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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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REGENERATIVE MATERIALS-THEIR INDICATIONS AND USE IN IMPLANTOLOGY: A LITERATURE REVIEW

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Abstract.

Introduction: The primary objective of any implant system is to achieve firm fixation to the bone, which can be influenced by both biomechanical factors and biomaterial selection. An array of materials is used for the replacement of missing teeth through implantation. The appropriate selection of biomaterials directly influences the clinical success and longevity of implants. Therefore, clinicians need to have adequate knowledge of the various biomaterials and their properties for their judicious selection and application in clinical practice. Recent materials, such as bioceramics and composite biomaterials, which are under consideration and investigation, show a promising future. For optimal performance, implant biomaterials should have suitable mechanical strength, biocompatibility, and structural biostability in the physiological environment.

Aim of study: The aim of this paper is to explain, through a review of the most current literature on regenerative materials, their indications, and their use in implantology:

- The significance of these materials in surgical implant procedures,
- The properties and indications of these materials,
- The classification of natural and synthetic materials,
- Their application in surgical procedures such as sinus lift, alveolar ridge augmentation, and implant placement.

Material and methods: This article is a literature review in which the most current scientific and professional data on regenerative materials in implant dentistry are discussed and presented. The data for this paper were gathered from university textbooks, as well as articles published and archived in PubMed, Science Direct, Dental Products Report, and other sources.

Conclusions: Bone grafts and substitute materials, which are either in particle or block form, are used in dentistry to regenerate missing hard tissue structures. There is a growing demand for new and more efficient grafting materials. Currently, bone grafts and substitute materials primarily serve as a structural scaffold for osteoregenerative processes, fulfilling the criteria of osteoconduction.

Key words. Bone graft, bioceramics, implant biomaterials.

Introduction.

The primary objectives of modern dental practice to restore patients to ideal anatomical contour, functional efficiency, esthetics, phonetic capability, and oral health, have been significantly advanced through the application of dental implantology.

Dental implants have revolutionized restorative dentistry, playing a key role in replacing missing teeth and improving overall oral health. This approach offers both functional and aesthetic benefits, especially when traditional options like dentures or bridges are not ideal.

In cases where the alveolar ridge has sufficient bone, multiple factors align to ensure a favorable long-term prognosis for implant-supported restorations.

These factors include the placement of an adequate number of appropriately sized implants, a favorable crown-to-implant ratio, proper ridge dimensions, sufficient bone density, and the favorable orientation of occlusal forces within the supporting structures.

Recent advancements in dental implantology have focused on refining the connection between the implant and surrounding tissues, ensuring optimal osseointegration and proper soft tissue healing. For an implant to succeed, it needs to form a strong bond with the bone, which requires careful attention to the biological processes involved in healing and integration. Similarly, the soft tissues must also heal in a way that supports the implant in the long term.

Advances in biomaterials science have prioritized the development of implant substrates designed to support osseointegration and soft tissue healing, ensuring compatibility with both hard and soft tissue structures [1].

Dental Implant.

The placement of dental implants in the maxilla or mandible creates a complex biomechanical and biological interface between the implant material and the surrounding oral tissues.

Endosseous implants, inserted directly into the alveolar bone differ from other implant systems designed for extra-osseous placement [2].

Classification of Biomaterials Based on Tissue Reaction.

Biomaterials based on their interaction with biological tissues and the resulting tissue response, are classified in three groups:

1. Bioinert Materials that remain chemically stable and providing structural support without initiating tissue interaction.
2. Bioresorbable: Materials facilitating natural tissue regeneration or replacement without requiring surgical removal.
3. Materials that actively engage with biological tissues to promote osseointegration or bone regeneration [3].

Bioinert Biomaterials:

The term "bioinert" refers to any material that, once placed in the human body, has minimal interaction with the surrounding tissue. Examples of this type of material are titanium, aluminum, zirconium, and polyethylene.

Bioactive Biomaterials.

Bioactive Materials in Dental Implantology:

The term "bioactive" refers to materials that, when implanted in the human body, actively interact with the surrounding osseous tissues and, in some cases, with soft tissues.

Bioresorbable Biomaterials:

The term "bioresorbable" refers to materials that, when implanted into the human body, undergo gradual resorption, allowing the site to be replaced by newly formed tissue, such as bone.

Common bioresorbable materials include: Tricalcium, Polylactic Acid-Polyglycolic Acid Copolymers [4].

Bone Grafts and Substitutes.

A bone graft refers to living tissue transplanted into a bone defect to facilitate osteogenesis. Bone grafts may be used alone or in combination with other biomaterials to enhance regenerative outcomes [5,6]. A bone substitute is a natural or synthetic biomaterial, typically comprising a mineralized bone matrix without viable cells, designed to support bone healing and regeneration similarly to a bone graft [7]. According to the United States Food and Drug Administration (FDA), bone graft materials used in dental and maxillofacial procedures are categorized based on their composition and functional properties:

1. Class II Devices: These include bone grafts intended to fill osseous defects or voids, facilitating natural bone regeneration in dental, oral, and orthopedic applications.

2. Class III Devices: These comprise bone grafts integrated with pharmacological agents, such as drugs or growth factors, to enhance osteoinductive and regenerative outcomes [8].

Alveolar Bone Resorption and Implications for Implant Placement.

Insufficient alveolar bone is most commonly observed following tooth loss, where rapid bone resorption occurs due to the absence of intraosseous stimulation typically provided by the periodontal ligament fibers [9].

Successful dental implant placement necessitates sufficient alveolar bone dimensions, generally requiring a minimum of 10 mm in vertical height and 3–4 mm in horizontal width to ensure primary stability and support osseointegration [10].

The ideal characteristics of material are:

Biocompatibility, Osteoconduction, Osteoinduction, Osteogenesis,

Osteoconduction: Refers to the graft material's capacity to provide a structural scaffold, facilitating the migration, attachment, and proliferation of osteogenic cells from the surrounding bone.

Osteoinduction: Describes the ability of the graft material to stimulate the differentiation of mesenchymal stem cells, derived from the host tissue or circulating blood, into osteoblasts **Osteogenesis:** Denotes the capability of living osteogenic cells within the graft material to directly synthesize new bone, actively contributing to the regeneration of the osseous defect.

Autologous Bone Grafting Sites in Dental and Maxillofacial Surgery.

Intraoral donor sites: Mental Symphysis, Mandibular Ramus, Retromolar Area, Maxillary Tuberosity. Bone Graft Classifications and Donor Sites:

1. Trabecular (Cancellous) Bone Grafts: Obtained from the maxillary tuberosity (intraoral) or extraoral locations such as the iliac crest and tibia.

2. Cortico-Cancellous Bone Grafts: Typically sourced from the iliac crest.

3. Cortical Bone Grafts: Derived from the mental symphysis, mandibular ramus, or cranial bone [11].

Indications for bone grafting:

Bone grafting is a common procedure in dental and maxillofacial surgery, indicated for: alveolar ridge preservation post-extraction, management of peri-implant deficiencies, alveolar ridge augmentation [12].

Necessary factors for the success of bone graft:

1. Osteoblasts are responsible for the formation of new bone. For a bone graft to be successful, the graft must contain osteoblasts.

2. Graft stabilization: Movement of the graft material will cause fibrous tissue to fill the defect instead of bone.

3. No tension on soft tissue: Bone is the slowest growing tissue. Guided bone regeneration is based on the separation of the graft site from the surrounding tissues [13-15].

Classification of Bone Graft and Substitute Materials:

- Autografts.
- Allografts.
- Xenografts.

Autografts:

Autogenous bone grafts, or autografts, are harvested from the patient's own body, commonly from intraoral sites such as the mandibular symphysis and mandibular ramus. There is a risk of injury to the inferior alveolar nerve, which can lead to temporary or permanent complications.

Mandibular ramus grafts are particularly suitable for augmenting sites that are less than 4 mm in thickness and involve up to four teeth [16-19].

Advantages: refer to grafts taken from one area of a patient's oral cavity or body and transplanted to another area within the same patient, because the tissue originates from the patient's own body, there are no issues with histocompatibility or immune rejection, making autografts the safest option biologically.

Disadvantages:

- requirement for secondary surgical visits, donor site damage.
- potential for residual scars.
- autografts are associated with higher surgical costs, with many surgical risks e.g. excessive bleeding, infection, inflammation and pain [19,20].

Allogarafts:

The main alternative to autotransplantation is the use of allograft materials.

Allograft materials are available as compact, cancellous, or compacto-cancellous grafts [21]. There are three forms of bone allograft:

1. Fresh-frozen bone (FFB) allografts are utilized in dental procedures, particularly for maxillary ridge augmentation. In dental practice, FFB allografts have been applied in procedures such as sinus augmentation and alveolar ridge reconstruction, offering an alternative to autogenous bone grafts and other allogeneic materials.

2. Freeze-dried bone allograft (FDBA): this allograft undergoes dehydration, freezing, and the inorganic portion of the bone is eliminated.

The extracellular matrix of bone tissue contains bone growth factors, proteins, and other bioactive materials necessary for osteoinduction and bone healing [22].

Allografts have been used successfully in combination with xenografts for guided bone regeneration (GBR) in bone augmentation procedures.

Allografts advantages: Filling periodontal defects, repairing maxillary and mandibullar defects [23].

Allografts disadvantages.

Variation in osteoconductive potential: Processing methods from different tissue banks can lead to significant variation in the composition and osteoconductive properties of the grafts.

Patient preference and ethical concerns: Some patients may refuse bone substitutes derived from animal or cadaveric sources due to ethical or personal reasons.

Risk of immune rejection: Although less common, allogeneic grafts carry a slight risk of immune rejection, as they come from a different individual.

Potential for disease transmission: There is a minor risk of transmitting infections or diseases from donor to recipient, despite stringent screening and processing [24-27].

Xenografts:

Xenografts are graft materials derived from a species unrelated to the host. The most common source of xenograft material in dentistry is deproteinized bovine bone. The bovine bone undergoes a stepwise heating process followed by chemical treatment with NaOH to produce a porous hydroxyapatite (HA) material containing only the inorganic components of the bone [24-26].

Xenografts advantages: The resulting porous structure closely resembles human bone, providing mechanical support and stimulating bone healing through osteoconduction.

Bovine bone substitutes are widely used in sinus lift and implant procedures due to their superior stability and low immunogenicity.

A promising xenograft material currently being investigated is Chitosan. Chitosan is able to stimulate bone regeneration by providing a structural scaffold that supports osteoblastic activity, mineralized bone matrix formation [24-26,28].

Xenografts disadvantages: Xenografts do not provide viable cells for phase I osteogenesis and must be rigorously treated to reduce antigenicity [29].

Onlay Bone Grafting.

Onlay bone grafting is a predictable procedure performed for the correction of cases with severe ridge resorption, either horizontally or vertically. Autogenous bone grafts are the most documented and commonly used donor bone, although recently other allogenic and xenogenic materials are being clinically investigated. For augmentation of severe ridge defects (less than 2 walls and require more than 3 mm of augmentation), augmentation utilising autogenous bone blocks results in increased success rates as compared to guided bone regeneration alone. Donor sites for autogenous onlay bone augmentation may be intra-oral or extra-oral. The most common intra-oral donor sites are the mandibular symphysis and the ramus of the mandible. Common extra-oral donor sites for harvesting non-vascularized bone grafts are the iliac crest, the calvarium, and the tibial bone. Most common vascularized bone-containing free flap donor sites are the free fibula flap, the deep circumflex iliac artery (DCIA) free flap, and the scapula-free flap. Once the bone graft is harvested, they should be trimmed and shaped to fit into the recipient site defect, with stabilization using osteosynthesis screws, followed by adequate soft tissue mobilization and tension-free primary closure of the grafted site. It is advisable to over-augment the defect to compensate for eventual resorption. A mixture of particulate bone, slow-resorbing xenografts, either alone or in combination, is used to fill the area between a corticocancellous block and the recipient site. The augmented material may be protected with a barrier membrane prior to being enveloped by the soft tissue closure [27].

Platelet-rich plasma (PRP).

Can be described as a biologic product derived from autologous blood with the plasma fraction containing platelets at a concentration of more than 3–5 times above baseline. PRP is derived from autologous blood by using a centrifuge and can be performed under local anaesthesia under aseptic conditions. An anticoagulant, like citrate dextrose solution formula A (ACD-A) or sodium citrate 3.8%, is used to inhibit platelet aggregation. Pure Platelet-rich plasma is a preparation without Leukocytes. It has low-density fibrin network after activation. Platelet-rich plasma (PRP) may be placed over the bone graft to provide an additional source of transforming growth factor beta (TGF-β) and vascular endothelial growth factor (VEGF), both of which promote collagen formation and blood vessel growth [27,28].

Maxillary sinus lift.

Sinus lift of the maxilla using implants is frequently problematic because of the extension of the maxillary sinus into the alveolar ridge area. In many cases the actual size and configuration of the maxilla are satisfactory in terms of the height and width of the alveolar ridge area. However, extension of the maxillary sinuses into the alveolar ridge may prevent placement of implants in the posterior maxillary area because of insufficient bony support. The sinus lift is a bony augmentation procedure that places graft material inside the sinus cavity but external to the membrane and augments the bony support in the alveolar ridge area. When only a few millimeters of augmentation are needed in conjunction with simultaneous implant placement, an indirect sinus lift is effective [29].

Indications for sinus lift:

- Loss of one or more teeth in the posterior region of the maxilla.
- Congenital absence of teeth.
- Loss of a significant amount of bone in height (<10mm) and width (<4mm).

Contraindications for sinus lift:

- Oroantral communication.
- Pseudocysts.
- Smoking.
- Chronic rhinosinusitis.

- Poor hygiene – are also known as relative contraindications.
- Acute sinus infections.
- Presence of tumors or cysts.
- Treatment with bisphosphonates – are also known as absolute contraindications.

Guided bone regeneration (GBR).

Guided bone regeneration is a bone-augmentation technique that uses the principle of space maintenance within a bony defect with the use of a barrier membrane. The barrier membrane excludes rapidly proliferating epithelial cells and connective tissue fibroblasts, thus allowing the ingrowth of slower-growing bone cells and blood vessels into the blood clot within the defect [27].

Guided bone regeneration inhibits connective tissue regeneration within osseous defects by way of a barrier, such as a membrane or foil. Long-term success is aided by implant insertion, minimizing bone resorption due to loading of the area [30].

Membranes.

These may be absorbable or nonabsorbable. Synthetic polymer and collagen membranes are absorbable. Nonabsorbable membranes include those reinforced with titanium, as well as metallic titanium network membranes. The main disadvantage of nonabsorbable membranes is the need to perform a second surgical procedure for their removal [30].

Barrier membranes are an important component for the success of the GBR procedure. Ideally, the barrier membranes must be non-toxic, biocompatible, cell occlusive with a certain degree of permeability for diffusion of nutrients, permit bonding and ingrowth of connective tissue during healing, should be of sufficient rigidity to maintain the space created and not collapse into the defect, it should be easy to handle clinically and should be able to be trimmed to tailor the material as per the size of the defect [27].

Split Crest.

The split-crest technique, used with immediate implant placement, involves longitudinally splitting the alveolar ridge using chisels, piezoelectric surgery, or oscillating saws. The buccal cortical bone plate is gently separated and displaced labially to widen the alveolar ridge, allowing for implant insertion with an appropriate diameter. Particulated autogenous bone graft or a bone substitute is often placed around the implants between the buccal and palatal cortical plates. Systematic reviews and meta-analyses show that this technique effectively reconstructs alveolar deficiencies, with high implant survival rates, significant ridge width gain, and minimal complications. The split-crest technique has been compared to lateral ridge augmentation with autogenous bone block grafts, showing no significant difference in implant survival between the two methods. However, lateral ridge augmentation resulted in a significantly greater gain in alveolar ridge width. Both techniques have been used for horizontal reconstruction of alveolar ridge deficiencies in both the maxilla and mandible [31-36].

Discussion.

In dental implantology, the selection of biomaterials and the appropriate surgical techniques play a crucial role in determining the success of the procedure. Bone grafting materials can be categorized into autografts, allografts, xenografts, and synthetic substitutes, with each type offering distinct benefits and drawbacks. Autografts are often considered the ideal choice because they possess osteogenic potential, containing living cells that directly promote bone formation. Since these grafts are sourced from the patient's own body, they eliminate concerns of immune rejection or disease transmission. However, harvesting these grafts requires an additional surgical procedure, leading to longer surgical times, higher costs, and potential complications such as pain or nerve injury. On the other hand, allografts, obtained from human donors, provide a practical alternative to autografts, eliminating the need for a second surgical site and reducing patient morbidity. While they offer osteoconductive support by acting as a scaffold for bone growth, they lack the ability to actively stimulate bone formation due to the absence of live cells. Despite a lower risk of immune rejection, allografts still carry a minor risk of disease transmission, even with thorough screening and sterilization procedures. Xenografts, typically derived from bovine sources, provide a scaffold for bone regeneration but, like allografts, lack osteoinductive properties. These materials require extensive processing to minimize antigenicity and the risk of immune rejection. Although xenografts do not directly stimulate bone formation, they can be combined with other regenerative materials such as platelet-rich plasma (PRP) or bone morphogenetic proteins (BMPs) to improve their osteogenic potential. Lastly, synthetic bone substitutes like hydroxyapatite (HA) and tricalcium phosphate (TCP) are designed to mimic the natural bone matrix and offer osteoconductive properties. These materials are widely available, pose no risk of disease transmission, and are biocompatible, but they typically lack the biological components needed for complete bone regeneration, limiting their osteogenic capacity compared to autografts.

In addition to the choice of biomaterials, surgical procedures such as Guided Bone Regeneration (GBR), sinus lifts, and ridge augmentation are essential in addressing bone deficiencies. GBR, a technique often used for bone volume augmentation, involves the use of barrier membranes that prevent the growth of non-osteogenic tissue into the graft site, thus facilitating bone formation. Resorbable membranes made from materials like collagen offer the advantage of not requiring a second surgery but may collapse under excessive pressure. Non-resorbable membranes, though more durable, necessitate additional procedures for removal. Sinus lifts and ridge augmentation are particularly important when there is insufficient bone volume, such as in the posterior maxilla, where sinus pneumatization can result in inadequate bone height. Autografts and allografts are generally the preferred materials for sinus lifts due to their regenerative properties, though xenografts and synthetic substitutes can also be successfully employed in less complex cases. As advancements continue in both biomaterials and

surgical techniques, there is growing focus on enhancing bone regeneration through bioactive and resorbable materials, which promise to improve graft integration, speed up the healing process, and ultimately provide better long-term outcomes for patients.

Conclusion.

Bone grafts and substitute materials, which are either in particle or block form, are used in dentistry to regenerate missing hard tissue structures. There is a growing demand for new and more efficient grafting materials. Currently, bone grafts and substitute materials primarily serve as a structural scaffold for osteoregenerative processes, fulfilling the criteria of osteoconduction.

In modern dental implantology, the success of the procedure is significantly influenced by the careful selection of biomaterials and the application of appropriate surgical techniques. The advancements in biomaterials such as autografts, allografts, xenografts, and synthetic substitutes have greatly enhanced the ability to regenerate bone and address deficiencies in the alveolar ridge. Autografts, being the gold standard, offer the best osteogenic potential, but their requirement for secondary surgical sites and associated risks complicate their use. Allografts and xenografts, although not osteoinductive, provide essential scaffolding for bone growth and reduce patient morbidity. Synthetic bone substitutes, like hydroxyapatite and tricalcium phosphate, provide biocompatible solutions with osteoconductive properties, but their regenerative capacity is limited compared to autografts. Surgical techniques, including Guided Bone Regeneration (GBR), sinus lifts, and ridge augmentation, are crucial for addressing bone volume deficiencies, ensuring successful implant integration. As the field of dental implantology continues to evolve, the use of bioactive and resorbable materials holds great promise for improving bone regeneration, accelerating the healing process, and achieving better long-term outcomes for patients.

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