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Is Single Puncture Arthrocentesis Type-1 Superior to Double Puncture Arthrocentesis in Temporomandibular Joint Disc Displacement Without Reduction?

Temporomandibular Eklem Redüksiyonsuz Disk Deplasmanlarında Tip-1 Tek Girişli Artrosentez Çift Girişli Artrosenteze Göre Daha Başarılı mı?

***Fatih TAŞKESEN*[1]** **Burak CEZAİRLİ[2]**

ÖZ

Amaç: Bu çalışmanın amacı temporomandibular ekleminde (TME) redüksiyonsuz disk deplasmanı olan hastalarda tip-1tek girişli ve çift girişli artrosentezin tedavi etkinliklerinin karşılaştırılmasıdır.
Araçlar ve Yöntem: Bu randomize prospektif çalışmaya tip-1tek girişli veya çift girişli TME artrosentezi yapılan 36 hasta dahil edilmiştir. Fonksiyona bağlı ağrı, maksimum ağız açıklığı ve çiğneme etkinliği gibi çeşitli parametreler tedavi başlangıcında ve takip randevularında kaydedilmiştir. Ayrıca hastaların işleme toleransı, ihtiyaç duydukları analjezik miktarı, işlemin kolaylığı ve süresi de değerlendirilmiştir. Her bir zaman noktasında gruplar arasındaki fark ve altıncı ay ile başlangıç değerleri yüzdelik değişimleri Mann-Whitney U testi ile belirlendi. Değişkenlerin grup içi değerlendirilmesinde Wilcoxon testi kullanıldı. İstatistiksel anlamlılık düzeyi p <0.05 olarak kabul edildi.
Bulgular: Çalışmanın sonunda değerlendirme parametrelerindeki değişiklikler iki grup arasında istatistiksel olarak benzer bulunmuştur (p>0.05). Bununla birlikte, çift girişli artrosentez tekniğinin süresi, tip-1tek girişli artrosentez tekniğine göre, anlamlı olarak daha kısa bulunmuştur (p<0.0001). Tip-1tek girişli artrosentez tedavisinde tekniğin uygulama kolaylığı istatistiksel olarak anlamlı derecede yüksek bulunmuştur (p<0.001). Çift girişli artrosentez uygulamasının hastalar tarafından tolere edilebilirliği tip-1 tek girişli artrosentez uygulamasına göre ilk gün ve ilk hafta kontrollerinde daha yüksek bulunmuş olsa da ilk ay sonunda iki tekniğin de hastalar tarafından tolere edilebilirliği benzer bulunmuştur.
Sonuç: Tip-1 tek girişli ve çift girişli artrosentez tedavilerinin etkinlikleri temporomandibular eklem redüksiyonsuz disk deplasmanında benzerdir. Tip-1 tek girişli artrosentez tekniği, düşük morbidite ve uygulama kolaylığı gibi avantajları nedeni ile temporomandibular eklemin redüksiyonsuz disk deplasmanı vakalarında ilk tedavi yöntemi olarak düşünülebilir.

Anahtar Kelimeler: artrosentez; temporomandibular eklem; temporomandibular eklem diski

ABSTRACT

Purpose: The aim of the study was to compare the effectiveness of single puncture arthrocentesis type-1 (SPA Type-1) and double puncture arthrocentesis (DPA) in patients with disc displacement without reduction (DDwoR) of the temporomandibular joint (TMJ).
Materials and Methods: This randomized prospective study included 36 consecutive patients who had TMJ arthrocentesis either with DPA or SPA Type-1. Several outcome parameters, such as pain on function, maximum mouth opening, and chewing efficiency were recorded at baseline and multiple follow-up assessments. Additionally, treatment tolerability, easiness and duration of the procedures and analgesics required postoperatively were also evaluated. The difference between the groups at each time point and percentages of sixth month-baseline changes were determined by the Mann-Whitney U test. Wilcoxon test was used for intra-group evaluation of variables according to baseline. Statistical significance level was accepted as p <0.05.
Results: The rates of improvement of the outcome variables were not significantly different between the two groups (p>0.05). However, the duration of the DPA technique was significantly shorter than the SPA Type-1 (p<0.0001). The ease of the procedure was statistically significantly higher in SPA Type-1 (p<0.001). Treatment tolerability was statistically higher in DPA than SPA Type-1 in one day and one-week period however was similar in the one-month period.
Conclusion: Both SPA Type-1 and DPA techniques are similarly effective in DDwoR. SPA Type-1 may be considered the first treatment modality in DDwoR due to its advantages over DPA as low morbidity and easiness.

Keywords: arthrocentesis; temporomandibular joint; temporomandibular joint disc

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[1] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Erzincan Binali Yıldırım University, Erzincan, Turkey.
[2] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Ordu University, Ordu, Turkey.
Corresponding Author: Fatih Taşkesen, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Erzincan Binali Yıldırım University, Erzincan, Turkey.
e-mail: taskesenfatih@gmail.com

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INTRODUCTION

Temporomandibular Joint (TMJ) disc displacement without reduction (DDWoR) refers to articular disc dislocation that the disc cannot be self-reduced in mouth maximum opening position.[1,2] DDWoR gives rise to mainly pain and limitation of mouth opening. Radiological findings represent an anterior position disc that cannot be reduced in mouth open position.[3]

The treatment of patients with DDWoR aims to relieve pain and restore function. Various conservative and surgical methods are used in the treatment of DDWoR. The conservative treatments include drugs, splints, and physiotherapy exercises. The surgical procedures include invasive and non-invasive modalities. Arthrocentesis is one of the most used minimally invasive procedures to treat TMJ DDWoR.[4,5]

TMJ arthrocentesis was first described by Nitzan [6] and developed as a modification of TMJ arthroscopy.[4,5] Conventional arthrocentesis refers to washing out joint cavity under hydraulic pressure by inserting two needles into superior joint cavity to lyse adhesions and flush out inflammatory mediators that cause pain.[5,7]

Many modifications have been described in the literature to decrease morbidity and to increase the comfort of both the patient and the surgeon in arthrocentesis procedure.[4,8,9] Guarda et al.[10] proposed a new arthrocentesis technique that uses a single needle for both injection and aspiration to avoid possible complications of two needles as facial nerve injury.[11] This technique was later described as single puncture arthrocentesis Type-1 by Senturk and Cambazoglu.[12] They classified TMJ arthrocentesis techniques according to the number of puncture sites as either single-puncture arthrocentesis (SPA) or double-puncture arthrocentesis (DPA). Further classification according to the number of needles used was made: Type-1: is a single needle cannula method in which the inflow and outflow occur through the same cannula and lumen; Type-2 is a double-needle or dual-needle cannula method in which the inflow and outflow occur through the same cannula but different lumens.[12]

A limited number of studies comparing the treatment efficacy of single puncture arthrocentesis (SPA) and double puncture arthrocentesis (DPA) have been reported in the literature.[8] Also, few of them have included an intraoperative comparison of these techniques.[7,13,14]

The objective of this study was to compare the intraoperative data concerning the duration and easiness along with the clinical efficacy of the conventional double puncture versus single puncture type-1 arthrocentesis for the management of temporomandibular joint disc displacement without reduction (DDWOR).

MATERIALS and METHODS

Study Design

This study recruited 36 patients with temporomandibular joint disc displacement without reduction (DDwoR), who were referred to the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Erzincan Binali Yıldırım University in April to July 2020. Patients were treated by SPA Type-1 or DPA. Informed consent was taken from all patients included in this study. This prospective randomized study was conducted with ethical approval (2020/03-17) in Erzincan Binali Yıldırım University clinical research and ethics committee.

Eligibility

Inclusion Criteria

Clinical diagnosis of unilateral TMJ disc displacement without reduction with limited opening based on Diagnostic Criteria for Temporomandibular Disorders (DC/TMD)[15] and confirmed by the findings of magnetic resonance images (MRI).

Exclusion Criteria

Presence of any systemic disease affecting TMJ, history of previous TMJ surgery, bilateral TMJ disc displacement and unavailable clinical records.

Sample Size

Thirty-six patients were randomly assigned into two groups based on the order in which they referred to the clinic: Group 1 (n=18), single puncture Type-1 arthrocentesis; Group 2 (n=18), conventional double puncture arthrocentesis. All arthrocentesis was conducted by a single experienced surgeon.

Outcome Measures

Pain on Function (PoF) was rated by patients (pain during chewing or speaking etc.) on a Numeric Rating Scale (NRS) (0-10 where 0 is no pain and 10 is the worst pain imaginable).

Pain-free maximum mouth opening (MMO) in millimeters was measured as the distance between the incisal edges of the upper and lower incisors by a caliper while patient's mouth is open as possible without any assistance and without pain in the masseter muscle.

Pain at rest (PaR) was rated by patients on a Numerical Rating Scale (NRS) (0-10 where 0 is no pain and 10 is the worst pain imaginable).

Duration of the Procedure was noted at the end of the procedure in minutes.

The number of analgesics used by the patients in the postoperative first week was noted.

Ease of the procedure was rated by the surgeon as the degree of easiness of the procedure on a VAS as 0-very easy 10-very difficult to perform at the end of the procedure.

Treatment tolerability, the degree to which overt adverse effects and post-operative complications (pain, feeling of pressure in TMJ area and disturbing sound) can be tolerated by the patient. Patients were asked to rate the tolerability on a 5-point scale (0- lowest, 4-highest) at operation day, 1st week, end of follow up period (6th month).

Chewing efficiency was rated by the patients on a VAS as 0-can only eat semi-liquid foods, 10-eat any solid food.

Subjective perceived effectiveness of the treatment was rated by patients on a 5-point Likert-type scale as 0- lowest, 4 highest values at the end of the follow-up period (6th month).

Lateral Movement of the mandible towards the affected Temporomandibular joint (LT) was measured as the distance between the midlines of the upper and lower incisors by a caliper in millimeters while patient's mandible was shifted towards the affected TMJ.

Lateral Movement of the mandible away from the affected Temporomandibular joint (LA) was measured as the distance between the midlines of the upper and lower incisors by a caliper in millimeters while the patient's mandible was shifted away from the affected TMJ.

Protrusive movement of the mandible was measured as the distance in horizontal direction between the incisal edges of upper and lower incisors by a caliper in millimeters when mandible moves forward.

Pain on function, pain at rest, pain-free maximum mouth opening chewing efficiency, lateral and protrusive mandibular movement values were evaluated preoperatively and postoperatively 1st week, 1st month, 3rd month, and 6th month.

Arthrocentesis Procedure

Posterior puncture method was used as described by Alkan and Etoz for DPA.[11] A straight line was drawn with a marker pen along the skin from the middle portion of the auricular tragus to the lateral cantus. The first puncture point was determined as 10 mm anterior and 2 mm inferior to the tragus, and the second 7 mm anterior and 2 mm inferior to the tragus. After injection of local anesthesia, the upper joint cavity was irrigated with 200 mL of Lactated Ringer's (RL) solution by inserting two 21-gauge needles. At the end of the procedure, after the withdrawal of one of the needles, 1 mL of sodium hyaluronate (SH) (Ostenil®, TRB Chemedica SA, Vouvry, Switzerland) was injected into the upper TMJ compartment through the other needle. The first reference point in DPA was used as the needle entry point for the SPA Type-1. With this technique, the inflow and outflow of solution were provided through the

same cannula and lumen of one 21-gauge needle as described by Guarda-Nardini et al.[10] The joint was irrigated with 200 mL of RL solution under high pressure. At the end of the procedure, 1 mL of SH was injected through the needle. All patients were prescribed one 20 mg of tenoxicam (Tilcotil, Roche, Basel, Switzerland) tablet once a day and recommended to use if they have pain.

Statistical Analysis

IBM SPSS 22 was used to analyze the data (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Descriptive statistics of the variables were presented as mean ± standard deviation in statistical analysis. The compatibility of the variables with the nominal distribution was tested with the Kolmogorov-Smirnov test. The difference between the groups at each time point and percentages of sixth month-baseline changes were determined by the Mann-Whitney U test when the normal distribution was not assumed. Wilcoxon test was used for intra-group evaluation of PoF and MMO variables according to baseline. Statistical significance level was accepted as $p < 0.05$.

RESULTS

All patients were evaluated for six months and no complications during or after the procedures were reported. In the DPA group (n=18), the mean age was 32.11±10.05 years; 17 were female and one was male. In the SPA Type-1 group (n=18), the mean age was 31.77±10.16 years; 17 were female and one was male. The mean age (p=0.922) and sex distribution (p=0.863) between the two groups were not significantly different.

Baseline values of the variables were not statistically significant (Table-1).

Table 1. Baseline values for the outcome variables.

Outcome parameters	(N = 18)	Groups DPA (N = 18)	p
PoF	7.33 ± 1.32	6.88 ± 1.07	0.279
PaR	3.83 ± 0.85	3.44 ± 0.70	0.171
Chewing Efficacy	4.72 ± 1.56	4.44 ± 1.42	0.584
MMO	27.11 ± 2.02	26.16 ± 2.70	0.226
La	6.55 ± 1.42	6.00 ± 1.32	0.214
Lt	7.55 ± 1.29	6.66 ± 1.49	0.104
Protrusion	5.72 ± 0.75	5.38 ± 0.77	0.161

PoF, pain on function; PaR, pain at rest; MMO, maximum mouth opening; La, lateral movement of the mandible away from the affected side; Lt, lateral movement of the mandible towards the affected side; SPA Type-1, single-puncture arthrocentesis type-1 group; DPA, double-puncture arthrocentesis group.

The MMO values increased significantly in both groups at the end of the follow-up period. This increase was statistically similar between the groups (Table-2,3). The PoF values decreased significantly in both groups at the end of the follow-up period. This decrease was statistically similar between the groups (Table-2,3) (Figure-1).

Table 2. Comparison of study variables between groups.

Outcome parameters	Follow-up	Groups SPA Type-1	DPA	p*
		Med (Min-Max)	Med (Min-Max)	
	Baseline	7.5 (5 – 9)	7 (5- 9)	0.279
	1. week	4 (1 – 6)	3 (2 – 5)	0.239
PoF	1. month	3 (2 – 5)	3 (1 – 5)	0.279
	3. month	3.5 (2- 5)	3 (2 – 5)	0.355
	6. month	4 (2 – 5)	4 (2 – 5)	0.265
	Baseline	27 (24 – 30)	25 (22 -31)	0.226
	1. week	39.5 (36 – 43)	36 (20 - 42)	0.001
MMO	1. month	40.5 (36 – 43)	36 (30 – 42)	0.001
	3. month	40.5 (36 – 43)	38 (35 – 43)	0.265
	6. month	40 (36 – 43)	38 (35 – 43)	0.181

PoF, pain on function; MMO, maximum mouth opening; SPA Type-1, single-puncture arthrocentesis group; DPA, double-puncture arthrocentesis group; Med, median; Min, minimum; Max, maximum.
* Mann-Whitney U test was used for comparing groups at follow-up periods.

Table 3. Comparison follow-up periods with baseline values.

Outcome parameters	Follow-up	Groups SPA Type-1	DPA	p*
		Mean ± SD	Mean ± SD	
	Baseline	7.33 ± 1.32	6.88 ± 1.07	
	1. week	3.83 ± 1.33	3.38 ± 0.97	< 0.00
PoF	1. month	3.22 ± 0.94	2.83 ± 0.92	< 0.00
	3. month	3.66 ± 1.02	3.33 ± 0.97	< 0.00
	6. month	3.94 ± 0.87	3.55 ± 0.98	< 0.00
	Baseline	27.11 ± 2.02	26.16 ± 2.70	
	1. week	39.44 ± 2.52	36.38 ± 2.63	< 0.00
MMO	1. month	39.72 ± 2.44	36.72 ± 2.63	< 0.00
	3. month	39.88 ± 2.37	38.83 ± 2.50	< 0.00
	6. month	39.72 ± 2.44	38.55 ± 2.47	< 0.00

PoF, pain on function; MMO, maximum mouth opening; SPA, single-puncture arthrocentesis group type-1; DPA, double-puncture arthrocentesis group;
SD, standard deviation.
*, Statistically significant when compared with baseline value in both groups ($p<0.05$, Wilcoxon test was used)

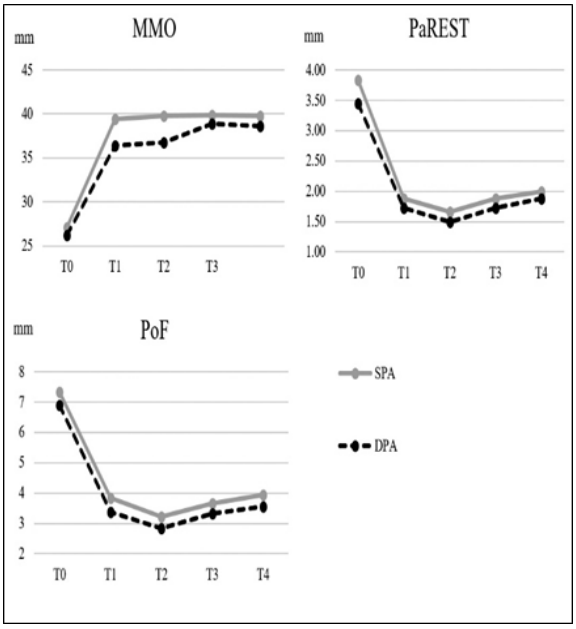

Figure 1. Maximum mouth opening, pain on function and pain at rest changes over time in the study groups.
PoF, pain on function; PaR, pain at rest; MMO, maximum mouth opening; SPA, single-puncture arthrocentesis group; DPA, double-puncture arthrocentesis group

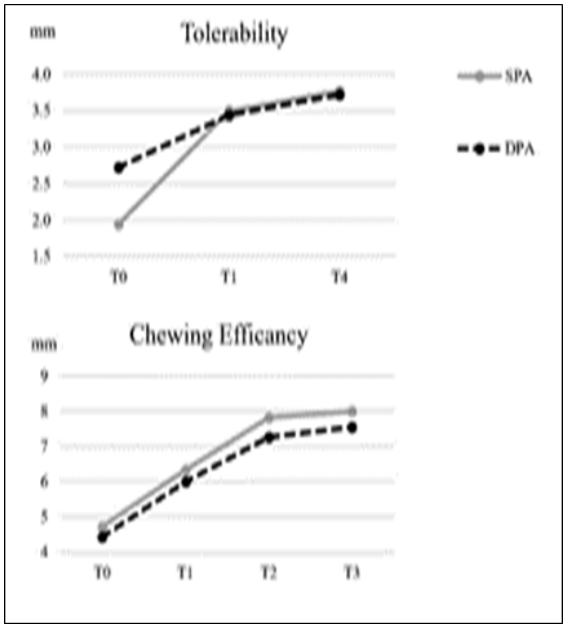

Figure 2. Tolerability and Chewing efficacy changes over time in the study groups.
SPA Type-1, single-puncture arthrocentesis group; DPA, double-puncture arthrocentesis group

The percentage change in MMO, PoF, PaR, LA, LT, protrusion, and chewing efficiency values from baseline to end of the follow-up period was statistically similar between the groups (Table-4). Ease of procedure was statistically significantly higher in the SPA Type-1 group than the DPA group ($p<0.001$) and treatment tolerability was statistically significantly higher in the DPA group than the SPA Type-1 group in the post-operative first day and first week ($p<0.007$) (Figure-2).

Table 4. Changes of the outcome variables at the end of the follow-up period compared to baseline values.

	Groups		
Outcome parameters	**SPA Type-1 (N = 18)**	**DPA (N = 18)**	**p**
PoF (%Δ)	-44.61 ± 15.45	-47.75 ± 14.39	0.533
PaR (%Δ)	-47.40 ± 13.10	-45.27 ± 17.22	0.839
Chew (%Δ)	91.16 ± 78.19	85.71 ± 59.94	0.816
MMO (Δ)	12.61 ± 2.09	12.38 ± 4.07	0.864
La (Δ)	1.22 ± 0.64	0.94 ± 1.62	0.696
Lt (Δ)	0.16 ± 0.92	0.27 ± 0.46	0.606
Protrusion (Δ)	0.72 ± 0.82	0.61 ± 1.14	0.839

PoF, pain on function; PaR, pain at rest; MMO, maximum mouth opening; La, Lateral movement of the mandible away from the affected side; Lt, Lateral Movement of the mandible towards the affected side; SPA Type-1, single-puncture arthrocentesis type-1 group; DPA, double-puncture arthrocentesis group; (%Δ); change in percentage; (Δ) difference.

However, this finding was not significant at post-operative 1st month measurements ($p>0.05$). Perceived treatment effectiveness was statistically similar between the groups at the end of the follow-up period ($p=0.791$) (Figure-2). Duration of the procedure was statistically significantly longer in the SPA Type-1 group (15.72 ± 1.67) group than in the DPA group (9.38 ± 1.50) ($p<0.001$). The amount of analgesics used in a one-week period was not statistically significant between the groups ($p=0.588$).

DISCUSSION

Single needle arthrocentesis technique and the other SPA modifications (combining two needles as one cannula) were suggested in the literature to decrease the morbidity of two needle insertions and to increase the easiness of the procedure. The methods developed generally aimed to prevent traumatizing tissues and to injure superficial temporal vessels and facial nerves caused by the second needle insertion in conventional arthrocentesis.[10,13] It is obvious that washing out the joint with one needle will cause higher hydraulic pressure and this pressure will cause more lysis and expansion of the joint cavity.[13,16]

The hypothesis in this study is whether the more hydraulic pressure in SPA-1 will come out with better treatment outcomes in DDwoR than DPA technique. Another aspect of

this study was to evaluate these techniques intraoperatively to find out the effect of higher pressure in SPA Type-1 and the second needle insertion of DPA on treatment tolerability as well as post-operative pain. Moreover, the effect of using a second needle in DPA on difficulty and the duration of the operation was aimed to evaluate.

Many studies have been published in the literature comparing SPA and DPA techniques.[7,13,14,17,18] While most of these studies focused on comparing the success of treatment efficacy of SPA and DPA techniques, only few studies evaluated and compared SPA Type-1 and DPA techniques intraoperatively.[7,13,17]

In the present study, MMO, pain, lateral and protrusive movements of mandible, and perceived treatment effectiveness values were measured to compare the efficacy of SPA Type-1 and DPA. Additionally, treatment tolerability and also easiness and duration of the procedure were measured to compare these techniques intraoperatively.

Statistically significant improvements were observed at six months with respect to baseline in MMO, pain on function, pain at rest, chewing efficacy, lateral and protrusive movements for both groups. These findings are consistent with previous studies.[8,13,17,19] The rate of improvement for these outcome variables was not significantly different between the SPA Type-1 and DPA groups. Guarda-Nardini et al. also reported no significant differences in any of these outcome variables in their study comparing two-needle and single-needle arthrocentesis.[13] Bayramoglu et al.[17] conducted a study comparing SPA Type-1 and DPA, including six months follow up and they concluded that SPA Type-1 and DPA are equally effective in terms of MMO and pain. Similarly Grossman et al.[18] and Senturk et al.[19] reported no statistical difference between these two techniques in terms of pain and MMO.

Perceived treatment effectiveness was statistically similar between the groups (p=0.791). Chewing efficiency was improved in both groups and was statistically similar between the groups at all follow-up periods. Guarda-Nardini et al. also found similar results in their study in terms of subjective treatment efficacy and chewing efficiency.[13]

Previous studies reported no statistically significant differences between SPA and DPA in terms of treatment tolerability.[13,17] However, in the present study, treatment tolerability was statistically significantly higher in the DPA group than in the SPA Type-1 group at short term (1 day and 1 week period that can be explained by the discomforting higher hydraulic pressure in SPA Type-1.

Senturk et al.[7] found a statistically significant difference in the duration of the procedure between the SPA Type-2 group and the SPA Type-1 group and DPA group in their study comparing SPA Type-1, SPA Type-2 and DPA techniques. They reported no difference between SPA Type-1 and DPA. Talaat et al.[14] reported a shorter operative time in SPA Type-2 than DPA. Bayramoglu et al. reported a statistically significant longer operation time in SPA Type-1 than DPA.[17] In the present study, the duration of SPA Type-1 was 15.7 minutes and 9.4 minutes for DPA. Duration of the procedure was statistically significantly longer in SPA Type-1 than DPA; as parallel with Bayramoglu et al. finding. This can be explained by the continuing circuit of inflow and outflow in the same cannula and lumen in SPA Type-1 causing operator to wait outflow of solution for a new inflow. This circuit takes more time than the DPA.[4,17]

The same amount of solution (200 mL RL) was used in both SPA Type-1 and DPA in the present study. The need to use as many solutions as in DPA, in SPA Type-1 technique should be discussed. It is likely to think that much smaller amounts of solution will be sufficient due to higher pressure during SPA Type-1 in DDwoR cases. Thus, SPA Type-1 treatment time will not be as long as expected and patients' tolerance will increase.

Senturk et al. found no statistical significant difference between the SPA Type-1 and DPA groups in terms of the easiness of the procedure to the operator however they found SPA Type-1 is easier. In the present study SPA Type-1 was found easier to perform than DPA. This result may be due to the difficulty of inserting the second needle in the DPA technique as mentioned in the studies previously.[10,11]

The amount of analgesics used in postoperative period was evaluated in a previous study by Bayramoglu et al.[17] They

reported that the amount of analgesics used by patients was not statistically significant between SPA Type-1 and DPA groups. However, they did not give any information about the amount of analgesics required or any statistical results. In the present study, analgesic pills were prescribed once a day and the number of pills in the first week were noted for each patient. The number of analgesics used was not statistically significant between the SPA Type-1 and DPA groups. It can be claimed that the high pressure in the SPA Type-1 group did not cause more pain postoperatively.

The SPA Type-2 (Sheppard Cannula and modifications) technique, which is rarely used in clinics because it requires special equipment, was not included in this study. Furthermore, it may not be necessary to compare this technique with DPA since it was unlikely to generate more pressure in the SPA Type-1 than the DPA technique.

To conclude, this study showed that the SPA Type-1 and DPA techniques had similar positive treatment efficacy outcomes in DDwoR cases. While DPA has superiority to SPA Type-1 in terms of the duration and the tolerability of the procedure in the short term, SPA Type-1 appeared much easier to perform. Further studies are required using fewer solutions in SPA Type-1 on equal terms, to gain more fair results in terms of tolerability, easiness, and duration of the techniques.

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Conflicts of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

Authors' Contributions

Concept/Design: FT, BC. Data Collection and/or Processing: FT, BC. Data analysis and interpretation: FT, BC. Literature Search: FT, BC. Drafting manuscript: FT, BC. Critical revision of manuscript: FT, BC. Supervision: FT, BC.

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