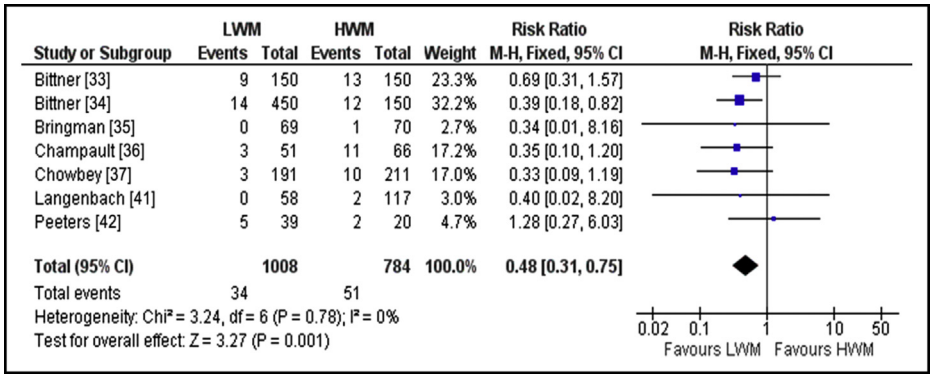

Figure 8 Chronic groin pain. M-H = Mantel-Haenszel.

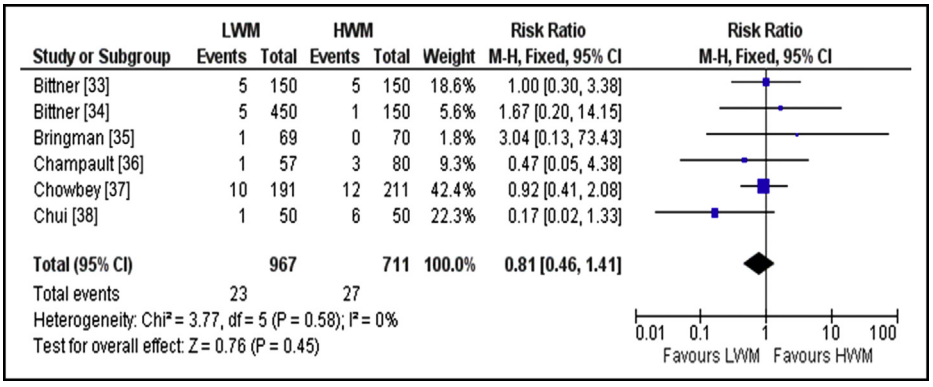

Figure 9 Other symptoms. M-H = Mantel-Haenszel.

Third, we analyzed total extraperitoneal and transabdominal preperitoneal approaches of LIHR together, which may potentially influence primary and secondary outcomes.

Fourth, there was potential overlap between the trials in which 1 particular type of mesh was LWM in 1 trial[40] but HWM in another trial.[38]

Last, studies recruiting small numbers of patients in this review may not have been sufficiently powered to recognize small differences in outcomes between LWM and HWM. Cost evaluation trials may eventually play a vital role in final decision making for mesh selection, considering that LWM is relatively expensive.

Conclusions

The use of LWM for LIHR is not associated with increased risk for hernia recurrence and reduces the incidence of chronic groin pain. LWM also reduces the risk for developing groin stiffness and foreign body sensations. LWM may routinely be used in LIHR. However, a high-quality trial with a longer follow-up duration is required to validate these findings, and until then, this review may be used as a reference and the only available evidence on this subject.

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