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**Is radiofrequency use in arthroscopic treatment of isolated medial meniscus horizontal cleavage tears more effective than mechanical debridement in young adults?**

Да ли је употреба радиофреквенције у артроскопском лијечењу изолираног хоризонталног расцепа медијалног менискуса делотворнији од механичког прилагођавања код младих одраслих особа?

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## Is radiofrequency use in arthroscopic treatment of isolated medial meniscus horizontal cleavage tears more effective than mechanical debridement in young adults?

Да ли је употреба радиофреквенције у артроскопском лијечењу изолираног хоризонталног расцепа медијалног менисуса делотворнији од механичког прилагођавања код младих одраслих особа?

### SUMMARY

**Introduction/Objective** Arthroscopic mechanical hand tools, motorized shavers, and bipolar radiofrequency are used in arthroscopic partial meniscectomy.

The aim of this study is to evaluate efficacy of radiofrequency on early clinical outcomes in patients who underwent arthroscopic partial meniscectomy with horizontal cleavage tear and without additional intraarticular knee pathology.

**Methods** A total of 37 patients complied with the study criteria. Patients were divided into two groups according to usage of bipolar radiofrequency. Patients were evaluated by using visual analog scale (VAS) and Tegner Lysholm knee scores at the end of the first year follow-up.

**Results** Twenty-two patients comprised the shaver-using group. Preoperative mean VAS score was  $7.9 \pm 0.8$ , and the Tegner Lysholm knee score was  $49.6 \pm 9.6$ . Fifteen patients comprised the bipolar radiofrequency-using group. Preoperative VAS score was  $7.8 \pm 0.9$ , and the Tegner Lysholm knee score was  $52.2 \pm 10.7$ . The mean VAS score was  $1.2 \pm 0.9$ , and the mean Tegner Lysholm knee score was  $89.5 \pm 8.1$  in shaver used group at last follow-up. At the last postoperative follow-up, the mean VAS score was  $1.1 \pm 1$ , and the Tegner Lysholm knee score was  $88.8 \pm 7.3$  in the bipolar radiofrequency-using group. No statistically significant differences between the VAS and Tegner Lysholm knee scores of the preoperative and postoperative controls of the two groups were observed ( $p \geq 0.05$ ).

**Conclusion** Radiofrequency use has no effect on early clinical outcomes in the arthroscopic treatment of isolated medial meniscus posterior horn horizontal cleavage tears; we do not recommend its use.

**Keywords:** Radiofrequency, Horizontal cleavage tear, Meniscus

### САЖЕТАК

**Увод/Циљ** У делимичној артроскопској менискектомији користе се артроскопски механички ручни алати, моторизовани бријачи и биполарна радиофреквенција.

Циљ ове студије је да се процени ефикасност радиофреквенције на раним клиничким исходима код пацијената који су били подвргнути делимичној артроскопској менискектомији са хоризонталном руптуром и без додатне интраартикуларне патологије колена.

**Метод** Укупно 37 пацијената испунило је критеријуме студије. Пацијенти су подељени у две групе према коришћењу биполарне радиофреквенције. Пацијенти су оцењени помоћу визуелне аналогне скале (ВАС) и *Tegner Lysholm knee* SCORE након годину дана праћења.

**Резултати** Двадесет два пацијента су користила шејвер. Преоперативни ВАС скор је био  $7.9 \pm 0.8$ , а *Tegner Lysholm knee* скор  $49.6 \pm 9.6$ . Петнаест пацијената чинило је биполарну групу која користи радиофреквенцију. Преоперативни ВАС резултат био је  $7.8 \pm 0.9$ , а *Tegner Lysholm knee* скор  $52.2 \pm 10.7$ . Просечна ВАС скор је био  $1.2 \pm 0.9$ , а средњи *Tegner Lysholm knee* скор  $89.5 \pm 8.1$  у групи која је користила шејвер приликом последње контроле. Током последње контроле, средња вредност ВАС била је  $1.1 \pm 1$ , а *Tegner Lysholm knee* скор је био  $88.8 \pm 7.3$  у групи која је користила биполарну радиофреквенцију. Нису примећене статистички значајне разлике између ВАС и *Tegner Lysholm knee* SCORE преоперативне и постоперативне контроле две групе ( $p \geq 0.05$ ).

**Закључак** Коришћење радиофреквенције нема ефекта на рани клинички исход у артроскопском лечењу изолованих хоризонталног руптура медијалног менисуса; не препоручујемо његову употребу.

**Кључне речи:** Радиофреквенција, хоризонтална руптура, Менискус

## INTRODUCTION

Horizontal cleavage tears in young people were first described by Biedert in 1993 [1].

Horizontal cleavage tears have a traumatic or non-traumatic etiology during degeneration caused by disruption of the load distribution in the knee joint. Horizontal cleavage tears extend to the inferior surface of the meniscus [2].

Degenerative meniscus tears usually involve horizontal cleavage tears and are more common in middle-aged patients. The prevalence of horizontal cleavage tears increases with age [3]. A mechanical relationship between meniscus degeneration and knee osteoarthritis is believed to exist, but no consensus on the relationship between the structures of the cartilage and meniscus and the sequence of degeneration is yet available. Conservative treatments, arthroscopic meniscus sutures, and arthroscopic partial meniscectomy are performed in the treatment of horizontal cleavage tears [4].

Arthroscopic mechanical hand tools, motorized shavers, and bipolar radiofrequency are used in arthroscopic partial meniscectomy. The use of radiofrequency can cause cell death due to thermal effects on cartilage tissue. Allen et al. found that cell death rates do not differ between debridement with punch and mechanical shaving and meniscus debridement using bipolar radiofrequency. The authors thus stated that bipolar radiofrequency does not damage the cartilage of joint surfaces and provides a smooth contour on the meniscus surface [5].

The aim of this study is to evaluate retrospectively the efficacy of radiofrequency on early clinical outcomes in patients who underwent arthroscopic partial meniscectomy with horizontal cleavage tear and without additional intra articular knee pathology.

## **METHODS**

This retrospective study was approved by the ethics board of our institution (No. 2019-18/01) and conducted in accordance with the Declaration of Helsinki. Informed written consent was obtained from all patients included in the study.

A total of 218 patients who underwent knee arthroscopy in our clinic in 2018 were evaluated retrospectively in our study. The inclusion criteria were age between 20 and 50 years, detection of tears in the posterior horn of the medial meniscus on preoperative MRI, and detection of only horizontal cleavage tears in the posterior horn of the medial meniscus

without any other intraarticular knee pathology during arthroscopy. Patients with VAS and Tegner Lysholm knee scores in their preoperative and postoperative follow-up files were included in the study. Patients who were under 20 and over 50 years of age; who had inflammatory arthropathy; who had cartilage problems in the medial, lateral, or patellar femoral joints; who had lateral meniscus tear or anterior cruciate ligament injuries in addition to the horizontal cleavage tear in the medial meniscus; and those with trauma history were excluded from the study.

### **Surgical technique**

Prophylaxis of the patients before surgery was performed with 1 g of cefazolin sodium. A tourniquet was applied to the extremity under general or spinal anesthesia. An anterolateral portal was created in all surgeries, and an anteromedial portal was created after diagnostic arthroscopy. First, the patellofemoral joint, lateral, and medial gutters were evaluated. The medial compartment medial meniscus, anterior cruciate ligament, lateral compartment, and lateral meniscus were then evaluated. Partial meniscectomy using appropriate angled punches was performed for patients who had horizontal cleavage tears in the posterior horn of the medial meniscus. During partial meniscectomy, the upper and lower flaps were excised by preserving the outer 50% of the meniscus. Meniscus contours were smoothed by using a shaver in some patients and bipolar radiofrequency in some patients. After the tourniquet was deflated, the portals were closed.

### **Postoperative follow-up and patient data collection**

All patients underwent a postoperative physical therapy program and were evaluated using VAS and Tegner Lysholm knee scores at the end of the first year of follow-up [6]. The surgical and follow-up files of patients who underwent arthroscopy with a follow-up period

of more than 1 year were evaluated retrospectively. A total of 37 patients complied with the study criteria. When the patients' operations were evaluated, we determined that bipolar radiofrequency was not used during the arthroscopic partial meniscectomy of 22 patients. Bipolar radiofrequency was used during the arthroscopic partial meniscectomy of 15 patients. Patients were divided into two groups according to bipolar radiofrequency use.

### Statistical analysis

The suitability of the data to a normal distribution was tested. Because the data were not normally distributed, pre- and postoperative VAS and Tegner Lysholm knee scores were analyzed by using the Wilcoxon test, which is a non-parametric version of the paired t-test. Differences in VAS and Tegner Lysholm knee scores between the bipolar radiofrequency-using and -non-using groups were also evaluated by the Mann–Whitney U test. A p value of <0.05 was considered statistically significant at the 95% confidence interval.

### RESULTS

Of the 37 patients who met the study criteria, 25 were male and 12 were female. The mean age of the patients was  $38.6 \pm 5.1$  years. Patients included in our study consisted of mostly heavy workers and the lifestyle in our country were the main reasons for younger average age for horizontal cleavage tears. Of the 22 patients without bipolar radiofrequency use during arthroscopic partial meniscectomy, 16 were male and 6 were female. The mean follow-up period was  $13 \pm 2.1$  months in this group. The preoperative mean VAS score was  $7.9 \pm 0.8$ , and the Tegner Lysholm knee score was  $49.6 \pm 9.6$ . Ten of the 15 patients in the bipolar radiofrequency-using group were male; the rest were female. The mean follow-up period was  $12 \pm 9.4$  months. In this group, the preoperative VAS score was  $7.8 \pm 0.9$ , and the Tegner Lysholm knee score was  $52.2 \pm 10.7$ . The mean VAS score was  $1.2 \pm 0.9$ , and the

mean Tegner Lysholm knee score was  $89.5 \pm 8.1$  in group which radiofrequency was not used at the last follow-up. At the last postoperative follow-up, the mean VAS score was  $1.1 \pm 1$ , and the Tegner Lysholm knee score was  $88.8 \pm 7.3$  in the bipolar radiofrequency-using group (Table 1). Statistically significant differences in the VAS and Tegner Lysholm knee scores of the preoperative and postoperative final controls of both groups ( $p \leq 0.05$ ) were observed. No statistically significant differences in the VAS and Tegner Lysholm knee scores of the preoperative and postoperative controls of the two groups ( $p \geq 0.05$ ) were found.

## DISCUSSION

Complex meniscal tears and cartilage defects are common among patients with early and advanced knee osteoarthritis. Pain and restriction of range of motion are also higher in this group of patients than in groups without knee osteoarthritis [7]. Major meniscus problems are more common in patients who need knee replacement than in those who do not need knee replacement [8, 9]. In particular, knees with macerations in the meniscus body and posteromedial horn are more in need of knee arthroplasty than control knees [8]. Antony et al. found that meniscal changes, such as meniscus maceration and meniscus extrusion, are more likely to cause structural changes than meniscus signal increases and meniscus tears. The authors hence determined that meniscal maceration has an effect on knee pain and knee osteoarthritis [10]. Horizontal cleavage tears are meniscus tears extending from the avascular zone to the vascular zone and considered degenerative meniscus tears [11]. Previous studies suggested that the earliest anatomic finding of knee osteoarthritis is a degenerative tear of the medial meniscus posterior horn. The aim of the present study is to exclude patients with chondral lesions and compare the treatment results of isolated medial meniscus horizontal cleavage tears by using bipolar radiofrequency and shaver.

Although patients with traumatic meniscus tears were not included in our study, Kim et al. divided 40-year-old patients with horizontal cleavage tears into two groups according to the etiology of their meniscus tear as traumatic or degenerative meniscus tears. IKDC scores increased from 58.1 to 84.6 in the traumatic group and from 59.1 to 85.1 in the non-traumatic group. Lysholm scores increased from 61.1 to 85.5 in the traumatic group and from 62.2 to 86.1 in the non-traumatic group. No statistically significant difference was found between the two groups [12]. According to our results, a statistically significant increase in Lysholm scores exists between the preoperative and postoperative final controls.

Partial meniscectomy is recommended for the treatment of degenerative horizontal cleavage tears because these tears are located in the avascular region and, therefore, have lower healing potential compared with acute traumatic tears [13]. Koh et al. found a decrease in contact area and increase in pressure on the medial compartment when they removed the inferior portion of horizontal cleavage tears in their study on cadaveric knees. The scholars found no further reductions in contact area or increases in pressure in medial femoral condyles with additional excision of the superior part of the horizontal cleavage tear [14]. Uquillas et al. found that resection of the upper or lower flap in horizontal cleavage tears or resection of both flaps does not change the pressure on the contact surface. The authors thus recommended the preservation of the outer 50% of the medial meniscus in horizontal cleavage tears in the posterior horn of the medial meniscus [15]. In our study, we attempted to preserve 50% of the peripheral portion of the meniscus of patients who underwent partial meniscectomy, and we excised both flaps.

Another approach in the treatment of horizontal cleavage tears is meniscus repair. Arno et al. found a 13% increase in contact pressure and 6% decrease in contact area as a result of horizontal cleavage tears in their cadaver study. The scholars thus stated that horizontal cleavage tears may cause cartilage degeneration by causing few but statistically

significant changes in tibiofemoral contact mechanics [16]. Beamer et al. conducted a study on cadaver knees and determined that contact area and pressure on the contact area are close to normal values after the repair of horizontal cleavage tears with sutures. Moreover, the contact area decreased and the pressure on the contact area increased in knees treated with subtotal or partial meniscectomy [17]. Billières et al. performed partial meniscectomy and open meniscus repair in 14 patients with degenerative horizontal cleavage tear and found a mean International Knee Documentation Committee score of  $86.1 \pm 10.9$  after 8.5 years of follow-up. The authors also found mean Knee Injury and Osteoarthritis Outcome Scores of  $91.4 \pm 7.5$  for pain,  $91.4 \pm 10.2$  for symptoms,  $97.1 \pm 4$  for daily activity,  $84.4 \pm 20.7$  for sports, and  $84 \pm 14.2$  for quality of life. The authors thus reported that repairing complex horizontal cleavage tears in young patients yields good subjective and objective results [18]. Despite these findings, however, negative results of horizontal cleavage tears after meniscus repair have been published. Biedert et al., for example, compared four groups, including those conservatively treated, treated by meniscus suture, treated by meniscus suture using fibrin glue, and treated by partial meniscectomy. The scholars reported that the best short-term clinical results are obtained in the group treated by partial meniscectomy [4]. Shanmugaraj et al. found that repair of horizontal cleavage tears has a higher complication rate than repair with partial meniscectomy [19]. Since a meniscus repair group was not present in our study, our findings are somewhat limited.

Spahn et al. performed arthroscopic debridement on patients with grade 3 chondropathy and degenerative tears of the medial meniscus. Here, cartilage debridement was performed by using radiofrequency in one group and shaving in another group. The authors reported that the clinical results of the radiofrequency group are better than those of the shaver group after 1 year of follow-up [20]. Spahn et al. reported that the results of



debridement with radiofrequency are better than those of mechanical debridement after 4 years [21].

Figuerola et al. investigated thermal effects on the meniscus using bipolar radiofrequency and found cellular changes in deeper tissues with bipolar radiofrequency in elderly patients; the authors thus recommended that precautions be taken during the use of bipolar radiofrequency in elderly patients during meniscectomy and advocated the use of low intensities [22]. Allen et al. found no difference in cell death rate between meniscal debridement with bipolar radiofrequency and debridement with motorized shaver and punches. These scholars found that radiofrequency does not damage the joint surfaces under the meniscus [5].

Grana et al. compared mechanical meniscectomy with meniscectomy using radiofrequency and found that cracks and clefts are formed on surfaces on which meniscectomy was performed mechanically; by comparison, the surfaces of menisci subjected to meniscectomy with radiofrequency were flatter and more homogeneous. The author further found that meniscectomy with radiofrequency offers more resistance than mechanical meniscectomy in static tests [23].

Vangsness et al. studied the effects of monopolar and bipolar radiofrequency devices on tissue during meniscectomy. No difference was detected between the two systems, and the use of radiofrequency factors, such as geometric shape of the probe, was reported to have an effect on the depth of thermal effect [24]. Studies showing the advantages of radiofrequency use and a low risk of osteonecrosis after use have been published. However, according to the findings of our study, the results of partial meniscectomy using radiofrequency and partial meniscectomy using shaver and punch are not significantly difference.

## CONCLUSION

We believe that radiofrequency use has no superior effect than mechanical debridement with motorized shaver and punches on early clinical outcomes in the arthroscopic treatment of isolated medial meniscus posterior horn horizontal cleavage tears in young adults. Usage of radiofrequency is high cost. Thus, we do not recommend its use.

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**Table.** Pre and post operative clinical scores of groups

<b>Time</b>	<b>Group with shaver</b>	<b>Group with radiofrequency</b>
Pre- op VAS score	7.9 ± 0.8	7.8 ± 0.9
Post-op VAS score	1.2 ± 0.9	1.1 ± 1
Pre-op Tegner Lysholm scores	49.6 ± 9.6	52.2 ± 10.7
Post-op Tegner Lysholm scores	89.5 ± 8.1	88.8 ± 7.3

Paper accepted