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Clinical Comparative Study of Two Kinds of Minimally Invasive Operation in The Treatment of Patients with Small Area Talar Osteochondral Injury

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Abstract

Objective: To investigate the clinical effects and safety differences of arthroscopic Kirschner wire drilling and arthroscopic microfracture in the treatment of patients with small area talar osteochondral injury.

Methods: Clinical data of 186 patients with small area talar osteochondral injury were retrospectively chosen in the period from January 2015 to June 2018 in our hospital and divided into 2 groups according to operation scheme differences including Kirschner group (88 patients) with arthroscopic Kirschner wire drilling and microfracture group (98 patients) with arthroscopic microfracture; and the excellent and good rate in ankle function, pain VAS score, AOFAS score, AAS score and Berndt Harty injury stage of ankle joint before and after operation and complications occurrences of 2 groups were compared.

Results: There was no significant difference in the excellent and good rate in ankle function between 2 groups (P>0.05). The pain VAS score at the last follow-up in 2 group were significantly less than before operation (P<0.05). The AOFAS score and AAS score at the last follow-up in 2 group were significantly more than before operation (P<0.05). There was no significant difference in the clinical index above at the last follow-up between 2 groups (P>0.05). There was no significant difference in the Berndt Harty injury stage of ankle joint at the last follow-up between 2 groups (P>0.05). No wound infection or neuromuscular injury was found and all the incisions healed in one stage and there was no re-operation cases in all patients at the follow-up process.

Conclusion: Arthroscopic Kirschner wire drilling and arthroscopic microfracture in the treatment of patients with small area talar osteochondral injury possess satisfactory overall efficacy and safety.

Keywords: Arthroscopy; surgery; talus; cartilage injury; clinical effects; safety

Introduction

Talar cartilage injury is a common severe injury disease of ankle joint in orthopedics department. There are localized cartilage denudation and deep subchondral involvement in the talar region (Ikoma et al., 2020). In Patients with ankle fracture or sprain, there are more than 50% of people with cartilage injury of taluse (Eren et al., 2019). For patients with talar cartilage injury, the basic principle of treatment should be to effectively relieve pain symptoms and restore the ability of daily living. In recent years, more and more scholars began to pay attention to the improvement of long-term prognosis (Luick et al., 2020). The current treatment options for small-scale talar cartilage injury include scraping of damaged tissue, drilling or micro fracture cone, among which drilling and micro fracture vertebral surgery are more recognized because they can stimulate the release of bone marrow mesenchymal stem cells and accelerate the repair of cartilage tissue (Looze et al., 2017). This study included 186 patients with small-scale talar cartilage injury in our hospital from January 2015 to June 2018. The purpose of this study was to investigate the difference in efficacy and safety between arthroscopic Kirschner wire drilling surgery and arthroscopic microfracture vertebral surgery in the treatment of small-scale

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talar cartilage injury.

1. Data and methods

1.1. general information

In this study, 186 patients with small-scale talar cartilage injury were treated in Tongren Hospital Shanghai Jiao Tong University School Of Medicine from January 2015 to June 2018. Among them, 88 cases were treated with arthroscopic Kirschner wire drilling surgery, and 98 cases were treated with arthroscopic micro fracture vertebral surgery. In the Kirschner wire group, there were 48 males and 40 females, with an average age of 41.36 ± 6.82 years, an average disease course of 14.83 ± 3.26 months, an average cartilage injury area of 1.26 ± 0.15 cm^2, and an average follow-up time of 17.63 ± 4.29 months. Among them, there were 73 cases of medial, 15 cases of lateral, 41 cases of left side, and 47 cases of right side according to the injury location. In micro fracture group, there are 55 cases of male and 43 cases of female, with average age of 41.87 ± 7.00 years, an average course disease of 14.59 ± 3.10 months, an average cartilage injury area of 1.21±0.18 cm^2, and the average follow-up time of 17.26 ± 4.09 months. Among them, there were 75 cases in the medial side, 23 cases in the lateral side, 45 cases in the left side and 53 cases in the right side according to the injury location. There was no significant difference in the general data between the two groups (P > 0.05). The study design was in line with the requirements of the Helsinki declaration, and informed consent was signed by patients and their families.

1.2. Inclusion and exclusion criteria

Inclusive criteria: 1). clinical diagnosis of talar cartilage injury; 2). ankle joint discomfort symptoms aggravated after exercise; 3). age ≥ 18 years old; 4). MRI showed cartilage damage within 1.5cm^2; 5). conservative treatment was ineffective for at least 3 mouth. Exclusion criteria: 1). previous ankle fracture or operation history; 2). other diseases affecting ankle function; 3). abnormal nerve function of affected limb.

1.3. Surgical methods

All anesthesia and operation were performed by the same group of doctors.

1.3.1. Preoperative treatment

General anesthesia or subarachnoid block combined with epidural anesthesia was used was used to maintain supine position and foot ankle suspension position. The incision was made through the anterolateral and anterolateral arthroscopic regular approaches, and the articular cavity was cleaned under the 30 ° arthroscopy with 2.7 mm lens. After the activity, the distal part was pulled to fully expose the tibiotalar joint to determine the area and degree of cartilage damage, and thoroughly clean the pathological cartilage tissue.

1.3.2. Kirschner wire group

According to the location of the lesion, a medial, lateral incision or a combined anterior medial incision was made, and a Kirschner wire (1.5mm in diameter) was inserted, and its tail end was connected with an electric drill to drill holes up to 3~4mm. After the operation is completed, pull out and then change the angle of drilling hole. Adjust the position of another drilling hole under the ankle joint with plantar flexion or back extension. The distance between drilling points is generally 3 ~ 4mm. The number of drilling holes is determined according to the damage area, and blood or bone marrow drops in the hole are appropriate.

1.3.3. Microfracture group

The incision was the same as the Kirschner wire group. 90° or 70° micro fracture cone was used with the tip perpendicular to the talus bone bed. Under the assistance of arthroscopy, the bone was knocked to 3 ~ 4mm in deep side. After pulling out, the micro fracture operation was completed at a distance of 3 ~ 4mm and blood or bone marrow drops in the hole was appropriate.

1.3.4. Postoperative treatment

After operation, the incision was covered with pressure and the ankle joint was fixed with inflatable compression brace. The distal toe was exercised after waking up. The incision was covered with ice 48 hours intermittently after operation. Passive ankle flexion and extension training was started 2 weeks after the operation. Section of the weight-bearing, ankle joint active flexion and extension and leg muscle group training were started at 4 weeks after operation. The brace was removed and patients are allowed walking with load at 8 weeks after operation. Swimming and bike training started at 12 weeks after operation.

1.4. Observation index

Vas scale was used to evaluate the degree of pain; 2). AOFAS scale and AAS scale were used to evaluate foot and ankle function (Cunningham and Adams, 2020); 3). Berndt-Harty injury stage was used to evaluate the repair effect of cartilage injury (Cunningham and Adams, 2020); 4). complications

during follow-up were recorded.

1.5. Clinical efficacy evaluation

The excellent and good rate of ankle function was evaluated according to AOFAS scale, of which excellent (90-100 points); good (75-89 points); fair (50-74 points); poor (0-49 points) (Carlson et al., 2020).

1.6. Statistical treatment

SPSS20.0 software was selected to process the data. Kolmogorov-Smirnov test was used to evaluate the normality; t-test was used to compare the measurement data in accordance with the normal distribution, expressed as $\bar{\chi} \pm s$. The comparison of counting data was performed by χ^2 test or Fisher exact probability method, expressed with rate. The difference was statistically significant when $P<0.05$.

2. Results

2.1. Analysis of excellent and good rate of ankle function

There was no significant difference in the excellent and good rate of ankle function between the two groups ($P>0.05$), see Table 1.

Table 1. **Comparison of excellent and good rate of ankle function between the two groups at the last follow-up**

Group	Total	Excellent	Good	Fair	Bad	excellent and good rate（%）
Kirschner wire group	88	56	22	10	0	88.64
Microfracture group	98	60	30	8	0	91.84

2.2. Analysis of pain VAS score, AOFAS score and AAS score

The VAS score of pain at the last follow-up of the two groups was significantly lower than that before operation, while AOFAS score and AAS score were significantly higher than those before operation ($P<0.05$). There was no significant difference in the above scores between the two groups at the last follow-up ($P>0.05$), see Table 2.

Table 2. **Comparison of VAS score, AOFAS score and AAS score between the two groups before and after operation**

Group	Total	VAS		AOFAS		AAS	
		Preoperative	Last follow-up	Preoperative	Last follow-up	Preoperative	Last follow-up
Kirschner wire group	88	6.37±1.06	2.17±0.56※	49.88±8.45	88.42±7.38※	4.51±0.83	5.74±1.13※
Microfracture group	98	6.53±1.12	2.10±0.62※	51.30±9.12	90.19±7.70※	4.60±0.86	5.60±1.08※

※Compared with preoperative，$P<0.05$

2.3. Berndt Harty injury staging analysis

There was no significant difference in Berndt Harty injury stage between the two groups at the last follow-up ($P > 0.05$), see Table 3.

Table 3. **Comparison of Berndt Harty injury stages between the two groups before and after operation (cases)**

Group	Total	Preoperative					Last follow-up				
		0	I	II	III	IV	0	I	II	III	IV
Kirschner wire group	88	0	32	28	20	8	38	32	18	0	0
Microfracture group	98	0	37	34	21	6	45	37	16	0	0

2.4. Analysis of complications

During the follow up after operation, in the Kirschner wire group and the microfracture vertebra group, 3 cases and 2 cases of joint discomfort occurred after walking for 2 hours or after strenuous exercise. Patients were recuperated or relieved spontaneously, and no other treatment was given. There were 4 cases and 6 cases of superficial peroneal nerve traction injury in Kirschner wire group and microfracture vertebral

group respectively, and skin numbness in dorsum of foot appeared, which improved after symptomatic treatment, without functional limitation. During the follow-up, no wound infection, nerve and muscle injury was found. All the incisions healed in one stage and no reoperation was found.

3. Discussion

Talar cartilage injury belongs to sports injury disease, and the mechanism of its occurrence and progression has not been determined. Some reports believe that its occurrence is related to ankle joint injury (Dhaliwal and Wines, 2020). Foreign scholars believe that 40%~55% of patients with talar cartilage injury can obtain effective pain relief after conservative treatment, but for those with fixed bone cartilage fragments, severe bone marrow edema, ligament instability secondary injury or ineffective conservative treatment, surgical treatment should be carried out as soon as possible (Duramaz and Baca, 2018).

The treatment mechanism of arthroscopic microfracture is to induce a large number of mesenchymal stem cells to accumulate in the cartilage damage area, stimulate the growth of fibrocartilage and the repair of defects, and the overall effect is satisfactory (Xu et al., 2020). In recent years, arthroscopic Kirschner wire surgery has been gradually used in the surgical treatment of articular osteochondral injury, which can adjust the diameter and change the direction during drilling. At the same time, it can directly reach the cartilage damage site through the skin, which has lower iatrogenic trauma degree, and can quickly and effectively deal with the deep and difficult to expose cartilage damage area. However, attention should be paid to the angle of movement during the operation (Rungprai et al., 2017). Other studies (Chopra et al., 2020) suggest that the depth adjustment is more flexible in the process of drilling with Kirschner wire. For example, the depth can be temporarily increased in thicker bone areas to achieve better bone marrow release effect. However, some scholars believe that the thermal effect of Kirschner wire drilling can increase the necrosis and edema of surrounding bone tissue, and stress fracture may occur in severe cases (Zhang et al., 2020). In this study, no osteonecrosis was found in the Kirschner wire group after operation, and only slight joint discomfort was observed after excessive activity. This may be related to the location of cartilage injury and the time of conservative treatment, but not affected by the specific operation.

Arthroscopic microfracture vertebroplasty and drilling are common surgical methods for cartilage injury, which are suitable for the treatment of most articular cartilage injuries. The existing reports have confirmed that the curative effect is defined, and there is no risk of secondary complications due to the thermal effect. However, in the actual operation process, it is difficult to effectively deal with the local injury area, which often needs the assistance of others. If the drilling direction is not consistent, it is easy to fracture the cone, so it is of higher requirements for the operator's operation technology and cooperation level (McCullough, 2020). Other studies have suggested that joint cavity exploration should be strengthened during the operation of micro fracture vertebra, and cartilage fragments should be completely removed to avoid the formation of joint free body after operation (Choi et al., 2020).

According to the existing opinion, the diameter and area of osteochondral injury treated by arthroscopy should be within 1.5cm and 1.5cm^2. Relevant clinical studies have analyzed the prognostic factors of cartilage injury treated by arthroscopy, and the results showed that the patients with injury area≤1.5cm^2 have better postoperative effect (Dombrowski et al., 2018). Another long-term follow-up study showed that the healing rate of patients with cartilage injury area diameter ≤ 1.5cm was 93%, while the healing rate of patients with cartilage damage area > 1.5cm was less than 10% (Ramponi et al., 2017). Based on the above evidence, It is believed that the area of patients with talar cartilage injury should be controlled within 1.5 cm^2.

Previous studies have shown that (Ramponi et al., 2017) arthroscopic microfracture vertebral surgery is better than debridement in the long-term functional improvement of talar cartilage injury, among which the excellent and good rate of self-evaluation function after operation of micro fracture vertebra is more than 90%, and the overall curative effect is better, while the arthroscopic microfracture vertebral surgery is closer to drilling operation. In this study, there was no significant difference in the excellent and good rate of foot and ankle function between the two groups (P>0.05), which further confirmed the above research point. At the same time, there were 3 cases in the Kirschner wire group and 2 cases in the micro fracture vertebral group of joint discomfort after walking for 2 hours or strenuous exercise, respectively. There were 4 cases and 6 cases of superficial peroneal nerve injury in the Kirschner wire group and the microfracture vertebral group respectively, with skin numbness in the dorsum of

the foot, which was considered to be caused by incision traction. After symptomatic treatment, the symptoms were improved without foot function limitation. No incision infection or neuromuscular injury was found in the follow-up process, and all the incision achieved primary healing, which suggesting that arthroscopic drilling and arthroscopic treatment can achieve close clinical efficacy and sound safety.

In conclusion, arthroscopic Kirschner wire drilling and microfracture vertebral surgery in the treatment of small-scale talar cartilage injury have good efficacy and safety and have clinical application value in terms of short-term efficacy. However, long-term follow-up study is still needed to confirm the long-term efficacy.

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