

# Evaluation of the Effect of Platelet Rich Fibrin Membrane on the Neurosensory Function Following Inferior Alveolar Nerve Lateralization for Implant Placement

Eman S. Shalaby<sup>1</sup>, Salah Yassin<sup>2</sup>, Ann Ali Abd-alkader<sup>3</sup>, Abdelmoez Elsharkawy<sup>4</sup>

<sup>1</sup>Assistant Lecturer, Oral and Maxillofacial Surgery Department Faculty of Dentistry Cairo University in Egypt., <sup>2</sup>Professor, Oral and Maxillofacial Surgery-Cairo University, <sup>3</sup>Professor of Neurophysiology-Faculty of Medicine-Cairo University, <sup>4</sup>Lecturer of Oral and Maxillofacial Surgery Department Faculty of Dentistry, Cairo University in Egypt

## Abstract

**Aim:** The aim of this study was to evaluate the effect of PRF membrane on the neurosensory disturbance of the inferior alveolar nerve following IAN lateralization surgery for immediate implant placement.

**Methodology:** The study was conducted on six patients underwent IAN lateralization surgery for immediate implant placement and the nerve was surrounded by PRF membrane. The neurosensory disturbance was evaluated using visual analogue scale preoperatively and postoperative at 1 week, 2 weeks, 1 month, 3 month and 6 month.

**Results:** At 1 week post-operative 100% of the patients had recorded complete absence of sensations in the lip and chin region. At 6 month post-operative (66.6%) of the patients has recorded score 4 and (33.3 %) of the patients have recorded score 5.

The mean and median value significantly decreased at one week post-operatively, then gradually increased in the subsequent observations. Friedman test revealed a significant difference between observations ( $p=0.00$ ).

**Conclusions:** The PRF membrane resulted in no immediate postoperative improvement of the neurosensory disturbance of the inferior alveolar nerve following IAN lateralization surgery for immediate implant placement and the nerve recovery followed the normal course.

**Keywords:** *Inferior alveolar nerve lateralization, inferior alveolar nerve repositioning, posterior atrophic mandible, inferior alveolar nerve neurosensory disturbance, platelet rich fibrin membrane.*

## Introduction

Rehabilitation of the posterior atrophic mandible with dental implant placement is complicated by the critical amount of residual bone above the mandibular canal.<sup>(1)</sup>

Inferior alveolar nerve repositioning has been used in cases of severely resorbed posterior edentulous atrophic mandibles when the bone height above IAN is less than 4 to 8 mms for immediate implant placement depending on the mandible native bone with high success and survival rates.<sup>(1,2)</sup>

There are two main techniques for IAN repositioning: IAN lateralization and IAN transposition. In the lateralization technique, a corticotomy is done to expose the IAN and then the nerve is retracted laterally during implant placement. Then the nerve is left to fall back into position, against the implants surface. In the transposition technique, another corticotomy is done

---

### Corresponding Author:

**Eman Sayed Ahmed Shalaby**

Address: 84 Elmahatta Elgharby Street, El-marg, Cairo, Egypt.

e-mail: emmoshalaby@gmail.com

Telephone Number: +201004762274

around the mental foramen and the incisive nerve is transacted to allow transposition of both mental and inferior alveolar nerve. (3)

IAN repositioning surgery has the advantage of permitting insertion of long implants (>10 mms) depending on the mandibular available bone without the need for augmentation procedures.(4) The use of long implants provides good survival and success rates in comparison with short implants due to better stress distribution of occlusal forces and better crown root ratio. (5)

The major complication of IAN repositioning is the neurosensory disturbance following the procedure.(2,6). Nerve damage can occur at any step during the surgery including the osteotomy, releasing of the nerve from the canal, retraction of the nerve outside the canal during drilling of the implant site and implant insertion. These surgical maneuvers cause mechanical trauma to the neurovascular bundle, also the postoperative ischemic edema and probable hematoma or chronic compression or irritation after surgery.(7,8)

Platelet rich concentrates such as Platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) have been administered as adjuvant therapies for nerve regeneration.(9,10)

The growth factors released from PRF may play an important role in nerve regeneration such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), fibroblast growth factor, epidermal growth factor, transforming growth factor-b1 (TGF-b1).(11,12)

The aim of this study is to assess the effect of PRF membrane on the healing of postoperative neurosensory disturbance following inferior alveolar nerve lateralization.

## Materials and Method

This study was conducted on six patients selected from the oral and maxillofacial surgery outpatient clinic of the academic hospital of the Faculty of Dentistry - Cairo University.

The eligible sides underwent Inferior alveolar nerve (IAN) lateralization with simultaneous dental implant

placement, the IAN was wrapped with PRF membranes to insulate it from implant and bone interface.

**Eligibility Criteria:** Adult patients with vertically atrophied posterior mandibular region, less than 8mm of bone above the mandibular canal requiring oral rehabilitation with dental implants. Patients should be free from any systemic conditions that may affect normal healing. Absence of any pathological conditions involving mandibular bones.

**Preoperative patient assessment:** All patients underwent CBCT examination for assessment of the IAN position. Patients with bone height less than 8mm of bone above the IAN were included in the study.

### Surgical Protocol:

- All the surgical procedures were performed under general anesthesia.

**Preparation of Platelet rich Fibrin:** 60 ml of venous blood samples were collected in vacutainer tubes. The tubes were immediately centrifuged at 3000 rpm for 15 minutes. The fibrin clot was gently extracted from the tube and separated from the surrounding layers by scissors. The PRF was then pressed in a special PRF box to produce the PRF membranes.

### Surgical Procedures:

- An intraoral crestal incision was performed beginning from retromolar area and ending with a releasing incision mesial to the location of the mental foramen. A full thickness mucoperiosteal flap was then reflected.
- For the exposure of the inferior alveolar neurovascular bundle, a bony window was cut using bone discs mounted on a low speed contra-angled headpiece according to the following parameters: (fig. 1).
  - The anterior border was cut 3-4 mm distal to the mental foramen.
  - The posterior border was cut 4-5 mm distal to the site of the most distal implant.
  - The upper and lower borders were cut 2-3mm above and below the mandibular canal respectively.



**Fig (1): The bony window for nerve exposure.**

- The neurovascular bundle was then completely released from the canal. Then a rectangular piece of sterile gloves was passed medial to it and used to retract the nerve laterally during implant drilling and placement.
- The PRF membrane was passed medial to the nerve to insulate the IAN from the implant surface and then was fully wrapped around the nerve to form a tubule around it. Fig (2).
- Tension free soft tissue closure of the flap was achieved using 4-0 resorbable sutures.



**Fig (2): Showing placement of the PRF membrane.**

**Outcome:** Subjective evaluation of the neurosensory function of the inferior alveolar nerve using visual analogue scale was performed **preoperative** as a base line then *postoperative* at time intervals (one week, two weeks, one month, three months and six months) to describe the alteration in sensation in the lower lip.

Using a visual analogue scale (VAS) 10 cm, 5 degree visual analogue scale with divisions at 2.5 cm intervals, the divisions on the VAS was:

1. Complete absence of sensations.

2. Almost no sensation.
3. Reduced sensation.
4. Almost normal sensation.
5. Fully normal sensation.

Patients were asked to mark “x” on the line at each testing session that represent their opinion about sensation of the lower lip and chin region.

**Statistical Analysis::** Data management and statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) version 18. Numerical data were summarized using means, standard deviations, median and range. Data were explored for normality by checking the data distribution and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Comparison of different observations within the group was performed by paired t test. None normally distributed numeric variables were compared by Mann-Whitney test. Comparisons over time regarding numeric variables were done by Friedman test and pairwise difference were detected by the Wilcoxon Signed rank test. Qualitative variables were expressed as number and percentages and were compared using Chi square test. P-values  $\leq 0.05$  were considered significant.

## Results

This study was conducted on six patients with residual bone height above the mandibular canal ranging from 4mm to 7mm. Five female patients and one male patient with age range 39-59 years.

**Subjective examination Results:** Preoperatively all the patients had a normal sensation on the lip and chin region in the indicated sides of surgeries and all of them had recorded VAS score 5.

At 1 weeks post-operative all the patients (100%) had recorded complete absence of sensations in the lip and chin region (VAS1).

At 2 weeks post-operative 3 patients recorded score 1 (50%) while the other 3 patients recorded score 2 (50%).

At 1 month postoperative 3 patients recorded score 3 (50%), 2 patients recorded score 2 (33.3%) and 1 patient recorded score 4 (16.7%),

At 3 month postoperative 2 patients recorded score 3 (33.3%), 3 patients has score 4 (50%) and one patient has recorded score 5 (16.7%),

At 6 month post-operative 4 patients (66.6%) has recorded score 4 and 2 patients have recorded score 5 (33.3%).

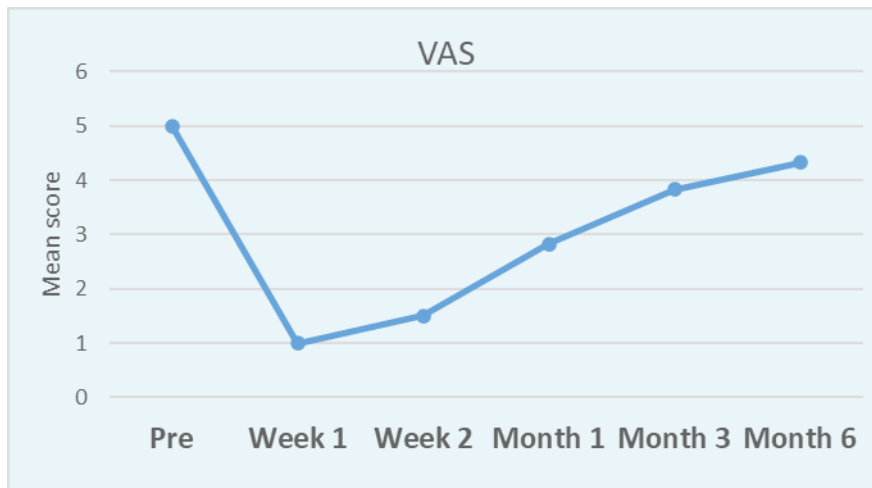
The mean and median value significantly decreased at one week post-operatively, then gradually increased

in the subsequent observations. Friedman test revealed a significant difference between observations ( $p=0.00$ ). Wilcoxon signed Rank test revealed no significant difference between Week 1 and week 2. Moreover, 3 and 6 months were not significantly different. (Table 1, Fig. 3).

**Table (1): Descriptive statistics of visual analogue scale, comparison of different observations over time (Friedman test)**

		Pre	Week1	Week2	1 Month	3 Month	6 Month	P (by time)
Group I	Mean±SD	5±0	1±0	1.5±0.55	2.83±0.75	3.83±0.75	4.33±0+.52	0.00*
	Median (range)	5 (5)	1 (1)	1.5(1 to 2)	3 (2 to 4)	4 (3 to5)	4 (4 to 5)	

Significance level  $p \leq 0.05$ , \*significant, ns=non-significant



**Fig. (3): Bar chart illustrating mean value of visual analogue scale at different observation times.**

### Discussion

Inferior alveolar nerve repositioning techniques are used for rehabilitation of edentulous posterior atrophic mandible where the use of standard dental implants or short dental implants is problematic without augmentation procedures to avoid injury of inferior alveolar nerve. Despite the great advantages offered by these techniques the postoperative neurosensory dysfunction in the lower lip and chin region is considered as a major complication which may lead to long term discomfort in some patients.

Some authors recommended the use of intervening material such as bone graft or resorbable membranes to act as a biological barrier between the threaded implant surface and the IAN to prevent nerve irritation subsequently decrease the NSD.<sup>(8,13)</sup>

The presence of a resorbable membrane as a barrier between the nerve and implant surface will allow presence of a larger distance between them and formation of a soft tissue zone thus serve to decrease the postoperative neurosensory dysfunction at least prevent thermal conduction via the implant. (14)

PRF membrane showed a good results when used as adjuvant agent in experimental and clinical studies for acceleration and promotion of nerve regeneration capacity and the nerve functional recovery.<sup>(9,15)</sup>

The results of subjective evaluation in this study showed presence of high percentage of the NSD following inferior alveolar nerve lateralization, this percentage reach to 100% of the patients. These results confirmed that the surgery of IAN lateralization carries an inherent risk of postoperative neurosensory disturbances in the

lip and chin region. These results are in line with many previous studies and systematic reviews. <sup>(2,6)</sup>

The results of this study showed that the PRF membrane has no significant effect on the immediate initial postoperative NSD following the surgery and the presence of the PRF membrane did not prevent the initial postoperative symptoms. Also the results showed that the patients returned to almost normal (VAS 4) or completely normal sensation (VAS 5) at 6 months postoperatively which indicate that the PRF membrane has no significant effect on decreasing the period of nerve healing.

The results of the current study are in contrast to the results of many experimental and clinical studies which showed that the PRF membrane can promote the histological and the functional recovery of the nerve healing.

The experimental study on segmental defect of the sciatic nerve of rats by Roth *et al.*, showed that PRF produce outcomes similar to the autogenous graft regarding functional recovery, and advocated the use of vein conduits filled with PRF as a favourable alternative treatment to nerve grafts. <sup>(16)</sup>

Also the experimental study by Torul *et al.*, on the Crush-type injury model on the sciatic nerves of rats, the results showed that PRF improved the functional recovery and axonal regeneration. <sup>(17)</sup>

The results of the current study are in agreement with the result of the experimental study by Senses *et al.*, on the sciatic nerve regeneration after segmental defect which concluded that PRF decreases functional recovery in sciatic nerve injury and histopathologic examination revealed that it may have negative effect on nerve regeneration. <sup>(18)</sup>

Also our results are in agreement with the study by which study the tubulisation effect of the PRF on the crush injury model. The results showed no improvement in the functional recovery of peripheral nerve crush injury model also there was no improvement of the axonal density. <sup>(19)</sup>

The results of the current study may be explained by that the PRF membrane tubulisation effect is not reliable and not effective as stated by Bayram *et al.*, or because most of the studies which showed positive effects of the PRF membrane on nerve healing was related to actual

nerve cutting which not resembling the injury type in the current study.

**Conclusion:** The results of this study showed that the PRF membrane has no significant effect on the immediate initial postoperative NSD following the surgery and the presence of the PRF membrane did not prevent the initial postoperative symptoms. Also the results showed that the patients returned to almost normal or normal sensation at 6 months postoperatively which indicate that the PRF membrane has no significant effect on decreasing the period of nerve healing.

**Funding:** The study was self-funded

**Competing Interests:** No conflict of interest

**Ethical Approval:** The Ethics and research committee, Faculty of Dentistry, Cairo University approved the study and patients' consent was obtained.

**Sources of Support:** This search did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## References

1. Sethi A, Banerji S, Kaus T. Inferior alveolar neurovascular bundle repositioning: a retrospective analysis. *Int J Oral Maxillofac Surg* [Internet]. 2017 Apr [cited 2019 Aug 15];46(4):518–23. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0901502717300206>
2. Rathod M, Kshirsagar RA, Joshi S, Pawar S, Tapadiya V, Gupta S, et al. Evaluation of Neurosensory Function Following Inferior Alveolar Nerve Lateralization for Implant Placement. *J Maxillofac Oral Surg* [Internet]. 2019 Jun 2 [cited 2019 Oct 12];18(2):273–9. Available from: <http://link.springer.com/10.1007/s12663-018-1124-1>
3. Abayev B, Juodzbalys G. Inferior Alveolar Nerve Lateralization and Transposition for Dental Implant Placement. Part II: a Systematic Review of Neurosensory Complications. *J oral Maxillofac Res* [Internet]. [cited 2019 Jul 25];6(1):e3. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25937874>
4. Khajehahmadi S, Rahpeyma A, Bidar M, Jafarzadeh H. Vitality of intact teeth anterior to the mental foramen after inferior alveolar nerve repositioning: Nerve transpositioning versus nerve lateralization. *Int J Oral Maxillofac Surg*. 2013;42(9):1073–8.

5. Papaspyridakos P, De Souza A, Vazouras K, Gholami H, Pagni S, Weber HP. Survival rates of short dental implants ( $\leq 6$  mm) compared with implants longer than 6 mm in posterior jaw areas: A meta-analysis. Vol. 29, *Clinical Oral Implants Research*. Blackwell Munksgaard; 2018. p. 8–20.
6. Martínez-Rodríguez N, Barona-Dorado C, Cortes-Breton Brinkmann J, Martín-Ares M, Leco-Berrocal MI, Prados-Frutos JC, et al. Implant survival and complications in cases of inferior alveolar nerve lateralization and atrophied mandibles with 5-year follow-up. *Int J Oral Maxillofac Surg* [Internet]. 2016 Jul [cited 2019 Dec 21];45(7):858–63. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26837718>
7. Hirsch JM, Brånemark PI. Fixture stability and nerve function after transposition and lateralization of the inferior alveolar nerve and fixture installation. *Br J Oral Maxillofac Surg*. 1995;33:276–81.
8. Hassani A, Saadat S, Moshiri R, Shahmirzadi S, Hassani A. Nerve Retraction During Inferior Alveolar Nerve Repositioning Procedure: A New Simple Method and Review of the Literature. *J Oral Implantol* [Internet]. 2013 Dec 17 [cited 2015 Apr 7]; Available from: <http://www.ncbi.nlm.nih.gov/pubmed/24344674>
9. Lichtenfels M, Colomé L, Sebben AD, Braga-Silva J. Effect of platelet rich plasma and platelet rich fibrin on sciatic nerve regeneration in a rat model. *Microsurgery*. 2013;33:383–90.
10. Bastami F, Vares P, Khojasteh A. Healing effects of platelet-rich plasma on peripheral nerve injuries. *J Craniofac Surg*. 2017;
11. Jiang H, Qu W, Li Y, Zhong W, Zhang W. Platelet-derived growth factors-bb and fibroblast growth factors-base induced proliferation of schwann cells in a 3D environment. *Neurochem Res*. 2013;
12. Oya T, Zhao YL, Takagawa K, Kawaguchi M, Shirakawa K, Yamauchi T, et al. Platelet-derived growth factor-B expression induced after rat peripheral nerve injuries. *Glia*. 2002;
13. de Campos C, Francischone C, Assis N, Devito K, Sotto-Maior B. Neurosensory Function and Implant Survival Rate Following Implant Placement With or Without an Interposed Bone Graft Between the Implant and Nerve: Prospective Clinical Trial. *Int J Oral Maxillofac Implants*. 2019;
14. Kahnberg KE, Henry PJ, Tan AES, Johansson CB, Albrektsson T. Tissue Regeneration Adjacent to Titanium Implants Placed with Simultaneous Transposition of the Inferior Dental Nerve: A Study in Dogs. *Int J Oral Maxillofac Implant*. 2000;
15. Khojasteh A, Hosseinpour S, Nazeman P, Dehghan MM. The effect of a platelet-rich fibrin conduit on neurosensory recovery following inferior alveolar nerve lateralization: a preliminary clinical study. *Int J Oral Maxillofac Surg*. 2016;
16. Roth F, Fernandes M, Valente SG, Santos JBG, Furukawa RB, Fernandes CH, et al. Platelet-Rich Fibrin Conduits as an Alternative to Nerve Autografts for Peripheral Nerve Repair. *J Reconstr Microsurg*. 2017;
17. Torul D, Bereket MC, Onger ME, Altun G. Comparison of the Regenerative Effects of Platelet-Rich Fibrin and Plasma Rich in Growth Factors on Injured Peripheral Nerve: An Experimental Study. *J Oral Maxillofac Surg*. 2018;
18. Senses F, Önder ME, Koçyigit ID, Kul O, Aydin G, Inal E, et al. Effect of platelet-rich fibrin on peripheral nerve regeneration. *J Craniofac Surg*. 2016;
19. Bayram B, Diker N, Akdeniz S, Helvacioğlu F, Tekindal MA, Erdem R. Effects of platelet-rich fibrin on sciatic nerve regeneration: a histomorphometric study. *Int J Oral Maxillofac Surg*. 2017.