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Platelet rich fibrin and its utility in nerve regeneration following maxillofacial procedures

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Abstract

nerve injuries though rare are a common and worrisome occurrence that causes many varied clinical morbidities both motor and sensory. The paper aims to propose the use of Platelet Rich Fibrin (PRF) gel as a therapeutic adjunct in treating the same. PRF has a multitude of growth accelerating factors that enhance clinical healing. The same principle therefore has been employed in the proposed protocol. **Conclusion:** this technical note paper aims to lay foundation to the concept of incorporating PRF in routine therapeutics of maxillofacial surgery to enhance nerve injuries following such surgeries.

Keywords: Nerve injury, Maxillofacial surgery, PRF**,** Healing, Therapeutic Protocol

Introduction :

Oral and maxillofacial surgical procedures, such as orthognathic surgery, maxillofacial trauma treatment, dento-alveolar surgery, temporomandibular joint surgery, cyst enucleation, extraction of the third molar, implant placement, and injection of anesthesia occasionally result in nerve injuries. The various nerves are involved in different types of maxillofacial injuries- infra orbital nerve in zygomatico-maxillary complex fractures, inferior alveolar nerve (IAN) in bilateral sagittal split osteotomy, IAN in implant surgery and lingual nerve in impacted tooth surgery among various other maxillofacial surgeries. The frequency of temporary inferior alveolar nerve injury is 0.5% to 5%, whereas permanent injury is <1% and includes numbness in the lower teeth, chin, and lower lip; difficulty in phonation and mastication; drooling of fluids and saliva; allodynia followed by paresthesia of the infraorbital nerve involvement (Yadav, Sachdeva & Verma ,2011 and Genu & Vasconcelos, 2008). Sensory nerve damage can be classified as paresthesia, dysesthesia, and anesthesia, which occur as a result of neuropraxia, axonotmesis, and neurotmesis, respectively (Libersa, Savignat & Tonnel, 2007)

Peripheral nerve injury in the head and neck region may result in significant morbidity for patients. This however is not generally anticipated nor addressed. Treatment of nerve injuries becomes more important due to functional, psychosocial and aesthetic considerations. The nerve regeneration process is associated with the various mechanisms of nerve injury, such as stretching, laceration, and compression, which result in different degrees of structural disruption and cellular loss. The type of injury has important implications in terms of the patient's potential to spontaneously recover normal sensory and motor nerve functions over. Nerve regeneration is usually complete in the case of first degree (neuropraxia) and second-degree (axonotmesis) injuries.

Discussion :

Partial or complete disruption of the perineurium results in third, fourth, and fifth degrees of nerve injuries. With these types of injuries, recovery without surgical intervention is slow and poor (Sunderland, 1951) Although the peripheral nervous system has a considerable capacity for repair after injury, its regeneration is comparatively one of the slowest regenerative processes in the body. There are several techniques in peripheral nerve repair, including microsurgery, grafting, tissue glues, pharmacologic agents, laser, and growth factors (Mc Carthy, 1999 and Smith & Robinson, 1995 and Hudson, Evans & Schmidt, 1999).

Platelet rich fibrin :

Platelet-rich fibrin (PRF), an autologous fibrin matrix, was first described in 2001. It is a widely used second-generation platelet concentrate (Choukroun, Adda & Schoeffler, 2001 and Dohan, Choukroun and Diss 2006 a, b). Platelet-rich fibrin has especially gained popularity in oral and maxillofacial surgery. It is derived from an autogenous preparation of concentrated platelets and contains many progenitor cells that are involved in wound healing and bone regeneration. It also includes numerous growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor (TGF)-b, insulin-like growth factor (IGF), platelet factor 4 (PF4), anti-vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), platelet derived endothelial cell growth factor. Theoretically, PRF accelerates early bone regeneration by angiogenesis, chemotaxis, mitosis, and stem-cell proliferation in the early phase of bone regeneration (Wu, Lee & Tsai, 2012 and Zhang, Tangl & Huber, 2012).

Biologic mechanisms of PRF :

Platelets are discoidal and anuclear structures formed from megakaryocytes in bone marrow. Their cytoplasm has innumerable granules which are secreted during activation. Platelets have a lifespan of 8 to 10 days. These granules contain a variety of proteins- platelet specific proteins like β-thromboglobulin or non-platelet specific like fibronectin, thrombospondin, fibrinogen and many other factors of fibrinolysis inhibitors, fibronectin, growth promoters, factors of coagulation among others. The platelet membrane is composed of a phospholipid double layer where receptors are inserted like collagen, thrombin among others. Activation is the essential in initiation and supporting hemostasis since aggregation occurs on injured site and leads to interaction of coagulation mechanisms. However, degranulation launches the initial stages of healing with the release of cytokines and its ability to stimulate proliferation and cell migration (Smith & Robinson, 1995).

Platelet Cytokines:

PDGFs :

(Stimulant of mesenchymatous lineages):

PDGFs (platelet-derived growth factors) are important regulators for proliferation, survival of mesenchymatous cell lineages migration, and proliferation. They possess the unique ability of inducing stimulation easily by inhibiting the development of these cells with their wide distribution of specific receptors.

For all tissue remodelling mechanisms and the embryonic development, the position of regulation node plays a crucial role. PDGFs, therefore, play an important role in mechanisms related to the physiological cicatrisation, the etiopathogenesis of atherosclerosis and manyother fibroproliferative diseases such as neoplasia and pulmonary and renal fibrosis [Hudson, Evans & Schmidt, 1999 and Choukroun, Adda & Schoeffler, 2001 and Dohan, Choukroun and Diss 2006).

TGFβ-1 :

(Fibrosis agent):

Transforming growth factor β (TGF-β) is a vast family involving more than 30 entities. The prototype molecule that is often referred to as ‘‘the’’ TGFβ is TGFβ-1 in truest sense. It is the most extensively secreted isoform, not only in the platelet α-granules, but also in general during intercellular dialog (Wu, Lee & Tsai, 2012).

The IGF axis :

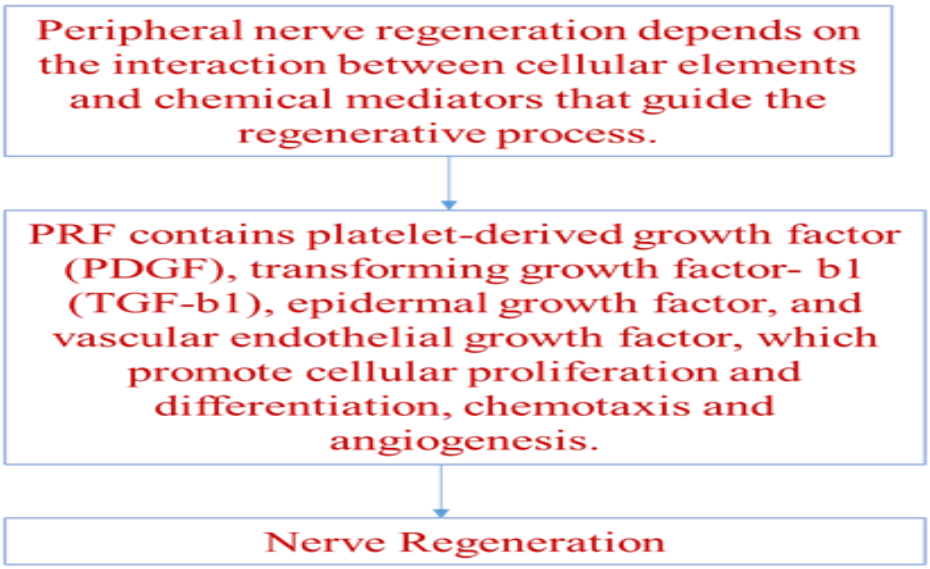
(Cell-protective agent):

Insulin-like growth factors (IGFs) I and II are positive regulators of proliferation and differentiation for most cell types, which inadvertently include tumor cells, which utilise the IGF system to enhance their survival rate (Zhang, Tangl & Huber, 2012). Though these cytokines are cell multiplication mediators, they mainly contribute to apoptosis regulation, by initiating survival signals protecting cells from various matricial apoptotic stimuli (Pripatnanont, Nuntanaranont & Vongvatcharanon 2013). Interestingly, IGFs are massively present in circulation of blood, even though they are released during platelet degranulation.

Mechanism of action of PRF in nerve regeneration :

The mechanism of PRF interaction on proximal nerve ending and injured nerve nerve endings can be attributed to the plethora of regenerative cells and growth factors that accelerate the clinical healing process

Figure 1: Mechanism of action of PRF in nerve regeneration

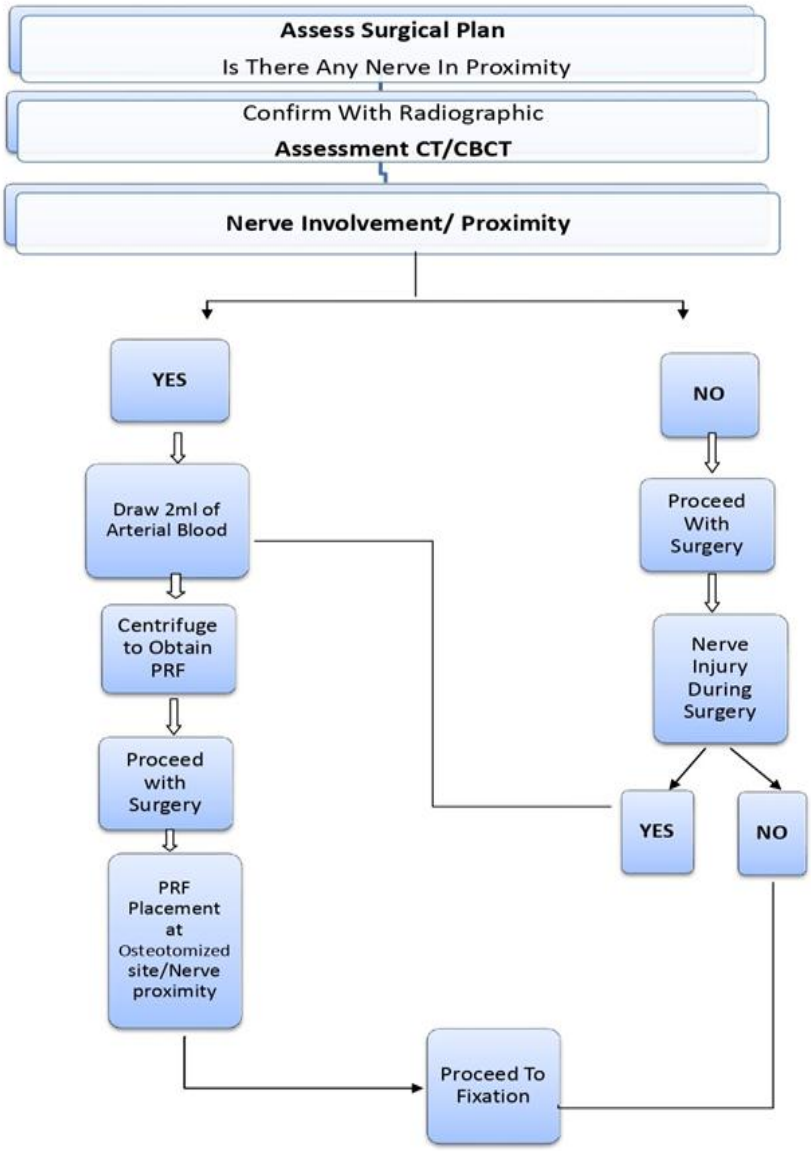


Relevance of PRF in maxillofacial nerve injuries:

PRF has proven its potential properties in nerve recovery and regeneration in various animal model and orthopaedic studies [Acar, Yolcu & Keles, 2015 and Oliveira, Silva &Ferreira, 2015 and Baslarli, Tumer & Ugur, 2015). Its role in the nerve function restoration and a faster recovery following BSSO was studied by Tabrizi et al (Tabrizi, Pourdanesh, Jafari & Behnia, 2018). The results of these studies are promising and intriguing. The use of PRF in nerve regeneration in the maxillofacial region will reduce the burden of the surgeon as well as patients of the procedure and ensure a holistic treatment success.

We propose a treatment algorithm for the use of PRF at instances of nerve injury or proximity to the nerve.

Figure 2: Algorithm for management of nerve injuries in maxillofacial region



Conclusion :

Nerve injuries in maxillofacial procedures and their subsequent delayed healing continue to be one of the challenges faced by a maxillofacial surgeon. The complications associated with these injuries causes disability of varied degrees to patients.be it physiologic or psychological impact these injuries cause, they are worrisome never the less. This paper aims to highlight the importance of PRF application in such clinical conundrum. PRF has proved to be a boon for a variety of purposes in maxillofacial surgery. It is now proven beyond any qualms of doubts that PRF accelerates in nerve recovery owing to the many pluripotent and totipotent cell regeneration and activation. Hence, we strongly advocate the use of PRF placement intra-operatively in maxillofacial trauma treatments, orthognathic surgery and implant surgeries among the other maxillofacial procedures. PRF will not only aid in both hard and soft tissue healing, (Pripatnanont,

Nuntanaranont & Vongvatcharanon 2013, Acar, Yolcu & Keles, 2015 and Oliveira, Silva &Ferreira, 2015) but shall also prove to be a game-changer for a holistic healing of a patient. Nerve injuries though rare are not insignificant owing to the many clinical manifestations it results in and PRF can prove to be a boon in bringing about improved clinical outcomes.

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CONFLICTS OF INTEREST :

The authors have no conflicts of interest to declare.

REFERENCES :

1. Yadav S, Sachdeva A, Verma A (2011). Inferior alveolar nerve damage following removal of mandibular third molar teeth. Journal of Innovative Dentistry, 1:1–4.
2. Genu PR, Vasconcelos BCE (2008). Influence of tooth section technique in alveolar nerve damage after surgery of impacted lower third molars. Int J Oral Maxillofac Surg, 37:923–928.
3. Libersa P, Savignat M, Tonnel A (2007). Neurosensory disturbances of the inferior alveolar nerve: a retrospective study of complaints in a 10-year period. J Oral Maxillofac Surg, 65:1486–1489.
4. Sunderland SA (1951). A classification of peripheral nerve injuries producing loss of function. Brain,74:491–516.
5. Mc Carthy J. Plastic Surgery (1999). Philadelphia: W.B. Saunders Company; Volume 1. W B Saunders Co Ltd, New york.
6. Smith KG, Robinson PP(1995). The re-innervation of the tongue and salivary glands after lingual nerve repair by stretch, sural nerve graft or frozen muscle graft. J Dent Res, 74:1850–1860.
7. Hudson TW, Evans GRD, Schmidt CE. Engineering strategies for peripheral nerve repair (1999). Clin Plast Surg, 26:617–628.
8. Choukroun J, Adda F, Schoeffler C (2001). Une opportunite' en paroimplantologie:le PRF. Implantodontie, 42:e62.
9. Dohan DM, Choukroun J, Diss A (2006a). Platelet rich fibrin: a second generation platelet concentrate. Part I: technological concepts and evaluation. Oral Surg Oral Med Oral Pathol Oral Radiol Endod,101:E37–40.
10. Dohan DM, Choukroun J, Diss A (2006b). Platelet rich fibrin: a second generation platelet concentrate. Part II: platelet related biologic features. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 101:E45–E50.
11. Wu CL, Lee SS, Tsai CH (2012). Platelet-rich fibrin increases cell attachment, proliferation and collagen-related protein expression of human osteoblasts. Aust Dent J, 57:207–212.
12. Zhang Y, Tangl S, Huber CD (2012). Effects of Choukroun's platelet-rich fibrin on bone regeneration in combination with deproteinized bovine bone mineral in maxillary sinus augmentation: a histological and histomorphometric study. J Craniomaxillofac Surg, 40:321–328.
13. Pripatnanont P, Nuntanaranont T, Vongvatcharanon S (2013). The primacy of platelet-rich fibrin on bone regeneration of various grafts in rabbit's calvarial defects. J Craniomaxillofac Surg, 41:e191–e200.
14. Acar AH, Yolcu U¨ Gu¨l M, Keles A (2015). Micro-computed tomography and histomorphometric analysis of the effects of platelet-rich fibrin on bone regeneration in the rabbit calvarium. Arch Oral Biol, 60: 606–614.

15. Oliveira MR, Silva deC, Ferreira A (2015). Influence of the association between platelet-rich fibrin and bovine bone on bone regeneration. A histomorphometric study in the calvaria of rats. Int J Oral Maxillofac Surg ,44:649–655.
16. Baslarli O, Tumer C, Ugur O (2015). Evaluation of osteoblastic activity in extraction sockets treated with platelet-rich fibrin. Med Oral Patol Oral Cir Bucal, 20:e111–e116.
17. Tabrizi R, Pourdanesh F, Jafari S, Behnia P (2018). Can platelet-rich fibrin accelerate neurosensory recovery following sagittal split osteotomy? A double-blind, split-mouth, randomized clinical trial. Int J Oral Maxillofac Surg, 47(8):1011–4.