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The use of platelet-rich plasma injections in the treatment of meniscal injuries- review of the literature

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Abstract

Introduction: In the knee joint are two menisci, which are fibrocartilaginous structures. The tears of the meniscus are one of the most common injuries within knee. Arthroscopy with suturing of torn or menisectomy are the most popular methods of treatment, however in long term observation menisectomy often results in osteoarthritis 10-20 years after surgery. For this reason, less invasive treatment methods are being sought, such as platelet-rich plasma injections. Platelet-rich plasma has many growth factors, which stimulates healing.

Objective: The aim of this study is to review latest the literature on the use of platelet-rich plasma injections in the patients with meniscus tears.

Material and methods: A literature review was conducted on databases such as PubMed and Google Scholar using the terms: "meniscus", "meniscus tear", "platelet-rich plasma", "platelet-rich plasma injections", "meniscus injuries treatment".

Conclusions: The injuries of meniscus are very common, and often must be treated by arthroscopy. Platelet-rich plasma has a positive impact on tissue healing. Platelet-rich plasma injuries in the patients with meniscal tears repair lead to improve healing rates compare with patients without PRP injections, but there is no guidelines and further studies are necessary.

Keywords: 'platelet-rich plasma', 'meniscus tears' 'platelet-rich plasma injections', 'menisectomy'

Introduction

In the knee, there are two fibrocartilaginous structures called menisci, that are located between the distal femoral condyle and the proximal tibial plateaus[1]. Meniscus play a role in shock absorption, joint stability and compatibility, stress transmission, response to load, compression, and tension [1,3]. They are crescent and wedge-shaped tissues featured by its regionally variant structure and biochemical composition[1]. Menisci are composed of three distinct layers, each serving different roles[2]. The middle lamellar region of meniscus have mixed population of chondrocytes and fibroblasts, it is composed of randomly arranged fibers and distinct radially arranged fibers at the periphery of meniscus [1,2,5]. The inner third region is made by chondrocyte like-cells and is avascular, whereas outer third region is constructed of dense fibrous matrix populated with fibroblast-like cells and is vascularized[1,4]. The superficial layer contacts the articulating joint surfaces and provides a smooth lubricating surface, it is composed of randomly orientated fibers, whereas circumferentially oriented fibers mixed with radially arranged binding fibers form the deeper layer[2,5]. A very important building substance in menisci is proteoglycan, primarily responsible for bearing loads [1]. We can divide meniscus into three segments: anterior horn, body and posterior horn[6]. Injuries to the menisci are a very common among athletes, but also in age or disease related degenerative injuries[1,7]

Types of meniscal injuries

Type 1: Meniscocapsular ligament tear

Meniscocapsular ligament tears involve the synovium, which results in separation from the posterior horn of the medial meniscus. This type of injury is located peripherally, often in the posteromedial “blind spot”, as a result, it is difficult to identify it during arthroscopy. However, these lesions are seen on MRI sequences as a peripheral vertical tears[6,8]. They can lead to fluid accumulation of posteromedial knee[6].

Type 2: Partial superior peripheral meniscal horn tear

This type of injury is characterized by peripheral partial thickness tear, which involves the superior margin of the posterior horn. In this type meniscotibial ligament stay intact and there is only a partial tear, which results in more stable and less long-term complications than in full thickness meniscocapsular tear[6,9].

Type 3: Hidden lesions

The hidden lesions are located in the most inferior part of the posterior horn and are associated with meniscotibial ligament instability. We can distinguish two subtypes, type 3A is a vertical peripheral tear of the inferior margin of the posterior horn, it is visible in MRI as linear vertical oblique fluid intensity with discontinuity of the meniscotibial ligament[6]. The second type 3B is characterized by tear of the meniscotibial ligament itself from its attachment to the posterior horn, which is visible on MRI as high T2 signal and disruption of the ligament[6].

Type 4: Complete tears

Type 4 lesions are characterized by complete longitudinal vertical tear in the red zone of the posterior horn and they lead to meniscotibial ligament instability[6]. We can divide it into subtype 4A in which meniscocapsular and meniscotibial attachments stay intact, however they are connected to the fragment of posterior horn, which lead to instability of the knee joint and subtype 4B which involves total tear of the junction between meniscocapsular and meniscotibial ligament, and posterior horn of the meniscus[6,10].

Type 5: Peripheral posterior horn meniscal double tear

This type is characterized by tear within the red zone of the meniscus, and unstable ligaments, because they are attached to the free-floating part of posterior horn. We can see it on MRI as a two linear high T2 signals. This is also the easiest type to diagnose arthroscopically[6].

Treatment of meniscal injuries

Injuries to the menisci can be treated both conservatively and surgically; the choice of method depends, among other factors: on the type of injury, the patient's age, their fitness, and the location of the meniscal tear[1]. Suturing torn is a method chosen in cases of meniscal injuries in the vascularized zone-outer third region[1]. There are two main methods of suturing, inside-out and outside-in[3]. However injuries in the avascular region are harder to treat, because of poor intrinsic healing capacity and deterioration of meniscus. Injuries of the avascular region must be treated surgically, the most common type of surgery is partial or total meniscectomy. Meniscectomy allows for the alleviation of pain symptoms; however, as a result of meniscal resection, we lose the shock-absorbing function[1,11]. A long-term effect of meniscectomy is the accelerated development of osteoarthritis in the knee joint[1,11]. Some sources indicate that even in 50% of patients, osteoarthritis may develop within 10-20 years after the meniscectomy[1,11]. Another technique of treatment is enhancement of healing, it is useful in the tears of avascular zone[3]. One example of this method is rasping of the synovium or the intercondylar, which results in increased vascular response[3, 12]. Additionally, tears of the meniscus we can also treat by transplantation, for example meniscus allograft transplantation or meniscus scaffold [13, 14]. Researches proves that in some patients especially in older group with degenerative tears, conservatively treatment can be effective[13]. However, in younger group of patients the better option is meniscus repair during arthroscopy[13]. Evidences showed that almost 80% of patients with peripheral reducible tears of the horizontal or longitudinal pattern were treated successfully by meniscus repair[13, 15].

Platelet-rich plasma

Platelet-rich plasma (PRP) is the liquid fraction from peripheral blood, which contains highly concentrated platelets, growth factors and bioactive components[16,17,18]. PRP has a positive role in the tissue healing by stimulation of angiogenesis, cell migration and proliferation and production of extracellular matrix[17,19]. PRP has a lot of growing factors: PDGF-regulates collagenase secretion and collagen synthesis, TGF-regulates endothelial, fibroblastic,

osteoblastic mitogenesis and stimulates undifferentiated mesenchymal cell proliferation; VEGF which is responsible for increases angiogenesis and vessel permeability and others like: EGF, CTGF, IGF-1, PF4, Ang1[17].

PRP has many different applications in medicine, particularly in accelerating the healing process of musculoskeletal injuries for example cartilage or ligaments[17,20].

Platelet-rich plasma injections in meniscal injuries

On the one hand, various clinical studies showed PRP injections in the patients with symptomatic tear of meniscus lead to radiological improvement and better functional scores[17,21]. On the other hand, various retrospective studies proves that there is not significant relief of pain or functional improvement after PRP injections[17, 22].

The safety of PRP injections into the knee joint was proved and currently, interest in this method is growing [23]. Many basic science studies have been conducted to assess the effectiveness of this method. A lot of theme showed that PRP injections could stimulate meniscal repair through many growth factors included in the PRP[17,24]. PRP induces meniscal cells and cooperates with synoviocytes, which are stimulated by platelet release, this mechanism lead to healing of meniscus[17, 25]. The studies showed that PRP has an important role on pain reduction[26]. The main factor responsible for postoperative pain is present of inflammatory factors, which are released after surgery[27]. PRP modulates meniscal environment, the growth factors present in the PRP can inhibit inflammation[28]. Moreover, many studies showed that VAS score after surgery were significantly lower in the PRP group than in the control group[17].

Currently, there are no standardization in PRP dosing and preparation[17]. Additionally, PRP could have different concentration of platelets, from 200,000 to >1 million platelets per microliter[29]. Preparations can also have different activating agent thrombin or calcium and different fibrin architecture[29]. Because of that, it is very hard to analyze and compare different studies about augmentation of PRP. Haunschild et al. analyzed 5 studies about PRP injections in

the meniscal tears, however in each study they use different doses and preparation method[30]. The amount of used PRP was between 2,7 and 8ml[30]. In only 2 of 5 studies described by Haunschild et al., imaging or arthroscopy was performed to assess the results of PRP injections[30]. For example, Pujol et al. showed that 1 year after surgery in group of patients after PRP injections were less patients with meniscal signaling than in control group[31]. Haunschild et al. reported that in 2 of 5 analyzed studies the efficacy of PRP injection was significant in contrast to control group, however in 3 of 5 studies there was not significant improvement in functional[30].

In the literature, there are contradictory research about PRP injections in the meniscus injuries. Sochacki et al. conducted a meta-analysis of 5 studies and showed that meniscal repairs with PRP injections has significantly lower failure rates than with PRP augmentation[32]. However one of analyzed study described no significant differences between the study groups[32]. The pooled failure rate is lower in the patients with PRP injections compared to those without PRP(10,8% vs 27%)[32]. There are also some research about PRP injections in meniscal surgeries concomitant with ACL reconstruction, and they showed no benefit of PRP in this group of patients[32,33]. The explanation for this may be the increase in growth factors resulting from increased bleeding in the joint from ACL tunnel drilling[32,34]. The healing of meniscus depends also on the location of tear. Tears located in the medial meniscus are a risk factor of worse healing compared to tears in the lateral meniscus. For this reason, injections of PRP may be able to improve healing in those patients[32]. On the other hand, tears located in the lateral meniscus, especially in the discoid menisci have higher recurrent rate and higher risk of osteoarthritis after surgery[35]. Dai et al. conducted a study and showed that in those patients PRP injection may lead to improved healing rates[36].

Conclusions

The meniscus plays very important role in the knee joint, injuries of the meniscus often lead to disfunction of knee joint and later to the osteoarthritis. Tears of meniscus are one of the most common injuries within knee joint, so proven and minimally invasive methods of treatment and acceleration of healing are necessary. The studies showed that patients with PRP injections has lower

postoperative pain. It is suggested that PRP injections could be recommend in meniscus injuries. Patients after PRP injections have better healing rates, but it differ depending on the dose and preparation of PRP, location and type of meniscal tear. Additionally, more randomized studies are necessary to assess the different forms of injections.

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