



THE PLACE OF ACELLULAR COLLAGEN MATRIX IN THE TREATMENT OF CARTILAGE DAMAGE OF THE KNEE JOINT

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ABSTRACT:

The collagen matrix has established itself as the standard in the treatment of chondral and osteochondral injuries of the knee joint.

Purpose: The application of this surgical technique aims at the restoration and regeneration of the defect with hyaline cartilage, which is the basis for achieving good early and long-term clinical results.

Material and Methods: We present 36 patients who are surgically treated with this technique. Patients are divided into two groups according to the etiological principle.

Results: Results are defined as good and very good and are comparable to the results of other similar retrospective studies.

Conclusions: The method is applicable in selected cases of a traumatic and degenerative nature and is an alternative to early knee arthroplasty.

Keywords: collagen matrix, cartilage damage, knee joint,

INTRODUCTION:

Treatment of damage to the articular cartilage of the knee joint places a number of challenges to modern traumatology [1]. The treatment of this pathology is aimed at restoring the joint cover with hyaline cartilage, thus aiming at achieving stability and full functional restoration of the adjacent joint [2], as well as prevention of pre-arthritis conditions [3]. Based on the etiological agent, cartilage damage is divided into two main groups:

1- Traumatic – they are specific for the young, physically active patient population as a result of acute or chronic trauma. They are often combined with damage to other soft tissue structures of the knee joint (articular-ligamentous apparatus, menisci) [4].

2-Degenerative – the articular cartilage damage is chronic, based on concomitant diseases or conditions such as static angular deviations of the knee joint, intra-articular fractures, age-related arthrosis, aseptic necrosis, metabolic and endocrine diseases [5].

In modern literature, there are many classifications grading the articular cartilage damage. In our practice, we use the Quaterbridge classification [6], which divides these injuries into four degrees:

Grade 0 – normal and intact articular cartilage;

Grade 1 – chondromalacia;

Grade 2 – Fissures and superficial partial defect without reaching the subchondral zone

Grade 3 – The chondral defect reaches the subchondral zone;

Grade 4 – The chondral defect also involves the subchondral bone;

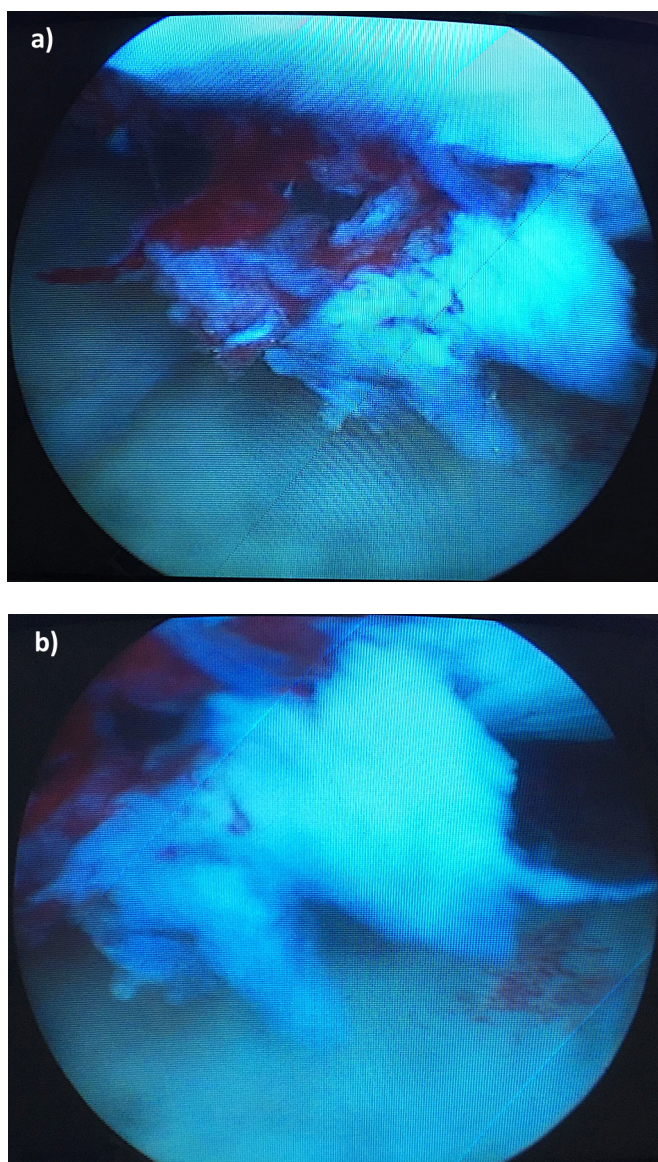
Our aim is to present surgical technique and results using acellular collagen matrix in the treatment of degenerative and traumatic chondral lesions of the knee joint.

MATERIAL AND METHODS:

For the period 2017-2022, 36 patients were surgically treated with this technique in the Orthopaedics and Traumatology Clinic at Medical University-Pleven. The chondral defects in all of the patients are diagnosed and evaluated with MRI scan. For twelve of these patients, we use CT-scan for evaluation of subchondral bone structure. The average age of the patients is 38 years. The patients are divided into two groups according to the etiological principle.

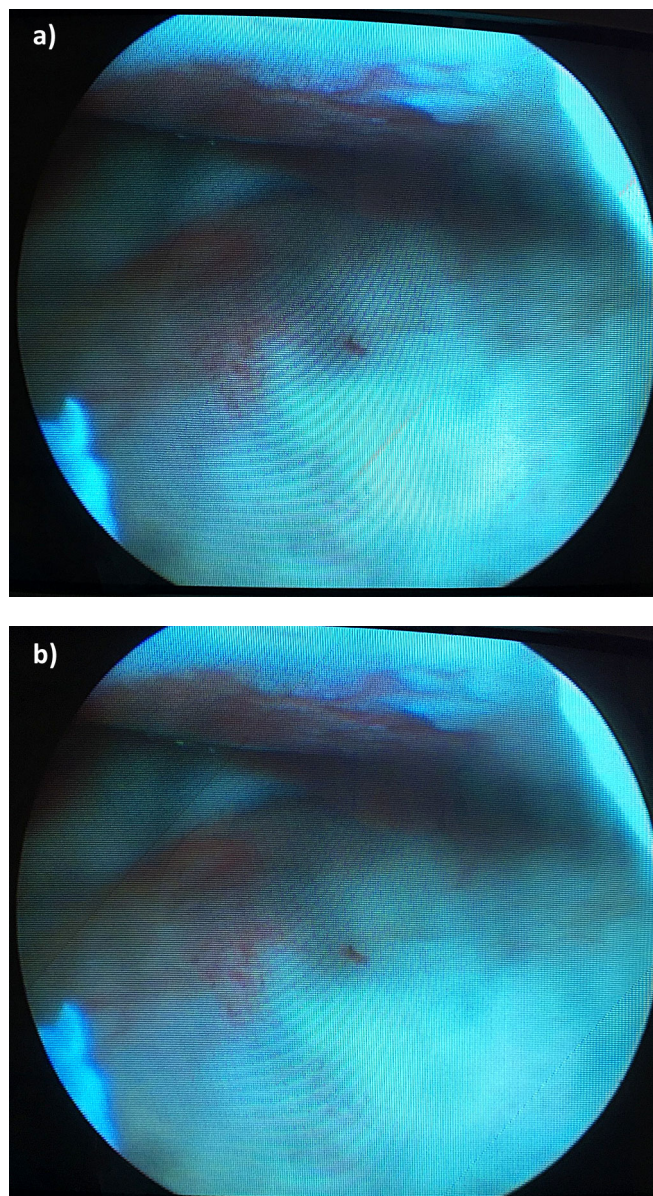
1. Patients with traumatic cartilage damage - 30 patients (fig. 1)

Fig. 1 a), b). Traumatic chondral defects



2. Patients with degenerative cartilage pathology - 6 patients (fig. 2)

Fig. 2 a), b). Degenerative chondral defects



The first group included 30 patients. The average age of the patients in this group is 30 years. The gender distribution is Male 21 / Female 9. The average size of the chondral defects is 4 sq. cm (Fig. 1). In 28 of the patients, the load-bearing zone of the medial femoral condyle was involved, in 2 of the cases - the load-bearing zone of the lateral femoral condyle. (fig.3)

Fig. 3. Chondral Defect



All patients from this group were treated primarily arthroscopically as the accompanying pathology (meniscus damage) was initially removed, and the cartilage damage was stabilized and prepared.

A second group includes 6 patients. The average age of the patients in this group is 48 years. The gender distribution is Male 3 / Female 3. Patients from this group are strictly selected and include those with moderately expressed and highly painful medial unicompartmental arthrosis, with preserved patellofemoral joint. Patients with expressed subchondral osteosclerosis and the presence of scar osteophytes, those with a rigid medial capsular ligamentous complex, and patients with expressed joint instability were not treated with this technique.

Our surgical algorithm includes the mandatory use of an Esmarch tourniquet. We remove all loose and unstable cartilage fragments with a small curette and shaver, creating a stable periphery of the defect. We preserve the integrity and intactness of the underlying subchondral bone.

The defect area is dried with a micro-aspirator, after which the defect is filled with the previously prepared and tempered acellular collagen matrix using a cannula. We wait for the hardening of the same one (on average about 5 min.), after which the operative intervention is completed.

Postoperatively, we immobilize the limb for 48 hours, after which active rehabilitation of the joint begins without loading. We allow partial load after 40 days full load after 90 days. For 22 patients – 20 patients from group one and 2 patients from group two, we did control MRI-scan 3 months after the operative treatment. In these cases we observe full regeneration of the chondral defect.

For one patient we did arthroscopic view of the chondral defect. This was done because the patient had suffered traumatic injury about six months after the acellular collagen matrix technique was used.

RESULTS:

This study covers 36 patients divided into two groups. 29 patients (80%) were clinically followed. Control examinations were carried out in the third, sixth and twelfth months.

To evaluate the results, we used the Rating System of the International Committee for Personal Documentation of the State of the Knee Joint in Operated Patients - IKDC.

The average value we obtained was 75.4, and these results are defined as good and very good and are comparable to the results of other similar retrospective studies. Two patients underwent unicompartmental knee arthroplasty at a later stage because of persistent pain in the medial compartment of the knee joint. The reason for this, in our opinion, is the expansion of medical indications in clinical cases with degenerative pathology.

DISCUSSION:

Numerous clinical studies and experimental animal studies have shown that early operative treatment has much better clinical results than conservative treatment [7].

The factors that determine the surgical behavior in these patients, in our opinion, are:

1. The size of the chondral damage;
2. The damage localization;
3. Outerbridge degree;
4. Presence of accompanying knee joint soft tissue damage;
5. Stability of the knee joint;

Meanwhile, numerous methods of treatment for isolated cartilage damage already exist. The early results using the acellular collagen matrix technique are comparable to the results achieved by other authors. [8,9,10].

With the method of debridement and lavage, temporary relief of the clinical symptoms is achieved, but it does not allow regeneration of the damaged cartilage [11].

The method of microfracture and abrasion arthroplasty leads to the formation of replacement fibrocartilage.

Autologous chondrocyte transplantation developed by Brittberg is aimed at restoring hyaline articular cartilage [12].

The modern development of biotechnology has led to the development and introduction of acellular collagen implants into clinical practice [13]. These acellular matrices fill the defect site and create an environment for cell migration. The autoregenerative potential is due to the neighboring migration of stem cells on the one hand and of fibroblasts on the other but differentiated to a chondroblastic phenotype. The in vitro ability of these matrices to stimulate the proliferation and synthesis of proteoglycans and type-II collagen has also been proven as the end result is repair of the defect with hyaline cartilage [14,15,16].

CONCLUSIONS:

The method is applicable in selected cases of a traumatic and degenerative nature and is an alternative to early knee arthroplasty.

The method is devoid of complications, does not require long-term rehabilitation, and allows patients to

resocialize early.

We believe that this technique is indicated for the treatment of cartilaginous damage of other large joints, providing an alternative in the treatment of cartilage pathology.

REFERENCES:

1. Dettlerline AJ, Goldberg S, Bach BR Jr, Cole BJ. Treatment options for articular cartilage defects of the knee. *Ortop. Nurs.* 2005 Sep-Oct;24(5):361-6. [PubMed]
2. Jiang CC, Hsieh CH, Liao CJ, Chang WH, Liao WJ, Tsai-Wu JJ, et al. Collagenase treatment of cartilaginous matrix promotes fusion of adjacent cartilage. *Regen Ther.* 2020 Jul 28;15:97-102. [PubMed]
3. Bath R, Eschweiler J, Betsch M, Gruber G. [Cartilage Repair of the knee joint.] [in German] *Orthopade.* 2017 Nov;46(11):919-927. [PubMed]
4. Gobbi A, Karnatzikos G, Kumar A. Long-term results after microfracture treatment for full-thickness knee chondral lesions in athletes. *Knee Surg Sports Traumatol Arthrosc.* 2014 Sep;22(9):1986-96. [PubMed]
5. Brittberg M, Gomoll HA, Canseco JA, Far J, Lind M, Hui J, et al. Cartilage repair in the degenerative ageing knee. *Acta Orthop.* 2016 Dec;87(sup363):26-38. [PubMed]
6. Slattery C, Kweon CY. Classifications in Brief: Outerbridge Classification of Chondral Lesions. *Clin Orthop Relat Res.* 2018 Oct;476(10):2101-2104. [PubMed]
7. Gotterbarm T, Breusch SJ, Schneider U, Jung M. The minipig model for experimental chondral and osteochondral defect repair in tissue engineering: retrospective analysis of 180 defects. *Lab Anim.* 2008 Jan;42(1):71-82. [PubMed]
8. Bentley G, Biant LC, Carrington RW, Akmal M, Goldberg A, Williams AM, et al. A prospective, randomized comparison of autologous chondrocyte implantation versus mosaicplasty for osteochondral defects in the knee. *J Bone Joint Surg Br.* 2003 Mar;85(2):223-30. [PubMed]
9. Dozin B, Malpeli M, Cancedda R, Bruzzi P, Calcagno S, Molfetta L, et al. Comparative evaluation of autologous chondrocyte implantation and mosaicplasty: a multicentered randomized clinical trial. *Clin J Sport Med.* 2005 Jul;15(4):220-6. [PubMed]
10. Gudas R, Stankevicius E, Monastyreckiene E, Pranys D, Kalesinskas RJ. Osteochondral autologous transplantation versus microfracture for the treatment of articular cartilage defects in the knee joint in athletes. *Knee Surg Sports Traumatol Arthrosc.* 2006 Sep;14(9):834-42. [PubMed]
11. Jørgensen AEM, Schjerling P, Krogsgaard MR, Petersen MM, Olsen J, Kjær M, et al. Collagen Growth Pattern in Human Articular Cartilage of the Knee. *Cartilage.* 2021 Dec;13(2_suppl):408S-418S. [PubMed]
12. Brittberg M. Autologous Chondrocyte transplantation. *Clin Orthop Relat Res.* 1999 Oct;(367 Suppl):S147-55. [PubMed]
13. Hangody L, Dobos J, Baló E, Pánics G, Hangody LR, Berkes I. Clinical experiences with autologous osteochondral mosaicplasty in an athletic population: a 17-year prospective multicenter study. *Am J Sports Med.* 2010 Jun;38(6):1125-33. [PubMed]
14. Jørgensen AEM, Agergaard J, Schjerling P, Heinemeier KM, van Hall G, Kjær M. The regional turnover of cartilage collagen matrix in late-stage human knee osteoarthritis. *Osteoarthritis Cartilage.* 2022 Jun;30(6):886-895. [PubMed]
15. Hsueh MF, Önnarfjord P, Bolognesi MP, Easley ME, Kraus VB. Analysis of "old" proteins unmasks dynamic gradient of cartilage turnover in human limbs. *Sci Adv.* 2019 Oct 9;5(10):eaax3203. [PubMed]
16. Lahm A, Dabravolski D, Rödiger J, Esser J, Erggelet C, Kasch R. Varying development of femoral and tibial subchondral bone tissue and their interaction with articular cartilage during progressing osteoarthritis. *Arch Orthop Trauma Surg.* 2020 Dec;140(12):1919-1930. [PubMed]

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