



15 Jahre Anwendung von Platelet-Rich Fibrin in der Zahnmedizin und der Kieferchirurgie

Wie hoch ist der klinische Evidenzgrad?

Ein Beitrag von Prof. Dr. mult. Shahram Ghanaati und Sarah Al-Maawi

Literaturangabe

- [1] S. Ghanaati, P. Booms, A. Orlowska, A. Kubesch, J. Lorenz, J. Rutkowski, C. Landes, R. Sader, C. Kirkpatrick, J. Choukroun, Advanced Platelet-Rich Fibrin: A New Concept for Cell-Based Tissue Engineering by Means of Inflammatory Cells, *J. Oral Implantol.* 40 (2014) 679–689. doi:10.1563/aid-joi-D-14-00138.
- [2] J. Choukroun, F. Adda, C. Schoeffler, A. Vervelle, Une opportunité en paro-implantologie: le PRF, *Implantodontie.* 42 (2001) 55–62.
- [3] J. Choukroun, S. Ghanaati, Reduction of relative centrifugation force within injectable platelet-rich-fibrin (PRF) concentrates advances patients' own inflammatory cells, platelets and growth factors: the first introduction to the low speed centrifugation concept, *Eur. J. Trauma Emerg. Surg.* 44 (2018) 87–95. doi:10.1007/s00068-017-0767-9.
- [4] K. El Bagdadi, A. Kubesch, X. Yu, S. Al-Maawi, A. Orlowska, A. Dias, P. Booms, E. Dohle, R. Sader, C.J. Kirkpatrick, J. Choukroun, S. Ghanaati, Reduction of relative centrifugal forces increases growth factor release within solid platelet-rich-fibrin (PRF)-based matrices: a proof of concept of LSCC (low speed centrifugation concept), *Eur. J. Trauma Emerg. Surg.* (2017). doi:10.1007/s00068-017-0785-7.
- [5] E. Dohle, K. El Bagdadi, R. Sader, J. Choukroun, C. James Kirkpatrick, S. Ghanaati, PRF-based matrices to improve angiogenesis in an in vitro co-culture model for bone tissue engineering, *J. Tissue Eng. Regen. Med.* (2017). doi:10.1002/term.2475.
- [6] A. Sharma, a. R. Pradeep, Autologous Platelet-Rich Fibrin in the Treatment of Mandibular Degree II Furcation Defects: A Randomized Clinical Trial, *J. Periodontol.* 82 (2011) 1396–1403. doi:10.1902/jop.2011.100731.
- [7] S. Ghanaati, S. Al-Maawi, Y. Schaffner, R. Sader, J. Choukroun, C. Nacopoulos, Application of liquid platelet-rich fibrin for treating hyaluronic acid-related complications: A case report with 2 years of follow-up, *Int. J. Growth Factors Stem Cells Dent.* 1 (2018) 74. doi:10.4103/GFSC.GFSC_11_18.
- [8] O. Ozgul, F. Senses, N. Er, U. Tekin, H.H. Tuz, A. Alkan, I.D. Kocyigit, F. Atil, Efficacy of platelet rich fibrin in the reduction of the pain and swelling after impacted third molar surgery: Randomized multicenter split-mouth clinical trial, *Head Face Med.* 11 (2015) 37. doi:10.1186/s13005-015-0094-5.
- [9] C.M. McCarthy, E.D. Collins, A.L. Pusic, Where do we find the best evidence?, *Plast. Reconstr. Surg.* 122 (2008) 1942–1947; discussion 1948–1951. doi:10.1097/PRS.0b013e31818d2098.
- [10] R. Paper, S. Ghanaati, C.A. Secondary, C. Author, S. Ghanaati, C.H. Vizcaino, S. Al-maawi, J. Lorenz, R.J. Miron, K. Nelson, F. Schwarz, J. Choukroun, R. Sader, S. Ghanaati, Fifteen years of platelet rich fibrin (PRF) in dentistry and oromaxillofacial surgery : How high is the level of scientific evidence ?, (2017).
- [11] M. Dhiman, S. Kumar, J. Duhan, P. Sangwan, S. Tewari, Effect of Platelet-rich Fibrin on Healing of Apicomarginal Defects: A Randomized Controlled Trial, *J. Endod.* 41 (2015) 985–991. doi:10.1016/j.joen.2015.04.004.
- [12] I.B. Geeta, G. Galagali, K. Sangeeta, S. Pushpa, F. Noushin, A natural meliorate: Revolutionary tissue engineering in endodontics, *J. Clin. Diagnostic Res.* 7 (2013) 2644–2646. doi:10.7860/JCDR/2013/6915.3638.
- [13] S. Singh, A. Singh, S. Singh, R. Singh, Application of PRF in surgical management of periapical lesions., *Natl. J. Maxillofac. Surg.* 4 (2013) 94–9. doi:10.4103/0975-5950.117825.
- [14] D. Subash, K. Shoba, S. Aman, S.K.I. Bharkavi, Revitalization of an immature permanent mandibular molar with a necrotic pulp using platelet-rich fibrin: A case report, *J. Clin. Diagnostic Res.* 10 (2016) ZD21–ZD23. doi:10.7860/JCDR/2016/21793.8902.
- [15] H. Bakhtiar, S. Esmaeili, S. Fakhr Tabatabayi, M.R. Ellini, M.H. Nekoofar, P.M.H. Dummer, Second-generation Platelet Concentrate (Platelet-rich Fibrin) as a Scaffold in Regenerative Endodontics: A Case Series, *J. Endod.* 43 (2017) 401–408. doi:10.1016/j.joen.2016.10.016.
- [16] and S.D. Nikhil D. Chandradas, Shivamurthy Ravindra, Vivekananda M. Rangaraju, Sheetal Jain, Efficacy of platelet rich fibrin in the treatment of human intrabony defects, *J. Adv. Pharm. Technol. Res.* 4 (2015) 25–30. doi:10.4103/2231.
- [17] S. Jankovic, Z. Aleksic, Use of Platelet-Rich Fibrin Membrane Following Treatment of Gingival Recession : A Randomized Clinical Trial, 32 (2012) 41–50.
- [18] A.R. Pradeep, K. Nagpal, S. Karvekar, K. Patnaik, S.B. Naik, C.N. Guruprasad, Platelet Rich Fibrin with 1% Metformin for the Treatment of Intrabony Defects in Chronic Periodontitis: A Randomized Controlled Clinical Trial, *J. Periodontol.* 12 (2015) 1–14. doi:10.1902/jop.2015.140646.

- [19] S. Jankovic, Z. Aleksic, I. Milinkovic, B. Dimitrijevic, The coronally advanced flap in combination with platelet-rich fibrin (PRF) and enamel matrix derivative in the treatment of gingival recession: a comparative study., *Eur. J. Esthet. Dent.* 5 (2010) 260–73. <http://www.ncbi.nlm.nih.gov/pubmed/20820456> (accessed May 27, 2019).
- [20] D. Kanoriya, A.R. Pradeep, V. Garg, S. Singhal, Mandibular Degree II Furcation Defects Treatment With Platelet Rich Fibrin and 1% Alendronate Gel Combination: A Randomized Controlled Clinical Trial, *J. Periodontol.* 88 (2016) 1–13. doi:10.1902/jop.2016.160269.
- [21] A. Sharma, a. R. Pradeep, Treatment of 3-Wall Intrabony Defects in Patients With Chronic Periodontitis With Autologous Platelet-Rich Fibrin: A Randomized Controlled Clinical Trial, *J. Periodontol.* 82 (2011) 1705–1712. doi:10.1902/jop.2011.110075.
- [22] M. Thorat, A.R. Pradeep, B. Pallavi, Clinical effect of autologous platelet-rich fibrin in the treatment of intra-bony defects: A controlled clinical trial, *J. Clin. Periodontol.* 38 (2011) 925–932. doi:10.1111/j.1600-051X.2011.01760.x.
- [23] P. Bajaj, A.R. Pradeep, E. Agarwal, N.S. Rao, S.B. Naik, N. Priyanka, N. Kalra, Comparative evaluation of autologous platelet-rich fibrin and platelet-rich plasma in the treatment of mandibular degree II furcation defects: A randomized controlled clinical trial, *J. Periodontal Res.* 48 (2013) 573–581. doi:10.1111/jre.12040.
- [24] H. Ajwani, S. Shetty, D. Gopalakrishnan, R. Kathariya, A. Kulloli, R.S. Dolas, A.R. Pradeep, Comparative evaluation of platelet-rich fibrin biomaterial and open flap debridement in the treatment of two and three wall intrabony defects., *J. Int. Oral Heal. JIOH.* 7 (2015) 32–7.
- [25] G. Ustaoglu, E. Ercan, M. Tunalı, The role of titanium-prepared platelet-rich fibrin in palatal mucosal wound healing and histoconduction, *Acta Odontol. Scand.* 74 (2016) 558–564. doi:10.1080/00016357.2016.1219045.
- [26] C.B. and V. Bharti, Evaluation of efficacy of autologous platelet-rich fibrin with demineralized freeze dried bone allograft in the treatment of periodontal intrabony defects, *J Indian Soc Periodontol.* 17 (2013) 361–366. doi:10.4103/0972.
- [27] a R. Pradeep, S. Karvekar, K. Nagpal, K. Patnaik, A. Raju, P. Singh, Rosuvastatin 1.2 mg in Situ Gel Combined With 1:1 Mixture of Autologous Platelet-Rich Fibrin and Porus- Hydroxyapatite Bone Graft in Surgical Treatment of Mandibular Degree II Furcation Defects: A Randomized Clinical Control Trial, *J. Periodontol.* (2015) 1–15. doi:10.1902/jop.2015.150131.
- [28] A. Agarwal, N.D. Gupta, Platelet-rich plasma combined with decalcified freeze-dried bone allograft for the treatment of noncontained human intrabony periodontal defects: a randomized controlled split-mouth study., *Int. J. Periodontics Restorative Dent.* 34 (2014) 705–11. doi:10.11607/prd.1766.
- [29] A. Agarwal, N.D. Gupta, A. Jain, Platelet rich fibrin combined with decalcified freeze-dried bone allograft for the treatment of human intrabony periodontal defects: a randomized split mouth clinical trail., *Acta Odontol. Scand.* 74 (2016) 36–43. doi:10.3109/00016357.2015.1035672.
- [30] S. Biswas, S. Sambashivaiah, R. Kulal, S. Bilichodmath, G.M. Kurtzman, Comparative Evaluation of Bioactive Glass (Putty) and Platelet Rich Fibrin in Treating Furcation Defects, *J. Oral Implantol.* 42 (2016) 411–415. doi:10.1563/aaid-joi-D-16-00023.
- [31] Y. SEZGIN, A. URAZ, I.L. TANER, R. ÇULHAOĞLU, Effects of platelet-rich fibrin on healing of intra-bony defects treated with anorganic bovine bone mineral, *Braz. Oral Res.* 31 (2017) 1–11. doi:10.1590/1807-3107bor-2017.vol31.0015.
- [32] V. Lekovic, I. Milinkovic, Z. Aleksic, S. Jankovic, P. Stan-kovic, E.B. Kenney, P.M. Camargo, Platelet-rich fibrin and bovine porous bone mineral vs. platelet-rich fibrin in the treatment of intrabony periodontal defects, *J. Periodontal Res.* 47 (2012) 409–417. doi:10.1111/j.1600-0765.2011.01446.x.
- [33] S. Aroca, T. Keglevich, B. Barbieri, I. Gera, D. Etienne, Clinical Evaluation of a Modified Coronally Advanced Flap Alone or in Combination With a Platelet-Rich Fibrin Membrane for the Treatment of Adjacent Multiple Gingival Recessions: A 6-Month Study, *J. Periodontol.* 80 (2009) 244–252. doi:10.1902/jop.2009.080253.
- [34] G.K. Sandhu, P.K. Khinda, A.S. Gill, H.S. Kalra, Surgical re-entry evaluation of regenerative efficacy of bioactive Gengigel() and platelet-rich fibrin in the treatment of grade II furcation: A novel approach., *Contemp. Clin. Dent.* 6 (2015) 570–573. doi:10.4103/0976-237X.169855.
- [35] A. Mathur, V.K. Bains, V. Gupta, R. Jhingran, R.P. Singh, Evaluation of intrabony defects treated with platelet-rich fibrin or autogenous bone graft: A comparative analysis, *Eur. J. Dent.* 9 (2015) 100–108. doi:10.4103/1305-7456.149653.
- [36] F. Munoz, C. Jiménez, D. Espinoza, A. Vervelle, J. Beugnet, Z. Haidar, Use of leukocyte and platelet-rich fibrin (L-PRF) in periodontally accelerated osteogenic orthodontics (PAOO): Clinical effects on edema and pain., *J. Clin. Exp. Dent.* 8 (2016) e119–24. doi:10.4317/jced.52760.
- [37] E. und A.A. in E. Öncü, Enhancement of Immediate Implant Stability and Recovery Using Platelet-Rich Fibrin, *Int. J. Periodontics Restorative Dent.* (2017). doi:10.11607/prd.2505.
- [38] P. Boora, M. Rathee, M. Bhoria, Effect of Platelet Rich Fibrin (PRF) on peri-implant soft tissue and crestal bone in one-stage implant placement: A randomized controlled trial, *J. Clin. Diagnostic Res.* 9 (2015) ZC18–ZC21. doi:10.7860/JCDR/2015/12636.5788.
- [39] J. Hehn, T. Schwenk, M. Striegel, M. Schlee, The effect of PRF (platelet-rich fibrin) inserted with a split-flap technique on soft tissue thickening and initial marginal bone loss around implants: results of a randomized, controlled clinical trial, *Int. J. Implant Dent.* 2 (2016) 13. doi:10.1186/s40729-016-0044-4.
- [40] B. Hamzacebi, B. Oduncuoglu, E.E. Alaaddinoglu, Treatment of Peri-implant Bone Defects with Platelet-Rich Fibrin., *Int. J. Periodontics Restorative Dent.* 35 (2015) 414–422 pp. doi:10.11607/prd.1861.
- [41] G. Kotsakis, H. Prasad, M. Rohrer, J. Hinrichs, F. Boufidou, K. Tosios, G. Kotsakis, Extraction socket management utilizing Platelet-Rich-Fibrin : A proof-of-principle study of the ' ' accelerated-early implant placement ' ' concept, *J. Oral Implantol.* (2015). doi:10.1563/aaid-joi-D-15-00001.
- [42] J. Choukroun, A. Diss, A. Simonpieri, M.-O. Girard, C. Schoeffler, S.L. Dohan, A.J.J. Dohan, J. Mouhyi, D.M. Dohan, Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part V: histologic evaluations of PRF effects on bone allograft maturation in sinus lift., *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* 101 (2006) 299–303. doi:10.1016/j.tripleo.2005.07.012.

- [43] Y. Zhang, S. Tangl, C.D. Huber, Y. Lin, L. Qiu, X. Rausch-Fan, 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. Cranio-Maxillofacial Surg.* 40 (2012) 321–328. doi:10.1016/j.jcms.2011.04.020.
- [44] N. Bolukbasi, S. Ersanlı, N. Keklikoglu, C. Basegmez, T. Ozdemir, Sinus Augmentation With Platelet-Rich Fibrin in Combination With Bovine Bone Graft Versus Bovine Bone Graft in Combination With Collagen Membrane, *J. Oral Implantol.* 41 (2015) 586–595. doi:10.1563/AAID-JOI-D-13-00129.
- [45] M. Tatullo, M. Marrelli, M. Cassetta, A. Pacifici, L.V. Stefanelli, S. Scacco, G. Dipalma, L. Pacifici, F. Inchingolo, Platelet rich fibrin (P.R.F.) in reconstructive surgery of atrophied maxillary bones: Clinical and histological evaluations, *Int. J. Med. Sci.* 9 (2012) 872–880. doi:10.7150/ijms.5119.
- [46] C.D. Gokhan GURLER, Effects of leukocyte-platelet rich fibrin on postoperative complications of direct sinus lifting, 65 (2016) 207–12.
- [47] A. Simonpieri, J. Choukroun, M. Del Corso, G. Sammartino, D.M. Dohan Ehrenfest, Simultaneous sinus-lift and implantation using microthreaded implants and leukocyte- and platelet-rich fibrin as sole grafting material: a six-year experience., *Implant Dent.* 20 (2011) 2–12. doi:10.1097/ID.0b013e3181faa8af.
- [48] T. Kanayama, K. Horii, Y. Senga, Y. Shibuya, Crestal Approach to Sinus Floor Elevation for Atrophic Maxilla Using Platelet-Rich Fibrin as the Only Grafting Material: A 1-Year Prospective Study, *Implant Dent.* (2015) 32–38. doi:10.1097/ID.000000000000327.
- [49] F. Inchingolo, M. Tatullo, M. Marrelli, A.M. Inchingolo, S. Scacco, A.D. Inchingolo, G. Dipalma, D. Vermesan, A. Abbinante, R. Cagiano, Trial with Platelet-Rich Fibrin and Bio-Oss used as grafting materials in the treatment of the severe maxillar bone atrophy: clinical and radiological evaluations., *Eur. Rev. Med. Pharmacol. Sci.* 14 (2010) 1075–84. <http://www.ncbi.nlm.nih.gov/pubmed/21375140> (accessed May 27, 2019).
- [50] M.P. Varghese, S. Manuel, S. Kumar L. K., Potential for Osseous Regeneration of Platelet-Rich Fibrin-A Comparative Study in Mandibular Third Molar Impaction Sockets, *J. Oral Maxillofac. Surg.* (2016) 1–8. doi:10.1016/j.joms.2017.01.035.
- [51] A. Temmerman, J. Vandessel, A. Castro, R. Jacobs, W. Teughels, N. Pinto, M. Quirynen, The use of leucocyte and platelet-rich fibrin in socket management and ridge preservation: a split-mouth, randomized, controlled clinical trial, *J. Clin. Periodontol.* 43 (2016) 990–999. doi:10.1111/jcpe.12612.
- [52] Y.R. Kumar, S. Mohanty, M. Verma, R.R. Kaur, P. Bhatia, V.R. Kumar, Z. Chaudhary, Platelet-rich fibrin: The benefits, *Br. J. Oral Maxillofac. Surg.* 54 (2016) 57–61. doi:10.1016/j.bjoms.2015.10.015.
- [53] S.S. Soydan, S. Uckan, Management of bisphosphonate-related osteonecrosis of the jaw with a platelet-rich fibrin membrane: Technical report, *J. Oral Maxillofac. Surg.* 72 (2014) 322–326. doi:10.1016/j.joms.2013.07.027.
- [54] T. Yelamali, D. Saikrishna, Role of platelet rich fibrin and platelet rich plasma in wound healing of extracted third molar sockets: a comparative study., *J. Maxillofac. Oral Surg.* 14 (2015) 410–6. doi:10.1007/s12663-014-0638-4.
- [55] A. Anwandter, S. Bohmann, M. Nally, A.B. Castro, M. Quirynen, N. Pinto, Dimensional changes of the post extraction alveolar ridge, preserved with Leukocyte- and Platelet Rich Fibrin: A clinical pilot study, *J. Dent.* 52 (2016) 23–29. doi:10.1016/j.jdent.2016.06.005.
- [56] N. Kumar, K. Prasad, L. Ramanujam, R. K. J. Dexith, A. Chauhan, Evaluation of Treatment Outcome After Impacted Mandibular Third Molar Surgery With the Use of Autologous Platelet-Rich Fibrin: A Randomized Controlled Clinical Study., *J. Oral Maxillofac. Surg.* (2014) 1–8. doi:10.1016/j.joms.2014.11.013.
- [57] D. Emanuele Ruga, DDS, Cesare Gallesio, MD, M. Paolo Boffano, Platelet-Rich Fibrin and Piezoelectric Surgery: A Safe Technique for the Prevention of Periodontal Complications in Third Molar Surgery, *J. Craniofac. Surg.* 22 (2011) 1951–1955. doi:10.1097/SCS.0b013e31822ea630.
- [58] A. Singh, M. Kohli, N. Gupta, Platelet rich fibrin: a novel approach for osseous regeneration., *J. Maxillofac. Oral Surg.* 11 (2012) 430–4. doi:10.1007/s12663-012-0351-0.
- [59] G. Sammartino, D.M.D. Ehrenfest, F. Carile, M. Tia, P. Bucci, Prevention of Hemorrhagic Complications After Dental Extractions Into Open Heart Surgery Patients Under Anticoagulant Therapy: The Use of Leukocyte- and Platelet-Rich Fibrin, *J. Oral Implantol.* 37 (2011) 681–690. doi:10.1563/AAID-JOI-D-11-00001.
- [60] H. Shawky, S.A. Seifeldin, Does Platelet-Rich Fibrin Enhance Bone Quality and Quantity of Alveolar Clef Reconstruction?, *Cleft Palate. Craniofac. J.* 00 (2015). doi:10.1597/14-290.
- [61] M. Dar, T. Hakim, A. Shah, L. Najar, G. Yaqoob, F. Lanker, Use of autologous platelet-rich fibrin in osseous regeneration after cystic enucleation: A clinical study, *J. Oral Biol. Craniofacial Res.* 6 (2016) S29–S32. doi:10.1016/j.jobcr.2016.04.004.
- [62] J.H. Park, J.W. Kim, S.J. Kim, Does the Addition of Bone Morphogenetic Protein 2 to Platelet-Rich Fibrin Improve Healing After Treatment for Medication-Related Osteonecrosis of the Jaw?, *J. Oral Maxillofac. Surg.* 75 (2016) 1176–1184. doi:10.1016/j.joms.2016.12.005.
- [63] T. Asaka, N. Ohga, Y. Yamazaki, J. Sato, C. Satoh, Y. Kitagawa, Platelet-rich fibrin may reduce the risk of delayed recovery in tooth-extracted patients undergoing oral bisphosphonate therapy: a trial study, *Clin. Oral Investig.* (2016) 1–8. doi:10.1007/s00784-016-2004-z.
- [64] S.S. Soydan, S. Uckan, Management of bisphosphonate-related osteonecrosis of the jaw with a platelet-rich fibrin membrane: technical report., *J. Oral Maxillofac. Surg.* 72 (2014) 322–6. doi:10.1016/j.joms.2013.07.027.
- [65] Z.B. Gönen, C. Yılmaz Asan, Treatment of bisphosphonate-related osteonecrosis of the jaw using platelet-rich fibrin, *Cranio - J. Craniomandib. Pract.* 9634 (2016) 1–5. doi:10.1080/08869634.2016.1203093.
- [66] S.E. Nørholt, J. Hartlev, Surgical treatment of osteonecrosis of the jaw with the use of platelet-rich fibrin: a prospective study of 15 patients., *Int. J. Oral Maxillofac. Surg.* (2016). doi:10.1016/j.ijom.2016.04.010.
- [67] Al-Maawi, C. Herrera-Vizcaino, E. Dohle, T.A. Zrnc, P. Parvini, F. Schwarz, R. Sader, J. Choukroun, S. Ghanati, Homogeneous pressure influences the growth factor release profiles in solid platelet-rich fibrin matrices and enhances vascular endothelial growth factor release in the solid platelet-rich fibrin plugs, *Int. J. Growth Factors Stem Cells Dent.* 1 (2018) 8. doi:10.4103/GFSC.GFSC_9_18.

- [68] S. Wend, A. Kubesch, A. Orlowska, S. Al-Maawi, N. Zender, A. Dias, R.J. Miron, R. Sader, P. Booms, C.J. Kirkpatrick, J. Choukroun, S. Ghanaati, Reduction of the relative centrifugal force influences cell number and growth factor release within injectable PRF-based matrices, *J. Mater. Sci. Mater. Med.* 28 (2017) 188. doi:10.1007/s10856-017-5992-6.
- [69] A. Kubesch, M. Barbeck, S. Al-Maawi, A. Orlowska, P.F. Booms, R.A. Sader, R.J. Miron, C.J. Kirkpatrick, J. Choukroun, S. Ghanaati, A low-speed centrifugation concept leads to cell accumulation and vascularization of solid platelet-rich fibrin: an experimental study in vivo, *Platelets.* (2018) 1–12. doi:10.1080/09537104.2018.1445835.
- [70] S. Ghanaati, S. Al-Maawi, C. Herrera-Vizcaino, G.G. Alves, M.D. Calasans-Maia, R. Sader, C.J. Kirkpatrick, J. Choukroun, H. Bönig, C.F. de A.B. Mourão, A proof of the low speed centrifugation concept in rodents: new perspectives for in vivo research, *Tissue Eng. Part C Methods.* (2018) ten.TEC.2018.0236. doi:10.1089/ten.TEC.2018.0236.
- [71] S. Ghanaati, M. Barbeck, P. Booms, J. Lorenz, C.J. Kirkpatrick, R.A. Sader, Potential lack of “standardized” processing techniques for production of allogeneic and xenogeneic bone blocks for application in humans, *Acta Biomater.* 10 (2014) 3557–3562. doi:10.1016/j.actbio.2014.04.017.
- [72] J. Lorenz, S. Al-Maawi, R. Sader, S. Ghanaati, Individualized titanium mesh combined with platelet-rich fibrin and deproteinized bovine bone: A new approach for challenging augmentation, *J. Oral Implantol.* (2018) aaid-joi-D-18-00049. doi:10.1563/aaid-joi-D-18-00049.
- [73] R. Verboket, C. Herrera-Vizcaíno, K. Thorwart, P. Booms, M. Bellen, S. Al-Maawi, R. Sader, I. Marzi, D. Henrich, S. Ghanaati, Influence of concentration and preparation of platelet rich fibrin on human bone marrow mononuclear cells (in vitro), *Platelets.* (2018) 1–10. doi:10.1080/09537104.2018.1530346.
- [74] S. Wend, A. Kubesch, A. Orlowska, S. Al-Maawi, N. Zender, A. Dias, R.J. Miron, R. Sader, P. Booms, C.J. Kirkpatrick, J. Choukroun, S. Ghanaati, Reduction of the relative centrifugal force influences cell number and growth factor release within injectable PRF-based matrices, *J. Mater. Sci. Mater. Med.* 28 (2017). doi:10.1007/s10856-017-5992-6.