Use of Ozone in Temporomandibular Joint Arthrocentesis, Clinical Study

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Abstract: Internal derangements are the most frequent articular causes of temporomandibular joint dysfunction, which involve progressive slipping or displacement of the articular disc. Temporomandibular joint arthrocentesis is considered a successful treatment in TMJ internal derangements. The aim of this study was to evaluate the efficacy of ozone application in arthrocentesis of temporomandibular joints with internal derangement. Thirty patients were evaluated in this study were presented with limited movement and pain in the TMJ. They were divided in two groups: group I, subjected to arthrocentesis using saline solution and group II, subjected to arthrocentesis using ozonized water. Pain levels were significantly decreased in both groups however the significant decrease in group II was reported at post operative, after first month and one year. Maximal mouth opening for all patient in both groups were improved and the significant increase was reported in group II after first month, six months and one year postoperatively. Conclusion: Clinical efficacy of arthrocentesis with ozone in the temporomandibular joint internal derangements. Efficacy of ozonized water as a clinically applicable form of ozone in ozone therapy for the temporomandibular joint.

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1. Introduction

Temporomandibular joint is a synovial joint, lined on its inner aspect by a synovial membrane, which secretes synovial fluid. The fluid acts as a joint lubricant and supplies the metabolic and nutritional needs of the non-vascularized internal joint structures.[1] Functions of the synovial fluid include lubrication of the joint, phagocytosis of particulate debris, and nourishment of the articular cartilage.[2]

Internal derangements are the most frequent articular causes of temporomandibular joint dysfunction, which involve progressive slipping or displacement of the articular disc. It supports the bones in the joint, preventing them from rubbing together and allows the joint to move smoothly. If the disc slips out of place or is displaced, it can prevent the proper movement of the condyle and cause dysfunction. The disc can degenerate, becoming misshapen or even torn.[3, 4]

Temporomandibular joint arthrocentesis was described by Nitzan et al as the simplest form of surgery in the TMJ, aiming to release the articular disc and to remove adhesions between the disc surface and the mandibular fossa by means of hydraulic pressure from irrigation of the upper chamber of the TMJ.[5]

In the most common procedure, Ringer's lactate or physiological saline is injected into the joint by the use of a needle introduced into the superior joint space after local or general anesthesia. This compartment will take up to 5ml of fluid and, by filling under pressure, any minor adhesions are broken down or lysed. A second needle is then placed into the same joint compartment to achieve through flow of fluid and to allow thorough washing or lavage of the joint.[6]

Medical ozone was proved to be of great therapeutic potentiality. In numerous cases it exceeds the resources of medication-based methods. The procedures of its application are simple, economically preferable and beneficial. There are experimental and clinical findings that make it possible to present the routes of ozone therapy application for effective and safe management of patients with various pathologies.[7]

Ozone has anti-inflammatory and analgesic effect. Its capacity to oxidize the compounds containing double bonds as the arachidonic acid and its derivatives, prostaglandins, in particular that participate in the development and sustaining the inflammatory process. Besides ozone regulates metabolic reactions in tissues at the place of inflammation and resolves pH.[8] The analgesic effect of

ozone is provided by oxidation of the products of albuminolysis, the so-called algopeptides that act on the nerve endings in the damaged tissue and determine the intensity of pain response.[8,9]

Aim of the study was to evaluate the efficacy of ozone application in arthrocentesis of temporomandibular joints with internal derangement.

2. Patients and Method:

The current study was performed clinically in the outpatient clinic at the department of Oral and Maxillofacial surgery, faculty of dentistry, Suez Canal University. Thirty patients were evaluated in this study twenty three females and seven males aged between 18 and 35 years. All of them were presented with limited movement and pain in the TMJ. They were divided randomly into two groups: group I, it was consisted of fifteen patients and prone to arthrocentesis using saline solution. Group II, it was consisted of fifteen patients and prone to arthrocentesis using ozonized water.

Patients with History of previous surgery, systemic inflammatory joint disease, and direct trauma to the facial bone, Hyperplasia, hypoplasia or tumor in the joint were excluded from this study. Patients with limited mouth opening caused by only muscle pain or muscle spasm were excluded also. All patients received different treatment modalities for TMJ dysfunction (muscle relaxants, diets, and physical therapy or oral splints) with no clinical improvement. All patients included in this study were diagnosed as having temporomandibular joint internal derangement, disc displacement without reduction and subjected to treatment by arthrocentesis.

Assessment of joint pain and functions were carried out by scoring pain scale and maximal mouth opening. On a visual analogue scale (VAS) with endpoints 0 score for no pain and 10 score for the worst pain experienced. All patients were asked to place a mark on the VAS line to represent their intensity of pain during joint function. Maximal assisted & unassisted mouth opening were measured inter-incisally with a millimeter caliper. Assisted mouth opening was measured after applying gentle pressure reaching maximal mouth opening. The mean of both measures were considered as the maximal mouth opening. Assessment of the pain score and visual analogue scale was performed preoperatively, immediate postoperative, then at two days, one week, two weeks, one month, six months and after one year.

All surgical procedures were performed in the outpatient clinic under local anesthesia. All selected patients were informed about the procedure, precautions, follow up appointments and complications. And they signed an informed consent. The patient was lying on supine position on the dental chair. The field was isolated with sterile drapes. The skin was disinfected with Providone-Iodine 10% (Betadine, the Nile Co. for Pharma, Cairo, Egypt (under license from Mundipharma AG, Basel, Sweitzwerlan.). The points of needle insertion was determined according to **Talaat *et al.*** by drawing the canthus-tragus line and a point 10 mm in front of the tragus and 2 mm below the canthus-tragus line in cases where the canthus–tragus distance was more than or equal to 70 mm. In cases where the canthus –tragus distance was less than 70 mm, the point of needle insertion was marked at a point 7 mm in front of the tragus and 2 mm below the canthus – tragus distance. Another point 2 mm anterior to the formed point was marked to serve as the point of insertion of the second needle.[10]

In group I, a 20-guage needle was inserted at the point 10 mm in front of the tragus and 2 mm below the canthus-tragus line and injecting 2 ml of saline solution was performed through the first needle to distend the joint space and the patient is instructed to open and close his joint. The second needle is inserted in the second point for the flow out of the solution. The joint was washed with about 200 ml. of saline solution injected into the upper joint compartment. The procedure was terminated and both needles were withdrawn.

In group II, the same procedure of was used however ozonized water was used instead of saline solution. Ozonized water was prepared using a standard glass bottle of 200 ml. capacity filled with injectable distilled water (distilled water for injection produced by EPICO, Egypt). It was bubbled with 70 µg /ml. ozone for 30 minutes at room temperature of 17-25^{o} C. A medical ozone/oxygen gas mixtures produced by ozone generator (*HUMAZON*® PROMEDIC, HUMARES GmbH, Bruchsal Germany). The ozone generator was fed with medical pure oxygen from a medical oxygen tank with regular flow rate and the zone generator is pre-adjusted to produce ozone concentration that was delivered at the outlet of ozone generator 70 µg /ml.

3. Results:

The range of patients ages in group I ranged from 18-34 years (mean: 25.933 ± 6.216). In group II patients ages ranged from 20-35 years (mean: 23.267± 5.861)**.**Group I included fifteen patients 11 were females (73%), and 4 were males (27%). Group II included fifteen patients 12 were females (80%), and 3 were males (20%).There were statistical significant majority in the number of female patients in both groups $P<0.005$ while no statistical significance in sex predilection between the study groups. Figure 1

Pain levels were significantly decreased in both groups from preoperative to the immediate postoperative, then at two days, one week, two weeks,

one month, six months and one year postoperatively as indicated in table 1. At the postoperative assessment of pain there was a statistically significant decrease in ozone group (group II) rather than group I. Analysis of pain scores After 2 days, first week and second week indicated that there were no statistical significant differences between both groups. After the first month, the decrease in pain levels in group II was statistically significant in comparison with group I (P<0.05). After the sixth month, there were no significant differences recorded between both groups. After the first year the mean of pain score in group I were elevated to (1.60 ± 0.737) showing a significant difference compared to group II (P<0.05). (figure 1).

Maximal mouth opening for all patient in both groups were reported preoperatively, immediate postoperative, then at two days, one week, two weeks, one month, six months and one year postoperatively table 2. At immediately postoperative, the maximal mouth opening improved in both groups without statistical significant differences between them (P=0.258). After two days, one week and two weeks, there were no statistical significant differences between both groups. The records of maximal mouth opening in both groups After 1 month, sixth month and one year indicated a significant increase in the mouth opening in group II in comparison with group I (P<0.05), (P <0.03) and (P <0.001), respectively. Figure 3.

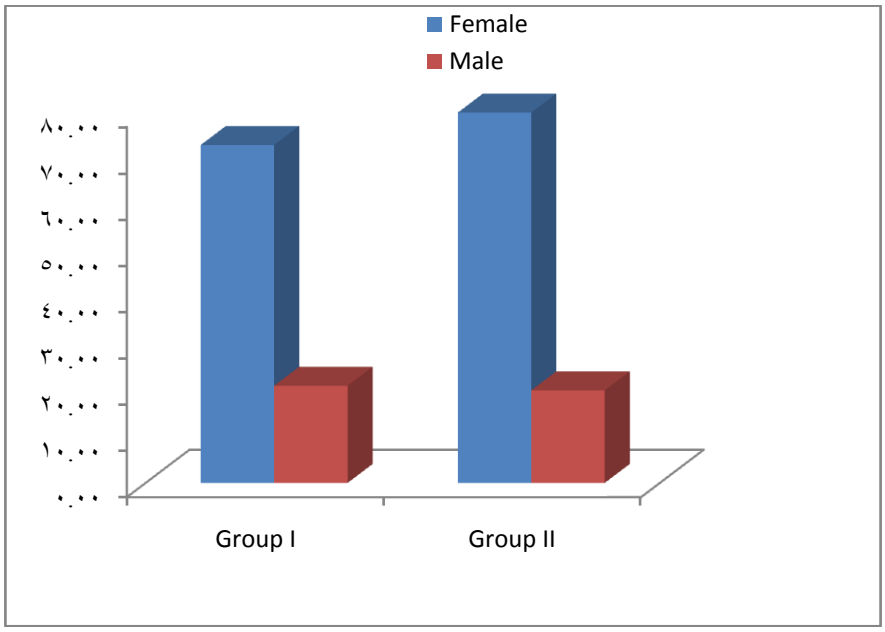

Figure1: Graph showing sex distribution in the study groups.

Table 1: Pain levels of two groups and changes for each group along the study period.

Group		Pain Score			Paired Differences			Paired Samples Test	
		Mean	±	SD	Mean	±	SD	t	*P*-value
Group I	Pre-Oper.	6.333	±	0.900		±			
	Post Oper.	1.600	±	0.632	4.733	±	0.884	20.744	<0.001*
	2 Days	2.267	±	0.799	4.067	±	0.961	16.387	<0.001*
	1 Week	0.600	±	0.910	5.733	±	1.163	19.094	<0.001*
	2 Weeks	0.067	±	0.258	6.267	±	0.961	25.252	<0.001*
	1 Month	0.333	±	0.488	6.000	±	0.756	30.741	<0.001*
	6 Months	0.400	±	0.632	5.933	±	1.223	18.793	<0.001*
	1 Year	1.600	±	0.737	4.733	±	1.223	14.992	<0.001*
Group II	Pre-Oper.	5.933	±	1.223		±			
	Post Oper.	0.933	±	0.704	5.000	±	1.069	18.114	<0.001*
	2 Days	2.133	±	0.640	3.800	±	0.941	15.638	<0.001*
	1 Week	1.067	±	0.594	4.867	±	1.187	15.876	<0.001*
	2 Weeks	0.400	±	0.507	5.533	±	1.246	17.200	<0.001*
	1 Month	0.000	±	0.000	5.933	±	1.223	18.793	<0.001*
	6 Months	0.467	±	0.640	5.467	±	1.125	18.812	<0.001*

	1 Year	0.600	±	0.737	5.333	±	1.447	14.270	<0.001*

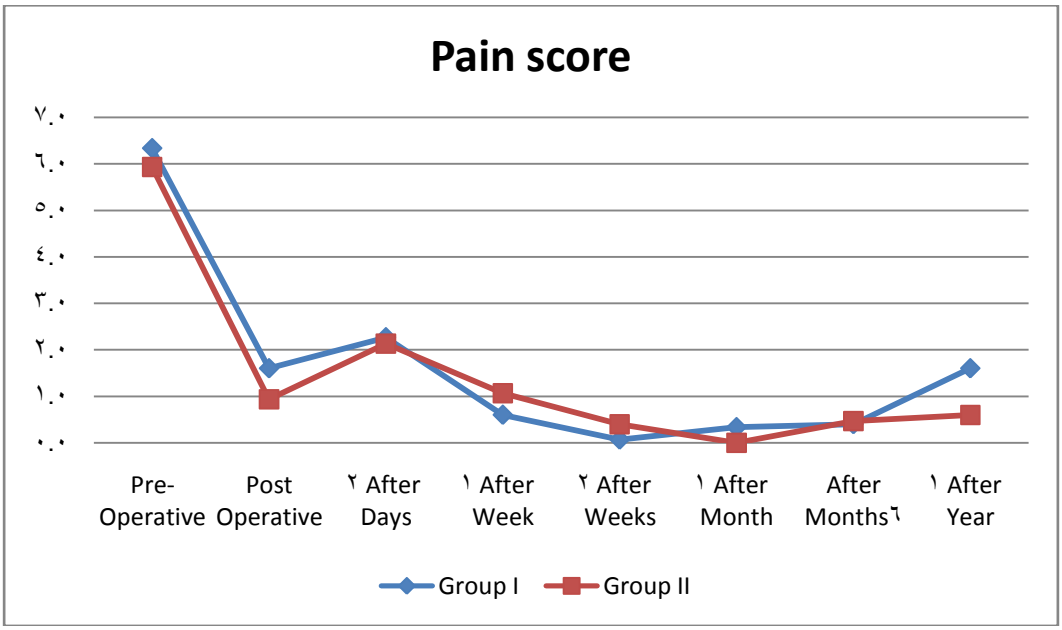

Figure 2: graph showing pain levels in both groups.

Table 2: maximal mouth opening of study groups and changes for each group along the study period.

	Max. m. opening		**Paired Differences**	**Paired Samples Test**	
		Mean ± SD	**Mean ± SD**	**t**	***P*-value**
Group I	**Pre-Oper.**	28.267 ± 4.131			
	Post-Oper.	40.667 ± 2.637	12.400 ± 3.906	12.295	<0.001*
	2 Days	36.533 ± 3.021	8.267 ± 4.061	7.883	<0.001*
	1 Week	37.400 ± 3.180	9.133 ± 3.482	10.159	<0.001*
	2 Weeks	38.533 ± 2.722	10.267 ± 3.807	10.444	<0.001*
	1 Month	38.733 ± 2.712	10.467 ± 3.461	11.711	<0.001*
	6 Months	38.800 ± 2.597	10.533 ± 3.603	11.323	<0.001*
	1 Year	37.600 ± 2.324	9.333 ± 3.352	10.783	<0.001*
Group III	**Pre-Oper.**	28.733 ± 3.918	±		
	Post-Oper.	39.06 ± 4.301	10.333 ± 3.457	11.576	<0.001*
	2 Days	35.267 ± 5.035	6.533 ± 2.850	8.878	<0.001*
	1 Week	36.733 ± 4.920	8.000 ± 2.563	12.087	<0.001*
	2 Weeks	37.733 ± 3.955	9.000 ± 2.619	13.311	<0.001*
	1 Month	41.133 ± 3.543	12.400 ± 2.849	16.859	<0.001*
	6 Months	41.400 ± 3.562	12.667 ± 2.968	16.528	<0.001*
	1 Year	41.400 ± 3.562	12.667 ± 2.968	16.528	<0.001*

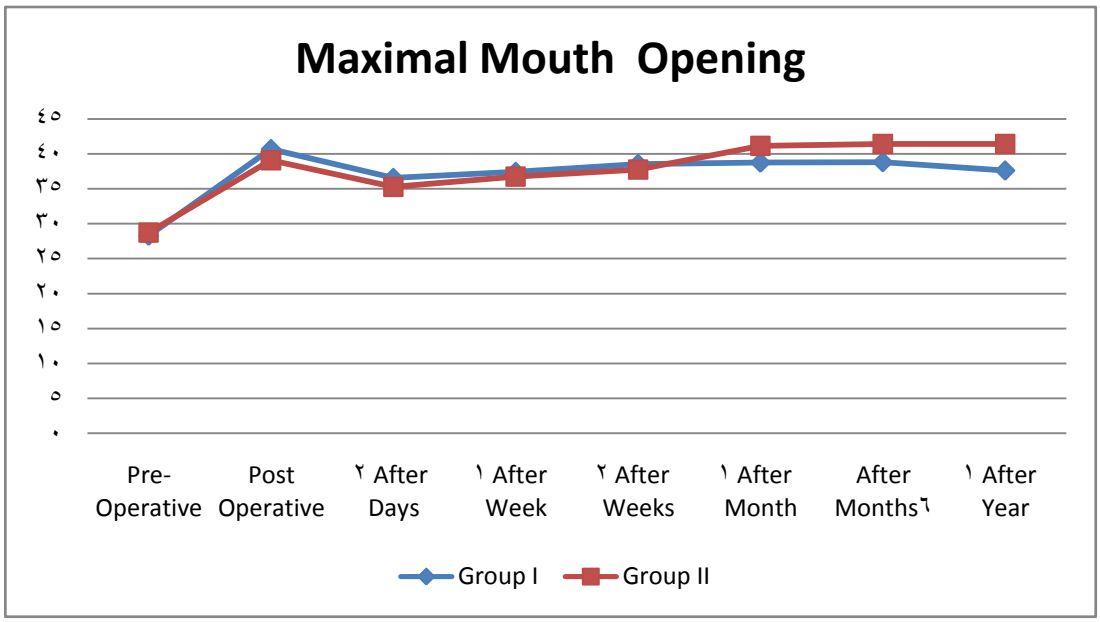

Figure 3: Graph showing maximal mouth opening in both groups.

4. Discussion:

Most of publications depended on the visual analogue scale, Maximal interincisal mouth opening and jaw function as evaluation criteria of arthrocentesis.[11]

Ozone is a naturally occurring compound consisting of three oxygen atoms. It has several known actions, such as antimicrobial, immune-stimulating, immune-modulatory, anti-inflammatory, biosynthetic bioenergetic, antihypoxic, analgesic and hemostatic effects. In this study patients of group II were subjected to arthrocentesis with ozonized water. Ozone was introduced in the form of ozonized injectable distilled water. Wash and lavage were performed to the affected joints using prepared ozonized injectable distilled water and patients were followed up for one year. All cases expressed generalized improvement in reduction of pain score and increase maximal mouth opening.

In agreement Sushama in 2011 reviewed the applications of ozone therapy in dentistry, he stated that ozone has been shown to possess unique properties and has potential applications to the clinical practice of dentistry and medicine. Ozone favours tissue hyperoxygenation following increased vascularization due to neoangiogenesis improving local tissue trophism and the inhibitory capacity of inflammatory metabolites. He stated that, ozone therapy presents great advantages when used as an adjunct to conventional treatments.[12]

In agreement with this study ozone were used in the form of ozonized injectable distilled water. Bocci in 2006 stated that, the essential concepts as any other gas, ozone dissolves physically in pure water in relation to the temperature, pressure and ozone concentration. Only in this situation does ozone not reacts and, in a tightly closed glass bottle, the ozonized water remains active for a couple of days. On the other hand, ozone reacts immediately as soon as it is dissolved in biological physiological saline and may produce hypochlorite which is very toxic.[8]

The results of the present study revealed that, Although VAS of pain levels for all patients decreased significantly in both groups after arthrocentesis, there was significant decreases in group II (arthrocentesis with ozone) more than group I. The decrease in pain level for all patients was referred to the efficacy of arthrocentesis procedure, wash and lavage of the joints that diluted the inflammatory mediators and released adhesions between the disc and mandibular fossa while the superiority of ozone group indicated the action of ozone on the joint.

These results were in agreement with Benvenuti (2006). He described his experience in the treating of acute and chronic disease of the large joints (knee, shoulder, and hip) by intra and periarticular injections of micro doses (From 15µg/ml to 25µg/ml) of an oxygen ozone gas mixture. The patients were assessed before and after treatment he found that in addition to resolution of joint pain, patients had good functional recovery of their daily activities and the treatment was well-tolerated.[9]

Mishra *et al.* evaluated the role of intra-articular ozone injection in knee osteoarthritis patients in comparison with corticosteroids (methylprednisolone). They found that the patients

received ozone achieved success rate 80% at three months and six months however the patients received corticosteroid achieved a lesser success rate 60%. They concluded that intra-articular injection of ozone relieved pain, stiffness and physical disability better than methylprednisolone.[13]

All patients included in this study achieved highly significant improvement in the maximal mouth opening from post-operative till one year which validate the efficacy of arthrocentesis in the treatment of temporomandibular joint internal derangement and improving the joint functions. Comparison between ozone group and control group in the maximal mouth opening revealed that, there were no significant differences were reported between both groups in the first two weeks. However there was a statistically significant increase in the maximal mouth opening in ozone group in comparison with control group arthrocentesis after the first and sixth month. Furthermore the highly significant increase was reported after the first year.

This were in agreement with the findings in the study published by Cavalcanti *et al.* in 2006, they investigate the effects of arthrocentesis on the improvement of internal derangement symptoms and jaw function in a series of patients with anterior disc displacement and closed lock jaw. All patients had improved pain and mouth opening following arthrocentesis while lateral movements and protrusion were unaltered.[14]

Conclusion:

From this study it has been concluded that: Arthrocentesis is an effective conservative procedure in treatment of temporomandibular joint internal derangement. Clinical efficacy of arthrocentesis with ozone in the temporomandibular joint internal derangements. Efficacy of ozonized water as a clinically applicable form of ozone in ozone therapy for the temporomandibular joint.

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