International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Tempro Mandibular Joint Internal Derangement: A Comparative Analysis of Ozone Gas and Ozonated Water Following Arthrocentesis

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Abstract

Managements for various Temporo-mandibular disorders (TMD) range from physical therapy and nonsurgical treatments to various surgical procedures. Usually, the treatment begins with nonsurgical therapies first, with surgery left as the last option. This study aimed to compare the outcome of ozone gas and ozonized water following arthrocentesis in patients with TMJ anterior disc displacement with reduction. Forty-two patients with anterior disc displacement with reduction were included and they were classified into three groups: arthrocentesis with Ringer's solution (group I), arthrocentesis followed by ozone gas (group II), arthrocentesis followed by ozonized water (group III). The maximum incisal opening (MIO) and visual analogue scale (VAS) were assessed. VAS showed a highly significant difference over different time points either preoperative or postoperative. In group II; VAS decreased significantly from 91.43±2.06 preoperative to 9.86±4.04; postoperatively. The VAS decreased significantly from 90.00±2.10 preoperative to 19.29±3.34; postoperatively in group III. MIO showed a highly significant difference among different time points either preoperative or postoperative. Ozone gas following arthrocentesis may be preferable than other intra articular injectable materials in management of TMJ anterior disc displacement with reduction due to it showed long term and significant efficacy with low morbidity.

Keywords: Arthrocentesis, Ozonated Water, Ozone gas, Tempro Mandibular Joint.

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1. Introduction

Temporomandibular joint (TMJ) which is known as ginglymoarthrodial joint, can be described as a bi-arthrodial joint. It has articular surface of the temporal bone, mandibular head, articular cartilage and synovial cavity surrounded by a fibrous capsule which covers the same joint [1]. The findings obtained by physical examination of temporo-mandibular disorders (TMD) include bruxism signs, decreased motion range, abnormal movements of mandible, and tenderness of masticatory and shoulder muscles, postural asymmetry, and pain with dynamic loading. It is essential to carry out a dental and oral examination to observe signs of tooth wear. A crepitus, click, or popping phenomenon which can be associated with joint closing or opening and accompanied with anterior disc displacement or osteoarthritis [2]. Masticatory and surrounding neck muscles with careful palpation may be accompanied with trigger points, myalgia, referred pain syndrome or myospasm [2-3]. As multifactorial disorders, TMDs require a multidisciplinary approach. Usually, first treatment options are noninvasive treatments, including occlusal splint (OS), photobiomodulation (PBM), manual therapy (MT), electrotherapy, acupuncture, oral exercises, and behavioral education therapies (OE/BE), as well as pharmacological therapy [4-5]. The primary goal of noninvasive therapies is pain relief, avoiding acute pain to become a chronic condition, which leads to changes of pain perception and delay of treatment responses [6-8]. Therapeutic modalities for the administration of intraoral ozone include irrigation with ozonized water, gas injection, and topical application of ozonized oil. Some of the injection protocols are intra-osseous injection of an ozone-oxygen gas mixture locally into the alveolus, subgingivally and intramuscularly into the inferior alveolar nerve area [9]. Also, the clinical efficacy of arthrocentesis with ozonized water in the temporomandibular joint internal derangements has been reported. Efficacy of ozonized water as a clinically applicable form of ozone in ozone therapy for the temporomandibular joint [8]. Using ozone gas treatment of joint disease has reached some promising results, including knee rheumatoid arthritis. In addition, clinical and experimental studies have demonstrated its safety and effectiveness [10].This study aimed to compare the outcome of ozone gas and ozonized water following arthrocentesis in patients with TMJ anterior disc displacement with reduction.

2. Patients and methods

Of the forty-two participants in this comparative investigation, none suffered any serious illness. Each patient received a brief explanation of the process and was required to sign a written consent form prior to the commencement of therapy. Approval was acquired before to initiating the study.

2.1. Inclusion & exclusion criteria

Individuals with anterior disc displacement who are between the ages of 18 and 45 noises produced by condylar movement. restricted mobility in joints due to discomfort. Masticatory muscular tenderness. both men and women were present. While, condylar boney disorder as tumor, coagulopathy blood problems, anterior disc displacement without reduction, patients with only muscular discomfort, local infection at the needle pass of insertion, and allergic reaction to ozone treatment were excluded.

2.2. Clinical Evaluation

Sufficient preoperative evaluation and documentation of medical history, physical examination, and radiographs for every instance. Three groups of fourteen patients each were randomly selected from the patient pool. Under local anaesthesia administered to the auriculotemporal nerve in an aseptic state, the treatment was carried out. The groups were divided as the following:

2.2.1. Group I

The head of each patient was turned to the contralateral side while they were seated at a 45° angle. In order to dilate the upper joint area, an 18-gauge needle was attached to a 10-milliliter Ringer's syringe and introduced into the superior compartment at the articular fossa. 18-gauge needle was introduced into the distended compartment in the area of articular prominence to facilitate unrestricted passage of Ringer's solution through the superior compartment. To aid in the lysis of adhesions, the jaw was manipulated in opening, excursive, and protrusive ways during the lavage. Ultimately, the anterior and posterior needles were extracted.

2.2.2. Group II

The identical procedures as Group I was carried out, and when arthrocentesis with Ringer's solution was finished, the anterior needle was taken out and two milliliters of ozone gas (with a concentration of ten micrograms per milliliter) were injected through the posterior needle into the superior compartment of the afflicted joint.

2.2.3. Group III

The same steps as in Group I was taken. After that, arthrocentesis using ozonized water was performed. A typical glass container with a capacity of 100 ml was filled with injectable distilled water to create ozonized water. It was bubbled for 30 minutes at room temperature (17–25°C) with 70 µg/ml of ozone. Then front and posterior needles were taken out.

2.3. Follow up assessment

There were no discovered complications following the procedure. Patients were checked on weekly, weekly, three-, six-, and twelve-month intervals following the operation. The visual analogue scale was used to measure the intensity of pain (VAS). The maximum incisal opening (MIO), which is determined by the maximum inter-incisal distance, was used to evaluate the jaw range of motion function in millimeters. Postoperative instructions and a five-day prescription for analgesics were given to each patient. Prior to surgery, immediately following the procedure, two days, one week, one, three, six, and twelve months later, all the parameters were measured for the patients.

2.4. Statistical analysis

After being examined in Microsoft Excel, the data was imported and examined in the Statistical Package for the Social Sciences (SPSS version 20.0). Contingent on the type of data, mean ± SD is used to represent the quantitative group, while numbers and percentages are used to represent the qualitative data. Differences between quantitative independent multiple using ANOVA. For significant results, the P value was set at <0.05, and for highly significant results, at <0.001.

3. Results

The average Visual Analogue Scale (VAS) in the arthrocentesis group-I postoperative recorded an average of 10.0±3.63, 15.0±4.42, 19.64±4.93, 26.43±3.87, and 36.43±4.98 after 1, 3, 6, 9, and 12 months; respectively. VAS showed a highly significant difference over different time points either preoperative or postoperative. The VAS decreased significantly (<0.001***) from 93.50 preoperative to 21.50 postoperatively (Table 1). The average Visual Analog Scale (VAS) in group-II treated with ozone gas recorded an average (SE) of 91.43±2.06, however, postoperative significantly decreased to an average of 18.57±7.02, 7.14±2.66, 4.29±1.37, 7.14±3.39, and 12.14±5.76 after 1, 3, 6, 9, and 12 months respectively. VAS showed a highly significant difference over different timepoints either preoperative or post operative as revealed by repeated measures analysis of variance (ANOVA) at 0.05 level. The VAS decreased significantly (<0.001***) from 91.43±2.06 preoperative to 9.86±4.04; postoperatively (Table 2). The average Visual Analog Scale (VAS) in group-III treated with ozonized water recorded an average (SE) of 90.00±2.10, however, postoperative VAS decreased significantly (p<0.001***) to an average of 5.71±2.02, 10.71±2.67, 15.71±3.59, 26.43±3.72, and 37.86±4.71 after 1, 3, 6, 9, and 12 months; respectively. VAS showed a highly significant difference over different timepoints either preoperative or postoperative as revealed by repeated measures analysis of variance (ANOVA) at 0.05 level. The VAS decreased significantly (<0.001***) from 90.00±2.10 preoperative to 19.29±3.34; postoperatively (Figure 1). The average Maximum Incisal Opening (MIO) in arthrocentesis groups preoperative recorded an average (SE) of 17.86±1.09, however, postoperative recorded an average of 33.50±1.25, 34.07±1.14, 33.21±1.21, 30.86±1.09, and 28.93±1.24 after 1, 3, 6, 9, and 12 months; respectively. MIO showed a highly significant difference among different time points either preoperative or postoperative. The MIO increased significantly (<0.001***) from 17.86 preoperative to 32.11 postoperatively (Table 3).

The average Maximum Incisal Opening (MIO) in group-II treated with ozone gas preoperative recorded an average (SE) of 21.0±1.76, however, postoperative MIO increased significantly (p<0.001***) to an average of 38.43±1.12, 39.79±1.16, 39.36±1.32, 37.64±1.70, and 36.36±2.13 after 1, 3, 6, 9, and 12 months; respectively. MIO showed a highly significant difference among different timepoints either preoperative or postoperative. The MIO increased significantly (<0.001***) from 17.86 preoperative to 32.11 postoperatively (Figure 2). The average Maximum Incisal Opening (MIO) in group-III treated with ozonized water preoperative recorded an average (SE) of 18.00±1.28, however, postoperative MIO increased significantly (p<0.001***) to an average of 35.36±1.16, 35.29±1.17, 33.79±1.12, 31.36±1.09, and 29.14±1.22 after 1, 3, 6, 9, and 12 months; respectively. MIO showed a highly significant difference among different timepoints either preoperative or postoperative. The MIO increased significantly (<0.001***) from 18.00±1.28 preoperative to 32.99±1.15 postoperatively (Table 4).

4. Discussion

Management of patients with TMD is probably the biggest challenge faced by professionals. Individuals with pain have a multifactorial problem with physical and psychosocial symptoms [11]. The majority of TMD patients can be successfully treated by non- surgical and minimally invasive therapies while invasive surgical interventions may be required for only a small part of TMD population [6]. Many of the treatments may work best when used in combination. It has been reported that 80 % of patients with signs and symptoms of TMD have some form of ID of the TMJ and up to 25% of the entire world population has internal derangement of the TMJ. Internal derangement can be diagnosed with considerable accuracy through the history, clinical examination and magnetic resonance imaging (MRI) may be useful [12-13]. In the current study, one of the most important points that MRI reported that joints were normal for 27 patients in spite of patients complain of severe pain and clicking. However, MRI reported anterior disc displacement with reduction for only 15 patients. Many conservative treatments of TMD have been proposed through the years, including pharmacotherapy, occlusal splint therapy, physiotherapy [14]. The most commonly used drugs are gabapentin, myorelaxants, non-steroidal anti-inflammatory drugs (NSAIDs), analgesics, benzodiazepines and corticosteroids [15-16]. In the past, treatment for TMD patients that did not respond to conservative treatment was surgical intervention which includes repair and repositioning of disc to reestablish normal mouth opening. However, variable efficacy, serious complications and high morbidity was reported [17]. Arthrocentesis is recognized as first line of interventional procedure in patients who do not respond to conservative treatment that's because of the minimal complications, low morbidity, relative ease, and less expense and may be finished with intra-articular injections for better results [18]. Several medical substances can be used after arthrocentesis such as non-steroidal anti-inflammatory drugs (NSAIDs), opioid analgesics, corticosteroid, sodium hyaluronate (SH), platelet-rich plasma (PRP) [9]. However, all of them assumed to be an optimal duration of therapy for only 6 months, after which it might be considerable for an additional injection [19]. Also, many side effects of intra-articular corticosteroid have been reported including destruction of articular cartilage, bone resorption and local tissue atrophy [20]. Ozone administration introduced intra-orally for oral infections include irrigation with ozonized water, topical application of ozonized oil. Some of the injection protocols are intra-osseous injection of an ozone locally into the alveolus, intramuscularly and into the inferior alveolar nerve area [21]. Extraoral, therapeutic protocols include nasal insufflations, trigger point injections and TMJ injections [22]. Ozone gas is a natural, colorless, unstable and highly reactive gaseous molecule and considered as one of the strongest among oxidant agents, a fact that explains its high reactivity. The actions of ozone on the human body include analgesic, antimicrobial, immune stimulating, anti-hypoxic, detoxicating and bio-synthetic effects [23]. On the other hand, Poznyak et al. who reported the toxic effects of ozone in gaseous phase may cause respiratory tract and eyes irritation, cough, headaches, nausea and vomiting and acute pulmonary edema [23]. The side effect appears only with long duration inhalation (one to four hours) of high ozone concentration on air (more than 10 mg/L).

In the present study, in a contrariwise to Poznyak et al., there was no reported complications related to ozone administration for the patients or the operators which can be explained due to low gas concentration and gas injected immediately intra-articular, so, there are no chance for long duration inhalation of ozone gas [23].

Studies also suggested that ozone improve in the decreased level of autophagy in chondrocytes stimulated with IL-1. Moreover, ozone treatment suppressed inflammation and helped maintain metabolic balance in chondrocytes stimulated with IL-1. This gas exerts its therapeutic effects through modulating a variety of pathways including accelerating glucose usage in cellular metabolism, improving protein metabolism, converting unsaturated fatty acids into hydro-soluble compounds, and increasing erythrocyte activity. So, it is suggested that the use of intra-articular injection of ozone gas may be an effective way to relieve disease- associated chronic pain [24-26].

The current study used a different form of ozone as a gas and as ozonated water for intra-articular injection following arthrocentesis which is a promising modality for patients with TMJ internal derangement and compare it with arthrocentesis which is also minimally invasive modality. This finding are in agreement with Hammuda et al., and with Arafat et al. who ozonized water injection in TMJ has been showed the efficacy of ozonized water as a clinically applicable form of ozone in ozone therapy for the temporomandibular joint [26-27]. The study that was done by Smith et al., and Bocci et al. who considered that ROS and LOPs may inhibit the release of proteolytic enzymes or pro-inflammatory cytokines and stimulate the proliferation of fibroblasts and chondrocytes with increased synthesis of the matrix and articular cartilage [28-29]. These results can explain the long term and significant outcome of group II. The reason for the favorable long-term effects in the ozone may be that ozone promotes better vascularization in bones and cartilage, and accelerating anabolism and recovery in osteoarticular diseases [30].

Table 1: The Visual Analog Scale (VAS) in GI (control Group) Arthrocentesis.

Treatment Pre/Post		Arthrocentesis		
		VAS		
		Mean	SD	SE
Pre- operative		93.50	7.39	1.97
Post-operative	1 m	10.00	13.59	3.63
	3 m	15.00	16.53	4.42
	6 m	19.64	18.45	4.93
	9 m	26.43	14.47	3.87
	12 m	36.43	18.65	4.98
	Total	21.50	16.34	4.37
ANOVA repeated measures		<0.001***		

***, **, ***;** Significant at $p<0.05$, <0.01, <0.001; NS, non-significant at $p>0.05$.

Table 2: The Visual Analog Scale (VAS) of group-II treated with ozone gas both pre-operative and postoperative.

Treatment Pre/Post		Ozone gas		
		VAS		
		Mean	SD	SE
Pre- operative		91.43	7.70	2.06
Post-operative	1 m	18.57	26.27	7.02
	3 m	7.14	9.94	2.66
	6 m	4.29	5.14	1.37
	9 m	7.14	12.67	3.39
	12 m	12.14	21.55	5.76
	Total	9.86	15.11	4.04
ANOVA repeated measures		<0.001***		

*, **, ***; Significant at p<0.05, <0.01, <0.001; NS, non-significant at p>0.05.

Table 3: Maximum incisal opening in GI (control Group) rthrocentesis.

Treatment Pre/Post		Arthrocentesis		
		MIO		
		Mean	SD	SE
Pre- operative		17.86	4.07	1.09
Post-operative	1 m	33.50	4.67	1.25
	3 m	34.07	4.25	1.14
	6 m	33.21	4.54	1.21
	9 m	30.86	4.07	1.09
	12 m	28.93	4.63	1.24
	Total	32.11	4.43	1.19
ANOVA repeated measures		**<0.001*** **		

*, **, ***; Significant at p<0.05, <0.01, <0.001; NS, non-significant at p>0.05.

Table 4: The Visual Analog Scale (VAS) and Maximum Incisal Opening (MIO) of group-III treated with ozonized water both pre-operative and postoperative.

Treatment Pre/Post		Ozonized water					
		VAS			**MIO**		
		Mean	**SD**	**SE**	**Mean**	**SD**	**SE**
Pre- operative		90.00	**7.84**	**2.10**	**18.00**	**4.79**	**1.28**
Post-operative	1 m	5.71	7.56	2.02	35.36	4.34	1.16
	3 m	10.71	9.97	2.67	35.29	4.39	1.17
	6 m	15.71	13.42	3.59	33.79	4.17	1.12
	9 m	26.43	13.93	3.72	31.36	4.09	1.09
	12 m	37.86	17.62	4.71	29.14	4.55	1.22
	Total	19.29	12.50	3.34	32.99	4.31	1.15
ANOVA repeated measure		<0.001***			<0.001***		

*, **, ***; Significant at p<0.05, <0.01, <0.001; NS, non-significant at p>0.05.

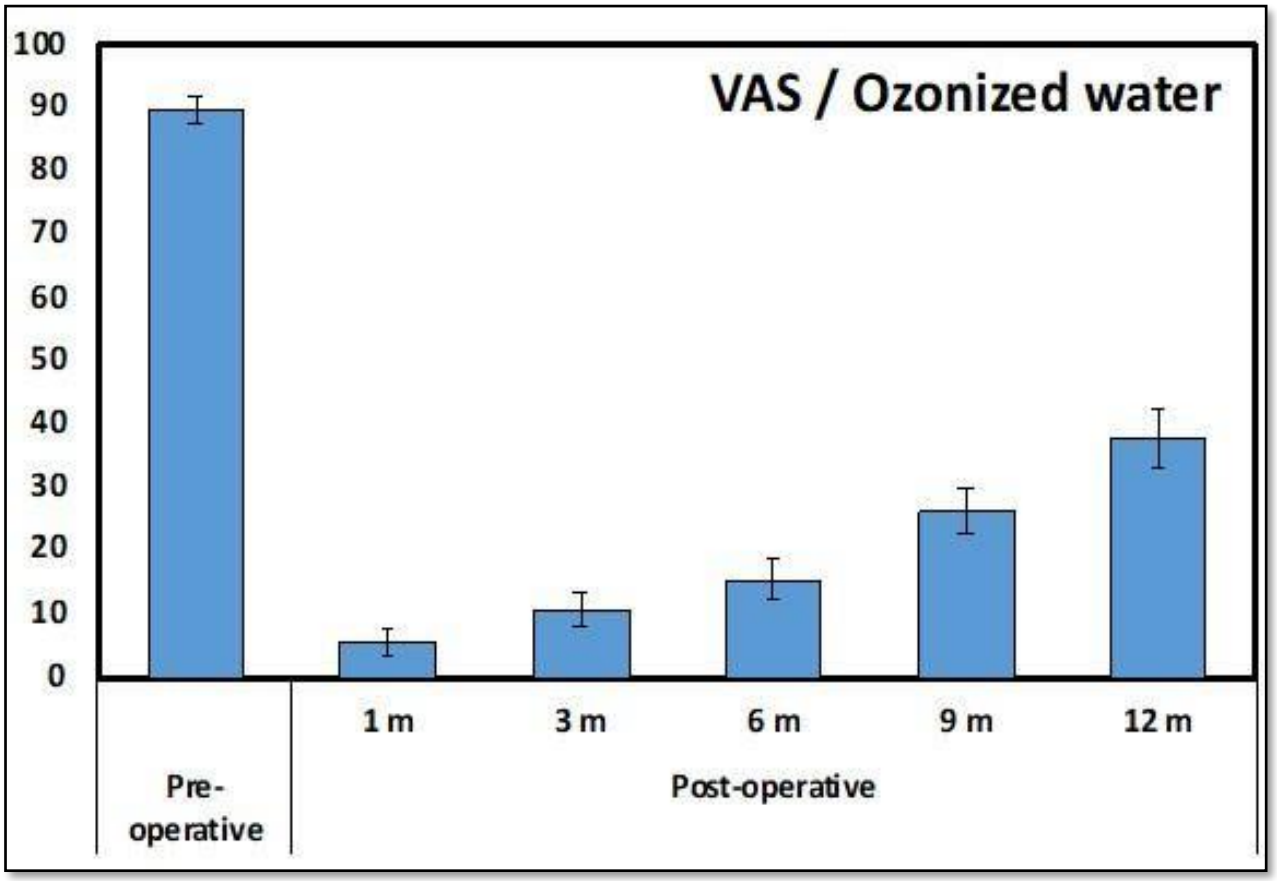

Figure 1: The Visual Analog Scale (VAS) of group-III treated with ozonized water both pre-operative and postoperative.

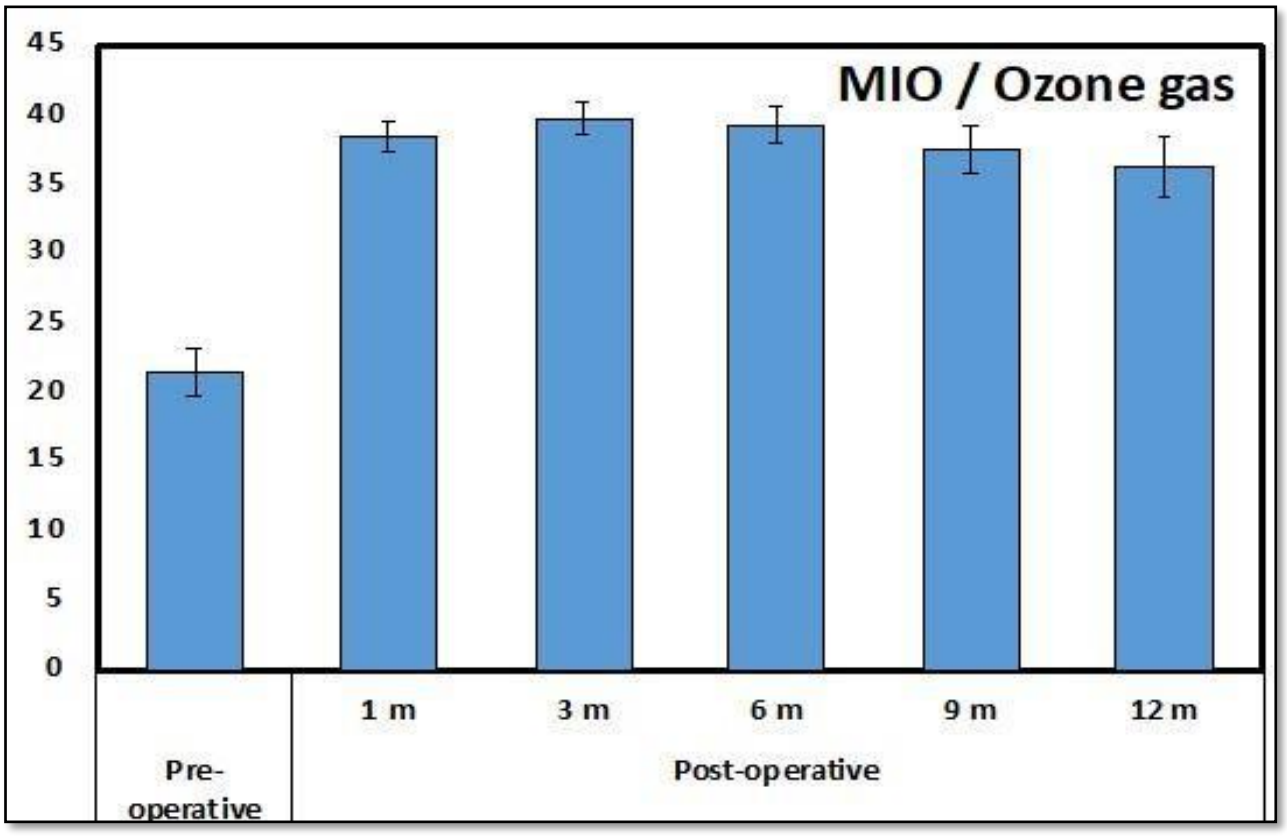

Figure 2: The Maximum Incisal Opening (MIO) of group-II treated with ozone gas both pre-operative and postoperative.

Conclusion

Ozone gas following arthrocentesis may be preferable than other intra articular injectable materials in management of TMJ anterior disc displacement with reduction due to it showed long term and significant efficacy with low morbidity.

Conflict of interest

No.

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