

Evaluation of arch bar fixation without surgical aid in jaw fracture treatment

Evaluación de la fijación de barras de arco sin ayuda quirúrgica en el tratamiento de fracturas de mandíbula

Farnaz Dehabadi¹, Seyed Hadi Hosseini² 

1. Department of Oral and maxillofacial surgery, Dental School, Mashhad University of Medical Sciences, Mashhad, Iran

2. Department of maxillofacial surgery, Dental School, Guilan University of Medical Sciences, Rasht, Iran.

Corresponding author

Farnaz Dehabadi

Department of Oral and maxillofacial surgery, Dental School,

Mashhad University of Medical Sciences, Mashhad, Iran

E-mail: dehabadif961@mums.ac.ir

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Abstract

Background: In traumatic patients, head, neck, and facial bone fractures are common. Inter-maxillary fixation (IMF) in jaw fracture surgery helps to improve the position of the maxilla and mandible, as well as the use of elastics in the postoperative period of fractures. IMF is performed with the use of wires applied directly on the teeth, or with quick-fix screws or with arch bars attached to them. Arch bar is the most complete technique for jaw fixation. This technique is time-consuming and manipulation of the wires lead to the increasing risk of glove puncture and needle stick injury to the surgeon or assistants. These problems lead to inventing alternative techniques.

Materials and Methods: This study was a clinical trial in which 36 patients require arch bar fixation were selected. They were randomly divided into treatment and control groups by cluster randomization. The first group treated with arch bar in the new method and the second group treated with the classic method of arch bar placement. For the new method the surgeon prebend the wires like U and pass their all trough interdental spaces by his own. These two groups were compared in terms of the time of placing arch bars, its vertical mobility after one week and one month, and the number of glove perforations. Finally, the data were analyzed using SPSS (version 22) software.

Result: A total number of 36 patients were included in this study, results showed that the average time for arch bar wiring in the classical and experimental groups was 40/39 ±3/071 and 29/33±2/567 minute respectively (p0.135). There was a statistically significant difference in the number of glove perforations between the classic and the experimental group (p0.024). In the present study, 61/1% of gloves in the experimental group were without holes, but in the classic group, 33/3% of gloves were without holes. In the classic group, 44/4% of gloves had 2 holes and 5/6% of gloves had 3 holes. None of the gloves in the experimental group had 3 holes. One week after wiring arch bar, there was no significant difference between those groups in the looseness rate (p 0.560). But after 1 month, a significant difference was found between groups because the average looseness rate in the experimental group was higher (p 0.016).

Conclusion: With due attention to statistical data, presented method had more efficiency due to less working time, fewer glove perforations, and simpler arch bar opening. Even there is no need for any professional assistants.

Keywords: Arch bar, jaw fractures, Intermaxillary fixation.

Resumen

Antecedentes: En los pacientes traumatizados, las fracturas de cabeza, cuello y huesos faciales son frecuentes. La fijación intermaxilar (FMI) en la cirugía de fracturas de mandíbula ayuda a mejorar la posición del maxilar y la mandíbula, así como el uso de elásticos en el postoperatorio de las fracturas. La FMI se realiza con el uso de alambres aplicados directamente sobre los dientes, o con tornillos de fijación rápida o con barras de arco unidas a ellos. La barra de arco es la técnica más completa para la fijación de la mandíbula. Esta técnica requiere mucho tiempo y la manipulación de los alambres conlleva un riesgo creciente de perforación del guante y de lesiones por pinchazo de aguja para el cirujano o los asistentes. Estos problemas llevan a inventar técnicas alternativas.

Materiales y métodos: Este estudio fue un ensayo clínico en el que se seleccionaron 36 pacientes que requerían la fijación de la barra del arco. Se dividieron aleatoriamente en grupos de tratamiento y de control mediante aleatorización por grupos. El primer grupo fue tratado con la barra de arco en el nuevo método y el segundo grupo fue tratado con el método clásico de colocación de la barra de arco. En el nuevo método, el cirujano predobló los alambres en forma de U y los pasó por completo a través de los espacios interdientales. Estos dos grupos se compararon en cuanto al tiempo de colocación de las barras del arco, su movilidad vertical después de una semana y un mes, y el número de perforaciones del guante. Por último, los datos se analizaron mediante el programa informático SPSS (versión 22).

Resultados: Un número total de 36 pacientes fueron incluidos en este estudio, los resultados mostraron que el tiempo medio de cableado de las barras de arco en los grupos clásico y experimental fue de 40/39 ±3/071 y 29/33±2/567 minutos respectivamente (p 0.135). Hubo una diferencia estadísticamente significativa en el número de perforaciones del guante entre el grupo clásico y el experimental (p 0.024). En el presente estudio, el 61/1% de los guantes del grupo experimental no tenían perforaciones, pero en el grupo clásico, el 33/3% de los guantes no tenían perforaciones. En el grupo clásico, el 44/4% de los guantes tenían 2 agujeros y el 5/6% de los guantes tenían 3 agujeros. Ninguno de los guantes del grupo experimental tenía 3 agujeros. Una semana después de alambrear la barra del arco, no hubo diferencias significativas entre esos grupos en la tasa de alojamiento (p 0.560). Pero después de 1 mes, se encontró una diferencia significativa entre los grupos porque la tasa media de alojamiento en el grupo experimental fue mayor (p 0.016).

Conclusión: prestando la debida atención a los datos estadísticos, el método presentado fue más eficaz debido al menor tiempo de trabajo, el menor número de perforaciones del guante y la apertura más sencilla de la barra del arco. Incluso no hay necesidad de ningún asistente profesional.

Palabras clave: Barra de arco, fracturas de mandíbula, fijación intermaxilar.

Introduction

The treatment of jaw fractures has a long history, from ancient Egypt to the present. Historical insight improves understanding of current techniques and provides the basis for the development of new methods. Since ancient times, physicians have described many different techniques for treating mandibular fractures, the principle of which has always been repositioned and immobilization of the bone fragments. However, during the past 50 years, an improvement of anesthetic and radiographic techniques, the introduction of antibiotics, specially designed instruments, and advances in biomaterial have allowed maxillofacial surgeons to improve outcomes while reducing morbidity. The main objective in all treatments for treating fractures is to obtain proper occlusion and stable joint movements by appropriate insertion of broken parts¹. Recently, typical surgical methods for the treatment of mandibular fractures is the arch bar method. Arch bar is composed of a hooked, stainless steel wire called Arch and ligated to teeth with stainless steel wires. However, arch bars can damage the teeth and periodontal tissue and tend to be uncomfortable for patients during the fixation period. Moreover, daily maintenance of oral hygiene is difficult for patients with an arch bar². Surgeons are also exposed to the risk of blood-transmitted diseases through skin punctures by wires when affixing these devices. The speed of action in arch wiring is very important during surgery². Arch bar is a simple and an initial treatment for most jaw fractures, especially for the mandible. Treatment by the arch bar is also necessary in some cases where the treatment plan includes insertion and rigid fixation. In some cases, it can be as a final treatment without the need for a hard fixation^{3,4}. There are several types of the arch bar for IMF, such as Erich, Winters, handmade, and plastic / polymeric^{4,5}. IMF helps maxilla-mandibular positioning in orthognathic surgery, and the use of elastics in the postoperative period of fractures or orthognathic surgery. The most complete IMF procedure comes with the arch bar. However, it has been performed with the use of wires applied directly on the teeth, or with arch bars wired to them⁶. These procedures are time-consuming, and manipulation of the wires lead to the increasing risk of glove puncture and needle stick injury to the surgeon or assistants. These problems lead to inventing alternative techniques. Therefore, aim of the present study was the evaluation of arch fixation without surgical aid in jaw fracture treatment.

Materials and methods

Thirty six patients with mandible fractures who were referred to Poursina Hospital and needed to Arch bar were selected. The patients were divided into two groups. Group I, consisted of 18 patients who were randomly treated with arch bar fixation without an assistant. Group

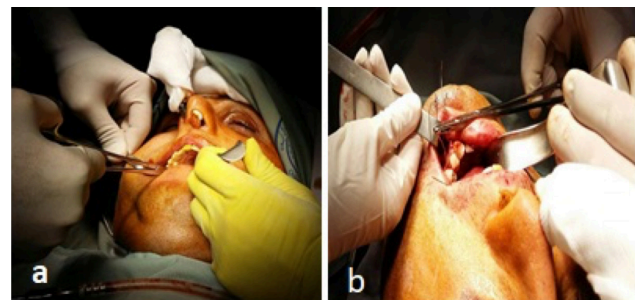
II consisted of 18 patients treated with arch bar fixation with an assistant as a control group. Then, two groups were compared in terms of the time of the wiring arch bar and its vertical mobility after one week and one month, and the number of glove perforations. Arch bar wires used were stainless steel. This new technique consist of following steps; while starting surgery, arch bar and prepared wires are placed on the patient's chest. The wires are prepared in the shape of U, that one arm is longer than another arm (**Figure 1**).

The right-handed surgeon stands on the right side of the patient's head. Then, the assistant only holds the retractor and suction in his hands. Overall during this technique the assistant's role is just retracting and do suction. In this step, the surgeon choose a quadrant (upper right) and holds a farabeuf retractor in one hand and wire holder forceps in the other hand. Also the assistant hold a tongue retractor (Minnesota retractor) and suction (**Figure 2**), then the surgeon begin to pass the U shape wire across the interdental space from the patient's posterior upper jaw teeth one by one to anterior teeth. The surgeon should catch on U wires by a wire holder from the longer arm and pass it through lingual side of each interdental tooth space. After the long arm of U wire passed through the distal interdental of each tooth, the surgeon takes another arm on lingual side by wire holder and pass it through mesial interdental space of the same tooth. When

Figure 1: U-shaped wires with a longer arm to fix the arch bar in the study method.



Figure 2: (a) surgical instruments holding technique at the beginning of surgery by the surgeon and his assistant. (b) the opposite lower quadrant.



the short arm of the wire appears in the Buccal area the surgeon takes both arms of U wire on the buccal side and pull it out until the wire fix beyond the tooth. This process continues for each tooth from posterior to anterior of the quadrant. After that the surgeon goes to another quadrant (its better the upper left side quadrant) and does the steps similar to process that done in the previous quadrant. At this stage, the surgeon immediately gives the farabeuf to his assistant and takes the Minnesota retractor from him for retracting tongue. Then the process continues as above while the assistant retract the buccal with farabeuf and suctioning (**Figure 2**).

The surgeon passes wires from lingual distal and mesial interdental spaces to buccal side and fix it by pulling out and continues this process for each tooth from posterior to anterior. After passing all the wires in the upper jaw and bending them, it is time to place the arc bar between arms in the buccal side and ties wires around arch bar (**Figure 3**).

Figure 3: Arch bar insertion after passing wires around the upper jaw.



After finishing the upper arch bar the surgeon all process as previous for the lower jaw arch bar from right to left and posterior to anterior on each quadrant. Finally, after the surgery, the surgeon recorded the operation time, and then pulled out his gloves in the scrub room. Then, he fills his gloves (MAXTER®) with normal saline to find any perforations (**Figure 4**).

In the control group, the conventional wiring method was used. With a professional assistant that mainly helps for fixing arch bars.

The postsurgical evaluation of the patients arch bars was done in two steps, one in the first week and one

in the first month for measurement the arch bar vertical displacement, looseness rate, by counting vertical displacement in three sites of each quadrant (posterior left, posterior right and anterior). Data were analyzed using SPSS software. Mann Whitney test was used to compare the non-parametric variables between two groups.

Figure 4: Saline filled surgical gloves at the end of operation for punctures.



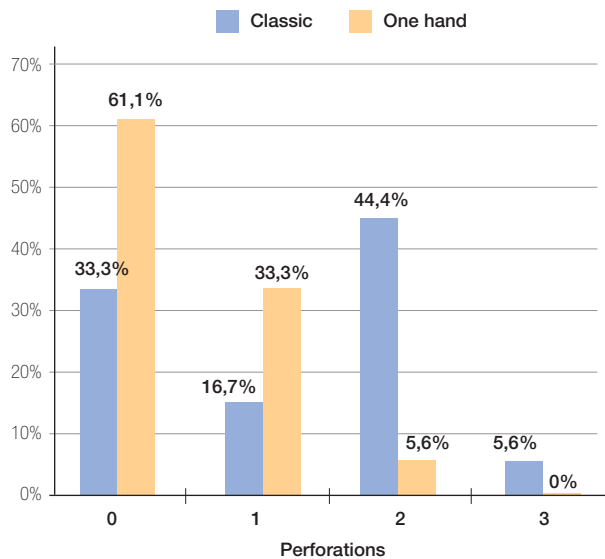
Results

In the present study, we have evaluated the arch fixation method between two groups. They were compared in terms of the time of the wiring arch bar, the number of glove perforations and the looseness rate of the arch. Shapiro-Wilk analysis showed that, the data follow the normal distribution, except for the number of glove perforations variable (**Table I**).

Table I: Determination of variables normality.

P value	Statistic	variable
168/0	984/0	Time of wiring arch bar (minute)
179/0	951/0	Time of wiring arch bar (second)
112/0	061/0	Number of glove perforations
237/0	994/0	Looseness rate of the arch after one week (mm)
102/0	950/0	Looseness rate of the arch after one month (mm)

Therefore, Mann Whitney test was used to compare the number of glove perforations between two groups and independent t-test was used for other variables. There was a statistically significant difference in the number of glove perforations between the classic and the experimental group ($p=0/024$). We observed that, 61/1% of gloves in the experimental group were without holes, but in the classic group, 33/3% of gloves were without holes. In the classic group, 44/4% of gloves had 2 holes and 5/6% of gloves had 3 holes. None of the gloves in the experimental group had 3 holes (**Figure 5**).

Figure 5: Frequency and number of glove perforations in control and experimental groups.

One week after wiring arch bar, there was no significant difference between those groups in the looseness rate ($p_{0/560}$). But after 1 month, a significant difference was found between groups because the average looseness rate in the experimental group was higher ($p_{0/016}$).

Discussion

According to the study of Chhabr, one of the criteria for success in fixing arches in jaw fractures is a smaller incidence of surgical glove perforations⁷. In the present study, the lowest number of glove perforations was seen in the experimental group. Despite the progress made in the fixation of jaw fractures, the IMF is still considered as

References

- Mukerji R, Mukerji G, McGurk M. Mandibular fractures: Historical perspective. *British Journal of Oral and Maxillofacial Surgery*. 2006; 44(3): 222-8.
- Imazawa T, Komuro Y, Inoue M, Yanai A. Mandibular fractures treated with maxillomandibular fixation screws (MMFS method). *Journal of Craniofacial Surgery*. 2006; 17(3): 544-9.
- Onishi K, Maruyama Y. Simple intermaxillary fixation for maxillomandibular osteosynthesis. *Journal of Craniofacial Surgery*. 1996; 7(2): 170-2.
- Bell RB, Wilson DM. Is the use of arch bars or interdental wire fixation necessary for successful outcomes in the open reduction and internal fixation of mandibular angle fractures?. *Journal of Oral and Maxillofacial Surgery*. 2008; 66(10):2116-22.
- Fonseca Raymond J, Walker Robert V, Norman Bett J. *Oral and maxillofacial trauma*. Elsevier (USA) Ed3, 2005; 569-613.
- Texhammar R, Schmoker R. Stable internal fixation in maxillofacial bone surgery: a manual for operating room personnel. Springer Science & Business Media; 2012.
- Chhabra N, Chhabra S, Thapar D. Evaluation of two different methods of arch bar application: A comparative prospective study. *Journal of maxillofacial and oral surgery*. 2015; 14(2): 432-40.
- Pigadas N, Whitley SP, Roberts SA, McAlister K, Ameerally P, Avery CM. A randomized controlled trial on cross-infection control in maxillofacial trauma surgery: a comparison of intermaxillary fixation techniques. *International journal of oral and maxillofacial surgery*. 2008; 37(8): 716-22.
- Crosher RF, Llewelyn J, MacFarlane A. Should patients with facial fractures be regarded as high risk for HIV?. *British Journal of Oral and Maxillofacial Surgery*. 1997;35(1):59-63.
- Lagvankar SP. A new method for arch bar fixation. *British Journal of Oral and Maxillofacial Surgery*. 1990;28(2):131-2.
- Abbasi AJ, Parvin M. New method of arch bar fixation. *British Journal of Oral and Maxillofacial Surgery*. 2017; 6(10):2116-22.

a necessity. Therefore, it is necessary to achieve a more appropriate, faster and more complete method to fixing an arch bar that requires a little time. The minimal risk of infection transmission is one of the most suitable criteria for treating jaw fractures and IMF. Prolonged surgical time, aggressive treatment and the use of sharp instruments during surgery can lead to failure of routine infection control⁸. The method mentioned in this study reduced the surgical time, reduced the risk of infection transmission and the penetration of sharp instruments into the surgeon's hands. Fixation of the arch bar is actually the most dangerous part of treating jaw fractures. The purpose of the present study was not only to present a new method for fixing arch bar as a safe method, but also was to compare the new method with the classic method, which was successful in this regard. Patients requiring arch bar are exposed to high HIV risk⁹. In the present study, the risk of transmission of infection was lower compared to the classical method. Reaching a more appropriate and more effective method to fixing the arch bar has been studied by some researchers^{10,11}. The arch bar fixing time in our presented method was shorter than the classic method for 11 minutes. The shorter fixation time in our study compared to the study conducted by Abassi¹¹ and Lagvankar¹⁰, indicates the importance of the one handed method.

Conclusion

The results of this study showed that the placement of the arch bar without the help of a professional assistant is possible. According to statistical data, presented method had more efficiency due to less working time, fewer glove perforations, and simpler arch bar opening. This technique was called the One Hand Arch bar Placement method by the authors that could be used by surgeons in the future.