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## Therapeutic effect of TENS on post-IMF Trismus and pain

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### Summary

The study set out to investigate the therapeutic effect of Transcutaneous Electrical Nerve Stimulation (TENS) in the alleviation of pain and post-IMF trismus, in patients undergoing jaw exercises to hasten mouth opening after being treated for fractures of the mandible. Two groups of patients, with 10 patients in each group, were used for the study. The groups were the experimental and the control groups. They were all treated for mandibular fractures, and had their jaws immobilized for 6 weeks, immediately after which they were started on jaw exercises. The Inter-incisal distances and number of acceptable wooden spatulae that the jaws could accommodate were noted and recorded. The experimental group was then placed on the TENS therapy for 20 minutes, after which the new inter-incisal distances and the number of acceptable wooden spatulae were recorded. The control group had no TENS therapy; the patients only waited for 20 minutes without any stimulation, before the new inter-incisal distances and the number of acceptable wooden spatulae were measured and recorded. It was observed that the inter-incisal distance and the number of acceptable wooden spatulae significantly increased in patients in the experimental group compared to the control group. It was concluded that TENS could be useful in relieving the pain associated with forced mouth-opening exercises aimed at overcoming trismus caused by muscle spasm, which is associated with prolonged immobilization of the jaws for the treatment of facial fractures.

**Keywords:** *Therapeutic, TENS, mandible, post-IMF, trismus*

### Resume

Cette étude investiguait l'effet thérapeutique de la stimulation électrique du nerf transmusculaire (SENT) pour l'allévation des douleurs et post-IMF trismus, aux patients suivant l'exercice des muscles des joues pour précipiter l'ouverture de la bouche après avoir traité les fractures mandibulaire. Deux groupes de 10 patients étaient recrutés et sub-divisé en groupe expérimentale et un groupe de contrôle. Ils étaient tous traités pour des fractures mandibulaire et avaient leurs joues immobilisées pour 6 semaines. Immédiatement après lequel ils commençaient l'exercice des muscles des joues. Les distances inter-incisales et le nombre de spatule en bois acceptable que les joues pouvaient accommoder étaient déterminés en enregistrés. Le groupe expérimental était ensuite placé à la stimulation électrique pour 20 minutes, suivit de l'enregistrement des nouvelles distances inter-incisales et le nombre de spatule. Le groupe de contrôle qui ne subit aucune stimulation électrique et étaient tous observés pour 20 minutes et les distances inter-incisales et le nombre de spatule mesurés et enregistrés. Il était observé que la distance inter-incisale et le nombre de spatule en bois augmentaient significativement aux patients ayant suivi la stimulation électrique

comparé au groupe de contrôle. Il était donc conclu que le SENT pourrait être utilisé pour améliorer le spasme des muscles associés avec l'immobilisation prolongée des joues pour le traitement des fractures faciale.

### Introduction

The management of facial bone fractures constitutes a significant portion of the workload of the Oral and Maxillofacial surgeon. The mandible has been reported as the most frequently involved part of facial skeleton in fractures [1,2,3]. The high vulnerability of the mandible to traumatic fractures has been ascribed to its prominence on the face, as well as its fragility as a result of the presence of many areas of natural weakness on it. These include the symphysis, the canine region, the angles, areas of impacted teeth and the neck of the condyle [4].

The general principles of treatment of these maxillofacial fractures include: "first aid," to keep the patient alive, "reduction" of the fracture, fixation, immobilization of the jaws and restoration of function [4,5].

"Reduction" involves the replacement of the fractured fragments into their correct anatomic relationship; it could be "open" or "closed". Fixation refers to methods used to maintain the fracture in the reduced anatomic position. "Immobilization" involves tying up the mandible and maxilla to prevent movement of the temporomandibular joint and hence movements across the fracture line, so as to allow the fracture to heal. The immobilization of jaw fractures is usually for a period of 6 weeks. This period may be shortened for fit young patients, or prolonged when the process is complicated by factors such as delay in initiating treatment or infection. [5]

Fixing the teeth of the lower jaw in normal centric occlusion against the upper dentition is usually used in treating a fractured mandible. This fixation of the jaws is referred to as Intermaxillary Fixation (IMF); and methods for achieving it include eyelet wiring, dental splint, arch bars and gunning splints.

The final stage in the general principle of treatment of maxillofacial fractures is "restoration of function," which includes measures such as physiotherapy, to exercise muscle, and prostheses, to treat loss of teeth. The prolonged immobilization of the jaws frequently leads to muscle spasm, thereby resulting in trismus when the IMF is eventually removed. The dental surgeon is thereby faced with the task of helping the patient to regain his or her normal degree of mouth opening.

The methods usually adopted to improve the degree of mouth opening involve jaw exercises. These are often accomplished with the use of wooden spatulae, Fergusson's mouth-gag and conical wooden screw. The exercises often cause severe pain in some patients, thereby prolonging the period of trismus.

Electrical stimulation in form of Transcutaneous Electrical Nerve Stimulation (TENS) is frequently used by Physical Therapists as an adjunct pain management technique. Several studies have been carried out to investigate the efficacy of TENS in pain modulation. Results from such studies have demonstrated various levels of success in the use of TENS [6,7,8]. Clinicians

**Table 1:** Records on experimental study group

Pre-TENS inter-incisal distance (cm) $X_1$	Post-TENS inter-incisal distance (cm) $X_2$	Increase in inter-incisal distance (cm) $X_2 - X_1$	Pre-TENS No. of wooden spatulae $N_1$	Post-TENS No. of wooden spatulae $N_2$	Increase in No. of wooden spatulae $N_2 - N_1$
1.3	1.8	0.5	10	14	4
1.5	1.9	0.4	10	13	3
1.5	2.0	0.5	10	14	4
1.5	2.1	0.6	9	14	5
2.6	3.1	0.5	14	18	4
1.3	1.7	0.4	6	10	4
3.8	4.3	0.5	12	16	4
3.0	3.7	0.7	13	18	5
3.2	3.4	0.2	14	16	2
2.6	3.0	0.4	14	16	2
Sum	22.3	27	112	149	37
Mean	2.23	2.7	11.2	14.9	3.7
SD	0.92	0.92	2.66	2.42	1.06

*S.D. is Standard Deviation*

**Table 2:** Records on control group

Initial inter-incisal distance (cm) $C_1$	Inter-incisal distance (cm) after 20 mins $C_2$	Increase in inter-incisal distance (cm) $C_2 - C_1$	Initial No. of wooden spatulae $W_1$	No. of wooden spatulae after 20 mins $W_2$	Increase in No. of wooden spatulae $W_2 - W_1$
2.7	2.8	0.10	13	14	1
3.2	3.2	0.00	15	15	0
1.5	1.5	0.00	8	8	0
1.7	1.8	0.10	10	11	1
2.5	2.5	0.00	12	12	0
1.8	1.8	0.00	9	9	0
1.4	1.4	0.00	7	7	0
1.4	1.5	0.10	8	9	1
1.6	1.6	0.00	10	10	0
1.9	1.9	0.00	11	11	0
Sum	19.7	20	103	106	3
Mean	1.97	2.0	10.3	10.6	0.3
S.D.	0.62	0.62	2.50	2.55	0.48

*S.D. is Standard Deviation.*

have therefore been using this technique to modulate pain on the back, during childbirth and in dental procedures.

This study therefore, set out to investigate the therapeutic effect of TENS in the alleviation of pain and post-IMF trismus in patients undergoing jaw exercises to hasten post IMF mouth-opening; after being treated for fractures of the mandible at the Maxillofacial Unit of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria.

#### Patients and methods

The study consisted of two groups of patients, with 10 in each group. The groups were the experimental and the control groups. The experimental group comprised 6 males and 4 females with ages ranging from 25 – 52 years. The control group also consisted

of 10 patients (9 males and 1 females with ages ranging from 22 – 60 years). All patients were involved in road traffic accidents (RTAs) and had fractures of mandible, which were unilateral in all cases and could be classified as being simple. The severity of the fractures could be adjudged as being similar. The patients were randomly selected into the groups and their consent sought before the study.

All the patients were treated at the Maxillofacial Unit, OAUTHC Ile-Ife. The principles of treatment had included: "reduction" of the fracture, fixation and immobilization of the jaws and restoration of function. The jaws were immobilized for 6 weeks, and as a result of the ensuing trismus, jaw exercises with wooden spatulae were started immediately after IMFs were removed. The wooden spatulae were of uniform thickness.

The spatulae were placed between the occlusal surfaces of the molars on the side of the jaw away from the healing fracture. The spatulae were gradually admitted until the patient could no longer admit any more spatulae because of pain. The spatulae were then counted, and the number recorded ( $N_1$  and  $C1$  for the experimental and the control groups respectively). The range of mouth-opening (inter-incisal distance in centimeters) was determined by measuring the distance between the edges of intact maxillary and mandibular incisors using a pair of dividers which was then measured out on a ruler, and recorded as ( $X_1$  and  $W1$  for the experimental and control groups respectively). The spatulae were removed, and the patients in the experimental group were subjected to the TENS therapy using the TENS machine.

For the TENS therapy, the skin on the masseter muscle of the patient, usually on the fracture side was properly cleansed with methylated spirit and dried. Conducting gel was spread on the surfaces of the two electrodes (Round size 3cm). The positive electrode was placed on the painful masseter whilst the negative electrode was placed on the zygomatic prominence, which acted as the reference. Pulse width of 100 microseconds and pulse rate of 50Hz was used for the patients. The amplitude of TENS was raised according to the tolerance level of each subject (but with no visible muscle contraction). Each treatment lasted for 20 minutes.

Immediately after the TENS therapy, the jaw exercise with wooden spatulae, was repeated. The maximum number of wooden spatulae that the patient could tolerate was noted ( $N_2$ ), and the new inter-incisal distance ( $X_2$ ) was measured. Table 1 shows the data for the experimental group.

Patients in the control group were then allowed to rest for 20 minutes without any stimulation. The jaw exercise was then repeated. The number of wooden spatulae ( $C_2$ ) that the mouth could tolerate and the inter-incisal distance ( $W_2$ ) were noted and recorded (Table 2) the data obtained were then analyzed.

## Results

From the experimental group, the mean Pre-TENS inter-incisal distance ( $mX_1$ ) was  $2.23 \pm 0.92$ cm. The mean Post-TENS inter-incisal distance ( $mX_2$ ) increased to  $2.7 \pm 0.92$ cm.

The mean Pre-TENS number of wooden spatulae ( $mN_1$ ) was  $11.2 \pm 2.66$ , while the means Post-TENS number of wooden spatulae was  $14.9 \pm 2.42$  (Table 1).

For the control group, the mean initial inter-incisal distance ( $mC_1$ ) was  $1.97 \pm 0.61$ cm. After 20 minutes the new mean inter-incisal distance ( $mC_2$ ) was  $2.0 \pm 0.62$ cm. The mean initial number of wooden spatulae ( $mW_1$ ) was  $10.3 \pm 2.49$ . After 20 minutes, the new mean number of wooden spatulae ( $mW_2$ ) was  $10.6 \pm 2.55$  (Table 2).

A test on the equality of variance of proportional growth for the experimental group and the control group was carried out. The appropriate statistics was the Variance ratio (F) statistics. The difference in inter-incisal distance was statistically significant ( $F = 7.66$ ,  $P < 0.05$ ). The difference in the number of wooden spatulae, from Tables 2 and 1 was also significant ( $F = 4.81$ ,  $P < 0.05$ ). These findings imply that the application of TENS induced statistically significant increases in both the inter-incisal distance and the number of wooden spatulae compared to the control group in which TENS was not applied. This is not surprising, as 7 of the proportional increases for inter-incisal distance and the number of wooden spatulae are zero for the control group, while there is more spread for the experimental group.

## Discussion

This study reveals that TENS is effective in relieving the pain associated with forced mouth opening in trismus following prolonged intermaxillary fixation of the jaws in the management of fractured mandibles. Restoring a normal degree of mouth opening for the patient following the removal of IMF could be a herculean task for both the dental surgeon and the patient, as a result of the ensuing pain.

Using the TENS machine, the TENS therapy or stimulation was performed for 20 minutes on the skin on the masseter muscle of the patients usually on the fracture side. All the patients involved in the present study benefited from the TENS therapy. They all had an improvement in the degree of mouth-opening after TENS therapy; indeed, there was an average of 0.47cm increase in the inter-incisal distance in the experimental patients (Table 1) while the average increase was only 0.03cm in the control group (Table 2) The variance was statistically significant ( $F = 7.66$ ).

Also for the experimental group, the average increase in the number of acceptable wooden spatulae after the TENS therapy was 3.7 spatulae (Table 1). Whereas for the control group, the increase was 0.3 spatula (Table 2). The variance was also statistically significant ( $F = 4.81$ ).

This result supports the finding of Gunn [9] who achieved good pain relief secondary to acute lumbosacral sprain in 86% of his patients after TENS therapy. The present study also supports the finding of Strassburg *et al.* [10] that 29 of their 30 patients underwent tooth extraction without additional anesthesia when TENS was applied over the trigeminal nerve at its exit through the mandible.

The mechanism by which TENS reduces pain in humans has not been fully established [7]. However, possible explanation of how TENS relieves pain can be attributed to its inhibitory effect on gelatinosa interneuron by closing the gate to the transmission of nociceptive information [11]. Belanger [7] postulated that TENS analgesic effect was partially modulated by the endogenous opiate - related pain modulating system in the brain.

This study therefore shows that TENS therapy could be very useful in relieving the pain associated with a forced mouth-opening aimed at overcoming trismus caused by muscle spasm which was associated with a prolonged IMF of the jaws in the management of fractured mandible. TENS relieved the pain on the masticatory muscle, thereby allowing for an increase in the degree of mouth opening.

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