Effect of Therabite Exercises on Microstomia after Facial Burn

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Abstract

Aim of Work: To investigate the effect of therabite exercises on microstomia after facial burn.

Subjects and Methods: Thirty patients were randomly divided into two equal groups; study group (GA) and control group. Control group (GB) treated by conventional therapy (gentle stretch by tongue depressor, active free and active resisted mouth exercises) and GA treated by same program of treatment as GB in addition to therabite exercise. Duration of treatment was a 10-week structured exercise program with exercise 5 times per day. Maximal interincisal opening and mandible function were assessed before the treatment, after 4 weeks (post 1) and after 10 weeks (post 2) by therabite range of motion scale, and Mandibular Function Impairement Questionnaire (MFIQ) respectively.

Results: Comparison of each variable pre and post-treatment in each group revealed a significant improvement in all different parameters in both groups: \( p < 0.01 \); however comparison between post results revealed that the GA showed a significant improvement higher than the GB in all different variables.

Conclusion: Therabite was beneficial therapeutic modality in the treatment of patients with microstomia after facial burn in expression of increment of maximal interincisal opening and improving mandible function.

Key Words: Facial burn – Microstomia – Therabite – Therabite scale – Mandibular Function Impairement Questionnaire (MFIQ).

Introduction

A BURN is a type of injury to flesh or skin caused by heat, electricity, chemicals, friction, or radiation [1]. The World Health Organization (WHO) estimates indicate that globally there were more than 7.1 million fire-related unintentional burns (X01-X09) in 2004 giving an overall incidence rate of 110 per 100,000 per year. The incidence in the East Mediterranean Region (EMR) was 187 per 100,000 per year compared to the lowest incidence in the Americas which was 19 and the highest incidence in South East Asia which was 243 per 100,000 per year. The WHO estimates that 310,000 people died in fires in 2004 across the world, the great majority being in low-income and middle-income countries with a global mortality rate amounting to 4.8 per 100,000 per year according to these WHO data, 29,000 deaths occurred in the EMR with a mortality rate of 5.6 deaths per 100,000. Burn injuries are one of the leading causes of morbidity and mortality in the middle east [2] representing 5-12% of all traumas [3].

Major burn injury is followed by an enormous inflammatory response. The burn wound contains a variety of cell types including platelets, neutrophils, lymphocytes, macrophages and fibroblasts, whose activity is regulated by a complex interplay of multiple cytokines as well as host neuroendocrine mechanisms. The principal molecular regulators controlling volution of the burn wound include Vascular Endothelial Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF) and Transforming Growth Factor-ß (TGF-ß). Major burn injury induces an inflammatory response, which is accompanied by the release of various cytokines. During this response, pro-inflammatory cytokines such as interleukin (IL)-1, IL-6, IL-8, tumor necrosis factor (TNF)-ct, or interferon (IFN)-y, and anti-inflammatory cytokines such as IL-4, IL-10, and Granulocyte-Colony Stimulating Factor (G-CSF) are released. Uncontrolled release of pro- and anti-inflammatory cytokines promotes immunological dysfunction that results in significant morbidity [4].

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Systemic response to a burn is associated with those affecting 30% or more of the total body surface area (TBSA) as a result of inflammatory mediator release into the circulation, metabolic, or immunological can be affected. Tissue and end-organ hypoperfusion is a consequence of hypovolaemia that results from fluid loss and splanchnic and peripheral vasoconstriction. Decreased cardiac contractility and increased capillary permeability, leading to extravasation of protein and fluid into the interstitial space, also contribute to hypotension. Respiratory effects include bronchoconstriction due to inflammatory mediators and may result in respiratory distress syndrome [5,6]. One of the problems resulting from facial burns is microstomia due to scarring and scar contraction in the oral commissure. The sphincter-like nature of the orbicularis oris muscle, and the absence of supporting skeletal structures to limit its contracting properties, increases the effects of scar contracture at the commissure [7]. Microstomia is a chronic reduction in the dimensions of the oral aperture and although it is not classified by any particular size criteria, it is defined by its effects on function or appearance [8]. Trismus, restricted mouth opening, is defined as a mouth opening of 35 mm or less [9,10]. Patients with microstomia and perioral scarring may suffer from a range of functional and aesthetic limitations. Impaired oral hygiene can result in severe tooth decay, halitosis and infections, which are difficult to treat due to limited access [7,11]. The therabite was used for jaw mobilisation. The device is constructed with a mandibular mouth piece that moves downwards in an anatomically correct track when the handle is squeezed. Broad mouthpieces with foam cushions spread the forces to protect the teeth. A precision-adjustment screw enables slow opening and permits precise setting. A C-shaped ‘hand aid’ assists the patient or the helper to maintain constant opening during the stretching procedure [12].

**Material and Methods**

Thirty patients with microstomia after facial burn were participated in the current study and these patients were selected from the outpatient clinics of El-Kasr El-Aini Hospital and EL-Gamaa Al-Shareyah Hospital for burns and tumors from September, 2016 to January, 2017. In this study the patients were randomly assigned into two equal groups (15 patients for each group). The exercise program consisted of a 10-week structured exercise program with exercise 5 times per day.

**Group A (study group):** It includes 15 patients who received therabite exercise with conventional therapy (gentle stretch by tongue depressor, active free and active resisted mouth exercises).

**Group B (control group):** It includes 15 patients who received conventional therapy (gentle stretch by tongue depressor, active free and active resisted mouth exercises).

**Criteria of patient selection:**

A- Inclusive criteria:
- Age between 25:45 years.
- All patients have microstomia after facial burn.
- Superficial and deep second degree facial burn.
- Both genders will participate in this study.

B- Exclusive criteria:
- Patients with poor general health.
- Patients with difficulties in filling out questionnaires.
- Diabetic patients.
- Congenital trismus or teeth abnormalities.
- Associated face or skull lesion.
- Tempromadibular joint diseases.

**Measurement of Maximal Interincisal Opening (MIO):**

To measure MIO, each subject was asked to open his or her mouth as wide as possible, and the examiner measured the maximum distance from the incisal edge of the maxillary central incisors to the incisal edge of the mandibular central incisors at the midline. A disposable scale was used to obtain this measurement (therabite range of motion scale) [13]. Record the measurement on the reverse side of the range of motion scale or in the separate patient progress log. Each patient in each group were assessed before (pre) and after the treatment (post 1 after 4 weeks) and (post 2 after 10 week at the end).

**Evaluation of improvement in mandible function:**

The method used to evaluate mandible function was the Mandibular Function Impairment Questionnaire (MFIQ) which consists of 11 items assessing perceived difficulties in mandibular function during social activities, speaking, taking large bite, chewing hard food, chewing soft food, work and/or daily activities, drinking, laughing, chewing resis-
tant food, yawing, and kissing. Six items assess perceived difficulties in mandibular function when eating hard cookies. Eating meat, eating a row carrot eating French bread, eating peanuts, and eating an apple. Eating includes taking a bite, chewing, and swallowing. Possible answers were: 0, no difficulty; 1, a little difficulty; 2, quite a bit of difficulty; 3, much difficulty; 4, very much difficulty or impossible without help. The scores are added to give a sum score (range 0-68). A higher score indicates more perceived mandibular function impairment and MFIQ score of 0 indicate no impairment. Internal consistency of the questionnaire range between 0.80 and 0.95 [14]. Each patient in each group were assessed before (pre) and after the treatment (post 1 after 4 weeks) and (post 2 after 10 week at the end).

Therapeutic procedures:

Group A (study group): The program was designed as follows:
- Warm-up movements consisting of jaw opening 10 times and small sideway movements of the jaws 10 times without using the jaw device.
- Passive stretching, with the jaw mobilizing device (therabite), 30 seconds (if possible), repeated 5 times.
- 5 repetitions of active exercise (bite toward resistance).
- Passive stretching again Fig. (1). Patients were instructed to relax in between the sessions. Furthermore, the patients were instructed to gradually increase the amount and intensity of the exercises to avoid pain or injury. During the exercise program, the patients were evaluated by an oral surgeon with measurement of maximal interincisal opening after 4 and 10 weeks [15].

Group B (control group): The program was designed as follows:
- Slide your lower jaw to the right and to the left. Hold it for 2 seconds. Repeat 5 times.
- Put two fingers on one side of your jaw. Slide your jaw towards your fingers while gently resisting with fingers. Hold it for 2 seconds. Repeat 5 times.
- Push your jaw down while gently resisting with fingers. Hold it for 2 seconds. Repeat 5 times.
- Protrude your jaw hold it for 2 seconds. Repeat 5 times [16].

Statistical analysis:

Descriptive statistics and unpaired t-test were conducted for comparison of the mean age between both groups. Unpaired t-test was conducted for comparison of maximal interincisal opening between groups at pre, post I, and post II measurements. ANOVA with repeated measures was conducted for comparison between pre, post I, and post II measurements of mean values of maximal interincisal opening in each group. Mann-Whitney U-test was conducted for comparison of MFIQ between groups at pre, post I, and post II measurements. Friedman test was conducted for comparison between pre, post I, and post II measurements of median values of MFIQ in each group. Wilcoxon Signed Ranks Test was conducted for pairs comparison of MFIQ. The level of significance for all statistical tests was set at $p<0.05$. All statistical measures were performed through the Statistical Package for Social Sciences (SPSS) Version 19 for windows [17].

Results

Subjects demographic data:

The mean ± SD age of Group A was 31.4 ±5.06 years, with maximum value of 43 years and minimum value of 26 years. The mean ± SD age of Group B was 33±3.87 years, with maximum value of 40 years and minimum value of 26 years. There was no significance difference between both groups in the mean age values ($p=0.34$).

Sex distribution:

The sex distribution of Group A revealed that there were 6 males with reported percentage of 40% and 9 females with reported percentage of 60%. The sex distribution of Group B revealed that there were 7 males with reported percentage of 47% and 8 females with reported percentage of 53%.

Mean values of maximal interincisal opening at pre-treatment, post I, and post II of Group A:

The mean ± SD maximal interincisal opening of Group A pre treatment was 28.73 ±1.83mm, while at post I was 35.26±3.84mm, and at post II was 41.53±4.51mm. Comparison between pre treatment, post I, and post II revealed a significant difference in maximal interincisal opening between the three time intervals ($p=0.0001$). The mean difference between pre-treatment and post I measurement was -6.53mm and the percent of change was 22.72%. There was a significant increase in
maximal interincisal opening at post I compared with pre-treatment ($p=0.0001$). The mean difference between pre-treatment and post II measurements was $-12.8\text{mm}$ and the percent of change was 44.55%. There was a significant increase in maximal interincisal opening at post II compared with pre-treatment ($p=0.0001$). The mean difference between post I and post II measurements was $-6.27\text{mm}$ and the percent of change was 17.78%. There was a significant increase in maximal interincisal opening at post II compared with post I ($p=0.0001$) (Table 1) & Fig. (2).

**Mean values of maximal interincisal opening at pre-treatment, post I, and post II of Group B:**

The mean $\pm$ SD interincisal opening of Group B pre-treatment was $28.4\pm2.19\text{mm}$, while at post I it was $30.73\pm2.98\text{mm}$, and at post II it was $34.53\pm2.16\text{mm}$. Comparison between pre-treatment, post I, and post II revealed a significant difference in interincisal opening between the three time intervals ($p=0.0001$). The mean difference between pre-treatment and post I measurement was $2.33\text{mm}$ and the percent of change was 8.2%. There was a significant increase in interincisal opening at post I compared with pre-treatment ($p=0.008$). The mean difference between pre-treatment and post II measurements was $-6.13\text{mm}$ and the percent of change was 21.58%. There was a significant increase in interincisal opening at post II compared with pre-treatment ($p=0.0001$). The mean difference between post I and post II measurements was $-3.8\text{mm}$ and the percent of change was 12.36%. There was a significant increase in interincisal opening at post II compared with post I ($p=0.0001$) (Table 2) & Fig. (2).

**Comparison of mean interincisal opening at pre-treatment, post I, and post II of Group A and B:**

As demonstrated in the (Table 3) the mean $\pm$ SD interincisal opening pre-treatment of Group A was $28.73\pm1.83\text{mm}$ and that of Group B was $28.4\pm2.19\text{mm}$. The mean difference between both groups was $0.33\text{mm}$. There was no significant difference in maximal interincisal opening between Group A and B pre-treatment ($p=0.65$). The mean $\pm$ SD maximal interincisal opening of Group A at post I was $35.26\pm3.84\text{mm}$ and that of Group B was $30.73\pm2.98\text{mm}$. The mean difference between both groups was $4.53\text{mm}$. There was a significant increase in maximal interincisal opening of Group A compared with B at post I ($p=0.001$). The mean $\pm$ SD maximal interincisal opening of Group A at post II was $41.53\pm4.51\text{mm}$ and that of Group B was $34.53\pm2.16\text{mm}$. The mean difference between both groups was $7\text{mm}$. There was a significant increase in maximal interincisal opening of Group A compared with B at post II ($p=0.0001$) Fig. (3).

**Median values of MFIQ at pre-treatment, post I, and post II of Group A:**

The median values of MFIQ of Group A pre-treatment was 44, while at post I it was 28, and at post II it was 15. Comparison between pre-treatment, post I, and post II measurements revealed a significant difference in MFIQ median values between the three time intervals ($p=0.0001$). There was a significant decrease in MFIQ at post I measurement compared with pre-treatment ($p=0.001$), significant decrease in median value of MFIQ at post II compared with pre-treatment measurement ($p=0.001$), and a significant decrease in median value of MFIQ at post II compared with post I measurement ($p=0.001$) (Table 4) & Fig. (3).

**Median values of MFIQ at pre-treatment, post I, and post II of Group B:**

The median values of MFIQ of Group B pre-treatment was 42, while at post I it was 35, and at post II it was 25. Comparison between pre-treatment, post I, and post II measurements revealed a significant difference in MFIQ median values between the three time intervals ($p=0.0001$). There was a significant decrease in MFIQ at post I measurement compared with pre-treatment ($p=0.001$), significant decrease in median value of MFIQ at post II compared with pre-treatment measurement ($p=0.001$), and a significant decrease in median value of MFIQ at post II compared with post I measurement ($p=0.001$) (Table 5) & Fig. (3).

**Comparison of median values of MFIQ at pre-treatment, post I, and post II of Group A and B:**

As demonstrated in the (Table 6), the median value of MFIQ pre-treatment of Group A was 44 and that of Group B was 42. There was no significant difference in the median values of MFIQ pre-treatment between Group A and B ($p=0.45$). The median value of MFIQ at post I of Group A was 28 and that of Group B was 35. There was a significant decrease in the median values of MFIQ of Group A at post I compared with Group B ($p=0.02$). The median value of MFIQ at post II of Group A was 15 and that of Group B was 25. There was a significant decrease in the median values of MFIQ of Group A at post II compared with Group B ($p=0.02$) Fig. (5).
Fig. (1): Therabite, a jaw stretching device for adults and children. (A): Star position, (B): End position.

Fig. (2): Mean interincisal opening at pre-treatment, post I, and post II of Group A and B.

Fig. (3): Median MFIQ at pre-treatment, post I, and post II of Group A and B.

Fig. (4): Mean interincisal opening at pre-treatment, post I, and post II of Group A and B.

Fig. (5): Median values of MFIQ at pre-treatment, post I, and post II of Group A and B.
Table (1): Comparison between pre-treatment, post I and post II mean values of maximal interincisal opening of Group A.

<table>
<thead>
<tr>
<th>Maximal interincisal opening (mm)</th>
<th>X ± SD</th>
<th>F-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Pre-treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post I</td>
<td>35.26±3.84</td>
<td>41.53±4.51</td>
<td>132.66</td>
<td>0.0001</td>
</tr>
<tr>
<td>Post II</td>
<td>41.53±4.51</td>
<td>34.53±2.16</td>
<td>7</td>
<td>5.41</td>
</tr>
</tbody>
</table>

Multiple comparison (Bonferroni test)

<table>
<thead>
<tr>
<th>MD</th>
<th>% of change</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-post I</td>
<td>−6.53</td>
<td>22.72</td>
<td>0.0001</td>
</tr>
<tr>
<td>Pre-post II</td>
<td>−12.8</td>
<td>44.55</td>
<td>0.0001</td>
</tr>
<tr>
<td>Post I-post II</td>
<td>−6.27</td>
<td>17.78</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Table (2): Comparison between pre-treatment, post I and post II mean values of maximal interincisal opening of Group B.

<table>
<thead>
<tr>
<th>Maximal interincisal opening (mm)</th>
<th>X ± SD</th>
<th>F-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Pre-treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post I</td>
<td>30.73±2.98</td>
<td>34.53±2.16</td>
<td>66.54</td>
<td>0.0001</td>
</tr>
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</table>

Multiple comparison (Bonferroni test)

<table>
<thead>
<tr>
<th>MD</th>
<th>% of change</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-post I</td>
<td>−2.33</td>
<td>8.2</td>
<td>0.008</td>
</tr>
<tr>
<td>Pre-post II</td>
<td>−6.13</td>
<td>21.58</td>
<td>0.0001</td>
</tr>
<tr>
<td>Post I-post II</td>
<td>−3.8</td>
<td>12.36</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Table (3): Comparison of pre-treatment, post I, and post II mean values of MIO between Group A and B.

<table>
<thead>
<tr>
<th>Maximal interincisal opening (mm)</th>
<th>X ± SD</th>
<th>MD</th>
<th>t-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Pre-treatment</td>
<td>28.73±1.83</td>
<td>28.4±2.19</td>
<td>0.33</td>
<td>0.45</td>
<td>0.65</td>
</tr>
<tr>
<td>Post I</td>
<td>35.26±3.84</td>
<td>30.73±2.98</td>
<td>4.53</td>
<td>3.6</td>
<td>0.0001</td>
</tr>
<tr>
<td>Post II</td>
<td>41.53±4.51</td>
<td>34.53±2.16</td>
<td>7</td>
<td>5.41</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Table (4): Comparison between pre-treatment, post I and post II median values of MFIQ of Group A.

<table>
<thead>
<tr>
<th>MFIQ</th>
<th>χ²</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>44</td>
<td>28</td>
<td>15</td>
</tr>
</tbody>
</table>

Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th>Z-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-post I</td>
<td>3.18</td>
<td>0.001</td>
</tr>
<tr>
<td>Pre-post II</td>
<td>3.19</td>
<td>0.001</td>
</tr>
<tr>
<td>Post I-post II</td>
<td>3.18</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table (5): Comparison of pre-treatment, post I and post II median values of MFIQ of Group B.

<table>
<thead>
<tr>
<th>MFIQ</th>
<th>χ²</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>42</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>

Wilcoxon Signed Ranks Test

<table>
<thead>
<tr>
<th>Z-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-post I</td>
<td>3.42</td>
<td>0.001</td>
</tr>
<tr>
<td>Pre-post II</td>
<td>3.41</td>
<td>0.001</td>
</tr>
<tr>
<td>Post I-post II</td>
<td>3.41</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table (6): Comparison of pre-treatment, post I, and post II median values of MFIQ between Group A and B.

<table>
<thead>
<tr>
<th>MFIQ</th>
<th>U-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>44</td>
<td>42</td>
<td>94.5</td>
</tr>
<tr>
<td>Group B</td>
<td>42</td>
<td>25</td>
<td>56.5</td>
</tr>
</tbody>
</table>

U-value: Mann-Whitney test value.
S: Significant.
p-value: Probability level.

Discussion

Microstomia is one of the most distressing results of burn. Deep burns of the face and lips often lead to the formation of scar tissue and contracture of perioral tissues with marked reduction in the ability of the patient to open their mouth [18]. Adequate oral opening not only affects the patient's cosmetic appearance, speech, and nutrition but is also mandatory for oral hygiene and dental
evaluation and intervention [19,20]. Compression therapy, mouth splinting, scar massage, contact media, exercise, patient education and neck splinting are standard treatments for the prevention and management of microstomia more specifically to microstomia splinting [21]. Although some reversal of microstomia can be accomplished with nonsurgical treatment modalities, surgery constitutes the best option for treatment [22].

If symptoms due to microstomia were not improving or were in fact even increasing under conservative measures such as scar massage, stretching exercises and splinting, it was decided to treat operatively. Reconstruction of the oral commissures was performed according to one of the following methods: (1) Triangular scar excision and mucosal YeV advancement (n=10), (2) Scar excision and wound closure with full-thickness or split-skin graft (n=4) and (3) Division of the contracture and closure of the resulting defect with two rhomboid mucosal flaps per side (n=4). Commissuroplasty is an early functional post-burn corrective procedure that often must be performed prior to completion of scar maturation. Mucosal advancement flaps are a viable procedure for the treatment of microstomia after facial burns, resulting in good aesthetic and functional outcome. Direct scar excision and skin grafting, although unavoidable in cases of extensive perioral scarring, frequently produces inferior results [23].

The use of an increasing number of tongue blades to stretch the facial tissues can also be advised [24].

Muscle stretching exercises for the mouth may be helpful to prevent further limitation of mouth movements. This includes forceful mouth opening with the help of sticks, ballooning of mouth, hot water gargling. This is thought to put pressure on fibrous bands [25].

A large variety of intraoral and extraoral microstomia appliances are in use. Some are static, unadjustable devices with no moveable parts. Many of these are tooth supported orthosis. Others are dynamic, permitting adjustments to accommodate changes that may occur in commissural dimensions, but only offer pressure in the horizontal direction [26]. Considerable progress has been seen over the years in preventing microstomia by means of oral splinting [21]. They are difficult to use and cause only simple static stretching but therabite is simple and easy to use [27,28]. The therabite has broad mouth pieces following the entire row of teeth and works by pressing the mouthpieces apart along the natural anatomical path of the jaw, thereby decreasing the risk that the teeth would procline. The Therabite system is listed in the US Food and Drug Administration (FDA). Results of previous studies suggest that therabite exercise therapy is superior in increasing mouth opening compared to conventional exercise therapy [29].

Adherence may be of great importance in obtaining an effect from therabite exercises, where treatment entails frequent and long-term use to sustain lasting benefits [30]. Compliance to exercise therapy is dependent on internal motivation and the perceived effect of exercises. Perceiving no treatment effect, reaching the exercise goal, and an insufficient opening range of the therabite have a negative effect on adherence [31].

So, this controlled randomized study was conducted to determine the effect of therabite on microstomia after facial burn, the parameters investigated in this study were maximal mouth opening and mandible function. The study showed there was no significant difference between both groups in the mean value of patients ages and maximal interincisal opening. Also there was no significant difference in the median values of MFIQ pre treatment between Group A and B (p=0.45).

Regarding MIQ, the mean ± SD maximal interincisal opening of Group A at post I was 35.26±3.84 mm and that of Group B was 30.73±2.98mm. The mean difference between both groups was 4.53mm. There was a significant increase in maximal interincisal opening of Group A compared with B at post I (p=0.001). The mean ± SD maximal interincisal opening of Group A at post II was 41.53±4.51 mm and that of Group B was 34.53±2.16mm. The mean difference between both groups was 7mm. There was a significant increase in maximal interincisal opening of Group A compared with B at post II (p=0.0001). The median value of MFIQ at post I of Group A was 28 and that of Group B was 35. There was a significant decrease in the median values of MFIQ of Group A at post I compared with Group B (p=0.02). The median value of MFIQ at post II of Group A was 15 and that of Group B was 25. There was a significant decrease in the median values of MFIQ of Group A at post II compared with Group B (p=0.02).

Regarding MFIQ, the study showed that There was no significant difference between both groups in the median values of MFIQ of Group A at post I compared with Group B (p=0.45), there was a significant decrease in the median values of MFIQ of Group A at post I compared with Group B (p=0.02) and a significant decrease in the median...
values of MFIQ of Group A at post II compared with Group B ($p=0.02$).

Results of this study concerning the effect of therabite exercises on microstomia after facial burn confirm the observations of: Pauli et al. [15], Gibbons and Abulhoul [27], Cohen et al. [29], Maloney et al. [28] and others.

Pauli et al., [15] investigated the impact of structured exercise with jaw mobilizing devices on trismus and its effect on trismus symptomatology and Health-Related Quality of Life (HRQL) in Head and Neck (H & N) cancer patients. Material and methods. Fifty patients with H & N cancer and trismus, i.e. Maximum Interincisal Opening (MIO) <35mm participated in a structured intervention program with jaw exercise. The patients in the intervention group underwent a 10-week exercise program with regular follow-up. A control group comprising of 50 patients with trismus and H & N cancer were matched to the intervention group according to gender, tumor location, tumor stage, comorbidity and age. HRQL and trismus-related symptoms were assessed. Results. The mean MIO improvement was 6.4mm (4.8-8.0) and 0.7 (0.3-1.7) mm in the intervention group and control group respectively, three months post-intervention commencement ($p<0.001$). The intervention group demonstrated a statistically significant improvement in role functioning, social functioning and global quality of life (EORTC QLQ C30) and in all Gothenburg Trismus Questionnaire (GTQ) domains, i.e. jaw-related problems ($p<0.001$), eating limitation ($p<0.05$) and muscular tension ($p<0.001$). Conclusion. We found that a structured jaw exercise program was effective and improved the mouth opening capacity significantly. The objective effect on trismus (MIO) was also reflected in the patient-reported outcome questionnaires where the patients who underwent the structured exercise program after cancer treatment reported improvements in HRQL and less trismus-related symptoms compared to the control group.

Gibbons and Abulhoul [27] presented the use of a mouth-opening appliance (therabite) to help to overcome persistent restriction of mouth opening after coronoidectomy to treat bilateral coronoid hyperplasia. Study presented a 36-year-old white man referred to this department with restricted mouth opening; on clinical examination the patient’s inter-incisal opening was limited to 20mm. He had no masseteric hyperplasia, but he did have thick fibrous bands that were palpable over the insertion of his temporalis muscle on his coronoid processes intraorally. Intraoral coronoidectomies were done under general anaesthetic using a fibre-optic technique to establish endotracheal intubation. Opening improved to 30mm at operation. Post-operatively the patient’s mouth opening reduced to 20mm during the next 4 weeks. He was given a therabite appliance to use for 5 minutes, three to five times a day. Over a period of 3 months this increased his mouth opening to 38mm. A year later his improved opening has remained stable and he has no evidence of regrowth of the coronoid processes. Spatulas and screws have been used to treat the sort of fibrosis that limits mouth opening but they are difficult to use and simply cause static stretching of the fibrosed areas; in contrast, the therabite appliance is simple and easy to use. They concluded finally that study case report shows that using a therabite mouth opening device with good compliance from the patient can improve the long-term outcome.

Cohen et al., [29] evaluated the use of a mechanical stretching device, the therabite, for the early post-operative management of trismus in select patients with a randomized controlled trial which included eleven patients with mandibular hypomobility and trismus as a sequel of oropharyngeal cancer, were treated using therabite. Treatment began within 6 weeks of composite resection surgery of oropharyngeal cancer usually in week 4 or 5. Maximal Interincisor Opening (MIO) was measured when subjects began to use the device and at the most recent post-operative visit by using a measuring gauge provided with the device. All were instructed to perform 6 repetitions, holding the mouth open for 6 seconds each time 6 times daily. The initial range setting was 25mm and was increased as tolerated. Follow-up ranged from 12 to 48 weeks after surgery. Compliance was assessed by patient self-reporting. Average initial MIO, ending MIO, and average gain were calculated. Differences in initial and ending MIO were subjected to statistical analysis by using the paired $t$-test. At initial postoperative measurement, mean MIO was 30mm (range, 24-38mm). Final average MIO was 40mm (range 30-57mm). There was a statistically significant difference between these 2 measurements ($p<0.01$). The average gain in MIO was 10mm (range, 1-21mm). Rating of jaw opening ability corresponded to “mildly decreased.” Average effect of jaw opening ability on eating was mild to no restriction. Four patients ate normal diets and 1 ate pureed foods. Average pain rating was mild to none. Four of 5 patients experienced minimal or no limitation on overall Quality of Life (QOL) relative to jaw opening ability. No complications related to use of the therabite were noted in either patients who did or did not complete the
study specifically, there were no adverse effects on the mandibular healing, surgical site, or free flap reconstruction.

Maloney et al., [28] designed a study to compare the effectiveness of a passive jaw motion device, the therabite, and Wooden Tongue Depressors (WTD), in patients with temporomandibular joint and muscle disorders, who did not improve after manual manipulation of the mandible and flat bite plane therapy. Forty-three patients were enrolled in the study and were classified as joint or muscle groups according to the research diagnostic criteria for TMD. Twenty-four were assigned to the joint group, and 19 patients were assigned to the muscle group. The patients were assigned at random to three treatment subgroups: 1. Passive jaw motion device therapy (Therabite); 2. Wooden Tongue Depressors therapy (WTD); and 3. Control group. All subjects received flat bite plane appliance therapy throughout the treatment period. Mandibular range of motion was measured for Maximum Interincisal Opening (MO), right and left lateral (Rt. Lateral, Lt. Lateral) and Protrusive (Pr) movements. Pain level was also assessed at the beginning and at the end of the treatment. The results suggested that a passive jaw motion device is effective in increasing range of motion in both groups of temporomandibular disorder patients, joint (intracapsular) and muscle (extracapsular). It also appears to decrease pain in patients with temporomandibular disorders. Pain was relieved to a greater degree in the muscle group than the joint group.

In relation to maximal interincisal opening values and mandibular function, the results of this study revealed that there were significant differences in maximal interincisal opening values and mandibular function after 1 month (post 1), after 10 weeks (post 2) between the treatment group and the control group that could prove the beneficial effect of the therabite in increasing interincisal opening values and improving mandibular function in patient with microstomia after facial burn as well as being safe, tolerated and shear method.

Limitations of our study were infrequent attendance of some patients, uncontrolled home program, personal differences between patients in life style, cultural level, education and cognitive problems, psychological status and finally co-operation of the patient and their relatives might affect the result of the measurement.

Conclusion:
The encouraging results of the this study and other previous studies contribute evidence of the therabite device as useful therapeutic option for treatment of microstomia after facial burn as well as being safe, tolerated and shear method, and validates further studies to evaluate treatments with a larger number of patients and for a longer period of follow-up.

References


تأتي تمارين الثيرابيتي على صفر القلم بعد الحروب الوجهية

الهدف: أجريت هذه الدراسة بهدف دراسة تأثير تمارين الثيرابيتي على صفر القلم بعد الحروب الوجهية.

الأشخاص وطرق البحث: ثلاثين مريضاً من كلا الجنسين تعرضوا للحروب الوجهية تراواج أعراهما بين 40-50 عامًا. وقد اختير المرضى وقسموا عشوائياً إلى مجموعتين متساويتين (مجموعة دراسة ومجموعة ضابطة) وقد أُطلق المجموعتين برنامج مخاطرعلاج الطبيعي من قبل الباحث بهدف في الأساس إلى زيادة حجم فتحة القلم وتحسينوظائفه عند المرضى بالموافقين وقد تم تتويج مجموعات الدراسة بالإضافة لبرنامج العلاج الطبيعي المختار مارتين للقدم بواسطة جهاز ثيرابيتي، واستمر العلاج المجموعة من شهره أسابيع بعدد خمس مرات في اليوم، وقد تم تقييم المرضى قبل وبعد شهر من العلاج ثم بعد شهرين ونصف من طريق تقييم إكليتيكي (ويشمل قياس حجم فتحة القلم وإنسحاب عن الاختلاف الطبيعي للفك السفلي القلم).

نتائج: وقد أظهرت النتائج الدراسة وجود تحسن إكلينيكي ملحوظ في المجموعتين ولكن مرتبط يوجود ملحوظ لدالة إحصائية واضحة في المجموعتين، كما أنه تبين النتائج أن التحسن في مجموعة العلاج بمارتين الثيرابيتي (مجموعة a) كان الأفضل.

الاستنتاج: يمكن استخدام تمارين الثيرابيتي كعلاج مباشر لصفر القلم بعد الحروب الوجهية حيث إنه يساعد على زيادة فتحة القلم وتحسين وظائفه.