Effect of arthroscopic surgery combined with platelet-rich plasma in the treatment of discoid meniscus injury of knee joint and its influence on serum inflammatory factors

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Abstract
This study was to observe the effect of arthroscopic surgery combined with platelet-rich plasma (PRP) in the treatment of discoid meniscus injury of knee joint and its influence on serum inflammatory factors. A total of 80 patients with discoid meniscus injury in our hospital from June 2014 to June 2016 were enrolled and divided into study group and control group randomly with 40 patients in each group. The control group was treated with arthroscopy alone, and the study group was treated with arthroscopy combined with PRP. The clinical efficacy of the two groups was observed, and the Lysholm scores, Knee injury and Osteoarthritis Outcome Score (KOOS scores), and serum inflammatory factors (IL-1, TNF-α, and IL-6) were compared between the two groups before and after treatment. Six months after the treatment, the improvement rate, defined as (Excellent + Good)/total*100, of the study group was 97.5%, significantly higher than that of the control group, which was 87.5% (P < 0.05); before treatment, there was no significant difference in both Lysholm scores and KOOS scores between the two groups (P > 0.05); and 6 months later, the Lysholm scores and KOOS scores in the two groups were both significantly higher than those before, and the scores in the study group increased more significantly compared with those of the control group (P < 0.05); the values of serum IL-1, TNF-α, and IL-6 in the two groups were both significantly lower than those before, and the values in the study group decreased more significantly compared with those of the control group (P < 0.05). In conclusion, arthroscopic surgery combined with PRP therapy can effectively improve the clinical symptoms and reduce the level of serum inflammatory factors in patients with discoid meniscus injury of the knee, which is worthy of promotion and application.

Keywords
arthroscopic surgery, discoid meniscus injury of knee joint, platelet-rich plasma, serum inflammatory factors

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Introduction
The discoid meniscus injury of knee joint is a congenital malformation, usually referred to as congenital discoid cartilage, due to incomplete resorption of the central part of the plate which maintain in disk shape other than the normal meniscus. There are no obvious typical symptoms in the early stage of the disease, which increase the difficulty of diagnosis and treatment. Furthermore, activities in patients’ daily life aggravate the injury repeatedly, resulting in articular cartilage abrasion, traumatic synovitis, and even accelerated joint degeneration or loss of function of the knee joint permanently. The knee joint will be worn when it...
is flexed and rotated because of the abnormal meniscus, for which patients with the disease are prone to early joint pain symptoms, anatomical structure is affected adversely, and even physiological activity is impacted seriously, compared with the normal. Therefore, it is necessary to take feasible measures to improve patients’ prognosis and quality of life. There is no need for treatment of discoid meniscus without injury, but patients with symptoms like knee pain, interlocking, and joint dysfunction should be treated surgically. Traditional total resection or partial resection can achieve good short-term effects, but the total resection will inevitably reduce biological function, and is prone to complications for the damages of meniscus such as transmission load and absorption shock. With the continuous improvement and development of medical science and technology recently, arthroscopic surgery has been widely used in the clinic for treating meniscus injury, which is superior to the traditional operation with advantages such as shorter operation time, minimally invasive, high accuracy, rapid recovery, and others and improves the defects of the latter, including excessive bleeding, long operation time, slow recovery, and large surgical wound. With the emphasis on the function of meniscus and the clinical application of arthroscopy, meniscus repair and suture by arthroscopy has become the standard treatment of meniscus injury. Subsequently, new difficulties have emerged to challenge clinicians in how to retain the meniscus as much as possible, improve meniscus regeneration and self-repair, and increase the success rate of meniscal repair under arthroscopy. Platelet-rich plasma (PRP), a kind of blood product obtained by centrifugation of autologous whole blood, can effectively improve the pain of patients with osteoarthritis, and restrain further development of the disease. Platelet in the PRP releases a large number of endogenous growth factors when activated, such as platelet-derived growth factor, insulin-like growth factor, transforming growth factor β, vascular endothelial growth factor, and fibroblast growth factor. In orthopedics, PRP plays a positive role in promoting the repair and regeneration of tissue injured. The growth factors and other cytokines in the PRP act on the injured meniscus by promoting cartilage metaplasia and capillary formation, and improving local blood supply. However, it is still unclear whether it can improve the meniscus regeneration and self-repair to increase the success rate of meniscal repair under arthroscopy. This study aimed to observe the effect of arthroscopic surgery combined with PRP in the treatment of discoid meniscus injury of knee joint and its influence on serum inflammatory factors, so as to provide references for the clinical treatment of the disease.

**Materials and methods**

**Patients**

A total of 80 patients with discoid meniscus injury in our hospital from June 2014 to June 2016 were enrolled, with 47 males and 33 females, from 21 to 42 years old (34.7 ± 1.6). Inclusion criteria: with symptoms of meniscus injury including knee pain, interlocking, snapping, and positive McMurray sign, and with Stoller level II or above in grading of meniscus injury diagnosed by magnetic resonance imaging (MRI) read by the same radiologist. Exclusion criteria: with cruciate ligament injury, with osteoarthritis defined on XR, with malignant tumor, in pregnancy, with incomplete clinical data, and with contraindications to arthroscopic surgery. All enrolled patients were divided into study group and control group randomly with 40 patients in each group. The participants and treating surgeons were blinded to allocation group. There were no significant differences in general information between the two groups. The study was approved by the institutional review board of our hospital and performed with the informed consent of patients and their families.

**Methods**

The control group was treated with arthroscopy alone as follows: with arthroscopy system by Stryker, an American company, checking the knee joint thoroughly, and suturing the meniscus according to the situation of injury (FasT-Fix or Outside-in Suture). Isometric contraction of the quadriceps femoris was performed on the first day after the operation, knee flexion and extension exercise on patients’ own 4 days later, and non-weight-bearing exercise 1 week later. The arthroscopic visions of joint before and after the operation are shown in Figures 1 and 2.

The study group was treated with arthroscopy combined with PRP prepared with specialized centrifuge by Wego Group Co., Ltd. The PRP gel was...
Liu prepared as follows: 50 mL peripheral blood of patients was centrifuged for the first time at 1400r/min for 10 min. After centrifugation, the blood was divided into three layers, the upper layer was serum layer and the lower layer was erythrocyte layer, and the middle layer was white membrane layer consisted of platelet and white cell mainly. Discard red blood cells, and the remaining part was centrifuged for second centrifugation at 1400r/min for 10 min until the sample divided into two layers. The PRP was in the bottom and mixed with activating agent (the mixture of 1000 U bovine thrombin and 1 mL of 10% calcium chloride solution) in a 5:1 proportion to get PRP gel. The PRP gel was sutured to the injured area during meniscus repair in the study group, and the other operations were the same as those in the control group.

**Observation indexes**

All patients were evaluated by Lysholm Knee Score before and 6 months after treatment with a total score at 100, which means the best. Function evaluation was performed 6 months after treatment by reference to the KOOS Score (Knee injury and Osteoarthritis Outcome Score), which consists of five subscales and 42 questions, including Pain (9 questions), Symptoms (7 questions), Function in daily living or ADL (17 questions), Function in sport and recreation or Sport/Rec (5 questions), and Knee related Quality of life or QOL (4 questions), with each question assigned a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale. The values of serum inflammatory factors including IL-1, TNF-α and IL-6 were measured by enzyme linked immunosorbent assay (enzyme-linked immunosorbent assay (ELISA)) with kits from Biosource Technologies Inc., an American company, according to the instructions, and then compared. The clinical efficacy was judged according to functional recovery and pain of the knee joint 6 months after treatment by asking the patients, which fell into four levels: Excellent—function of the joint

| Table 1. Comparison of clinical efficacy between the two groups. |
| Groups       | n  | Excellent | Good | Not bad | Bad | Improvement rate (%) |
|--------------|----|-----------|------|---------|-----|----------------------|
| Control group| 40 | 25        | 10   | 5       | 0   | 87.5                 |
| Study group  | 40 | 34        | 5    | 1       | 0   | 97.5                 |
| X²           |    |           |      |         |     | 6.702                |
| P            |    |           |      |         |     | 0.009                |
returned to normal, and symptoms and signs disappeared; Good—knee joint returned to normal generally, with occasional pain during movement; Not bad—mild knee joint dysfunction remained, with mild pain during movement; Bad—no improvement totally. Improvement rate was defined as (Excellent + Good)/total*100.

**Statistical methods**

All statistical analyses were processed with SPSS 21.0 software package. The measurement data were expressed as mean ± SD and compared with t-test, and the enumeration data were compared with χ² test, respectively. A $P$ value < 0.05 was considered to be statistically significant.

**Results**

**Comparison of clinical efficacy between the two groups**

Six months after the treatment, the improvement rate of the study group was 97.5%, significantly higher than that of the control group, which was 87.5% ($P < 0.05$). See Table 1.

**Comparison of Lysholm scores and KOOS scores between the two groups**

Before treatment, there was no significant difference in both Lysholm scores and KOOS scores between the two groups ($P > 0.05$); and 6 months after treatment, scores in the two groups were both significantly higher than those before, and the scores in the study group increased more significantly compared with those of the control group ($P < 0.05$). See Table 2.

**Comparison of values of serum inflammatory factors between the two groups**

Before the treatment, there was no significant difference in the values of IL-1, TNF-α, and IL-6 between the two groups ($P > 0.05$); and 6 months after treatment, the values of those serum inflammatory factors in the two groups both decreased significantly than those before, and the values in the study group decreased more significantly compared with those of the control group ($P < 0.05$). See Table 3.
Discussion

There are two different mechanisms of wound healing due to the special structure of meniscus. In the red area of the meniscus (vascular area), abundant blood supply provides mesenchymal cells with nutrition to induce healing. While in the white area (avascular area), the healing relies on meniscus itself to repair, which leads to heal difficulty and even ineffectively. The suturing repair for treatment of meniscus injury has remarkable effects in the red area with improvement rate as high as 90%, but not so effective for injuries in the white area. Most of the meniscus injuries in young adults have tears in the two areas simultaneously. And in this case, it is not advisable to perform simple meniscectomy only unless the injury is too bad to be sutured, which leads to degeneration of articular cartilage and long-term complications of subchondral bone sclerosis.

PRP is a blood product by centrifuging autologous whole blood. PRP can improve the activity and regeneration of meniscus cell, and promote the synthesis of sulfated glycosaminoglycan. PRP plays a part positively in meniscus injury through the large number of fibrin within it to provide support for meniscal repair, which have been confirmed both in vivo and in vitro experiments.

The results of this study showed that, 6 months after the treatment, the values of serum inflammatory factors in the two groups decreased significantly than those before, and the values in the study group decreased more significantly compared with those of the control group. These results suggested that arthroscopic surgery combined with PRP therapy reduced the level of serum inflammatory factors in patients with discoid meniscus injury effectively because of the decreased inflammatory exudation by PRP, presumably.

In sum, arthroscopic surgery combined with PRP therapy can effectively improve the clinical symptoms and reduce the level of serum inflammatory factors in patients with discoid meniscus injury of the knee, which is worthy of promotion and application.

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Table 3. Comparison of values of serum inflammatory factors between the two groups.

| Groups       | n | IL-1 (pg/L) Before | After | TNF-α (pg/L) Before | After | IL-6 (pg/L) Before | After |
|--------------|---|-------------------|-------|-------------------|-------|-------------------|-------|
| Control group| 40 | 89.4 ± 3.7        | 36.7 ± 2.4 | 125.3 ± 7.8      | 34.7 ± 2.5 |
| Study group  | 40 | 89.2 ± 3.4        | 25.2 ± 3.8 | 121.4 ± 2.1      | 17.2 ± 1.6  |

| t  | 0.689 | 6.117 | 0.503 | 7.744 | 0.205 | 7.136 |
| P  | 0.731 | 0.001 | 0.771 | 0.000 | 0.893 | 0.000 |

PRP has been demonstrated recently to have an anti-inflammation potential role. IL-1 is an important inflammatory factor that leads to acute phase protein synthesis, fever, and other symptoms systemically and destructive lesions and inflammation of tissues locally, when acute or chronic inflammation happens. TNF-α can synergistically inhibit prostaglandin synthesis and play an important role in the pathogenesis of osteoarthritis. IL-6 can participate in multiple physiological and pathological processes by activating T cells and B cells to produce acute phase protein. The result of this study showed that, 6 months after the treatment, the values of serum inflammatory factors in the two groups decreased significantly than those before, and the values in the study group decreased more significantly compared with those of the control group. These results suggested that arthroscopic surgery combined with PRP therapy reduced the level of serum inflammatory factors in patients with discoid meniscus injury effectively because of the decreased inflammatory exudation by PRP, presumably.
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