Clinical and Experimental Obstetrics & Gynecology

Clin. Exp. Obstet. Gynecol. **2023**; 50(11): 251
https://doi.org/10.31083/j.ceog5011251

Systematic Review

Baseball Suture versus Traditional Suture in Laparoscopic Myomectomy: A Systematic Review and Meta-Analysis

Tong Jiang[1,*], Xiuzhen Xue[1]

[1]Department of Obstetrics, the First Affiliated Hospital, and College of Clinical Medicine of Henan University of Science and Technology, 471003 Luoyang, Henan, China

*Correspondence: 200320281418@stu.haust.edu.cn; 15737925879@139.com (Tong Jiang)

Academic Editor: Michael H. Dahan

Submitted: 1 June 2023 Revised: 5 August 2023 Accepted: 25 August 2023 Published: 29 November 2023

Abstract

Background: Uterine myoma, which seriously threatens women's physical and mental health and quality of life, is the most common benign pelvic tumor in gynecology. At present, laparoscopic myomectomy (LM) has become an effective and commonly surgical method in clinical practice. The aim of this study, using meta-analysis method, is to analyze the advantages and disadvantages of baseball suture comparing with traditional one, and provide a theoretical basis for the selection of surgical suture methods. **Methods**: CNKI, WanFang Data, VIP, PubMed, web of science and the Cochrane Library are searched to collect original data and cases. Two researchers independently screen the literature according to the inclusion and exclusion criteria, extract the data and cross check them. Then RevMan 5.4 and STATA 14 are used for statistical analysis. The difference is statistically significant ($p < 0.05$). **Results**: Compared with the traditional suture method, the operation time of LM with baseball suture method is shorter, the amount of intraoperative bleeding is less, the time required for postoperative exhaust, first getting out of bed, hospitalization, and uterine incision suture is shorter, the incidence of needle eye bleeding is lower, the decline of average hemoglobin is lower, and the incidence of pelvic infection is lower, while the difference is statistically significant ($p < 0.05$). The incidence of postoperative morbidity is lower, while the difference is not statistically significant ($p > 0.05$). **Conclusions**: Baseball suture has progressiveness and important value in LM surgical suture. The hemostasis and healing effect is ideal, which can enable patients to recover more quickly, reduce the pain and economic burden caused by the operation, and also enable surgeons to complete the operation more conveniently and efficiently. The protocol of the review was registered on the PROSPERO platform (https://www.crd.york.ac.uk/PROSPERO/) with the registration number CRD42022370262.

Keywords: laparoscopic myomectomy; baseball suture; traditional suture method; uterine myoma; suture method

1. Introduction

Uterine myoma is the most common benign pelvic tumor in gynecology, in which the incidence rate is 25% among women of childbearing age, and 70% among women of early perimenopause [1]. Most of the patients show bladder and rectal compression symptoms such as prolonged menstruation, increased menstruation, abdominal pain, infertility and abortion, dysuria, constipation, which seriously threaten women's physical and mental health and quality of life. At present, laparoscopic myomectomy (LM) has become an effective and commonly surgical method in clinical practice. Compared with the traditional laparotomy, LM does not cut off all layers of abdominal wall tissue and abdominal wall nerves, so it has less interference to the abdominal cavity and intestinal tract, and the lighter postoperative tissue inflammation. As a consequence, the patient suffers from the slighter abdominal wall pain, and the shorter time of postoperative fever and intestinal paralysis, which has little impact on the subsequent pregnancy outcome. However, there exists postoperative rare complications in LM, such as parasitic myoma and disseminated peritoneal leiomyomatosis. The technical difficulties in LM often refer to suturing the tumor cavity hardly and long hemostasis time. Therefore, the selection of suture mode is crucial. Baseball sewing method first appears in the literature of Takeuchi *et al*. [2] in 2003. It is named because its appearance after continuous sewing is similar to that of baseball and the principle of using baseball sewing. In this paper, the advantages and disadvantages of baseball suture compared with traditional suture are studied by using meta-analysis method for the first time, which provides a theoretical basis for the selection of surgical suture methods.

2. Materials and Methods

2.1 Protocol and Registration

The protocol of the review was registered on the PROSPERO platform (https://www.crd.york.ac.uk/PROSPERO/) with the registration number CRD42022370262.

2.2 Inclusion and Exclusion Criteria

Inclusion criteria: (I) Study design type: randomized controlled study (RCT), retrospective study; (II) Participants: female patients with hysteromyoma, which are treated with surgical treatment plan of laparoscopic myomectomy; (III) Interventions: baseball suture is used in the experimental group, while traditional suture is used in the

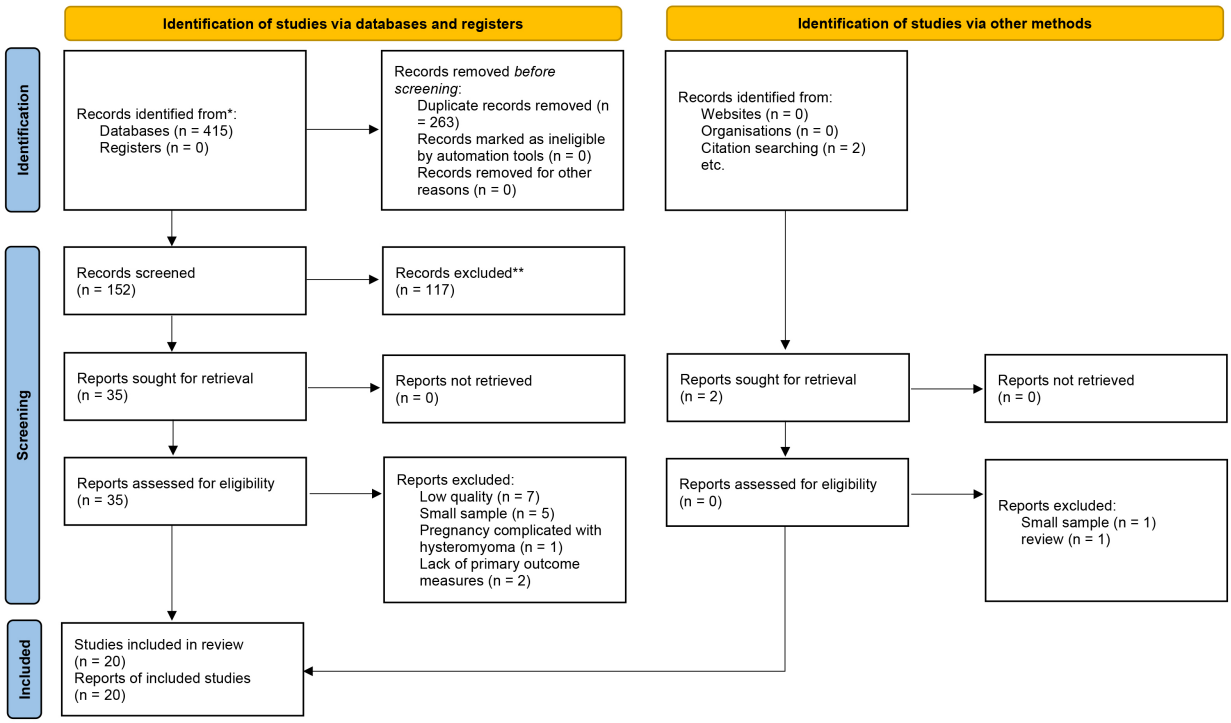

Fig. 1. The literature screening process. *Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

control group; (IV) Outcome measures: primary outcomes include operation time, intraoperative bleeding, while secondary outcomes include suture time of uterine incision (tumor body), time of exhaust after operation, time of getting out of bed for the first time, hospital stay.

Exclusion criteria: (I) The patient was pregnant with hysteromyoma, and the surgical treatment was abdominal myomectomy; (II) Overview, case report, conference summary and animal experiment; (III) The literature with unavailability of the full text, lacking of required outcome measures, obviously wrong data, low quality, and small sample (sample size of each group: $n < 30$).

2.3 Literature Retrieval Strategy

The databases of CNKI, Wanfang, VIP, PubMed, Web of Science and the Cochrane Library are searched to collect the research on the comparison of the effects of baseball suture and traditional suture in laparoscopic myomectomy. The retrieval time limit is from the establishment of the databases to October 4, 2022. In addition, the references included in the literature are traced to supplement the relevant literature. The retrieval method is the combination of the following subject words and free words including corresponding Chinese terms: (myomectomy or Uterine myoma* or myoma* of uterus or uterine leiomyoma or hysteromyoma) AND (baseball or traditional or continuous) AND (suture*).

The accuracy of professional terminology is verified by experienced clinical doctors. The search terms are adjusted according to the specific database, all retrieval strategies are determined after multiple pre-retrieval.

2.4 Literature Screening and Data Extraction

Two researchers (TJ and XZX) independently screen the literature according to the inclusion and exclusion criteria, extract the data and cross check them. In case of any disagreement, it shall be settled through discussion or consultation with a third party (QQZ). In the initial screening of literature, title and abstract are read firstly to exclude the obviously irrelevant literature, and then the full text is further read to determine whether to include it. If necessary, we may contact the original study author via email or telephone to obtain or check the information that is ambiguous but important for this study.

Data extraction contents include basic information (title, author, publication time, region, research type), baseline characteristics of the participants (total sample size, sample size of each group, average age of patients, tumor length, number of myomas, suture method of control group) and outcome measurements and outcome measurement data concerned. The above data are extracted and recorded in a Spread-sheet of Microsoft Office Excel software version 2021 (Microsoft Corp., Redmond, WA, USA).

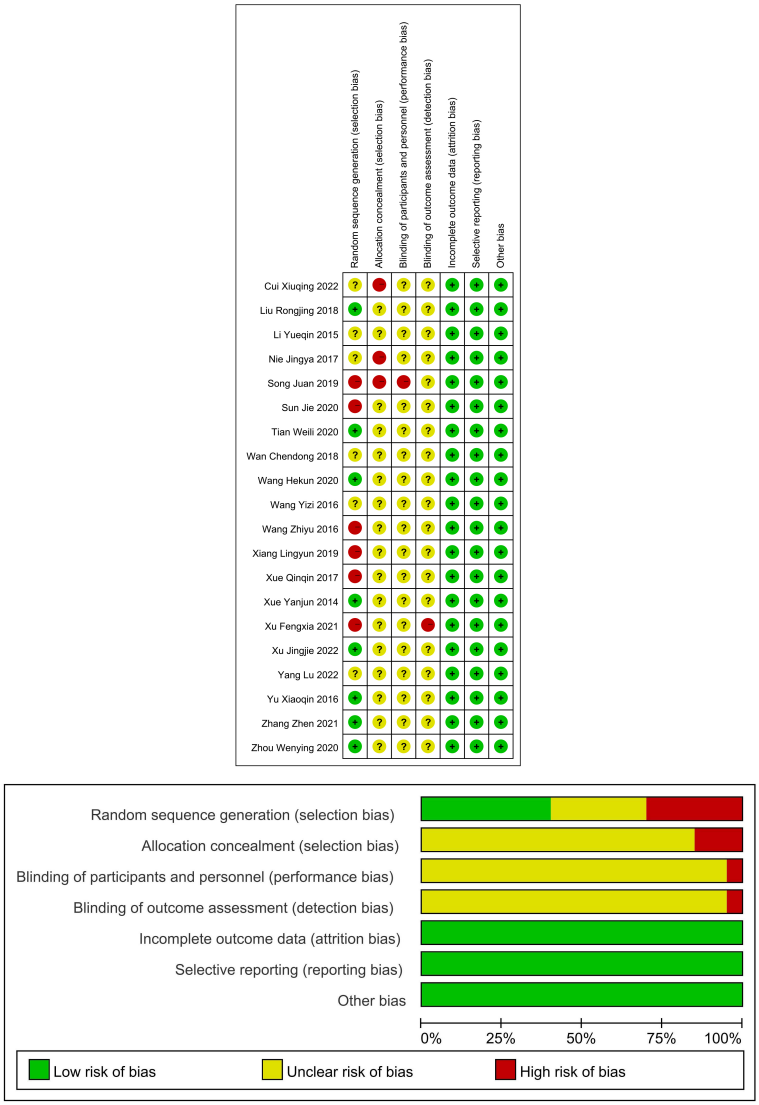

Fig. 2. Assessment of probable bias by the included trials.

2.5 Literature Quality Evaluation

Two researchers independently evaluate the quality of methodology included in the study and cross check the results. The New castle Ottawa Scale (NOS) is used for literature quality evaluation, and the articles are relatively high-quality with the scores of 5–9 [3].

2.6 Statistical Analysis

RevMan software version 5.4 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) is used for statistical analysis. The measurement data are expressed by standardized mean difference (SMD) and 95% confidence interval (CI), and the counting data are expressed by odds ratio (OR) and 95% CI. When the statistical heterogeneity among studies is small ($I^2 \leq 50\%$), the fixed effect model is used. Otherwise ($I^2 > 50\%$), the random effect model is used. Furthermore, when the number of included studies is more than (or is) 10, STATA software version 14.0 (Stata Corp., College Station, TX, USA) is used to conduct Begg and Egger tests to quantitatively detect publication bias. If there is publication bias, the shear compensation method shall be used for correction. For the included studies, the sensitivity analysis is carried out one by one with the method of exclusion, and the change of the total combined effect is observed to judge whether the meta-analysis results are stable. All tests are bilateral tests and the inspection level of meta-analysis is set as $\alpha = 0.05$, which means $p < 0.05$ is statistically significant.

3. Results

3.1 Literature Screening Process and Results

A total of 415 related articles is obtained through primary screening, and are gradually checked according to inclusion and exclusion criteria. Finally, 12 RCTs and 8 retrospective studies [4–23] are included. The literature screening process is shown in Fig. 1.

Table 1. The basic characteristics of the included literature.

Author, year	Study type	Group	Sample size	Average age	Maximum diameter of hysteromyoma (cm)	Number of hysteromyomas	Suture method	NOS score
Cui *et al*, 2022 [4]	RCT	EG	30	35.8 ± 3.0	6.0 ± 1.2	4.1 ± 0.5	baseball suture	8
		CG	30	35.2 ± 2.5	6.0 ± 1.2	4.1 ± 0.5	Continuous+embedded suture	
Li, 2015 [5]	RCT	EG	50	27.18 ± 7.83	Myoma volume: 3–10 cm^3	NR	baseball suture	6
		CG	50	27.18 ± 7.83		NR	Continuous suture	
Wang *et al*, 2016 [6]	Retrosp	EG	54	36.5 ± 7.6	8.2 ± 2.41	1–2	baseball suture	7
		CG	62	37.2 ± 6.4	7.7 ± 3.28	1–2	Continuous suture	
Nie *et al*, 2017 [7]	RCT	EG	50	34.42 ± 6.32	5.37 ± 0.53	NR	baseball suture	6
		CG	50	35.56 ± 4.74	5.72 ± 0.47	NR	8-character-pattern	
Wan *et al*, 2018 [8]	Retrosp	EG	107	36.6 ± 8.5	6.9 ± 1.8	NR	baseball suture	6
		CG	68	37.3 ± 9.6	6.8 ± 1.9	NR	Continuous suture	
Wang *et al*, 2016 [9]	Retrosp	EG	45	37.71 ± 5.67	6.59 ± 1.30	1.36 ± 0.80	baseball suture	8
		CG	50	37.90 ± 5.86	6.14 ± 1.78	1.20 ± 0.50	Continuous suture	
Xu, 2021 [10]	Retrosp	EG	62	45.41 ± 2.54	8.24 ± 0.35	NR	baseball suture	6
		CG	52	45.17 ± 2.65	8.33 ± 0.32	NR	Interrupted+Continuous suture	
Xiang, 2019 [11]	Retrosp	EG	43	36.74 ± 8.21	6.97 ± 1.74	NR	baseball suture	7
		CG	43	36.91 ± 8.57	6.93 ± 1.58	NR	Continuous suture	
Yang *et al*, 2022 [12]	RCT	EG	30	43.10 ± 6.10	6.80 ± 1.15	1.49 ± 1.48	baseball suture	8
		CG	30	41.76 ± 6.50	7.48 ± 1.92	1.91 ± 1.40	Continuous suture	
Zhang, 2021 [13]	RCT	EG	40	45.68 ± 1.32	8.24 ± 0.23	NR	baseball suture	6
		CG	40	45.32 ± 1.35	8.35 ± 0.24	NR	Continuous suture	
Liu, 2018 [14]	RCT	EG	158	36.6 ± 4.2	5.4 ± 2.3	4.5 ± 2.6	baseball suture	8
		CG	156	38.4 ± 4.5	5.3 ± 2.7	4.7 ± 2.7	Continuous suture+8-character-pattern	
Xu *et al*, 2022 [15]	RCT	EG	80	45.14 ± 4.97	4.52 ± 1.18	2.36 ± 0.75	baseball suture	7
		CG	80	44.23 ± 5.14	4.78 ± 1.25	2.34 ± 0.74	Continuous mattress suture	
Song *et al*, 2019 [16]	Retrosp	EG	45	40.24 ± 4.02	8.05 ± 0.80	1.89 ± 0.18	baseball suture	8
		CG	45	40.03 ± 4.01	8.14 ± 0.81	1.94 ± 0.19	Continuous suture	
Sun, 2020 [17]	Retrosp	EG	30	27.1 ± 0.9	NR	NR	baseball suture	6
		CG	30	26.7 ± 1.2	NR	NR	Continuous suture	
Tian, 2020 [18]	RCT	EG	75	45.03 ± 4.84	NR	NR	baseball suture	6
		CG	60	45.39 ± 4.31	NR	NR	Interrupted+Continuous suture	
Wang *et al*, 2020 [19]	RCT	EG	43	38.56 ± 2.06	5.29 ± 1.37	1~3	baseball suture	7
		CG	43	38.37 ± 2.04	5.36 ± 1.58	1~3	Continuous suture	
Gan *et al*, 2016 [20]	RCT	EG	48	36.5 ± 7.5	8.9 ± 0.8	NR	baseball suture	6
		CG	48	36.3 ± 7.6	9.0 ± 0.7	NR	Continuous lock stitch suture	
Zhou, 2020 [21]	RCT	EG	60	35.21 ± 7.76	5.01 ± 2.00	2.69 ± 1.04	baseball suture	8
		CG	60	36.07 ± 7.69	4.87 ± 1.96	2.65 ± 0.94	Continuous suture	
Xue *et al*, 2014 [22]	RCT	EG	35	38.83 ± 3.22	5.89 ± 0.50	NR	baseball suture	6
		CG	35	38.83 ± 3.22	5.89 ± 0.50	NR	8-character-pattern	
Xue *et al*, 2017 [23]	Retrosp	EG	30	40.3 ± 1.2	5.3 ± 2.1	2.6 ± 0.8	baseball suture	8
		CG	30	39.5 ± 2.2	5.5 ± 1.7	2.9 ± 0.4	Continuous lock stitch suture	

RCT, randomized controlled study; NR, not reported; NOS, the Newcastle-Ottawa Scale; EG, experimental group; CG, control group; Retrosp, retrospective.

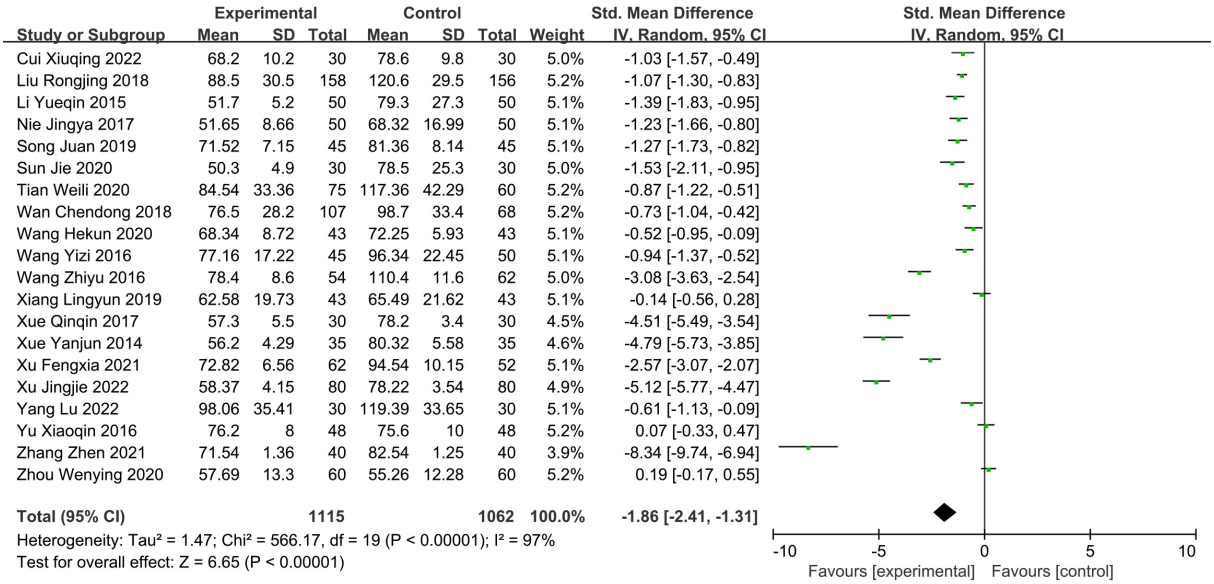

Fig. 3. Forest plot comparing of operation time. SD, standard deviation; 95% CI, 95% confidence interval.

3.2 Basic Characteristics, Quality Evaluation and Bias Risk Evaluation Results of Included Literature

Table 1 (Ref. [4–23]) and Fig. 2 give the basic characteristics and assessment of probable bias of the literature.

3.3 Meta-Analysis Results

3.3.1 Operation Time

A total of 20 studies is included, including 12 RCTs and 8 retrospective studies, in which there are 2177 patients with uterine leiomyoma, including 1115 patients with baseball suture and 1062 patients with traditional suture. Heterogeneity test shows $I^2 = 97\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that the operation time of the experimental group with baseball suture is shorter than that of the control group with traditional suture, and the difference is statistically significant [SMD = –1.86, 95% CI (–2.41, –1.31), $p < 0.00001$] (Fig. 3).

3.3.2 The Volume of Intraoperative Bleeding

A total of 20 studies (12 RCTs and 8 retrospective studies) is included, in which there are 2177 patients with uterine leiomyoma, including 1115 patients with baseball suture and 1062 patients with traditional suture. Heterogeneity test shows $I^2 = 97\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that the volume of intraoperative bleeding of the experimental group with baseball suture is less than that of the control group with traditional suture, and the difference is statistically significant [SMD = –2.91, 95% CI (–3.57, –2.25), $p < 0.00001$] (Fig. 4).

3.3.3 Postoperative Exhaust Time

A total of 14 studies is included, including 7 RCTs and 7 retrospective studies, in which there are 1271 patients with uterine leiomyoma, including 634 patients with baseball suture and 637 patients with traditional suture. Heterogeneity test shows $I^2 = 75\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that postoperative exhaust time of the experimental group with baseball suture is shorter than that of the control group with traditional suture, and the difference is statistically significant [SMD = –1.28, 95% CI (–1.53, –1.03), $p < 0.00001$] (Fig. 5).

3.3.4 First Off the Bed Time

A total of 10 studies is included, including 6 RCTs and 4 retrospective studies, in which there are 916 patients with uterine leiomyoma, including 458 patients with baseball suture and 458 patients with traditional suture. Heterogeneity test shows $I^2 = 92\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that first off the bed time of the experimental group with baseball suture is shorter than that of the control group with traditional suture, and the difference is statistically significant [SMD = –1.32, 95% CI (–1.82, –0.81), $p < 0.00001$] (Fig. 6).

3.3.5 Hospital Stay

A total of 14 studies is included, including 7 RCTs and 7 retrospective studies, in which there are 1312 patients with uterine leiomyoma, including 661 patients with baseball suture and 651 patients with traditional suture. Heterogeneity test shows $I^2 = 90\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that hospital stay of the experimental group with baseball suture is shorter than that of the control group with traditional suture,

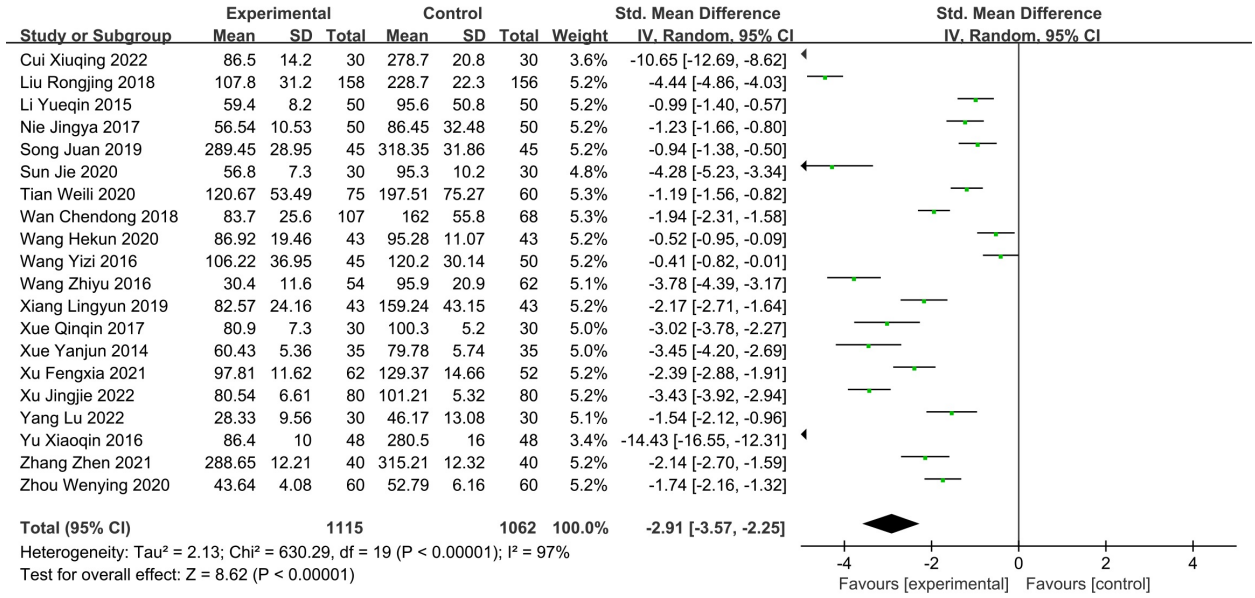

Fig. 4. Forest plot comparing of the volume of intraoperative bleeding.

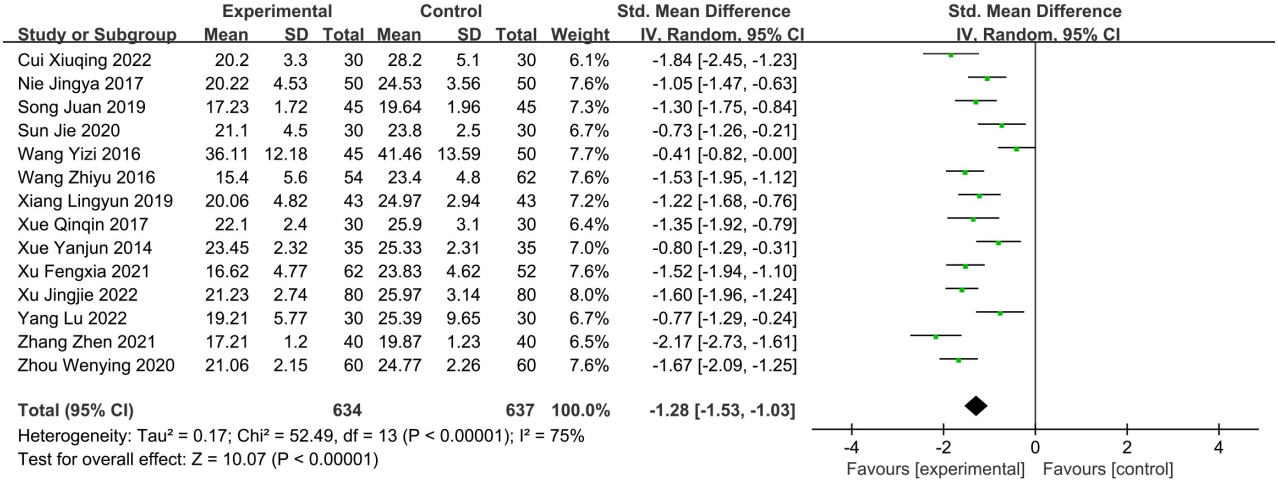

Fig. 5. Forest plot comparing of postoperative exhaust time.

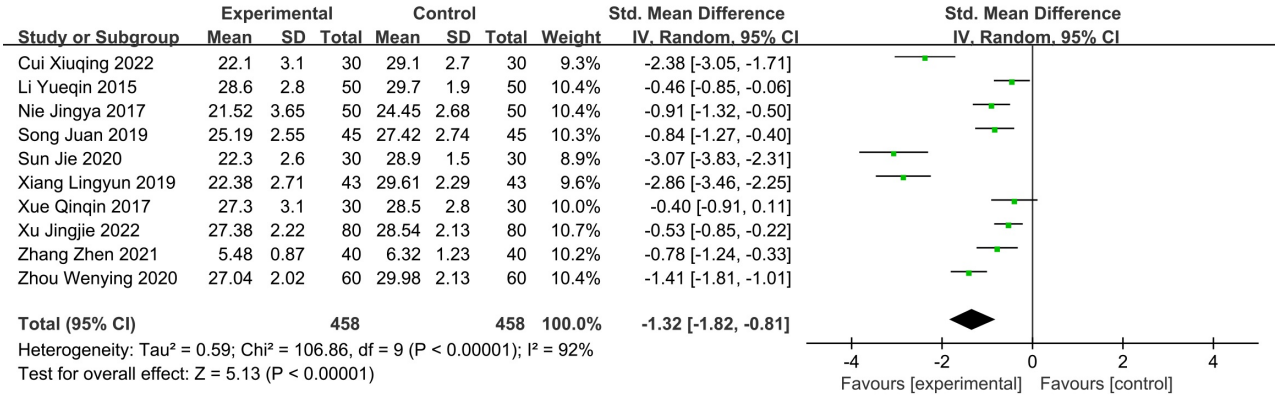

Fig. 6. Forest plot comparing of first off the bed time.

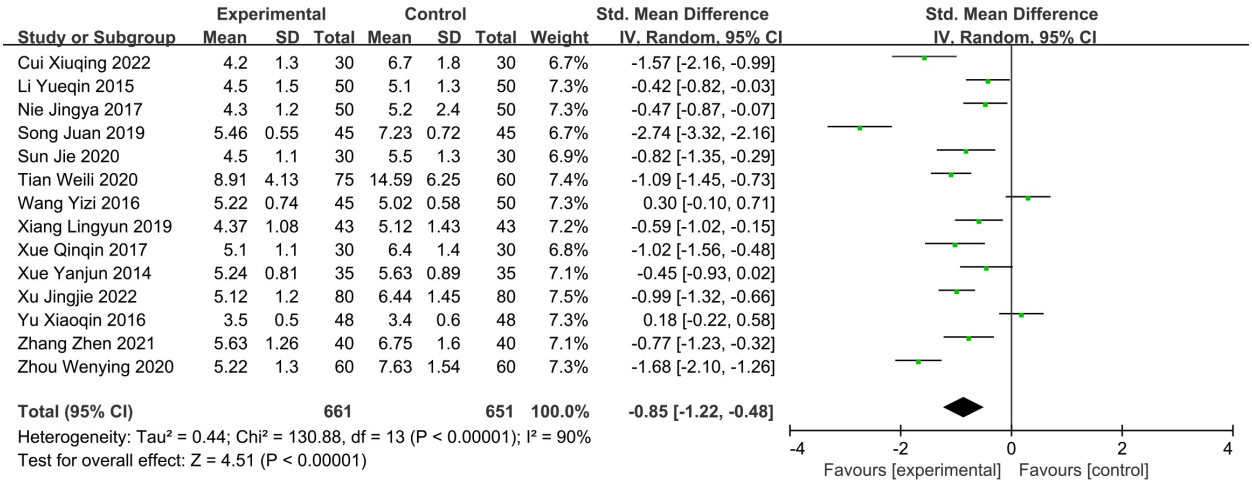

Fig. 7. Forest plot comparing of hospital stay.

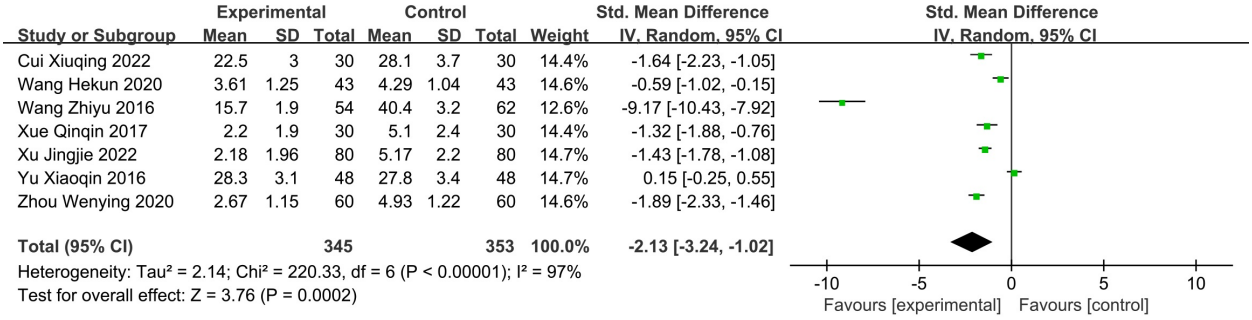

Fig. 8. Forest plot comparing of suture time of uterine incision.

and the difference is statistically significant [SMD = –0.85, 95% CI (–1.22, –0.48), $p < 0.00001$] (Fig. 7).

3.3.6 Suture Time of Uterine Incision

A total of 7 studies is included, including 5 RCTs and 2 retrospective studies, in which there are 698 patients with uterine leiomyoma, including 345 patients with baseball suture and 353 patients with traditional suture. Heterogeneity test shows $I^2 = 97\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that suture time of uterine incision of the experimental group with baseball suture is shorter than that of the control group with traditional suture, and the difference is statistically significant [SMD = –2.13, 95% CI (–3.24, –1.02), $p = 0.0002$] (Fig. 8).

3.3.7 Needle Eye Bleeding Rate

A total of 4 studies is included, including 2 RCTs and 2 retrospective studies, in which there are 602 patients with uterine leiomyoma, including 298 patients with baseball suture and 304 patients with traditional suture. Heterogeneity test shows $I^2 = 0\%$, $p = 0.4$, so fixed effect model is used for meta-analysis. The results show that needle eye bleeding rate of the experimental group with baseball suture is less than that of the control group with traditional suture, and the difference is statistically significant [OR = 0.13, 95% CI (0.07, 0.24), $p < 0.0001$] (Fig. 9).

3.3.8 Average Hemoglobin Decline Degree

A total of 4 studies is included, including 1 RCTs and 3 retrospective studies, in which there are 461 patients with uterine leiomyoma, including 246 patients with baseball suture and 215 patients with traditional suture. Heterogeneity test shows $I^2 = 96\%$, $p < 0.00001$, so random effect model is used for meta-analysis. The results show that average hemoglobin decline degree of the experimental group with baseball suture is less than that of the control group with traditional suture, and the difference is statistically significant [SMD = –2.81, 95% CI (–4.11, –1.51), $p < 0.0001$] (Fig. 10).

3.3.9 The Incidence of Postoperative Morbidity

A total of 2 studies is included, including 1 RCT and 1 retrospective study, in which there are 489 patients with uterine leiomyoma, including 265 patients with baseball suture and 224 patients with traditional suture. Heterogeneity test shows $I^2 = 12\%$, $p = 0.29$, so the fixed effect model is used for meta-analysis. The results show that the incidence of postoperative morbidity of the experimental group with

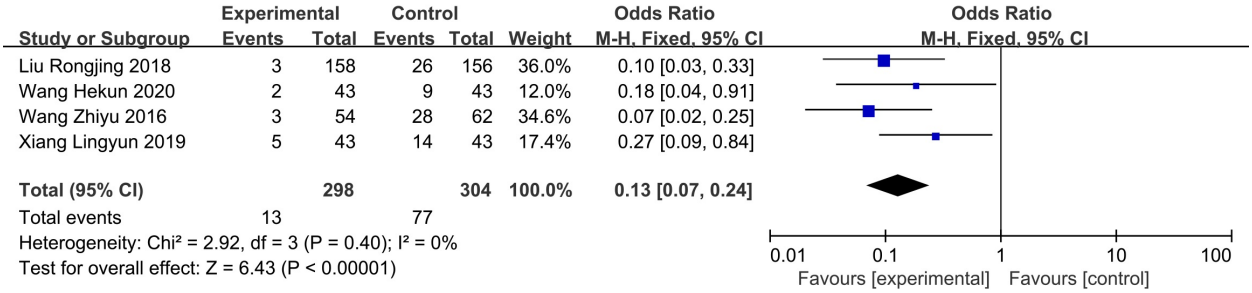

Fig. 9. Forest plot comparing of needle eye bleeding rate. M-H, Mantel-Haenszel method.

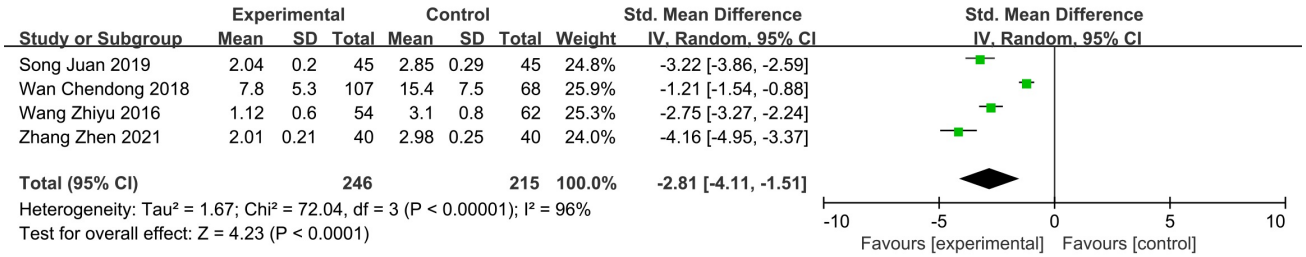

Fig. 10. Forest plot comparing of average hemoglobin decline degree.

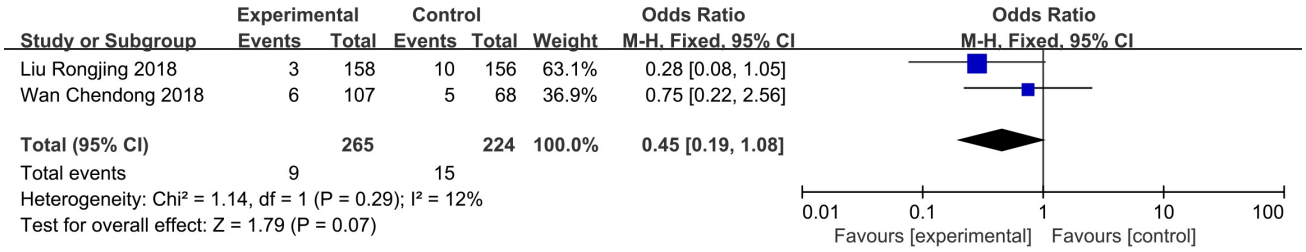

Fig. 11. Forest plot comparing of the incidence of postoperative morbidity.

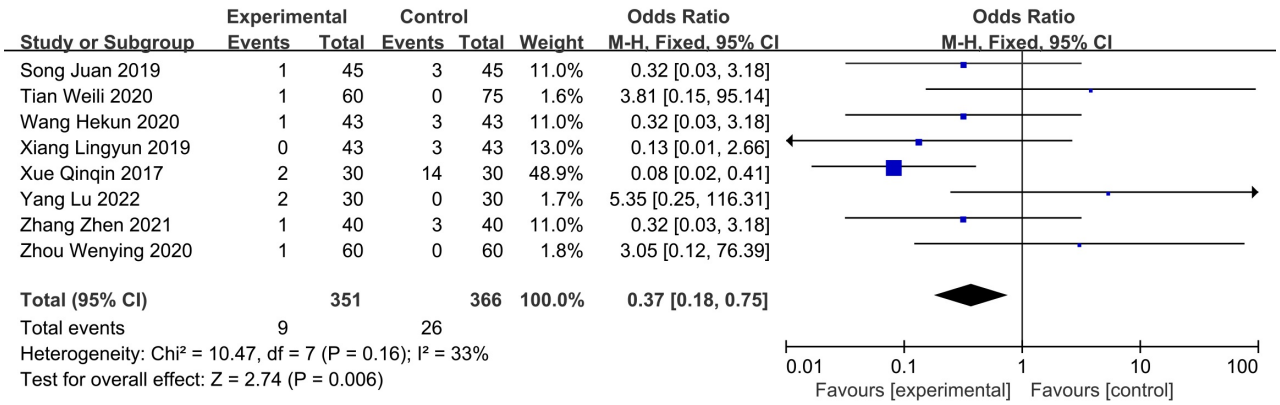

Fig. 12. Forest plot comparing of the incidence of pelvic infection.

baseball suture is less than that of the control group with traditional suture, and the difference is not statistically significant [OR = 0.45, 95% CI (0.19, 1.08), $p = 0.07$] (Fig. 11).

3.3.10 The Incidence of Pelvic Infection

A total of 8 studies is included, including 5 RCTs and 3 retrospective studies, in which there are 717 patients with uterine leiomyoma, including 351 patients with baseball suture and 366 patients with traditional suture. Heterogeneity test shows $I^2 = 33\%$, $p = 0.16$, so the fixed effect model is used for meta-analysis. The results show that the incidence of pelvic infection of the experimental group with baseball suture is less than that of the control group with traditional

suture, and the difference is statistically significant [OR = 0.37, 95% CI (0.18, 0.75), $p = 0.006$] (Fig. 12).

3.3.11 Publication Bias

RevMan 5.4 software is used to draw funnel plot to detect publication bias, and the results show that the distribution of scattered points is asymmetric on the left and right (Fig. 13). Further, STATA 14 software is used to conduct Egger's test, and the results show that there is no significant publication bias (Egger's test, $t = -1.35$, $p = 0.195 > 0.05$) (Fig. 14).

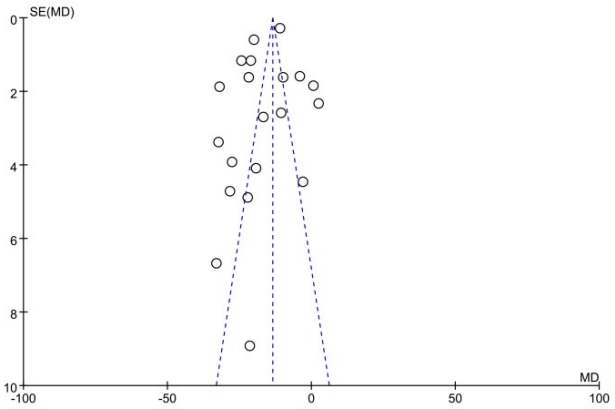

Fig. 13. Funnel plot. SE, standard error; MD, mean deviation.

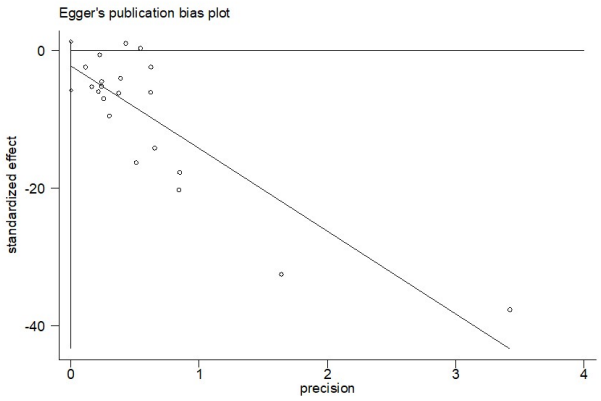

Fig. 14. Publication bias.

3.3.12 Sensitivity Analysis

STATA 14 software is used for sensitivity analysis, and the results show that after removing any study in turn, the total combined effect of meta-analysis does not change significantly, suggesting good stability of the results (Fig. 15).

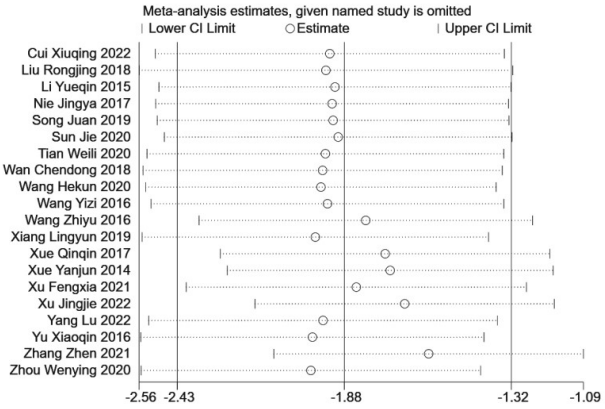

Fig. 15. Sensitivity analysis.

4. Discussion

The pathogenesis of uterine leiomyoma is still unclear. The current researches show that age (50 years old is the peak of the disease), race (black women), hormone levels (higher levels of estradiol, progesterone, progesterone receptor B (PR-B), luteinising hormone (LH)), exposure to endocrine disruptors (phthalates, polychlorinated biphenyls, plasticizers, bisphenol A, dioxins), obesity (centripetal obesity), lifestyle and eating habits (insufficient physical activity, mental stress, excessive red meat intake, lack of vitamin D3) and other factors are closely related to the incidence of uterine fibroids [24]. The only operation plan for radical treatment of uterine leiomyoma is total hysterectomy, which is applicable to patients who have completed fertility and have no fertility related needs. Abdominal or vaginal operation can be selected according to the size and prolapse degree of the uterus. For patients of childbearing age or who wish to retain the uterus, whether to operate is generally determined clinically according to the severity of the patient's symptoms, infertility or abortion caused by hysteromyoma, risk of malignant disease and other factors, and surgical methods such as laparotomy, laparoscopy, hysteroscopy, vaginal, minimally invasive or non-invasive are selected according to the International Federation of Gynecology and Obstetrics (FIGO) classification of hysteromyoma and fertility needs. For pregnant women with uterine leiomyoma, myomectomy during cesarean section by experienced surgeon does not increase the risk of postoperative complications [25]. For patients with type II or above myoma who have fertility needs or want to retain the uterus, open surgery or laparoscopic surgery can be selected [26,27]. It is generally recommended that LM is feasible if the number of myomas is less than 2–3, and the maximum myoma diameter is less than 9 cm. Otherwise the risk of conversion to laparotomy will increase significantly [28]. The technical difficulties of LM mainly lie in reducing the bleeding caused by myoma removal, safely and firmly suturing the uterine incision, and removing the myoma from the abdominal cavity as completely as possible. Among

them, the choice of the method of suturing the uterine incision after myoma removal directly affects the length of the operation, the amount of bleeding during the operation and the recovery after the operation. If the uterine wound cannot be effectively stopped bleeding, a second operation may be performed due to intraperitoneal bleeding after the operation. In addition, poor uterine incision healing increases the risk of uterine rupture in subsequent pregnancies. Therefore, scientific suture method is the key to the success of LM.

In baseball, when the bat hits the ball, the average force is 18,436 N, and the maximum force at the peak can reach 36,982 N [29], which shows that the anti hitting performance of baseball is very strong. The baseball sewing method used in the process of preparing the baseball can make two pieces of leather materials side by side and closely connected, which is an important factor to ensure the baseball resistance. According to the LM operation experience of Fernandes *et al.* [30], Lin *et al.* [31] and Xie *et al.* [32], baseball suture is an advanced muscle layer suture technology, which is conducive to controlling surgical bleeding, shortening the operation time, and reducing postoperative complications so that patients can be discharged as soon as possible. The results of this meta-analysis show that compared with the traditional suture method, the baseball suture method has shorter operation time, less intraoperative bleeding, shorter time required for postoperative exhaust, first getting out of bed, hospitalization, and uterine incision suture, lower incidence of needle eye bleeding, lower decline in average hemoglobin, lower incidence of pelvic infection ($p < 0.05$), lower incidence of postoperative morbidity ($p > 0.05$). The common traditional suture methods applied to LM include continuous suture, intermittent suture, layered suture. Continuous suture only joins the wounds on both sides together, producing a force towards the middle, lacking downward pressure. Therefore, when closing a large and deep tumor cavity, in order to fully stop bleeding and leave no hematoma or dead cavity, it is necessary to adopt gradual layered suture, that is, first conduct deep suture on the base, and then conduct shallow suture from bottom to top, generally using intermittent, continuous or "8" suture. The following defects are found during stitching. (I) If the distance of needle and thread across both sides of the incision is large, the muscle layer needs to be tightened relatively. The distance across the wound is positively related to the probability of muscle layer breakage. If the pulling direction is not noticed or the force is too strong, it is easy to cause muscle layer tearing and needle eye bleeding. If there is more bleeding, it will flow to the pelvic cavity. Repeated sutures are needed to stop bleeding and flush the abdominal cavity, resulting in prolonged suturing time and operation time, postoperative pelvic adhesion, infection. (II) There is a large amount of tissue in the suture. In order to prevent the knot from loosening, an assistant is often needed to clamp the suture to prolong the operation time. After the suture was tightened, the proximal and distal tissues were not evenly stressed, resulting in loose compression, increased bleeding rate and prolonged postoperative drainage. If additional reinforcement suture is required, the operation time will be prolonged. (III) Repeated suture leads to more suture knots, which is easy to cause postoperative inflammatory reaction. (IV) The longer suture time leads to the longer opening time of the tumor cavity blood sinus, increased intraoperative bleeding, and increased risk of intraoperative blood transfusion and postoperative anemia.

The needle and thread path of the baseball suture method is opposite to that of the traditional suture method. Each needle enters the tumor cavity from the bottom and goes out to the serous layer. It can accurately locate the needle entry point and determine the needle point. The needle holding and needle entry operations are relatively flexible and simple. During the operation, the needle distance and span can be reasonably controlled according to the situation to ensure full layer continuous suture of wounds on both sides. During suture, the suture can be tightened after each needle release. The amount of tissue in each needle suture is about half of that in simple continuous suture. Two needle sutures are forces in two opposite directions. It is conducive to reducing the tension required at the pinhole, local decompression, difficult to cut tissues, and tight compression between tissues to reduce bleeding. Compared with continuous suture, each stitch of baseball suture has a more effective hemostatic effect on local tissues. According to the mechanical principle, baseball suture can not only produce inward force by pressing the tissues on both sides to the middle, but also make the wound tissues press to the depth of the tumor cavity to generate downward pressure. The double force compresses the muscle layer to make the hemostasis effect more ideal. During suture, it is generally unnecessary to trim the redundant seromuscular tissue, and it can naturally turn inward and press into the tumor cavity to carry out compression hemostasis and landfill the dead cavity. The serous surface suture of natural inversion is smooth and smooth, which can achieve the effect of peritoneum and reduce postoperative pelvic adhesion. It is believed [9] that for intramural fibroids with a diameter bigger than 5 cm and a deep location, especially submucous uterine fibroids, baseball suture is better because of the large wound and deep tumor cavity after myoma removal. It is believed [8] that if the tumor cavity is too large and deep, they can turn back and perform another serous layer baseball suture to fully fill the tumor cavity. Because of the transverse direction of uterine arcuate artery and spiral artery, transverse incision is more suitable for LM with baseball suture.

In addition, Tian found that the incidence of postoperative blood transfusion treatment in patients with baseball suture was lower than that in the control group ($p < 0.05$) [18]. At the same time, combined with the results of this meta-analysis, that is, the incidence of needle eye

bleeding and the decrease of average hemoglobin of patients in the experimental group are relatively low, which indicates that the use of baseball suture may be better for hemostasis and healing of uterine incision. Chen [33] included pregnant and non-pregnant patients into the study at the same time, and there was no statistically significant difference in the proportion of pregnant women between the experimental group and the control group ($p < 0.05$). This study may indicate that for the LM of pregnant women, the use of baseball suture may benefit more. Wan *et al.* [8] found that there was no statistically significant difference in the delivery rate between the baseball suture and the traditional suture ($p > 0.05$), and none of the pregnant women in the experimental group and the control group had uterine rupture during pregnancy and delivery. Xu *et al.* [15] found that the incidence of subsequent adverse pregnancy (spontaneous abortion, placenta previa) in the experimental group was lower than that in the control group ($p < 0.05$). Zhang [34] specially studied the influence of baseball suture LM on fertility and pregnancy outcome. The control group adopted simple continuous suture method. There was no statistically significant difference between the two groups in the postoperative pregnancy rate, the incidence of adverse pregnancy outcome (premature delivery, spontaneous abortion, ectopic pregnancy), and delivery mode (cesarean section rate, vaginal delivery rate) ($p > 0.05$). These studies show that baseball suture does not increase the risk of adverse pregnancy outcomes after surgery. Zhang [13] found that seven days after LM, the serum E_2 level of patients using baseball suture was lower than that of the control group, and the LH level was higher than that of the control group ($p < 0.05$). Xu *et al.* [15] found that the serum E_2 level of patients with baseball suture was higher than that of the control group in the first month after operation, while the FSH (Follicle-stimulating Hormone) and LH levels were lower than that of the control group ($p < 0.05$). The results of the two studies are different. Except for the suture method, it may also be affected by the location and size of the myoma, the age of the patient, the original underlying disease, and the postoperative time. Because the uterine artery blood flow supplies the ovary and thus affects the ovarian function, more research is still needed to confirm the effect of baseball suture on the uterine artery blood flow.

5. Conclusions

To sum up, the baseball suture method has important clinical application value. From the mechanical point of view, it can act on tissues in a fine and uniform manner, producing good hemostasis and healing effects, enabling patients to recover more quickly, reducing the pain and economic burden caused by the operation, and enabling surgeons to complete the operation more conveniently and efficiently. We look forward to more detailed and more advanced clinical studies in the future, and constantly update the existing surgical techniques.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

TJ and XZX designed and performed the research study, analyzed the data. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

We would like to express our gratitude to all those who helped us during the writing of this manuscript. Thanks to Dr. QiongQiong Zhou for her contributions to verifying the accuracy of professional terminology and as the third party in solving the disagreement of literature screening and data extraction. Thanks to all the peer reviewers for their opinions and suggestions.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/j.ceog5011251.

References

[1] Stewart EA, Cookson CL, Gandolfo RA, Schulze-Rath R. Epidemiology of uterine fibroids: a systematic review. BJOG: An International Journal of Obstetrics and Gynaecology. 2017; 124: 1501–1512.

[2] Takeuchi H, Kuwatsuru R. The indications, surgical techniques, and limitations of laparoscopic myomectomy. Journal of the Society of Laparoendoscopic Surgeons. 2003; 7: 89–95.

[3] Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions. 5th edn. John Wiley & Sons Ltd: Chichester, England. 2008.

[4] Cui XQ, Zhou WY, Wu HT, Li FY. Clinical application of baseball suture in laparoscopic myomectomy. Public Medical Forum Magazine. 2022; 26: 148–150. (In Chinese)

[5] Li YQ. Clinical application of baseball suture in laparoscopic myomectomy. Electronic Journal of Clinical Medical Literature. 2015; 2: 6994–6995. (In Chinese)

[6] Wang ZY, Zhang Y, Zhang YQ, Li J, Chen L, Guo YE. Application of baseball suture in laparoscopic myomectomy. Journal of Ningxia Medical University. 2016; 38: 1066–1068. (In Chinese)

[7] Nie YJ, Xu XH, Fang Z. Application of baseball suture in laparoscopic myomectomy. Zhejiang Practical Medicine. 2017; 22: 346–347. (In Chinese)
[8] Wan CD, Zhu CY, Wei FF. Clinical application of baseball suture in laparoscopic myomectomy. Journal of Laparoscopic Surgery. 2018; 23: 594–597. (In Chinese)
[9] Wang YZ, Ouyang L. Application of baseball suture in laparoscopic myomectomy. Journal of Modern Oncology. 2016; 24: 3981–3984. (In Chinese)
[10] Xu FX. Clinical effect of single-layer continuous inversion suture in laparoscopic surgery for patients with uterine intramural myoma. Modern Diagnosis and Treatment. 2021; 32: 1425–1426. (In Chinese)
[11] Xiang LY. Effect of baseball suture on bleeding volume and postoperative recovery in laparoscopic myomectomy. World Journal of Complex Medicine. 2019; 5: 29–31. (In Chinese)
[12] Yang L, Sang L, Wu HH. Effect of laparoscopic myomectomy combined with baseball suture in the treatment of hysteromyoma. Chinese Journal of Primary Medicine and Pharmacy. 2022; 29: 679–682. (In Chinese)
[13] Zhang Z. Effect of two suture methods on postoperative recovery of patients undergoing laparoscopic myomectomy. Journal of Practical Gynecologic Endocrinology. 2021; 8: 22–24. (In Chinese)
[14] Liu RJ. Application of baseball suture and traditional suture in laparoscopic myomectomy. Chinese Journal of Woman and Child Health Research. 2018; 29: 674–676. (In Chinese)
[15] Xu JJ, Liu JX. Application of mattress suture and baseball suture in laparoscopic hysteromyoma surgery. Henan Medical Research. 2022; 31: 295–297. (In Chinese)
[16] Song J, Zhang SF, Wang JP. Application of baseball suture in laparoscopic myomectomy. Modern Diagnosis & Treatment. 2019; 30: 3991–3993. (In Chinese)
[17] Sun J. Comparison of baseball suture and traditional continuous suture in laparoscopic myomectomy. Systems Medicine. 2020; 5: 128–130. (In Chinese)
[18] Tian WL. Application effect of baseball suture in laparoscopic myomectomy. Medical Equipment. 2020; 33: 104–105. (In Chinese)
[19] Wang HK, Li XL, Ou JH. Feasibility and effect of baseball suture in laparoscopic myomectomy through single umbilical hole. Practical Clinical Journal of Integrated Traditional Chinese and Western Medicine. 2020; 20: 78–80.
[20] Gan XQ, Liu J, Lin H, Zhang L, Zhang Q, Huang LQ, *et al*. Application of baseball suture in huge laparoscopic myomectomy. Practical Journal of Clinical Medicine. 2016; 13: 37–39. (In Chinese)
[21] Zhou WY. Application of baseball suture in laparoscopic myomectomy. Contemporary Medicine. 2020; 26: 161–162. (In Chinese)
[22] Xue YJ, Lin LH. Comparative study of different suture methods in hysteromyomectomy. Medical Information. 2014; 26: 219–219. (In Chinese)
[23] Xue QQ, Li G. Application value of baseball suture in hysteromyomectomy. Journal of Clinical Research. 2017; 34: 2198–2200. (In Chinese)
[24] Pavone D, Clemenza S, Sorbi F, Fambrini M, Petraglia F. Epidemiology and Risk Factors of Uterine Fibroids. Best Practice & Research. Clinical Obstetrics & Gynaecology. 2018; 46: 3–11.
[25] Guler AE, Guler ZÇD, Kinci MF, Mungan MT. Myomectomy During Cesarean Section: Why Do We Abstain From? Journal of Obstetrics and Gynaecology of India. 2020; 70: 133–137.
[26] Wang WW, Wang SX. Interpretation of guidelines for diagnosis and treatment of uterine leiomyoma. Journal of Practical Obstetrics and Gynecology. 2022; 38: 101–103. (In Chinese)
[27] Saito K, Ishikawa T, Onose M, Ibi R, Tatsumi K, Miyasaka N. Laparoscopic ultrasonography-guided myomectomy of submucosal myoma for preserving endometrial integrity. Clinical and Experimental Obstetrics & Gynecology, 2022, 49: 172.
[28] Seinera P, Arisio R, Decko A, Farina C, Crana F. Laparoscopic myomectomy: indications, surgical technique and complications. Human Reproduction. 1997; 12: 1927–1930.
[29] Escamilla RF, Fleisig GS, Groeschner D, Akizuki K. Biomechanical Comparisons Among Fastball, Slider, Curveball, and Changeup Pitch Types and Between Balls and Strikes in Professional Baseball Pitchers. The American Journal of Sports Medicine. 2017; 45: 3358–3367.
[30] Fernandes RP, Fin F, Magalhães R, Pareja R, Romeo A, Tsunoda A, *et al*. Stepwise Laparoscopic Myomectomy and the Baseball Closure. Journal of Minimally Invasive Gynecology. 2021; 28: 1278–1279.
[31] Lin ZQ. Surgical Treatment in Uterine Leiomyoma. Chinese Journal of Family Planning & Gynecotokology. 2012; 4: 38–40+45. (In Chinese)
[32] Xie LL, Liu YY, Wang DY, Liu CH, Zhou H, Lin ZQ, *et al*. Application of a 'Baseball' Suture Technique in Uterine Myomectomy Following Laparoscopic Enucleation of Uterine Leiomyoma (Fibroid). Medical science monitor: international medical journal of experimental and clinical research. 2018; 24: 3042–3049.
[33] Chen YN. Application of baseball suture in myomectomy. Journal of Practical Gynecologic Endocrinology. 2019; 6: 19–20. (In Chinese)
[34] Zhang SQ. Effect of baseball suture on fertility and pregnancy outcome in laparoscopic myomectomy. Master thesis. Shandong University. 2021. (In Chinese)