Volume 10, Issue 05, May 2024,
Publish Date: 21-05-2024
Doi https://doi.org/10.55640/ijmsdh-10-05-09

International Journal of Medical Science and Dental Health (Open Access)

PLATELET-RICH PLASMA IN ORAL AND MAXILLOFACIAL SURGERY: A COMPREHENSIVE LITERATURE REVIEW

LUIS RODRIGO VELASCO MOLINA[1], ORISEL OLIVA DIMAS[2], KAROL JANICE ESTRADA MENCIAS[3], RONALD JONNATHAN FUENTES JARAMILLO[4], JESSICA ELIZABETH MACHADO PARRA[5]

[1]Dentistry, Independent Investigatori, Ecuador
[2]Dentistry, Master´s Degree in Emergency Care in Stomatology, Ministerio de Sa lud, Ecuador
[3]Dentistry, Universidad de las Américas, Ecuador
[4]Dentistry, Clinic Dental Implant, Universidad Católica Santiago de Guayaquil, Ecuador
[5]Dentistry, Universidad Nacional de Chimborazo, Ecuador

ABSTRACT

Platelet-rich plasma (PRP) is well recognized and frequently used therapeutic tool for surgeons in oral and maxillofacial surgery (OMFS). It is become popular due to its regenerative potential of autologous blood components that enhance tissue repair while improving overall surgical outcomes. we decided to discuss historical evolution of PRP and OMFS, preparation methods and biological mechanisms, OMFS applications, more precisely, efficacy of PRP in OMFS. PRP was originated from early explorations in wound healing research and now it has made continuous refinement and is being used in widespread application across diverse medical specialities. In OMFS, PRP is prepared through centrifugation methods where PRP is concentrate platelets and other important growth factors that are essential for tissue regeneration, or improving bone density and regrowth. Clinical applications span from bone and soft tissue augmentation to the management of temporomandibular joint disorders and maxillofacial pathology. Various pieces of evidence promise promising outcomes, but the efficacy of PRP in enhancing bone regeneration remains debated among researchers and physicians, which necessitates further research and comprehensive validation. Complications of PRP administration are rare but may include infection, nerve damage, tissue calcification, or even blindness in some cases, which emphasizes careful patient selection and monitoring is evident. PRP future in OMFS is promising for more personalized therapies and standardized protocols. More discoveries will be made through mixed or combination treatments with PRP and it will expand applications, technological advancements, and efficacy in long-term outcome.

Keywords: Platelet-rich plasma, regenerative potential, surgical outcomes, preparation methods, OMFS applications, efficacy of PRP, and complications.

INTRODUCTION

PRP (platelet-rich plasma) is a newer method that treats many illnesses in various medical treatments such as oral and maxillofacial surgery. PRP is like a healing magnifier as it focuses the endogenous potential of a patient's blood components, the platelets, to the areas of tissue injury or degeneration, thus increasing rate of tissue healing process. It is emphasized that PRP, as a means of regeneration, rapid healing soft tissue, and promoting surgical success provides therapeutic benefits in oral and maxillofacial surgery. This technique is utilized in a wide variety of procedures, such as tooth implantation positioning and facial trauma treatment. [1].

Platelet-rich plasma (PRP) is highly versatile clinical component to Oral and Maxillofacial Surgery (OMFS), thus granting practitioners an all-encompassing tool for tissue regeneration and wound healing. The efficacy of PRP depends on intended meticulous preparation methods and selected techniques for PRP application individually for details of OMS procedures. PRP is established by obtaining autologous blood obtaining from patient and then it is allowed to centrifuge where concentrated levels of platelets and growth factors is obtained. PRP protocols vary for functionality because mostly, outcomes rely on methodology and physicians. Surgeons consider centrifugation speed, duration, and activator agents for production. [1]. PRP growth factors include PDGF, TGF-β, VEGF and these factors are essential components of tissue repair after surgery. Delivery methods include direct application, injection, or scaffold integration. In this era, advanced devices amd methods has optimized PRP's regenerative potential for example controlled-release systems, targeted delivery systems, microfluidic devices, customized scaffolds, and bioactive coatings [1][2].

Historical Perspective PRP and Oral and Maxillofacial Surgery (OMFS)

A treatment for platelet-rich plasma (PRP) that has grown over time, together with transfusion and wound healing research, has an origin more than 7 decades ago. By the late 1930s, surgeons had started to work with embryonic extracts in the process of wound healing. They were successful and Dorothy E. Cronkite and co worked with thrombin and fibrin for skin graft procedure. In the 1950s and 1960s, the researchers by the names of Kingsley and et al. introduced new techniques of platelet concentrate preparation by employing plastic flexible containers, which were originally meant for the disposable blood, into circulation. This landmark research laid the foundation of the trend which was to grow and develop into a sizeable discipline. Therefore, being always in evolution, PRP has already been applied not only in orthopaedics and also in sports medicine but also in cosmetic dermatology. [3].

Oral and Maxillofacial Surgery (OMFS) discipline has go through an epic journey which is marked by several significant milestones. In Ancient Egypt military surgeons recorded their remedies for mandibular fractures with bandages soaked in honey and egg white in 2700 BC. Greek priests offered a variety of herbal remedies and dental extractions (1200 BC). Despite poor technology at that time, Hippocrates introduced dental treatments in the 4th century BC. In the Roman era, Arlus Celsus qualified dental care and advised careful tooth extraction (25-50 BC). During the Middle Ages, there was lack of regulation in medical practice such as surgeries allowing individuals outside the medical

profession to practice medicine. Surgery underwent significant changes during Middle ages, which was major breakthrough in maxillofacial and oral surgery, when advancements techniques and knowledge started gradually emerging. In the Renaissance period (specifically 1510-1590), Ambroise Paré, a French barber-surgeon, made notable contributions to the field of surgery as he introduced improvements in oral surgery techniques and wound management, including the adoption of ligatures instead of cauterization for wound closure, and the use of innovative prosthetic devices. Paré's innovations has also helped to advance surgical practices and laid the foundation for modern surgical techniques. Other advancements such as Simon P. Hullihen's (1810-1857) development of modern anesthesia, have revolutionized surgical practices because anesthesia use ensures procedures are conducted with greater safety and comfort for patients. American physician, William Morton, finally discovered ether anaesthesia (1819-1868). James E. Garretson's definition of the OMFS scope and his promotion of dental-medical integration in the US were notable (1828-1895). These developments collectively changed OMFS into a distinct surgical speciality, which combined age-old philosophies with advanced technologies [4]. In recent era, one of the latest advancements in Oral and Maxillofacial Surgery (OMFS) is increasing utilization of virtual surgical planning (VSP) and 3D printing technology, now, AI and VR are emerging technologies with potential applications in oral and maxillofacial surgery. AI algorithms are being use for diagnosis, treatment planning, and surgical guidance. Surgeons use VR surgical simulation and patient education in OMFS. Till now, these technologies are not directly involved in administering PRP to promote healing after oral surgeries but AI and VR can be used to optimize PRP preparation and guide its injection [24].

METHODOLOGY

The critical approach follows a systematic search strategy, our research was conducted using databases such as MEDLINE, PubMed, and Science Direct. We analyze with the utilization of keywords such as Platelet-rich plasma (PRP), Oral and maxillofacial surgery (OMFS), Tissue regeneration, Bone healing, Surgical outcomes, Growth factors, Centrifugation, Clinical applications, Efficacy, Complications, Future directions, Personalized therapies, Standardized protocols, Combination treatments, Tissue engineering. We only selected the publications in English and those that explored the role of PRP in oral and maxillofacial surgery. We included randomized trials, systematic reviews, and narrative reviews that were peer-reviewed. Only published studies were selected from 2013-2024 to keep our research current. Other reports, unpublished studies, grey literature, and un-authentic papers were excluded.

Clinical Applications

Oral and maxillofacial surgery (OMFS) has vast array of surgical specialties beyond its more familiar procedures. OMFS surgeons have specializations and perform surgeries for bone regeneration, reconstruction, bone grafting, and distraction osteogenesis as these surgeris restore facial structure and function. Other OMFS clinical applications includes soft tissue augmentation and wound healing where diverse techniques are employed to speed up tissue recovery and regeneration. OMFS surgeons possess expertise in managing Temporomandibular joint (TMJ) disorders as well and they provide both surgical and non-surgical interventions to alleviate discomfort and pain faced by patients and restore normal jaw function. OMSF physicians excel in diagnosing and treating a spectrum of oral diseases, spanning infections to tumors or cysts. [6].

Additionally, Oral and maxillofacial (OMF) applications also cover procedures such as tooth extraction, root tip surgeries, cyst and tumor removal, pre-prosthetic surgeries, and dental implant placement. OMFS surgeons manage maxillofacial trauma and perform orthognathic surgery and genioplasty and adjust jaw misalignment and facial distortions. OMF applications include salivary gland disorders, oral cancer, facial nerve disorders, and collaborate for holistic cleft lip/palate care. [8].

OMF reconstructive surgery require bone grafting to rebuild lost or damaged areas, tissue flaps to transfer tissue, and microsurgery to reconnect blood vessels and nerves; this is done to restore form and function after trauma, disease, or congenital disabilities. Aesthetic surgical operations include rhinoplasty, blepharoplasty, and rhytidectomy to improve the overall facial appearance. In case of sleep apnea caused by anatomical factors, Uvulopalatopharyngoplasty (UPPP) surgery is performed to remove excess throat tissue or maxillomandibular advancement (MMA) to reposition the jaws and enlarge the airway. OMFS constantly upgrades and incorporates technologies like virtual surgical planning (VSP) and robotic-assisted surgery to improve precision and decrease invasiveness while exploring tissue engineering for regenerative solutions. Hence, OMFS surgeons are invaluable in restoring oral health, function, and aesthetics and skillfully dealing with complex facial and neck [8].

Mechanisms of Action

A high platelet count, surpassing normal levels, characterizes platelet-rich plasma (PRP).I n PRP, about 1,000,000 platelets are concentrated in a 5 mL plasma volume, unlike the 150,000-300,000/1 L ranges prevalent in regular blood. The wound's haemostasis phenomenon initiates alpha granules' exudation from the autologous. Platelets are the main factor in activating and enhancing the release of various growth factors important in cellular differentiation, chemotaxis, and proliferation, thus greatly increasing osteogenesis. The wound-healing processes get activated with the release of multiple growth factors directly, stimulating blood flow, cell proliferation, and bone regeneration while coagulating the procoagulant effect simultaneously. Typical instructions for preparing PRP involve simultaneously mixing calcium chloride and thrombin with PRP. This will trigger the activation of alpha granules, essential for the significant release of growth factors. The released growth factors are epithelial cell growth factor, epidermal growth factor (EGF), insulin-like growth factor-I, vascular endothelial growth factor (VEGF), transforming growth factor-beta (TGF-b), and platelet-derived growth factor (PDGF). The PDGF is unique among the factors as it exhibits significant role in the repair of soft and hard tissue, cell division, reproduction and intercellular attraction, which are the first stages of angiogenesis, one of the primary mechanisms of wound healing. In addition, fibrinogen and PDGF-related fibronectin facilitate wound healing by assisting with wound remodelling and contraction. PRP gel administration is related to connective tissue repair and bone regeneration owing to the increased levels of TGF-b1 and TGF-b2, which stimulate the production of cellular fibronectin and collagen, attracting fibroblasts and enhancing protease inhibitor activities while reducing protease actions, thus inhibiting collagen degradation. Previous investigations have highlighted the favourable effects of PRP administration on bone regeneration [9]. Clinical Efficacy Of PRP in OMS and Outcomes

Clinical Efficacy Of PRP in OMS and Outcomes

Author(s)	Year	Methodology	Results and Outcomes

Maidah Hanif and Muhammad Azhar Sheikh[10]	2021	Randomized controlled trial was conducted over a period of 6 months. 130 patients with impacted mandibular wisdom teeth were selected and divided equally into two groups: the PRP group and the non-PRP group. The pain was measured using the Visual Analogue Scale (VAS), and trismus was measured using a Vernier calliper before surgery, immediately after surgery, and on the 3rd and 7th follow-up visits.	PRP group showed lower mean postoperative pain on the seventh day (P-value <0.0001) than the non-PRP group. Trismus was less reported in the PRP group (P-value <0.00065) which suggests that Platelet Rich Plasma effectively reduces trismus and pain after surgical mandibular third molar teeth extraction.
Pietro Gentile, et al[12]	2010	The study evaluated 15 cases involving reconstructive jaw surgery, post-extraction alveolar bone regeneration, and oral implantology. It assessed the impact of local platelet-rich plasma (PRP) application on bone regeneration in the jaws.	PRP treatment demonstrated efficacy, as evidenced by high patient satisfaction and low morbidity postoperatively. This suggests that the quality of PRP's results promotes bone regeneration in maxillofacial surgery.
Aafreen Aftab et al[5]	2020	It was a prospective study with 100 patients. Experimental group received PRP gel after the third molar extraction, while the control group did not. Pain, swelling, and mouth opening were measured post-op.	The experimental group who has receiver PRP had lower pain, less swelling, and better mouth opening. Radiographically, there was a significant difference in bone regeneration at 10 and 16 weeks.

		Radiographic analysis was performed at 4, 10, and 16 weeks.	It was proved PRP gel enhances wound healing and bone regeneration post-extraction.
Lilies Dwi Sulistyani et al [15]	2022	Systematic review of English scientific articles retrieved from ScienceDirect and MEDLINE (via PubMed). This study includes only studies comparing PRP-treated and control groups undergoing surgery without PRP were included.	Of 19 articles reviewed, only 9 reported significant improvement in bone regeneration with PRP treatment for maxillofacial defects. Despite PRP's popularity, previous literature needs more consensus on its efficacy in how surgeons can enhance bone regeneration in the maxillofacial region.
Antonino Albanese[16]	2013	Systematic literature search using Dickersin's strategy, MeSH terms, and text words in databases like MEDLINE, EMBASE, and the Cochrane Library. Criteria: RCTs, literature reviews, and English articles from 2007 to 2012, excluding in vitro trials. Quality assessment of RCTs considered bias, randomization, and blindness.	Efficacy of PRP in maxillofacial surgery varies. Studies demonstrate its potential in enhancing soft tissue healing after tooth extractions, with improved pain management and accelerated healing observed in some cases. PRP influence on bone regeneration remains inconclusive according to findings. There are conflicting findings regarding its effectiveness in promoting bone formation. While PRP shows promise in

			certain aspects of maxillofacial surgery, further research is needed to validate its efficacy comprehensively.
Eduardo Anitua[11]	2021	A narrative review compiling existing evidence on the efficacy of PRP in oral and maxillofacial surgery, focusing on the composition perspective, was conducted. A systematic literature search was also conducted.	Various platelet-rich plasma (PRP) types, classified by the presence or absence of leukocytes were used in oral and maxillofacial surgery. In results, PRP shows promise in enhancing soft and hard tissue regeneration, varying efficacy depending on composition and application. platelet-poor PRP (P-PRP) demonstrates consistent benefits in alveolar ridge preservation, post-extraction complications, bone augmentation, and TMJ disorders, emphasizing the importance of composition and preparation in determining PRP's effectiveness.
Doiphode[17]	April 2016	The study included 30 patients with bilateral mandibular third molar impaction. Platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) were applied	The PRF, a platelet-rich fibrin group, showed decreased probing depth compared to the PRP and control groups, indicating better soft tissue healing. PRP and PRF

		to extraction sites, and patients were recalled postoperatively in the 2nd, fourth, and sixth months. Statistical analysis was conducted using IBM SPSS software.	demonstrated increased bone density, suggesting efficacy in inducing hard tissue regeneration.
Cristina Barona-Dorado[18]	2014	A systematic review of published literature and key categories include human randomized clinical studies.	Based on the reviewed literature, scientific evidence supporting the use of PRP in retained third molar surgery needs to be revised. The authors suggest the necessity for randomized clinical trials before making recommendations for the clinical application of PRP in such cases.
Shyamkumar Sriram et al.,[19]	2023	Review is adhered to PRISMA 2020 guidelines, using PICO for research questions. They included human studies on PRP-treated OLP in English (Jan 2000–Jan 2023), ≥10 participants. They do not include plasma-rich fibrin or cutaneous LP studies. Search was conducted on Google Scholar, PubMed/MEDLINE with MeSH terms. Two authors screened with a third resolving discrepancies.	PRP shows promise in oral surgery for oral lichen planus (OLP) treatment, yielding varied pain reduction and lesion improvement outcomes. Studies compared PRP with corticosteroids, highlighting PRP's gradual clinical response and comparable efficacy. Despite some concerns about side effects and recurrence, PRP offers a potential therapeutic avenue for OLP management.

		Outcome assessment include VAS, NRS scales. Data extraction included study details. Bias assessed using NIHR tools.	
Mustafa Cenk Durmuşlar et al.,[20]	2014	Eighteen patients were scheduled for post-operative visits at 1, 3, and 6 months post-operatively. Probing depths were measured, and digital panoramic radiographs were taken.	Mustafa Cenk Durmuşlar et al did not found any significant differences in probing depths between the two groups. The radiographic assessment showed no significant difference between groups at first and sixth-month intervals. At three months postoperatively, the radiographic density at the PRP side was significantly higher. The combined use of PRP and bovine-derived HA graft materials for treating intra-bony defects is an appropriate approach for achieving earlier bone regeneration.

DISCUSSION

Numerous research studies have been conducted to investigate the effectiveness of PRP in oral and maxillofacial surgeries, focusing on its ability to ease pain, control wound healing, and regenerate bone. Hanif and Sheikh's randomized controlled trial showed that PRP significantly decreased postoperative pain and trismus compared to non-PRP groups after the extraction of impacted mandibular wisdom teeth [10]. The effects of this were corroborated by Aftab et al., who found reduced pain, swelling, and improved mouth opening in the PRP group after mandibular third molar extraction [14]. Gentile et al.

identified PRP as a viable treatment option for bone regeneration after reconstructive jaw surgery and post-extraction alveolar bone regeneration [12]. Sulistyani et al. 's systematic review found that while some studies reported a significant improvement in bone regeneration with PRP treatment, there was no consensus on its effectiveness [15]. Anitua's narrative review showed that PRP could have implications for tissue regeneration, with composition having a key role in its effectiveness [11]. Barona-Dorado's meta-analysis unveiled the scarcity of randomized trials that prove the effectiveness of PRP in surgical procedures where the third molar is extracted. Despite the fact that varying outcomes recorded, PRP is a novel technology that adds up healing wounds and bone regeneration in oral and maxillofacial surgery. Despite this, certain studies still need to be conducted as further proof of the efficiency and also the most effective application and composition procedure.

Clinical blindness in ocular areas has been implicated with the obstruction of the ophthalmic artery by platelet rich plasma injection. The backward flow of emboli into the cerebrovascular system can result in the infarction of the retina and choroid due to the injection under high pressure. The really fine anastomoses between facial arteries pose a risk of embolism into the ophthalmic artery and lead to the ischemic events and permanent vision loss. Platelet-rich plasma (PRP) treatment is recognized to be safe for the concern of oral and maxillofacial surgery. Nevertheless, it is necessary to consider the possible risks, such as rare infections at the site of the injection. It has a small risk of temporary or, in rare cases, permanent nerve damage and some patients may experience tissue damage, mild pain, or allergic reactions [21].

The PRP may calcify on certain occasions, forming a small calcium deposit. In addition to that, there may be a conflict with medicines or dietary supplements. Although it is a rare possibility, transmission of blood-borne diseases such as hepatitis or HIV is a theoretical risk, but it can be avoided by proper screening and preparation. The effectiveness of PRP is important to be mentioned. Also, it may not be as successful as one expects. The method can also take your money if you are not insured. For a safe and successful result, it is important to consult a qualified and experienced oral and maxillofacial surgeon who will thoroughly discuss these risks and address any concerns before treating them [22]. When performing bone grafting, implants and a host of other smaller procedures, the real power of PRP lies in its hidden applications and improved treatment approaches. With the advancement of PRP's mechanisms of action research, it can be expected that it is a significant change towards tailored therapies. This may be done by creating a specific component for PRP that will include specific growth factors and cytokines that will help patients address their individual needs and any other unique requirements of the surgical procedures. Protocols standardisation of the PRP preparation will also contribute greatly to precise and reproducible clinical outcomes. The consensus on the optimum platelet concentration, leukocyte inclusion, and activation methods will be the key to general acceptance and comparative research. Future of PRP may be in different combination therapies, where they will be given together with other regenerative products such as bone morphogenetic proteins (BMPs) or stem cells. Thus, this technique will supercharge the regenerative ability of PRP and speed up the healing process, mainly in complicated reconstructive surgeries.

The possibilities for PRP have a great potential to expand as well. Apart from its current use in bone and soft tissue regeneration, PRP may find applications in nerve repair, treatment of oral mucosal lesions, and even craniofacial reconstruction. Innovative PRP preparations with improved stability and

directed delivery systems will be key for enlarging its application area. Technological developments will be at the core of the future PRP use revolution. Automated systems for PRP preparation, point-of-care devices for intraoperative use, and innovative delivery methods like hydrogels and scaffolds will make PRP therapy more available and effective in the clinical setting. The combination of PRP with tissue engineering is tremendously promising. PRP can help activate the scaffold and development of vascularized tissues, thus leading to the development of patient-tailored engineered grafts to treat maxillofacial disease [23]

CONCLUSION

PRP is valuable therapy for oral and maxillofacial surgery that improves tissue regeneration and surgery outcomes in addition to other surgical procedures. The frequent use of PRP's effect on bone regeneration, notwithstanding its numerous applications and the possibility of individualized therapies, points to the future of this technique. Standardized protocols, multiple treatment options, and technological progress make a point to improve PRP application service. In future, nerve repair and tissue engineering applications will revolutionise the surgical practice. The future effect of the PRP will be the subject of a long-term study to check its durability and improve its clinical effectiveness. PRP continues to improve the level of care in oral and maxillofacial surgery with the ongoing research and innovation.

References

1. Albanese A, Licata ME, Polizzi B, Campisi G. Platelet-rich plasma (PRP) in dental and oral surgery: from the wound healing to bone regeneration. Immunity & Ageing [Internet]. 2013 Jun 13;10(1). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3683340/
2. Fertala A. Beyond drugs and surgery. In: Elsevier eBooks [Internet]. 2023. p. 45–51. Available from: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/platelet-rich-plasma
3. Mościcka P, Przylipiak A. History of autologous platelet-rich plasma: A short review. Journal of Cosmetic Dermatology [Internet]. 2021 Jul 14;20(9):2712–4. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9291029/
4. Lee KC, Chuang SK. History of innovations in oral and maxillofacial surgery. Frontiers of Oral and Maxillofacial Medicine [Internet]. 2022 Mar 1;4:6. Available from: https://fomm.amegroups.org/article/view/54627/html
5. Aafreen Aftab,. Oral & Maxillofacial Surgery; A historical review of the development of the surgical discipline. ResearchGate. Available from: https://www.researchgate.net/publication/323396752_Oral_Maxillofacial_Surgery_A_historical_review_of_the_development_of_the_surgical_discipline

6. Acri TM, Shin KH, Seol D, Laird NZ, Song I, Geary SM, et al. Tissue engineering for the temporomandibular joint. Advanced Healthcare Materials/Advanced Healthcare Materials [Internet]. 2018 Dec 17;8(2). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7075314/
7. Mali NAM. Introduction to oral and maxillofacial surgery [Internet]. 2016. Available from: https://www.jaypeedigital.com/eReader/chapter/9789385999871/ch1
8. Isaac, R., Tahim, A. S., Payne, K. F. B., Goodson, A. M. C., & Brennan, P. A. (2022). Oral and Maxillofacial Surgery: An Illustrated Guide for Medical Students and Allied Healthcare Professionals. Faringdon, Oxfordshire: Libri Publishing.
9. View of Role of platelet-rich plasma in maxillofacial surgery. Available from: https://www.ijcmph.com/index.php/ijcmph/article/view/9088/5490
10. Hanif M, Sheikh MA. Efficacy of platelet rich plasma (PRP) on mouth opening and pain after surgical extraction of mandibular third molars. Journal of Oral Medicine and Oral Surgery [Internet]. 2020 Nov 13;27(1):9. Available from: https://www.jomos.org/articles/mbcb/full_html/2021/01/mbcb200021/mbcb200021.html
11. Anitua E, Fernández-De-Retana S, Alkhraisat MH. Platelet rich plasma in oral and maxillofacial surgery from the perspective of composition. Platelets [Internet]. 2020 Dec 22;32(2):174–82. Available from: https://pubmed.ncbi.nlm.nih.gov/33350883/
12. Gentile P, Bottini DJ, Spallone D, Curcio BC, Cervelli V. Application of Platelet-Rich plasma in maxillofacial surgery. the Journal of Craniofacial Surgery/the Journal of Craniofacial Surgery [Internet]. 2010 May 1;21(3):900–4. Available from: https://pubmed.ncbi.nlm.nih.gov/20485077/
13. Efficacy of autologous platelet rich plasma gel in soft and hard tissue healing after surgical extraction of impacted mandibular third molar - A prospective study. ResearchGate. Available from: https://www.researchgate.net/publication/341472854_Efficacy_of_autologous_platelet_rich_plasma_gel_in_soft_and_hard_tissue_healing_after_surgical_extraction_of_impacted_mandibular_third_molar_-_A_prospective_study
14. Aftab A, Joshi UK, Patil SR, Hussain E, Bhatnagar S. Efficacy of autologous platelet rich plasma gel in soft and hard tissue healing after surgical extraction of impacted mandibular third molar - A prospective study. Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology [Internet].

2020 Jul 1;32(4):241–6. Available from: https://www.sciencedirect.com/science/article/abs/pii/S221255582030034X

15. Sulistyani LD, Julia V, Ariawan D, Utomo YA, Reksoprodjo MR, Sandi WHS. Efficacy of platelet-rich plasma on promoting bone healing in maxillofacial defects: a systematic review [Internet]. Universitas Indonesia. 2022. Available from: https://scholar.ui.ac.id/en/publications/efficacy-of-platelet-rich-plasma-on-promoting-bone-healing-in-max
16. Albanese A, Licata ME, Polizzi B, Campisi G. Platelet-rich plasma (PRP) in dental and oral surgery: from the wound healing to bone regeneration. Immunity & Ageing [Internet]. 2013 Jun 13;10(1). Available from: https://immunityageing.biomedcentral.com/articles/10.1186/1742-4933-10-23
17. Doiphode A, Hegde P, Mahindra U, Kumar S, Tenglikar P, Tripathi V. Evaluation of the efficacy of platelet-rich plasma and platelet-rich fibrin in alveolar defects after removal of impacted bilateral mandibular third molars. Journal of International Society of Preventive and Community Dentistry [Internet]. 2016 Jan 1;6(7):47. Available from: https://journals.lww.com/jpcd/fulltext/2016/06001/evaluation_of_the_efficacy_of_platelet_rich_plasma.9.aspx
18. Barona-Dorado C, González-Regueiro I, Martín-Ares M, Arias-Irimia O, Martínez-González JM. Efficacy of platelet-rich plasma applied to post-extraction retained lower third molar alveoli: A systematic review. Med Oral Patol Oral Cir Bucal. 2014 Mar 1;19(2):e142-8.
19. Sriram S, Hasan S, Alqarni AS, Alam T, Kaleem SM, Aziz S, et al. Efficacy of Platelet-Rich plasma therapy in oral lichen planus: a Systematic review. Medicina [Internet]. 2023 Apr 11;59(4):746. Available from: https://www.mdpi.com/1648-9144/59/4/746
20. Durmuşlar MC, Alpaslan C, Alpaslan G, Çakır M. Clinical and radiographic evaluation of the efficacy of platelet-rich plasma combined with hydroxyapatite bone graft substitutes in the treatment of intra-bony defects in the maxillofacial region. Acta Odontologica Scandinavica [Internet]. 2014 Jul 9;72(8):948–53. Available from: https://medicaljournalssweden.se/actaodontologica/article/view/37303
21. Karam E, Gan A, Mendoza RM, Martinez E, Perez E. Visual Loss after Platelet-rich Plasma Injection into the Face. Neuro-ophthalmology [Internet]. 2020 Mar 26;44(6):371–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7722697/

22. Platelet-Rich plasma (PRP) injections. Johns Hopkins Medicine. 2023. Available from: https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/plateletrich-plasma-prp-treatment
23. Gharpinde MR, Pundkar A, Shrivastava S, Patel H, Chandanwale R. A comprehensive review of Platelet-Rich plasma and its emerging role in accelerating bone healing. Curēus [Internet]. 2024 Feb 13; Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10939108/
24. Miragall M, Knoedler S, Kauke-Navarro M, Saadoun R, Grabenhorst A, Grill F, et al. Face the Future—Artificial Intelligence in oral and maxillofacial surgery. Journal of Clinical Medicine [Internet]. 2023 Oct 30;12(21):6843. Available from: https://www.mdpi.com/2077-0383/12/21/6843