Comparative meta-analysis of cold snare polypectomy and endoscopic mucosal resection for colorectal polyps: assessing efficacy and safety

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Colorectal polyps are commonly treated with surgical procedures, with cold snare polypectomy (CSP) and endoscopic mucosal resection (EMR) being the two most prevalent techniques. This meta-analysis aimed to compare the efficacy and safety of CSP and EMR in the management of colorectal polyps. Comprehensive searches were conducted in PubMed, Embase, CINAHL, Web of Science, and Cochrane Library databases, covering publications up until June 2024. The primary outcome was complete resection rate, and secondary outcomes included en bloc resection rate, immediate and delayed bleeding, perforation, and procedure time. The Mantel-Haenszel method was employed for the analysis of binary endpoints, while the inverse variance method was used for continuous outcomes. Subgroup analysis was performed to explore potential sources of heterogeneity. Six studies involving 15,296 patients and 17,971 polyps were included in the meta-analysis. CSP had a significantly lower complete resection rate compared to EMR (OR: 0.44, 95% CI: 0.21–0.94, p=0.0334). However, there was no significant difference between CSP and EMR in en bloc resection rate, perforation, or procedure time. Interestingly, CSP had a significantly lower delayed bleeding rate compared to EMR (OR: 0.45, 95% CI: 0.27–0.77, p=0.0034), but there was no significant difference in immediate bleeding rate. In conclusion, CSP is a safe, efficient, and effective technique comparable to EMR. The choice of technique should be based on the individual patient and polyp characteristics.

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Abstract

Colorectal polyps are commonly treated with surgical procedures, with cold snare polypectomy (CSP) and endoscopic mucosal resection (EMR) being the two most prevalent techniques. This meta-analysis aimed to compare the efficacy and safety of CSP and EMR in the management of colorectal polyps. Comprehensive searches were conducted in PubMed, Embase, CINAHL, Web of Science, and Cochrane Library databases, covering publications up until June 2024. The primary outcome was complete resection rate, and secondary outcomes included en bloc resection rate, immediate and delayed bleeding, perforation, and procedure time. The Mantel-Haenszel method was employed for the analysis of binary endpoints, while the inverse variance method was used for continuous outcomes. Subgroup analysis was performed to explore potential sources of heterogeneity. Six studies involving 15,296 patients and 17,971 polyps were included in the meta-analysis. CSP had a significantly lower complete resection rate compared to EMR (OR: 0.44, 95% CI: 0.21─0.94, p=0.0334). However, there was no significant difference between CSP and EMR in en bloc resection rate, perforation, or procedure time. Interestingly, CSP had a significantly lower delayed bleeding rate compared to EMR (OR: 0.45, 95% CI: 0.27─0.77, p=0.0034), but there was no significant difference in immediate bleeding rate. In

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Introduction

Colorectal cancer (CRC) is the third most diagnosed cancer and the second leading cause of cancer-related death worldwide. In 2020, there were approximately 1.9 million new cases and 935,000 deaths from CRC (Sung et al., 2021). Colonic polyps can progress to cancer (Gong et al., 2023), and studies have demonstrated that undergoing endoscopy and their removal can significantly decrease morbidity and mortality associated with colorectal malignancies (Zauber et al., 2012). Different techniques are available for polyp removal. Gastroenterologists typically select a technique based on local healthcare policies and their clinical expertise. The common techniques are cold snare polypectomy (CSP), hot snare polypectomy (HSP) and endoscopic mucosal resection (EMR).

CSP is generally considered the safer, quicker, and more cost-effective option compared to HSP and EMR, as it does not require the use of more invasive procedures, such as electrocautery or submucosal injection (Ferlitsch et al., 2017; Schett et al., 2017; Kawamura et al., 2018). CSP has been shown to have a lower incidence of adverse events, such as postoperative bleeding and perforation, compared to endoscopic electrocautery resection (Uraoka et al., 2022). However, the Guidelines for Colorectal Cold Polypectomy demonstrated this evidence is low-quality (Uraoka et al., 2022). The European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline also provides low-quality evidence recommending that piecemeal CSP may reduce the risk of deep mural injury for polypectomy of sessile polyps (10-19 mm) under certain conditions (Ferlitsch et al., 2017). Therefore, further high-quality studies are needed to confirm the clinical advantages of using CSP.

The choice of colorectal polyp removal technique depends on the size of the lesion. For lesions smaller than 10 mm, CSP is the recommended technique (Uraoka et al., 2022). Its complete resection rate is comparable to HSP (Qu et al., 2019), but its incomplete resection rate is higher than EMR (Zhang et al., 2018). For lesions beyond 10 mm, the choice of technique is based on the gastroenterologist's judgment (Uraoka et al., 2022). To date, no definitive conclusion has been reached regarding the superiority of CSP over EMR. Therefore, we conducted this systematic review and meta-analysis to compare the efficacy and safety of CSP and EMR for colorectal polyps.

Materials & Methods

The detailed protocol of this systematic review and meta-analysis was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO) under ID: CRD42022336152 to ensure its integrity and accountability.

Search strategy

A comprehensive literature search was conducted in five databases: Cochrane Library, CINAHL, Embase, PubMed, and Web of Science. The search included articles published up to June 2024 that reported on the safety and efficacy of CSP and EMR for removing colon polyps. The search strategies were identical across all databases and can be found in Article S1.

Selection criteria

The inclusion and exclusion criteria for this study were developed based on the Cochrane Collaboration guidelines and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) recommendations (Page et al., 2021). We employed the Population, Intervention, Comparison, and Outcome (PICO) framework to define the criteria and identify the relevant studies for this review.

The inclusion criteria encompassed the following: 1) studies that included patients who had undergone colonoscopy; 2) studies assessing the effectiveness (including complete resection rate and en bloc resection rate) and safety (such as immediate bleeding, delayed bleeding, perforation, and procedure time) of CSP and EMR; and 3) randomized controlled trials (RCTs) and cohort trials with valid data.

The exclusion criteria were animal studies, conference abstracts, case reports, review articles, editorials, notes, and letters, and case series with fewer than 10 patients were excluded. Additionally, studies involving patients with inflammatory bowel disease, familial polyposis, significant infectious disease, pregnancy, chronic kidney disease, or a history of liver cirrhosis were excluded. Non-English language articles were also excluded.

The definitions of CSP and EMR may vary slightly in the literature. In this review, CSP is defined as the use of a snare alone without electrocautery. EMR is defined as an approach that involves submucosal injection around the polyp to achieve satisfactory tissue elevation, followed by the placement of an open snare around the polyp. The snare is then tightened to include approximately 2 to 3 mm of normal mucosa around the base of the polyp, and electrocautery is used for excision. Studies that do not adhere to these definitions were excluded from this review.

Study selection

All search results were imported into EndNote X9 software. Duplicates were removed using the automated "find duplicates" feature, followed by a manual review. Two independent authors (Shouqi Wang and Qi Zhang) then screened the titles and abstracts to identify potential studies. Full-text articles were retrieved for further evaluation, and studies meeting the predefined eligibility criteria were selected. In cases of disagreement, a third author (Weixia Zhou) conducted a blinded reassessment without knowledge of the other authors' opinions. Subsequently, the three authors engaged in discussions to reach a consensus. The review process was not blinded to authors, institutions, or journals. All studies comparing the effects and adverse events of CSP with EMR were included, regardless of whether the data were primary or secondary endpoints.

Study outcomes

The primary outcomes of this study were the complete resection rate achieved using CSP and EMR. Complete resection was defined as the removal of a polyp with histologically negative horizontal and vertical margins. Secondary outcomes included safety parameters such as the en bloc resection rates (visual polyp eradication assessed by the endoscopist's expertise and judgment), immediate and delayed bleeding events, perforation, and the procedure time (excluding anesthesia and preparation).

Data extraction

Two authors independently extracted data using standardized forms. The following data were extracted from each included study: author and year of publication, study design, country, study period, number of included patients, age and sex of patients, number of lesions, mean lesion size, morphology of the lesion, polyp removal method, complete resection rate, en bloc resection rate, immediate and delayed bleeding, perforation, and procedure time.

Quality assessment

The methodological quality and risk of bias of each study were assessed by all authors according to the Cochrane Handbook for Systematic Reviews of Interventions version 6.4. The Cochrane Risk of Bias 2 (ROB2) (Sterne et al., 2019) was used to assess the quality of randomized controlled trials (RCTs), and the Risk of Bias in Non-Randomized Studies of Interventions (ROBINS-I) tool was used to assess the quality of retrospective cohort studies (Sterne et al., 2016). Disagreements were resolved through discussion among all authors.

Statistical analysis

Meta-analyses were conducted using R (version 4.2.1) with the 'meta' and 'metafor' packages (Lortie & Filazzola, 2020). Odds ratios (ORs) along with 95% confidence intervals (CIs) were calculated using the Mantel-Haenszel method to analyze binary outcome data. Standardized mean differences (SMDs) with 95% CIs were calculated using inverse variance weighting for continuous outcomes.

Heterogeneity was assessed using the I^2 statistic, where values above 50% or a chi-square test p-value<0.1 indicated significant heterogeneity (Higgins & Thompson, 2002). Potential sources of heterogeneity were investigated through sensitivity analyses, including fixed-effects versus random-effects models, subgroup analyses, meta-regression, and by excluding individual studies one at a time. Publication bias was assessed using a funnel plot and Egger's test, with a *p*-value < 0.1 for Egger's test considered statistically significant (Shi et al., 2017).

Results

Studies selected for analysis

The research strategies and selection criteria identified 1048 publications, primarily sourced from Embase and Web of Science (Fig. 1). After removing duplicates, 667 studies remained.

Screening of titles and abstracts resulted in 50 potentially relevant articles. Upon a thorough full-text review, 44 publications were excluded, leaving 6 studies eligible for inclusion in the meta-analysis. These comprised 3 RCTs (Zhang et al., 2018; Li et al., 2020; Rex et al., 2022) and 3 cohort studies (Fig. 1) (Noda et al., 2016; Ito et al., 2018; Saito et al., 2022).

Study characteristics

This meta-analysis included a total of 15,296 patients and 17,971 polyps across six selected studies. One study compared complications associated with resection treatments for colorectal polyps, including cold forceps polypectomy procedures, cold snare polypectomy (CSP), hot biopsies, hot snare polypectomy (HSP), endoscopic or piecemeal endoscopic mucosal resection (EMR/p-EMR), and endoscopic submucosal dissection (ESD) (Saito et al., 2022). Another trial conducted a three-arm comparison of efficacy and safety among CSP, cold snare endoscopic mucosal resection (CS-EMR), and EMR (Li et al., 2020). In a separate study, the efficacy of CSP and CS-EMR versus HSP and hot snare endoscopic mucosal resection (HS-EMR) was investigated for colorectal lesions measuring 6-15 mm (Rex et al., 2022). The other three studies employed a two-arm design to compare CSP and EMR, with a primary focus on their efficacy and adverse reactions (Noda et al., 2016; Zhang et al., 2018; Ito et al., 2018).

The six included studies were published between 2016 and 2022, with three conducted in Japan, two in China, and one in the United States (Table 1). Regarding the macroscopic type of polyps, three studies did not impose any restrictions, one excluded pedunculated polyps, and two specifically focused on nonpedunculated colorectal lesions. The mean or median age of patients treated with CSP ranged from 51.6 to 72.0 years, while for patients treated with EMR, it ranged from 51.6 to 68.0 years. Male patients accounted for 55% to 78.3% of cases in both CSP and EMR groups. The average polyp size ranged from 5.00 to 11.95 mm for CSP and from 4.00 to 12.22 mm for EMR. Five of the six studies reported the complete resection rate, with CSP groups ranging from 42.9% to 100.0% and EMR groups ranging from 60.9% to 98.5%. Three studies provided data on the en bloc rate. The incidences of perforation, immediate bleeding, and delayed bleeding were low. The duration of the procedures reported in the three RCTS varied between 2.12 and 4.70 minutes for the CSP groups and between 3.41 and 5.50 minutes for the EMR groups (Table 1 and 2).

Assessment of inherent bias

According to the Cochrane risk of bias analysis, the overall risk of bias for the included studies was considered to be low to moderate. However, one RCT failed to report blinding of participants and personnel (Fig. 2). Another RCT by Zhang et al. (Zhang et al., 2018) did not adequately describe the randomization method, which may have compromised allocation concealment. On the other hand, the ROBINS-I tool indicated that although these studies employed methodological controls, some risks of bias remained, particularly in the classification of interventions and reporting of outcomes (Fig. 3 and Table 3).

Complete resection rate

Five studies reported the complete resection rate for lesions removed by CSP and EMR (Noda et al., 2016; Zhang et al., 2018; Ito et al., 2018; Li et al., 2020; Rex et al., 2022), encompassing a total of 883 lesions removed by CSP and 1800 lesions removed by EMR. The complete resection rate ranged from 42.9% to 100% in the CSP group and 60.9% to 98.5% in the EMR group (Table 2). A significant difference in the complete resection rate was observed between CSP and EMR (OR: 0.44, 95% CI: 0.21–0.94, p=0.0334), with high heterogeneity (I^2=80%).

Subgroup analyses were conducted based on the study location (China, Japan, and the U.S.), significant differences between CSP and EMR in the Japanese and Chinese analyses (OR: 0.61, 95% CI: 0.48–0.79, p<0.001 and OR 0.20, 95% CI: 0.11–0.35, p<0.001, respectively) (Fig. 4A). The Chinese analysis exhibited no heterogeneity (I^2=0%), while the Japanese analysis demonstrated moderate heterogeneity (I^2=65%). Due to the limited number of included studies, a comprehensive assessment of publication bias was challenging.

En bloc resection rate

This analysis included the three studies that examined the en bloc resection rate (Table 2), with a total of 475 lesions in the CSP group and 559 lesions in the EMR group. En bloc resection rates ranged from 58.8% to 99.3% for CSP and 84.6% to 97.5% for EMR. Statistical analysis revealed no significant difference in en bloc resection rates between CSP and EMR (OR: 0.48, 95% CI: 0.16–1.43, p=0.1872). However, there was moderate heterogeneity (I^2=61%) (Fig. 4B).

Perforation

Perforation was reported in four out of the six included studies (Table 2), involving a total of 5262 lesions removed in the CSP group and 11746 lesions in the EMR group. No statistical significance was found between CSP and EMR (OR: 0.67, 95% CI: 0.18–2.53; p=0.5525), and no heterogeneity was observed (I^2=0%) (Fig. 5A).

Immediate bleeding

Immediate bleeding was reported in four studies (Table 2). Subgroup analyses based on study location (China, Japan, and the U.S.) were conducted due to significant heterogeneity (p=0.9513, I^2=83%). A statistically significant difference was found between CSP and EMR in the Chinese analysis (OR: 3.35, 95% CI: 1.05–10.74, p=0.0087) (Fig. 5B), with low heterogeneity (I^2=46%). However, the overall analysis indicated that CSP may not differ significantly from EMR (OR: 1.06, 95% CI: 0.23–4.68, p=0.9513).

Delayed bleeding

Five studies with data on delayed bleeding were included in this analysis, comprising 5829 patients in the CSP group and 12009 patients in the EMR group (Table 2). One of these studies reported no delayed bleeding events. For the remaining studies, the delayed bleeding rate ranged from 0.00% to 1.23% in the CSP group and 0.20% to 2.71% in the EMR group. The CSP group had a significantly lower delayed bleeding rate compared to that of EMR (OR: 0.45, 95% CI: 0.27–0.77, p=0.0034), with no heterogeneity observed (I^2=0%) (Fig. 5C).

Procedure time

Three out of the six studies included in this analysis were RCTs that measured procedure time (Table 1). These studies involved a total of 367 patients in the CSP group and 372 patients in the EMR group (Table 2). These studies exhibited a high level of heterogeneity (I^2=92%), leading to a subgroup analysis based on the geographic location of the studies (China vs. U.S.) (Fig. 5D). The subgroup analysis revealed that the CSP group in China had a significantly shorter procedure duration compared to the EMR group (SMD -0.32, 95% CI: -0.48 – -0.17, p<0.0001) (Fig. 5D), and no heterogeneity was observed (I^2=0%). However, when considering the overall effect, the analysis indicated that CSP may not differ significantly from EMR (SMD -0.68, 95% CI: -1.39–0.02, p=0.0580).

Discussion

The findings of this meta-analysis indicated that significant differences were found between CSP and EMR regarding the complete resection rate and delayed bleeding, but not in other measurements, including the en bloc resection rate, perforation, immediate bleeding, and the procedure time.

To date, there have been limited studies directly comparing the efficacy and safety of CSP and EMR for treating colorectal polyps. Previous investigations have primarily focused on comparing EMR with endoscopic submucosal dissection (ESD) (Chao, Zhang & Si, 2016; Pan et al., 2018; Shahini et al., 2022) or CSP with hot snare polypectomy (HSP) (Fujiya et al., 2016; Takeuchi et al., 2022). For instance, Xin Yuan et al. (Yuan et al., 2021) conducted a systematic review and pooled analysis comparing the effectiveness and safety of different endoscopic resection methods. However, their study only included the R0 resection rate and en bloc resection rate as outcome measures, with limited data available for CSP. In contrast, our meta-analysis in this study provides more specific comparisons of polyp removal methods and includes multiple outcome measures for direct comparisons. We also introduced the assessment of the complete resection rate and delayed bleeding between CSP and EMR to our analysis, providing clinically valuable results.

Comparative evaluation of safety

Consistent with a previous study (Abe et al., 2018), our findings demonstrate that CSP does not significantly reduce the incidence of perforation compared to other polyp resection approaches. The incidence of perforation in clinical studies is rare for both CSP and EMR (Abe et al., 2018), which may explain the lack of difference in perforation rates between the two methods in our study.

The comparable low incidence of immediate bleeding between CSP and EMR may be attributed to a similar low incidence factor (Bahin et al., 2016), However, in terms of delayed bleeding, CSP is generally associated with a low incidence rate, as supported by previous studies (Paspatis et al., 2011; Bahin et al., 2016; Chang et al., 2019). Our findings reveal a significantly lower incidence of delayed bleeding with CSP compared to EMR. This difference can be explained by the absence of electrocautery in CSP, which eliminates the potential thermal injury to the colonic wall and lowers the risk of subsequent delayed bleeding (Lorenzo-Zúñiga et al., 2014). Additionally, the mechanical tearing wounds created by cold polypectomy may facilitate easier healing compared to the thermal tissue damage induced by electrocautery at the edges of the mucosal defect in EMR (Lorenzo-Zúñiga et al., 2014). The thermal injury can lead to tissue necrosis that extends both horizontally and vertically, potentially increasing the likelihood of delayed bleeding.

It is important to note that other factors may also have influenced the findings of this study. For instance, studies have suggested that the use of more endoscopic clips may reduce the rate of delayed bleeding (Matsumoto et al., 2016; Spadaccini et al., 2020). However, the prophylactic use of hemostatic clips has not been proven to prevent delayed bleeding after conventional polypectomy (Matsumoto et al., 2016; Spadaccini et al., 2020). Furthermore, the number of endoscopic clips used was not specified in the included studies of this meta-analysis.

In terms of procedure time, we observed a non-significant difference, with CSP being slightly shorter than EMR (Table 2 and Fig. 5D). One possible explanation for this finding is the additional time required in EMR for the elevation of flat polyps before submucosal injection (Ichise et al., 2011; Uraoka et al., 2014). However, it is also possible that the flat polyps can be more difficult to snare in CSP and lead to a longer procedure time.

Comparative evaluation of effectiveness

In this study, we observed comparable en bloc resection rates between CSP and EMR (Table 2 and Fig. 4B). Previous literature has indicated that the rate of en bloc resection tends to be higher for specific lesions, such as residual or recurrent adenoma (RRA) in nonpedunculated colorectal lesions (Belderbos et al., 2014). However, our study included a diverse range of polyps, which may have contributed to the lack of difference in en bloc resection rates between CSP and EMR.

The EMR has demonstrated enhanced complete resection than CSP in this meta-analysis. Several factors may contribute to this difference. EMR allows for the removal of larger lesions using a "piecemeal" resection technique, where polyps are removed in multiple fragments (Scheer et al., 2022). Additionally, EMR offers the option for additional therapeutic interventions, such as submucosal injection of agents, thermal hemostasis, or the use of endoscopic clips (Zhang et al., 2018). EMR is commonly employed in polyp removal using a snare and an electrosurgical unit to ensure complete resection (Ferlitsch et al., 2017).

Furthermore, the studies included in our analysis focused on lesions with a diameter of less than 20 mm. Although CSP may be applied to larger polyps (Tate et al., 2018; Yoshida et al., 2021), Japanese guidelines still recommend its use for adenomas smaller than 10 mm (Uraoka et al., 2022). A study has shown that the complete resection rates for CSP and EMR are similar for colorectal polyps measuring 3-10 mm (Wang et al., 2024). Therefore, using CSP in these relatively large lesions might have contributed to the lower complete resection rate compared to EMR.

The utilization of various types of CSP procedures and adherence to clinical guidelines vary among endoscopists with varying levels of training (Torres et al., 2022). The skill and experience of the endoscopists have also been shown to impact the rate of complete resection (Pohl et al., 2013). In this analysis, the included studies involved endoscopists who were specialists with a specific interest in colorectal cancer prevention and polypectomy, which may limit the generalizability of the results (Rex et al., 2022). However, it is worth noting that the studies in our analysis explicitly stated that polypectomies were performed by experienced endoscopists in both groups, and a specific number of endoscopy examinations had to be completed each year (Zhang et al., 2018; Li et al., 2020). This suggests that the variability in endoscopist skills was minimized within the study population.

The subgroup analysis of the complete resection rate in China, Japan, and the U.S. revealed heterogeneity (Fig. 4A). This heterogeneity may be attributed to several factors. One potential factor is the variation in definitions of complete resection. Among the studies analyzed, two defined complete resection as the absence of histologically negative horizontal and vertical edges of the resected polyp, whereas three others defined it as the absence of visible adenomas or hyperplastic tissue in forceps samples histologically taken from four quadrants of tissue at the base and wound edge. Therefore, these differences may have influenced the number of complete resections reported in the included studies.

Another factor that may influence the complete resection rate is the variability in polyp size. The range of polyp sizes observed in the analyzed studies was wide, and this variability has a direct impact on the achievement of complete resection. In general, smaller polyps are more easily and completely removed.

Moreover, the use of narrow-band imaging (NBI) during biopsy sampling could potentially affect the complete resection rate of polyps (Tsuji et al., 2018). The application of NBI as a diagnostic tool may influence the accuracy of polyp detection and subsequent resection. However, the included studies in this analysis did not provide information regarding the use of NBI. Additionally, the choice of snares used in the resection procedure may also contribute to the varying rates of complete polyp resection (Din et al., 2015). Different types of snares could have different efficacy and safety profiles, which might impact the overall success of the resection.

Limitations

This meta-analysis is limited by the absence of data on recurrence rates after CSP and EMR in the six included studies. Recurrence rates are crucial for prognosis, as CSP of sessile serrated lesions (SSLs) ≥10 mm has been associated with a higher recurrence rate (Yoshida et al., 2021). The unavailability of this information precluded the investigation of this factor.

Additionally, the study lacks a cost-effectiveness analysis of CSP and EMR. Compared to EMR, CSP does not require an electrosurgical system or submucosal injection, potentially resulting in lower cumulative direct costs (Oh, Choi & Cho, 2022). EMR resection margins for polyps larger than 20 mm may also involve thermal ablation to reduce adenoma recurrence rates (Chandrasekar et al., 2020), which can incur additional costs. However, the included studies did not provide cost information, hindering the analysis of cost differences.

The analysis conducted in this study did not include the thickness of the wire utilized in CSP. This decision was based on previous research findings (Giri et al., 2022), which indicated that the diameter of the wire is not associated with either the effectiveness or safety of CSP.

This meta-analysis includes only six studies that met the selection criteria, which may limit the statistical power of the results. Nevertheless, these studies involved a substantial sample size of 15,296 patients, and subgroup analyses were employed to address heterogeneity between studies. This study adheres to the Cochrane Collaboration's rigorous methodology, including comprehensive search strategies, independent selection and data abstraction, and quality assessment, to enhance the reliability and generalizability of the findings.

Conclusions

This meta-analysis provides evidence that EMR has a higher complete resection rate but a higher delayed bleeding rate compared to CSP. However, en bloc resection rate and perforation rate are similar between the two techniques. Interestingly, CSP does not increase the risk of immediate bleeding or reduce the procedure time. Based on these findings, we conclude that CSP is a safe and effective polypectomy technique comparable to EMR. Further research is warranted to investigate the long-term follow-up of polyp recurrence and to conduct a cost-benefit analysis comparing CSP and EMR.

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Table 1(on next page)

Baseline characteristics of included studies in the meta-analysis.

Table 1:

Baseline characteristics of included studies in the meta-analysis.

First author	Publication year	Study type	Location	Time interval	Polyp size (mm)	Macroscopic type
Hisatsugu Noda	2016	Cohort study	Japan	May 2014 – June 2015	3 – 15	Unlimited
Qisheng Zhang	2017	RCT	China	March 2014 – May 2016	6 – 9	Non-pedunculated colorectal lesions
Akihiro Ito	2018	Cohort study	Japan	September 2014 – October 2016	≤ 9	Non-pedunculated colorectal lesions
Dazhou Li	2020	RCT	China	July 2017 – March 2019	6 – 20	Unlimited
Douglas Rex	2022	RCT	US	August 2018 – March 2021	6 – 15	Non-pedunculated colorectal lesions
Yutaka Saito	2022	Cohort study	Japan	January 2015 – March 2017	Unlimited	Unlimited

Table 2(on next page)

Characteristics of included studies comparing Cold Snare Polypectomy (CSP) and Endoscopic Mucosal Resection (EMR) for colon polyp resection.

Table 2:

Characteristics of included studies comparing Cold Snare Polypectomy (CSP) and Endoscopic Mucosal Resection (EMR) for colon polyp resection.

First author	Number of lesions	Number of patients (male/total)	Mean patient age (year)	Mean polyp size (mm)	Complete resection rate	En bloc rate	Perforation rate	Immediate bleeding	Delayed bleeding	Procedure time (min)
Hisatsugu Noda										
CSP	175	83/106	66.8	5.0	93/175	NA	0/175	NA	0/175	NA
EMR	1010	285/423	67.9	6.8	615/1010	NA	0/1010	NA	2/1010	NA
Qisheng Zhang										
CSP	267	96/179	64.5 ± 7.7	7.4±1.5	194/212	234/267	NA	5/267	0/267	4.7 ± 3.4
EMR	258	101/179	65.8 ± 9.4	7.7±1.4	200/203	245/258	NA	3/258	0/258	5.5 ± 2.7
Akihiro Ito										
CSP	373	85/126	72 (median)	4 (median)	79/184	NA	0/373	NA	2/373	NA
EMR	699	261/408	68 (median)	5 (median)	114/184	NA	0/699	NA	19/699	NA
Dazhou Li										
CSP	244	77/129	51.63 ± 14.395	11.95 ± 3.35	199/244	139/140	1/244	23/244	3/244	3.01 ± 1.019
EMR	267	80/137	51.59 ± 14.495	12.22 ± 3.77	255/267	230/236	2/267	5/267	7/267	3.41 ± 0.925
Douglas Rex										
CSP	68	34/59	66.2±9.9	9.4±3.1	68/68	40/68	NA	0/59	NA	2.12 ± 1.52
EMR	65	39/56	67.0±8.4	10.0±3.1	125/136	55/65	NA	4/56	NA	5.12 ± 2.53
Yutaka Saito										
CSP	4770	3218/4437	67.13±10.75	5.68	NA	NA	2/4770	7/4770	12/4770	NA
EMR	9775	6499/9057	65.47±11.58	9.82	NA	NA	6/9770	31/9775	48/9775	NA

Table 3(on next page)

Newcastle-Ottawa Scale (NOS) scores of the included cohort studies.

Table 3:

Newcastle-Ottawa Scale (NOS) scores of the included cohort studies.

NOS items	**Studies** Hisatsugu Noda	Akihiro Ito	Yutaka Saito
Selection			
Representativeness of the exposed cohort	*	*	*
Selection of the non-exposed cohort	*	*	*
Ascertainment of exposure	*	*	*
Demonstration that outcome of interest was not present at the start of the study	*	*	*
Comparability of cohorts based on the design or analysis	**	**	**
Outcome			
Assessment of outcome	*	*	*
Follow-up long enough for outcomes to occur	*	*	*
Adequacy of follow-up of cohorts	0	0	0
Total scores (9/9)	8/9	8/9	8/9

Figure 1

PRISMA-guided assessment protocol for studies identified in the meta-analysis.

CSP, cold snare polypectomy; EMR, endoscopic mucosal resection

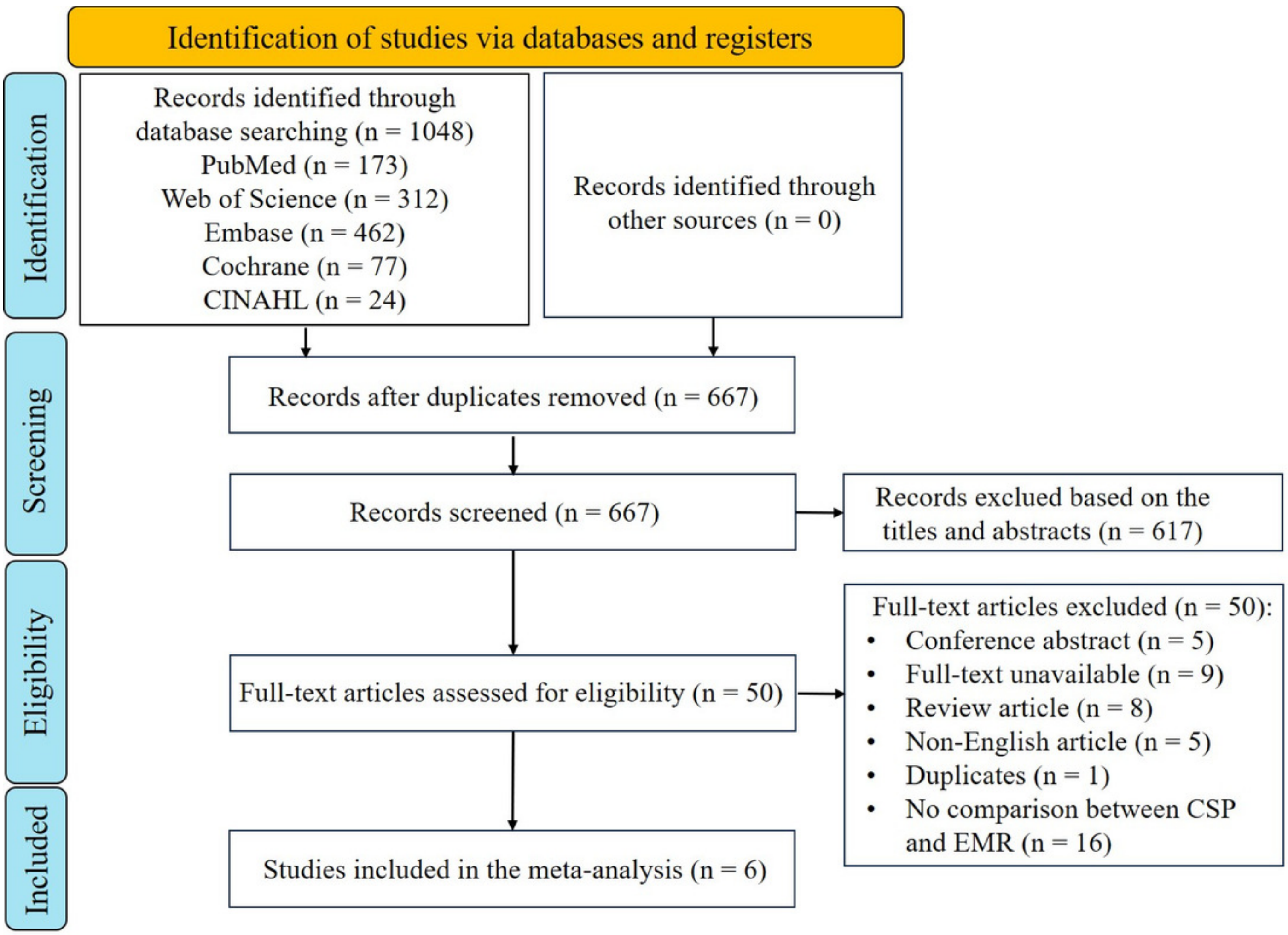


Figure 2

(A) Overall and (B) individual Cochrane risk of bias (ROB2) assessment for the three included RCTs studies.

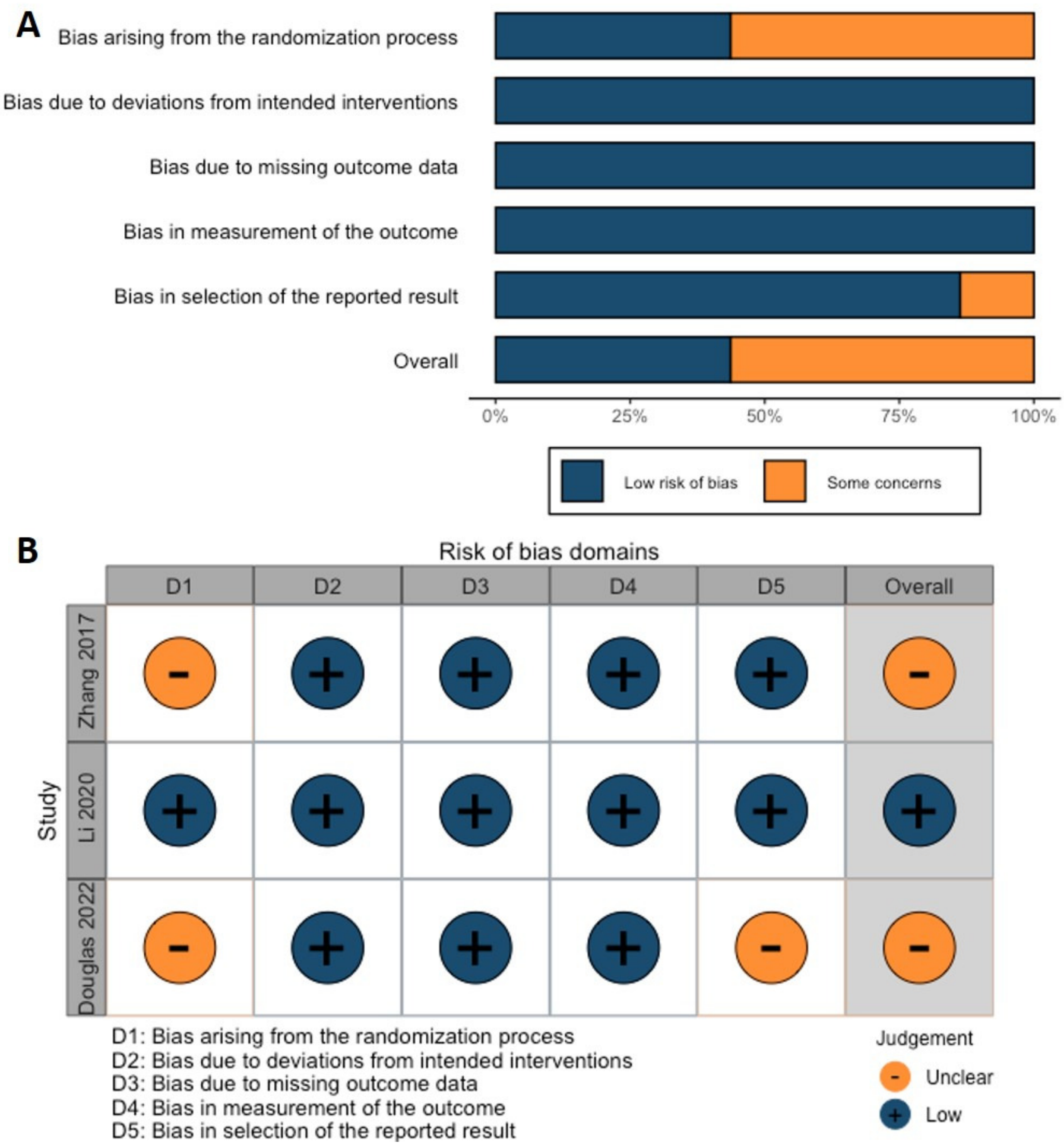

A
Bias arising from the randomization process
Bias due to deviations from intended interventions
Bias due to missing outcome data
Bias in measurement of the outcome
Bias in selection of the reported result
Overall
0%
25%
50%
75%
100%
Low risk of bias
Some concerns
B
Risk of bias domains
D1
D2
D3
D4
D5
Overall
Study
Zhang 2017
Li 2020
Douglas 2022
D1: Bias arising from the randomization process
D2: Bias due to deviations from intended interventions
D3: Bias due to missing outcome data
D4: Bias in measurement of the outcome
D5: Bias in selection of the reported result
Judgement
Unclear
Low

Figure 3

(A) Overall and (B) individual Risk of Bias in Non-Randomized Studies of Interventions (ROBINS-I) assessment for the three included retrospective cohort studies.

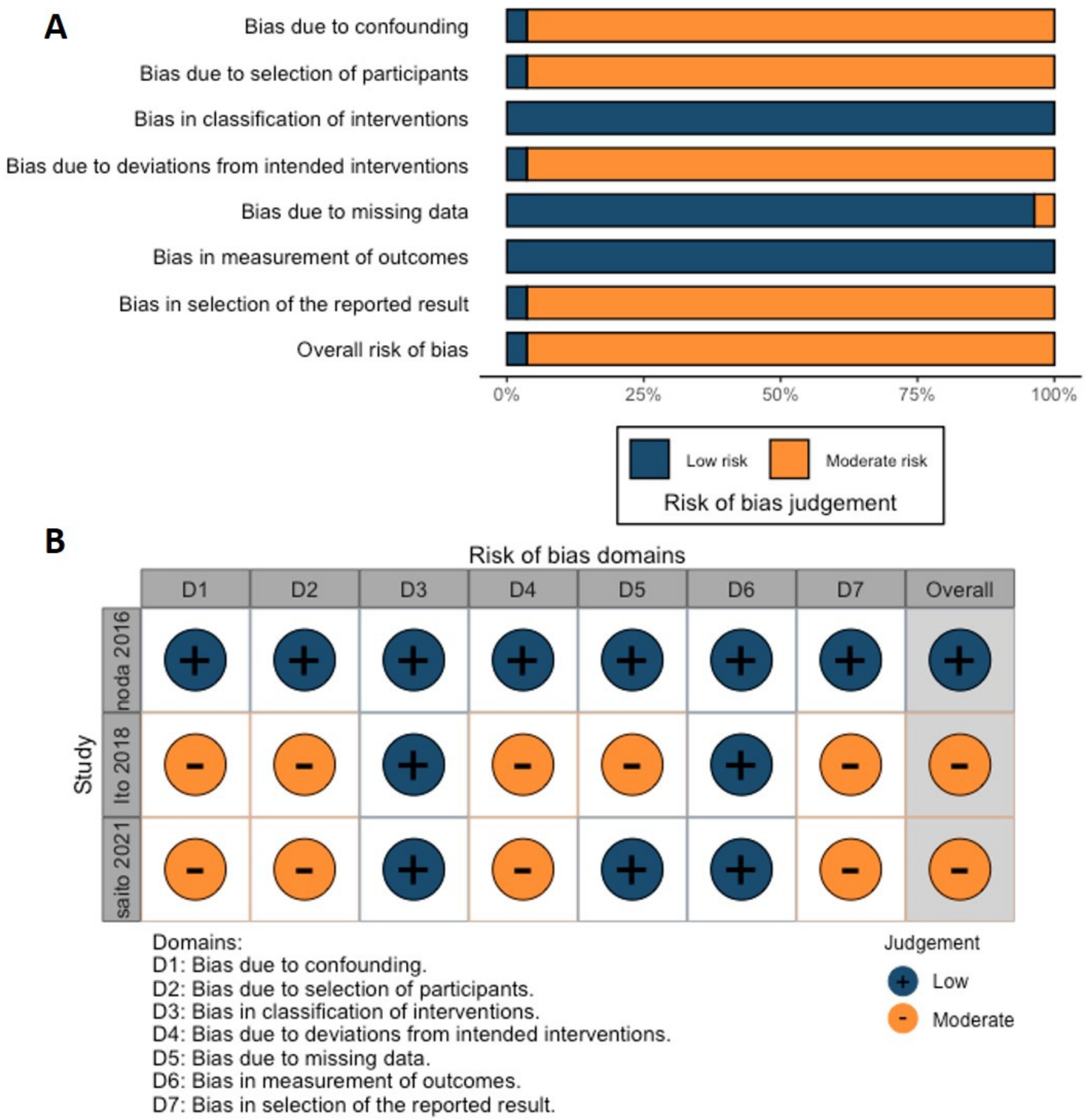


Figure 4

Forest plot comparing the effectiveness measurements of cold snare polypectomy (CSP) and endoscopic mucosal resection (EMR) for (A) complete resection rate and (B) en bloc rate.

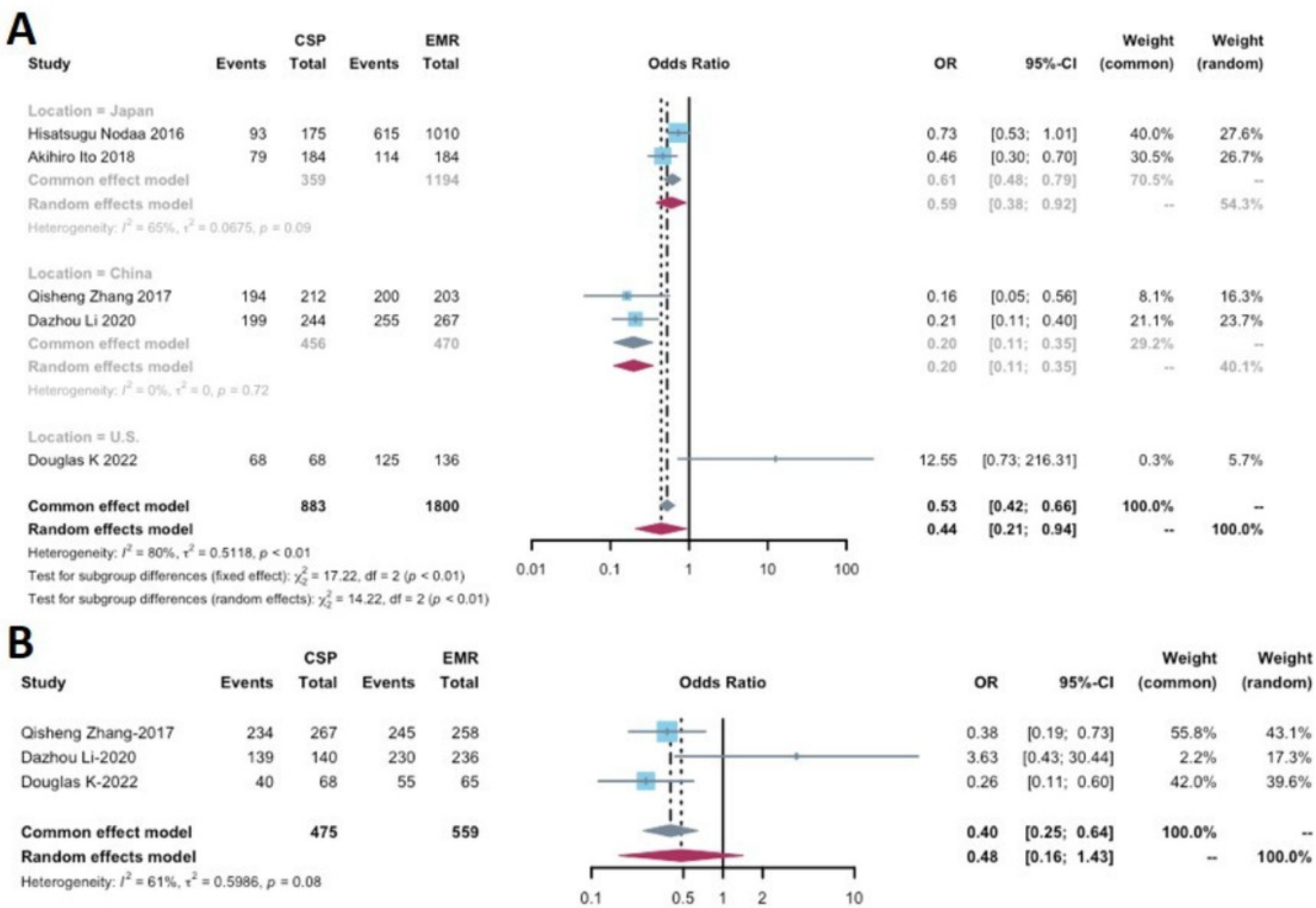
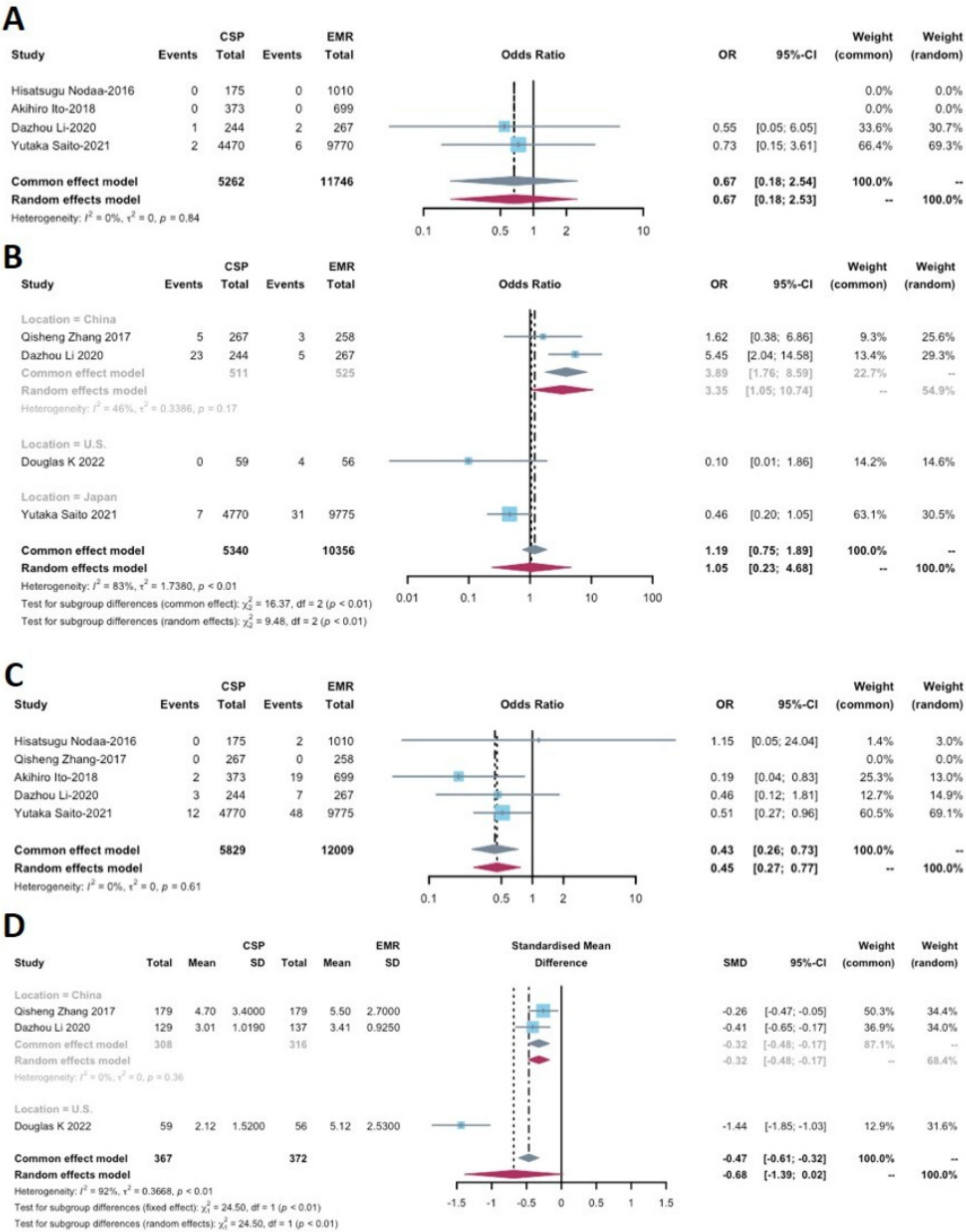


Figure 5

Forest plot comparing the safety profiles of cold snare polypectomy (CSP) and endoscopic mucosal resection (EMR) for (A) perforation, (B) immediate bleeding, (C) delayed bleeding and (D) procedure time.


A
Study Events CSP Total Events EMR Total Odds Ratio OR 95%-CI Weight (common) Weight (random)
Hisatsugu Nodaa-2016 0 175 0 1010 0.0% 0.0%
Akihiro Ito-2018 0 373 0 699 0.0% 0.0%
Dazhou Li-2020 1 244 2 267 0.55 [0.05; 6.05] 33.6% 30.7%
Yutaka Saito-2021 2 4470 6 9770 0.73 [0.15; 3.61] 66.4% 69.3%
Common effect model 5262 11746 0.67 [0.18; 2.54] 100.0% --
Random effects model 0.67 [0.18; 2.53] -- 100.0%
Heterogeneity: I² = 0%, τ² = 0, p = 0.84
0.1 0.5 1 2 10
B
Study Events CSP Total Events EMR Total Odds Ratio OR 95%-CI Weight (common) Weight (random)
Location = China
Qisheng Zhang 2017 5 267 3 258 1.62 [0.38; 6.86] 9.3% 25.6%
Dazhou Li 2020 23 244 5 267 5.45 [2.04; 14.58] 13.4% 29.3%
Common effect model 511 525 3.89 [1.76; 8.59] 22.7% --
Random effects model 3.35 [1.05; 10.74] -- 54.9%
Heterogeneity: I² = 46%, τ² = 0.3386, p = 0.17
Location = U.S.
Douglas K 2022 0 59 4 56 0.10 [0.01; 1.86] 14.2% 14.6%
Location = Japan
Yutaka Saito 2021 7 4770 31 9775 0.46 [0.20; 1.05] 63.1% 30.5%
Common effect model 5340 10356 1.19 [0.75; 1.89] 100.0% --
Random effects model 1.05 [0.23; 4.68] -- 100.0%
Heterogeneity: I² = 83%, τ² = 1.7380, p < 0.01
Test for subgroup differences (common effect): χ²₂ = 16.37, df = 2 (p < 0.01)
Test for subgroup differences (random effects): χ²₂ = 9.48, df = 2 (p < 0.01)
0.01 0.1 1 10 100
C
Study Events CSP Total Events EMR Total Odds Ratio OR 95%-CI Weight (common) Weight (random)
Hisatsugu Nodaa-2016 0 175 2 1010 1.15 [0.05; 24.04] 1.4% 3.0%
Qisheng Zhang-2017 0 267 0 258 0.0% 0.0%
Akihiro Ito-2018 2 373 19 699 0.19 [0.04; 0.83] 25.3% 13.0%
Dazhou Li-2020 3 244 7 267 0.46 [0.12; 1.81] 12.7% 14.9%
Yutaka Saito-2021 12 4770 48 9775 0.51 [0.27; 0.96] 60.5% 69.1%
Common effect model 5829 12009 0.43 [0.26; 0.73] 100.0% --
Random effects model 0.45 [0.27; 0.77] -- 100.0%
Heterogeneity: I² = 0%, τ² = 0, p = 0.61
0.1 0.5 1 2 10
D
Study Total Mean CSP SD Total Mean EMR SD Standardised Mean Difference SMD 95%-CI Weight (common) Weight (random)
Location = China
Qisheng Zhang 2017 179 4.70 3.4000 179 5.50 2.7000 -0.26 [-0.47; -0.05] 50.3% 34.4%
Dazhou Li 2020 129 3.01 1.0190 137 3.41 0.9250 -0.41 [-0.65; -0.17] 36.9% 34.0%
Common effect model 308 316 -0.32 [-0.48; -0.17] 87.1% --
Random effects model -0.32 [-0.48; -0.17] -- 68.4%
Heterogeneity: I² = 0%, τ² = 0, p = 0.36
Location = U.S.
Douglas K 2022 59 2.12 1.5200 56 5.12 2.5300 -1.44 [-1.85; -1.03] 12.9% 31.6%
Common effect model 367 372 -0.47 [-0.61; -0.32] 100.0% --
Random effects model -0.68 [-1.39; 0.02] -- 100.0%
Heterogeneity: I² = 92%, τ² = 0.3668, p < 0.01
Test for subgroup differences (fixed effect): χ²₁ = 24.50, df = 1 (p < 0.01)
Test for subgroup differences (random effects): χ²₁ = 24.50, df = 1 (p < 0.01)
-1.5 -1 -0.5 0 0.5 1 1.5