Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 4
Open Access

A Novel Technique For Arch Bar Fixation Using Suturing Needle And Wires - A Prospective Study

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Cite this paper as: MANAN GUPTA, RAJPRAKASH BHASKARAN, MURUGESAN KRISHNAN, SANTHOSH P. KUMAR (2024) A Novel Technique For Arch Bar Fixation Using Suturing Needle And Wires - A Prospective Study *Frontiers in Health Informatics, 13* (4), 229-238

Abstract

Background:

Advancements in surgery aim to make procedures atraumatic and reduce operative time. Techniques for interdental wiring, like Erich's arch bar fixation, have seen improvements over time. Maxillomandibular fixation (MMF) is the oldest and most widely used technique of immobilization of jaws for management of facial trauma. Although arch bar provides sufficient immobilization, it has a number of disadvantages. It is a cumbersome procedure and requires much time especially for trainees to pass the wires interdentally. Many simple modifications have been tried in reducing application time and hence increasing patient comfort, but none tried to modify the wire. The aim of this study is to evaluate a new technique in reducing intra operative time, patient comfort in terms of pain and ease of operator in Erich's arch bar fixation.

Results:

It was found that the operative procedure was difficult in 4.3%, moderate in 47.8% and easy in 47.8% of the participants in experimental group (Group A), while difficult in 52.2%, moderate in 39.1% and

easy in 8.7% of the participants in the control group (Group B). The mean visual analog score (VAS) was 2.96 with standard deviation (SD) of 0.97 in group A while 4.65 with SD of 0.88 in group B. Mean operative time in group A was 41.61 minutes with SD 5.4 while in group B was 60.04 minutes with SD of 6.2.

Conclusion:

The technique is time-saving and more comfortable to operator as well as patient over conventional use of straight wires in Erich's arch bar fixation.

***Keywords**: Arch Bar, Suturing Needle, Wires, Pain, Ease of operator, Intra operative time*

INTRODUCTION:

Maxillomandibular fixation (MMF) is the oldest and most widely used technique of immobilization of jaws for management of facial trauma (1). Immobilization of the fractured bone segments aims to reduce the motion along the continuity disruption, which is important to promote timely healing or union. Although technology has advanced to a position where most of the cases of maxillofacial fracture can be treated by open reduction and internal fixation (ORIF) with ease, but traditional conservative methods still hold their place in management of adequate occlusal stability (2). The most commonly used MMF technique for management of facial trauma is the wired arch bar. The primary goal in management of maxillofacial fractures is to keep the reduced fracture segment stabilized by achieving dental occlusion. Although it provides sufficient immobilization, it has a number of disadvantages. It is a cumbersome procedure and requires much time especially for trainees to pass the wires interdentally (3). As one has to operate in confined area, presence of many wires ends close to each other create difficulty to pass each individual wire below and above the Erich's arch bar. This difficulty could be avoided if pre-stretched wires are available attached with suturing needle. A simple modification of MMF technique allows easy passing of wire interdentally, reducing application time and hence increasing patient comfort. Although time is not a factor to judge the superiority of one technique or instrument over the other but it gives a reflection of the overall comfort throughout the procedure. Keeping these facts in mind, we attempted to design a simple technique to pass wires interdentally in a shorter period of time to eventually reduce overall time for Erich's arch bar fixation that can provide sufficient immobilization (2).

MATERIAL AND METHODS

This prospective study was carried out at Saveetha Dental College, Chennai, Tamil Nadu, in the Department of Oral and Maxillofacial Surgery. The sample size was calculated using the G-power software with a confidence interval of 95%. Using simple randomization, fifty participants were included in the study, and they were divided into group A (experimental group) in which new technique was used, using a pre-stretched 6 cm long 26-gauge soft stainless-steel wire welded to 3/8 reverse cutting needle at the eyed end. While conventional technique of using only pre-stretched 6 cm long wires were used in Group B for arch bar fixation. Similar post-operative instructions and medications were given to patients in both groups.

Inclusion criteria

Patients in the age range of 18-60 years, irrespective of gender, requiring arch bar fixation in both upper and lower arches were enrolled in the study.

Exclusion criteria

Patients who are medically compromised like diabetes and hypertension, smokers, alcoholics, pregnant females, anxious patients, episodes of epilepsy, presence of inflammation or infection at the surgical site, partially or completely edentulous and the presence of prosthesis in the oral cavity were excluded from the study.

Surgical procedure

Under standard aseptic conditions, patient draping was done, and intraoral irrigation was done using 0.9% normal saline. In group A, the invention consists of 2 parts, one is the 24 mm long 3/8 reverse cutting suturing needle for guiding the wire into interdental area, secondly 6 cm long 26 G soft stainless-steel wire. The technique merges the simple principle of suturing and interdental wiring, where stainless steel wire is welded to 3/8 stainless steel reverse cutting suturing needle at the eyed end to make it a single entity, giving maximum mechanical strength possible **[Figure 1]**. Arch bar ends were bend to the contour of the 1st molar bilaterally.

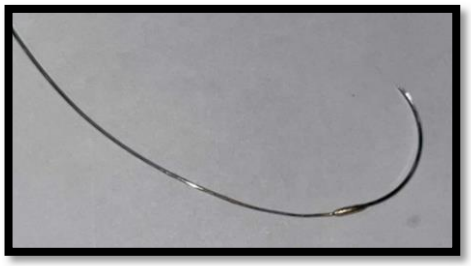


Figure 1: Stainless steel wire welded to 3/8 stainless steel reverse cutting suturing needle

The needle is glided into the embrasure area below contact point of the 2 adjacent teeth from the buccal side below the arch bar and pulled from lingual side with help of needle holder **[Figure 2]**, then encircling the tooth it can inserted from the lingual side and pulled from the buccal side above the arch bar.

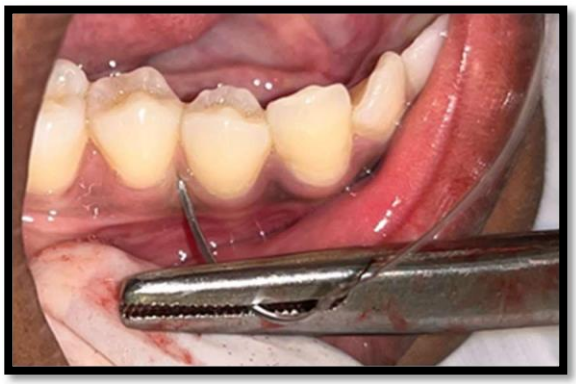


Figure 2: Needle glided into the embrasure area

Once the wire is nicely fit around the tooth, both the ends of wire can be held tightly and tie the arch bar individually to each tooth using apical pull while twisting wire. Secure full arch with a wire loops which can safely be placed around stable teeth. After twisting the wire is cut and rosette neatly into embrasures **[Figure 3]**. Place into maxillomandibular fixation with wire or elastics andocclusion was checked.

Figure 3: Arch bar is secured with wires

Similarly, in group B, conventional technique was followed using wires and arch bar only and same over/under arch bar technique. Similar post-operative instructions and medications were given to patients in both groups. Patients were instructed to use any mouthwash. Patients were recalled at regular intervals for checkup.

Outcome parameters

Clinical parameters that were assessed in the study are operative time, pain and ease of operator. Pains were assessed using the 10-point Visual analog scale (VAS). Ease of operator was described in terms of how comfortable the operator was while performing the procedure and was scored as difficult, moderate and easy, which were given scores of 1, 2 and 3 respectively for the purpose of statistical evaluation.

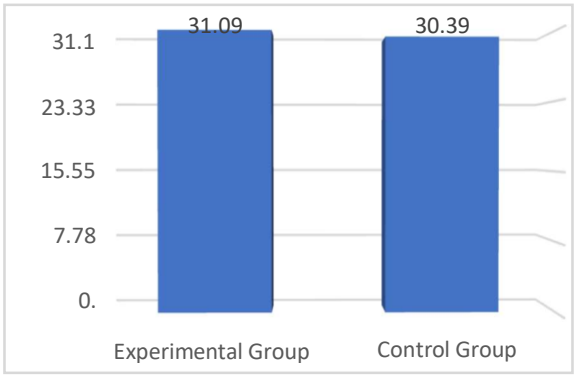
Statistical analysis

Data will be entered into the Excel sheet. Data will be analyzed using SPSS (Statistical Package for Social Sciences) 22.0 version, IBM Corp. Descriptive statistics will be performed. Categorical data will be compared using the Chi-Square test and continuous data between the groups will be compared using the unpaired‘t’ test or Mann-Whitney U test. The level of significance will be set at $P \leq 0.05$.

RESULTS

Comparison of mean age of participants between the groups

It was found that there was no statistically significant difference in mean age of study participants between the experimental and control group ($P = 0.76$). (**Graph 1, Table 1**)



Graph 1: Mean age of study participants between the groups

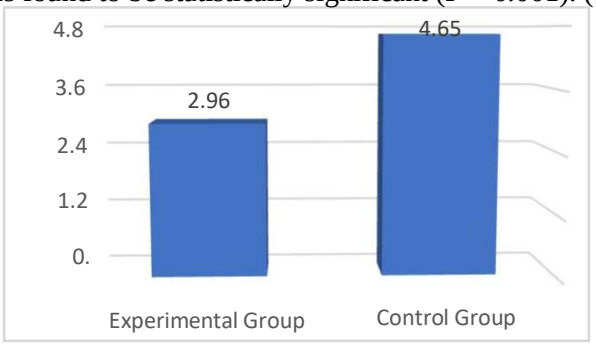
Table 1: Comparison of mean age of participants between the groups

	Number	**Mean**	**SD**	**t**	**P value**
Experimental Group	23	31.09	6.1	0.305	P = 0.76
Control Group	23	30.39	9.02		NS

SD-standard deviation; NS-not significant using unpaired t-test

Mean pain scores (VAS) of study participants between the groups

It was found that participants in the control group higher pain scores than participants in the experimental group. The mean difference in pain scores was found to be statistically significant (P = 0.001). (**Graph 2, Table 2**)



Graph 2: Mean pain scores (VAS) of study participants between the groups

Table 2: Comparison of mean pain scores (VAS) of study participants between the groups

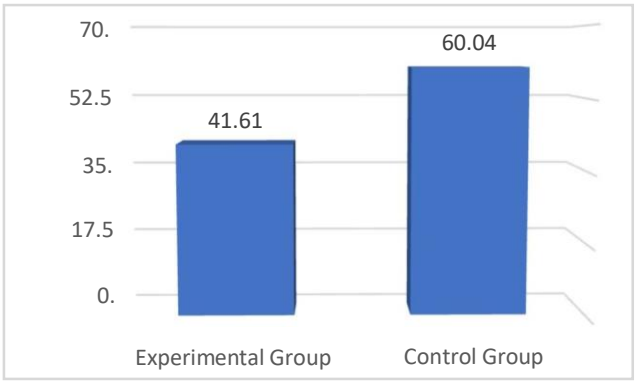
	Number	**Mean**	**SD**	**t**	**P value**
Experimental Group	23	2.96	0.97	-6.17	P = 0.001**
Control Group	23	4.65	0.88		

SD-standard deviation; **statistically significant using unpaired t-test

Mean operative time between the two groups

It was found that mean operative time taken was found to be longer in the control group when compared to the

experimental group. The mean difference between the group was found to be statistically significant (P = 0.001). (**Graph 3, Table 3**)



Graph 3: Mean operative time between the two groups

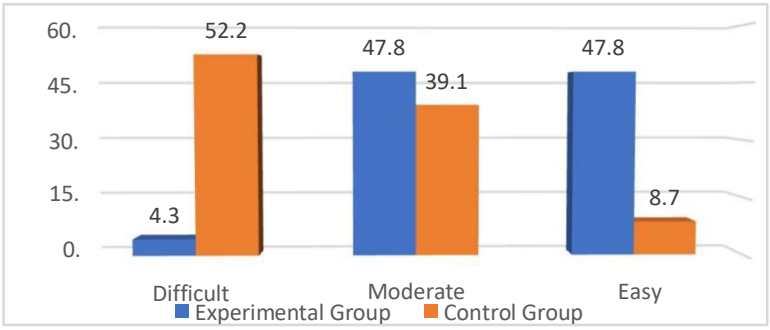
Table 3: Comparison of mean operative time between the two groups

	Number	**Mean**	**SD**	**t**	**P value**
Experimental Group	23	41.61	5.4	-10.64	P = 0.001**
Control Group	23	60.04	6.2		

SD-standard deviation; **statistically significant using unpaired t-test

Distribution of participants according to ease of operator

It was found that the operative procedure was difficult in 4.3% of the participants in experimental group (Group A) when compared to 52.2% of the participants in the control group (Group B). In addition, the operative procedure was moderate in 47.8% of participants in experimental group when compared to 39.1% of participants in control group. Furthermore, the operative procedure was found to be easy in 47.8% of the participants in experimental group when compared to 8.7% of the participants in the control group. This difference in distribution was found to be statistically significant (P = 0.001). (**Graph 4, table 4**)



Graph 4: Distribution of participants according to ease of operator

Table 4: Distribution of participants according to ease of operator

	Experimental Group	Control Group	Total	P value
Difficult	1 (4.3)	12 (52.2)	13	
Moderate	11 (47.8)	9 (39.1)	20	P = 0.001**
Easy	11 (47.8)	2 (8.7)	13	
Total	23 (100)	23 (100)	46	

**Statistically significant using Chi-square test

DISCUSSION

Maxillofacial trauma is any physical trauma to the facial region, is commonly encountered by maxillofacial surgeons, and associated with high morbidity (4). The maxillofacial region can be divided into three parts: (i) the upper face – the frontal bone and frontal sinus (ii) the midface – the nasal, ethmoid, zygomatic, and maxillary bones; and (iii) the lower face – the mandible (5). In a retrospective survey conducted between 2009 and 2017, with 944 patients of maxillofacial trauma in Chennai, the most common etiological factor observed was RTAs, followed by assault and falls. However, the most common bone involved was the mandible, and in the mid face region, zygomatic maxillary complex fractures were the most common (6). They can be treated by ORIF or closed reduction (IMF). ORIF is substantially proven to be a universally accepted, gold standard treatment for mandibular fractures owing to its several advantages. It was noted that the most common complication was infection leading to plate removal (7). The other complications that followed them were wound dehiscence, occlusal disturbances, and neurological disturbances such as paresthesia and facial nerve paralysis (FNP). Inferior alveolar nerve paresthesia in patients was transient and resolved within 3–6 month postoperatively (8). The goal of MMF is to provide indirect stabilization of fractures of the maxilla, the mandible, or both (9). The most commonly used MMF technique for management of facial trauma is the Erich's arch bar. According to D.V. Trupthi at el. average time of application of Erich's arch bar is 68.25 min (10) while by Pankaj Pathak at el. it is 82.50 min (11) and Brett J King at el. it is 31.3 ±9.3 minutes (12). The variation noticed is mainly dependent of the experience of the operator since the most time consuming and technique sensitive step is passing of wires interdentally which usually involves bending of tip of wire after hitting the tooth, bone or arch bar. Thus, increasing the time of procedure, damages more of papilla and wasting of wires. Since time, patient comfort and ease of doing a procedure enhances the quality of treatment (13). Hence many different methods have been done to reduce the duration of its application by bonding it with teeth or using hybrid arch bars but were never able to provide the amount of stability achieved with wires (14).

Our study concludes that a statistically significant reduction is noticed in duration of procedure with the use of combination of suture needle and wires compared to the conventional technique. Pain can be reduced during the procedure and hence increase patient corporation in the group using new technique compared to the group using conventional technique.

Thus, the novel technique for arch bar fixation using a suturing needle and wires holds promising future prospects due to its advantages over conventional methods. It is simple, less technique sensitive, requires much lesser time by reducing the number of attempts, increases the patient's comfort and causes less wastage of wires.Also beyond

maxillofacial trauma, the technique could be adapted for other surgical contexts requiring temporary stabilization or fixation, such as orthognathic surgeries.It's important to note that while the study highlight the only few potential benefits,integration with other advanced materials or technologies, such as bioengineered wires orrobotic-assisted surgery, could further enhance its utility. Further scientific research and testing is required to validate and quantify these claims in different applications. While for education and training purpose, incorporating this technique into medical and dental curricula could standardize its use (15).

Limitations of the study

The limitations of the study were that, it was conducted on a small population with limited parameters and under different conditions. In further studies, the sample size has to be increased. The study was also conducted at a single center; further studies must be conducted at multiple centers.

CONCLUSION

Passing of the wires interdentally while fixing the Erich's arch bar consume most of the time, this can be reduced significantly if suturing needle is attached to the wire in order to prevent its tip from bending unnecessarily after hitting bone, tooth or arch bar and thus allow its smooth passage requiring a smaller number of attempts than conventional technique. Another reason for more patient comfort and less chances of tissue damage is the curvature in the needle which follows the path of embrasure area, hence making this technique more successful, superior and less technique sensitive than the conventional technique.

Declarations

Ethics approval and consent to participate
The study got approval from the Institutional Human Ethical Committee (IHEC) with the reference number - IHEC/SDC/OMFS-2301/24/032. Treatment consents were obtained from all participants after explaining the procedure to the patient.

Consent for publication
All necessary consents were obtained from all participants for treatment and publication.

Availability of data and material
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interests.

Funding
It was a self-funded study.

Acknowledgements
To Saveetha Dental College, Chennai - Tamil Nadu, in the Department of Oral and Maxillofacial Surgery and Banthia & Co. Advocates.

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