The Relevance of Choukroun's Platelet-Rich Fibrin and Metronidazole During Complex Maxillary Rehabilitations Using Bone Allograft. Part I: A New Grafting Protocol

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Extensive bone grafting remains a delicate procedure, because of the slow and difficult integration of the grafted material into the physiological architecture. The recent use of platelet concentrates aims to improve this process of integration by accelerating bone and mucosal healing. Choukroun's platelet-rich fibrin (PRF) is a healing biomaterial that concentrates in a single autologous fibrin membrane, most platelets, leukocytes, and cytokines from a 10 mL blood harvest, without artificial biochemical modification (no anticoagulant, no bovine thrombin). Whether used as a membrane or as fragments, PRF allows a significant postoperative protection of the surgical site and seems to accelerate the integration and remodeling of the grafted biomaterial. These properties are particularly helpful for vestibular bone grafting on the alveolar ridges. Moreover, it provides a very high quality of gingival maturation. A small quantity of a 0.5% metronidazole solution (10 mg) can also be used to provide an efficient protection of the bone graft against unavoidable anaerobic bacterial contamination. This article describes a new technique of total maxillary preimplant bone grafting using allograft, Choukroun's PRF membranes and metronidazole. This first part focused on the preimplant reconstructive treatment using allogeneic bone granules. PRF membranes are particularly helpful to protect the surgical site and foster soft tissue healing. This fibrin biomaterial represents a new opportunity to improve both the maturation of bone grafts and the final esthetic result of the peri-implant soft tissue. (Implant Dent 2009;18:102–111)

Key Words: bone graft, fibrin, freeze-dried bone allograft, platelet concentrate, platelet-rich fibrin (PRF), platelet-rich plasma, metronidazole, sinus-lift

For the past several years, preimplant surgery has made it possible, through the use of bone grafting, to obtain a more or less total reconstitution of the alveolar walls. This first therapeutic step allows the adequate positioning of the implants and the long-term success of implant-supported reconstruction.[1–5] However, these large-scale grafts often require autogenous bone taken from the patient's calvaria (parietal bone is very often used in France)[6–8] or iliac crest.[9–11] It implies a rather significant operation under general anesthesia, with all of the risks associated with hospitalization and with donor site morbidity. The relative seriousness of such a procedure discourages many patients and dissuades them from using these treatments which, however, are essential to their facial rehabilitation, after many years of psychological, esthetic, and functional discomfort.

To simplify the graft protocols, bone substitutes have been considered as an alternative solution to the autogenous grafts. These substitution biomaterials can be divided into 3 overall groups: entirely synthetic products (Cerasorb, Nanobone, etc.), xenografts (lyophilized bovine bone, Bio-Oss type, etc.), and allogeneic grafts (human bone from a tissue bank). This allogeneic bone is generally considered as an efficient and secure product.[12–14] Nonetheless, its use during large-scale bone grafting is relatively undeveloped, owing to the long waiting period necessary for its proper integration before implants can be loaded, and to their mechanical properties, which make surgical manipulation difficult.[15] Therefore, although they are frequently used for sinus grafts,[16,17] their use during significant bone grafting for alveolar ridges thickening remains limited.

In France, the use of Choukroun's platelet-rich fibrin (PRF) has played a significant role in the evolution of

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these concepts.[18] This innovative biomaterial can be defined as a platelet and immune concentrate[19–23] that combines in a single fibrin membrane most healing- and immunity-conducive constituents from a 10 mL sample of blood.

PRF was perfected in France by Choukroun *et al*[18] in 2001. Unlike other platelet concentrates developed throughout the world,[24–26] this technique requires neither anticoagulants nor bovine thrombin (nor any other gelifying agent). It is nothing else than centrifuged blood without additives, conforming to all French laws related to the reimplantation of blood products. This technology requires adequate table centrifuge and collection kit (PC-02, Process Ltd., Nice, France).[27]

The protocol is very simple: whole blood is drawn in 10-mL tubes without anticoagulant[27] and is immediately centrifuged at around 400 g for 12 minutes (Process protocol, Nice, France). Within few minutes, the absence of anticoagulant allows the activation of the majority of the platelets contained in the sample, in contact with the tube walls, thus triggering a coagulation cascade. The fibrinogen is at first concentrated in the upper part of the tube, until the effect of the circulating thrombin transforms it into a fibrin network. The result is a fibrin clot located in the middle of the tube and soaked with acellular plasma, with a maximum number of platelets caught in the fibrin mesh.

When used as a membrane, PRF enables the protection of operative sites from outside aggression and serves as a matrix to accelerate the healing of wound edges,[28] much like a fibrin bandage.[22,29] When mixed with the graft material, the fibrin clot functions as a biological connector between the different elements of the graft, and as a matrix which favors neo-angiogenesis, the capture of stem cells, and the migration of osteoprogenitor cells to the center of the graft.[22,23] The addition of PRF to graft material could therefore become a serious opportunity to develop new therapeutic procedures by improving the integration of bone substitution materials during preimplant grafting.[30–32] The clinical case that follows is a detailed illustration of this concept.

CLINICAL ILLUSTRATION

The Initial Situation

A 52-year-old female patient consulted on December 4, 2002. Because of a series of infections and a severe periodontal disease which was not immediately diagnosed, she had for many years been wearing a partial removable dental prosthesis. The 3 remaining teeth (17, 26, 27), secondarily infected, had induced a polypoid reaction in the mucous membrane of the right sinus. Given her young age, this prosthesis was, for her, a source of permanent psychological suffering and a symbol of the mutilation of her face. Under the prosthesis, the maxillary alveolar ridges had already undergone significant centripetal resorption, both in height and—especially—in thickness. It was thus impossible to place axial implants without a preimplant reconstruction of the maxillary using bone grafts. This diagnosis was confirmed by the computed tomography scan examination, which clearly showed a subantral bone height of 3 mm and anterior ridges measuring less than 3 mm thick (Fig. 1). It was decided to first eliminate all remaining maxillary and mandibular sources of infection. Then, a complete removable maxillary prosthesis and a partial mandibular prosthesis were temporarily used.

After being clearly and openly informed on the different therapeutic options available to her, the patient accepted a multiphase treatment plan combining preimplant allografts and complete implant-supported maxillary rehabilitation.

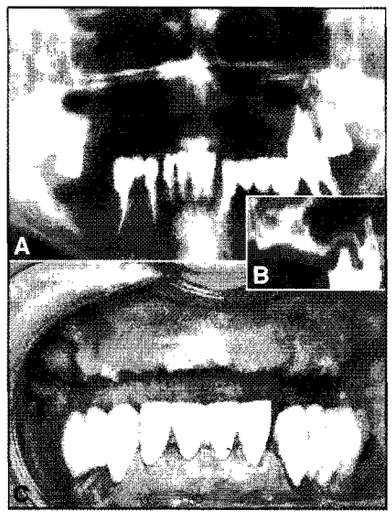

Fig. 1. At the patient's first consultation at the end of 2002, she had only 3 remaining posterior teeth in the maxillary (**A**). They were sources of infection into the sinus and had induced the polypoid thickening visible on the computed tomography scans (**B**). The patient displayed considerable maxillary bone resorption, which had contributed to the collapse of the lower level of the face and to the absence of lip support. Extraction of the infected teeth and cleansing of the oral cavity revealed extremely thin maxillary alveolar ridges (**C**).

Graft Surgery

During the preimplant phase, it was necessary to reconstruct resorbed maxillary bone structures. Indeed, the remaining architecture was unsuitable for adequate implantation. The entire surgical site was first opened, then the medullar bone along the vestibular side of the anterior alveolar ridges was stimulated, to facilitate proper vascularization and integration of the graft. In the posterior area, the 2 sinuses were opened to be filled (Fig. 2).

The bone graft consisted of a combination of freeze-dried bone allograft Phoenix (TBF, Mions, France) and of PRF. This mixture, soaked in metronidazole (0.5% solution), was used to fill the sinuses and to considerably thicken the vestibular side of the anterior and central alveolar ridges (Fig. 3, A). To protect the graft and to accelerate healing of the crestal incision, a large quantity of PRF membranes was used to cover the entire grafted area (Fig. 3, B). Sutures should keep the PRF membranes flattened under the flap (Fig. 3, C). Three days after the surgery, the sutures were removed. The PRF membranes acted as fibrin bandages, enabling quick closure of the surgical site despite the substantial volume of bone added (Fig. 4). Three months after graft surgery and healing on a PRF fibrin bed, gingival tissue looked thick and keratinized. Note that the PRF membranes

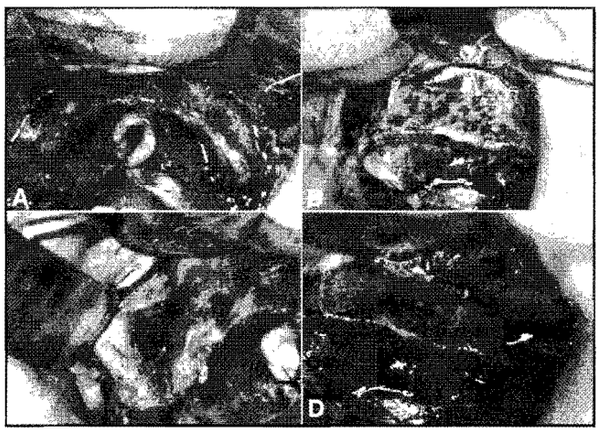

Fig. 2. First, the entire surgical site was opened (**A**). The medullar bone along the vestibular side of the anterior alveolar ridges was stimulated (**B**). In the posterior area, the 2 sinuses were opened to be filled (**C and D**).

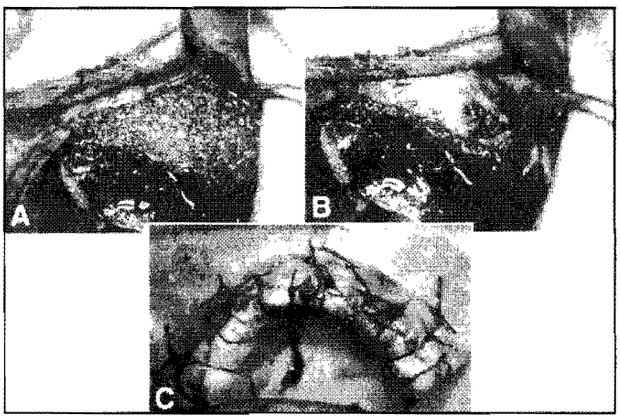

Fig. 3. The mixture of human lyophilized bone (Phoenix freeze-dried bone allograft, TBF, France) and PRF, soaked in metronidazole, was used to fill the sinuses and to considerably thicken the vestibular side of the anterior and central alveolar ridges (**A**). PRF membranes were placed to cover the entire grafted area (**B**). After suturing, the PRF membranes were protected under the flap (**C**). One day after the graft surgery, healing of the incision line seemed already satisfactory for the protection of the graft underneath.

were obtained using the standard protocol described in the scientific literature.[18,19]

To avoid pressure on the grafted material (it could induce mobility and fibrosis of the graft), the patient was not allowed to wear a temporary removable prosthesis for the 40 days after the surgery. This waiting period is considerably shorter in the case of autogenous onlay bone grafts fixed with screws, because the allograft biomaterial is constituted of bone granules and has not a rigid architecture. The initial healing time should be long enough to allow the bone graft to become compact, before functional forces are applied.

Ten weeks (75 days) after the surgery, a preimplant computed tomography scan was performed. There was a radiological homogeneity between the grafted bone and the remaining alveolar walls (Fig. 5). The graft appeared to be integrated.

DISCUSSION

PRF and Metronidazole for Bone Grafting

Choukroun's PRF is a matrix of autologous fibrin, in which are embedded a large quantity of platelet and leukocyte cytokines during centrifugation.[19–21] The intrinsic incorporation of cytokines within the fibrin mesh implies their progressive release over time, as the network of fibrin disintegrates. At one of its extremities, each PRF clot also concentrates most platelets and leukocytes collected in its 10 mL tube of blood.

The use of this platelet and immune concentrate during bone grafting offers the following 4 advantages:

First, the fibrin clot plays an important mechanical role. Although it does not possess significant adhesive properties (unlike fibrin glues or platelet-rich plasmas), the strength of PRF membranes enables a biomaterial to be maintained and protected against moderate parasitic forces.[33] Moreover, mixed with the graft, PRF fragments serve as a biological connector between bone particles. Soaked in serum, they favor the adhesion of allogeneic bone chips and constitute a biological cement between these fragments. This cohesion gives to the graft a biomechanical strength which is crucial during the first steps of healing, particularly on a site as exposed as the vestibular surface of a maxillary alveolar wall.

Second, the integration of this fibrin network with fragments of allogeneic bone facilitates cellular migration, particularly for endothelial cells necessary for the neo-angiogenesis,[34] vascularization and survival of the graft, as well as for mesenchymal stem cells (drifting or close to wound site). The incorporation of a fibrin network into a grafted mass of lyophilized inactive bone would thus be very positive: paths of cellular migration would appear within the bundles of PRF that vein the graft. Moreover, this fibrin bandage acts as a healing matrix[35] for the soft tissue around the incision and the whole wounded site. Indeed, we can systematically observe a high gingival maturation after healing on PRF membranes, with a thickening of keratinized gingival tissues which improves the esthetic integration and final result of prosthetic rehabilitations.[33]

Third, the platelet cytokines, essentially platelet-derived growth factors, transforming growth factor β-1, and insulin-like growth factors, seem

gradually released as the fibrin matrix is resorbed, thus creating a perpetual process of healing.[20,28] These mechanisms of gradual release are used by the organism to guide healing and connective tissue remodelling (such as bone), but such a phenomenon is difficult to reproduce synthetically. PRF, however, through physiological polymerization, seems to have this slow release property. It reproduces the elementary mechanisms of hemostasis and healing, on the scale of a fibrin clot which is large enough to be used clinically. In the middle of a bone graft, particularly with lyophilized bone, such a mid- and long-term capacity to maintain healing and remodeling would be extremely beneficial for the maturation of the graft and its overall integration over time.[23]

Lastly, the role of PRF in immunity seems significant, because of the presence in the fibrin clot of an important number of leukocytes activated by the centrifugation, and because of the incorporation of inflammatory and anti-inflammatory cytokines into the network of fibrin.[21] The gradual release of these molecules would play a significant role in the self-regulation of inflammatory and infectious phenomena within the grafted material. Indeed, all clinical experiences emphasized that the use of PRF seems to reduce postoperative pain and edemas, and to limit even minor infectious phenomena. The control of inflammation and especially the risk of sepsis within a bone graft seems yet another decisive reason to use PRF during bone grafting.

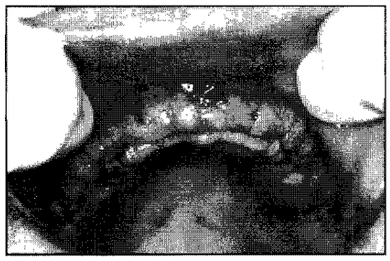

Fig. 4. Three days after the graft surgery, the sutures were removed. The PRF membranes had acted as fibrin bandages, enabling quick closure of the surgical site despite the substantial volume of bone added.

Metronidazole could be another decisive surgical adjuvant. This antibiotic from the nitro-5-imidazole family is often used orally or applied locally. Incorporated into the graft material during bone graft surgery, it protects against the systematic peroperative contamination by anaerobic bacteria.[36] However, metronidazole will never replace rigorous aseptic conditions during the operation, combined with a general antiseptic covering. This protocol is not an antibiotherapy: 2 mL of this 0.5% solution are containing only 10 mg of metronidazole, i.e., 1/20 of a standard 200 mg oral tablet. This is just enough to limit the contamination of the biomaterial and to protect the early phases of bone construction from infection and the related inflammatory reaction. The local use of this small quantity of metronidazole thus enables the practitioner to increase the quality of maturation of the graft, and to reduce the risk of developing bone infection and, eventually, necrosis.

The combination, within the graft, of these 2 adjuvants seems to increase the radiological and histological quality of the grafted bone tissue.[23] The use of PRF membranes likewise considerably improves the healing and maturation of soft tissue.[33] In this sense, PRF is a healing concentrate: it contains, in a single usable membrane, most key elements of hemostasis and healing.

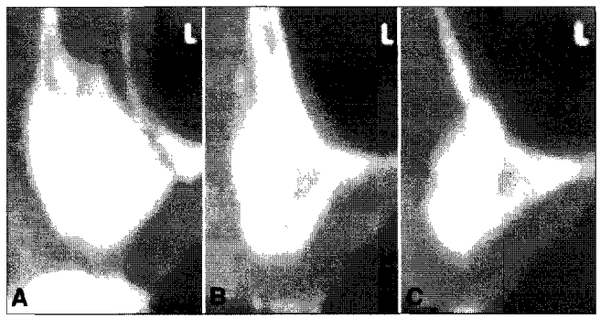

Fig. 5. Ten weeks (75 days) after surgery, a preimplant computed tomography scan showed that the graft seemed integrated. There was a complete radiological homogeneity between the grafted bone and the remaining alveolar walls.

CONCLUSION

The use of bone substitutes during extensive bone grafting remains a delicate procedure, because of the challenge of adequate integration of the graft. The use of PRF during these interventions offers better postoperative control of the surgical site and seems to accelerate the integration and remodeling of the grafted biomaterial. Combined with existing maxillofacial implant reconstructive therapy, PRF represents a new opportunity to improve grafting procedures, keeping in mind that it is a healing biomaterial and not a "miracle" product. It just increases the potential for therapeutic success when used by a skilled practitioner.

Disclosure

The authors claim to have no financial interest, directly or indirectly, in any entity that is commercially related to the products mentioned in this article.

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ID Abstract Translations

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Die Bedeutung des Thrombozytreichen Fibrins von Choukroun (PRF) und Metronizadol bei komplexen Wiederherstellungsbehandlungen im Oberkiefer unter Anwendung von Knochenallotransplantat. Teil I: Ein neues Transplantierungsprotokoll. Teil I

ZUSAMMENFASSUNG:Weitreichende Knochengewebstransplantation bleibt nach wie vor schwierig, da das transplantierte Material sich nur langsam und unter Schwierigkeiten in die physiologische Gesamtarchitektur eingliedert. Die neuartige Verwendung von Thrombozytkonzentraten zielt darauf ab, diesen Integrationsprozess durch die Beschleunigung der Heilung von Knochengewebe und Schleimhaut zu verbessern. Bei Choukrouns Thrombozytreichem Fibrin (PRF) handelt es sich um ein heilendes Biomaterial in einem Konzentrat einer einzelnen autologen Fibrinmembran, den meisten Thrombozyten, Leukozyten und Zytokinen aus einer 10 ml Blutprobe ohne künstliche biochemische Veränderung. d.h. keine Antikoagulantien oder Rinderthrombin. Ob als komplette Membran oder in Fragmenten eingesetzt, immer bietet das Thrombozytreiche Fibrin einen bedeutenden Schutz der chirurgischen Eingriffstelle nach der Operation und scheint gleichzeitig die Integration sowie den Neuaufbau des transplantierten Biomaterials zu beschleunigen. Diese Eigenschaften sind besonders bei Transplantierung von Vestibularknochen am Alveolarkamm von großem Vorteil. Außerdem sorgt dieses Material für ein gutes Maß an Zahnfleischreifung. Eine geringe Menge einer 0,5%-igen Metronizadollösung (10mg) kann außerdem eingesetzt werden, um das Knochentransplantat gut gegen unvermeidbare anaerobe bakterielle Verunreinigungen zu schützen. Dieser Artikel beschreibt eine neuartige Technik der kompletten Knochentransplantierung im Oberkiefer vor Implantierung mittels Allotransplantat, Membranen von Choukrouns Thrombozytreichem Fibrin und Metronizadol. Dieser erste Teil konzentriert sich auf die rekonstruktive Behandlung vor Implantatsetzung unter Verwendung von allogenen Knochengranula. Die Membranen aus Thrombozytreichem Fibrin sind zum Schutz der chirurgischen Eingriffstelle sowie zur Beschleunigung des Heilungsprozesses des Weichgewebes von besonderem Vorteil. Dieses Fibrin-Biomaterial bietet damit ganz neuartige Optionen zur Verbesserung sowohl der Reifung der Knochentransplantate als auch des abschließenden ästhetischen Ergebnisses des Weichgewebes im das Implantat umlagernden Gewebe.

SCHLÜSSELWÖRTER: Knochentransplantat, Fibrin, gefriergetrocknetes Knochenallotransplantat (FDBA), Thrombozytkonzentrat, Thrombozytreiches Fibrin (PRF), Thrombozytreiches Plasma (PRP), Metronizadol, Sinusanhebung

SPANISH / ESPAÑOL

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La relevancia de la fibrina rica en plaquetas de Choukroun (PRF por sus siglas en inglés) y metronidazol durante rehabilitaciones maxilares complejas usando un aloinjerto de hueso. Parte I: Un nuevo protocolo para injertos. Parte I

ABSTRACTO: Los extensos injertos de hueso siguen siendo un procedimiento delicado, debido a la integración lenta y dificultosa del material injertado en la arquitectura fisiológica. El uso reciente de concentrados de plaquetas trata de mejorar este proceso de integración al acelerar la curación del hueso y la mucosa. La fibrina rica en plaquetas de Choukroun (PRF por sus siglas en inglés) es un biomaterial de curación que concentra en una sola membrana de fibrina autóloga la mayoría de las plaquetas, leucocitos y citocinas de una recolección de sangre de 10 mL sin modificación bioquímica artificial (sin anticoagulante, sin trombina de bovinos). Ya sea que se use como membrana o como fragmentos, la PRF permite una protección postoperatoria significativa del lugar quirúrgico y parece acelerar la integración y remodelación del biomaterial injertado. Estas propiedades son particularmente útiles para el injerto de hueso vestibular en las crestas alveolares. Además, proporciona una maduración gingival de muy alta calidad. También se puede usar una pequeña cantidad de solución de metronidazol al 0,5% (10 mg) para proporcionar una protección eficaz del injerto de hueso contra la contaminación inevitable con bacterias anaeróbicas. Este artículo describe una nueva técnica para el injerto de hueso maxilar total previo al implante usando un aloinjerto, las membranas de PRF de Choukroun y metronidazol. Esta primera parte se concentra en el tratamiento reconstructivo previo al implante

usando gránulos de hueso alogénico. Las membranas de PRF son particularmente útiles para proteger el lugar quirúrgico y apoyar la curación del tejido suave. Este biomaterial con fibrina representa una nueva oportunidad para mejorar la maduración de los injertos de hueso y el resultado estético final del tejido suave periimplante.

PALABRAS CLAVES: injerto de hueso, fibrina, aloinjerto de hueso congelado-desecado (FDBA por sus siglas en inglés), concentrado de plaquetas, fibrina rica en plaquetas (PRF), plasma rico en plaquetas (PRP), metronidazol, elevación del seno

PORTUGUESE / PORTUGUÊS

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A relevância da Fibrina Rica em Plaquetas (PRF) de Choukroun e metronidazol durante complexas reabilitações maxilares usando enxerto aloplástico de osso. Parte I: um novo protocolo de enxertamento. Parte I

RESUMO: O enxertamento extensivo de osso permanece um procedimento delicado, devido à lenta e difícil integração do material enxertado na arquitetura fisiológica. O uso recente de concentrados de plaquetas visa melhorar esse processo de integração acelerando a cura do osso e mucosal. A Fibrina Rica em Plaquetas (PRF) de Choukroun é um biomaterial curativo que concentra numa única membrana de fibrina autóloga, sobretudo plaquetas, leucócitos e citocinas de coleta de sangue de 10mL, sem modificação bioquímica artificial (sem anticoagulante, sem trombina bovina). Se usada como membrana ou fragmento, a PRF permite uma significativa proteção pós-operatória do local cirúrgico e parece acelerar a integração e remodelação do biomaterial enxertado. Essas propriedades são particularmente úteis para enxertamento de osso vestibular nos rebordos alveolares. Além disso, proporciona uma qualidade muito alta de maturação gengival. Uma pequena quantidade de solução de metronidazol a 0,5% (10mg) também pode ser usada para proporcionar uma proteção eficiente do enxerto ósseo contra inevitável contaminação bacteriana anaeróbica. Este artigo descreve uma nova técnica de total enxertamento de osso pré-implante maxilar usando enxerto aloplástico, membranas PRF de Choukroun e metronidazol. Esta primeira parte focalizou o tratamento reconstrutivo pré-implante usando grânulos de osso alogeneico. As membranas PRF são particularmente úteis para proteger o local cirúrgico e promover a suave cura do tecido. Este biomaterial de fibrina representa uma nova oportunidade de melhorar tanto a maturação de enxertos de osso quanto o resultado estético final do tecido mole do periimplante.

PALAVRAS-CHAVE: enxerto ósseo, enxerto aloplástico de osso seco por congelamento (FDBA), concentrado de plaquetas, Fibrina Rica em Plaquetas (PRF), Plasma Rico em Plaquetas (PRP), metronidazol, elevação da cavidade

RUSSIAN / РУССКИЙ

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Обоснованность применения богатого тромбоцитами фибрина (PRF) по методу Шукруна и метронидазола при проведении комплексной реабилитации верхней челюсти с применением костного аллотрансплантата. Часть I: новый протокол трансплантации. Часть I

РЕЗЮМЕ. Обширная костная трансплантация остается деликатной процедурой из-за медленной и трудной интеграции трансплантационного материала в физиологическую архитектуру. Внедряемая в последнее время практика использования тромбоцитарной массы преследует цель улучшить данный процесс интеграции посредством ускорения регенерации костной и мышечной ткани. Богатый тромбоцитами фибрин (PRF) по Шукруну – это регенерационный материал на одинарной аутогенной фибриновой мембране, большую часть тромбоцитов, лейкоцитов и цитокинов получают из забора крови объемом 10 мл, без искусственной биохимической модификации (без антикоагулянта и бычьего тромбина).

Используемый либо в виде мембраны, либо в виде фрагментов, PRF обеспечивает значительную постоперационную защиту области операции и, вероятно, ускоряет интеграцию и реструктуризацию трансплантированного материала. Данные свойства особенно полезны для трансплантации вестибулярной кости на альвеолярные гребни. Более того, он обеспечивает очень высокое качество развития десневой ткани. Чтобы обеспечить эффективную защиту костного трансплантата от неизбежного загрязнения анаэробными бактериями,

можно использовать небольшое количество 0,5 % раствора метронидазола (10 мг).

В статье описывается новая методика полной предимплантационной трансплантации верхней челюсти с использованием аллотрансплантата, PRF-мембран по Шукруну и метронидазола. В данной части рассматривается предимплантационная реконструктивная терапия с использованием аллогенных костных гранул. PRF-мембраны особенно эффективны для защиты области операции и стимулирования регенерации мягких тканей. Данный фибриновый биоматериал открывает новые возможности как для улучшения развития костного трансплантата, так и для обеспечения конечного эстетического результата в виде периимплантационных мягких тканей.

КЛЮЧЕВЫЕ СЛОВА: костный трансплантат, фибрин, лиофилизированный костный трансплантат (FDBA), тромбоцитарная масса, богатый тромбоцитами фибрин (PRF), богатая тромбоцитами плазма (PRP), метронидазол, синус-лифтинг

TURKISH / TÜRKÇE

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Kemik allogreft kullanan kompleks maksiller rehabilitasyonlarda Choukroun'un Plateletten Zengin Fibrini (PRF) ve metronidazol. Bölüm I: Yeni bir greftleme Protokolü. Bölüm I

ÖZET: Büyük ölçüde kemik greftleme, greft materyalinin fizyolojik mimariye ağır ve zor entegrasyonu nedeniyle nazik bir prosedürdür. Yakın geçmişte platelet (trombosit) konsantrelerinin kullanımı, kemik ve mukoza iyileşmesini hızlandırmak suretiyle bu entegrasyon sürecini geliştirmeyi amaçlamaktadır. Choukroun'un Plateletten Zengin Fibrini (PRF), yapay biyo-mekanik değişiklik olmadan (anti-koagülan veya bovin trombin olmadan) 10 mL'lik bir kan hasatından alınan çoğu plateleti, lökositi ve sitokini tek bir otolog fibrin membranında yoğunlaştıran iyileştirici bir biyo-materyaldir. Gerek membran olarak, gerekse parça olarak kullanıldığında PRF, cerrahi yerinde anlamlı derecede post-operatif koruma sağlamakta ve greftlenen biyo-materyalin entegrasyonunu ve yeniden şekillenmesini hızlandırmaktadır. Bu nitelikler, özellikle de alveoler krette vestibular kemik greftlemeye yardımcı olur. Ayrıca, bu şekilde yüksek kaliteli diş eti olgunlaşması da sağlanmaktadır. Kemik greftini kaçınılmaz anaerobik bakteri kontaminasyonuna karşı etkin bir şekilde korumak için küçük miktarda 0.5% metronidazol solüsyonu (10 mg) da kullanılabilir. Bu çalışma, allogreft, Choukroun'un PRF membranları ve metronidazol kullanılarak gerçekleştirilen yeni bir total maksiller, implant öncesi kemik greftleme yöntemini sunmaktadır. Bu birinci bölüm, allogenik kemik granülleri kullanan implant öncesi rekonstrüktif tedaviye odaklanmaktadır. PRF membranları, cerrahi yerini korumak ve yumuşak dokunun iyileşmesini teşvik etmek açısından özellikle yararlıdır. Bu fibrin biyo-materyali, hem kemik greftlerin olgunlaşmasının ve hem de peri-implant yumuşak dokunun son estetik görüntüsünün geliştirilmesi açısından yeni bir fırsat sunmaktadır.

ANAHTAR KELİMELER: kemik grefti, fibrin, dondurulmuş kuru kemik allogrefti (FDBA), platelet konsantresi, Plateletten Zengin Fibrin (PRF), Plateletten Zengin Plazma (PRP), metronidazol, sinüs kaldırma.

JAPANESE / 日本語

複雑な上顎骨機能再生における、同種移植骨を使用したコークラン多血小板繊維素成(PRF)とメトロニタゾールの妥当性:パートI:新移植術プロトコール

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パートI

研究概要: 大規模な移植術は移植材が生理的構造へ融合するまで時間がかかり、かつ困難なために未だに微妙な処置である。最近は骨と粘膜の治癒を促進し融合プロセス改善をはかる目的で濃厚血小板製剤が使用されている。コークラン多血小板繊維素成(PRF)は治癒力を備えたバイオマテリアルで、採血量10mLから分別した多量の血小板と白血球そしてサイトカインを、人工生化学修正(抗凝固剤またはウシ由来トロンビン)を加えずに、1枚の同種移植繊維素成メンブレンに濃縮したものである。 PRFはメンブレンまたは断片のどちらの使用法でも術後部位の保護にすぐれ、また移植後のバイオマテリアルの融合と改変も促進すると見られる。

こうした特性は歯槽堤前庭骨移植にことのほか有効であるばかりか、極めて優れた質の歯茎成熟化にも役立つ。さらに微量(10mg)の0.5%メトロニタゾール液を使用することによって、骨移植部位を不可避な嫌気性バクテリア汚染から効果的に保護することができる。

この論文は同種移植骨とコークランPRFメンブレンそしてメトロニタゾールを使用した、インプラント術前全置換上顎骨骨移植の新テクニックを説明したものである。パートIでは同種移植骨微粒子を使用したインプラント術前再建治療に焦点をあてた。

PRFメンブレンは術後部位の保護にすぐれた効能を示し、また軟組織治癒を促進する。 この繊維素成バイオマテリアルは骨移植を成熟化し、最終的にインプラント周辺軟組織の審美性を改善する新たな将来性を特徴づけている。

キーワード: 骨移植, 繊維素成(フィブリン), ヒト冷凍乾燥骨 (FDBA), 濃縮血小板製剤, 多血小板繊維素成 (PRF), 多血小板血漿 (PRP),メトロニタゾール、上顎洞底挙上術

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CHINESE / 中国語

使用異體骨移植物進行複雜上頷重建期間，Choukroun 的富含血小板的纖維蛋白 (PRF) 及甲硝唑的相關性。第一部分

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摘要：
大規模骨移植仍是一項棘手的手術，原因在於移植材料與生理架構的整合緩慢而困難。近期有關血小板濃縮液的使用，其目標是透過加速骨質與粘膜癒合，改善此整合流程。Choukroun 富含血小板的纖維蛋白 (PRF) 是一種具有治療功用的生物材料，可以從 10mL 採血中集凝聚單一自體纖維蛋白膜、大多數血小板、白血球與細胞激素，沒有人工生化修改 (無抗凝血劑、無牛科動物萃取的凝血酶)。無論是做為薄膜或碎片，PRF 都能提供手術部位顯著的術後保護，而且似乎能加速移植生物材料的整合與重組。這些特性對於齒槽脊骨上的前庭骨移植尤其有幫助。此外，它也提供非常高品質的齒齦成熟度。使用少量的甲硝唑溶液 (0.5%，10mg) 也可以提供有效的骨移植物保護，防治難以避免的厭氧細菌感染。

本文章說明使用異體移植物、Choukroun 的 PRF 薄膜及甲硝唑進行完全上頷移植前骨移殖的新技術。第一部份專注於使用異體骨細粒的植體前重建治療。PRF 薄膜對於保護手術部位及促進軟組織癒合尤其有幫助。此纖維蛋白生物材料代表的是改善骨移植物成熟度及植體周圍軟組織的最後美學結果的新契機。

關鍵字：骨移植、纖維蛋白、冷凍乾燥異體骨移植物 (FDBA)、血小板濃縮液、富含血小板的纖維蛋白 (PRF)、富含血小板的血漿 (PRP)、甲硝唑、竇增高。

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KOREAN / 한국어

골형 동종이식을 이용한 복합 상악 재건술 중 Choukroun의 혈소판 풍부 섬유소(PRF)와 메트로니다졸 의 관련성 (적합성) Part I: 새로운 이식 프로토콜 Part I

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요약:
광범위 골 이식은 여전히 정교함을 요하는 작업으로, 이식 물질의 생리구조 내 융합 지연과 어려움이 따른다. 최근 사용된 혈소판 농축물은 뼈와 점막의 치유를 가속화함으로써 이러한 융합 과정을 개선시키는 것을 목적으로 한다. Choukroun의 혈소판 풍부 섬유소(PRF)는, 인공적으로 생화학적 변형(항응고제 처리 및 소(bovine)의 트롬빈이 없는)을 하지 않은10mL 혈액 채취물의 단일 자가 섬유소막 및 대부분의 혈소판, 백혈구, 그리고 사이토카인을 농축한 치유 생체물질이다. 막으로 사용되거나 조각으로 사용되든 지 상관없이, PRF는 수술 후 수술부위의 중요한 보호작용을 하며 이식된 생체물질의 융합과 재형성을 가속화시키는 것으로 보인다. 이러한 속성들은 특히 이들 융기의 전정골 이식에 도움을 줌과 동시에 잇몸이 잘 성숙되게 해준다. 소량의 0.5% 메트로니다졸 용액(10mg) 또한 골 이식 시 혐기성균 감염이 불가피하게 발생하는 것을 효과적으로 보호한다.

본 논문은 Choukroun의 PRF 막과 메트로니다졸 동종이식을 이용한 전체 상악 임플란트 전 골이식에 적용되는 새로운 기술에 대해 기술하고 있다. 제 1부에서는 동종 골 파편을 이용한 임플란트 전 재건 치료에 집중하였다. PRF 막은 특히 수술부위 보호와 연 조직 치유 촉진에 도움이 된다. 섬유소 생체물질은 골 이식의 성숙도를 향상시키고 최종적으로 임플란트 주변 연조직에 심미적 결과를 이끌어내는 새로운 기회를 제공한다.

키워드: 골 이식, 냉동건조 동종이식(FDBA), 혈소판 농축물, 혈소판 풍부 섬유소 (PRF), 혈소판 풍부 혈장 (PRP), 메트로니다졸, 상악동 거상술

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