THE EFFECT OF TWO KINDS OF MODIFIED BROSTRÖM SURGERIES ON PAIN AND AOFAS SCORE IN PATIENTS WITH LATERAL COLLATERAL LIGAMENT INJURY OF ANKLE

Yunlong Shen, Zhanfeng Zhang, Shufeng Huang, Jikang Min, Xiaojie Dou, Haidong Li, Rong Wu*
Department of Orthopaedics, The First People's Hospital of Huzhou (The First Affiliated Hospital of Huzhou University), Huzhou, Zhejiang, 313000, PR China

ABSTRACT

Introduction: *To investigate the effect of open and arthroscopically modified Broström surgery on pain and the American Orthopaedic Foot and Ankle Society (AOFAS) score in patients with lateral collateral ligament injury of the ankle.*

Materials and methods: *148 patients with lateral collateral ligament injury of ankle admitted to our hospital from July 2015 to July 2021 were enrolled retrospectively and divided into 2 groups according to different surgical procedures, that is, the control group (78 cases) who underwent open modified Broström surgery and the observation group (70 cases) who underwent arthroscopically modified Broström surgery. The surgery time, incision length, length of stay, visual analogue scale (VAS) score, AOFAS score and incidence of surgical complications of 2 groups were compared.*

Results: *There was no significant difference between 2 groups in surgery time (P>0.05). The incision length and length of stay of the observation group were significantly lower than those of the control group (P<0.05). The VAS scores 1 week, 4 weeks and 24 weeks after surgery and at the last follow-up of 2 groups were significantly higher than those before surgery(P<0.05). The VAS score of the observation group 1 week after surgery was significantly lower than that of the control group (P<0.05). The AOFAS scores 4 weeks, 24 weeks and 48 weeks after surgery and at the last follow-up of 2 groups were significantly higher than those before surgery (P<0.05). The AOFAS score of the observation group 4 weeks after surgery was significantly higher than that of the control group (P<0.05). There were no complications like incision infection, skin necrosis and vascular tendon injury after surgery. There was no significant difference between 2 groups in the incidence of superficial peroneal nerve injury (P>0.05).*

Conclusion: *Compared with open surgery, arthroscopically modified Broström surgery can efficiently minimize surgical trauma and shorten the length of stay, which has advantages in improving early efficacy and excellent safety in the treatment of lateral collateral ligament injury of the ankle.*

Keywords: *Arthroscopy, surgery, ankle joint, collateral ligament injury, pain.*

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Introduction

Ankle sprain is one of the common athletic injuries clinically, which accounts for more than 15% of the total athletic injury diseases. If these patients don't receive standard treatment, they may progress to chronic injury, chronic ankle instability, traumatic or adhesive arthritis, and in severe cases, permanent ankle dysfunction[1]. Conservative treatment is the first choice for patients who have ankle sprain, and generally speaking, the overall response rate is 70%~80%. However, patients who have no obvious remission after more than 6 months of conservative treatment often necessitate surgical treatment[2]. Surgical treatment of ankle sprain can repair the injured ligament isomorphically to regain the mechanical stability of joint, and effectively facilitate the recovery of ankle function[3]. At present, common surgical procedures for lateral collateral ligament injury of the ankle include Broström, Watson-Jones and Broström-Evans-Gould, etc. The modified Broström surgery is especially the most

widely applied[4, 5]. Previous reports have revealed that open and arthroscopic Broström surgeries can realize satisfactory anatomical repair in the treatment of lateral collateral ligament injury of ankle, but there is relatively little evidence on comparison between the two[6]. In view of the above problems, 148 patients with lateral collateral ligament injury of ankle admitted to our hospital from January 2015 to January 2020 were included in our work retrospectively. According to different surgical procedures, the effect of open and arthroscopically modified Broström surgeries on pain and AOFAS score in patients with lateral collateral ligament injury of ankle is discussed. Below, the process will be reported.

Materials and methods

General data

A total of 148 patients with lateral collateral ligament injury of ankle admitted to our hospital from July 2015 to July 2021 were included retrospectively and divided into 2 groups according to different surgical procedures, that is, the control group (78 cases) who underwent open modified Broström surgery and the observation group (70 cases) who underwent arthroscopically modified Broström surgery. In the control group, there were 48 males and 30 females, aged 19~45, with an average age of (33.17±7.56). The follow-up time was 18~33 months, with an average follow-up of (27.61±5.46) months. According to the injury site, there were 51 cases on the right side and 27 cases on the left side. According to the cause of injury, there were 45 athletic injuries, 12 traffic accident injuries and 11 walking sprains. According to the injury condition, 70 cases were injured by anterior talofibular ligament, and 8 cases were injured by anterior talofibular ligament+ calcaneofibular ligament. In the observation group, there were 44 males and 26 females, aged 18-47, with an average age of (33.80±7.74).

The follow-up time was 19~34 months, with an average follow-up of (28.05±5.64) months. According to the injury site, there were 46 cases on the right side and 24 cases on the left side. According to the cause of injury, there were 40 athletic injuries, 11 traffic accident injuries and 9 walking sprains. According to the injury condition, 65 cases were injured by anterior talofibular ligament, and 5 cases were injured by anterior talofibular ligament+ calcaneofibular ligament. There was no significant difference between the two groups in terms of general data (P>0.05). The research design complied with the Declaration of Helsinki.

Inclusion and exclusion criteria

Inclusion criteria:

• Chronic ankle instability in clinical diagnosis;

• Both the anterior drawer test and anterior drawer and varus stress test of ankle before surgery were (+);

• MRI verified lateral collateral ligament injury;

• Ineffective after more than 6 months of conservative treatment;

• Unilateral closed injury;

• Complete clinical data.

Exclusion criteria:

• Complicated by perianal fracture;

• Complicated by vascular nerve or tendon injury;

• Previous ankle surgery;

• Converted from arthroscopic to open surgery.

Surgical method

All patients underwent varus stress test and anterior drawer test after admission, and the quantity and severity of lateral collateral ligament injuries were evaluated by MRI. All surgeries were performed by the same group of surgeons and anesthesiologists. The patients were placed in the supine position and intraspinal anesthesia was administered. The ankle stability was evaluated by anterior drawer test under preoperative anesthesia.

Open modified Broström surgery

At the distal end of lateral malleolus, a 3cm arc incision was made, and reached the attachment on fibula via the skin and fascia, and sharp dissection of ligament complex was realized. The operator ensured that the ankle joint was in the neutral position (90°) of dorsiflexion, inserted an anchor about 1cm above the fibular tip, and made a mattress suture horizontally: anterior talofibular ligament and inferior extensor retinaculum, strained, the fibular periosteal flap was sutured and a knot was tied.

Arthroscopically modified Broström surgery

Before surgery, a surgical safety zone was plotted, and the inferior extensor retinaculum and vital nerve tendons were marked. The ankle lens (2.7 mm) took routine medial and lateral approaches, in which the lateral approach should be close to the anterior edge of the fibula as far as possible, and avoid superficial peroneal nerve to the greatest

extent. First of all, the operator probed whether there were other lesions in the joint and dealt with them in time, examined the anterior edge of the distal fibula, clarified the injury of anterior talofibular ligament, removed hyperplastic synovial tissues and the attachment of anterior talofibular ligament.

An anchor was drilled about 1cm above the distal end of the fibula, and another anchor was placed about 1cm above it. The suture on the anchor was threaded into the needle, threaded out from the anterolateral side to the medial side in turn from the anterolateral side of ankle and about 1.5 cm from the distal end of fibula, and then threaded out from anterolateral side to the medial side in turn. The 4 sutures were about 0.5cm apart. After threading, a 2~3mm incision was made in the suture center of two groups, the suture was delineated, the subcutaneous tissues and skin were separated, and then all sutures were threaded out from the lateral side.

After the ankle joint was dislodged for traction, it was placed in the neutral position, tightened, knotted and the skin was sutured. Eventually, an anterior drawer test was performed again to assess ankle stability and the patient wore protective boots to fix the ankle joint.

Observed indicators

The surgery time, incision length and length of stay were recorded, and the percentage was calculated; VAS was used to evaluate the degree of postoperative pain. The higher score, the more severe pain. The patients were scored before surgery, 1 week, 4 weeks and 24 weeks after surgery and at the last follow-up(7); AOFAS scale was used to evaluate joint function.

The higher score, the better recovery of joint function. The patients were scored before surgery, 4 weeks, 24 weeks and 48 weeks after surgery and at the last follow-up[7]. The incidence of postoperative complications were recorded, such as incision infection, skin necrosis, vascular, tendon and nerve injuries, etc.

Statistical processing

SPSS20.0 software was selected to process data. Kolmogorov-Smirnov test was used to evaluate normality. The measurement data that conformed to normal distribution were compared by independent sample t-test and repeated ANOVA and expressed by ($\bar{x}\pm s$). The enumeration data were compared by χ^2 test and expressed by %. P<0.05 was considered to be statistically significant.

Results

Comparison of surgery time, incision length and length of stay between two groups

There was no significant difference between two groups in surgery time (P>0.05). The incision length and length of stay of the observation group were significantly lower than those of the control group (P<0.05). See Table 1.

Groups	Number of Cases	Surgery Time (min)	Incision Length (cm)	Length of Stay (d)
Control group	78	52.04±7.92	3.55±0.58	8.78±1.50
Observation Group	70	50.30±6.85	1.70±0.32*	6.83±1.31*

Table 1: Comparison of surgery time, incision length, and length of stay between two groups.
**Compared with the control group, P<0.05.*

Comparison of VAS score before and after surgery between two groups

The VAS scores 1 week, 4 weeks and 24 weeks after surgery and at the last follow-up of 2 groups were sig-nificantly higher than those before surgery(P<0.05). The VAS score of the observation group 1 week after surgery was significantly lower than that of the control group (P<0.05). See Table 2.

Groups	Number of Cases	Before Surgery	1 Week After Surgery	4 Weeks After Surgery	24 Weeks After Surgery	Last Follow-up
Control group	78	7.11± 1.26	3.58± 1.35△	1.72± 0.78△	1.20± 0.45△	0.42± 0.08△
Observation Group	70	7.25± 1.12	3.07± 1.01△*	1.66± 0.63△	1.18± 0.40△	0.46± 0.07△

Table 2: Comparison of VAS score before and after surgery between two groups.
**P<0.05 compared with the control group; △P<0.05 compared with before surgery.*

Comparison of AOFAS score before and after surgery between two groups

The AOFAS scores 4 weeks, 24 weeks and 48 weeks after surgery and at the last follow-up of 2 groups were significantly higher than those before surgery (P<0.05). The AOFAS score of the observation group 4 weeks after surgery was significantly higher than that of the control group (P<0.05). See Table 3.

Groups	Number of Cases	Before Surgery	4 Week After Surgery	24 Weeks After Surgery	48 Weeks After Surgery	Last Follow-up
Control group	78	40.45± 3.90	55.77± 4.23△	89.39± 3.35△	94.61± 3.19△	95.25± 2.70△
Observation Group	70	42.60± 3.42	76.59± 6.09△*	87.56± 2.40△	92.13± 2.37△	97.19± 1.95△

Table 3: Comparison of AOFAS score before and after surgery between two groups.
**P<0.05 compared with the control group; △P<0.05 compared with before surgery.*

Comparison of the incidence of postoperative complications between two groups

No postoperative complications, such as incision infection, skin necrosis and vascular tendon injury were observed in the enrolled patients after surgery. There were 3 cases of superficial peroneal nerve injury in the control group, and 2 cases of superficial peroneal nerve injury in the observation group, and the incidences were 3.85% (3/78) and 2.86% (2/70) respectively. There was no significant difference between two groups in terms of the incidence of superficial peroneal nerve injury (P>0.05).

Discussion

As early as 1960, Broström surgery was used to repair lateral collateral ligament injury of the ankle. It can complete direct anatomical repair of anterior talofibular ligament+ calcaneofibular ligament, and has advantages in the protection of the activity of ankle joint and subtalar joint[8]. Many open Broström surgeries have been reported, but research on the application under arthroscopy, especially the comparison with open surgery, is still underpowered[9, 10]. The main advantage of open modified Broström surgery in the repair of lateral collateral ligament injury of the ankle is that related ligament injury can be visualized and the incision can be repaired by extending the arc incision of lateral malleolus[11]. Many reports involving open modified Broström surgery been proved to be effective. In recent years, with the development of minimally invasive arthroscopic techniques and the improvement of the proficiency of surgeons, it has also been applied to anatomical repair of lateral collateral ligament of ankle joint[12]. A study of 28 cases of lateral collateral ligament injury of the ankle showed that the mean AOFAS score of patients after arthroscopic Broström surgery reached 86, and the overall efficacy was satisfactory[13].

According to the results of this study, the VAS score and AOFAS score of two groups after surgery were higher than those before surgery, the VAS score of the observation group 1 week after surgery was significantly lower than that of the control group, and The AOFAS score of the observation group 4 weeks after surgery was significantly higher than that of the control group, indicating that compared with open surgery, arthroscopic Broström surgery is superior in the relief of pain symptoms and the recovery of joint function in the early stage. This is probably related to the smaller incision and degree of tissue dissection of arthroscopic surgery and easier neurovascular protection[14]. What's more, after arthroscopic surgery, patients have better subjective feelings, and higher compliance with early weight-bearing and functional exercise was a potential cause of better early out-come[15].

A 10-year-long follow-up study showed that the functional and imaging results of patients without calcaneofibular ligament reconstruction of lateral collateral ligament of ankle joint were satisfactory[16]. Another study documented that compared with patients who only had anterior talofibular ligament repaired, patients who had both the anterior talofibular ligament and calcaneofibular ligament repaired had no significant advantages in the improvement of joint function 3 years after surgery[17]. In this study, 13 patients with anterior talofibular ligament+calcaneofibular ligament injuries were included, 8 of whom underwent open surgery and 5 of whom underwent arthroscopic surgery. The postoperative follow-up showed that the results were satisfactory, and most of them returned to normal exercise level within 6 months after surgery. In terms of safety, the incidence of complications after arthroscopically modified Broström surgery varies greatly from report to report. Some studies reveal that common postoperative complications of patients include delayed incision healing, superficial peroneal nerve palsy and local tenderness, etc[18]. In this study, there were 3 cases of superficial peroneal nerve injury in the control group and 2 cases of superficial peroneal nerve injury in the observation group, and the incidences were 3.85% (3/78) and 2.86% (2/70) respectively. After analysis, the author believed that the possible reasons for postoperative nerve injury were: the anchor suture wrapped around the inferior extensor retinaculum or the sural fascia tissue excessively, which increased the traction and tension of superficial peroneal nerve. After surgery, the adaptability of these patients increased over time, and the symptoms can be significantly improved or disappear after the tension was eased. In this study, the intervention for the above patients was dominated by rest, supplemented by neurotrophic drugs and all patients got remission 3 to 6 months after surgery.

The concept and technology of postoperative rehabilitation of lateral collateral ligament injury of the ankle have constantly developed in recent years. Among them, the modified Broström surgery recommends that one can walk with partial weight-bearing within 3~14d after surgery with the support of protective boots, and bear full weight

from week 4 onwards[19]. Studies have shown that there is no significant difference between open and arthroscopically modified Broström surgeries in ultimate load, indicating that both groups can achieve satisfactory strength and early weight-bearing in ligament repair[20]. Although the arthroscopically modified Broström surgery has many strengths and long learning curve, it often takes doctors with little experience in arthroscopic surgery to grasp it. The open surgery can be performed visually, offer better suture firmness and deal with calcaneofibular ligament injuries. For this reason, the author holds that in clinical practice, an appropriate surgical procedure can be selected flexibly according to the patient's conditions and the operator's treatment experience. The open surgery can be used as the basis of surgical treatment of lateral collateral ligament injury of the ankle and remedial surgery after arthroscopic surgery.

To sum up, compared with the open surgery, arthroscopically modified Broström surgery can efficiently minimize surgical trauma and shorten the length of stay, have advantages in improving early efficacy and excellent safety in the treatment of lateral collateral ligament injury of the ankle.

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Corresponding Author:
Rong Wu
Department of Orthopaedics, The First People's Hospital of Huzhou (The First Affiliated Hospital of Huzhou University), Huzhou, Zhejiang, 313000, PR China
Email: wr1215sci@126.com
(China)