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EFFECT OF OCCLUSAL SPLINT AND ITS COMBINATION WITH PHYSICAL THERAPIES IN MANAGEMENT OF TEMPOROMANDIBULAR DISORDERS: A COMPARATIVE ANALYSIS USING HELKIMO'S INDEX

Dental Science

Dr Barasha Goswami* *Corresponding Author
Dr Jogeswar Barman
Dr Nirupam Paul
Dr Alak Bhattacharya

ABSTRACT

Background: Use of occlusal splint in the management of TMD is well established. However, literatures regarding the use and effect of physical therapy in conjunction with occlusal splints are very sparse.
Objective: This study is designed to evaluate the efficacy of occlusal splint and its combination with physical therapies (physical exercise and thermo-coolant therapy) in management of TMD using Helkimo's Index.
Method: Present study consisted of forty three consecutive patients diagnosed with TMD according to Research Diagnostic Criteria for TMD (RDC/TMD). Patients were assigned into three groups: G1= patients treated with occlusal splint alone (n = 15), G2= patients treated with occlusal splint and physical exercise (n= 13) and G3= occlusal splint and thermo-coolant therapy (n=15). The treatment outcomes were analysed using Helkimo's anamnestic and dysfunction index at each follow up weeks and finally at the end of 2nd month.
Result: Significant improvements are noted in all the three groups at the end of 2nd month. Inter group comparisons show a better treatment outcome in G2 and G3 when compared to G1 at the end of 2nd month. However, no significant difference is found between physical exercise and thermo-coolant therapy when both this modalities are combined with splint therapy.
Conclusion: Occlusal splint therapy is a viable treatment modality for management of symptoms of TMD and conjunction of physical therapy has added advantage to the occlusal splint therapy.

KEYWORDS

TMD, occlusal splint, physical exercise, thermo-coolant therapy, Helkimo's index, anamnestic scale and dysfunction index

INTRODUCTION:

Occlusal appliance therapy has been shown to be an effective treatment modality in managing the TMD since the days of Costen's bite raising appliance[1].The prime objective of the occlusal splint therapy is to establish a harmonious relation among the biologic attributes of the stomatognathic system. On recent past; physical therapies in the form of thermo-coolant therapy, manual "hand-on" exercises like soft tissue mobilization, muscle conditionings have been suggested which may be effective in reduction of muscle pain and TMJ dysfunction. However, there is lack of literature regarding pre and post treatment assessment of improvement and /or severity of signs and symptoms and weather there is any added advantage of physical therapies when they are combined with splint therapy. Further, the results of the few available studies to determine the effect of these combination therapies are also not consistent. Hence, the present study was designed to evaluate the efficacy of occlusal splint therapy alone or in conjunction with physical therapies such as exercise therapy and thermo-coolant therapy in the management of temporomandibular disorders using Helkimo's Index[2].

METHODOLOGY:

Forty three patients reported to the Regional Dental College and hospital, Guwahati, India suffering from pain and dysfunctions of TMJ and orofacial muscle were enrolled in the study. Diagnosis was done using RDC/TMD criteria[3]. Severity of the cardinal signs and symptoms of TMD was analysed according to Helkiomo's anamnestic and dysfunction indices. Questionnaire for anamnestic component which includes answers to questions in "yes" or "no and Clinical dysfunction component which includes clinical examination. After receiving questionnaires, patients' severity of signs and symptoms was analysed according to anamnestic scale as follows:

0: No symptoms
I: Mild symptoms included sensation of the jaw fatigue, jaw stiffness, and TMJ sounds (clicking or crepitus)
II: Severe symptoms included one or more of the following: (a) Difficulty in the mouth opening, (b) Jaw locking, (c) Mandible dislocation and its painful movement, and (d) Painful TMJ region and/or masticatory muscles.

- Assessment of clinical examination was done according to Helkimo's dysfunction index as follows:

- Mandibular opening
>40 mm = 0
30-39 mm = 1
<30 mm = 5

- Mandibular deviation
<2 mm = 0
2-5 mm = 1
>5 mm = 5

- TMJ dysfunction (clicking, locking, and luxation)
No impairment = 0
Palpable clicking =1
Evident clicking= 5

- TMJ pain
No pain =0
Palpable pain =1
Palpebral pain =5

- Muscle pain
No pain = 0
Palpable pain =1
Palpebral pain =5

Scores assigned for the five symptoms were summed up. Each individual had a total dysfunction score ranging from 0 to 25 points. Depending on the values obtained, the patients were classified as follows:
Di 0- no dysfunction;
Di I - mild dysfunction (1–4 points);
Di II - moderate dysfunction (5–9 points);
Di III- severe dysfunction (9–25 points).

Distribution Of Subjects:

After initial assessment of severity of sign and symptoms and level of dysfunction, subjects selected for the study were distributed into three

groups based on the clinical diagnosis and therapy was prescribed as follows:

Group 1: G1= Occlusal splint therapy (n=15), Group 2: G2= Occlusal splint therapy and physical exercise in the form of soft tissue mobilization and muscle conditioning like passive muscle stretching, assisted muscle stretching and resistance exercises (n=13), Group 3: G3:= Occlusal splint therapy along with thermo-coolant therapy (n=15)

Patients suffered from myofacial pain and dysfunction was treated with stabilization splint. Subjects presented with variable TMD related both muscular and intracapsular signs and symptoms; they were given stabilization splint initially for diagnostic purpose and response were noted. If the symptoms were not improved or became worse, stabilisation splints were converted to ARS (anterior repositioning splint). Out of 43 patients 32 patients were given permissive splint and 11 patients were given ARS. Patients complaining of pain were given thermo-coolant therapy whereas patients with difficulty in mouth opening were mostly given physical therapy.

Data Collection: The base line data was collected for each subject using the Helkimo's Index before initiating any treatment. Subsequently the same index was used to collect data during follow up of each patient on 1st, 2nd, 3rd and 4th week and finally on completion of 2 months of therapy

RESULTS:

Statistical analysis of the collected data to determine the effect of occlusal splint and its combination with physical therapies reveals the following results.

Table 1: Shows cross tabulation for comparison of frequency distribution of anamnestic scale and dysfunction index of each G 1, G 2 and G 3 in its baseline data. The differences in the distributions of the three groups were tested for statistical significance using Pearson's Chi square test at 0.05 significance level. The test indicated that the difference in the distributions is statistically not significant for both anamnestic scale and dysfunction index with p value of 0.141.and 0.496 respectively.

Table 2: shows anamnestic and dysfunction scale comparison of G 1 in subsequent weeks where anamnestic scale difference between week 4 and 2 months as well as between baseline and 2nd month is found to be statistically significant with p value of 0.014 and 0.015 respectively. For dysfunction scale, significant difference in mean has been found between 4th week and 2nd month as well as between baseline and 2nd month with p values of 0.023 and 0.006 respectively.

Table 3: shows that at 2nd month, the mean anamnestic scale of G2 is observed to be lower than that of G1 and the difference between the groups is statistically significant with p = 0.006. For dysfunction scale, difference in mean is significantly lower for Group 2 than Group 1with p value 0.033.

Table 4: shows that at 4th week and 2nd month, the mean anamnestic scale score of G 3 is lower than that of G1. The difference between the groups is statistically significant with p value of 0.003 and 0.020 respectively. For dysfunction scale, at 3rd week, 4th week and 2nd month the mean Di scale score of G3 is observed to be lower than that of G1. The difference in means between the groups is statistically significant with p values of 0.023, 0.003 and 0.011 respectively.

Table 5: shows no significant difference in mean between G 2 and G 3 in subsequent weeks for both anamnestic scale and dysfunction scale.

Table 6: Shows intergroup and intragroup comparison of combined scores of anamnestic scale and dysfunction index of Helkimo's index at the follow up periods. In intragroup comparison, decrease in the mean combined scores has been found in all the three groups at subsequent weeks with differences are being significant at 4th week and 2nd month. In intergroup comparison, mean combined scores of G 2 and G 3 has been found to be lower than G1 and this difference is significant at the end of 2nd month.

Table 1: Cross Tabulation For Comparison Of Frequency Distribution Of Anamnestic Scale And Dysfunction Index Of Each Group 1, Group 2 And Group 3 In Its Baseline Data:

			GROUP			TOTAL	P value of Pearsons Chi Square test at 0.05 significance level
			GROUP 1	GROUP 2	GROUP 3		
Anamnestic scale	BASELINE	NO SYMPTOMS	0	0	0	0	0.141, NS
		MILD SYMPTOMS	2	0	0	2	
		SEVERE SYMPTOMS	13	13	15	41	
		TOTAL	15	13	15	43	
Dysfunction index	BASELINE	Di 0 - NO DYSFUNCTION	0	0	0	0	0.496, NS
		Di I - MILD DYSFUNCTION	6	2	5	13	
		DI II - MODERATE DYSFUNCTION	6	8	5	19	
		Di III - SEVERE DYSFUNCTION	3	3	5	11	
		Total	15	13	15	43	

NS= Non Significant

Table 2: Anamnestic And Dysfunction Scale Of Group 1 – Comparison Of The Follow Up Dates:

G1		N	ANAMNESTIC SCALE				DYSFUNCTION SCALE			
			Mean	SD	Means comparison	P values of Wilcoxon Matched Pair test at 0.05 significance level	Mean	SD	Means comparison	P values of Wilcoxon Matched Pair test at 0.05 significance level
Pair 1	Baseline	15	1.87	0.35	B < W1	0.317, NS	1.80	0.77	W1 < B	0.157, NS
	Week 1	15	1.93	0.26			1.67	0.82		
Pair 2	Week 1	15	1.93	0.26	W2 < W1	0.317, NS	1.67	0.82	W2 < W1	0.317, NS
	Week 2	15	1.87	0.35			1.60	0.74		
Pair 3	Week 2	15	1.87	0.35	W3 < W2	0.317, NS	1.60	0.74	W3 < W2	0.317, NS
	Week 3	15	1.80	0.41			1.33	0.62		
Pair 4	Week 3	15	1.80	0.41	W3 = W4	1.00, HNS	1.33	0.62	W4 < W3	1.00, HNS
	Week 4	15	1.80	0.41			1.27	0.59		
Pair 5	Week 4	15	1.80	0.41	2 M <W4	0.014,S	1.27	0.59	2M < W4	0.014,S
	2 Months	15	1.20	0.77			1.00	0.38		

Pair 6	Baseline	15	1.87	0.35	W4 < B	0.564, NS	1.80	0.77	W4 < B	0.564, NS
	Week 4	15	1.80	0.41			1.27	0.59		
Pair 7	Baseline	15	1.87	0.35	2M < B	0.015, S	1.80	0.77	2M < B	0.015, S
	2 Months	15	1.20	0.77			1.00	0.38		

B= Baseline, W= Week, M= Month, NS=Non-Significant, S=Significant, HNS=Highly Non-Significant, SD=Standard Deviation

Table 3: Anamnestic And Dysfunction Scale Comparison Between Group 1 And Group 2:

Group Statistics										
			ANAMNESTIC SCALE				DYSFUNCTION SCALE			
		N	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level
Baseline	G1	15	1.87	0.35	G1 < G2	0.180, NS	1.80	0.77	G1 < G2	0.292, NS
	G 2	13	2.00	0.00			2.08	0.64		
WEEK 1	G1	15	1.93	0.26	G1 < G2	0.352, NS	1.67	0.82	G1 < G2	0.347, NS
	G 2	13	2.00	0.00			1.92	0.76		
WEEK 2	G1	15	1.87	0.35	G1 < G2	0.180, NS	1.60	0.74	G2 < G1	1.00, HNS
	G 2	13	2.00	0.00			1.54	0.52		
WEEK 3	G 1	15	1.80	0.41	G1 < G2	0.426, NS	1.33	0.62	G2 < G1	0.189, NS
	G 2	13	1.85	0.55			1.08	0.28		
WEEK 4	G 1	15	1.80	0.41	G2 < G1	0.065, NS	1.27	0.59	G2< G1	0.030, S
	G 2	13	1.15	0.99			0.85	0.38		
2 MONTHS	G1	15	1.20	0.77	G2 < G1	0.006, S	1.00	0.38	G2 < G1	0.033, S
	G 2	13	0.38	0.51			0.62	0.51		

NS=Non-Significant, S=Significant, HNS=Highly Non-Significant, SD=Standard Deviation

Table 4: Anamnestic And Dysfunction Scale Comparison Between Group 1 And Group 3

Group Statistics										
			ANAMNESTIC SCALE				DYSFUNCTIONSCALE			
		N	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level
Baseline	G 1	15	1.87	0.35	G1 < G3	0.150, NS	1.80	0.77	G1 < G3	0.508, NS
	G 3	13	2.00	0.00			2.00	0.85		
WEEK 1	G1	15	1.93	0.26	G1 < G3	0.317, NS	1.67	0.82	G3 < G1	0.367, NS
	G 3	13	2.00	0.00			1.40	0.63		
WEEK 2	G 1	15	1.87	0.35	G3 < G1	0.630, NS	1.60	0.74	G3 < G1	0.098, NS
	G-3	13	1.80	0.41			1.20	0.41		
WEEK 3	G 1	15	1.80	0.41	G3 < G1	0.112, NS	1.33	0.62	G3 < G1	0.023, S
	G 3	13	1.47	0.64			0.93	0.26		
WEEK 4	G 1	15	1.80	0.41	G3 < G1	0.003, S	1.27	0.59	G3< G1	0.003, S
	G 3	13	0.80	0.94			0.60	0.51		
2 MONTHS	G1	15	1.20	0.77	G3 < G1	0.020, S	1.00	0.38	G3 < G1	0.011, S
	G 2	13	0.53	0.64			0.53	0.52		

NS=Non-Significant, S=Significant, SD=Standard Deviation

Table 5: Anamnestic And Dysfunction Scale Comparison Between Group 2 And 3

Group Statistics										
			ANAMNESTIC SCALE				DYSFUNCTION SCALE			
		N	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level	Mean	SD	Means comparison	P values of Mann Whitney test at 0.05 significance level
Baseline	G 2	15	2.00	0.00	G2 = G3	Not computed	2.08	0.64	G3 < G2	0.804, NS
	G 3	13	2.00	0.00			2.00	0.85		
WEEK 1	G 2	15	2.00	0.00	G2 = G3	Not computed	1.92	0.76	G3 < G2	0.054, NS
	G 3	13	2.00	0.00			1.40	0.63		
WEEK 2	G 2	15	2.00	0.00	G3 < G2	0.082, NS	1.54	0.52	G3 < G2	0.067, NS
	G 3	13	1.80	0.41			1.20	0.41		
WEEK 3	G 2	15	1.85	0.55	G3 < G2	0.108, NS	1.08	0.28	G3 < G2	0.164, NS
	G 3	13	1.47	0.64			0.93	0.26		
WEEK 4	G 2	15	1.15	0.99	G3< G2	0.341, NS	0.85	0.38	G3 < G2	0.158, NS
	G 3	13	0.80	0.94			0.60	0.51		
2 MONTHS	G 2	15	0.38	0.51	G2< G3	0.506, NS	0.62	0.51	G3 < G2	0.667, NS
	G 2	13	0.53	0.64			0.53	0.52		

NS=Non-Significant, S=Significant, SD=Standard Deviation

Table 6: Intergroup And Intragroup Comparison Of Combined Scores Of Dysfunction Index And Anamnestic Scale At The Follow Up Dates:

	GROUP 1	GROUP 2	GROUP 3	P values - inter-group	Significantly different pairs with p values
Baseline	3.67 (± 0.81)	4.08(± 0.64)	4.00 (± 0.84)	0.298, NS	-
Week 1	3.60(± 0.82)	3.92(± 0.75)	3.40 (± 0.63)	0.16, NS	-
Week 2	3.47(± 0.83)	3.54(±0.51)	3.00 (± 0.65)	0.09, NS	-

Week 3	3.13(± 0.74)	2.92(±0.64)	2.40 (± 0.73)	0.019, S	G3 < G1, p = 0.026, S
Week 4	3.07(± 0.79)	2.00(±1.22)	1.40 (± 1.29)	0.003, S	G3 < G1, p = 0.002, S
2 months	2.20(± 1.01)	1.00(±0.81)	1.07 (± 0.96)	0.004, S	G2 < G1, p = 0.011, S G3 < G1, p = 0.013, S
P value of baseline & week 1	0.564, NS	0.157, NS	0.024, S		
P value of week 1 & week 2	0.157, NS	0.025, S	0.014, S		
P value of week 3 & week 2	0.096, NS	0.020, S	0.007, S		
P value of week 3 & week 4	0.564, NS	0.016, S	0.007, S		
P value of Week 4 & 2 months	0.009, NS	0.017, S	0.262,NS		
P value of Baseline & week 4	0.030, S	0.002, S	0.001,S		
P value of Baseline & 2 months	0.001, S	0.001, S	0.001,S		

NS = Non-Significant
S = Significant

DISCUSSION:

Several therapies have been advocated for the patients with TMD, most of them are conservative and reversible while few are irreversible. Occlusal splint is one of such therapies which have been discussed in the stomatology literatures for past many decades, yet; its efficacy has been still debated.

In the present study, when pair wise comparison is done between mean scores of anamnestic scale and dysfunction index in subsequent follow up periods, significant improvements are found in all the three groups, i.e. G1(occlusal splint alone), G2 (occlusal splint + physical exercise) and G3 (occlusal splint + thermo-coolant therapy). These improvements are indicated by decrease in the mean difference in both anamnestic and dysfunction scores individually as well as decrease in mean combined scores of both the indices. Similar results were obtained by Okeson[4] and Ekberg[5] in their study where improvement of overall subjective symptoms was reported with stabilisation splint at the end of 4th weeks and 10th week respectively. Similarly anterior repositioning splint has also been found to provide effective relief in patients with intra-articular disorder.[6-7] In the present study both permissive and anterior repositioning splint are used and results are found consistent with studies by Schmitter[8], Behr[9], Devi[10].

The important aspect considered in this study is to assess the combine effect of physical therapy and occlusal splint. Physical exercise in the form of soft tissue mobilization, muscle conditioning, passive muscle stretching, assisted muscle stretching and resistance exercise has been prescribed for the patients along with occlusal splint (G2). When the mean anamnestic scale and dysfunction index of G2 are analysed it is found to be lower of than that of G1 and the differences are found to be significant for both indices at the end of 2nd months. In fact the combined mean value of anamnestic and dysfunction index is also found to be lower for G2 compared to G1 and the difference is found to be statistically significant. The above findings are comparable with the study conducted by Ismail et al[11] where significantly higher active jaw opening was found in the group which received occlusal splint and physical therapy compared to the other group which received only occlusal splint as treatment modality. Similar results were found by Gomes et al[12] and Gomes and his othercoworkers[13] where combination of massage therapy with occlusal splint showed improved mandibular range of motion.

When comparison is done between G3 and group G1, less mean anamnestic and dysfunction scores as well as combined values of both the scores are found for G3 than G1 at subsequent follow up periods with difference of mean is found to be significant at 4th week and 2ndmonth. It depicts the additional benefit of thermo-coolant therapy with occlusal splint in management of TMD. This result of the present study is in accordance with the study done by Nelson[9] who concluded that the use of a moist heating pad is an effective adjunct to bite plane splint therapy. Results of the present study also support findings of some previous studies done by Schwartz[14] and Travell[15] who used coolant therapy for management of myofacial pain and dysfunction.

When combined mean scores of anamnestic and dysfunction indices are compared between G1, G2 and G3; at 4th week and 2nd month, significant differences in mean scores are found amongst the three groups. When pair wise comparison of combined mean scores are analysed, significant difference is observed between G1 and G3, indicating G3 has significantly lower combined mean value than G1. This implies a better treatment outcome of G3 than G1. The combined mean scores of G2 shows lower value than G1; but it is not found to be statistically significant at the end of 4th week. Though there is no statistically significant difference between the combined mean score of G2 and G3, the present study shows G3 to be modestly more efficacious than G2. It may be because of the patients' compliance more towards the application of heat than performing physical exercise as recommended which naturally depends on the patients' own motivation.

The result of the present study is in contrast to some previous studies which found the effect of occlusal splint to be doubtful. Sato[16] and his co-workers in their study have found that 41.9 % of the patients with disc displacement with reduction who refused any treatment had a significant increase in mouth opening and decrease in pain after one year, although joint noises remained unchanged. Other studies comparing the outcome of occlusal splints with that of a control group have concluded that although the overall improvement in pain, joint sounds and maximal opening was noticeable in experimental group, no significant differences could be found with the control groups.[17, 18, 19] Studies by Preeti et al[19] and by Azam S et al [20] found no additional benefit of masticatory muscle exercise when it was prescribed along with occlusal splint in relieving facial pain and increasing the mobility of the mandible although the overall improvement in pain, joint sounds, and maximal opening was noticeable. These above mentioned studies did not use Helkimo's index to access the severity of signs and symptoms which may be the possible reason for discordance with the present study. Moreover, the treatment of control or the duration of the study periods may show variable results along with the sample size, psychological factor and fluctuation of the disease condition.[21]

The present study also has some limitations. Because of the diverse group of patients' homogeneity in patient selection could not be taken into account, although multitude was increased by excluding patients with general diseases that might affect the treatment outcome. It should also be noted that the groups were not uniform regarding the sub classification of TMD diagnosis, which is another limitation of the study. Therefore; further studies, specially randomized controlled trials with sufficient sample size and long term follow up are suggested to assess the efficacy of occlusal splint and adjunct therapies on distinct sub-groups of TMD.

CONCLUSION:

Within the limitations of the present study following conclusions can be drawn:

1. Occlusal splint is a viable and promising treatment modality in the management of temporomandibular disorder.
2. Physical therapies in the form of physical exercise and thermo-coolant therapy provide an added advantage to the splint therapy in management of TMD.
4. Thermo-coolant therapy provides a better treatment outcome than physical exercise but this difference is not statistically significant.
5. Physical therapies in the form of soft tissue mobilization, muscle conditioning and thermo-coolant therapy has additional benefit to the splint therapy and can be recommended as practical treatment adjuncts for management of TMD.

REFERENCES:

1. Costen JB: Syndrome of ear and sinus symptoms dependent upon functions of the temporomandibular joint. Ann OtoRhinolLaryngol 1934; 3:1–4.
2. Helkimo M. Studies on function and dysfunction of the masticatory system. II. Index for anamnestic and clinical dysfunction and occlusal state. Sven TandlakTidskr 1974; 67:101-21.

3. Truelove EL, Sommers EE, LeResche L, Dworkin SF, Von Korff M. Clinical diagnostic criteria for TMD. New classification permits multiple diagnoses. J Am Dent Assoc 1992; 123(4):47–54.
4. Okeson JP, Kemper JT, Moody PM: A study of the use of occlusion splints in them treatment of acute and chronic patients with craniomandibular disorders. J Prosthet Dent. 1982;48: 708-712.
5. Ekberg E, Nilner MA, Vallon D. Occlusal appliance therapy in patients with temporomandibular disorders: A double-blind controlled study in a short-term perspective. ActaOdontol Scand. 1998; 56:122-128.
6. Tsuga K, Akagawa Y, Sakaguchi R, Tsuru H: A short-term evaluation of the effectiveness of stabilization-type occlusal splint therapy for specific symptoms of temporomandibular joint dysfunction syndrome. J Prosthet Dent. 1989 May; 61(5):610.
7. Tecco S, Salini F, Epifania E, D'Attilio M. Treatment of Joint Pain and Joint Noises Associated with a Recent TMJ Internal Derangement: A Comparison of an Anterior Repositioning Splint, a Full-Arch Maxillary Stabilization Splint, and an Untreated Control Group. Cranio. 2004;22(3):209-219.
8. Schmitter M, Zahran M, Duc JM, Henschel V, Rammelsberg P. Conservative therapy in patients with anterior disc displacement without reduction using 2 common splints: a randomized clinical trial.J Oral Maxillofac Surg. 2005 Sep;63(9):1295-303.
9. Behr M, Stebner K, Kolbeck C, Faltermeier A, Driemel O, Handel G.Outcomes of temporomandibular joint disorder therapy: observations over 13 years. ActaOdontol Scand. 2007; 65(5): 249-253.
10. Devi J, Verma M, Gupta R (2017) Assessment of treatment response to splint therapy and evaluation of TMJ function using joint vibration analysis in patients exhibiting TMJ disc displacement with reduction: A clinical study. Indian J Dent Res 28(1): 33-43
11. Ismail F, Demling A, Hessling K, Fink M, Stiesch-Scholz M. Short-term efficacy of physical therapy compared to splint therapy in treatment of arthrogenous TMD. J Oral Rehabil. 2007; 34(11):807-13.
12. Gomes et al. Effects of massage therapy and occlusal splint therapy on mandibular range of motion in individuals with temporomandibular disorder: a randomized clinical trial. J manipulative physiolther. 2014; 37:164-169.
13. Gomes CA, El Hage Y, Amaral AP, Politti F, Biasotto-Gonzalez DA. Effects of massage therapy and occlusal splint therapy on electromyographic activity and the intensity of signs and symptoms in individuals with temporomandibular disorder and sleep bruxism: a randomized clinical trial Chiropractic & Manual Therapies. 2014;22:43
14. Schwartz LL. Ethyl chloride treatment of limited painful mandibular movement, J Am Dent Assoc.1954; 48:497–507.
15. Travell J. Ethyl chloride spray for painful muscle spasms, Arch Phys Med Rehabil. 1952;33:291–298.
16. Sato S, Kawamura H, Motegi K. Management of nonreducingtemporomandibular joint disc displacement. Evaluation of three treatments. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 1995; 80:384–38.
17. Dao TT, Lavigne GJ, Charbonneau A, Feine JS, Lund JP. The efficacy of oral splints in the treatment of myofacial pain of the jaw muscles: a controlled clinical trial. Pain 1994; 56:85-94.
18. Johansson A, Wenneberg B, Wagersten C, Haraldson T. Acupuncture in treatment of facial muscular pain. ActaOdontolScand 1991; 49:153-8.
19. Preeti AK, Manish K, Rupal JS, Ghanshyam P. Efficacy of Appliance Therapy on Temporomandibular Disorder Related Facial Pain and Mandibular Mobility: A Randomized Controlled Stud., J Indian Prosthodont Soc. 2014; 14(3):251–261.
20. Madani AS, M Amirtaher. Original Comparison of three treatment options for painful temporomandibular joint clicking. Journal of Oral Science. 2011; 53(3):349-354.
21. Conti PC, de Azevedo LR, de Souza NV, Ferreira FV. Pain measurement in TMD patients: evaluation of precision and sensitivity of different scales. J Oral Rehabil. 2001; 28:534–539.