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Comparative Efficacy of Occlusal Splint Therapy and Conservative Physiotherapy in the Treatment of Temporomandibular Joint Pain: A Longitudinal Study

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ABSTRACT

Temporomandibular joint disorders significantly impact patients' quality of life. Occlusal splint therapy and conservative physiotherapy (Transcutaneous Electrical Nerve Stimulation (TENS) and Electrical Muscle Stimulation (EMS)) are common treatments for temporomandibular joint disorders. However, their comparative long-term efficacy remains unclear.**Objectives:** To compare the efficacy of occlusal splint therapy and conservative physiotherapy (TENS and EMS) in improving mouth opening and reducing pain in temporomandibular joint disorder patients over six months.**Methods:** A longitudinal quasi study of 12 months was conducted with 112 patients randomly assigned to occlusal splint therapy (n=56) or conservative physiotherapy (n=56). Pre-operative and post-operative mouth opening and Visual Analog Scale (VAS) pain intensity scores were measured at 3 weeks, 6 weeks, 12 weeks, and 6 months. Independent sample t-tests and repeated measures Analysis of Variance (ANOVA) were used for statistical analysis.**Results:** Both groups showed significant improvements in mouth opening and visual analogue scale scores over time. The occlusal splint group demonstrated superior long-term outcomes, with greater improvements in mouth opening and pain reduction at 12 weeks and 6 months. RM-ANOVA revealed significant time effects for both treatments.**Conclusions:** It was concluded that occlusal splint therapy provides greater long-term improvement in mouth opening and pain reduction compared to TENS and EMS. These findings suggest the importance of considering treatment duration and follow-up in managing temporomandibular joint disorders.

INTRODUCTION

Temporomandibular joint (TMJ) disorders are a group of disorders that include the issues arising in TMJ, jaw muscles and associated structures. Common outcomes of these disorders are pain and tenderness, limited mouth opening and decreased voluntary bite force resulting in decreased chewing efficacy significantly impacting the quality of life of patients [1]. The etiology of TMJ disorders includes malocclusion, parafunctional habits, stress-induced muscle tension, trauma and sometimes iatrogenic causes like 3rd molar extraction, inferior alveolar nerve block or other dental surgical procedure [1, 2]. Common treatment offered for acute TMJ disorders of non-traumatic origin is occlusal splint therapy, physiotherapy which includes transcutaneous electric nerve stimulation (TENs) and Electrical muscle stimulation (EMS) combined with pharmacological help like muscle relaxants, anti-

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inflammatory drugs and pain killers [3, 4]. Occlusal split therapy is a commonly used treatment modality for TMJ disorders due to its established effectiveness in pain relief and other symptomatic improvement. The treatment includes the provision of a hard-occlusal splint commonly known as stabilizing split or Michigan splint. It works by redistributing occlusal forces more favourable thereby decreasing stress and strain on jaw muscles and TMJ leading to the resolution of symptoms and a decrease in pain. It was confirmed that occlusal splints are an effective treatment for TMJ disorders in both the long term and the short-term. List and Axelsson also reported that if splint therapy is properly conducted it can result in sustained pain reduction and long-term functional benefits [5]. Conservative physiotherapy techniques include TENS and EMS. TENS is effective in providing immediate pain relief and works by stimulating nerve fibers reducing pain perception, while EMS is effective in providing deep muscle stimulation leading to improvement in muscle function strength and endurance. Hassan et al., reported that TENS and EMS are good and recommended treatment modalities in the reduction of pain and symptomatic relief of TMJ disorder particularly in the acute phase [3]. While both treatment modalities are prevalent, their comparative long-term efficacy in managing TMJ disorders remains underexplored. The findings will help clinicians make informed treatment decisions, potentially leading to improved patient outcomes, reduced pain, enhanced jaw function, and better overall quality of life for individuals suffering from TMJ disorders.

Temporomandibular joint (TMJ) disorders significantly affect oral function and quality of life due to pain, limited mouth opening, and muscle dysfunction. Although both occlusal splint therapy and conservative physiotherapy (TENS and EMS) are widely used, there is insufficient evidence comparing their long-term efficacy in improving functional outcomes and pain relief. Most existing studies focus on short-term effects or isolated treatment modalities, leaving a clear gap in understanding sustained therapeutic benefits. This study aims to fill this gap by evaluating the effectiveness of occlusal splint therapy versus TENS and EMS in improving mouth opening and reducing pain over six months. This study provides comparative evidence on the effectiveness of occlusal splint therapy versus conservative physiotherapy (TENS and EMS) in treating temporomandibular joint disorders..

METHODS

A longitudinal quasi experimental study with 12 months' follow-up was employed to compare the efficacy of occlusal splint therapy and conservative physiotherapy (TENS and EMS). Recruitment of patients started from Feb 2022 and all the patients had their one-year follow-up till Feb 2023. The study was approved by the institutional review board Ref # UCD/ERCA/21/10ab. Patients of age 18-40 having temporomandibular joint pain with more than one month's history were included. Patients in pain with complaints of TMJ clicking, limited mouth opening (MO) and/or jaw deviation were also included. However, patients with a history of treatment with TENS, EMS or occlusal splint therapy were excluded. Patients with TMJ disorders of non-muscular origin (e.g., arthritis, structural abnormalities) or a history of acute trauma leading to TMJ problems were also excluded. Participation in the study was voluntary, though patients who had known allergies to acrylic were also excluded. The study was performed on patients reporting to the prosthodontics clinic of Fatima Memorial Hospital and the private dental clinics of the investigators of this study. A sample size of 112 was calculated using the reference article [6]. 120 participants (considering some dropouts) were enrolled in the study over one year. 3 participants took consent back after 3 weeks while 5 participants stopped responding during different times of data collection. The total number of participants lost during the study was 8. All the patients had to sign the voluntary consent form after which they picked a slip from a jar that contained 120 slips (60 physiotherapies and 60 occlusal splint therapy) using the lottery method. Patients were then referred for initiation of the treatment, and the assigned doctor treated the patient for a full 6 months. Investigators who evaluated the outcomes were completely blind to the grouping of the participants. Physiotherapy (TENS and EMS) group was named Group A and the occlusal splint therapy group was named Group B. Data were collected from 112 patients with TMJ disorders, 54 in Group A and 58 in Group B. Group A was given TENS therapy 20 minutes' session three times a week and EMS therapy 20 minutes' therapy three times a week. Each therapy was given on alternative days and Sunday was kept therapy free. All the patients in Group A bought a portable TENS-EMS rechargeable device and instructions about the frequency setting, mode setting duration setting and treatment schedule were given to the patients in written form by the specialist physiotherapist according to the protocol. Group B was provided with a custom-made hard acrylic stabilizing occlusal splint with canine and incisal guidance such that centric relation becomes equal to centric occlusion in the splint occlusal scheme. All the splints were made such that freeway space is not violated. Patients were advised to wear a splint for all the sleep time and 6 hours in the day along with the nightwear. Patients were evaluated every week by the relevant doctor but data were collected at the following interval; pre-operatively and then post-operatively on 3 weeks, 6 weeks, 12 weeks and 6-month intervals by the investigators. Mouth Opening

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(MO) was recorded from inter-incisal opening measured in millimetres using a caliper. Whereas, the Visual Analog Scale (VAS) for Pain was noted on a 10-point scale to assess pain intensity. Descriptive statistics were calculated for baseline characteristics and follow-up measurements. Independent sample t-tests and Repeated Measures ANOVA (RM-ANOVA) were performed to assess between-group and within-group differences over time respectively.

RESULTS

Out of 112 samples, 61 male and 51 female were part of the study. Both treatment groups had similar MO and VAS scores pre-operatively (p>0.05), however showed significant improvements in MO and VAS scores over time with therapy. Group A has a higher mean MO at 3, 6, and 12 weeks compared to the occlusal splint therapy group. At 6 months, Group B shows a higher mean MO than the TENS and EMS groups. The descriptive statistics for mouth opening (MO) at various time points are provided in table 1.

Table 1: Comparison of Mouth Opening (MO) as Outcome Variable

Variables	Pre-Op MO Mean	3 Weeks Post Op MO Mean	6 Weeks Post Op MO Mean	12 Weeks Post Op MO Mean	6 Months Post Op MO Mean
Total Mean	31.82 ± 4.33	35.52 ± 4.74	37.1 ± 3.93	39.07 ± 3.2	39.71 ± 3.36
TENS And EMS (n=54)	31.70 ± 4.2	37.89 ± 3.7	38.96 ± 56	39.68 ± 3.1	37.85 ± 3.0
Occlusal Splint (n=58)	31.89 ± 4.4	33.16 ± 4.4	35.25 ± 3.8	38.46 ± 3.2	41.57 ± 2.6
p-value	0.862	<0.001	<0.001	0.045	<0.001

OP=operation. Independent t-test was used to evaluate inter-group comparison. p>0.05 was considered significant.

Group A had lower mean VAS at 3 and 6 weeks compared to the occlusal splint therapy group, however, the VAS scores improved drastically in Group B at 12 weeks and 6 months. The descriptive statistics for Visual Analog Scale (VAS) scores at various time points are provided in Table 2.

Table 2: Comparison of VAS Scores as Outcome Variable

Variables	Pre-Op VAS	3 Weeks Post-OP VAS	6 Weeks Post-OP VAS	12 Weeks Post-OP VAS	6 Months Post-OP VAS
Total Mean	7.62 ± 0.92	5.8 ± 1.3	5.07 ± 1.13	3.8 ± 1.16	3.1 ± 1.86
TENS And EMS (n=54)	7.6 ± 0.9	4.85 ± 0.99	4.41 ± 0.96	4.2 ± 1	4.6 ± 1.1
Occlusal Splint (n=58)	7.64 ± 0.94	6.75 ± 1.03	5.43 ± 1.18	3.43 ± 1.15	1.75 ± 1.19
p-value	0.839	<0.001	<0.001	<0.001	<0.001

Independent t-test was used to evaluate inter-group comparison. p>0.05 was considered significant.

The study revealed that both treatment groups show a consistent increase in MO over time. Group A has a higher mean MO at 3, 6, and 12 weeks compared to the occlusal splint therapy group. At 6 months, Group B shows a higher mean MO than the TENS and EMS groups. Regarding VAS scores, both treatment groups show a consistent decrease in VAS scores over time. Group A has lower mean VAS at 3 and 6 weeks compared to the occlusal splint therapy group. At 12 weeks and 6 months, Group B shows lower mean VAS than the TENS and EMS group in figure 1.

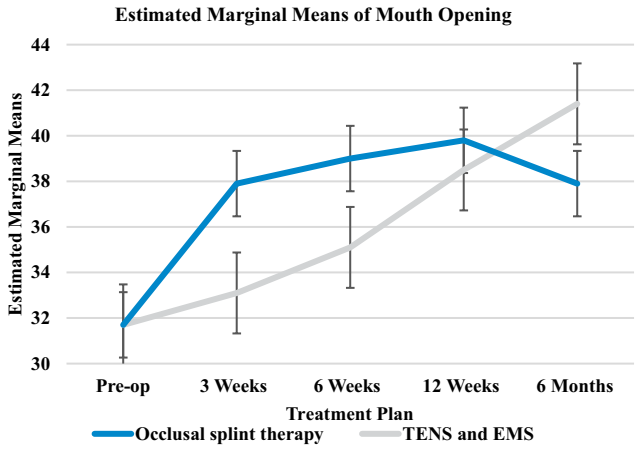

Figure 1: MO with Treatment Plan

RM-ANOVA tests of within-subject effects for MO and VAS both have p-values of <0.001, indicating significant changes over time. The p-value for between-subject effects is 0.061 for MO and 0.161 for VAS, suggesting no significant difference between the two treatment groups overall, despite significant changes over time. The VAS scores over time are illustrated in figure 2.

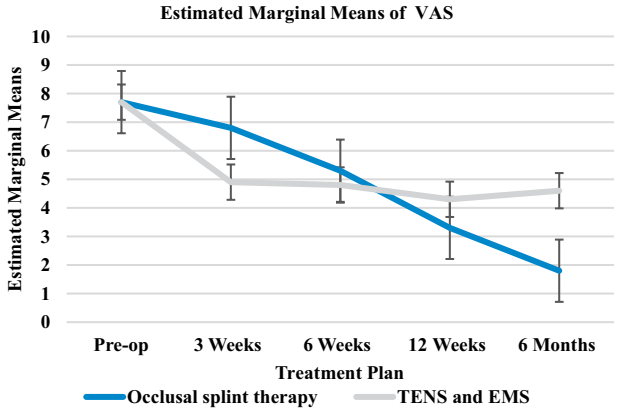

Figure 2: VAS Score Graph with Treatment Plan

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DISCUSSION

Occlusal splint therapy has been shown to effectively reduce pain and improve jaw function by stabilizing the occlusal relationship and redistributing forces across the TMJ [7].In this study, patients using occlusal splints experienced significant improvements in MO and VAS scores over the 12-week and 6-month follow-up periods. This aligns with previous research indicating that occlusal splints are beneficial in the long-term management of TMJ disorders [8]. Interestingly, while the occlusal splint group showed less improvement in MO and VAS scores during the initial 3 and 6 weeks compared to the TENS and EMS group, they demonstrated superior outcomes at 12 weeks and 6 months.This suggests that occlusal splint therapy may have a more gradual, yet sustained effect on TMJ disorder symptoms [9, 10].This delayed but steady improvement highlights that the splint therapy improves the muscle forces, creates occlusal harmony provides mutually protected occlusion, reducing any parafunctional habit by acting as a habit breaker and providing adequate time for the muscle to heal and gain strength [11].ENS and EMS therapies are effective non-invasive treatments for TMJ pain and dysfunction, primarily through pain modulation and muscle stimulation [6, 12]. In this study, the TENS and EMS group showed significant initial reductions in VAS scores and improvements in MO during the first 6 weeks, outperforming the occlusal splint group. These findings are consistent with existing literature, which supports the immediate analgesic effects of TENS and the muscle-strengthening benefits of EMS [9, 13]. However, the observed decline in effectiveness beyond the 6-week mark, culminating in less favourable outcomes at 12 weeks and 6 months compared to occlusal splint therapy, suggests that while TENS and EMS are effective in the short term, their long-term benefits may not be as robust [14]. This might be due to the need for ongoing sessions to maintain therapeutic effects, highlighting a potential limitation in the sustainability of conservative physiotherapy or maybe muscles not responding beyond a specific means [3, 15].There can be another because which can be investigated but within the scope of the study occlusal splint therapy shows better results in long-term than conservative physiotherapy [16, 17]. A similar finding was observed by Madani and Mirmortazavi, who compared TENS with occlusal splints, highlighting both treatments' effectiveness, with variations in short-term and long-term benefits.They found that while TENS provided more immediate pain relief, occlusal splints showed better long-term outcomes in terms of pain reduction and functional improvement [18].The comparative efficacy of conservative physiotherapy and occlusal splint therapy remains an area of interest. Fouda AA in 2020 gives a systematic review emphasized the need for a holistic approach, incorporating both physical and psychological interventions for optimal TMJ disorder management [19]. Similarly, Greene and Obrez questioned the importance of changing the occlusion while managing TMJ disorders [20]. Huttunen *et al.*, underscored the role of a multidisciplinary approach in achieving better outcomes, suggesting that combining different treatment modalities could be more effective in managing complex cases of TMJ disorders. These studies underscore the importance of considering both short-term and long-term outcomes when evaluating treatment efficacy [12]. The current study considers both short-term and considerably long-term outcomes of both treatment modalities with parameters like MO and VAS. Significant improvements in MO and VAS scores were observed over time for both treatment groups. Statistical data analysis indicates that the effectiveness of the treatments varies over time. The initial superiority of TENS and EMS in reducing pain and improving MO is followed by the greater long-term benefits of occlusal splint therapy. This underscores the importance of treatment duration and follow-up in managing TMJ disorders [21]. The treatment can be highly effective if conservative physiotherapy is used as a treatment modality to reduce the VAS score and increase MO in the acute phase while occlusal splint therapy is used for long-term improvement of symptoms. These findings suggest that clinicians should consider the time-dependent effects of these treatments when developing management plans for TMJ disorders. Occlusal splint therapy may be more suitable for patients seeking long-term relief, whereas TENS and EMS could be recommended for immediate pain relief and short-term improvements. Combining these therapies could potentially offer both immediate and sustained benefits, optimizing patient outcomes.

This study is limited by its quasi-experimental design and use of non-probability sampling, which may affect generalizability of results. The follow-up period, although extended to six months, may still be insufficient to evaluate long-term relapse or sustained stability of outcomes. Additionally, reliance on patient compliance (especially in splint wear and home physiotherapy use) may introduce variability in results. Future studies should adopt randomized controlled designs with larger, multi-center samples and longer follow-up durations. Incorporating objective imaging or functional muscle assessment tools alongside clinical parameters would further strengthen evidence and help establish more standardized treatment protocols for TMJ disorders.

CONCLUSIONS

It was concluded that both occlusal splint therapy and conservative physiotherapy (TENS and EMS) are effective

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in managing TMJ disorders, with each treatment demonstrating unique strengths over different periods. Occlusal splint therapy provides significant long-term benefits, while TENS and EMS offer effective short-term relief. These findings can guide clinicians in tailoring treatment plans based on individual patient needs and treatment goals, ultimately improving the quality of care for patients with TMJ disorders.

Authors' Contribution

Conceptualization: MSN, MH[1], SZ, SS
Methodology: MSN, MH[1], MH[2], MS, SZ, SS
Formal analysis: MSN, MH[2], MS, SZ
Writing and Drafting: MSN, MH[1], MH[2], MS, SZ, SS
Review and Editing: MSN, MH[1], MH[2], MS, SZ, SS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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