Occlusion

The effect of reduced disclusion time in the treatment of myofascial pain dysfunction syndrome using immediate complete anterior guidance development protocol monitored by digital analysis of occlusion

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Statement of problem: Chronic myofascial pain dysfunction syndrome (MPDS) has been a nightmare for patients suffering from it, who have been treated with various treatment options with varied outcomes. This population of patients has been neglected, due to nagging revisits to a clinician and decreased percentage of success.

Objective: T-Scan-based immediate complete anterior guidance development (ICAGD) has been shown by a researcher to reduce the muscle hyperactivity consistent with MPDS. The purpose of this study is to evaluate the effect of reduced disclusion time in lateral excursions in treating the MPDS symptoms.

Materials and methods: Fifty-one myofascial pain patients with symptoms in the area of the head and neck region were treated with ICAGD. The quantified force and time data from T-Scan records were used to correct the prolonged disclusion time, and the subjects were assessed for the symptom relief. The Wilcoxon Signed Ranks Test was used for statistical analysis ($P<0.05$ denotes significant changes).

Results: The changes in disclusion time and intensity of various symptoms were found to be statistically significant ($P<0.05$) from Day 1 onwards, and patients were relieved of their symptoms after reduction of disclusion time of less than 0.5 seconds.

Conclusion: The results clearly indicated that ICAGD protocol reduces musculoskeletal-based symptoms of MPDS patients, and this protocol can prove beneficial for the clinical treatment success.

Keywords: Myofascial pain dysfunction syndrome (MPDS), Immediate complete anterior guidance, Development (ICAGD), TMD (temporomandibular disorders), Disclusion time (DT)

Introduction

Orofacial pain was incorporated into the authors' practice in 2010 to provide healthcare to those beautiful human beings who have been suffering from varied symptoms, which include headaches, migraines, early morning facial stiffness, trauma to musculoskeletal tissues (muscles, ligaments, tendons), low back aches, nutritional deficiencies, nervous tension, or stress.

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The treatment options used by the authors include vapocoolant spray and stretching of the muscles involved, injections of local anesthetic directly into the trigger point(s), massage therapy, physical therapy, exercise, elimination of stress, changing sleeping habits, the use of tricyclic antidepressants in low doses , non-steroidal anti-inflammatory drugs, muscle relaxants, biofeedback, counseling, etc.

Despite its diverse etiology, occlusal instability has long been considered an important aetiological factor. Occlusal interferences can induce tooth pain, mobility, as well masticatory muscle hyperactivity, although data does not indicate that they are the cause of chronic jaw dysfunction problems.[1,2]

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Occlusal equilibration had been advocated by numerous authors as a successful treatment modality.[3–7] Others have shown the same improvements in symptoms by mock occlusal equilibration, as well as real occlusal adjustment.[8–12] However, some authors contend that myofascial pain dysfunction syndrome (MPDS) is a stress-related disorder not brought on by occlusal factors.[13–15]

These controlled studies[3–12] employed incomplete occlusal equilibration procedures, which were based upon articulating paper markings wherein only centric relation contact points and non-working interferences were equilibrated, but working side interferences were not removed. Measurable anterior guidance disclusion was not achieved in all these subjects. Lastly, no objective occlusal criteria were used to assess that complete interference removal had been definitively achieved.

A published study that analyzed the size of 600 articulating paper marks made at varying human occlusal loads from 0 to 500 N, showed that articulating paper-mark area (size) was not representative of the occlusal force content within the given mark.[16] This study indicated statistically that equal-size marks on neighbouring teeth did not demonstrate equal occlusal load content. Thus, utilizing solely articulating paper-based occlusal equilibration would likely be a completely subjective, non-reliable occlusal treatment method from which to attempt to determine ideal occlusal adjustment end-results and treatment effect reliability.[16]

A correlation between posterior tooth contact in mandibular eccentric movements and muscle activity was described.[17] The more time taken for excursive movement (more than >0.4 seconds) leads to longer compression of the periodontal ligament, thereby leading to muscle hyperactivity through the biofeedback system and lactic acid build-up with ischemic changes. The lactic acid then accumulates over time as these prolonged excursive contacts continually hyperactivate the involved musculature, thereby producing the ischemic symptomotology often seen in the MPDS subject.[18,19]

Since 1991, a computer analyzed occlusal equilibration procedure called immediate complete anterior guidance development (ICAGD) to reduce disclusion time by either reduction or addition has been described in the literature.[20] It has been shown to reduce muscle hyperactivity and successfully treat the symptoms of MPDS.[17–23]

The ICAGD procedure was only possible to perform because of the time measurement capability of the T-Scan occlusal analysis system (T-Scan versions I, II, and III; Tekscan Inc., Boston, MA, USA). ICAGD is a computer-guided, measured coronoplasty based on specific tome-based numerical occlusal endpoints.[20] The ICAGD-required precision occlusal adjustment endpoint, where the posterior Disclusion Time of <0.4 seconds per excursion is achieved, cannot be confirmed visually or by marking treated teeth with paper labelling.

The Disclusion Time is an entity measured by the T-Scan occlusal analysis system and its force movie software.[24,25] The Disclusion Time is defined as the duration of time that working and non-working molars and premolars are in contact during a mandibular excursive movement, that is commenced from complete habitual intercuspation, and extends through to the contact of solely anterior guiding surfaces (canines, and/or lateral and central incisors).[23] The therapeutic goal of ICAGD is to quickly disclude the posterior teeth in less than 0.5 seconds per excursion, primarily in right and left excursions and secondarily in protrusive excursions.[20] Once measurably short excursive Disclusion Times are achieved in each excursion, a new habitual, unguided, intercuspated position is achieved, which is refined with further T-Scan occlusal analysis to optimize bilateral simultaneity during closure, and the occlusal balance by quadrant and arch-half.[25] The ICAGD occlusal adjustment end-results can be objectively assessed, and where needed, therapeutically improved, using the T-Scan system's occlusal force and timing analysis software features. In this way, the ICAGD technique minimizes subjectively assessing the occlusal end-results, which are routinely performed in conventional unmeasured occlusal equilibration procedures.[26]

In published studies since 1991, measurable immediate anterior guidance control over the excursive movements has been shown to reduce excursive muscle hyperactivity, thereby stopping the ongoing lactic acid accumulation, and its related symptoms in MPDS subjects.[17,22,27–29] Alternatively, a visual determination of complete posterior tooth disclusion during an excursive movement is a highly error-prone procedure because the clinician cannot 'see' the lingual-to-lingual working interference contacts that have been determined to be a significant contributor to masticatory muscular hyperactivity.[29]

This study was undertaken to evaluate the possibility of successfully treating MPDS symptoms using a measurement-driven, diagnostic treatment protocol, based upon the T-Scan-guided ICAGD coronoplasty. The therapeutic treatment goal was to reduce

prolonged posterior Disclusion Time to <0.5 seconds in both the right and left mandibular excursions

Materials and Methods

Fifty-one MPDS symptomatic patients, who met the below inclusion criteria, were recruited to assess the efficacy of reduced Disclusion Time in left and right lateral excursions.

Inclusion criteria

1. Patients who demonstrated MPDS symptoms who presented with Angle's Class I maxillomandibular relations.
2. Patients who demonstrated MPDS symptoms who presented with Angle's Class III maxillomandibular relations, but had shallow anterior guidance contacts.
3. Patients who demonstrated MPDS symptoms who presented with Angle's Class II (Division 1) maxillomandibular relations but had definitive anterior guidance contacts.

Exclusion criteria

1. Patients who demonstrated MPDS symptoms who presented with Angle's Class II (Division 2) malocclusion, with no anterior guidance contacts.
2. Patients who demonstrated MPDS symptoms and had severe anterior open occlusion. These patients were not considered for the ICAGD protocol, as the amount of tooth adjustment required to effectively shorten the Disclusion Time would likely be excessive.
3. Patients who demonstrated MPDS symptoms who had prior disc re-capture surgery.

Symptom assessment questionnaire

At each study visit, subjects were asked to answer a questionnaire about the current status of their symptoms. All the patients were given an ordinal number questionnaire to fill out that included a wide range of MPDS symptoms (Table 1), which used a scale of 0–10 to describe symptom severity (0, no symptoms; 1–3, mild symptoms; 4–6, moderate symptoms; 7–10, severe symptoms). The common musculoskeletal symptoms that were graded were morning jaw pain, jaw fatigue, facial tension, difficulty in eating or chewing, clenching difficulty, temporal headaches, and neck pain. From study visit to study visit, the subjects were not allowed to review their previous answers, to avoid bias in their differing questionnaire responses, visit-to-visit.

The 51 subjects' visit-to-visit questionnaire scores were computed into means with standard deviations, SEM: The standard error of the mean (SEM) is the standard deviation of the sample-mean's estimate of a population mean (it can also be viewed as the standard deviation of the error in the sample mean relative to the true mean, since the sample mean is an unbiased estimator, mean and mean differences). Median values were also computed, as were Z and P values.

If $P<0.05$, the authors rejected the null hypothesis and accepted the alternate hypothesis. If $P\geq0.05$, the null hypothesis was accepted.

Z scores are measures of standard deviation and both Z and P values statistics are associated with the standard normal distribution; this distribution relates standard deviations with probabilities and allows significance and confidence to be attached to Z scores and P-values.

Since the mean and median of different groups of individuals were compared, a non-parametric test like the Wilcoxon Signed Ranks Test was used for statistical analysis.

The included subjects then underwent a T-Scan III digital occlusal analysis, which quantified their closure occlusal forces against time, and measured their right and left excursive Disclusion Times, such that pre-treatment Disclusion Time values in seconds, were obtained for both right and left excursions.

Measurement of Disclusion Time

Before commencing any treatment occlusal adjustments, the Force Movie mode of the T-Scan was

Table 1 Symptom assessment questionnaire on ordinal scale

	Ordinal scale										
	No symptoms	Mild			Moderate			Severe			
Symptoms assessed	0	1	2	3	4	5	6	7	8	9	10
Temporal head ache											
Morning jaw pain											
Jaw fatigue											
Facial tension											
Difference in chewing/eating											
Clenching											
Neck pain											

Table 2 Analysis of disclusion time means (in seconds) pre- to post-treatment for left lateral excursion

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1 — Pre	2.00	1.67	0.23	1.608	−6.215	<0.001
Day 1 — Post	0.39	0.11	0.02			
Day 8 — Pre	0.39	0.12	0.02	0.006	−2.699	0.007
Day 8 — Post	0.38	0.11	0.01			
Day 1 — Pre	2.00	1.67	0.23	1.612	−6.215	<0.001
Day 8 — Pre	0.39	0.12	0.02			
Day 1 — Pre	2.00	1.67	0.23	1.627	−6.215	<0.001
1 month	0.37	0.11	0.02			
Day 1 — Pre	2.00	1.67	0.23	1.634	−6.215	<0.001
6 months	0.36	0.11	0.02			
Day 1 — Pre	2.00	1.67	0.23	1.644	−6.215	<0.001
1 year	0.35	0.11	0.02			

utilized to measure and calculate the pre-treatment Disclusion Times in seconds.[1] Each excursive movement (right and left) was recorded three times to obtain a Mean values for each excursion per subject. These values were later compared with the post-treatment Disclusion Time recordings made on Day 8, 1 month, 6 months, and 1 year, from the initial Disclusion Time recordings for left and right lateral excursive movements and the mean combined disclusion times (Tables 2–4).

ICAGD was performed in two phases

Phase I

After analyzing the pretreatment Disclusion Time data of each subject, either the ICAGD enameloplasty (reduction) was performed, or composite additions were placed on the lingual surfaces of the maxillary canine teeth, so both established immediate posterior disclusion of <0.5 seconds per excursion. At this point, post-treatment T-Scan records were taken, and if the Disclusion Time was not <0.5 seconds in duration in either excursion, further ICAGD corrections were made to the occlusion where required. Occlusal adjustments were suspended when subsequent T-Scan recordings verified that the Disclusion Times per excursion were <0.5 seconds in duration.

After the ICAGD procedure, when measurable short Disclusion Time had been adjusted into the habitual closure arc occlusal contact pattern, or established additively with the composite addition, the subject informed the treating clinician: where, in their occlusion, it felt pressurized; if any rocking between contacts existed; if their occlusion seemed to feel equal on both the left and right sides of their mouth; if they were experiencing any apparent temporalis, facial, neck, or ear pain when they would self-occlude; whether they felt blocked while gliding from side to side across their anterior teeth; if there was any noticeable tension in their face; and if there was anything they did not generally like about their new occlusal design. Subtle adjustments were then made based upon their subjective feel to enhance the patient's comfort with the new occlusal design.

Additionally, each subject was specifically asked if their new occlusion appeared to feel 'noticeably lighter' posteriorly, because this is the desirable therapeutic occlusal 'feel' change for the subject to experience, resultant from a correctly performed ICAGD coronoplasty. The new 'lighter' feel indicates their posterior teeth no longer excessively

Table 3 Analysis of disclusion time means (in seconds) pre- to post-treatment for right lateral excursion

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1 — Pre	1.98	1.45	0.20	1.577	−6.215	<0.001
Day 1 — Post	0.40	0.11	0.02			
Day 8 — Pre	0.38	0.14	0.02	0.018	−3.099	0.002
Day 8 — Post	0.36	0.13	0.02			
Day 1 — Pre	1.98	1.45	0.20	1.603	−6.215	<0.001
Day 8 — Pre	0.38	0.14	0.02			
Day 1 — Pre	1.98	1.45	0.20	1.625	−6.215	<0.001
1 month	0.35	0.11	0.02			
Day 1 — Pre	1.98	1.45	0.20	1.631	−6.215	<0.001
6 months	0.35	0.11	0.02			
Day 1 — Pre	1.98	1.45	0.20	1.638	−6.215	<0.001
1 year	0.34	0.12	0.02			

Table 4 Analysis of combined disclusion time means (in seconds) pre- to post-treatment for left and right Lateral excursions

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1 — Pre	1.99	1.21	0.17	1.591	−6.215	<0.001
Day 1 — Post	0.40	0.10	0.01			
Day 8 — Pre	0.38	0.11	0.02	0.011	−3.288	0.001
Day 8 — Post	0.37	0.10	0.01			
Day 1 — Pre	1.99	1.21	0.17	1.605	−6.215	<0.001
Day 8 — Pre	0.38	0.11	0.02			
Day 1 — Pre	1.99	1.21	0.17	1.626	−6.215	<0.001
1 month	0.36	0.10	0.01			
Day 1 — Pre	1.99	1.21	0.17	1.631	−6.215	<0.001
6 months	0.36	0.10	0.01			
Day 1 — Pre	1.99	1.21	0.17	1.639	−6.215	<0.001
1 year	0.35	0.10	0.01			

frictionally engage, such that post-treatment, the involved teeth do not compress the periodontal ligament mechanoreceptors as often, nor for as long a time as in the pre-ICAGD condition. The performed ICAGD coronoplasty allows the new occlusal design to operate with lessened muscle activity and lower lactic acid production, which increases the availability of oxygen for improved muscular function, muscular tissue healing, and reduced muscular symptoms.

Each subject was then instructed to observe any noted physical changes that resulted from treatment. Muscle relaxation, decreased muscular pain, and released stress within the facial muscles were all indications that the short Disclusion Time had begun to physiologically lessen symptoms. The subject was told to be prepared to report on any symptom changes at the 8-day, Phase 2 study visit.

Phase 2

On the eighth day, 1-week post-treatment excursive T-Scan recordings were made, and any T-Scan-detected occlusal interferences were cleared from within the new habitual self-intercuspated position. And, any prolonged Disclusion Time that was found on involved posterior teeth, was then corrected to once again bring the Disclusion Time per excursion below 0.5-second duration. Post-op Disclusion Time recordings were then made, after which the subject answered their 8-day questionnaire regarding symptom improvements, or lack thereof.

Subsequent to the Phase 2 correction visit, the subject was recalled at 1-month, 6-month, and 1-year periods of observation, for both changes in their Disclusion Times, and changes with their pre-treatment reported symptoms.

Statistical analysis

The Wilcoxon Signed Ranks Test was used for statistical analysis of the Disclusion Time Means per Study Visit.

> *The Null hypothesis: there would be no significant difference in the Disclusion Times (in seconds) between the pre-treatment and post-treatment Disclusion time intervals ($mu_1 = mu_2$).*
> *The Alternate hypothesis: there was a significant difference in the Disclusion Times (in seconds) between the pre-treatment and post-treatment Disclusion time intervals ($mu_1 \neq mu_2$).*

The Level of Significance: alpha = 0.05.

Decision criterion: If the compared *p*-values differed with the level of significance of $P<0.05$, the null hypothesis will be rejected, and the alternate hypothesis would be accepted. If $P \geq 0.05$, the null hypothesis would be accepted. Computations of the *p* values were based upon the data reported in Tables 2–18.

Table 5 Comparison of mean intensity of 'Morning jaw pain' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	2.71	2.58	0.36	2.627	−4.804	<0.001
Day 8	0.08	0.39	0.05			
Day 1	2.71	2.58	0.36	2.706	−4.804	<0.001
1 month	0.00	0.00	0.00			
Day 1	2.71	2.58	0.36	2.706	−4.804	<0.001
6 months	0.00	0.00	0.00			
Day 1	2.71	2.58	0.36	2.706	−4.804	<0.001
1 year	0.00	0.00	0.00			

Table 6 Comparison of mean intensity of 'jaw fatigue' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	1.43	2.39	0.33	1.373	−3.531	<0.001
Day 8	0.06	0.42	0.06			
Day 1	1.43	2.39	0.33	1.431	−3.530	<0.001
1 month	0.00	0.00	0.00			
Day 1	1.43	2.39	0.33	1.431	−3.530	<0.001
6 months	0.00	0.00	0.00			
Day 1	1.43	2.39	0.33	1.431	−3.530	<0.001
1 year	0.00	0.00	0.00			

Table 7 Comparison of mean intensity of 'facial tension' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	1.33	1.98	0.28	1.333	−3.757	<0.001
Day 8	0.00	0.00	0.00			
Day 1	1.33	1.98	0.28	1.333	−3.757	<0.001
1 month	0.00	0.00	0.00			
Day 1	1.33	1.98	0.28	1.333	−3.757	<0.001
6 months	0.00	0.00	0.00			
Day 1	1.33	1.98	0.28	1.333	−3.757	<0.001
1 ear	0.00	0.00	0.00			

Results

Analysis of Disclusion Time means of the left lateral excursion and the right lateral excursion, pre- to post-treatment for the entire group of 51 treated subjects

The Disclusion Time changes from pre- to post-treatment were analyzed at the various time intervals within the 1-year period of observation. There were statistically significant differences found between the pre- and post-treatment intervals ($P<0.5$). The differences between Day 1 pre-treatment Disclusion Time means with Day 8, 1 month, 6 months, and 1 year values showed statistically significant differences for each visit ($P<0.05$) (Tables 2–4).

The subsequent recall visits (1 month, 6 months, 1 year) showed statistically equivalent values of the Disclusion Time means ($P>0.5$), and all reported post-treatment Disclusion Time means per recall visit, were within 0.4 seconds duration as per the correct ICAGD treatment protocol.

The mean difference was greater following treatment on Day 1 (both right and left excursions) and was reduced on Day 8, due to the consistent values of Disclusion Time measured after Day 8, which showed the Disclusion Time values were significantly reduced following ICAGD.

The left excursion values showed greater mean difference values on Day 1, pre- to post-treatment (mean difference: 1.608). Thereafter, mean differences with day 1 pre-treatment values, and the subsequent recall visits also showed greater mean differences, that remained fairly constant through the 1-year period of study observation (Table 2: the mean difference values ranged from 1.612 to 1.644). This mean difference showed that there was a statistically significant reduction of the left Disclusion Time from the ICAGD treatment.

The right excursion values showed similar changes. The mean difference obtained on Day 1 pre- to post-treatment was greater than the Day 8 changes (mean difference: 1.577). The mean differences with Day 1 pre-treatment values and Day 8, 1 month, 6 months, and 1 year all showed greater values of mean differences (Table 3: mean difference values ranged from 1.603 to 1.638). This mean difference showed

Table 8 Comparison of mean intensity of 'difference in chewing /eating' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	0.94	1.79	0.25	0.941	−3.201	0.001
Day 8	0.00	0.00	0.00			
Day 1	0.94	1.79	0.25	0.941	−3.201	0.001
1 month	0.00	0.00	0.00			
Day 1	0.94	1.79	0.25	0.941	−3.201	0.001
6 months	0.00	0.00	0.00			
Day 1	0.94	1.79	0.25	0.941	−3.201	0.001
1 year	0.00	0.00	0.00			

Table 9 Comparison of mean intensity of 'clenching' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	4.61	3.25	0.46	3.961	−5.272	<0.001
Day 8	0.65	1.18	0.17			
Day 1	4.61	3.25	0.46	4.608	−5.297	<0.001
1 month	0.00	0.00	0.00			
Day 1	4.61	3.25	0.46	4.608	−5.297	<0.001
6 months	0.00	0.00	0.00			
Day 1	4.61	3.25	0.46	4.608	−5.297	<0.001
1 year	0.00	0.00	0.00			

Table 10 Comparison of mean intensity of 'temporal headache' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	5.67	2.11	0.30	5.157	−6.015	<0.001
Day 8	0.51	1.01	0.14			
Day 1	5.67	2.11	0.30	5.667	−6.008	<0.001
1 month	0.00	0.00	0.00			
Day 1	5.67	2.11	0.30	5.667	−6.008	<0.001
6 months	0.00	0.00	0.00			
Day 1	5.67	2.11	0.30	5.667	−6.008	<0.001
1 year	0.00	0.00	0.00			

Table 11 Comparison of mean intensity of 'neck pain' from pre-treatment Day 1 to other time intervals

Time interval	Mean	Std dev	SE of mean	Mean difference	*Z*	*P*-value
Day 1	0.55	1.71	0.24	0.549	−2.032	0.042
Day 8	0.00	0.00	0.00			
Day 1	0.55	1.71	0.24	0.549	−2.032	0.042
1 month	0.00	0.00	0.00			
Day 1	0.55	1.71	0.24	0.549	−2.032	0.042
6 months	0.00	0.00	0.00			
Day 1	0.55	1.71	0.24	0.549	−2.032	0.042
1 year	0.00	0.00	0.00			

Table 12 Comparison of median intensity values of 'morning jaw pain' from pre-treatment Day 1 to other time intervals

Jaw pain	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	3	…	0	8	…	…
Day 8	0	15.50	0	2	−4.804	<0.001
1 month	0	15.50	0	0	−4.804	<0.001
6 months	0	15.50	0	0	−4.804	<0.001
1 year	0	15.50	0	0	−4.804	<0.001

that there was a statistically significant reduction of right Disclusion Time from the ICAGD treatment. The standard deviation for the Disclusion Time means remained fairly constant following ICAGD treatment (standard deviation=0.11–0.12 for left excursion, and 0.11–0.14 for the right excursion).

Combined right and left excursion Disclusion Time means analysis

The Disclusion Time means for combined left and right excursions were compared from pre- to post-treatment where there were statistically significant differences ($P<0.001$) (Table 4).

Table 13 Comparison of median intensity values of 'morning jaw pain' from pre-treatment Day 1 to other time intervals

Jaw fatigue	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	0	…	0	7	…	…
Day 8	0	8.50	0	3	−3.531	<0.001
1 month	0	8.50	0	0	−3.530	<0.001
6 months	0	8.50	0	0	−3.530	<0.001
1 year	0	8.50	0	0	−3.530	<0.001

Table 14 Comparison of median intensity values of 'facial tension' from pre-treatment Day 1 to other time intervals

Facial tension	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	0	…	0	6	…	…
Day 8	0	9.50	0	0	−3.757	<0.001
1 month	0	9.50	0	0	−3.757	<0.001
6 months	0	9.50	0	0	−3.757	<0.001
1 year	0	9.50	0	0	−3.757	<0.001

Table 15 Comparison of median intensity values for 'differences in chewing/eating' from day 1 to other time intervals

Differences in chewing/eating	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	0	…	0	6	…	…
Day 8	0	7.00	0	0	−3.201	0.001
1 month	0	7.00	0	0	−3.201	0.001
6 months	0	7.00	0	0	−3.201	0.001
1 year	0	7.00	0	0	−3.201	0.001

Table 16 Comparison of median intensity values for 'clenching' from day 1 to other time intervals

Clenching	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	6	…	0	8	…	…
Day 8	0	18.50	0	4	−5.272	<0.001
1 month	0	18.50	0	0	−5.297	<0.001
6 months	0	18.50	0	0	−5.297	<0.001
1 year	0	18.50	0	0	−5.297	<0.001

Table 17 Comparison of median intensity values for 'temporal headache' from day 1 to other time intervals

Temporal headache	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	6	…	0	8	…	…
Day 8	0	24.00	0	4	−6.015	<0.001
1 month	0	24.00	0	0	−6.008	<0.001
6 months	0	24.00	0	0	−6.008	<0.001
1 year	0	24.00	0	0	−6.008	<0.001

The combined right and left Disclusion Time means for the recall visits were compared with Day 1 pre-treatment values, to determine the mean magnitude of change. The results showed there were statistically significant changes for the 1-year period of observation ($P<0.001$). The mean differences compared to Day 1 pre-treatment values, were also greater and consistent for all recall visits (Table 3; the mean differences ranged from 1.605 to 1.639)

Intensity of muscular discomforts:

The ordinal scale questionnaire was used to assess the severity of various temporomandibular disorder symptoms where the median values of the scores for the entire group were determined for statistical comparison. The symptoms evaluated were jaw pain, jaw fatigue, facial tension, difficulty in chewing, morning jaw pain, clenching, temporal headache, and neck pain. The changes in mean intensity of all

Table 18 Comparison of median intensity values for 'neck pain' from day 1 to other time intervals

Neck pain	Median	Mean rank	Minimum	Maximum	*Z*	*P*-value
Day 1	0	…	0	7	…	…
Day 8	0	3.00	0	0	−2.032	0.042
1 month	0	3.00	0	0	−2.032	0.042
6 months	0	3.00	0	0	−2.032	0.042
1 year	0	3.00	0	0	−2.032	0.042

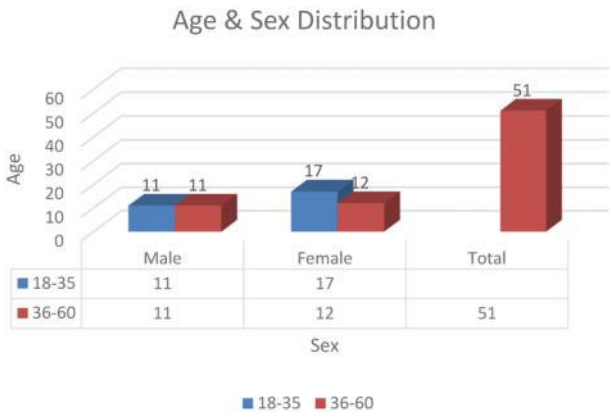

Figure 1 Age and sex distribution.

symptoms was found to be statistically significant between Day 1 and Day 8 ($P<0.05$); Day 1 and 1 month ($P<0.05$); Day 1 and 6 months ($P<0.05$); as well as Day 1 and 1 year ($P<0.05$), as seen in Tables 5–11. The median was also calculated and subjected to the statistical analysis (Table 12–18). The changes in the median intensity values of the various studied MPDS symptoms were found to be statistically significant between Day 1 and Day 8 ($P<0.05$); Day 1 and 1 month ($P<0.05$); Day 1 and 6 months ($P<0.05$); as well as Day 1 and 1 year ($P<0.05$).

Discussion

The Alternate hypothesis was accepted because the results of this study show there was a significant difference in the Disclusion Times (in seconds) between the pre-treatment and post-treatment Disclusion time intervals ($mu_1 \neq mu_2$) when lengthy Disclusion Time was shortened to less than 0.5 seconds per excursion. Additionally, this study's Results were in agreement with the findings reported in previous Disclusion Time Reduction studies involving the ICAGD coronoplasty as treatment for MPDS symptoms.

In the patients group we see 29 women to 22 men and 28 of them are in the age group of 18 to 35 years, to 23 of them in 36 to 60 years of age. This shows a predilection of MPDS affecting young adults which seems to be more common among women than men marginally, as seen in Figure 1.

The role of occlusion in activating MPDS symptoms has long been debated. While some authors have shown occlusal equilibration to be a successful treatment modality in treatment of such disorders,[5–7] other controlled studies have shown that there were similar symptom resolutions in both the control and the treated groups.[8–12] The results of this study, and others that preceded this study, indicate that this treatment method will likely reduce MPDS symptoms due to the physiologic muscle activity lowering effect achieved by ICAGD,[29] than when attempts are made to retrude the mandible into Centric Relation during traditional occlusal equilibration procedures. Lengthy Disclusion Time has been shown to elevate muscle activity levels as shown by a simultaneous EMG study, and that proper reduction of Disclusion Time to less than 0.4 seconds can reduce the muscle hyperactivity and the related symptoms.[17,29]

The concept of treating the MPDS patients with ICAGD is not new. Various studies have been performed in the past evaluating their effect on symptoms. A study by Kerstein[17] in 1991, performed on seven female subjects with MPDS, and treated with ICAGD to reduce Disclusion Time to less than 0.4 seconds showed statistically significant changes pre- to post-treatment Disclusion Time and significant symptom resolution. Additionally, the same author showed that statistically significant muscle activity level reductions occurred in 45 symptomatic MPDS patients, when ICAGD was properly performed.[29] Lastly, in a controlled occlusal adjustment study that compared treated, placebo, and untreated MPDS subject groups with respect to their differences in Disclusion Time, showed that symptom remissions began in the treated group within 1 week after the Disclusion Time was reduced to less than 0.4 seconds, and symptom resolution lasted for the 1-year period of post-treatment observation.[28]

The present study showed the multiple recall visit Disclusion Time means were statistically equivalent to the post-treatment Day 1 Disclusion Time mean. Further, the standard deviations from recall visit-to-visit remained fairly constant throughout the 1-year period of observation. The mean differences also remained constant when a comparison between Day 1 pre-treatment and subsequent visit measurements was made. This suggests that once Disclusion Time is reduced to less than 0.4 seconds, it is a lasting occlusal change. These findings are very similar to those of another Disclusion Time Reduction study that verified that once the Disclusion Time was properly reduced to less than 0.5 seconds, it remained constant, leading to the retention of proper muscle function and low symptom appearances.[27]

In the presented study, the population selected for treatment had their symptoms evaluated by questionnaire at 4 subsequent recall appointments (Day 8, 1 month, 6 months, 1 year), during which the subjects were not allowed to view their previous symptom responses. This made subjective symptom

assessment visit-to-visit, far more reliable for the statistical analyses. The results obtained from the many recall date questionnaires showed there was significant symptom resolution within the treated population, which was maintained during the 1-year period of observation. These findings indicated there were physiologic benefits obtained from treating MPDS subjects using the ICAGD protocol.

The only limitation of this study is the absence of a controlled group. Being an observational study design of a treatment protocol, this is not a significant drawback.

Conclusion

Even in the absence of a controlled group, the following inference can be drawn from the study results. The findings of this study corroborate prior evidence that when Disclusion Time is reduced to less than 0.4 seconds per excursion, it is effective in reducing the MPDS muscular symptoms. In the present study, the significant change in Disclusion Time duration ($P<0.05$) after the ICAGD coronoplasty was performed, was correlated with statistically significant reductions in muscular-based MPDS symptoms that began immediately after the Day 1 treatment visit ($P<0.05$).

When the right and left lateral excursive Disclusion Times of 51 patients were compared from pre-treatment to post-treatment with ICAGD, the indications were:

1. Lateral excursive Disclusion Time, if prolonged will be potentially etiologic for MPDS symptoms.

2. Reducing the left and right excursive Disclusion Times to <0.5 seconds per excursion will bring down the symptoms of MPDS.

3. When MPDS is treated by the ICAGD technique using the T-Scan III computerized occlusal analysis system, MPDS symptoms will rapidly resolve shortly after the ICAGD treatment is rendered.

The advent of Disclusion Time Reduction therapy using properly performed ICAGD is a potentially new direction in the treatment of myofascial pain dysfunction patients. Further longitudinal studies should be performed using ICAGD in the MPDS affected population.

Disclaimer Statements

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