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Meta-analysis of Minimally Invasive Internal Fixation in the Treatment of Complications of Anterior Pelvic Ring Injury

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Abstract: Objective: To analyze the literature on the application of minimally invasive internal fixation in the surgical treatment of pelvic fractures, and to evaluate the effect of minimally invasive internal fixation on the surgical treatment of pelvic fractures. Methods: PubMed, Web ofScience, CBM, CNKI, VIP and Wanfang databases were searched. The collection period started from September 2017, and the literatures were submitted after the collection. Prior to pelvic fracture surgery, we will conduct a controlled clinical trial using minimally invasive internal fixation techniques. We will carefully review the literature of all participating experiments according to preset screening and ranking criteria and obtain valid results from them. We will use RevMan5.3 software to complete the meta-analysis. A total of 638 patients were enrolled in 9 clinical practices, including 279 patients in the practice group using minimally invasive internal fixation technique and 359 patients in the practice group using traditional methods. After meta-analysis, we can get: Compared with traditional surgical techniques, patients using minimally invasive internal fixation techniques had operative duration [SMD: -2.81, CI: 95%CI (-3.76, -1.85)], intraoperative blood loss: -3.28, CI: 95%ci (-4.72, -1.85)], and postoperative complications: 0.47. With a 95%ci of 0.25, these are more effective than traditional surgical techniques. In addition, in patients with minimally invasive internal fixation, the superior rate of reduction of pelvic fractures after surgery was [OR=2.09], which is significantly different from that of traditional surgical techniques. Our conclusions are as follows: In pelvic surgery, minimally invasive internal fixation technology can significantly shorten the postoperative treatment time, reduce massive bleeding, and alleviate surgical complications, and also significantly improve the function of the pelvis, and its improvement effect [OR=1.94, 95%CI (1.15, 3.28)] is significantly better than that of traditional surgical techniques.

Because the anatomical characteristics of the pelvis are very complex, its appearance is also very irregular, and it is connected with many key blood vessels and nerves, so once there is a fracture in the pelvis, it is easy to be accompanied by nerve damage, which affects the blood flow of the whole body, and even coagulation function disorders. Therefore, the risk of treating this disease is extremely high, and the difficulty of treatment is also very high, once the treatment is not proper, there may be serious complications such as limb atrophy, pelvic deformation, and damage to important nerves. In recent years, due to the progress of science and technology, the advent of minimally invasive internal fixation technology has provided a new idea for the diagnosis and treatment of pelvic fracture, which can not only effectively improve the physical and mental health of patients, but also provide them with more accurate preoperative preparation, intraoperative guidance and more delicate implants, so as to reduce the pain of patients and reduce their pressure on families and society. Multiple clinical cases have demonstrated that minimally invasive internal fixation techniques for the treatment of pelvic fractures have a good prognosis, and by using the 3D model constructed by Mimics and other software, we are able to accurately produce a complete fracture model, so as to achieve precise surgical protocols and obtain satisfactory results. Although the current study only focused on a small clinical practice, patients with minimally invasive internal fixation had significantly improved performance in fracture reduction, postoperative recovery, and the occurrence of complications compared with traditional surgical techniques. Therefore, the current study has achieved positive results. However, regarding the impetus of this technique in patients with pelvic fractures, Larger practice is still needed to confirm, and there is no consensus yet. The purpose of this study was to compare the efficacy of minimally invasive internal fixation treatment group and conventional treatment group in the treatment of pelvic fractures, and to evaluate the effectiveness of the two treatment methods through meta-analysis, with a view to providing valuable recommendations for clinicians.

1. Data and Methods

1.1. Inclusion and Exclusion Criteria

(1) Study type: All controlled clinical trials involving preoperative planning for the treatment of pelvic fractures with minimally invasive internal fixation were conducted in Chinese and English only. (2) Study subjects: The patients included in the study had no age or gender restrictions, and were diagnosed with pelvic fractures and Tile type B and C unstable pelvic fractures by clinical, X-ray and CT and required surgical treatment. (3) Interventions: CT data were used to reconstruct the three-dimensional pelvis and quickly make individual specimens of pelvic fractures for surgical design, preoperative planning or as surgical guides. (4) Measurement indicators: 1 of the following parameters, operation time, intraoperative blood loss, postoperative 3d evaluation rate of fracture reduction quality according to Matta standard, postoperative function score according to Majeed standard, postoperative complications, etc. (5) Exclusion criteria: literature published in languages other than Chinese and English, animal experiments, non-case-control clinical case reports and reviews, republished literature, and literature reports with poor experimental design.

1.2. Search Strategy

Through searching on September 30, 2017, we collected data from PubMeD, Web of Science, National Biomedical Literature Database System (CBM), CNKI, VIP, Wanfang and other database systems. Data about "pelvic fracture" and "Minimally invasive internal fixation treatment (3d printing)" were collected, as well as a number of journals such as "Chinese Bone Injury", "Chinese Journal of Orthopaedics", "Chinese Journal of Spinal Cord", etc., to study how to apply minimally

invasive internal fixation technology to clinical controlled trials of pelvic fractures. In order to gain more knowledge. Search for information on this topic.

1.3. Bias Risk Assessment and Data Extraction for Included Studies

After careful review by two professional evaluators, relevant information is extracted from the literature according to relevant procedures such as collection, collation, testing and verification. After multiple tests, a consensus is finally obtained. If there is any dispute, a consensus can be reached through discussion, while the third professional evaluator can follow the Cochrane evaluation guidelines. Conduct a detailed review of the collected information, including: (1) the sampling method used, the distribution plan, etc. (2) In order to ensure that the data of the two groups are similar, blind evaluation should be considered. (4) In order to ensure the accuracy of the data, the situation of the patients in the RG and the control group, as well as their behavior, should be examined to ensure the accuracy of the data. According to the results of the study, it is divided into three levels: Level A, as long as the participants are completely consistent in the conditions under consideration, there is not much risk of any deviation; Level B, where there is a greater risk as long as the participant has 1 or more ambiguities in the conditions under consideration; At level C, as long as the participant is ambiguous in 1 of the conditions considered, there is a greater risk.

1.4. Statistical Processing

Using RevMan 5.3 software, we analyzed the effects of pelvic fracture treatment, focusing on the improvement of pelvic function after treatment, with secondary measures including duration of treatment, amount of blood loss after treatment, and complications after treatment. We also used different models to evaluate the treatment effect and calculated the pooled effect size OR value as well as the 95% CI, and used analytical methods to assess the reliability of the treatment effect.

2. Results

2.1. Literature Search and Screening

After strict data screening, 151 articles were selected from 159 articles and classified into 7 Chinese articles and 1 English articles respectively. For the specific research process, please refer to Figure 1. We performed minimally invasive internal fixation on 638 patients, 279 of whom received this treatment and 359 of whom only received conventional surgery. In terms of experimental design, 3 articles adopted randomized controlled experiments, while the rest adopted non-randomized controlled experiments, details of which can be seen in Table 1.

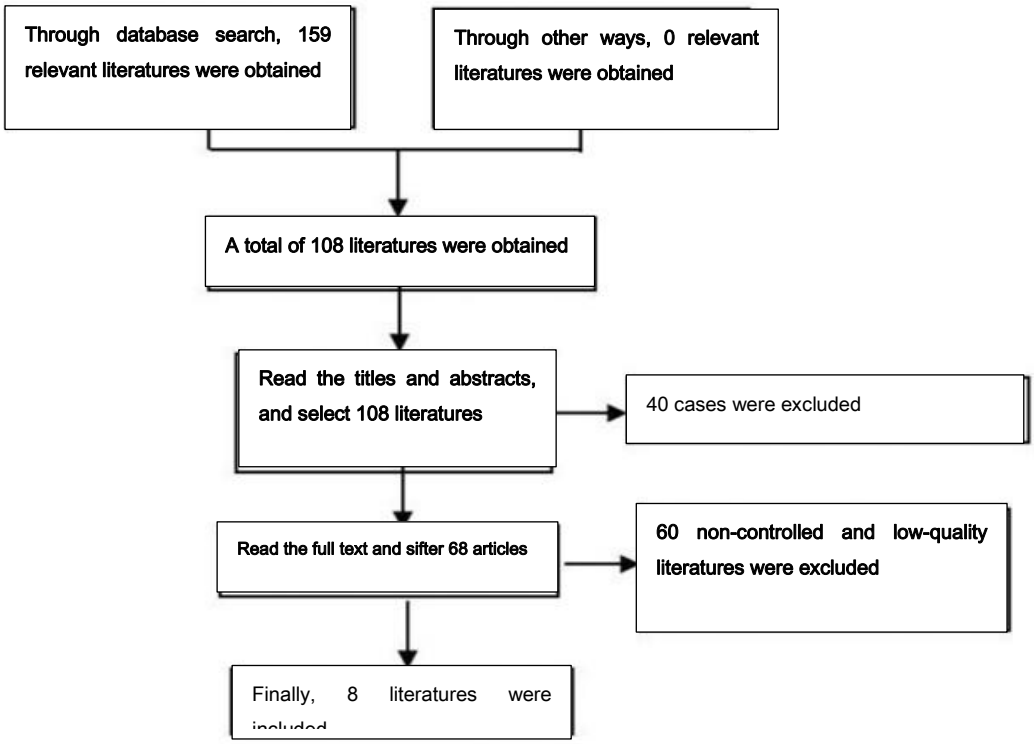

Figure 1. Flow chart of literature screening

Table 1. General characteristics of included studies

author	Year of publication	Boy/girl	Boy/girl	Boy/girl	Follow-up time (months)	Outcome index
Zhu Jiang	2016	14/18	38/36	C32	12~120	abcde
Zhao Zhigang	2017	65/72	33.1±4.9/32.6±4.7	B43-C22/B47-C25	6~15	acde
Han Wenxing	2017	27/27	43.4±2.8/42.7±2.6	B13-C14/B13-C14	6	abcde
Wangmu State	2017	28/36	32.4±7.6/34.5±8.4	C28/C36	12~20	abcde
Niu Hui	2017	15/15	49.1±8.7/47.2±7.3	B7-C8/B8-C7	Not mentioned	abcde
Wang Huaidong	2017	15/15	46.1±0.1/45.1±0.3	Not mentioned	Not mentioned	abd
Fei Xueliang	2016	42/49	38.4±7.2/39.1±6.8	B15-C27/B20-C29	12.5-40	abcde
Dong Zhongyang	2015	73/27	37.2±3.6/33.1±4.3	B25-C48/B53-C74	6~72	abcd

2.2. Baseline Analysis and Quality Evaluation Results

After careful screening, a total of 8 studies, 7 from China, 1 from overseas. These studies were all controlled clinical trials, which recorded basic information about the respondents and their differences in detail, and gave treatment strategies and prognostic indicators for each group. In addition, three other studies used randomization, although many of the studies did not elaborate on how this grouping worked or how randomization was used, as shown in Table 2.

Table 2. Methodological quality evaluation of included studies

author	Random	Allocation hiding	Blind method	Lost follow-up	Result data integrity	Baseline similarity	Methodological quality assessment
Zhu Jiang	no	Not mentioned	Not mentioned	no	Yes	Yes	B
Zhao Zhigang	no	Not mentioned	Not mentioned	no	Yes	Yes	B
Han Wenxing	Yes	Not mentioned	Not mentioned	no	Yes	Yes	B
Wangmu State	no	Not mentioned	Not mentioned	no	Yes	Yes	B
Niu Hui	no	Not mentioned	Not mentioned	no	Yes	Yes	C
Wang Huaidong	Yes	Not mentioned	Not mentioned	no	Yes	Yes	B
Fei Xueliang	Yes	Not mentioned	Not mentioned	no	Yes	Yes	B
Dong Zhongyang	no	Not mentioned	Not mentioned	no	Yes	Yes	B

2.3. Results of Meta-analysis

2.3.1 Good and Good Rate of Pelvic Fracture Reduction

The good and good rate of pelvic fracture reduction refers to the evaluation of minimally invasive internal fixation treatment quality according to Matta and other criteria. The Matta standard results given in the two literatures were anatomical reduction, satisfactory reduction and unsatisfactory reduction. After comprehensive deliberation by three reviewers, the proportion of anatomical reduction and satisfactory reduction was calculated as excellent and good rate in this paper. Eight articles reported the use of minimally invasive internal fixation treatment and conventional protocol for the treatment of pelvic fractures, including a total of 638 patients, including 279 patients in the minimally invasive internal fixation treatment group and 359 patients in the conventional group. Results As shown in Figure 2, the data of all independent studies were homogeneous (heterogeneity test x ²=8.27,P=0.31,P=15%). Therefore, the combined effect size OR was adopted by the fixed-effect model, 0R=2.09, 95%CI (1.32,3.30). The results of meta-analysis showed that the reduction rate of pelvic fractures in the minimally invasive internal fixation group was higher than that in the conventional group.

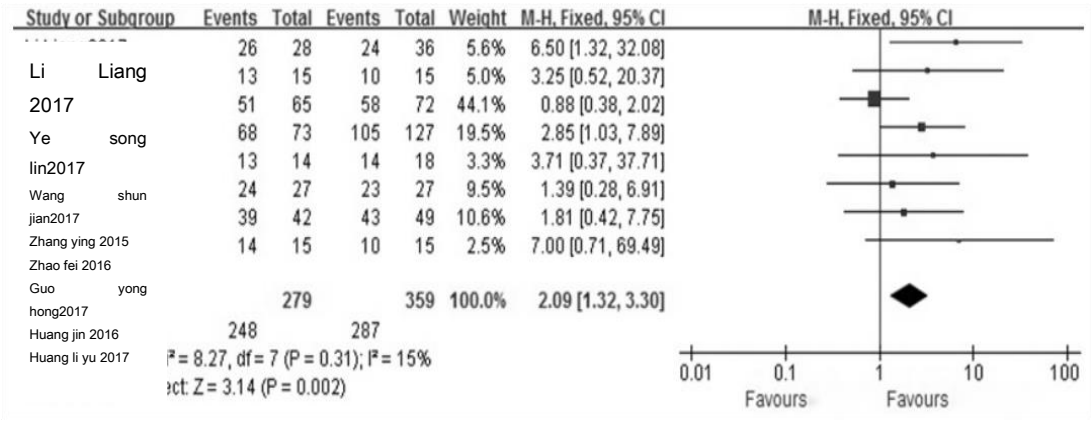

Figure 2. Forest map of the superior reduction rate of pelvic fractures between the minimally invasive internal fixation treatment group and the conventional group

2.3.2 Excellent and Good Rate of Pelvic Function

According to Majeed's scoring system, the evaluation of pelvic ability is based on five factors (pain, standing posture, sitting, sexual function and operation), and its scores are set as follows: >85 is the best, 70-84 is the best, 55-69 is the worst, and <55 is the lowest. After the evaluation of 6 studies, the improvement of pelvic ability after surgery was significant, with a total of 408 subjects, among which 191 subjects were treated with minimally invasive internal fixation technique and 217 subjects were treated with traditional surgical methods, and the data of all subjects were not statistically significant. Therefore, We will use a fixed effect model to evaluate its impact. According to the meta-analysis, the use of minimally invasive internal fixation can significantly improve the pelvic capacity after surgery, with an OR value of 1.94 and a ci value of 95% (1.15, 3.28).

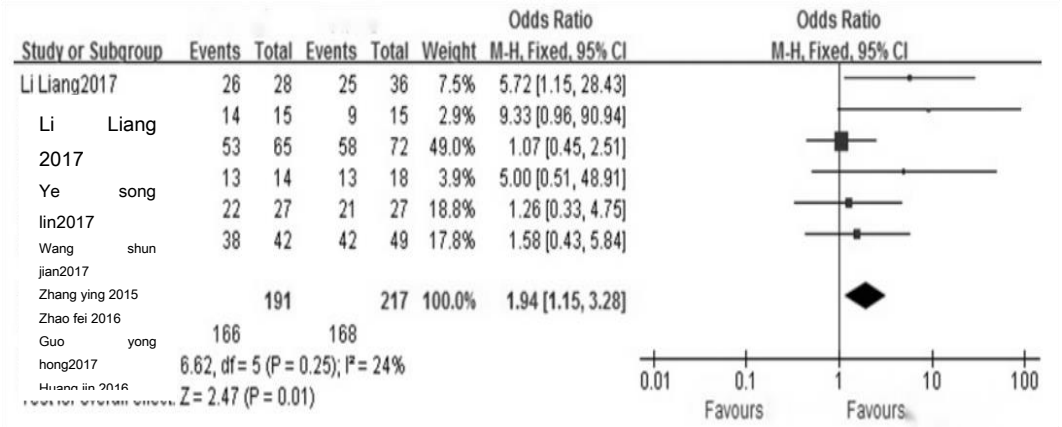

Figure 3. Superior and superior rate of pelvic functional recovery after surgery between the minimally invasive internal fixation treatment group and the conventional group

2.3.3 Operation Time

A total of 606 patients were compared in seven studies, 265 of whom used minimally invasive internal fixation techniques versus 341 who used traditional surgical techniques. According to the

data in Figure 4, we find that there are significant differences in these data. Therefore, we propose to use the random effects model to estimate the joint effect size, where the joint effect size of the standardized mean difference SMD=-2.81, 95%CI (-3.76, -1.85), and conclude that: The surgical time for pelvic fractures using minimally invasive internal fixation techniques is shorter than that of traditional surgical techniques.

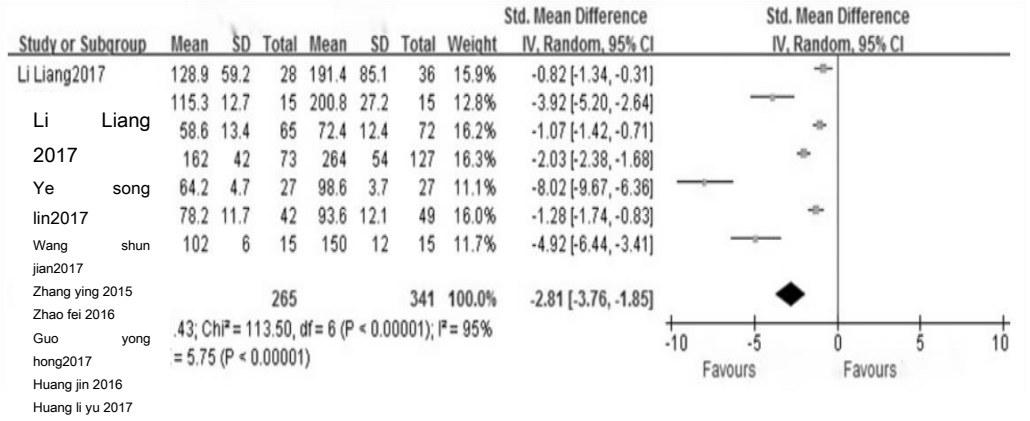

Figure 4. Superior and superior rate of pelvic functional recovery after surgery between the minimally invasive internal fixation treatment group and the conventional group

2.3.4 Intraoperative Blood Loss

Six studies were analyzed with a total of 468 patients, including 199 patients using minimally invasive internal fixation and 269 patients using conventional surgical techniques. There was a statistically significant difference in these data (P<0.001, P=96%). Therefore, we used a random effects model to evaluate the size of the effect. After meta-analysis, we found that patients using minimally invasive internal fixation had significantly less blood loss after surgery compared to the control group. The combined effect size of the standardized mean difference SMD=-3.28, 95%CI (-4.72, -1.85), suggesting that the degree of bone damage after surgery was significantly lower in patients treated with this technique than in controls.

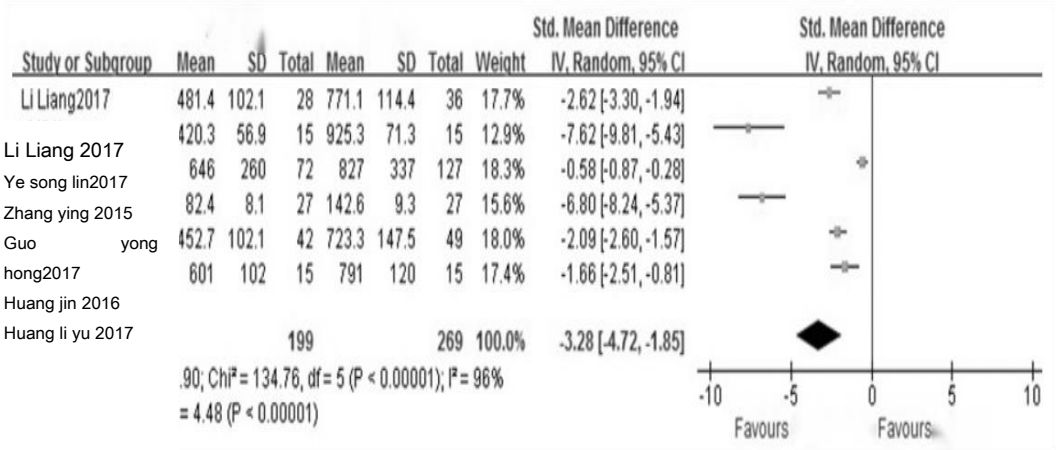

Figure 5. Forest map of the comparison of intraoperative blood loss between the minimally invasive internal fixation treatment group and the conventional group

2.3.5 Postoperative Complications

In 7 studies, we collected 608 postoperative complications, including knife infection, failure to complete fracture recovery, nerve damage, etc. Among them, 264 cases were collected in the minimally invasive internal fixation group and 344 cases were collected in the conventional group. These data showed significant statistical correlation (x^2=2.61, P=0.76, x^2=2.61, P=0.76, etc.). P=0%), we used a fixed effects model to assess these effects. Based on the meta-analysis, we can see that there are some statistical differences in the prevalence of postoperative complications between the two groups of patients. For example, with OR=0.47 and 95%CI (0.25, 0.87), we can see that patients treated with minimally invasive internal fixation have a much lower incidence of postoperative complications.

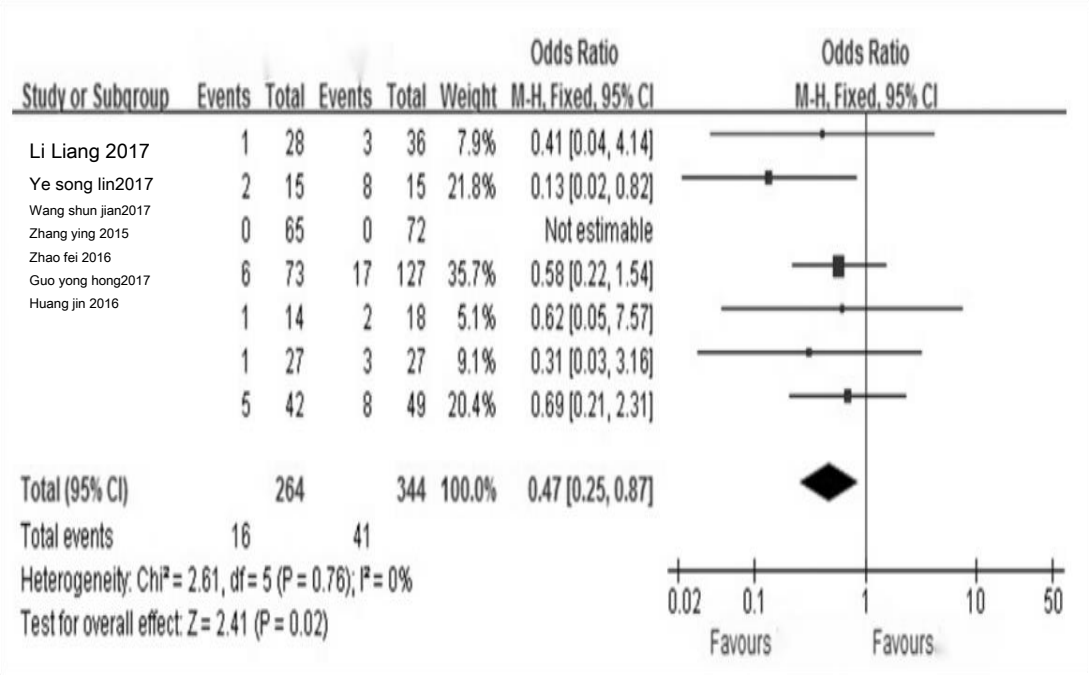

Figure 6. Forest chart of complication rate comparison between minimally invasive internal fixation treatment group and conventional treatment group

2.4. Sensitivity Analysis

After meta-analysis, we found that the overall results did not change significantly when screening out the good and good rates of pelvic fracture reduction in all studies, indicating that the results were relatively stable and that individual studies did not have a significant impact on the overall results. After removing the literature with the highest weight, the combined effect size OR reached OR=3.04, and the ci value reached 95%CI (1.71,5.41), with no significant changes. For details, please refer to FIG.7.

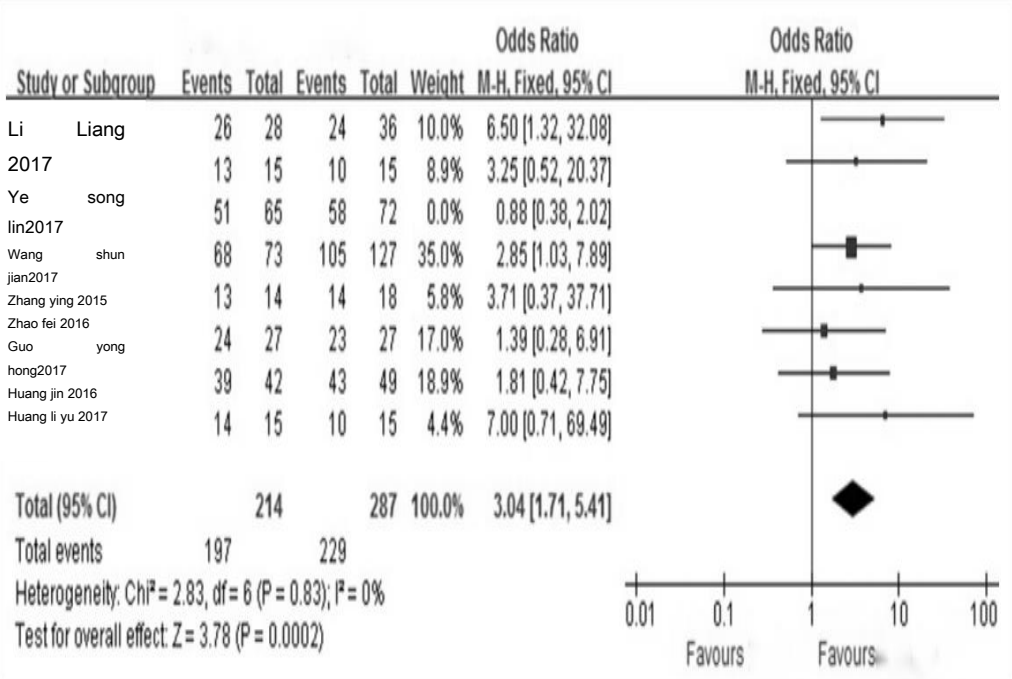

Figure 7. Sensitivity analysis of good and good rate of pelvic fracture reduction

2.5. Bias Assessment

Through funnel plot analysis, we found that 9 studies on the rate of good reduction of pelvic fractures all presented a basically symmetrical graph, as shown in Figure 8, indicating that the bias of these studies was small, so no experiments with negative results were found.

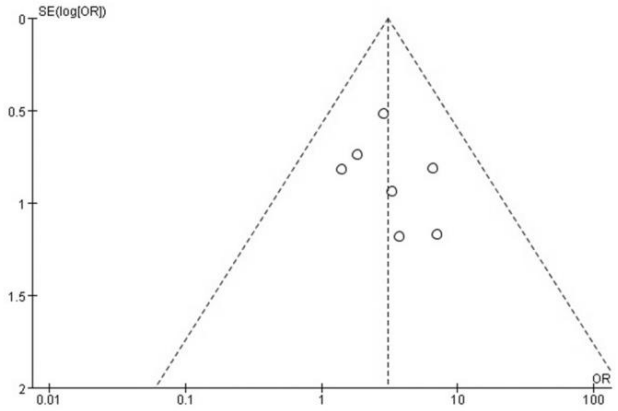

Figure 8. Funnel diagram included in the study

3. Discuss

3.1 Minimally Invasive Internal Fixation Treatment and Its Application and Significance in the Field of Orthopedics

Through the use of advanced internal fixation technology, the stability of the bone can be greatly improved, which greatly facilitates the operation of medical nurses. This technique uses high-hardness steel plates without the need for additional plaster support, which can significantly

simplify the operation of medical nurses, while also significantly reducing the risk of complications for patients, thus better helping patients to recover. The application of internal fixation technology has gone beyond the traditional clinical operation, it can not only improve the symptoms of patients, but also more safely and accurately complete some complex surgeries, such as anterior correction of scoliosis internal fixation, implant internal fixation, etc., due to its unique design, it can be more safely and accurately completed. Thus, it can better meet the clinical needs of clinicians and give patients better quality treatment.

Microorthopaedics has made great progress in recent years due to the continuous development of arthroscopy and other advanced microprocedures, the most common of which are discectomy, dermoscopic disc incision implantation, thoracoscopic and laparoscopic scoliosis orthopedic fixation, and cytological diagnosis and treatment of cancer and other diseases. In recent years, minimally invasive techniques have become an important direction of medical research due to their widespread use. Especially in the joint, spine and navigation AIDS, its application has made remarkable achievements. To this end, researchers are actively studying how to evaluate the advantages of this technology more comprehensively in order to promote its rapid development. After the clinical application in the 21st century, minimally invasive technology has risen rapidly, it has changed from a traditional surgical treatment method to a more advanced treatment mode, its emergence has greatly changed the traditional surgical treatment, and in the future will inherit and broaden the scope of surgical treatment, thus promoting the development of the entire medical community. Due to the popularity of minimally invasive technology, it has gone beyond the previous gross, cellular and molecular level, and has gone deep into the genetic level, allowing doctors to get rid of the previous open surgery, promote the non-invasive orthopedics, and provide the possibility for achieving safer and more effective treatment.

3.2. Findings of This Study

Through meta-analysis, we can clearly see that minimally invasive internal fixation can significantly improve the condition of children with pelvic fractures, effectively reduce the hospital duration of children, greatly reduce the number of discharge of children, and effectively improve the postoperative recovery of children, so as to achieve a better prognosis. During the 10-year follow-up period, there was no statistically significant difference between the advantages and disadvantages of patients using minimally invasive internal fixation techniques and those in the general population according to Majeed guidelines for pelvic fracture evaluation. Between the first and last follow-up, the advantage and disadvantage of patients using minimally invasive internal fixation changed most dramatically. After a relatively long course of treatment, the physical and mental health of the patient has significantly deteriorated, so it is necessary to conduct a large number of continuous follow-up investigations in order to have a deep understanding of this.

3.3. Bias Risks and Limitations of This Study

One of the challenges of this paper is that: (1) most sample data sources are non-randomized, and there are no multiple focused clinical trials; In addition, most of the trials did not use blind methods, which caused the accuracy of the results to be affected, and there was a certain degree of bias. After careful screening, we ensured that all studies met the appropriate criteria and that there were no statistically significant differences between the two groups of patients. In order to reduce the impact of bias, we also specially selected some excellent journals, so that our research has good internal authenticity. In addition, we also found that all the studies involved different pelvic fracture types and surgical methods, so our experimental conclusions have high reliability. (2) Although some

important reference indicators have been identified, some key factors are still missing, such as the length of the surgical suture, the frequency of fluoroscopy during the procedure, and the recovery period of the fracture. (3) The "funnel plot" points out that due to the low quality of the experiment and the low accuracy of the data, it is recommended to carry out subgroup analysis of the subjects' age, personality, Tile classification and other factors, and strengthen monitoring of other factors to obtain accurate research results. In addition, the study of randomized double-blind controlled trials should be strengthened to obtain more accurate data.

3.4. Conclusion and Clinical Prospect

Although minimally invasive internal fixation technology has performed well in the treatment of pelvic fractures, it still cannot meet the needs of clinicians due to the current state of technology and material science limitations. (1) In order to solve this problem, we can use computer simulation technology to accurately design the installation position, size and shape of the steel plate. By using the minimally invasive internal fixation model made of absorbable materials, the adhesion degree of the plate to the pelvic structure can be greatly improved, so as to realize the reduction and fixation of the fracture more effectively. At present, titanium powder is the only metal material that can be used for minimally invasive internal fixation treatment, and the internal fixation model made of absorbable materials will avoid the patient's second surgery to remove the internal fixation.

Through the adoption of minimally invasive internal fixation technology, the reduction and internal fixation of pelvic fractures can be quickly and precisely completed, thus greatly improving the quality of reduction, effectively restoring the patient's normal life, and significantly reducing the treatment cycle and reducing the postoperative heavy bleeding rate, thus contributing to the recovery of patients. The application potential of minimally invasive internal fixation technology in the future is worthy of further exploration.

Funding

If any, should be placed before the references section without numbering.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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