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· 专家论坛 ·

## 血浆基质在口腔种植水平骨增量中的应用

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**【摘要】** 牙齿缺失伴随着牙槽骨吸收或缺损,导致骨量和软组织量不足。种植治疗除恢复缺失牙的咀嚼功能外,还需恢复牙弓的轮廓和外形,引导骨再生术是骨增量的常用手段。异种颗粒状骨替代材料因其降解时间长、免疫反应低等优点,在临床水平骨增量领域应用广泛,但存在操作不便、成骨活性低等问题。血浆基质能有效提高口腔组织再生效果、减少术后并发症的出现,在口腔组织再生中的应用逐渐增多。本文首先介绍了血浆基质在水平骨增量中的主要应用形式(固态血浆基质膜、血浆基质骨块),并根据临床常用的骨增量决策方案,即是否能够在理想位置植入种植体以及植入后是否存在骨开裂对水平骨缺损进行重新分类,其中Ⅰ类水平骨缺损为缺牙位点骨量可供植入理想尺寸的种植体,且种植体周围无骨开裂,但牙槽骨轮廓比非缺牙区凹陷的情况;Ⅱ类水平骨缺损为缺牙位点骨量根据未来修复体位置确定的种植位点植入理想尺寸种植体后,种植体三侧均有骨,但颊侧骨壁存在骨开裂(骨开裂长度小于种植体长度的50%)的情况;Ⅲ类水平骨缺损为缺牙位点骨量不足以在理想位置植入理想尺寸的种植体,需要先行植骨恢复骨量以利于种植体植入的情况。本文随后对血浆基质在不同水平骨缺损类型中的应用方法进行阐述:在Ⅰ类水平骨缺损中主要采用固态血浆基质膜替代胶原膜使用;在Ⅱ类水平骨缺损中使用血浆基质骨块充填种植体植入后的骨缺损区,覆盖胶原膜,并在胶原膜表面覆盖固态血浆基质膜;在Ⅲ类水平骨缺损中采用血浆基质骨块替代自体骨块充填缺损区,并用钛钉进行固定,胶原膜和固态血浆基质膜双重覆盖后缝合固定。本文旨在为口腔临床医师全面了解血浆基质、简化引导骨再生术操作以及血浆基质在水平骨增量中的应用提供参考。

**【关键词】** 水平骨增量; 引导骨组织再生; 血浆基质; 牙种植; 骨缺损分类; 胶原膜; 异种颗粒状骨替代材料; 骨块

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**Application of plasmatrix in horizontal bone augmentation for implant placement** ZHANG Yufeng, WANG



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**【Abstract】** Tooth loss is accompanied by alveolar bone absorption or defect, resulting in insufficient bone and soft tissue. In addition to restoring the masticatory function of missing teeth, implant treatment should also needs to restore the contour and shape of the dental arch. Guided bone regeneration is a common means of bone increase. Xenogeneic granular bone substitute materials are widely used in the field of clinical bone augmentation due to their advantages of long degradation time and low immunogenicity, but other problems, such as inconvenient operation and low osteogenic activity, remain. Plasmatrix can effectively improve the effect of oral tissue regeneration and reduce the occurrence of postoperative complications, and its application in oral tissue regeneration is gradually increasing. This article first introduces the main application forms of plasmatrix in horizontal bone augmentation (mainly solid plasmatrix membrane and plasmatrix bone block), and reclassifies horizontal bone defects according to commonly used decision-making schemes in clinical bone augmentation, in other words, whether the implant can be placed in the ideal position and whether there is bone dehiscence after implantation. Type I defects refers to the situation where the bone at the implant site can allow the insertion of an implant with ideal size, and there is no bone dehiscence around the implant, but the alveolar bone contour is not ideal; type II defects refers to the situation that when an ideal size implant is placed at the implant site determined by the future prosthesis position, there will be bones on three sides of the implant, but there is bone dehiscence in the buccal bone wall (the length of bone dehiscence is less than 50% of the implant length); type III defects refers to the situation where the bone volume at the implant site is not enough to for the placement of the ideal size implant at the ideal position, and bone grafting is required to restore the bone volume before the implant placement. The application of plasmatrix in different types of bone defects is then described. In type I bone defects, the solid plasmatrix membrane is used instead of the collagen membrane; in type II bone defects, the bone defect around the implant is filled by plasmatrix bone block and then covered with collagen membrane and solid plasmatrix membrane; and in type III bone defects, plasmatrix bone block is used to replace autogenous bone block to fill the defect area, and titanium screws are used for fixation. The defect is then covered with a collagen membrane and a solid plasmatrix membrane. This article aims to provide oral clinicians with a comprehensive understanding of plasmatrix and simplify the guidelines for bone regeneration operations.

**【Key words】** horizontal bone augmentation; guided bone regeneration; plasmatrix; dental implantology; classification of bone defects; collagen membrane; xenogeneic granular bone substitute materials; bone block

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牙齿缺失往往伴随着牙槽骨吸收或缺损,导致骨量和软组织量不足,难以进行种植体修复。为了保障种植体周围组织的长期稳定、实现美学种植修复以及种植体的长期存留,种植位点必须有充足的骨量,唇颊侧需有至少2 mm的骨组织<sup>[1]</sup>。

血浆基质是一种自体血液离心产物的总称,主要包含血液中的血小板等活细胞、纤维蛋白和生长因子,广泛应用于口腔组织再生、面部美容、运动医学等领域<sup>[2-3]</sup>。血浆基质共包含四代产物,从最早一代发展到第四代,因其制备参数的不断改良,其内容物和有效成分逐渐增多,在口腔临

床组织再生中的应用也逐渐成熟<sup>[4-7]</sup>。

笔者结合相关实验研究和临床经验,对血浆基质在牙槽骨水平骨缺损中的应用进行阐述,同时,基于血浆基质在骨增量中的应用,提出了新型水平骨缺损分类,以期能为口腔临床医师提供更好的水平骨增量临床解决方案。

## 1 血浆基质与引导骨再生

血浆基质是采集静脉血离心制备的产物,其主要成分为纤维蛋白、细胞成分和生长因子等,这三种成分也是组织再生的关键。血浆基质的细胞

成分可释放生长因子,帮助组织再生<sup>[8-9]</sup>;纤维蛋白结构可以维持空间<sup>[10]</sup>、结合并缓释生长因子<sup>[11]</sup>;生长因子能够促进组织再生相关细胞的增殖、迁移和分化<sup>[12]</sup>。血浆基质产物有凝胶状固体和液体两种形式,这两种形式又可根据临床场景制作成不同形态的产物进行使用。

引导骨再生术(guided bone regeneration, GBR)是目前最常见和有效的牙槽骨局部骨增量的方式<sup>[13]</sup>,它的主要原则是采用屏障膜隔离软组织与骨缺损区,防止软组织长入缺损区;并在骨缺损区植入骨再生材料,维持缺损区成骨空间,促进骨组织再生<sup>[14]</sup>。根据GBR的需求,可将血浆基质制备成两种不同形式进行使用。

### 1.1 固态血浆基质膜

使用固态血浆基质采血管采集患者静脉血,将采血管置于血浆基质制备平台,选择固态血浆基质制备程序,取出黄色凝胶状固态血浆基质,使用血浆基质套盒制备成固态血浆基质膜。该膜质地均一,为黄白色,有一定的弹性<sup>[15]</sup>。

### 1.2 血浆基质骨块

使用液态血浆基质采血管采集患者静脉血,将采血管置于血浆基质制备平台,选择液态血浆基质制备程序,采用注射器吸取液态血浆基质层即可获得液态血浆基质<sup>[16-17]</sup>。应用血浆基质制备套装,将固态血浆基质膜剪成碎片,和一定质量的骨粉(常用低替代率的颗粒状异种骨替代材料)混

合后,将液态血浆基质滴入,即可获得血浆基质骨块<sup>[18]</sup>。血浆基质骨块为一个完整不松散并具有一定弹性和强度的块状物<sup>[19-20]</sup>,可根据缺损区形态和需求进行塑形。

## 2 水平骨缺损分类及临床操作

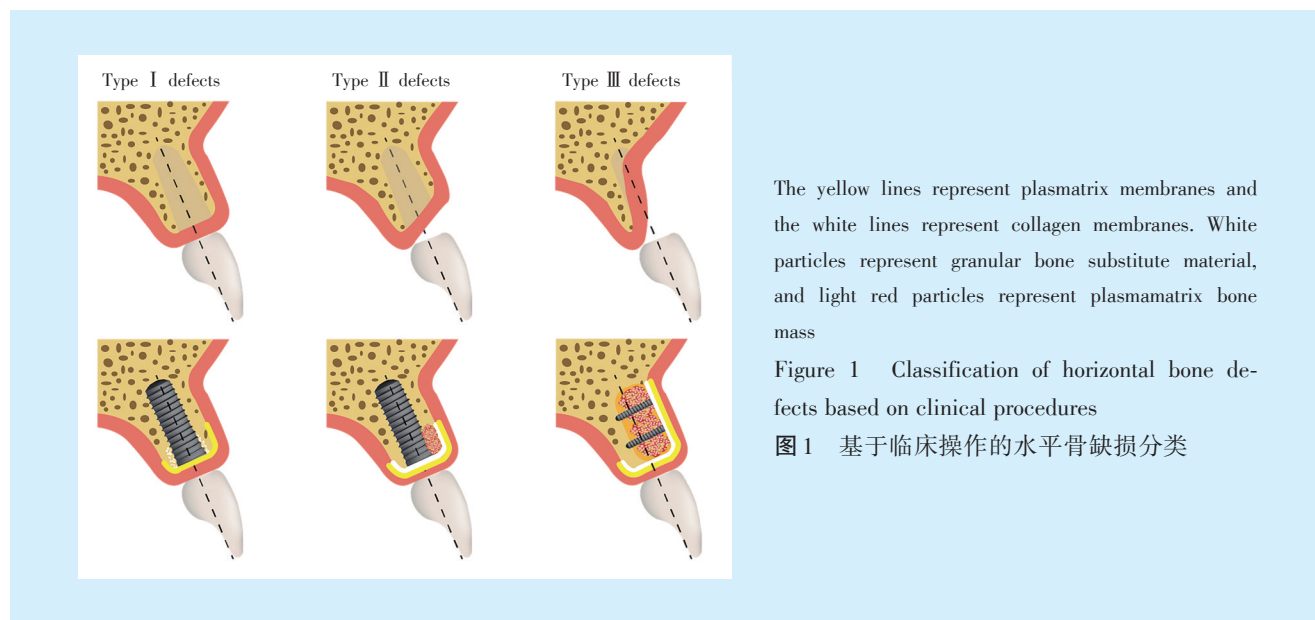
### 2.1 传统骨缺损的分类及临床操作

在临床上,骨缺损的形态和大小决定了医师最终选用何种屏障膜、是否同期植入种植体,因此Benic等<sup>[21]</sup>将骨缺损进行了分类,根据不同的临床情况归纳了不同的操作方法。

### 2.2 新型水平骨缺损分类及血浆基质在不同分类中的应用

Benic等的水平骨缺损分类涵盖了各种水平骨缺损的情况,分类细致全面。然而,其分类条目众多,记忆和实施存在难度,各分类对应的解决方案必须使用各种不同的骨替代材料和屏障膜<sup>[22-24]</sup>,材料成本高、技术敏感性大<sup>[25]</sup>。

血浆基质中富含组织再生所需有效生物成分,可以有效促进口腔组织再生。血浆基质骨块具有一定机械强度,能够维持植骨区域的空间和稳定性;同时,骨块具有可塑性,能够根据缺损形态设计骨块,实现个性化骨增量。因此,笔者团队基于血浆基质在骨增量中的应用,期待简化临床流程、扩大血浆基质适用范畴<sup>[15,26]</sup>,提出了新的水平骨缺损分类(图1)。



The yellow lines represent plasmatrix membranes and the white lines represent collagen membranes. White particles represent granular bone substitute material, and light red particles represent plasmatrix bone mass

Figure 1 Classification of horizontal bone defects based on clinical procedures

图1 基于临床操作的水平骨缺损分类

2.2.1 I类水平骨缺损 I类水平骨缺损是指缺牙位点骨量可供植入理想尺寸的种植体,且种植

体周围无骨开裂,但牙槽骨轮廓比非缺牙区凹陷的情况。

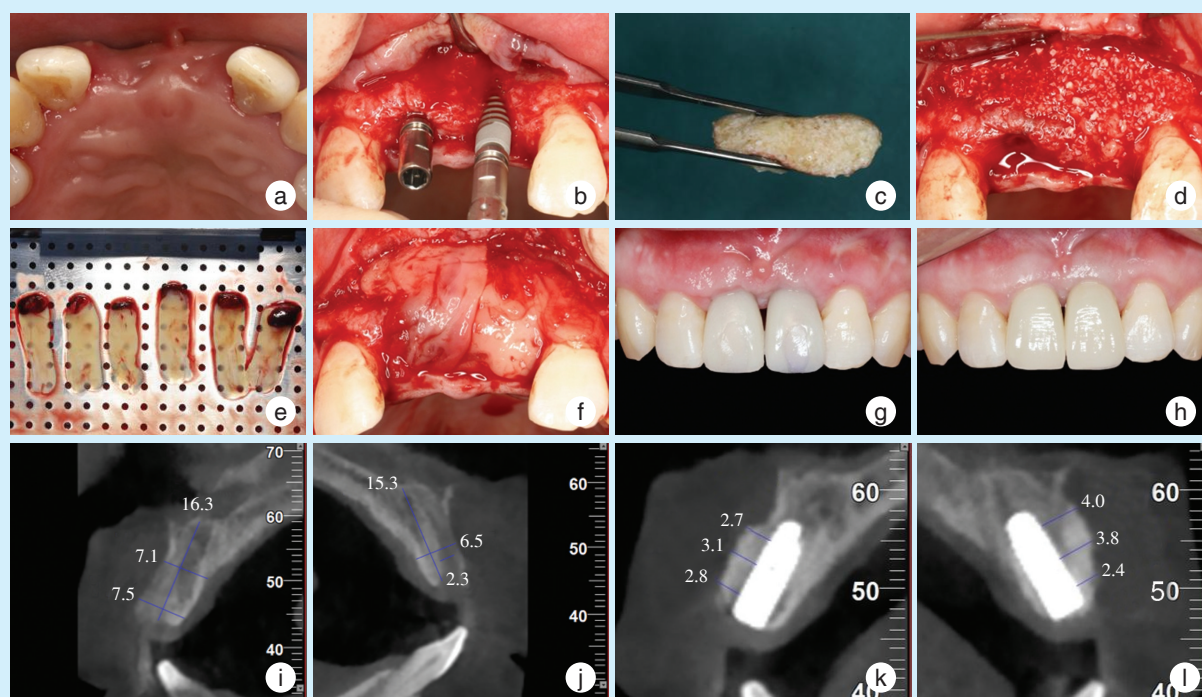
对于 I 类水平骨缺损,可在种植开始前抽取患者血液,制作血浆基质膜。术中在牙槽骨轮廓凹陷区域缺损区域充填颗粒状骨粉,再使用固态血浆基质膜替代可吸收胶原膜覆盖缺损区<sup>[27]</sup>,可轻度过充填,以补偿骨再生过程中材料的吸收及可能发生的轻度移位现象。血浆基质在此区域可缓释生长因子,促进骨充填材料的血管化,其内部的干细胞可在此处发挥再生作用;另外,血浆基质含有的白细胞具有抗炎和抗菌的作用<sup>[28-29]</sup>,可减少术后水肿、疼痛、感染等的可能性<sup>[26,30]</sup>。

**2.2.2 II类水平骨缺损** II类水平骨缺损是指缺牙位点骨量根据未来修复体位置确定的种植位点植入理想尺寸种植体后,种植体三侧均有骨,但颊侧骨壁存在骨开裂(骨开裂长度小于种植体长度的1/2)的情况。

对于 II 类水平骨缺损,可在种植开始前抽取患者血液,制作血浆基质骨块。在骨缺损区的皮质骨表面制备滋养孔,将血浆基质骨块放置在骨缺损区。在血浆基质骨块表面覆盖可吸收胶原膜,

再覆盖固态血浆基质膜后进行缝合。在此类缺损中,血浆基质骨块相比于颗粒状骨粉而言,具有完整性、便于操作、不容易移位的优点,并且血浆基质也赋予了材料更高的生物活性。在可吸收胶原膜表面覆盖一层固态血浆基质膜能够进一步促进软组织再生,减少术后不适<sup>[31]</sup>。

血浆基质在 I 类及 II 类水平骨缺损中应用的典型病例见图 2,术前即可见骨弓轮廓凹陷,口腔锥形束 CT (cone beam CT, CBCT) 显示患者牙槽骨高度尚可,但 11 宽度仅 7.1 mm, 21 宽度为 6.5 mm, 按照未来修复方向植入种植体则无法保证唇侧骨厚度。在植入后,可见 11 唇侧无骨开裂,但唇侧轮廓不够饱满,属于 I 类水平骨缺损; 21 唇侧存在骨开裂,但种植体周围有骨,骨开裂的长度不超过种植体长度的 1/2, 因此属于 II 类水平骨缺损。术中制备血浆基质骨块,将其覆盖在骨缺损处,在表面盖上固态血浆基质膜后缝合; 术后 6 个月 CBCT 显示唇侧骨量大于 2 mm; 植入术后 22 个月可见口内美学效果良好。



a: the preoperative bone arch contour was concave; b: labial bone dehiscence after implant placement; c: preparation of plasmatrix bone; d: placement of plasmatrix bone in a labial bone defect; e: preparation of plasmatrix membrane; f: plasmatrix membrane on the surface of the collagen membrane; g: temporary restoration completed; h: photo of the final restoration 22 months after bone augmentation; i: alveolar bone width of 11 at 7.1 mm before surgery; j: alveolar bone width of 21 at 6.5 mm before surgery; k: 6 months after surgery, the labial bone of 11 was abundant; l: 6 months after surgery, the labial bone of 21 was abundant

Figure 2 A case of plasmatrix application in type I and type II horizontal bone defects

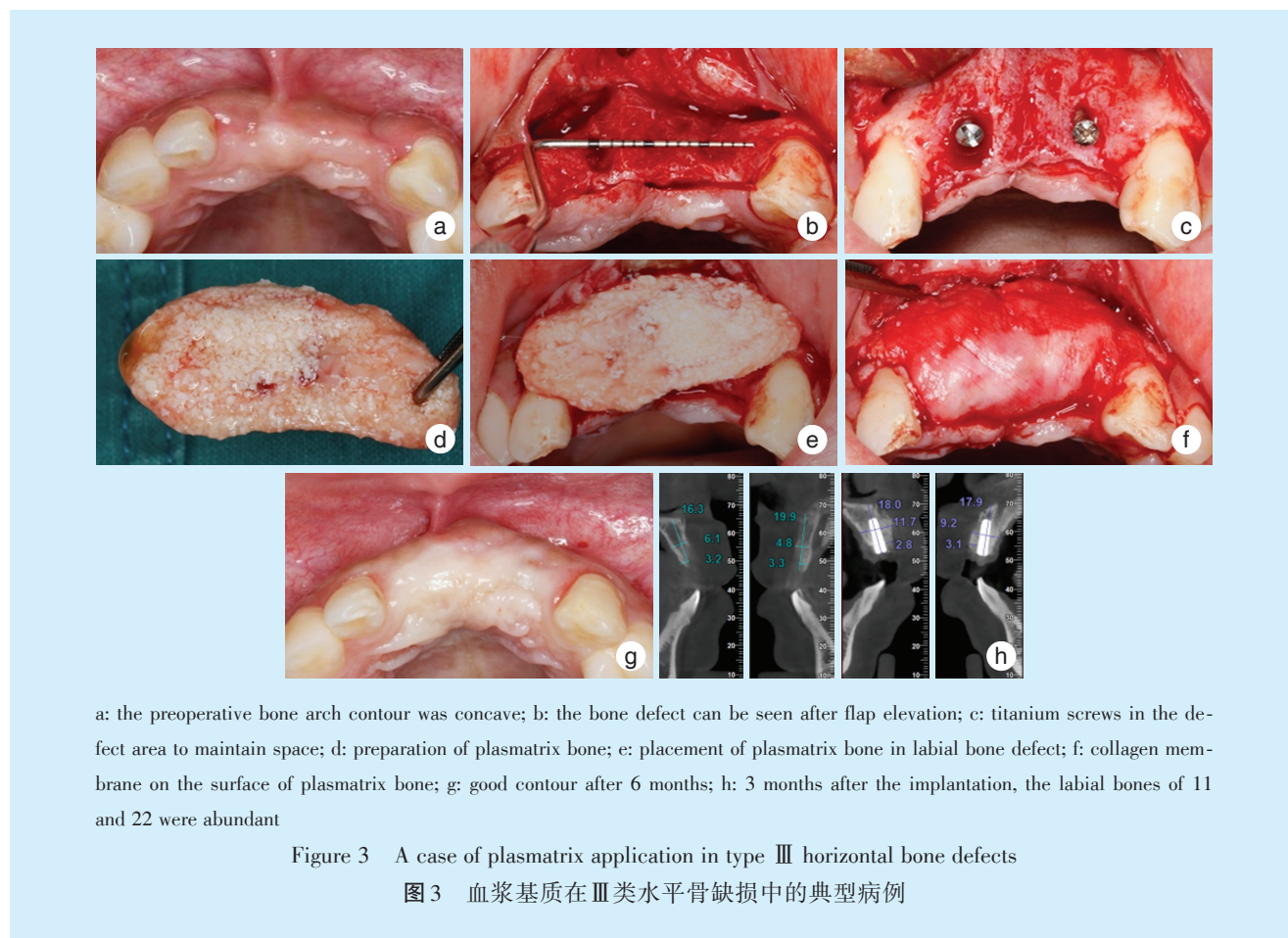
图 2 血浆基质在 I 类及 II 类水平骨缺损中的典型病例

**2.2.3 Ⅲ类水平骨缺损** Ⅲ类水平骨缺损是指缺牙位点骨量不足以在理想位置植入理想尺寸的种植体,需要先行植骨恢复骨量以利于种植体植入的情况。

对于Ⅲ类水平骨缺损,需要先行骨增量手术,待骨增量完成后延期进行种植操作。可在手术开始前抽取患者血液,制作血浆基质骨块。在骨缺损区的皮质骨表面制备滋养孔,将血浆基质骨块放置在骨缺损区,采用钛钉等方式固定血浆基质骨块。血浆基质骨块表面再覆盖可吸收胶原膜,并在可吸收胶原膜的表面覆盖固态血浆基质膜。在此类缺损中使用血浆基质骨块,避免了自体骨供给量有限的问题,还能够减轻收取自体骨块给患者带来的不适、疼痛,降低感染风险。血浆基质骨块制

备完成后,具有一定的机械强度,可代替自体骨块对缺损区起到支撑作用,还能够根据患者骨缺损区的形态进行塑形。另外,在术前还可提前设计数字化植骨导板,根据导板形态塑形血浆基质骨块,更好地实现以修复为导向的水平骨增量<sup>[32]</sup>。

血浆基质在Ⅲ类水平骨缺损中的典型病例见图3,术前即可见骨弓轮廓凹陷,CBCT显示患者牙槽骨高度尚可,但11牙槽嵴顶宽度仅3.3 mm,22宽度为3.2 mm,按照未来修复方向植入种植体则无法维持种植体稳定,因此属于Ⅲ类水平骨缺损。术中制备血浆基质骨块,将其覆盖在骨缺损处,用钛钉进行固定,使用胶原膜覆盖后缝合;术后6个月进行种植体植入,植入后3个月CBCT显示唇侧骨量大于2 mm。



### 3 总结与展望

经过数十年的发展,GBR已经被广泛地应用于水平骨缺损的组织再生中,并取得了良好的效果。然而,对于较大范围的水平骨缺损,自体骨移植虽可获得较好的再生效果,却存在来源受限、术后并发症较多等问题。

目前血浆基质的制备技术及其在口腔组织再生中的应用都逐渐完善和成熟,根据患者自身的情况和水平骨缺损的分类应用不同形式的血浆基质制品,能够有效提高临床组织再生效果,简化手术流程。然而,目前血浆基质在水平骨缺损的GBR技术中的使用也存在一些问题,如缺乏多中

心临床研究、目前暂时缺乏血浆基质统一的制备和使用指南、血浆基质膜降解过快、血浆基质骨块强度仍低于自体骨块等问题。

未来血浆基质的研究方向,将主要围绕着如何提高血浆基质相关产品的强度、如何延长其降解时间和如何提高其生物活性进行。相信随着材料科学和循证医学的不断发展,未来血浆基质的制备和使用标准将进一步统一,并且其制备方式将不断优化,更好地服务患者,使水平骨增量更加简单、有效。

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