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Comparison of Platelet Rich Plasma Dressing with Conventional Saline Dressing on Spoke Wheel Injury Wounds in Pediatric Patients: A Randomized Controlled Trial

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ABSTRACT

Objectives: To compare the outcome of topical Platelet Rich Plasma (PRP) dressing versus normal saline dressings on Wheel spoke injury (WSI) wounds in terms of duration of wound healing, wound infection, pain and need for hospital stay. **Methods:** It was a Randomized controlled trial conducted in Department of Pediatric Surgery KEMU/Mayo Hospital Lahore from September 2023 to August 2024. Children 12 years of age or younger presenting with WSI having an open wound which was allowed to heal by secondary intention were included in the study. Group A got normal saline soaked dressing daily and group B was given topical PRP dressing. The PRP rich gel layer obtained after centrifuging patients' own blood sample was applied on wound. This was done once weekly for maximum 4 sessions. Variables like duration of wound healing, wound infection and pain along with other parameters were recorded. **Results:** Our sample consisted of total 69 patients 34 were Group A as control and 35 were Group B as cases. Mean age was 8.2 $\pm$ 1.8 years with male predominance. Mean duration of healing was less for Group B having p value <0.001. Group B cases had less wound infection rate and it was found to be statistically significant (p value 0.04 for gross signs of infection and 0.015 for bacterial growth on wound culture). There was significant reduction in post dressing pain in PRP group only after 3rd week of dressing (p 0.009). **Conclusion:** We conclude that topical PRP is a promising adjunct in treating WSI in addition to other injuries with tissue loss. It can serve as an economical treatment option for rapid healing of WSI patients especially in developing nations.

INTRODUCTION

Wheel spoke injuries (WSI) happen as a result of a body component becoming trapped in the spokes of a bicycle or motorcycle, most frequently the foot. Since motorcycles are a common mode of transportation in developing nations like Pakistan, the frequency of these injuries is rising daily. In Nigeria, the prevalence of WSI is 10.3%, while incidence of these injuries in Lahore Pakistan is 21.7%.[1,2] WSI are known to cause a wide range of wounds ranging from abrasions, bruises, lacerations, friction burns, tendon injuries, bony injuries, heel pad loss, soft tissue loss to neurovascular injuries. Most commonly injury occurs at the heel pad and on the dorsum of the foot.[3] Often grading is done by Tscherne and Oestern classification, consisting of grade 0 as no or minor soft tissue swelling, grade I is minor bruise or abrasion, grade II includes skin laceration

or loss of skin layer and grade III is major soft tissue injury which may include tendon, neurovascular injury or fracture.[4] Traditionally these wounds are treated with thorough wound washes, debridement, antibiotic and wet to dry saline dressings.

Platelet Rich plasma (PRP) is a substance extracted from blood and known to have plethora of growth factors and active ingredients. The clinical use of PRP has abundantly increased over the past two decades.[5] It has been abundantly used now in tendon, bony injuries and surgical wounds.[6] Platelets in PRP releases wide variety of substances including serotonin, adenosine triphosphate (ATP), catecholamines, fibrinogen, albumin, osteocalcin, osteonectin, calcium ions, clotting factors and many growth factors like TGF alpha, PDGF, TGF beta , insulin like growth factor, fibroblast growth factor and VEGF.[7] Recently PRP has been used topically to treat acute trauma wounds in a study.[8] It's also a novel healing agent for surgical sites and chronic ulcers.[9] PRP promotes healing intention on account of its revascularization, cell proliferation, antibacterial, anti-inflammatory and re-epithelializing properties.[10]

WSI wounds are difficult to heal and challenging to treat due to the gross contamination, bacterial infection and dangerous mechanisms involved in the injury usually causing avulsion of soft tissue. Damage to the patterned septations of the heel pad in these injuries is a troublesome event that causes loss of the shock absorbing feature of the heel thus resulting in increased pain and disability. Thus the injuries require multiple debridement, reconstructive surgeries, specialized dressings, long hospital stays, increase number of days out of school and delay in the treatment of other underlying injuries. Moreover, the stigma of fearing reconstructive surgeries among the population of developing countries or not being able to afford it prolongs the misery of the patient as high grade injuries usually require plastic surgery. Long in-patient days and adherence to quackery also compel most patients to prefer conservative treatments first over surgery. Therefore, there is need to devise a proper treatment method to fill the hiatus in standardized management protocols of these injuries. Ensuring rapid healing without complications is required for children who pose to be the most susceptible group of population affected by these adverse traumas.

Recognizing the fact that topical PRP serves as a cost efficient out-patient method to treat wounds as it is autologous and no study was found narrating its effects particularly on WSI, we intended to use it on these wounds. Our aim was to prevent pain and trauma to the patient because of multiple debridement and surgeries along with saving the cost of expensive dressings and prolong hospital stays.

MATERIAL AND METHODS

This was a Randomized Controlled Trial carried out in the Department of Pediatric Surgery, KEMU/ Mayo Hospital Lahore from September 2023 to August 2024. We used simple random sampling to allocate patients to control Group A and case Group B i.e. normal saline soaked dressing group and topical PRP dressing group respectively. Our independent variables were the type of dressing used for the wound (normal saline dressing and topical PRP dressing). Dependent variables were duration of complete wound healing (time in days taken by the wound edges to approximate and epithelialize on gross examination), occurrence of wound infection (gross signs like necrotic tissue, slough, pus or bacterial growth on wound culture), need of hospital stay, duration for preparation for reconstructive surgery (healthy granulation tissue with no micro-organism growth on wound culture) and post dressing pain using VAS analog score. [11]

The study was conducted abiding by ethical standards and principles. We commenced data collection after approval from Institute Review Board of King Edward Medical University (IRB Number 359/RC/KEMU dated 18/9/23). All subjects gave informed consent before participating in the study. We included all patients who were 12 year old or younger and presented with WSI having at least a Grade 2 wound which was allowed to heal with secondary intention. Wounds ranging from 5 to 10 cm in largest dimension were taken. Patients with associated vascular injury, other systemic injuries, osteomyelitis or any immunodeficiency state were excluded from the study. Patient presenting later than 3 days of the injury were excluded. Patients whose guardians opted for reconstructive surgery

during the course of treatment were also not considered in this study. All wounds were thoroughly washed, dressing was done and patient was discharged with oral antibiotics, analgesics and instructions for daily wound wash and saline soaked wet to dry bandage for control group. Patients with wounds having gross contamination and bone exposed were admitted indoor and given intravenous antibiotics. For PRP group 5ml of patient's own blood (7ml for wounds greater than 7cm in greatest dimension) was withdrawn in vials available with the 80-1B electric centrifuge device and centrifuged at 4000 RPMs for 15 minutes. The platelet rich gel layer was removed from vial with forceps and applied on the washed and cleaned wound. The thin plasma layer was aspirated in a syringe and sprayed over the wound then a saline soaked sterile gauze layer was put over it and covered with dry gauze and crepe bandage. This was done once weekly till wound healed or for maximum 4 sessions. Each PRP dressing was opened after 72 hours followed by daily wound wash and saline dressing for the rest of the week until next PRP dressing was done on start of new week. During the course of treatment the site of wound, wound healing, granulation tissue, pain and signs of infection were assessed every week and wound swab for bacterial growth was taken if infection was suspected. The patients were followed till the wounds healed or maximum till 3 months from the time of presentation.

The data was collected using a structured Performa recording data like patient's age, gender, site of wound and dependent variables. Collected data from Performa was entered to SPSS version 27. Comparison of quantitative data among two groups was done with independent sample t-test. Qualitative variables were compared using Chi square test. P value of less than 0.05 is considered to be significant taking 95% confidence interval.

RESULTS

Our sample consisted of total 69 patients 34 were Group A as control and 35 were Group B as cases. Age of patients ranged from 4 to 12 years with mean age as 8.2 $\pm$ 1.8 years. There was male predominance with 18 females and 51 males. The parts of foot involved in the wound are enlisted in Table 1.

Table 1

Parts of foot injured

S.no.	Part of foot injured	Number of patients (N=69)
1.	Heel pad	47
2.	Lateral part of foot	16
3.	Dorsum	6
4.	Toes	1
5.	Other	1

Bony tissue was exposed in 17 patients and tendons were exposed in 9 patients (Figure 1). All wounds with exposed tendon healed within the 3 month follow up period while 4 patients with exposed bony surface did not heal in Group A and one fail to heal in Group B. In total 8 cases from Group A while 3 from B ceased from healing completely in the follow up period. No statistically significant difference was found in both groups regarding the fact that the wound healed or not having p value **0.09**. Despite that there was statistically significant difference in the duration of healing in both groups having p value **<0.001**. Mean duration of healing in group A was 41.88$\pm$8.1 days while that of group B was 34.79 $\pm$ 6.7 days.

Table 2

Relationship of variables among both groups

S. no.	Variable	Number of patients in Group A (N=34)	Number of patients in Group B (N=35)	P value
1	Gross signs of wound infection	12	5	0.04
2	Bacterial growth on wound culture	9	2	0.019
		Mean VAS score of Group A	**Mean VAS score for Group B**	
3	Post dressing pain on day of 1st dressing (mean VAS score)	9.2	9	0.11
4	VAS pain score on the day of dressing after 1st week	8.3	8.1	0.24

5	VAS pain score on the day of dressing after 2nd week	6.5	6.3	0.066
6	VAS pain score on the day of dressing after 3rd week	5.5	5.17	0.019

The rate of hospital admissions among both groups was not significant. Group B cases had less wound infection rate and it was found to be statistically significant as details are mentioned in Table 2. There was significant reduction in post dressing pain in PRP group only after 3rd week of dressing. For those wounds which did not healed during the period of follow up, we noted the time duration after which the wound was prepared for reconstructive surgery if the patient opted. This mean duration for group A was 31.1 days while for Group B was 24 days and had statistically significant difference having p value **0.034**.

Figure 1A
A 7 years old boy with injury to heel and exposed bony surface was treated by topical PRP dressing
Figure 1B
Same patient after 5 weeks of injury with marked decrease in wound size and granulation tissue covering bone

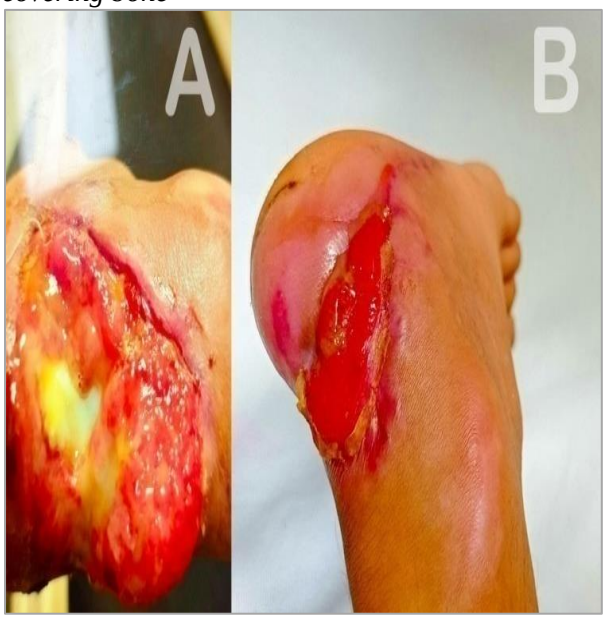
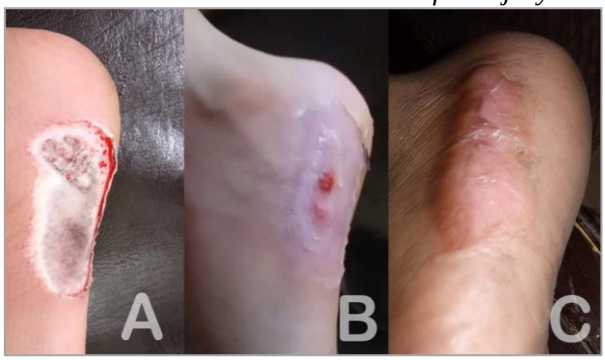


Figure 2A
A 9 year girl with WSI wound with topical PRP gel applied over it on 15th day of treatment
Figure 2B
same girl at 30th day of treatment as wound nears healing.

Figure 3A
6 year old boy with full thickness friction burn due to motorcycle wheel spokes
Figure 3B
Patient's wound healed completely at 28 days after topical PRP dressings
Figure 3C
Same wound with scar at 3 months after injury



DISCUSSION

Most of the literature regarding WSI is from developing countries, frequently addressing their epidemiological factors and pattern of injuries. There is hardly any published research work on these injuries to discover cost effective therapies using outpatient procedures. The healing properties of platelet rich plasma and its amplifying use in chronic ulcers and orthopedic procedures compelled us to apply it on WSI wounds.[5,6] A study from Greece used PRP gel over fresh open wounds caused by trauma and found promising results, such that may eliminate the need of plastic surgery.[12]

Epidemiology and patterns of injury were not recorded in detail, as they were beyond the scope of this study. Heel pad was the most common site of entrapment as described in previous studies.[2,13] Similar to our results Kazako et al. established that PRP gel caused rapid rate of healing in wounds notably decreasing the treatment buden.[12] We also found PRP promoting granulation tissue growth at an increased pace when compared to that of controls. Thus these wounds were prepared for any flap or graft procedure earlier than group A. We also found that topical PRP significantly reduced wound infection rates which were in line with the deductions of multiple studies.[14] This fact was affirmed by an animal study which studied the effect of topical PRP on infected wounds of rats.[15] Results of this animal study showed decrease counts of bacterial cells in the wound and decrease in pro inflammatory cytokines and inflammatory markers like C-reactive proteins in serum of cases treated with PRP as compared to the controls.[15] It can eliminate the cost of in-patient stay, debridement and intravenous antibiotics required for an infected wound.

Exposed bones in an open wound pose dangerous risk of getting the bone infected owing to its relatively limited vascular supply. Such wounds can result in osteomyelitis and sometimes to catastrophic events like bone necrosis if there is periosteal compromise. Being cognizant of these facts topical PRP on wounds has given tremendous results in our study. We had 7 patients with bone exposed from the wound in group A and 10 patients in group B. Majority had small surface area of calcaneus exposed. Wounds of 4 out of 7 patients from group A while only 1 out of 10 patients from group B failed to heal in the given follow up time. This showed promising ability of PRP to promote growth of granulation tissue over bony surface consequently rescuing the patient from reconstructive coverage procedures, debridement and resources of in-patient treatment.

The effect of topical PRP on pain is not studied substantially in literature but theoretically it is considered to decrease pain owing to its inhibition of the pro-inflammatory processes. On contrary a meta-analysis investigating the use of PRP in knee arthroplasty documented no significant contrast on post operative pain intensity among study groups.[16] PRP showed decrease in pain when used for tendinopathy in another study.[17] However our study showed significant reduction in pain after 3rd week of treatment only. We did not study the effect of topical PRP on scar quality but a meta-analysis suggests that use of PRP combined with micro-needling sufficiently reduced hypertrophic scars and keloids.[18] So we can assume that topical PRP may result in better scar quality if the wounds are followed for a long period of time.

CONCLUSION

We conclude that topical PRP is a promising adjunct in treating Wheel spoke injuries in addition to other complicated injuries with skin and soft tissue loss. It effectively accelerated wound healing process and prevented wound infection. Further need of comparing the outcomes of topical PRP and graft/flap procedures need to be done in terms of hospital stay, recovery, scar quality, pain and quality of life in order to declare PRP as alternate to these procedures. This can make treatment rapid and economical for patients especially in low income countries.

REFERENCES

1. Agu, T. (2017). Motorcycle spokes entrapment foot injuries: Prevalence, and pattern of presentation in a private orthopedic and trauma center, southeast Nigeria – A 10-year retrospective analysis. *African Journal of Trauma*, *6*(1), 6. https://doi.org/10.4103/ajt.ajt_8_17
2. Naumeri, F. (2019). Motor cycle spoke wheel injuries in children: A preventable accident. *Turkish Journal of Trauma and Emergency Surgery*. https://doi.org/10.14744/tjtes.2019.04052
3. Keerio, N. H., Majoka, M. W., Lakhani, S., Saqlain, H. A., Abidi, S. A.,

& Hussain, A. (2023). Pattern and presentation of pediatric spoke wheel entrapment injuries: Our hospital experience. *Pakistan Journal of Medical and Health Sciences*, *17*(4), 612-613. https://doi.org/10.53350/pjmhs2023174612

4. Oestern, H., & Tscherne, H. (1984). Pathophysiology and classification of soft tissue injuries associated with fractures. *Fractures with Soft Tissue Injuries*, 1-9. https://doi.org/10.1007/978-3-642-69499-8_1
5. Rainys, D., Samulėnas, G., Kievišas, M., Samulėnienė, E., Pilipaitytė, L., & Rimdeika, R. (2017). Platelet biology and the rationale of PRP therapy in chronic wounds. *European Journal of Plastic Surgery*, *40*(2), 87-96. https://doi.org/10.1007/s00238-017-1279-x
6. Kon, E., Filardo, G., Di Martino, A., & Marcacci, M. (2010). Platelet-rich plasma (PRP) to treat sports injuries: Evidence to support its use. *Knee Surgery, Sports Traumatology, Arthroscopy*, *19*(4), 516-527. https://doi.org/10.1007/s00167-010-1306-y
7. Patel, H., Pundkar, A., Shrivastava, S., Chandanwale, R., & Jaiswal, A. M. (2023). A comprehensive review on platelet-rich plasma activation: A key player in accelerating skin wound healing. *Cureus*. https://doi.org/10.7759/cureus.48943
8. Yuan, T., Guo, S., Han, P., Zhang, C., & Zeng, B. (2012). Applications of leukocyte- and platelet-rich plasma (L-PRP) in trauma surgery. *Current Pharmaceutical Biotechnology*, *13*(7), 1173-1184. https://doi.org/10.2174/138920112800624445
9. Qu, W., Wang, Z., Hunt, C., Morrow, A. S., Urtecho, M., Amin, M., Shah, S., Hasan, B., Abd-Rabu, R., Ashmore, Z., Kubrova, E., Prokop, L. J., & Murad, M. H. (2021). The effectiveness and safety of platelet-rich plasma for chronic wounds. *Mayo Clinic Proceedings*, *96*(9), 2407-2417. https://doi.org/10.1016/j.mayocp.2021.01.030
10. Xu, P., Wu, Y., Zhou, L., Yang, Z., Zhang, X., Hu, X., Yang, J., Wang, M., Wang, B., Luo, G., He, W., & Cheng, B. (2020). Platelet-rich plasma accelerates skin wound healing by promoting re-epithelialization. *Burns & Trauma*, *8*. https://doi.org/10.1093/burnst/tkaa028
11. Zieliński, J., Morawska-Kochman, M., & Zatoński, T. (2020). Pain assessment and management in children in the postoperative period: A review of the most commonly used postoperative pain assessment tools, new diagnostic methods and the latest guidelines for postoperative pain therapy in children. *Advances in Clinical and Experimental Medicine*, *29*(3), 365-374. https://doi.org/10.17219/acem/112600
12. Kazakos, K., Lyras, N., Tryfonidis, M., Tilkeridis, C., & Verettas, D. (2008). The use of autologous platelet-rich plasma gel as an aid in the management of acute trauma wounds. *Injury Extra*, *39*(5), 185-186. https://doi.org/10.1016/j.injury.2007.11.363
13. Khan, O. P., Ali, S. M., Bhutto, I. A., Butt, S. A., Saeed, G. A., Makhdoom, A., & Memon, S. A. (2021). Pattern of Motorbike Spoke wheel injuries in children presenting to the Accident and Emergency Department of a Tertiary care hospital. *Journal of Pakistan Orthopaedic Association*, *33*(03), 117–120.
14. Zhang, W., Guo, Y., Kuss, M., Shi, W., Aldrich, A. L., Untrauer, J., Kielian, T., & Duan, B. (2019). Platelet-rich plasma for the treatment of tissue infection: Preparation and clinical evaluation. *Tissue Engineering Part B: Reviews*, *25*(3), 225-

236. https://doi.org/10.1089/ten.teb.2018.0309

15. Pourkarim, R., Farahpour, M. R., & Rezaei, S. A. (2022). Comparison effects of platelet-rich plasma on healing of infected and non-infected excision wounds by the modulation of the expression of inflammatory mediators: Experimental research. *European Journal of Trauma and Emergency Surgery*, *48*(4), 3339-3347. https://doi.org/10.1007/s00068-022-01907-0

16. Li, F., Li, Y., Qiao, C., Zhu, J., Chen, J., & Zhang, P. (2017). Topical use of platelet-rich plasma can improve the clinical outcomes after total knee arthroplasty: A systematic review and meta-analysis of 1316 patients. *International Journal of Surgery*, *38*, 109–116. https://doi.org/10.1016/j.ijsu.2016.12.013

17. Balasubramaniam, U., Dissanayake, R., & Annabell, L. (2015). Efficacy of platelet-rich plasma injections in pain associated with chronic tendinopathy: A systematic review. *The Physician and Sportsmedicine*, *43*(3), 253–261. https://doi.org/10.1080/00913847.2015.1005544

18. Ebrahimi, Z., Alimohamadi, Y., Janani, M., Hejazi, P., Kamali, M., & Goodarzi, A. (2022). Platelet-rich plasma in the treatment of scars, to suggest or not to suggest? A systematic review and meta-analysis. *Journal of Tissue Engineering and Regenerative Medicine*, *16*(10), 875–899. https://doi.org/10.1002/term.3338