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ORIGINAL ARTICLE

# Role of Platelet Rich Plasma in Sciatic Autogenous Nerve Grafts Regeneration in Male Albino Rats; Experimental Study

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## ABSTRACT

**Background:** There have been attempts to promote vascularization surrounding the nerve and boost SC activation and proliferation since peripheral nerve injuries frequently result in poor functional recovery. Rich in growth factors, platelet-rich plasma (PRP) has demonstrated promise in fostering neuron regeneration and tissue repair. This study aimed to evaluate the effect of local administration of PRP on nerve grafts regeneration.

**Methods:** In this experimental study, twenty male Sprague-Dawley rats (250–350g) were used. Six rats served as PRP donors, while the remaining 14 underwent sciatic nerve grafting, with nerve segments measuring approximately 1cm. Nerve repair was performed using 9/0 polypropylene sutures under a surgical microscope. In the grafted rats, PRP was locally applied to the repair site on the right side, while the left side underwent standard repair without PRP, allowing for comparative analysis of regenerative outcomes.

**Results:** Proximal nerve fiber counts (right: 215.7±68.6; left: 182.8±63.7) showed no significant difference (p=0.201), suggesting PRP's limited proximal impact. Conversely, distal counts on the PRP-treated right side (192.8±58.8) were significantly higher than the left (133.7±49.6; p=0.008), highlighting PRP's distal efficacy. On the right, proximal-to-distal fiber density decreased slightly (215.7vs. 192.8; p=0.353), indicating consistent regeneration. In contrast, the left side exhibited a significant proximal-to-distal decline (182.8vs. 133.7; p=0.031). Right graft site counts (right:172±43.07) (left:129.14±33.38) p value: 0.0076. underscoring PRP's role in maintaining axonal growth. **Conclusions:** Platelet-rich plasma significantly enhances peripheral nerve regeneration, particularly at the distal graft segment, as evidenced by higher nerve fiber counts, whereas no substantial difference was observed proximally.

**Keywords:** Platelet-rich plasma (PRP); Nerve Graft; Nerve Fiber Density; Neurotization Index

## INTRODUCTION

Peripheral nerve injuries are relatively common and have a large societal cost; 2.8% of all trauma patients experience morbidity from them, leaving many with long-term disability [1].

Nerve graft reconstruction is still the gold standard and yields the best results, even though there are other ways to fix nerve abnormalities. However, recovery rates might not be enough even when nerve grafts are utilized to repair nerve deficiencies [2].

To support the existing gold standard approach, studies on nerve regeneration have examined the possibilities of other treatments, such as growth factors, hormones, and mediators.

Platelet rich plasma (PRP) is utilized as an autologous cell treatment and contains numerous bioactive plasma and platelet alpha granules that aid in tissue repair and wound healing [3].

It is a completely safe process that can be made from autologous blood samples. PRP preparation is quick, easy, practical, and affordable [4].

However, it has been shown that PRP performs worse than autologous nerve grafting whether used as a scaffold for nerve defect locations or as a filler for artificial nerves [5].

Some experimental research has revealed that PRP has a favorable effect on nerve regeneration [6] .

This study aimed to evaluate the effect of local administration of platelet rich plasma on nerve grafts regeneration.

## METHODS

This experimental and histopathological study was conducted at the Zagazig University Hand and Microsurgery Center (ZUHMC), Plastic and Reconstructive Surgery Department, Faculty of Medicine, Zagazig University, Egypt. The study period extended from May 2023 to April 2024. All animals were obtained from a controlled microsurgery laboratory to minimize experimental variability. Included (20) spargue-dawley young adult male rats with an average weight of 250-350 grams that were all subjected to the experiment, six of them were used as donors of PRP while (14) rats were subjected to harvesting of sciatic nerve graft measuring about 1cm and then separated into two equal parts and repaired under a surgical microscope using 9/0 polypropylene sutures; Group 1: After nerve restoration, activated PRP was injected across the epineurium on the right side (PRP group). Group (2), the control group on the left: merely the primary repair. The Institutional animal care and Use committee of the Faculty of Medicine, Zagazig University, approved the study (**ZU-IACUC/3/F/54/2023**). Following the recommendations of the Declarations of Helsinki as well as the European Community's rules for the use of experimental animals, the experiment was carried out.

About 3 mL blood was drawn by heart puncture to prepare PRP, and it was promptly transferred into 3 mL tubes that contained 3.2% sodium citrate as an anticoagulant. To separate the plasma layer, the blood samples were first centrifuged for 10 minutes at room temperature at 2000 rpm. A sterile pipette was used to delicately aspirate the top layer of plasma, which was then placed into fresh sterile tubes devoid of anticoagulant. To concentrate the platelets, a second centrifugation was carried out for five minutes at 3500 rpm. The resulting Platelet-Rich Plasma (PRP) was collected from the lower part of the tube using a sterile pipette and pooled into a single sterile container. Prior to administration, 10% calcium chloride was added to the PRP to activate it and cause platelet degranulation and growth factor release.

***Surgical procedure:***

All the maneuvers carried on in this experiment concerning the rats were highly ethical and merciful. All rats received proper anesthesia Ketamine/Xylazine cocktail (Ketamine 25mg + Xylazine 10mg per ml) with a dosage of 0.1mL/100g rat weight then preparing the rats by shaving the hind limbs. The rats were then prepared by shaving their hind limbs. The rats in Group 1 were placed on a rodent operating board, prone. A 1–2 cm skin incision was made 0.5 cm lateral to the spine along the line between the flank and the hind limb, extending laterally over the crista iliaca, after the surgical site had been properly sterilized with 10% povidone-iodine. Blunt dissection was used to weaken the incision and reveal the fascial plane between the gluteal and biceps muscle groups. The sciatic nerve was exposed with gentle blunt dissection in this plane, which also reduced stress and stopped the gluteal and popliteal arteries from leaking blood. A 1 cm section of the sciatic nerve was carefully collected, and a backdrop material was positioned underneath the nerve. Immediate primary epineural repair was performed bilaterally using 9/0 polypropylene sutures (Figure 1). Using a 28 G

syringe, 1 mL of platelet-rich plasma (PRP) was injected around the epineurium on the right side (PRP group) at both the proximal and distal ends of the graft. Nerve grafting and healing were carried out on the left side (control group) without PRP infiltration. Using 4/0 Vicryl for the muscle and 4/0 Prolene for the skin, the wounds were closed in layers on all rats. Lastly, 10% povidone-iodine was applied to the skin incision.

***Clinical Follow-up:***

Following surgery, each rat was placed in a different cage and kept under surveillance every day for the first four weeks, then every week until the eight-week follow-up period was over. Rats were monitored for wound healing, feeding, grooming, and general health. For seven days in a row, the wound was dressed every day, and ceftriaxone was injected intramuscularly at a dose of 0.2 mg/g body weight to identify any improbable postoperative sequelae. We looked for any unusual findings, including ulceration or paralysis, on the hind limbs' feet. In the first week, two rats perished. Rats were allowed to live normally in groups until the conclusion of the follow-up period when their skins had fully healed.

***Biopsy preparation and histological evaluation:***

All rats were corrected and killed with an overdose of anesthetic eight weeks after surgery. After re-approaching and harvesting the nerves on both sides, a 20 mm segment was removed from the center of the harvested graft, 0.5 cm distally and 0.5 cm proximally. In the therapy group, we tie a long knot to indicate the distal end, while in the control group, we tie a small knot to indicate the proximal end. The nerve tissue was embedded in blocks of paraffin wax after being preserved for at least 48 hours in a 10% formalin/saline solution. After creating histologic slices that were 6 microns thick, a specific staining called H&E was applied. A light microscope was used for histological investigation, and two highly qualified examiners counted the number of nerve fibers. Both the distal and proximal segments as well as the graft site had bilateral nerve fiber counts in the PRP-treated and non-treated groups. At a 400X magnification, nerve fibers were counted over the long axis of the fascicles and in a series of neighboring sections. The average count of two observers was then determined. Then, using the procedure, a neurotization index was calculated as a percentage in G1 and G2.

The following formula was subsequently used to determine each group's neurotization index:

$$\text{Neurotization Index (\%)} = \left(\frac{\text{Average number of nerve fibers in the distal segment}}{\text{Average number of nerve fibers in the proximal segment}}\right) \times 100$$

***Statistical analysis***

Version 24 of the Statistical Program for Social Science (SPSS) was used to analyze the data. Frequencies and percentages were used to express the qualitative data. The mean ±SD was used to express quantitative data. A discrete collection of numbers' means, or average, is the central value, or more precisely, the sum of the values divided by the total number of values. A set of values' degree of dispersion is measured by the standard deviation (SD). Whereas a high SD suggests that the values are dispersed throughout a larger range, a low SD suggests that the values tend to be near the defined mean. When comparing two groups, use the independent sample T test (T) (for normally distributed data). When the p-value was less than 0.05, it was deemed significant, and when it was less than 0.001, it was deemed very significant.

## RESULTS

A sciatic nerve graft, approximately 1 cm in length, was harvested from 14 rats, while six animals served as PRP donors. By the end of the 12th week, twelve rats were still alive. An hour after surgery, they began to move around slowly, and around four hours later, they began to drink and eat. Ten days after surgery, the skin sutures were taken out, indicating that the wound had healed satisfactorily. Two rats showed signs of wound dehiscence and skin infection one week after the sutures were removed. After receiving standard treatment with saline wash and local antibiotics, the infected wounds were allowed to heal on their

own. For a few weeks after surgery, the animals' right and left feet developed ulcers and showed signs of weakness (dropped feet). By the end of the follow-up period, there was a discernible improvement in the foot's ulceration and weakness. The rats showed improved mobility and motor power in both surgical limbs towards the end of the 8th week. Two rats died postoperatively due to anesthesia complications as shown in Table 1.

***Histopathological findings:***

In both groups the examination concluded that the sciatic nerves had adequate regeneration with intact approximations and no gaping or ruptures and mentioned the inflammatory changes in the nerves like whitening and thickening of the epineurium near the area of repair in both groups (Figure 2).

G1 and G2 nerve repairs revealed intact approximations under a microscope. The proximal (Figure 3A) and distal (Figure 3B) segments of G1 showed much more nerve fiber regeneration than those of G2.

**Figure (3A&B):** A photomicrograph taken eight weeks after surgery demonstrates the density of proximal segment regenerating nerve fibers in the PRP group.

**Figure S1(A&B):** A photomicrograph demonstrating the density of the distal segment's regenerated nerve fibers in the PRP-treated**.**

In Table 2, there was no statistically significant difference in the mean distal nerve axon fiber count between the right and left sides (p = 0.201). The mean fiber count on the right side was 215.7 ± 68.6 (range: 110–325), compared to 182.8 ± 63.7 (range: 104–303) on the left side. On the other hand, a different analysis showed that the mean number of distal nerve axon fibers on the right side was statistically significantly higher than that on the left (p = 0.008). While the left side showed a lower mean of 133.7 ± 49.6 (range: 77–223), the right side had a mean fiber count of 192.8 ± 58.8 (range: 106–312).

**Figure S2(A&B):** Photomicrograph showing normal organization, myelinated and unmyelinated of the nerve fibers in graft site.

Table 3 demonstrated no statistically significant difference in the neurotization index between the right and left sides (p = 0.227). The mean neurotization index on the right side was 100.6 ± 44.8 (range: 32.6–177.3), whereas on the left side it was 81.4 ± 36.8 (range: 29.7–137.6).

It indicates statistically significant difference between the two means at the 0.05 level as shown in table 4.

**Table 1:** Describing data of studied rats

| Species/ Common name | Strain/ breed | Weight | Sex | Total number | Source |
|---|---|---|---|---|---|
| **Spargue-dawley** | **Outbreed multipurpose** | **250-350 gm** | **Male** | **20** | **Microsurgery lab.** |

**Table 2:** Comparisons of nerve fiber count between sites proximal and distal to the graft site between right and left side

| | | Right (N = 14) | Left (N = 14) | T | P-value |
|---|---|---|---|---|---|
| **Nerve fiber count proximal to the graft** | **Mean ±SD** | **215.7 ± 68.6** | **182.8 ± 63.7** | **1.31** | **0.201 NS** |
| | **Range** | **110 - 325** | **104 – 303** | | |
| **Nerve fiber count distal to the graft** | **Mean ±SD** | **192.8 ± 58.8** | **133.7 ± 49.6** | **2.87** | **0.008 S** |
| | **Range** | **106 - 312** | **77 - 223** | | |

**T: independent sample T test.** **S: p-value < 0.05 is considered significant.**

**NS: p-value > 0.05 is considered non-significant.**

**Table 3:** Comparisons of neurotization index between right and left side

| | | Right (N = 14) | Left (N = 14) | T | P-value |
|---|---|---|---|---|---|
| **Neurotization index** | **Mean ±SD** | **100.6 ± 44.8** | **81.4 ± 36.8** | **1.23** | **0.227 NS** |
| | **Range** | **32.6 – 177.3** | **29.7 – 137.6** | | |

**T: independent sample T test. NS: p-value > 0.05 is considered non-significant.**

**Table 4:** Comparison between Right and Left nerve graft sites

| | | Right (N = 14) | Left (N = 14) | T | P-value |
|---|---|---|---|---|---|
| **Nerve fibers at graft site** | **Mean ±SD** | 172±43.07 | 129.14±33.38 | 2.94 | 0.0076 |
| | **Range** | 100-250 | 80-172 | | |

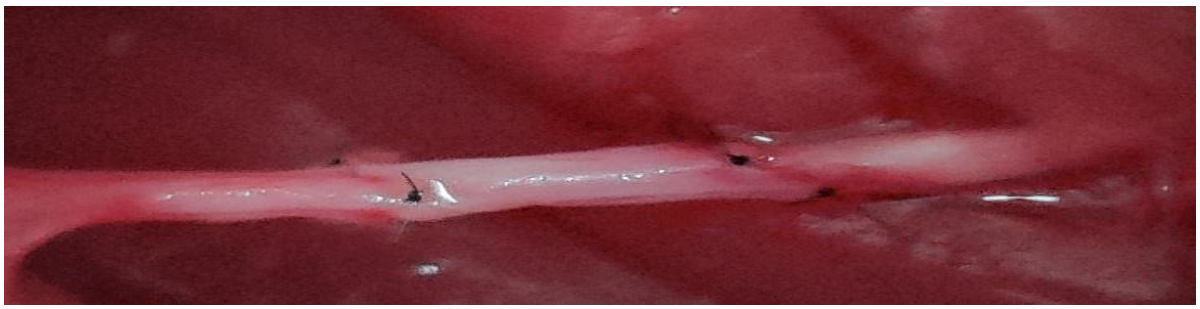


**Figure 1:** Repair of sciatic nerve graft

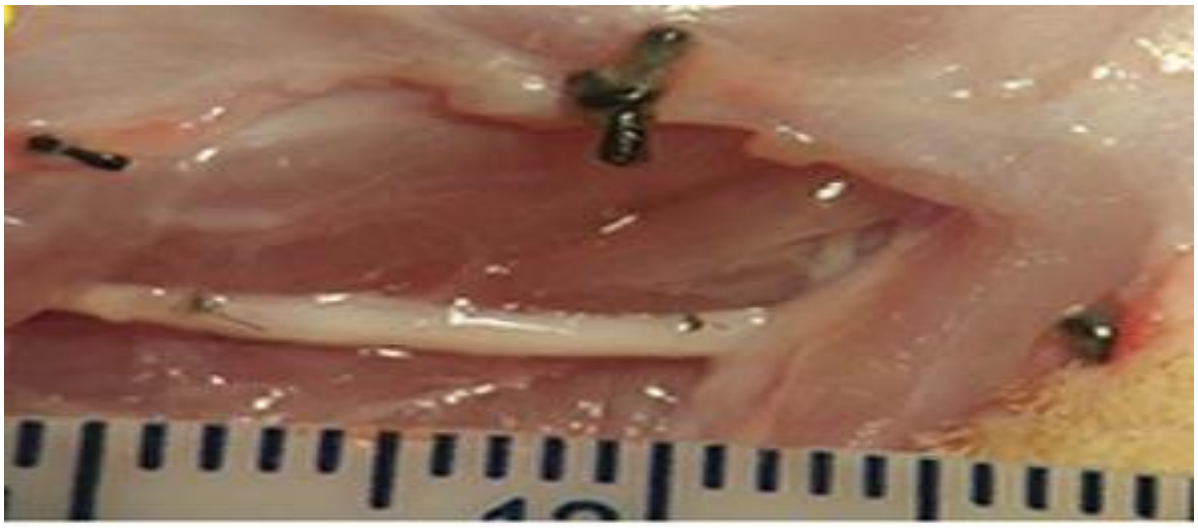
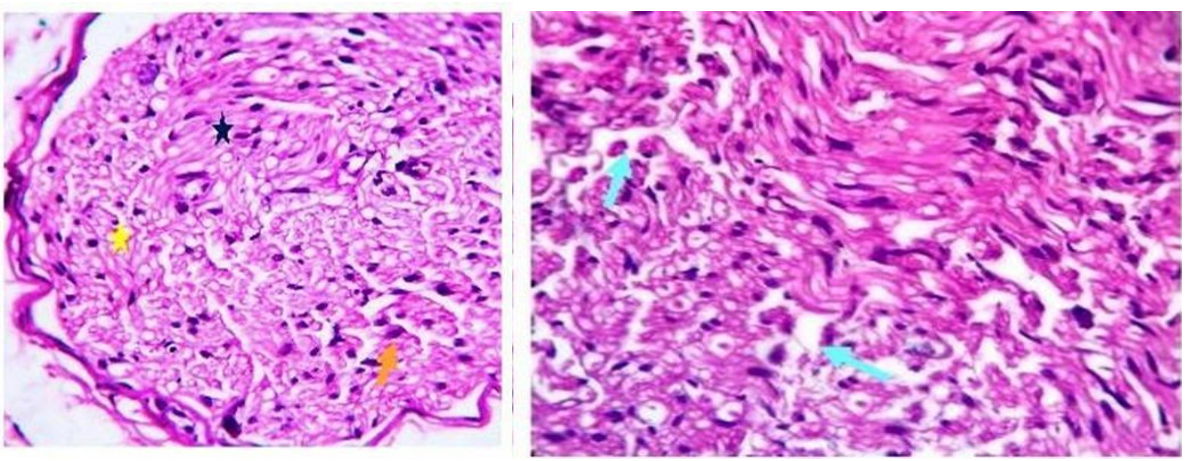


**Figure 2:** Whitening and thickening of the nerve trunk



A B

**Figure (3A&B):** Photomicrograph showing the density of regenerating nerve fibers of the proximal segment in the PRP group 8 weeks postoperatively. (G1) (a) and control untreated group (G2) (b). H&E stain X400. (yellow and orange stars showing normal myelinated nerve fibers and dark star showing unmyelinated nerve fibers in a & blue arrows in b showing unmyelinated nerve fibers).

## DISCUSSION

Peripheral nerve injuries (PNI) are a common yet complex clinical challenge, often resulting in serious functional disability due to the loss of nerve continuity and subsequent muscle denervation. The ability to restore function through nerve regeneration has been a primary focus of both clinical and experimental research, leading to the development of various nerve repair techniques. Traditional methods, such as End-to-End nerve repair, have been the mainstay in clinical practice; however, their limitations in promoting consistent and robust nerve regeneration have prompted the exploration of more advanced techniques [7].

Some efforts have been made to improve vascularization surrounding the nerve and boost SC activation and proliferation to encourage nerve regeneration following nerve repair. Numerous studies have also shown that GFs can be locally administered to the nerve graft site [10], that support cells, like SCs, can be delivered, and that GFs can be included in an artificial nerve or acellular nerve allograft [8–9].

Because of its high concentration of growth factors and bioactive chemicals that support tissue healing, inflammation reduction, and cell proliferation, platelet-rich plasma (PRP) has become a promising biological therapy. PRP is derived from autologous blood, making it a safe, simple, and cost-effective option for enhancing nerve regeneration. Previous studies have suggested that PRP can improve nerve fiber density and accelerate axonal growth, but its role in sciatic autogenous nerve grafts remains under investigation [11].

The observation that platelet-rich plasma (PRP) maintains nerve fiber density along the nerve length is supported by several studies. For instance, a study by Anitua et al. [12] highlighted PRP's role as a biological therapy assisting nerve regeneration, emphasizing its potential to enhance axonal growth and maintain fiber density along the nerve. These findings align with the current study's results, suggesting that PRP contributes to consistent nerve regeneration across different nerve segments. Similarly, Wang et al. [13] showed that PRP improves nerve fiber density in both proximal and distal segments by influencing angiogenesis and intracellular ubiquitin levels, which in turn promotes peripheral nerve regeneration following sciatic nerve injury.

In this study, a total of 14 adult male albino rats with weight ranged from 250 to 350 grams were utilized, the rats were divided into two groups, (Group A , PRP treated Rats) and (Group B non PRP treated Rats), The comparison of proximal nerve fiber count (to

the graft site) between the right and left sides in the studied rats (N = 14 per group) reveals no statistically significant difference. The mean nerve fiber count at the proximal nerve axon was higher on the right side (215.7 ± 68.6) compared to the left side (182.8 ± 63.7), but the T-value of 1.31 and a P-value of 0.201 indicate that this difference is not statistically significant (NS). The range of nerve fiber counts was 110–325 on the right side and 104–303 on the left side, showing considerable overlap. This suggests that while there was a slight increase in nerve fiber density on the right side, possibly due to the local administration of platelet-rich plasma (PRP), the difference was not substantial enough to confirm a significant impact of PRP on proximal nerve regeneration in this experimental setting.

The comparison of distal nerve fiber count (to the graft site) between the right and left sides in the studied rats (N = 14 per group) demonstrates a statistically significant difference. The mean nerve fiber count at the distal site to the graft was higher on the right side (192.8 ± 58.8) compared to the left side (133.7 ± 49.6), with a T-value of 2.87 and a P-value of 0.008, indicating statistical significance (S). The range of nerve fiber counts was 106–312 on the right side and 77–223 on the left side, showing a notable difference favoring the right side. This suggests that the local administration of platelet-rich plasma (PRP) on the right side had a positive effect on distal nerve fiber regeneration, enhancing axonal growth and nerve healing. The significant improvement in distal nerve fiber density supports the potential of PRP as an effective adjunct in nerve graft procedures to promote peripheral nerve regeneration.

The Comparison between Right and Left nerve graft sites indicates statistically significant difference between the two means at the 0.05 level. The mean nerve fiber count at the Right graft site was 172 ± 43.07, while at the Left graft site, it was 129.14 ± 33.38, with a T-value of 2.94 and a P-value of 0.0076, indicating significance. The range of nerve fiber counts was 100–250 at the Right and 80–172 at the Left side.

## CONCLUSION

The findings of this study suggest that platelet-rich plasma (PRP) enhances peripheral nerve regeneration, particularly at the distal segment of the nerve graft. While there was no significant difference in proximal nerve fiber density between PRP-treated (right) and non-treated (left) sides, the distal segment on the right side showed significantly higher nerve fiber counts compared to the left side, indicating improved regeneration with PRP. Additionally, the left side exhibited a statistically significant decline in nerve fiber density from proximal to distal segments, whereas the right side maintained more consistent fiber density, further supporting PRP's positive effect. These results highlight PRP as a potential therapeutic adjunct to enhance nerve regeneration in autogenous nerve grafting, reducing fiber loss and improving outcomes. However, further studies, including functional assessments, are necessary to confirm these findings and establish PRP's long-term benefits in clinical applications.

**Conflict of Interest:** There are no conflicting interests, according to the authors.

**Financial Disclosures:** No specific grant from a public, private, or nonprofit funding organization was awarded for this study.

**Availability of the data:** Upon reasonable request, the associated author will make the datasets created and/or examined during the current work available.

**Authors contribution:** In addition to writing and getting the paper ready for publication, the writers oversaw gathering and analyzing the data. The final version was examined and approved by all authors.

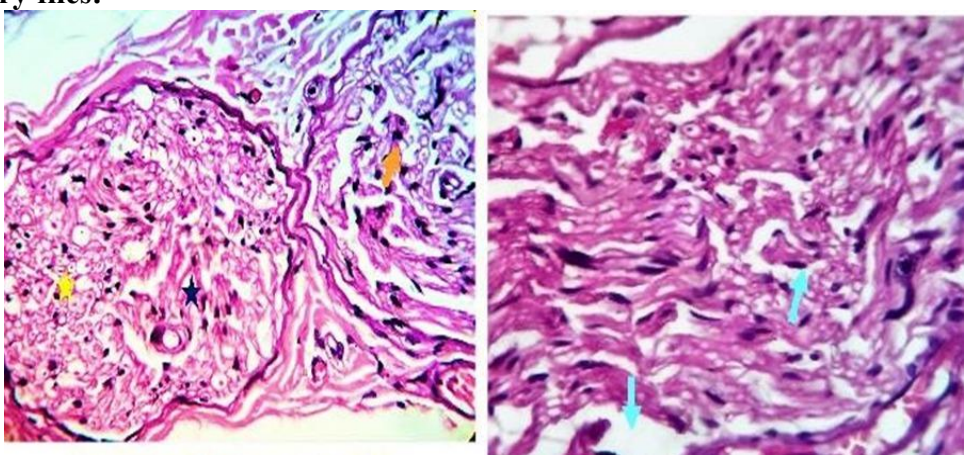
**Supplementary files:** Figure S1(A&B), Figure S2 (A&B).

## REFERENCES

1. Huang W, Begum R, Barber T, Ibba V, Tee NCH, Hussain M, et al. Regenerative potential of silk conduits in repair of peripheral nerve injury in adult rats. *Biomaterials*. 2012;33(1):59-71.

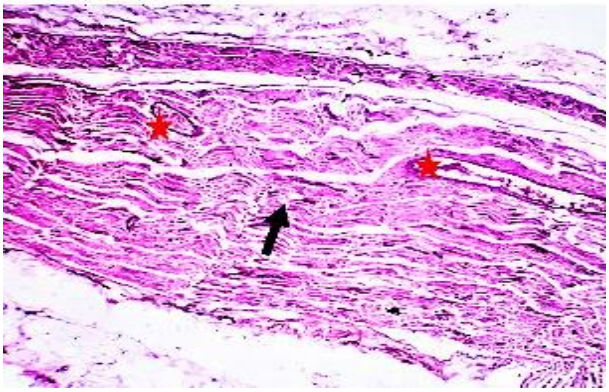
2. Evans GR. challenges to nerve regeneration. Seminars in surgical oncology.2000;19(3),312-8.
3. Cervelli V, Lucarini L, Spallone D, Brinci L, De Angelis B. Use of platelet rich plasma and hyaluronic acid on exposed tendons of the foot and ankle. *J Wound Care*. 2010;19(5):186-90.
4. Rutkowski JL, Speicher JL, Thomas JM, Bering CL, Radio NM, Smith DM, et al. Analysis of a rapid, simple and inexpensive technique used to obtain PRP for use in clinical practice. *J Oral Implantol*. 2008; 34:25-33.
5. Zheng C, Zhy Q, Liu X, Huang X, He C, Jiang L, et al. Improved peripheral nerve regeneration using acellular allografts loaded with PRP. *Tissue Eng Part A*. 2014; 20:3228-40.
6. Elgazzar RF, Mutabagani MA, Abdelaal SE, Sadakah AA. Platelet rich plasma may enhance peripheral nerve regeneration after cyanoacrylate reanastomosis: a controlled blind study on rats. *Int J of Oral Maxillofacial Surg*. 2008;37(8):748-55.
7. Elfar JC. Priming the stump in peripheral nerve injury (Commentary on Zhang et al. (2017). Eur J Neurosci. 2017; 45:748–9.
8. Gu X, Ding F, Yang Y, Liu J. Construction of tissue engineered nerve grafts and their application in peripheral nerve regeneration. *Prog Neurobiol*. 2011;93(2):204-30.
9. Jesuraj NJ, Santosa KB, Macewan MR, Moore AM, Kasukurthi R, Ray WZ, et al. Schwann cells seeded in acellular nerve grafts improve functional recovery. Muscle & Nerve.2014, 49;267-76.
10. Sánchez M, Garate A, Delgado D, Padilla S. Platelet-rich plasma, an adjuvant biological therapy to assist peripheral nerve repair. *Neural Regen Res*. 2017;12(1):47-52.
11. Dos Santos RG, Santos GS, Alkass N, Chiesa TL, Azzini GO, da Fonseca LF, et al. The regenerative mechanisms of platelet-rich plasma: a review. *Cytokine*. 2021; 144:155560.
12. Anitua E, Delgado D, Sanchez P, Prado R, Orive G, Padilla S. Platelet-rich plasma, a source of autologous growth factors and biomimetic scaffold for peripheral nerve regeneration. *Expert Opin Biol Ther*. 2017; 17(2): 197-212.
13. Wang SL, Liu XL, Kang ZC, Wang YS. Platelet-rich plasma promotes peripheral nerve regeneration after sciatic nerve injury. *Neural Regen Res*. 2023;18(2):375-81.

**Supplementary files:**



A B

**Figure S1 (A&B):** Photomicrograph showing the density of the regenerating nerve fibers of the distal segment in the PRP-treated (a) and non-treated (b) groups, H&E X400. (yellow and orange stars showing normal myelinated nerve fibers and dark star showing unmyelinated nerve fibers in A & blue arrows in b showing unmyelinated nerve fibers (descending arrow) & (ascending arrow) showing myelinating nerve fibers)



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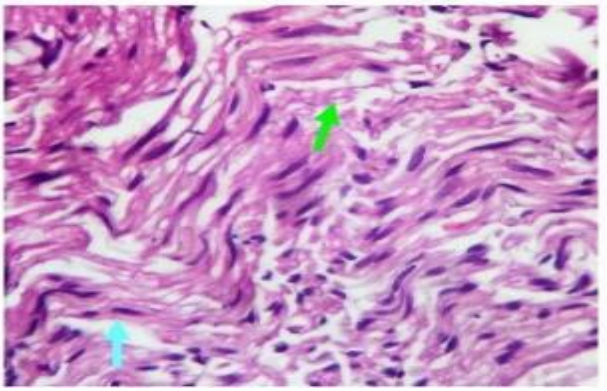

B

**Figure S2 (A&B):**

**A:** Photomicrograph shows normal organization of the nerve fibers in graft site of group (A) treated group (black arrow) while red stars showed new angiogenesis).

**B:** Photomicrograph showing myelinated and unmyelinated nerve fibers in graft site of group (B) untreated group (green arrow shows mild neuronal degeneration and blue arrow showed mild peri-neural edema).

## Citation

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