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Review Article

Comprehensive systematic review on the self-gripping mesh vs sutured mesh in inguinal hernia repair

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ABSTRACT

Objective: The objective of this systematic review is to analyse the randomised control trials (RCTs) comparing the self-gripping mesh (SGM) with sutured mesh fixation (SMF) in open inguinal hernia repair.

Materials and methods: RCTs comparing SGM with SMF in open inguinal hernia repair were selected from medical electronic databases and analysis was performed using the principles of meta-analysis with RevMan version 5 statistical software.

Results: Seventeen RCTs involving 3863 patients were used for the final analysis. In the random effect model analysis, the operative time [mean difference − 7.72, 95 %, CI (−9.08, −6.35), Z = 11.07, $P = 0.00001$] was shorter for open inguinal hernia repair with SGM. However, there was noteworthy heterogeneity ($Tau^2 = 4.24$; $Chi^2 = 1795.04$, df = 12; ($P = 0.00001$; $I^2 = 99$ %) among the included studies. The incidence of chronic groin pain [odds ratio 1.17, 95 %, CI (0.88, 1.54), Z = 1.09, $P = 0.28$], postoperative complications [odds ratio 0.92, 95 %, CI (0.73, 1.16), Z = 0.71, $P = 0.48$] and recurrence [odds ratio 1.31, 95 %, CI (0.80, 2.12), Z = 1.08, $P = 0.28$] were statistically similar between both groups, without heterogeneity.

Conclusion: SGM failed to demonstrate a clinical advantage over SMF in terms of perioperative outcomes although the duration of surgery was shorter in SGM.

Introduction

Hernia repair is one of the most common surgical procedures worldwide [1]. The global burden of groin hernia is >20 million patients annually [2]. In the NHS England alone, almost 100,000 hernia repairs are done annually [3]. Therefore, inguinal hernia repair is one of the most common surgeries performed worldwide. Lichtenstein tension–free repair, originally described in 1984 [4], is still the most popular technique for groin hernia. International guidelines for hernia repair published in 2018, still consider this technique to be the reference standard for this repair [2].

Initial repair of the hernia is successful in most of the cases. Nonetheless, 10–15 % of the patients undergo re-operation due to the recurrence [2]. Also, current evidence demonstrates that 1–3 % of patients suffer from chronic pain, and it is considered to be the most feared complication of groin hernia repair [2]. These complications have a significant negative impact globally not only for the patients but also for the hospital and governments in terms of financial burden.

It is hypothesized that the cause for post-operative chronic pain and recurrence is multifactorial including but not limited to the patient's age, hernia size, type of mesh, method of fixation, and the surgeon's expertise [5–8]. Conventional repair involves the use of sutured mesh fixation (SMF) constituting prolene material. Numerous advances have been made in the groin hernia repair to decrease this burden and one of them is the use of self-gripping mesh (SGM) in the open inguinal hernia repair [9].

Multiple published studies in the literature have demonstrated the superiority of the SGM over conventional SMF, in terms of reduced post-operative pain, operative time and recurrence [10–12]. On the contrary, numerous studies have also shown similar postoperative outcomes between the SMF and the SGM [13–15].

The objective of this updated and comprehensive systematic review is to consolidate the findings of the previously published literature on comparing SGM versus SMF in inguinal hernia repair. This will help the surgeons to be mindful while choosing the mesh for the groin hernia repair.

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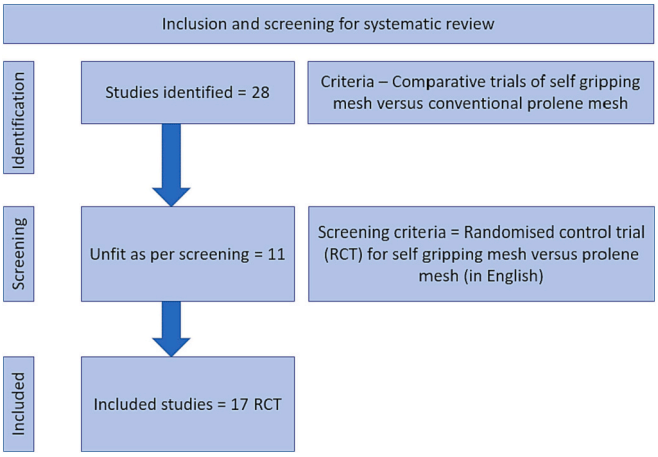

Fig. 1. PRISMA flowchart showing literature search outcomes.

Methods

Data sources and literature search technique

Electronic databases like PubMed, EMBASE, MEDLINE and Cochrane Library were reviewed and carefully analyzed. Relevant articles were identified with the use of MeSH terms and Boolean operators (AND, OR, NOT) were used to refine and narrow down the search results. The references were further analyzed to identify the relevant articles for a detailed analysis.

Trial selection

The inclusion criteria for the systematic review were comparative randomised control trials (RCTs) between the SGM conventional SFM in the inguinal hernia repair.

Endpoint

Chronic groin pain at follow-up on six months or more was considered as the principal endpoint in the systematic review on comparison of SGM versus SFM in the open inguinal hernia repair. The secondary outcomes were post-operative complications, operative time and recurrence.

Data collection and management

The data reported was collected from the included studies by the independent researchers on a standard data extraction sheet. Data collected was reviewed by the involved researchers and an agreement on the quality of data among the researchers was satisfactory. A mutual agreement was taken in the rare event of a discrepancy among the researchers. Extracted data included the list of authors, country, year of publication, type of study, demographic details of the study population, chronic groin pain, recurrence, operative time and the post-operative complication among the subset of SGM and the SFM.

Statistical analysis

RevMan version 5.4 (Review Manager 5.4, The Nordic Cochrane Centre, Copenhagen, Denmark) was used in the statistical analysis [16]. For comparing the operative time, the standardized mean difference and a confidence interval (CI) of 95 % were used for binary data analysis for continuous variables under the random-effects model analysis [17,18]. A forest plot was used to calculate the heterogeneity and by computing the chi^2 test, with significance set at $P < 0.05$ as well as using the I^2 test with a maximum value of 30 % identifying low heterogeneity [19]. For the calculation of Std. the mean difference, the inverse-variance method was used under the random effect model [20] analysis. If no event happened in the treatment and the control group, 0.5 was added to the cell frequency in the sensitivity analysis, according to the method recommended by Deeks et al. [21]. In the event of unavailable standard deviation, the guidelines provided by the Cochrane Collaboration were used for the risk of bias calculation [17]. The criteria used as per the guidelines assumed that variance was the same in both the groups since this might not be true in all the cases, and if this is the case then variance was estimated either from range or *P*-value. The estimate of the difference between both techniques was pooled, depending upon the effect weights in results determined by each trial estimate variance. A graphical display of the results was represented by using a forest plot. The square around the estimate represented the accuracy of estimation (sample size) while the horizontal line represented 95 % CI. The methodological quality of the included trials was initially assessed using published guidelines of Jadad et al., Chalmers et al. and Rangel et al. [22–24].

For comparing the chronic pain, postoperative outcome and recurrence odds ratio a CI of 95 % was used for binary data analysis for dichotomous variables under the random-effects model analysis

Table 1
Demographics of the included studies.

Title	Country	Type	Age (Mean ± SD) (years)		Gender (male %)	
			SGM	SFM	SGM	SFM
A J Quyn - 2012	UK	RCT	63.8 ± 7.76	61.9 ± 15.74	91.66	90
Anadol - 2011	Turkey	RCT	56 ± 16*	56 ± 13*	100	100
Ceith - 2014	Estonia	RCT	57.9 ± 17.4	54.4 ± 17.3	92.9	90.7
Chatzimavroudis –2014	Greece	RCT	56.7 ± 17.9	62.3 ± 15.7	92	100
Fan - 2016	China	RCT	62.0 ± 15.7	62.6 ± 49	81.81	95.65
Jorgensen - 2012	Denmark	RCT	56.4 ± 18.46*	70.75 ± 16.11*	100	100
Jose L. Porrer - 2014	Spain	RCT	55.7 ± 12.27	55.7 ± 12.27	97.8	97.8
Kingsnorth - 2012	UK	RCT	NR	NR	100	100
Kirsi - 2015	Finland	RCT	56 ± 14	95	57 ± 14	94
Mateusz - 2022	Poland	RCT	44.6 ± 13.5	47.2 ± 15.25	94.33	88.63
Matthias - 2010	Germany	RCT	64.2 ± 12.97	66.8 ± 11.66	91.67	88.46
Molegraaf - 2017	Netherlands	RCT	63.1 ± 14.6	61.4 ± 16.2	100	100
Pierides - 2012	Finland	RCT	58.99 ± 2.05*	56.63 ± 1.84*	94.95	92.86
Sanders - 2014	UK	RCT	56.9 ± 12.2	57.4 ± 10.9	100	100
Verhagen - 2016	Netherlands	RCT	54 ± 17	52.5 ± 16.75	98.89	96.15
Wang - 2019	China	RCT	41.2 ± 15.2	44 ± 16.1	0	0
Zwaans 2017	Netherlands	RCT	61 ± 14	59 ± 16	99.28	98.51

NR – Not reported, UK – United Kingdom, SD – Standard deviation, RCT – Randomised control trials.
* Data extrapolated with AI from existing data.

Table 2
Treatment protocol among the included studies.

Title	SGM	SFM
A J Quyn - 2012	Pro-Grip (Covidien, Germany), fixed under EO aponeurosis, Nerves preserved	6× 11-cm prolene mesh (Ethicon Edinburgh), Sutured at PT, IL and CT, Nerves preserved
Anadol - 2011	Parietene Pro-Grip (Sofradim, France), Nerves preserved	8 × 15-cm standard polypropylene mesh, Repair of the posterior wall of inguinal ligament, Nerves preserved
Ceith - 2014	Parietex Pro-Grip mesh (Covidien, Estonia), 8 × 12 cm, Nerves preserved	Monofilament polypropylene, 6 × 14 cm, Nerves preserved
Chatzimavroudis −2014	Parietex Pro-Grip mesh (Covidien, Estonia), 12 × 8 cm, one suture placed at pubic tubercle, Nerves preserved	Polypropylene mesh, 10 × 15 cm, Nerves preserved
Fan - 2016	Pro-Grip mesh, Ilioinguinal Nerve preserved	Polypropylene mesh, Ilioinguinal Nerve preserved
Jorgensen - 2012	polypropylene 8 × 12-cm Pro-Grip mesh, Nerve dissection recorded, Under EO aponeurosis	10 × 15-cm polypropylene mesh, Nerve preserved
Jose L. Porrer - 2014	Parietene Pro-Grip (Covidien, Ireland), 8 × 12 cm, no sutures used, Inguinal nerves tried to be preserved	Polypropylene mesh of 9 × 15 cm, Inguinal nerves tried to be preserved
Kingsnorth - 2012	Parietex Pro-Grip, one stitch allowed at PT Nerve dissection summarized	Polypropylene mesh, Nerve dissection summarized
Kirsi - 2015	Parietex Pro-Grip, 14 × 9 cm, Nerves preserved if possible	9 × 13 cm polypropylene mesh, Nerves preserved if possible
Mateusz - 2022	Parietene Pro-Grip (Covidien)	standard lightweight macroporous mesh
Matthias - 2010	11 × 9-cm Parietene progrip (Covidien, Germany), Nerves preserved	polypropylene mesh 12× 10 cm (Optilene), Nerves preserved
Molegraaf - 2017	Parietex Pro-Grip mesh, Nerves tried to be preserved, if cut ends buried	Lightweight polyester mesh, Nerves tried to be preserved, if cut ends buried
Pierides - 2012	Parietene Pro-Grip 12 × 8 cm, Nerves preserved whenever possible	Parietene Light 15 × 10 cm, Nerves preserved whenever possible
Sanders - 2014	Pariete progrip mesh, Nerves dissected documented	Parietene light mesh, Nerves dissected documented
Verhagen - 2016	Pro-Grip, Nerves preserved if possible	standard polypropylene, Nerves preserved if possible
Wang - 2019	Parietene Progrip 12 × 8 cm	polypropylene mesh (Optilene)
Zwaans 2017	Progrip, nerves dissection up-to surgeon	Polypropylene, nerves dissection up-to surgeon

EO – External oblique, PT – Pubic tubercle, Ilioinguinal ligament, CT – Conjoint tendon.

[17,18]. A forest plot was used to calculate the heterogeneity and by computing the chi^2 test, with significance set at $P < 0.05$ as well as using I^2 test with a maximum value of 30 % identifying low heterogeneity [19]. For the calculation of the odds ratio Mantel-Haenszel method was used under the random effect model analysis for dichotomous variables [20]. If no event happened in the treatment and the control group, 0.5 was added to the cell frequency in the sensitivity analysis, according to the method recommended by Deeks et al. [21]. In the event of unavailable standard deviation, the guidelines provided by the Cochrane Collaboration were used for the risk of bias calculation [17]. The criteria used as per the guidelines assumed that variance was the same in both the groups since this might not be true in all the cases, and if this is the case then variance was estimated either from range or *P*-value. The estimate of the difference between both techniques was pooled, depending upon the effect weights in results determined by each trial estimate variance. A graphical display of the results was represented by using a forest plot. The square around the estimate represented the accuracy of estimation (sample size) while the horizontal line represented 95 % CI. The methodological quality of the included trials was initially assessed using published guidelines of Jadad et al., Chalmers et al. and Rangel et al. [22–24].

Results

The primary search of the databases led to twenty-eight studies. Initial screening led to the exclusion of eleven studies. Out of these two of the studies were excluded as they were not in English. Seventeen RCTs were included in the final systematic review (Fig. 1).

Characteristics and demographics of included studies

Seventeen RCTs on 3863 patients were included to study for the updated comprehensive systematic review on the comparison of self-gripping mesh versus conventional mesh in the inguinal hernia repair and principles advised by the Cochrane Collaboration were used in this analysis. The PRISMA flow chart which was used in the selection of the trial is given in Fig. 1. The trials included were conducted in the UK [10,11,30], Turkey [12], Estonia [25], Greece [26], China [27,37], Denmark [28], Spain [29], Finland [31,35], Poland [32], Germany [33] and Netherlands [34,36,38]. Primary demographic characteristics of the studies included are specified in Table 1 and the protocol used in the treatment for each study is given in Table 2. Artificial intelligence was used in the extrapolation of mean age and standard deviation in a few of the articles due to the unavailability of the data in the desired parameters and it is demarcated in the Table 1.

Methodological quality of included studies

The methodological quality of the included RCTs was included and concise in Table 3. The randomization in RCTs was done electronically [10,27–30,34,37], and the concealment was done using sealed envelopes [10,25,26,28,30,31,33,35–37]. Single blinding [10,25,30,35], double blinding [27,28,31,33,34,36–38], no blinding [26,29,32] and in rest it was not reported.

Outcome of the primary and secondary variable

In chronic pain comparison, random effect model analysis was used [odds ratio 1.17, 95 %, CI (0.88, 1.54), Z = 1.09, $P = 0.28$] favors conventional prolene, but results were statistically insignificant. No heterogeneity was seen ($Tau^2 = 0.00$; Chi2 = 6.99, df = 9; ($P = 0.64$; $I^2 = 0$ %) between included RCTs (Fig. 2). For the postoperative complications, random effect model analysis was used [odds ratio 0.92, 95 %, CI (0.73, 1.16), Z = 0.71, $P = 0.48$] with no heterogeneity ($Tau^2 = 0.00$; $Chi^2 = 10.90$, df = 11; ($P = 0.45$; $I^2 = 0$ %) (Fig. 3) and for recurrence, random effect model analysis was used [odds ratio 1.31, 95 %, CI (0.80, 2.12), Z = 1.08, $P = 0.28$] with no heterogeneity ($Tau^2 = 0.00$; $Chi^2 = 9.79$, df = 12; ($P = 0.63$; $I^2 = 0$ %) (Fig. 5) both were statistically similar between SGM and SMF groups. For operative time random effect model was used again, progrip mesh was associated with the reduced operative time [mean difference − 7.72, 95 %, CI (−9.08, −6.35), Z = 11.07, $P = 0.00001$] compared to sutured mesh. However, there was noteworthy heterogeneity ($Tau^2 = 4.24$; $Chi^2 = 1795.04$, df = 12; (P = 0.00001; $I^2 = 99$ %) (Fig. 4) among the studies included.

Discussion

Key findings

Seventeen RCTs on 3863 (1890 patients in the SGM group and 1973 patients in the SMF group) patients were used in the systematic review on comparison of self-gripping mesh versus conventional mesh in the

Table 3
Quality of the randomised control trials among the included trials.

Study	Randomization technique	Concealment	Blinding	Intention to treat analysis	Ethical Approval	Registration number	Power calculation
A J Quyn - 2012	NR	NR	NR	NR	Approved	NR	NR
Anadol - 2011	NR	NR	NR	NR	Approved	NR	NR
Ceith - 2014	Manual	Sealed envelope	Single blinding	Reported	Approved	NR	Reported
Chatzimavroudis −2014	Manual	Sealed envelope	No blinding	NR	Approved	NR	NR
Fan - 2016	Computer generated	NR	Double blinding	NR	Approved	NCT00960011	Reported & achieved
Jorgensen - 2012	Computer generated	Sealed envelope	Double blinding	Reported	Approved	NCT00815698	Reported & achieved
Jose L. Porrer - 2014	Computer generated	NR	No blinding	NR	NR	Not done	NR
Kingsnorth - 2012	Computer generated	Sealed envelope	Single blinding	NR	Approved	NCT00827944	Reported & achieved
Kirsi - 2015	Manual block randomization	Sealed envelope	Double blinding	NR	Approved	NCT01592942	Reported & achieved
Mateusz - 2022	Simple randomization	NR	No blinding	NR	NR	NCT00827944	NR
Matthias - 2010	Manual	Sealed envelope	Double blinding	Reported	NR	Not reported	Reported & achieved
Molegraaf - 2017	Computer generated	NR	Double blinding	Reported	Approved	NCT01830452	Reported & achieved
Pierides - 2012	NR	Sealed envelope	Single blinding	NR	Approved	NCT01026935	Reported & achieved
Sanders - 2014	Computer generated	Sealed envelope	Single blinding	NR	Approved	NCT00827944	Reported & not achieved
Verhagen - 2016	Manual	Sealed envelope	Double blinding	NR	Approved	NTR1212	Reported & achieved
Wang - 2019	Computer generated	Sealed envelope	Double blinding	NR	Approved	ChiCTR1800017360	Reported & achieved
Zwaans 2017	NR	NR	Double blinding	NR	Approved	NTR1212	NR

NR – Not reported.

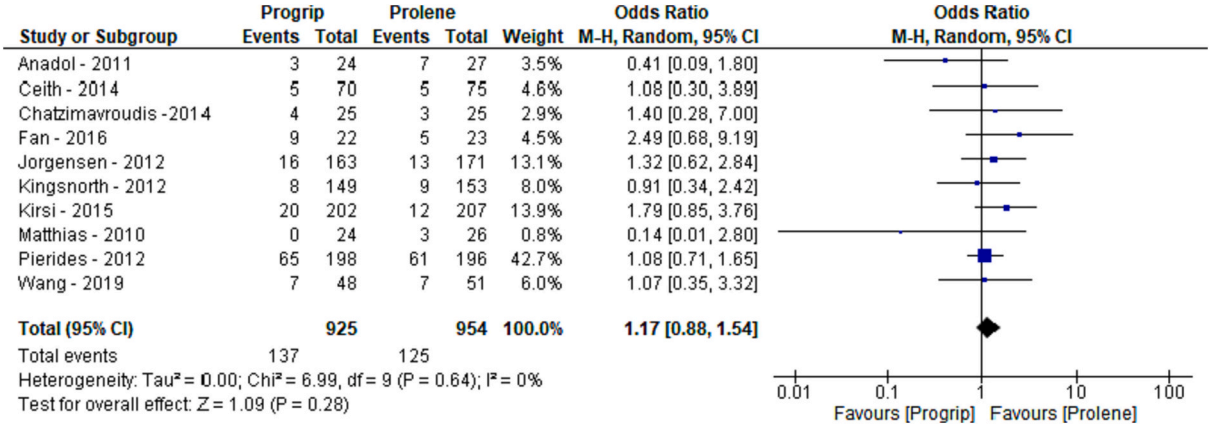

Fig. 2. Forest plot showing the chronic pain in using progrip mesh versus conventional prolene mesh. The outcome is presented as odds ratio with 95 % confidence interval.

inguinal hernia repair. SGM failed to prove any clinical advantage over SMF for chronic groin pain, post-operative outcomes and recurrence but, the SGM seems to have decreased operative time compared to SMF.

Comparison with existing literature

A review of the existing literature led to the identification of 5 existing meta-analyses Molengraff et al. in 2017 [39], Sanjay et al., in 2014 [40], Sanjay et al., in 2013 [41], Steensel et al., in 2017 [42] and Bullen et al., in 2021 [43] comparing SGM between SMF had similar conclusions. They concluded that SGM has similar post-operative outcomes as SMF but SGM was having a shorter post-operative time when compared to the SMF.

Strength and limitations

A thorough review of the literature shows this systematic review is the largest, most comprehensive and updated systematic review on the comparison of self-gripping mesh versus conventional mesh in the inguinal hernia repair. Randomization was not reported in [11,12,35,38], concealment was not reported in [10,12,27,29,32,34,38] and blinding was not reported in [10,12]. There was significant heterogeneity among the included trials in comparing the operative time. The RCTs used in the systematic review despite their shortcomings were of good strength.

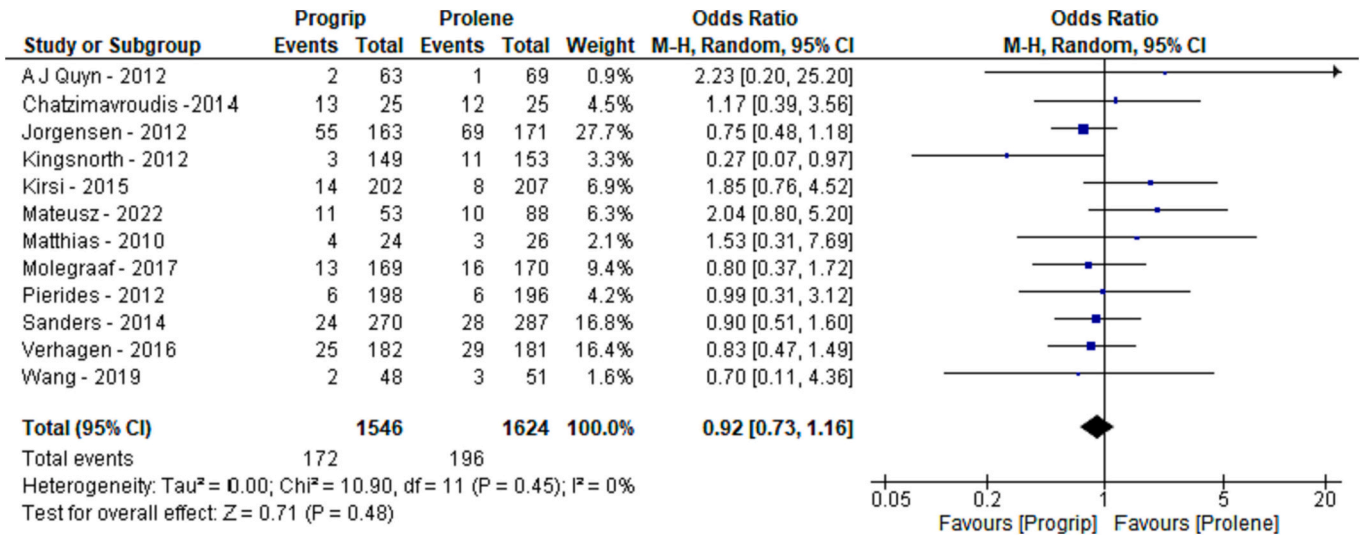

Fig. 3. Forest plot showing the post operative complication in using progrip mesh versus conventional prolene mesh. The outcome is presented as odds ratio with 95 % confidence interval.

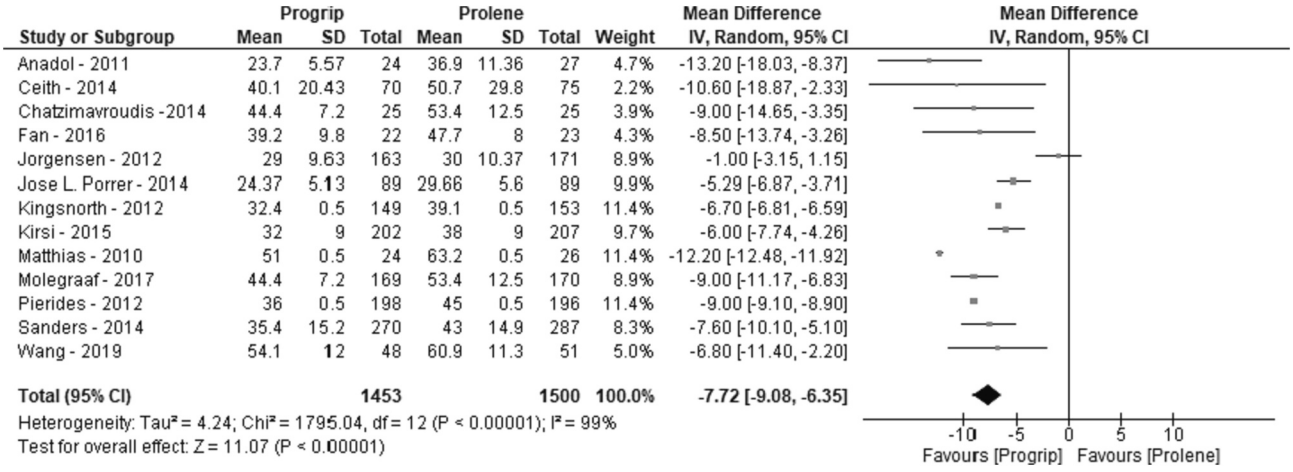

Fig. 4. Forest plot showing the operative time in using progrip mesh versus conventional prolene mesh. The outcome is presented as mean difference with 95 % confidence interval.

Implications

The SGM (pro-grip mesh) was thought to be a viable replacement for the conventional SMF, as mesh fixation material could be one of the factors leading to chronic groin pain. This systematic review has shown that there is no superiority in terms of the perioperative outcomes. Although the operative time was shorter in the SGM (pro-grip mesh), the financial implications of this have to be studied further.

Conclusion

SGM failed to prove any clinical advantage over SMF for perioperative outcomes although the duration of operation was shorter in the SGM when compared with the SMF. Further data might be needed to understand the financial implications of the SGM versus SMF to have a better understanding of the effects as perioperative outcomes of these two techniques are comparable.

Disclosure

All authors have also completed the PRISMA checklist.

All authors have completed the ICMJE uniform disclosure form. The authors have no conflicts of interest to declare.

Sajid MS, the principal author of this systematic review performed a systematic review on the same topic in 2014 [41].

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

This is a systematic review and hence no ethical approval was taken.

CRediT authorship contribution statement

Anurag Singh: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Writing – original draft, Writing – review & editing. **Atreya Subramanian:** Data curation, Formal analysis, Methodology, Writing – original draft. **Wei H. Toh:** Data curation, Writing – original draft. **Premjithlal Bhaskaran:** Methodology, Writing – original draft. **Anam Fatima:** Resources, Writing – original draft. **Muhammad S. Sajid:** Conceptualization, Data curation, Project administration, Supervision, Writing – original draft, Writing – review & editing.

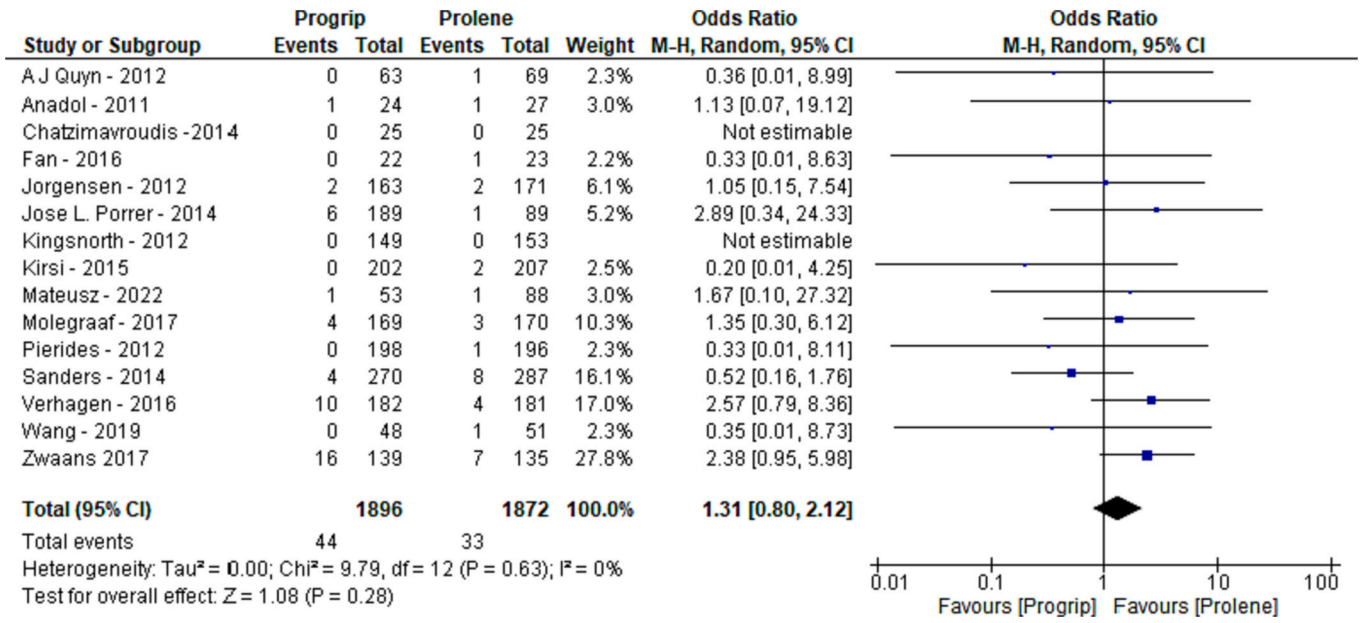

Fig. 5. Forest plot showing the recurrence in using progrip mesh versus conventional prolene mesh. The outcome is presented as odds ratio with 95 % confidence interval.

Declaration of competing interest

None to declare.

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