



MODIFIED METHOD OF VACUUM FORMED SPLINTS FOR INTERMAXILLARY FIXATIONS

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ABSTRACT **OBJECTIVES:** The aim of this study is presenting of modified alternative method of vacuum formed splints for mandible fractures treatment efficacy in compare with Erich arch bars.

MATERIAL AND METHODS: 113 patients were treated for mandible fractures from the period of 2015-2017 years. 63 patients randomly selected for study group were treated using modified vacuum formed splints and 50 patients treated by Erich arch bars were selected for control group. Both techniques were assessed for the time required for placement and removal of each type of intermaxillary fixation technique, oral hygiene status by PMA index and complications associated with both techniques. For comparison of means in two groups two-sided Student's t-test was used.

RESULTS: With regards to the Erich arch bars splints exhibited a shorter mean operating time and chair time for removing (30, 04 min. vs 0, 53 min. SE-0.224). Also, significantly high index of PMA (severe gingivitis) was registered in patients with arch bars group in compare with study group (46, 2289 vs.7, 0187. p<0.05)

CONCLUSIONS: According to study results, it is possible to propose Modified Vacuum Formed Splints as an alternative to arch bars for mandible fractures treatment efficacy.

KEYWORDS : Mandible fractures; Intermaxillary fixation; Arch bars, Vacuum formed splints

INTRODUCTION

Mandible fractures are one of the frequently occurring injuries of the facial skeleton. They can be treated by Intermaxillary fixation alone or by osteosynthesis with, or without intermaxillary fixation. The main goals in successfully treating mandible fractures include: reduction of the fracture, stabilization of the fracture, and achievement of proper dental occlusion [1]. Nowadays, with the conception of open reduction internal fixation (ORIF), the crucial goal of modern maxillofacial surgery is to achieve the highest possible quality of life by returning the patient to the best possible condition [2]. Various techniques have been employed from time to time to achieve maxillo-mandibular fixation (MMF) [3].

The Erich arch bar (EAB) and eyelets wire were the most commonly used methods of intermaxillary fixation prior to the conception of ORIF [2]. Twisting a wire around a tooth conveys little feel as to its tightness and there is a danger of avulsion if force is too great [1].

Recent studies have reported some disadvantages of EAB application such as the long operating time, needle-stick injuries, the high plaque index, periodontal damage, movement of the teeth in lateral and extrusive direction [3, 4]. Furthermore, in some clinical situations such as anterior open bite is present, in pediatric fractures, patients with mental disorders, and in partial and completely edentulous fractures, EAB should be avoided [5]. Thus, since 1989 alternative methods, like the Intermaxillary Fixation Screws (IFS), have been developed to eliminate these disadvantages and promote occlusal stability during the operating time [6]. IFS method eliminated needle-stick injuries and decreased the operating time, as well as favoring better gingival health maintenance [4, 7]. However, this method also has limitations, such as iatrogenic root injuries, screw fractures, mucosal coverage of the screw and screw loosening [8, 9]. On the other hand, EAB was better than IFS in terms of postoperative occlusal stability.

The aim of this study is presenting of Modified Vacuum Formed Splints (MVFS) as an alternative method of IMF for mandible fractures treatment efficacy in compare with the Erich arch bars.

MATERIAL AND METHODS

Objectives of the Study is to compare the efficacy and advantages of proposed vacuum formed splints v/s Erich Arch Bar for IMF in the treatment of mandible fractures.

For the period of 2015-2017 years 113 patients with acceptable number of teeth present for occlusion and IMF were treated for mandible fractures in Department of ENT and Maxillofacial Surgery of YSMU "Heratsi" №1 Hospital and "Astghik" Medical center. From 113 patients 109 were men and 4 women at the age ranges of 15-65 years (mean age 31.2).

63 patients randomly selected for study group were treated using modified vacuum formed splints (MVFS), and 50 patients treated by EAB were selected for control group.

From the 63 Study Group patients four with minimally displaced mandible fractures were treated conservatively only by MVFS under local anesthesia and 59 patients with significant displacement undergo ORIF under general anesthesia. Five Control Group patients with minimally displaced mandible fractures were treated only conservatively by EAB (1 patient under general anesthesia and 4 under local) and 45 patients have EAB splinting under general anesthesia before osteosynthesis (Table 1). In both groups IFS was left for 4-6 weeks.

Both techniques were assessed for the following parameters: time required for placement and removal of each type of IMF technique, oral hygiene status by PMA index and complications associated with both techniques. The collected data was entered in database and analyzed with SPSS 21. For comparison of means in two groups two-sided Student's t-test was used, comparing before and after data paired t-test was performed. In all cases results were considered statistically significant when p<0.05.

Modified Vacuum Formed Splints preparation technique

C or A silicone impression material was using intraoperatively for impression taking from upper and lower jaws. Average timing for

impression taking was 12.42 min (SE- 0.128). 1,5 mm thickness EVA (Ethylene vinyl acetate) material were used in technical laboratory for vacuum formed splints preparation and 4-6 orthodontic buttons were fixed in each splint for intermaxillary elastics fixation. Both, upper and lower splints intakes areas of teeth and 3-4 mm of gingival region (Fig. 1). On the second post operation day splints were fixed on the teeth by smooth force clicking and they quite firmly fixed to provide intermaxillary fixation with elastics. It fixed enough tight even if patients try to open month, thus not required any adhesives usage (Fig.2).

Oral hygiene PMA index was used to evaluate the oral hygiene status at the time of first day and 6-th weeks after the IMF and were scored accordingly.

RESULTS

With regards to the EAB methods of intermaxillary fixation MVFS exhibited a shorter mean operating time (12.42 min vs. 52.10 min), needle-stick injuries were exclude as well as periodontal and mucosal damage and teeth movement. There was also significant difference in IMF removal time between groups. The chair time of EAB removal requires local anesthesia and takes average 30.04 min (SE-0.224) and even under anesthesia it was quite uncomfortable procedure for patients. It brings to additional trauma and gingival bleeding. And it takes no more than minute (0.53 min) to remove MVFS without any discomfort for patients.

The results of PMA index in both groups are demonstrated in Table 2. As shown in Table mean PMA indexes in Study Group (MVFS) and Control Group (Erich arch bars) before treatment were comparable: 7.142 ± 0.489 and 8.567 ± 0.568 ($p < 0.05$). However, after IMF removal values of PMA were significantly different: 7.222 ± 0.494 ($p < 0.05$) in MVFS Group and 46.672 ± 1.516 ($p < 0.05$) in Control Group. Wherein PMA values in Study Group before and after treatment were only slightly differed: 7.142 ± 0.489 ($p < 0.05$) before treatment and 7.222 ± 0.494 ($p < 0.05$) after.

Although both the techniques offers good postoperative intermaxillary fixation, maintenance of oral hygiene and patient acceptance was good with IMF with MVFS compared to arch bars.

DISCUSSION

The principles of treatment for mandibular fractures have changed recently although the objective of reestablishing the occlusion and masticatory function remains the same [3]. Mandibular fractures can be treated by Intermaxillary fixation alone, or by osteosynthesis with or without intermaxillary fixation [1]. Different methods have been used for intermaxillary fixation [5, 10, 11, 12, 13, 14, 15] Erich Arch bars are currently the most common methods of achieving intermaxillary fixation, as it promoted better occlusal stability, although other methods are described [16]. However, the placement of arch bar is time consuming and uncomfortable to the patient [4]. As mentioned Nandini et al.[1] in their study, the time taken for Group with IMF screws ranged from 5.7 to 14.0 min with mean time of 8.52 min as compared to Group treated with Arch bars patients were the time taken ranged from 75 to 115 min with mean of 100 min. In current study the mean time for Vacuum Splints impression taking is 12.42 min. in compare with 52.10 min of EAB installation.

Many authors in their studies recommended IFS as alternative to EAB [1, 3, 4, 6, 7]. Despite the fact that IFS method is easy to apply, inexpensive, reduce the risk of needle stick type injuries associated with wires and not time consuming it carries the risk of damage to the roots of the teeth [3, 7, 8, 9, 17]. The tooth morbidity depending on the radiographic findings was 30% in Group with IFS and was 0% in Group with Arch Bars by Nandini et al.,[1]. In compare with IFS method there was no any tooth morbidity in presented study Group treating by MVFS.

Among the disadvantages of using arch bar include movement of teeth in lateral and extrusive direction, needle-stick injuries, the high plaque index, periodontal damage, lip or gingival alteration, movement of the teeth in lateral and extrusive direction and it is not suitable for dentition that carry extensive crown and bridge work [1, 2, 3, 4, 15, 18]. While thinking of an ideal design for an MMF technique, the factors that should be considered include easy and quick application; low cost; need to securely hold the lower jaw tight to the upper jaw; avoidance of forces on front teeth as they are easily moved out of alignment; being minimally invasive; being safe for the patient during application and

healing; and also presence of an emergency quick release system [14, 19]. The proposed Modified Vacuum Splint method is tight enough for intermaxillary secure holding and at the same time allow patient to open month in emergency situations. The other advantage of recommended vacuum splints is possibility for usage for dentitions that carry crowns and bridge works, as well usage in patients with dystopic teeth or severe crowding, when EAB fixation is impossible and IFS insertion is due to root damage.

Lloyd et al., [20] have described a case history of slightly displaced condylar fracture treatment with vacuum formed splints. Vacuum-formed splints made from thermoplastic clear foil, 1 mm thick and 125mm in diameter (Imprelon 'S') were constructed for both jaws. The splints were trimmed with a bur and several holes were drilled through the occlusal surfaces to allow cement escape. The splints were cemented intraorally using glass ionomer cement. In our study the borders of splints intakes about 2-3 mm of gingival margin and provide enough mechanical retention of excluding any adhesive using.

Trupthi et al., [21] proposed method of intermaxillary fixation with vacuum formed splints made from thermoplastic clear foil and constructed for both the jaws and fixed with glass ionomer cement (GIC). They have compared the clinical efficacy of vacuum formed splints and arch bar fixation in treating minimally displaced mandibular fractures. For preparing the vacuum formed splints, alginate impressions of both the arches were taken and the models prepared. Occlusal splints with 1.5 mm thermoplastic sheet, using the Biostar machine were prepared for both the arches. Six to eight custom made cleats which were made from 0.7 mm hard stainless steel wire were fixed at regular intervals to each splint. Splints were trimmed and the occlusal contact areas were removed. Using glass ionomer cement the splints were cemented intraorally.

The mean chair side time taken by vacuum formed splint fixation, as noted authors, was 18.05 min. In compare, chair side time for fixation of proposed Modified Splints takes 1-2 min., as there fixed by clicking only. Furthermore, in proposed splints we don't remove occlusal contact areas, thus providing a vertical interdental distance approximately 3 mm, which is close to vertical dimension at rest. Probably, it could be assumed, that a prolonged (4-6 week) position of the TMJ structures in this intermaxillary position is less prone to stress, than with prolonged tight teeth occlusion.

The oral hygiene status is another cornerstone in choosing of MMF method. Poor oral hygiene was reported in many studies on patients with mandibular fractures treated with using arch bars [1, 21, 22]. Arabian et al., [23] provide the prospective clinical study concerning assessment of pocket depth changes in treatment with arch bars. Pocket depth was measured before arch bars placement, one and 12 months after removing them. The study demonstrated a significant change in the pocket depths one month following removal of arch bars but a considerable improvement was detected following 12 months without any periodontal treatment. Trupthi et al., [21] compared the periodontal status of the patients treated with EAB and vacuum formed splints using the gingival index and the oral hygiene index on both the groups. The gingival index was assessed for vacuum formed splint and conventional arch bar group on 3rd day, 7th day and the day of removal of appliances. On an average, there was 70 % of mild gingivitis and 30 % of moderate gingivitis in relation to the vacuum formed splints. But only 8.3 % of the conventional arch bar group had mild gingivitis, 71.7 % had moderate gingivitis and 20 % had severe gingivitis.

In current study, an objective measurement was done using gingival index PMA to measure the severity of gingivitis immediately before IMF applying and on the day of removal. It was recorded that significantly high index of PMA (severe gingivitis) was registered in patients with arch bar group than in patients with Modified Vacuum Formed Splints group ($46, 2289$ vs. $7, 0187$. $p < 0.05$).

CONCLUSIONS

Although both techniques offer good postoperatively fixation, Modified Vacuum Formed Splints reduce the operating time, minimize chair side time for removing without any anesthesia and discomfort for patients, exclude periodontal trauma, provide good maintenance of oral hygiene and good patient acceptance compared to arch bars. According to study results it is possible to propose Modified Vacuum Formed Splints as an alternative to arch bars for IMF in mandible fractures.

Conflict of interest

There is no financial relationship with any commercial entity and no conflicts of interest.

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Table 1: Patients distribution by treatment type

Mandible fracture treatment type	Study Group	Control Group
Only conservative by IMF	4	5
IMF with ORIF	59	45

Table 2: PMA index value in both groups

Groups	PMA Index (before IMF) (mean ± SE)	Day of removal IMF (mean ± SE)
Study Group (MVFS)	7.142 ± 0.489 max. 14,012 min.,00	7.222 ± 0.494*† max. 14,20 min.,00
Control Group (Erich arch bars)	8.567 ± 0.568 max. 12,82 min.,00	46.672 ± 1.516* max. 68,00 min. 33,40

* p < 0.05 – before – after (paired t-test)

† p < 0.05 – with control (independent t-test)



Figure 1. Modified vacuum formed splints in oral cavity



Figure 2. Modified vacuum formed splint view on model



Figure 3. Modified vacuum formed splints on the day of fixing (a) and removal day (b)



Figure 4. PMA testing before splints fixing (a) and on removal day (b)

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