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Virtual Reality and Pain of Temporomandibular Joint After Cervicofacial Burn: A Randomized Controlled Trial

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Abstract

Objectives: *This single-blind, randomized controlled trial aims to investigate the effect of virtual reality on pain associated with temporomandibular joint (TMJ), maximal mouth opening (MMO), and quality of life in patients with cervicofacial burns.*

Background: *Chronic pain and limitation of TMJ movements may occur following cervicofacial burn, in which chronic TMJ pain is the most common and with virtual reality (VR) which is a new form of cognitive distraction for pain, helps in reducing pain, improving TMJ range of motion (ROM) and patients' quality of life.*

Methods: *Forty-Eight patients aged from 18 to 40 years who were suffering from chronic pain of the TMJ after cervicofacial burn were randomly selected from a specialized burn hospital (Hospital Legitimacy Assembly for Tumors and Burns) in Obour City, Cairo, Egypt. Patients randomly allocated into two groups: VR group (n=24) and Control group (n=24). The VR group was treated by wearing a fully immersive Head-Mounted Display virtual reality, watching a landscape view with application of Maitland mobilization for 15 to 30 seconds for 10 repetitions, 5 times per week for 4 consecutive weeks in addition to regular medical care and ROM home exercises. The Control Group received Maitland mobilization in addition to regular medical care and ROM home exercises. Treatment started 6 months post-burn. MMO was used to assess TMJ ROM, pressure algometry was used to assess TMJ pain, both were evaluated respectively on Day 1, 14, and 28 post-treatments. Quality of life was assessed using The University of Washington Quality of Life Questionnaire (UW-QOL) on Day 1 and 28 post-treatments.*

Results: *Virtual Reality significantly reduced chronic TMJ pain compared to Maitland mobilization ($p<0.05$). Virtual Reality demonstrated superior pain reduction with MMO improvement on day 14 and 28 post-treatments while UW-QOL showed improvement on day 28 post-treatments ($p<0.05$) compared with Maitland mobilization.*

Conclusions: *Virtual Reality can significantly improve chronic TMJ pain, MMO, and UW-QOL with cervicofacial burn patients compared to standard Maitland Mobilization.*

Keywords: *Virtual Reality, Maitland Mobilization, Cervicofacial Burn, Maximal Mouth Opening, Pain, Questionnaire.*

1. INTRODUCTION

Burn injuries are considered and represented as one of the important traumas one can sustain in the human body. Globally, burns cause substantial health problems, and there is a high risk of mortality in developing countries. The World Health Organization (WHO) survey shows that approximately 5500 people die annually from burns and their related consequences (1)

Out of different types of burns, cervicofacial burn (CB) is commonly occurring at home, usually in the kitchen while cooking. Females are affected more than males in this type of burn, with a death rate of 4.9 per 100,000 people (2)

Several consequences such as difficulty in speech and swallowing, reduction of oral aperture, flattening of lips, narrowing of nasal cavity, keloid formation, psychological trauma, fear of pain, and limitation of joint movements may occur following cervicofacial burn, in which temporomandibular joint (TMJ) dysfunction is being the most common in physical therapy perspective Without these interventions, the normal healing process can potentially result in scarring, skin contractures, and limited range of motion (ROM). Thus, participation in such rehabilitation activities is crucial for minimizing long-term disability (3)

Virtual reality (VR) is a new form of cognitive distraction and is an effective adjunctive, analgesic for post-burn physical therapy. The VR gives the individual the illusion of "going into" the 3-dimensional computer-generated environment. The strength of the presence is thought to reflect the amount of attention that is drawn into the virtual world (4)

There are different schools of manual therapy approaches available in the field of physiotherapy. Maitland's joint mobilization technique is one among these schools working with the principle of low and high amplitude passive oscillation techniques of joints and bones. Studies report that these Maitland joint mobilization techniques are commonly used in different joint and muscle problems to restore their normal function. This technique is more user-friendly and has no side effects than other techniques used for TMJ to improve ROM (5)

2. METHODS

Study Design

This study was a randomized, controlled, single-blind trial conducted between January 2024 and January 2025, evaluating the effect of VR on the pain of TMJ after cervicofacial burn.

Ethical Considerations

This trial is reported under the Consolidated Standards Of Reporting Trials (CONSORT) statement (6) (*Supplementary file 1*), This study was conducted by the principles of the Declaration of Helsinki and was approved by the Research Ethical Committee of the Faculty of Physical Therapy, Cairo University (approval number P.T.REC/012/004672).

Patients provided written informed consent after receiving comprehensive study information. Participation was voluntary with unrestricted withdrawal rights. Data confidentiality was ensured through secure storage, restricted access, and anonymized publication of results.

Settings

The study was conducted at a specialized burn hospital (Hospital Legitimacy Assembly for tumors and burns) in Obour City, Cairo, Egypt.

Patients

Patients' recruitment took place at the outpatient clinics of the physiotherapy department for burns via healthcare referrals and direct patient contact. Initial screening assessed eligibility per study criteria. Eligible patients received comprehensive study information with opportunities for clarification.

1. The inclusion criteria were as follows: (1) Patients were adults in the age group between 18 and 40 years old ;(2) Both sexes contributed to the study to allow for gender comparisons; (3) Patients who were suffering from chronic TMJ burn;(4)Patients with second degree deep Partial thickness cervicofacial burn;(5) All Patients with Total Body Surface Area (TBSA) 11-25% involvement., as assessed clinically.
2. Study exclusion criteria encompassed: (1) Dislocation or fracture of TMJ.; (2) Systemic diseases, degenerative, inflammatory or infective TMJ arthritis; (3) Intraoral signs of masticatory dysfunction; (4) Facial asymmetry; (5) Retrognathism; (6) Prognathism;(7) History of severe motion sickness; and (8) Mental health problems.

Sample Size Calculation

Forty-eight patients were included in this study. The number of study patients was determined. Based on data on pain during physical therapy derived from (6), who found a significant effect of VR on pain reduction in adult burn patients during physical therapy, the number of subjects required for this study was 24 subjects

for each group. G*POWER statistical (G*power version 3.1) was used to calculate the sample size with a power of 80%, α-level of 0.05, and effect size of 0.83.was added to the number obtained.

Randomization & Blinding

A randomized, single-blind study design was used to ensure unbiased treatment allocation. Eligible patients were randomly assigned to two groups: (1) VR Group (10 F &14 M) and (2) control group (13F &11M), using a computer-generated randomization sequence with a 1:1 allocation ratio. The randomization sequence was generated by an independent statistician using a permuted block randomization method with a block size of six.

Allocation concealment was maintained using sealed, opaque, sequentially numbered envelopes, opened only after patients completed baseline assessments and provided informed consent. Due to the nature of the interventions, blinding of patients and treating clinicians was not feasible. However, outcome assessors were blinded to the patients' group allocations.

To maintain blinding, all study-related documents were labeled with unique participant identification numbers rather than group assignments. The study coordinator kept a separate, confidential log linking the identification numbers to the group assignments, which was not accessible to the outcome assessors.

Outcome measures

- ***Maximal Mouth Opening for TMJ ROM assessment:***

Maximal mouth opening capacity (MOC) was defined as the maximal interincisal distance on unassisted active mouth opening. A metallic ruler with a millimeter scale was passively placed between the edges of the upper and lower central incisors. The measurement was read and recorded to the nearest millimeter. If the central incisors were missing or the patient was not cooperative, no measurement was performed. In case of erupting central incisors, the pair with the smaller interincisal distance was chosen (7)

This was an ideal method of measuring mouth opening, in which the patient was asked to sit relaxed and instructed to open the mouth as much as possible. Measure the maximum mouth opening (interincisal distance) with the help of a 10 cm metal scale. It was considered a valid and reliable method of measuring temporomandibular joint range of motion (8). It was measured on day 1, day 14, and day 28 post-treatment.

- ***Pressure Algometry for pain assessment***:

Pressure pain threshold (PPT) was defined as the minimal amount of pressure that produces pain. A simple handheld pressure algometry (PA) with a spring was commonly used, although more sophisticated electrical devices with a strain or pneumatic pressure gauge had been developed. They hold the peak force or pressure (kp (kilopond) = 10 N, or Newton = 100 kPa (kilopascal)) until they are taxed, and some may also be connected to a computer, allowing for continuous output. PPT was measured with a probe 1.6 mm in diameter or larger reflects the tenderness of deep tissues, as anesthesia of skin only affects the results of smaller probes (9)

The most used surface area of probes is 0.5 or 1 cm2. The PA is placed perpendicular to the tissue surface, and pressure is applied steadily at a constant rate. Reported pressure application rates had ranged from 0.05 to 20 N/s. Higher PPT scores were recorded at higher application rates. Ideally, compression should be performed slowly enough to allow the subject time to react when pain is felt. When the subject reports feeling pain, the action of pressure is stopped, or to avoid delay by the tester, by pressing a switch on an electronic PA (10)

Pressure Pain Threshold was measured on day 1, day 14 and day 28 post-treatment for right and left TMJ three times each side and the median value of these measurements was utilized.

- ***The University of Washington Quality of Life Questionnaire (UW-QOL):***

The University of Washington Head and Neck Quality of Life (UW-QOL) was a well-validated QOL instrument. Domain score was determined by offering participating patients a set of options (Likert scale) for each domain. The maximum (best) score was 100, the minimum was 0. As an example, the domain pain offers the following options: 100, I have no pain; 75, there is mild pain not requiring medication; 50, I have moderate pain that requires regular medication (codeine or nonnarcotic); 25, I have severe pain controlled

only by narcotics; and 0, I have severe pain not controlled by antibiotics (11).There was an Arabic version of the UW-QOL questionnaire (12).

The UW-QOL questionnaire was assessed on day 1 and day 28 post-treatment for quality-of-life assessment.

Procedures

Steps of The Virtual Reality (VR) headset and Maitland Mobilization for TMJ treatment procedures (Group A) (13):

Application:

- Patients were treated as outpatients; they were given information about the measurement and treatment procedures, as well as about the virtual reality (VR) headset and Maitland mobilization before the beginning of the treatment. Each patient's history sheet was taken, and they were asked to follow the physician's and physical therapist's instructions.
- The position of the Patient applied was the most comfortable and relaxed position, which is a high supine lying position.
- Patients wore his/her virtual reality (VR) headsets to see a landscape view for distraction pain and the therapist applied Maitland mobilization as in the first phase of three sessions (each session 10 repetitions) of distraction, anterior, medial, and lateral glide mobilization at grades I and II were applied to TM joint. In the second phase, grade III and grade IV mobilization were given consecutively for 5 sessions per week with 10 repetitions each session for a total of 4 consecutive weeks.
- **Maitland mobilization procedure**:

- Distraction: The therapist fixed the Patient's forehead with one hand and applied the distraction force through the same side lower molars with the 1st finger, while the 2nd and 3rd fingers of the other hand provided the counterforce on the inferior aspect of the mandible.
- Anterior glide: The Therapist fixed the Patient's forehead with one hand and applied the anterior force through the same side lower molars with the 1st finger, while the 2nd and 3rd fingers of the other hand provided the counterforce on the inferior aspect of the mandible.
- Medial/lateral glide: The Therapist fixed the Patient's contralateral mandible with one hand and applied the medial/lateral glide force with the other hand through the mandibular condyle of the ipsilateral side.

- Active home exercises were given for protrusion, extrusion, and lateral deviation for 15 _30s for 10 repetitions, 5 days a week for 4 weeks as follows:

o Protrusion (forward movement):
- Starting position**:** Sit or stand upright with your teeth slightly apart.
- Movement: Slowly slide your lower jaw forward so that your bottom teeth move in front of your upper teeth.
- Hold: 15–30 seconds.
- Return: Bring the jaw back to the starting position.
- Reptations: 10 times, 2–3 sets per day, 5 days a week for 4 weeks.

o Extrusion (backward movement):
- Starting position: Sit or stand upright with your teeth slightly apart.
- Movement: Gently pull your lower jaw backward as if making an overbite (upper teeth move slightly ahead of the lower teeth).
- Hold: 10–15 seconds.
- Return: Relax to the neutral position.
- Reptations: 10 times, 2–3 sets per day, 5 days a week for 4 weeks.

o Lateral deviation (side-to-side movement):
- Starting position: Relax your jaw, teeth slightly apart.
- Movement: Move your lower jaw as far as comfortable to the right, keeping your head still.
- Hold: 10–15 seconds.

- Return: Back to the center, then move to the left.
- Reps: 10 times, 2–3 sets per day, 5 days a week for 4 weeks.
- Sessions continued for 5 days a week for 4 weeks while receiving regular medical care.

In The Control group:

- Patients received Maitland mobilization same as in the study group, and they were asked to do a certain set of active home exercises, which were also being given for protrusion, extrusion, and lateral deviation for 15 _30 seconds for 10 repetitions, 5 days a week for 4 weeks.
- These exercises were done 3 times a day, 5 days per week 8 _10 repetitions each time, for 4 weeks.
- Patients also received regular medical care, the same as the study group.

Monitoring of adverse events and patient comfort

A standardized protocol monitored intervention-related adverse events. Patients reported discomfort, pain, or unusual symptoms directly to therapists or coordinators. Documentation included event severity, duration, and interventions taken. Therapists monitored patient feedback, adjusting treatment sessions or providing rest periods as needed to maintain comfort.

Statistical analysis

The characteristics of the subjects were compared between groups using an unpaired t-test. Chi squared test was conducted for comparison of sex distribution between groups. The Shapiro-Wilk test was employed to check for normal distribution of the data. Levene's test assessed the homogeneity of variances between the groups. Mixed MANOVA was conducted to investigate the effect of treatment on MMO and PPT. Mixed ANOVA was conducted to investigate the effect of treatment on UW-QOL. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. There was no missed data. All statistical tests were considered significant at $p < 0.05$. The statistical analyses were carried out using SPSS version 25 for Windows (IBM SPSS, Chicago, IL, USA) (14).

3. RESULTS

Subject characteristics

Forty-eight patients with second-degree cervicofacial burn injuries participated in this study. The characteristics of the patients in both groups are displayed in **Table (1).** There were no significant differences between the groups regarding age and sex distribution ($p > 0.05$).

For Mean MMO, the VR group showed an improvement of approximately 59.13%, while the Control group improved by about 27.69%. Regarding Mean UW-QOL, the VR group experienced an improvement of roughly 28.38%, compared to the Control group's improvement of approximately 11.53%. In terms of Mean PPT on the right side, the VR group demonstrated a significant improvement of about 78.89%, whereas the Control group improved by approximately 36.75%. Finally, for Mean PPT on the left side, the VR group had an improvement of around 83.33%, and the Control group showed an improvement of about 40.63%.

Table 1. Basic characteristics of patients

	VR group	Control group			
	mean ±SD	**mean ±SD**	**MD**	**t-value**	**p-value**
Age (years)	31.63 ± 7.03	29.50 ± 6.55	2.13	1.08	0.28
Sex, N (%)					
Females	10 (42%)	13 (54%)	($\chi^2 = 0.75$)		0.39
Males	14 (58%)	11 (46%)			

SD, standard deviation, MD; mean difference, χ^2, chi squared value p-value, Probability value

Effect of treatment on Maximal Mouth Opening and Pressure Pain Threshold:

Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F = 46.37$, $p = 0.001$, partial eta squared = 0.87). There was a significant main effect of time ($F = 345.05$, $p = 0.001$, partial

eta squared = 0.98). There was a significant main effect of treatment (F = 23.18, p = 0.001, partial eta squared = 0.61).

There was a significant increase in MMO and PPT of right and left sides in both groups on day 14 and day 28 compared with day 1 ($p < 0.001$) and a significant increase on day 28 compared with day 14 ($p < 0.001$). There was no significant difference between groups in pretreatment ($p > 0.05$). There was a significant increase in MMO and PPT of the right and left sides of the VR group compared with that of the control group on days 14 and 28 post-treatment ($p < 0.001$). **(Table 2).**

Effect of treatment on University of Washington Quality of Life Questionnaire:

Mixed ANOVA revealed that there was a significant interaction of treatment and time (F = 20.58, p = 0.001, partial eta squared = 0.31). There was a significant main effect of time (F = 108.18, p = 0.001, partial eta squared = 0.70). There was a significant main effect of treatment (F = 13.95, p = 0.001, partial eta squared = 0.23).

There was a significant increase in UW-QOL in both groups on day 28 compared with day 1 ($p < 0.001$). **(Table 3).**

There was a significant increase in UW-QOL of the VR group compared with that of the control group on day 28 post-treatment (MD = 13.26, d = 1.64, $p < 0.001$).

Table 2. ***Mean Maximal Mouth Opening and Pressure Pain Threshold on day 1, 14, and 28 post-treatments of the VR and control groups:***

	VR group	Control group				
	mean ± SD	**mean ± SD**	**MD**	**95% CI**	**p-value**	**D**
MMO (mm)						
Day 1	26.21 ± 1.56	26.79 ± 1.67	-0.58	-1.52: 0.35	0.22	
Day 14	33.96 ± 3.26 [a]	31.08 ± 2.26 [a]	2.88	1.24: 4.51	0.001	1.03
Day 28	41.71 ± 3.2 [a, b]	34.21 ± 2.45 [a, b]	7.50	5.84: 9.16	0.001	2.63
	p = 0.001	***p = 0.001***				
PPT on the right side (kg/cm²)						
Day 1	1.80 ± 0.35	1.66 ± 0.27	0.14	-0.04: 0.32	0.13	
Day 14	2.48 ± 0.39 [a]	1.95 ± 0.31[a]	0.53	0.32: 0.73	0.001	1.51
Day 28	3.22 ± 0.47 [a, b]	2.27 ± 0.36 [a, b]	0.95	0.71: 1.19	0.001	2.26
	p = 0.001	***p = 0.001***				
PPT on the left side (kg/cm²)						
Day 1	1.68 ± 0.34	1.60 ± 0.30	0.08	-0.11: 0.26	0.43	
Day 14	2.40 ± 0.36 [a]	1.93 ± 0.31 [a]	0.47	0.28: 0.66	0.001	1.38
Day 28	3.08 ± 0.40 [a, b]	2.25 ± 0.32 [a, b]	0.83	0.63: 1.05	0.001	2.31
	p = 0.001	***p = 0.001***				

SD: standard deviation, MD: mean difference, d: Cohen's effect size, p-value P: Probability value, [a] significant difference with day 1, [b:] significant difference with day 14.

Table 3. ***Mean University of Washington Quality of Life Questionnaire: on day 1 and 28 post-treatment of the VR and control groups:***

UW-QOL	**VR group**	**Control group**				
	Mean ±SD	**Mean ±SD**	**MD**	**95% CI**	**p-value**	**d**
Day 1	64.34 ± 8.45	62.17 ± 8.63	2.17	-2.80: 7.14	0.38	
Day 28	82.60 ± 7.30	69.34 ± 8.79	13.26	8.57: 17.96	0.001	1.64
MD	-18.26	-7.17				

95% CI	-21.74: -14.78	-10.65: -3.69
	p = 0.001	***p = 0.001***

SD: standard deviation, MD: mean difference, d: Cohen's effect size, p-value, Probability value,

4. DISCUSSION

This single-blind randomized controlled trial (RCT) investigated whether integrating Virtual Reality (VR) into standard Maitland mobilization provides additional therapeutic benefits for burn survivors experiencing temporomandibular joint (TMJ) pain.

The findings revealed that both the control group and the VR group achieved significant improvements in pain levels, maximal mouth opening (MMO), and quality of life (QoL) after 14 and 28 days of intervention. However, patients who received VR demonstrated significantly greater pain reduction and MMO improvement, particularly between days 14 and 28, indicating that VR has a sustained and augmentative effect beyond conventional therapy.

The results align with the growing body of literature supporting VR as an effective adjunctive therapy for pain management. **Li et al. (15)** emphasized that pain control in chronic care often depends on pharmacological interventions, but VR offers a non-pharmacological alternative that delivers analgesia with minimal side effects. This is particularly relevant in burn rehabilitation, where drug side effects, tolerance, and the need for prolonged therapy are significant concerns.

Rischer et al. (16) described VR's ability to leverage attentional distraction and induce relaxation, thereby reducing anxiety, which is often elevated in burn survivors. Anxiety and stress can exacerbate TMJ discomfort through increased muscle tension, and VR's capacity to modulate these psychological factors may explain the additional improvements in MMO observed in our study. Furthermore, immersive VR can facilitate engagement in therapeutic exercises, such as jaw range-of-motion activities, making them more enjoyable and potentially enhancing compliance and functional outcomes.

Our findings are consistent with those of **Rousseaux et al. (17),** who reported that VR can augment traditional pain management strategies, including pharmacological interventions, by lowering both pain intensity and anxiety. The versatility of VR applications extends beyond distraction; it encompasses cognitive-behavioral therapy, mindfulness training, and graded exercise programs, all of which can contribute to functional and psychological recovery in burn survivors. **Goudman et al. (18),** in a systematic review, concluded that immersive VR is more effective in generating analgesia compared to non-immersive two-dimensional VR systems. With decreasing costs of immersive VR equipment, such interventions may soon become feasible for widespread clinical and even home-based applications.

Cerritelli et al. (19) suggested that combining manual therapy with VR constitutes a holistic mind-body approach, targeting sensorimotor integration and distorted body image perception—issues that frequently affect burn patients with TMJ dysfunction. By incorporating psychological, interoceptive, and exteroceptive stimulation, VR may enhance the overall therapeutic experience and outcomes.

Despite substantial supportive evidence, some studies have reported less pronounced effects. **Ahern et al. (20)** found no statistically significant improvements in functional capacity and mobility with VR alone, although they acknowledged that VR may provide added value when integrated with other rehabilitation strategies**. Soltani et al. (21)** also reported that, in some trials, VR-based rehabilitation did not significantly outperform standard interventions in improving joint ROM, indicating variability in effectiveness. Additionally, **Georgescu et al. (22)** observed that while VR is generally effective in managing burn-related pain, many systematic reviews fail to provide detailed guidance on its optimal application for specific rehabilitation goals, such as TMJ dysfunction.

Furthermore, the effectiveness of VR is influenced by the quality of immersion, patient engagement, and individualized factors. **Tao et al. (23)** highlighted limitations, including discomfort or contraindications associated with VR headset use in patients with extensive facial burns, skin sensitivity, or limited cervical mobility. Individual susceptibility to cybersickness—manifesting as nausea, dizziness, or disorientation—may

further limit VR's applicability. Nevertheless, **Lan et al. (24)** and **Eijlers et al. (25)** reported that these adverse effects are generally rare and mild, with most studies failing to establish a direct causal link between VR and side effects, as opioids and other analgesics may also contribute. **Parry et al. (26)** and subsequent reports found no evidence of VR-induced eye strain, headaches, or mental fatigue, reinforcing its overall safety.

The findings from this trial support the use of VR as an effective adjunct to manual therapy in the management of TMJ pain among burn survivors. By addressing both physiological and psychological contributors to pain, VR may offer a multidimensional therapeutic approach that enhances treatment adherence and patient satisfaction. As VR technology becomes more affordable and accessible, it has the potential to serve as a valuable self-management tool in outpatient and home rehabilitation settings, empowering patients to take an active role in their recovery.

This study has several limitations that warrant consideration. The short follow-up period precludes conclusions regarding the long-term sustainability of VR's benefits. The study also did not stratify results based on burn severity, headset comfort, or prior VR experience, all of which may moderate treatment response. Furthermore, the intervention relied on a single VR protocol, leaving unanswered questions about the relative efficacy of different VR environments, levels of immersion, and session frequencies. Future research should aim to determine the most effective VR protocols, explore predictors of treatment responsiveness, and assess cost-effectiveness for broader clinical implementation.

In conclusion, this RCT adds to the growing evidence supporting VR as an adjunctive therapy in burn rehabilitation for TMJ dysfunction. Virtual Reality significantly improves pain relief, MMO, and QoL compared to manual therapy alone. While the findings corroborate existing literature on VR's analgesic and functional benefits, conflicting evidence underscores the need for further investigation into patient-specific factors, optimal VR design, and long-term outcomes. Nevertheless, the integration of VR into TMJ rehabilitation represents a promising step toward comprehensive, patient-centered care that addresses both the physical and psychological dimensions of pain management.

Strengths and limitations

Study strengths include randomized controlled design, parallel-group allocation, objective/subjective outcome measures, and rigorous methodology, enhancing internal validity. Limitations comprise small sample size, brief follow-up, potential confounders, single-blinding bias, and lack of cost-effectiveness analysis or implant system variability assessment.

Future Directions

Future research priorities include conducting multi-center trials with larger sample sizes, extended follow-up to assess long-term outcomes, and investigations into the neurophysiological effects of VR to understand its influence on the brain's pain control system. Additional studies should evaluate the impact of patient-specific factors such as TMJ dysfunction and systemic conditions on therapeutic efficacy, explore different VR modalities and content (including active vs. passive VR, customized VR, and home-based programs), compare VR with other adjuvant therapies like biofeedback, acupuncture, and manual techniques, and assess the cost-effectiveness of VR interventions compared to standard care.

5. CONCLUSION

This randomized controlled single-blinded study demonstrated that virtual reality can significantly improve maximal mouth opening, pain management, and quality of life in patients with temporomandibular joint chronic pain after cervicofacial burns compared to standard treatment. The study's findings suggest that integrating these interventions into post-burn protocols can enhance treatment outcomes and patient satisfaction.

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