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Original Article

Effectiveness of Rocabado exercises in patients with rheumatoid arthritis in remission with temporomandibular joint involvement: A randomized-controlled study

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ABSTRACT

Objectives: This study aims to investigate the effectiveness of Rocabado exercises in patients with rheumatoid arthritis (RA) in remission with temporomandibular joint (TMJ) involvement.

Patients and methods: Between May 2023 and July 2023, a total of 42 patients (4 males, 38 females; mean age: 47.8±13.9 years; range, 21 to 73 years) were included in this single-center, single-blind, randomized-controlled study. Only the RA patients in remission for at least three months, with TMJ complaints and who had TMJ involvement detected by magnetic resonance imaging (MRI) were included. The patients were randomized into the Rocabado exercise group (n=21) and standard TMJ exercise group (n=21). The home-based exercise programs for both groups continued for six weeks. A Visual Analog Scale (VAS) was used to evaluate pain. The TMJ examination findings were recorded. The maximum interincisal distances were measured. To evaluate the quality of life, the patients were asked to fill the Turkish Oral Health Impact Profile-14 (OHIP-14).

Results: Demographic and baseline characteristics were similar between the groups. Standard TMJ exercises group showed an improvement only for OHIP-14 after treatment. Rocabado exercises group showed a statistically significant improvement for interincisal distance, OHIP-14, VAS pain, number of patients with limited mouth opening, TMJ pain with palpation, and pterygoid pain with palpation after treatment.

Conclusion: Our study results indicate that Rocabado exercises may be effective in RA patients with TMJ involvement in relieving pain and improving the quality of life due to oral health.

Keywords: Oral health, pain, rheumatoid arthritis, Rocabado exercises, temporomandibular joint.

Rheumatoid arthritis (RA), a chronic autoimmune disease characterized by progressive joint damage, is seen 0.5 to 1% of the population.[1] By immune cell infiltration and increased inflammatory mediator release in synovial tissue of the peripheral joints, deterioration of the joint structure and function occurs.[2]

The frequency of temporomandibular joint (TMJ) involvement in patients with RA is 2 to 86%.[3] Clinical symptoms and findings include TMJ pain, locking, limitation of movement, crepitation, and pain with palpation in the joint and masticatory muscles.[4] Imaging findings are erosion, cyst, flattening and sclerosis of the condyles.[2] The frequency of disc displacement in RA patients has been reported as 55%.[5] The incidence of anterior disc displacement without reduction in RA patients has been reported to be approximately 20%.[6]

Rocabado exercises have been developed to reduce TMJ stress, to increase mobility, to provide postural improvement in the cervical and upper thoracic area, and to increase neuromuscular control all in these regions.[7,8] On the other hand, apart from physical therapy modalities, the effectiveness of

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standard exercise techniques[9] in TMJ pain has been proven.[10]

In Rocabado exercise protocol,[7] six exercises with six repetitions are recommended to be done six times a day for a total of six weeks. By this exercise program which is reported in the TMJ disorders literature, both as a group program and as an individual intervention, patients learn a new postural position, restore their original muscle length and stiffness, normal joint mobility, and body balance.[7] That is why, it is natural to assume that these exercises would be effective in eliminating symptoms and improving the quality of life (QoL) due to oral health in RA which causes pain, stiffness, and limitation in TMJ.

On the other hand, there is no study investigating Rocabado exercises in RA patients with TMJ involvement in the literature. In the present study, we, therefore, aimed to investigate the effectiveness of Rocabado exercises in patients with RA in remission with TMJ involvement.

PATIENTS AND METHODS

The single-center, single-blind, randomized-controlled study was conducted at Ondokuz Mayıs University Faculty of Medicine Department of Physical Medicine and Rehabilitation between May 2023 and July 2023. Female and male patients aged over 18 years old who were diagnosed as seropositive or seronegative RA according to the American College of Rheumatology (ACR) 2010 RA classification criteria[11] were included in the study. Only the RA patients with TMJ complaints (pain, clicking, limitation) and who have TMJ involvement detected by magnetic resonance imaging (MRI) were included. In addition, patients were required to be in remission for at least three months. Disease activity was determined by the Disease activity score in 28 joints (DAS28) calculated by sedimentation and patients with DAS28 <2.6 were accepted in remission.[12] Exclusion criteria were as follows: those under the age of 18, who were not in remission or had a remission duration less than three months, those with other inflammatory diseases, who had trauma in the jaw, who did not have MRI examinations, who could not learn exercises, those who did not comply with the exercise program, who could not be reached and followed via phone during the study, who withdrew from the study, those who had increased disease activity during the study and who made medication changes. A total of 87 RA patients with TMJ involvement confirmed by MRI were reviewed. Forty of them were not in remission. Forty seven patients who were in remission were asked for their eligibility to participate the study and five of them were further excluded. Finally, a total of 42 patients (4 males, 38 females; mean age: 47.8±13.9 years; range, 21 to 73 years) were included in the study (Figure 1). Using a computer program, the patients were randomized to Group 1 (Rocabado exercises, n=21) and Group 2 (standard TMJ exercises, n=21). Two patients excluded from the study in Group 1 and three patients excluded from the study in Group 2 were replaced by new patients who met the inclusion criteria (Figure 1). The study was terminated when 42 patients, 21 patients in each group, completed their exercise programs.

The Rocabado exercise protocol is as follows:[7]

1. Rest position for the tongue: The end of the tongue is placed on the upper palate, just behind the front teeth. Diaphragmatic breathing is performed from the nose to make clicking sound with tongue. The use of auxiliary respiratory muscles is avoided.
2. Control of TMJ rotation: Opening of the mouth under control in the "hinge" style. In the rest position for the tongue, to prevent anterior translation of the condyle, the mouth is opened slowly and controlled.
3. Rhythmic stabilization technique: In the rest position for the tongue, resistance to the right and left lateral deviation of the chin, resistance against the opening and closing of the jaw (resistance with index finger) is applied.
4. Stabilized head flexion: While the body is in an upright position, the hands are clamped at the back of the head, at C2-7 levels and craniocervical flexion (head shaking movement) is trained.
5. Axial extension of the neck: While the body is in an upright position and the eyes and ears remain at the same level (upper cervical flexion and lower cervical extension), cervical retraction is performed by bending the head to the back.
6. Shoulder girdle retraction: While the body is in an upright position, retraction and depression are performed in the shoulder girdle without deteriorating the stance of the cervical vertebrae.

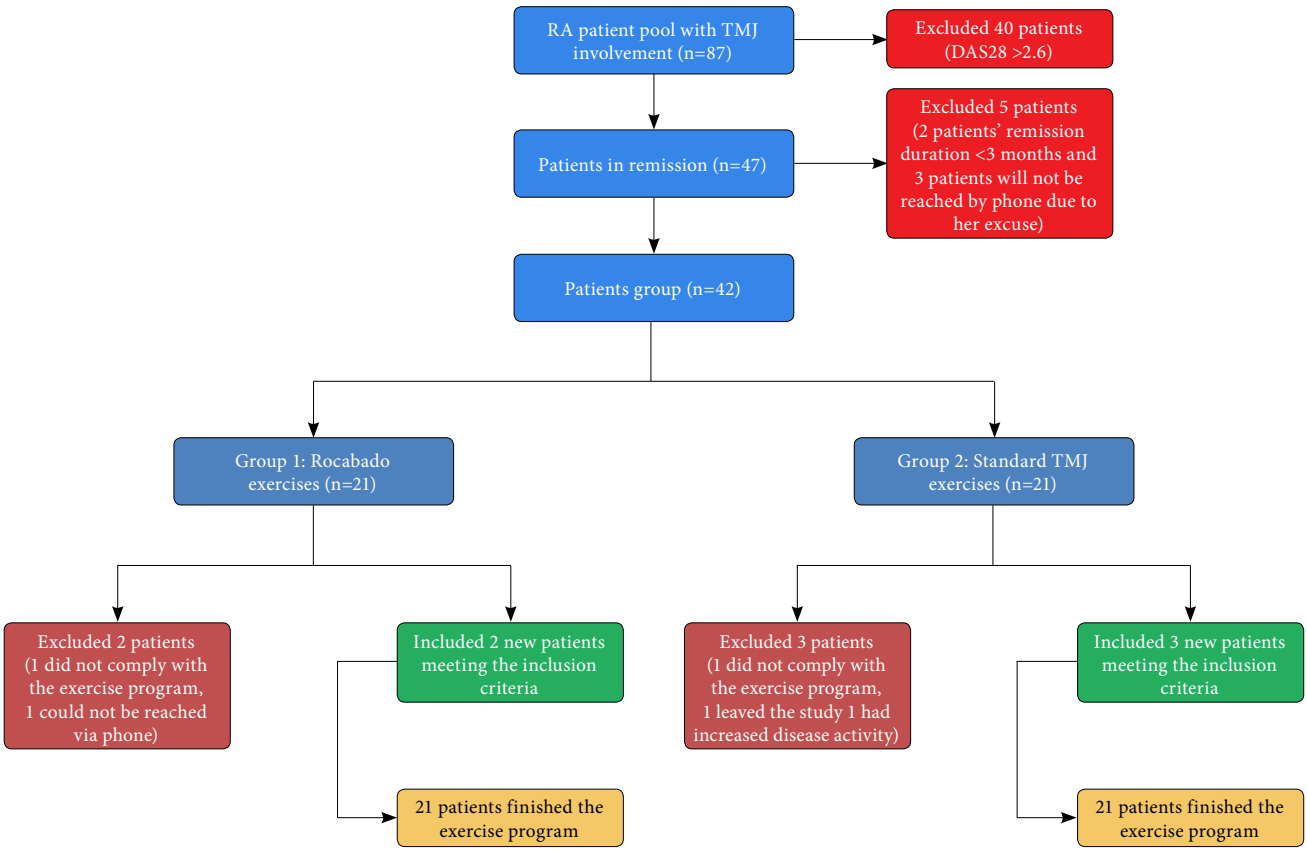

Figure 1. Participants flow diagram.
RA: Rheumatoid arthritis; TMJ: Temporomandibular joint; DAS28: Disease activity score in 28 joints.

Standard TMJ exercises are as follows:[9]

1. The end of the tongue is placed on the upper palate. Mouth is opened while one index finger on the chin and the other index finger on the TMJ, in front of a mirror. Five times a day with 5 reps.
2. The end of the tongue is placed on the upper palate. Mouth is opened while the index fingers are on the both TMJs, in front of a mirror. Five times a day with 5 reps.
3. Start the exercise while the end of the tongue is placed on the upper palate. Mouth is opened while one index finger on the chin and the other index finger on the TMJ, in front of a mirror. End of the tongue is separated from the palate while the mouth is fully opened. Five times a day with 5 reps.
4. The end of the tongue is placed on the upper palate. Mouth is opened while the index fingers are on the both TMJs, in front of a mirror. End of the tongue is separated from the palate while the mouth is fully opened. Five times a day with 5 reps.
5. In the rest position, resistance to the right and left lateral deviation of the chin, resistance against the opening of the jaw, resistance in the cross direction toward the left ear, resistance in the cross direction toward the right ear and resistance backwards the chin (resistance with index finger for 2 sec) is applied. Five times a day with 5 reps.
6. In the rest position, mouth is opened while the index finger is between the incisors. This position is prevented after taking out the finger, and resistance to the right and left lateral deviation of the chin, resistance against the opening of the jaw, resistance in the cross direction toward the left ear, resistance in the cross direction toward the right ear and resistance backwards the chin (resistance with index finger for 2 sec) is applied. Five times a day with 5 reps.

7. In the rest position, mouth is opened while the index and the middle fingers are between the incisors. This position is prevented after taking out the finger, and resistance to the right and left lateral deviation of the chin, resistance against the opening of the jaw, resistance in the cross direction toward the left ear, resistance in the cross direction toward the right ear and resistance backwards the chin (resistance with index finger for 2 sec) is applied. Five times a day with 5 reps.

The exercise program for both groups continued for a total of six weeks. Exercises were instructed to patients. After making sure that patients learned the exercises in full and correctly, patients were asked to apply exercises at home. All patients were called by phone at least once a week and ensured that they did exercises on time and correctly. A patient excluded from the study was replaced by a new patient who met the inclusion criteria. All patients were evaluated before and after treatment. The researcher who evaluated patients was blind to the group allocation.

Demographic data of the patients were recorded. A Visual Analog Scale (VAS) between 0-100 mm was asked to be signed to determine a score for the level of pain. The TMJ examinations of all patients were done. The palpation of condyle was done and during the palpation, discomfort and tenderness declared by the patients and TMJ movements were examined. Clicking and crepitation during the mouth opening and closing was recorded. The maximum oral opening was determined by measuring interincisal distances using digital caliper. The results were recorded in mm. Values <40 mm were considered as limited mouth opening.[3] Examination of the chewing muscles was performed, while the jaw was in the physiological rest position.

To evaluate the QoL due to oral health, the patients were asked to fill the Turkish Oral Health Impact Profile-14 (OHIP-14), each answer was scored between 0-4 and all points were summed and total score was obtained.[13]

Statistical analysis

Study power analysis and sample size calculation were performed. Total sample size was calculated as 42 with an effect size of 0.8, power 80% and p=0.05.[8]

Statistical analysis was performed using the IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to check normality distribution of variables. Continuous data were expressed in mean ± standard

TABLE 1
Demographic variables, seropositivity, disease activity, and MRI findings of patient groups

	Group 1 (n=21)					Group 2 (n=21)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Age (year)			48.1±13.4					47.4±14.7			0.878[a]
Female patients (%)	19	90.5				19	90.5				1.000[b]
Disease duration (month)				84	12-240				96	36-384	0.318[c]
RF positive (%)	8	38.1				8	38.1				1.000[b]
Anti-CCP positive (%)	10	47.6				11	52.4				1.000[b]
RF and Anti-CCP positive (%)	8	38.1				7	33.3				1.000[b]
DAS28			2.3±0.2					2.2±0.3			0.200[a]
Disc displacement (%)											0.574[d]
With reduction	11	52.4				9	42.9				
Without reduction	4	19				7	33.3				
Erosion positive (%)	15	71.4				18	85.7				0.454[b]
Osteophyte positive (%)	12	57.1				16	76.2				0.326[b]
Flattened condyle (%)	9	42.9				8	38.1				1.000[b]
Narrowed joint space (%)	7	33.3				9	42.9				0.751[b]
Disc degeneration (%)	11	52.4				17	81				0.100[b]
Effusion positive (%)	8	38.1				4	19				0.306[b]

MRI: Magnetic resonance imaging; SD: Standard deviation; RF: Rheumatoid factor; Anti-CCP: Anti-citrullinated cyclic peptide; DAS28: Disease Activity Score in 28 joints and sedimentation; Significance level p<0.05; a: T-test; b: Fisher exact test; c: Mann-Whitney U test; d: Chi-square test; Group 1: Rocabado exercises; Group 2: Standard temporomandibular joint exercises.

deviation (SD) or median (min-max), while categorical data were expressed in number and frequency. The Mann-Whitney U test was used to compare for non-normally distributed data, while the t-test was used for normally distributed data. The chi-square and Fisher exact test were used to analyze the difference

TABLE 2
Comparison of the groups before and after treatment

	Group 1 (n=21)					Group 2 (n=21)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Interincisal distance millimeter											
Before treatment				45	15-50				46	35-50	0.340[a]
After treatment				46	37-50				46	36-50	0.770[a]
p value			0.001[c*]					0.102[c]			
OHIP 14											
Before treatment			29.7±6.5					30.7±5.6			0.614[f]
After treatment			15.1±3.6					25.2±3.9			<0.001[f*]
p value			<0.001[e*]					<0.001[e*]			
VAS pain											
Before treatment				3.5	2-5.8				2.9	2.3-6.4	0.032[a*]
After treatment				1.9	0-3.3				2.9	2.1-6.1	<0.001[a*]
p value			<0.001[c*]					0.082[c]			
Limited mouth opening (%)											
Before treatment	9	42.9				7	33.3				0.751[b]
After treatment	3	14.3				6	28.6				0.454[b]
p value			0.031d*					1.000[d]			
TMJ pain with palpation (%)											
Before treatment	16	76.2				12	57.1				0.326[b]
After treatment	6	28.6				10	47.6				0.341[b]
p value			0.013[d*]					0.500[d]			
Masseter pain with palpation (%)											
Before treatment	6	28.6				2	9.5				0.238[b]
After treatment	1	4.8				3	14.3				0.606[b]
p value			0.063[d]					1.000[d]			
Temporal pain with palpation (%)											
Before treatment	3	14.3				2	9.5				1.000[b]
After treatment	0	0				2	9.5				0.488[b]
p value			0.250[d]					1.000[d]			
Pterygoid pain with palpation (%)											
Before treatment	12	57.1				12	57.1				1.000[b]
After treatment	2	9.5				8	38.1				0.067[b]
p value			0.002[d*]					0.125[d]			
Clicking (%)											
Before treatment	11	52.4				11	52.4				1.000[b]
After treatment	11	52.4				11	52.4				1.000[b]
p value			1.000[d]					1.000[d]			
Crepitation (%)											
Before treatment	11	52.4				8	38.1				0.536[b]
After treatment	11	52.4				8	38.1				0.536[b]
p value			1.000[d]					1.000[d]			
Bruxism (%)											
Before treatment	4	19				3	14.3				1.000[b]
After treatment	1	4.8				3	14.3				0.606[b]
p value			0.250[d]					1.000[d]			

SD: Standard deviation, OHIP-14: Oral health impact profile 14; VAS: Visual Analog Scale; TMJ: Temporomandibular joint; * Significance level p<0.05; a: Mann-Whitney U test; b: Fisher exact test; c: Wilcoxon test; d: McNemar test; e: Paired sample t-test; f: T-test; Group 1: Rocabado exercises; Group 2: Standard temporomandibular joint exercises.

between the two groups in terms of categorical data. The paired sample t-test, Wilcoxon test, and McNemar test were used in the group comparisons before and after treatment. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 42 patients, 21 patients in each group, completed the study. The age, sex distribution, disease duration, frequency of seropositivity and disease activity were similar between the groups. Also, no significant difference was found between the groups in terms of the MRI findings (Table 1).

Comparing the groups according to the examination findings before treatment, there was no significant difference between the groups, except for the higher VAS pain scores in Group 1. Standard TMJ exercises group showed an improvement only for OHIP-14 after treatment (p<0.001). Rocabado exercises group showed a statistically significant improvement for interincisal distance, OHIP-14, VAS pain, number of patients with limited mouth opening, TMJ pain with palpation and pterygoid pain with palpation after treatment. The Improvement of OHIP-14 and VAS pain was significantly better in the Rocabado exercises group (p<0.001). Frequency of patients with joint sounds did not change in both groups after treatment. For the masseter pain with palpation, temporal pain with palpation and bruxism, the decrease in the patient numbers was more in the Rocabado exercises group, but it did not reach statistical significance (Table 2).

DISCUSSION

To the best of our knowledge, this is the first study to investigate the effectiveness of Rocabado exercises in RA patients with TMJ involvement. In the literature, the number of studies examining TMJ involvement in RA patients with MRI is quite low, and the publication date of these studies is relatively old. One of the main strengths of our study is that TMJ involvement is confirmed by MRI in RA patients.

In the current study, we found that Rocabado exercises were effective in relieving pain and improving the QoL due to oral health and showed better results than the standard TMJ exercises group.

Exercise treatment in TMJ diseases has an important place. Exercise approaches mainly aim to reduce symptoms, decrease pain, and restore normal strength, length, function, and coordination of the muscles. Rocabado exercises[7,8] have been demonstrated as an effective method in reducing pain, development of masticatory muscles' function and correcting the posture. These six exercises are constructed on the head-to-neck, neck-to-shoulder, and lower jaw-to-upper jaw postural relationships. Patients learn to correct the forward posture of head, restore their previous muscle length and stiffness, normal joint mobility, and body balance.[7] Commonly, joint disorders and muscle activity alterations lead to TMJ and masticatory muscles pain. This condition causes a vicious cycle and, TMJ and masticatory muscles pain leads to muscle activity alterations, limitation of mouth opening, stress, anxiety, depression, poor sleep, low QoL due to oral health, additional TMJ disorders, and postural alterations.[8] It is well known that Rocabado exercises play an active role in breaking this vicious cycle. These exercises seem to be effective in improving masseter muscle elasticity.[8] An optimal length-tension relationship of the mandibular elevators, resulting in greater posterior translation force from the deep portion of the masseter and the horizontal fibers of the temporalis. Positive effects of stretching of masticatory muscles on muscle flexibility may cause a significant increase in maximum mouth opening and masseter pressure pain threshold. Thus, the QoL due to oral health may be improved by the improving clinical conditions such as temporary pain and fatigue in masticatory muscles, temporal headache, and joint locking. In our study, Rocabado exercises were found to be effective in reducing pain and improving the QoL due to oral health. There was a significant improvement in the pain scores only in the Rocabado exercises group. This finding indicates that Rocabado exercises may be effective in TMJ pain in RA patients with TMJ involvement. Also, in addition to the significant decrease in patients those with pain by palpation of TMJ and pterygoid muscles, without reaching the level of significance, the decrease of patient number those with pain by palpation of masseter and temporal muscles and those who had bruxism in the Rocabado exercises group, suggests that Rocabado exercises are effective in improving the pain and tenderness detected by the physical examination of the joint and masticatory muscles.[8] These findings may be due to the ability of Rocabado exercises to increase neuromuscular control and to improve the posture.[7] Although the standard TMJ exercise group showed a significant improvement in terms of OHIP-14, the difference between the pre-and post-treatment was significantly more prominent in the Rocabado exercise group. This finding can be interpreted as Rocabado

exercises are more effective in improving the QoL due to oral health than standard TMJ exercises.

Disc displacement may cause joint locking, pain, and limitation of joint movement. The TMJ limitation may prevent full mouth opening or occlusion. Also, it frequently limits some vital daily activities, such as eating and speaking. The disruption of neuromuscular control may lead to locking so that contraction of the masseter, temporalis, and medial pterygoid muscles causes condylar elevation while the disc remains in a displaced position. Improving the mandibular neuromuscular control during activities involving extreme mouth opening may be useful. Improved motor control may prevent limitation, locking and pain. In our study, a significant majority of the patients had disc displacement and limitations in the mouth opening. It is emphasized in the literature that disc displacement is frequently encountered in RA patients and that this can be seen independently of other RA-related structural abnormalities.[3] In our study, the incidence of disc displacement in both groups was more than 70%. In the literature, normal values for interincisal distance are specified as 53 to 58 mm[14] and the values below 40 mm were considered as limited mouth opening.[3,4,14] In our study, approximately one-third of the patients were found to have limited mouth opening. This frequency has been reported in the literature approximately 20%.[3,4] Comparing the groups, the significant increase in the average interincisal distance and the significant decrease in the number of patients with limited mouth opening in Rocabado exercise group showed the effectiveness of the Rocabado exercises in improving the mouth opening than the standard TMJ exercises.

In the literature, the incidence of effusion in TMJ in RA patients has been reported between 33 and 90%.[5,15] In our study, the incidence of effusion was less than reported in both groups and there was no significant difference between the groups. We have attributed this to that we only included patients in remission in our study. In the current study, similar to the literature, MRI findings indicating the TMJ involvement such as erosion, flattening of the condyle, osteophyte formation, and narrowing in the joint space were common.[15-17]

Disease activity was evaluated in our study and patients with remission and remission in progress were included in the study. Thus, we attempted to prevent the results of our study to be affected by the changes that may arise from the increase or decrease in disease activity. Although, the sample size was calculated with power analysis, it should be better to study in large patient populations. Another limitation to this study was the home-based exercise programs. We attempted to standardized the exercise programs and also to follow all patients via phone, but it should be better to design the study with hospitalized patients.

In conclusion, our study results indicate that Rocabado exercises may be effective in RA patients with TMJ involvement in relieving pain and improving the QoL due to oral health. Further multi-center, large-scale, randomized-controlled studies using Rocabado exercises are warranted to confirm its feasibility in daily practice.

Ethics Committee Approval: The study protocol was approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (date: 31.05.2023, no: 2023/149). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design, data collection and/or processing, literature review, writing the article, critical review, references and fundings, materials: M.I., II., S.A.; Control/supervision: II.; Analysis and/or interpretation: M.I., II.

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