

# 下颌阻生智齿拔除切口设计对第二磨牙牙周状况影响的研究进展

孙小茜<sup>1</sup>, 李崑崑<sup>2</sup>, 杨鑫旭<sup>1</sup>, 罗琦凡<sup>3</sup>, 毕文娟<sup>1\*</sup>

<sup>1</sup>华北理工大学口腔医学院, 河北 唐山

<sup>2</sup>唐山市工人医院口腔科, 河北 唐山

<sup>3</sup>华北理工大学冀唐学院, 河北 唐山

收稿日期: 2026年4月22日; 录用日期: 2026年5月16日; 发布日期: 2026年5月26日

## 摘要

下颌阻生第三磨牙拔除术是口腔临床常见手术, 但其操作易对相邻第二磨牙牙周状况产生不良影响, 切口设计作为手术核心环节, 对术后第二磨牙牙周健康及并发症的发生具有关键作用。本文通过梳理国内外相关研究, 系统阐述了三角形瓣与改良三角形瓣、信封瓣与改良信封瓣、Szmyd瓣、逗号瓣等常见切口设计的操作特点及对第二磨牙牙周健康的具体影响, 同时分析了阻生牙类型、患者年龄、术前牙周基础状况、去骨方式及缝合技术等其他因素对术后第二磨牙远中牙周组织愈合的作用机制。此外, 本文还归纳了富血小板纤维蛋白、引导组织再生术、骨移植、胶原蛋白海绵填充等现阶段临床用于保障第二磨牙牙周健康的常用材料与方法。目前关于各类切口设计的适应症及长期临床效果仍缺乏统一结论, 未来仍需开展更多高质量的临床研究, 为下颌阻生第三磨牙拔除术的切口选择及牙周保护策略提供更多的医学依据。

## 关键词

切口设计, 阻生牙, 第三磨牙, 邻牙牙周健康

# Research Progress on Incision Design for Extraction of Impacted Mandibular Wisdom Teeth and Its Effect on Periodontal Status of the Second Molar

Xiaoqian Sun<sup>1</sup>, Weiwei Li<sup>2</sup>, Xinxu Yang<sup>1</sup>, Qifan Luo<sup>3</sup>, Wenjuan Bi<sup>1\*</sup>

<sup>1</sup>College of Stomatology, North China University of Science and Technology, Tangshan Hebei

<sup>2</sup>Department of Stomatology, Tangshan Gongren Hospital, Tangshan Hebei

\*通讯作者。

文章引用: 孙小茜, 李崑崑, 杨鑫旭, 罗琦凡, 毕文娟. 下颌阻生智齿拔除切口设计对第二磨牙牙周状况影响的研究进展[J]. 临床医学进展, 2026, 16(5): 2370-2382. DOI: 10.12677/acm.2026.1652047

## Abstract

Extraction of impacted mandibular third molars is a common procedure in clinical dentistry, which may easily adversely affect the periodontal status of the adjacent second molars. As a key step in surgery, incision design plays a vital role in the periodontal health of the second molars and the occurrence of postoperative complications. This paper systematically reviews the domestic and international studies, expounds the operational characteristics of common incision designs such as triangular flap, modified triangular flap, envelope flap, modified envelope flap, Szmyd flap and comma flap, and their specific effects on the periodontal health of the second molars. It also analyzes the mechanism of other factors, including impaction type, patient age, pre-operative periodontal status, bone removal method and suture technique, on the healing of the distal periodontal tissue of the second molars after surgery. In addition, this paper summarizes the common clinical materials and methods to protect the periodontal health of the second molars, such as platelet-rich fibrin, guided tissue regeneration, bone grafting and collagen sponge filling. At present, there is still no unified conclusion on the indications and long-term clinical effects of various incision designs. More high-quality clinical studies are needed in the future to provide more medical evidence for incision selection and periodontal protection strategies in the extraction of impacted mandibular third molars.

## Keywords

Incision Design, Impacted Tooth, Third Molar, Periodontal Health of Adjacent Teeth

Copyright © 2026 by author(s) and Hans Publishers Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## 1. 引言

下颌阻生第三磨牙是临床最常见的阻生牙类型，发生率约为 66%~77% [1]。由于其位置异常且萌出受阻，常诱发邻牙龋坏、智齿冠周炎、牙根吸收等并发症，严重时还会导致邻牙周周缺损[2]。目前，大多数学者主张对存在病理症状的下颌阻生第三磨牙进行预防性拔除，尤其是中高位近中倾斜的情况[3]。然而，拔除手术可能引发一系列术后并发症，如：疼痛、肿胀、出血、暂时性张口受限，还可能对相邻的第二磨牙造成损伤[4]。Aniko-Włodarczyk 等人的研究显示，拔除下颌阻生第三磨牙后，邻近第二磨牙的远端探诊深度显著增加[5]；Kugelberg 等人也观察到，术后 2 年，相邻第二磨牙远中探诊深度  $\geq 7$  mm 的发生率达 43.3%，骨丧失  $\geq 4$  mm 的发生率为 32.1% [6]。

在与手术相关的各类因素中，切口设计被认为是影响术后并发症及邻近第二磨牙牙周健康的关键因素之一[7]，其不仅关系到术野清晰度，还影响术后组织愈合进程。此外，第三磨牙拔除后第二磨牙牙周健康还受多种因素影响，包括第三磨牙的倾斜角度、阻生深度、患者年龄、术前牙周状况以及口腔卫生水平等[8]。为减少术后并发症，临床上已引入多种辅助手段，如使用镇痛剂、皮质类固醇和抗生素，优化瓣形设计与缝合技术、放置引流管，以及采用臭氧治疗、冷冻治疗、富血小板血浆、富血小板纤维蛋白、超声骨刀手术和激光治疗等[9]，以期促进第二磨牙远中牙周健康。

鉴于目前关于下颌阻生第三磨牙拔除对第二磨牙牙周健康影响仍存在争议,且切口设计等关键因素的作用尚未明确[10],本综述旨在阐明不同拔牙切口设计对第二磨牙牙周健康的影响,系统梳理下颌阻生第三磨牙拔除后第二磨牙远中牙周状态的相关影响因素,并归纳总结可改善第二磨牙牙周健康预后的临床技术。

## 2. 基于牙周保护原则的切口设计分类

### 2.1. 牙周友好型切口

#### 2.1.1. 改良三角形瓣

Jing Zhao 等人对标准三角形瓣进行了改良,将第二磨牙颊侧和远中的切口从龈缘向根方移动 1~2 mm,其核心理念是通过保留第二磨牙周围的牙龈纤维、结合上皮和颊侧附着龈,减少第二磨牙潜在的牙周并发症。与传统瓣设计不同,改良三角瓣将颊侧和远中的切口设置于附着龈区域,最大程度保留了围绕第二磨牙龈沟及牙周软组织附着结构的完整性,既维持了软组织对牙根的自然封闭状态,又尽可能避免破坏龈下菌群生态平衡,从而有利于术后牙周组织的恢复[11]。Suarez-Cunqueiro 等人的研究证实,与传统三角形瓣相比,改良三角瓣能显著减轻第二磨牙远中牙周袋,更有利于术后牙周健康。然而,龈缘旁切口的设计会增加皮瓣两侧张力,导致术后短期伤口裂开风险上升,该并发症通常为暂时性的,最终可愈合[12]。Chen 等人也支持此种保留邻近磨牙周围完整牙龈颈环的设计,认为其有助于改善术后探诊深度,具有保护第二磨牙牙周健康的优势[13]。

#### 2.1.2. 改良信封瓣

改良信封瓣从第二磨牙近中颊线角至远中面中部,围绕第二磨牙做龈沟内切口,再沿下颌支前缘外侧做一远中切口[14]。该皮瓣采用单一水平切口翻折,龈沟内切口可根据需求向前延伸,其设计对血供破坏较小,能减少术中出血量,且便于伤口缝合,由于皮瓣基底较宽、血供丰富,缝合时易于对位[15]。Stephens 等人发现改良信封瓣术前与术后 3 个月的相关指标无显著差异,且术后 3 个月第二磨牙的探诊深度有所改善[16]。与改良三角形瓣相比,改良信封瓣摒弃了下颌第二磨牙近中颊侧牙龈的垂直切口,降低了缝合难度,在完全水平阻生下颌第三磨牙拔除术中的手术效率与改良三角形瓣相当,且能显著减轻术后第 3 天和第 7 天的肿胀程度,改善张口情况,这可能得益于其创伤更小、牙龈瓣复位更理想[17]。但改良信封瓣也存在潜在问题:围绕牙齿做龈沟内切口会损伤牙周膜,并且该设计不利于术者操作,增加去骨和分冠难度[18]。

#### 2.1.3. Szmyd 瓣

Szmyd 瓣采用单一水平切口,通过降低骨膜抬高瓣膜,相较于需要垂直切口的三角形瓣,对组织血供的干扰更小,且更易于伤口闭合[13]。Ahmad 等人的研究结果表明,除术后 6 个月的远中位点外,信封瓣组探诊深度显著大于 Szmyd 瓣组,这可能是由于信封瓣前部的邻间缝合因血肿压力导致伤口边缘错位,增加伤口裂开风险,进而引发临床附着丧失和探诊深度增加[19];Alqahtani 等人的研究也显示,信封瓣组的骨吸收率显著高于 Szmyd 瓣组[18]。此外,由于 Szmyd 瓣翻瓣范围更小,第二磨牙颊侧的骨吸收通常少于远中侧,相邻部位的牙周袋深度也相应减小[20]。

然而,不同研究中 Szmyd 瓣与其它瓣对邻近第二磨牙牙周的影响存在差异。Rosa 等人研究显示,三角形瓣和 Szmyd 瓣均会导致相邻第二磨牙出现牙周并发症,术后 3 个月和 6 个月时,均出现牙周探诊深度增加、临床附着水平丧失和骨吸收水平上升,且两者之间无显著差异[21];Kirtiloğlu 等人发现,三角形瓣和 Szmyd 瓣在术后 1 周、2 周和 4 周时,第二磨牙远中和颊侧位点的平均探诊深度存在显著差异,但术后 1 年的探诊深度和临床附着水平无显著差异[22];Arta 等人的研究同样表明,Szmyd 瓣和三角瓣在

术后 2 周、4 周和 6 个月时的牙周状况结果相似。因此, Szmyd 瓣与三角形瓣对第二磨牙牙周健康无显著影响, 与信封瓣设计相比, Szmyd 瓣更利于保护邻近第二磨牙的牙周健康, 这与其翻瓣范围更有限、对血供破坏更小以及并发症风险更低有关。因此, Szmyd 瓣是下颌阻生第三磨牙拔除术中一种利于保护邻牙牙周健康、值得优先考虑的切口设计[23]。

#### 2.1.4. 逗号瓣

逗号瓣是舌侧瓣的亚型, 其优势在于改良后的瓣可完全覆盖骨缺损, 且由于无远中切口, 颞肌肌腱下部和磨牙后垫等邻近解剖结构保持完整, 咀嚼时伤口受牵拉力影响较小, 因此不易裂开[24]。逗号瓣切口起始于第二磨牙远中后方、前庭沟最深点, 向前延伸至第二磨牙下方某点, 随后平滑转向并向上弯曲, 在第二磨牙远颊线角处与龈缘汇合, 继续沿第二磨牙远中做沟内切口, 形成以远舌为基底的逗号形黏骨膜瓣[25]。Nageshwar 等人的研究结果显示, 与传统瓣形设计相比, 采用逗号瓣的患者术后疼痛更轻、肿胀程度更低, 愈合后邻牙的牙周缺损更小[26]。Edmund Bailey 等人的研究进一步显示, 与改良信封瓣相比, 逗号瓣在术后 7 天、14 天的牙龈愈合评分更佳, 第二磨牙远中位点探诊出血率更低, 且术后 1 周最大开口度更大, 有利于术后牙周维护[27]。

#### 2.1.5. 无瓣手术入路

与传统信封瓣相比, 无瓣手术入路被证明是下颌第三磨牙手术拔除的一项进步, 是一种合适的选择[28]。无瓣手术入路从下颌第二磨牙表面的附着龈处从远中舌侧至远中颊侧做第一切口, 然后以第一切口的远中端为起点做第二切口, 该切口在颊侧黏膜处呈半圆形, 最终止于下颌第二磨牙颊侧牙冠的釉牙骨质界, 且位于两个颊尖之间。因未翻起全厚黏膜瓣, 无瓣手术入路结束后无需缝合创口。研究表明, 改良无瓣手术入路可改善术后早期恢复情况, 在附着龈改善、水肿和疼痛减轻方面优于传统入路。此外, 采用无瓣手术入路可显著缩短手术时间, 由于无需翻瓣, 瓣的弹性可使牙齿顺利取出, 并且凭借其弹性记忆, 瓣能复位至原位, 从而提高了患者的舒适度, 提升其临床可行性。研究表明, 对于 Pell 和 Gregory 分类中 I~II 类、A-B 类的下颌阻生第三磨牙, 采用无瓣手术入路拔除, 可以在减轻水肿、疼痛以及改善第二磨牙远中牙龈边缘的附着龈管理方面展现出良好的应用前景[29]。

#### 2.1.6. 三角侧旋皮瓣

三角侧旋皮瓣在下颌支做水平切口, 从第二磨牙近中颊侧边缘开始至远中面做龈沟内切口, 在近中区域做约 2~3 mm 的松弛切口, 于第二磨牙颊侧行骨膜上剥离, 为二期愈合创造条件, 然后将皮瓣旋转并向外侧复位, 实现一期愈合。该设计的优势在于可通过皮瓣复位改善伤口愈合情况, 避免因伤口裂开引发牙周问题。对第二磨牙牙周健康而言, 术后 90 天探诊深度显著低于信封瓣, 菌斑指数和牙龈指数更低。研究显示, 采用一期缝合的三角侧旋皮瓣是减少第二磨牙远中侧潜在探诊深度的更有效方法, 且能减少牙龈退缩风险, 更有利于第二磨牙远中牙周组织再生修复[7]。

#### 2.1.7. 龈沟内环形切口法

既往报道采用龈沟切口切开范围较大, 直达下颌第二磨牙近中龈沟, 对牙龈再附着情况影响较大[30]。阿布都卡地尔·巴吐尔在既往报道的基础上进行了改良, 于第二磨牙近中龈乳头、牙冠颊中点处切开, 沿着龈沟切透骨膜, 直至牙槽嵴顶, 抵骨切至远中颊侧 1.5 cm, 即龈沟内环形切口[31]。该切口与标准信封瓣相比, 减少了向第二磨牙近中的延伸, 近中切口止点不累及近中龈乳头, 翻瓣术后野暴露符合手术需求, 同时不会影响术后牙龈形态及再附着状态[32]。研究显示, 采用龈沟内环形切口与标准信封瓣拔除第三磨牙后 3 个月, 下颌第二磨牙六个位点牙周探诊深度较术前均无显著变化, 提示龈沟内环形切口对术后牙龈再附着情况无显著影响。术后牙龈再附着情况的恢复还可能受到口腔卫生状况的影响, 因此在患者口腔护

理与清洁习惯较好的情况下，术后恢复均较为理想[33]。此外，两组牙龈撕裂和舌侧骨板骨折的发生率差异均无统计学意义，表明龈沟内环形切口不会增加上述第三磨牙拔除术后常见并发症的发生风险。

## 2.2. 牙周常规型切口

### 2.2.1. 标准三角形瓣

三角形瓣是下颌阻生第三磨牙拔除术中最常用的切口设计之一，切口起始于远中，从下颌支向第二磨牙的远颊线角做远中切口，随后沿第二磨牙龈沟做沟内切口，延伸至近颊线角，再向前弯曲至下颌前庭沟作垂直松弛切口，皮瓣与骨面形成轻度钝角。与信封式皮瓣相比，三角形瓣通过增加一条颊侧垂直松弛切口，优化了手术视野暴露和操作可达性，降低了皮瓣损伤的风险，同时便于处理术中并发症，尤其适用于低位阻生第三磨牙的拔除。此外，垂直松弛切口能降低皮瓣张力，有助于伤口快速愈合[11]。

关于三角形瓣对第二磨牙牙周健康的影响，现有研究仍存在争议。Baqain 等人研究表明，从术后第 7 天至 5.5 个月，三角形瓣组第二磨牙远中探诊深度的增加量始终小于信封瓣组，最终随访时基本恢复至术前水平，而信封瓣组仍存在 0.26 mm 的探诊深度增加，提示三角形瓣设计更利于第二磨牙远中牙周袋深度的恢复[34]。Korkmaz 等人的研究也显示，术后 3 个月，三角形瓣组的探诊深度显著小于信封瓣组，更有利于邻牙牙周健康[7]。然而，三角形瓣垂直切口本身可造成骨膜损伤，进而影响愈合过程的稳定性，对牙周恢复产生不利影响[35]；若垂直切口损伤咀嚼肌附着，还可能引发更强烈的炎症反应，波及第二磨牙牙周组织[9]。Castagna 等的研究发现，术后 2 个月，梯形瓣、边缘瓣、乳头分离瓣和乳头切断瓣在第二磨牙远中探诊深度、临床附着水平等牙周参数上无显著差异[36]；Yong Hur 的研究也表明，拔牙 3 个月后，不同切口对邻近第二磨牙的牙周探诊深度和临床附着水平均无显著影响[37]，这些研究提示随着术后时间延长和牙周组织愈合，不同皮瓣设计的差异会逐渐缩小。

### 2.2.2. 标准信封瓣

信封瓣是另一种常用的手术切口设计，标准操作为沿下颌第二磨牙远中牙槽嵴顶做一水平切口，随后从第二磨牙远中沿颊侧龈沟向前延伸做沟内切口。该设计仅采用单一水平切口翻瓣，手术创伤较小，对骨膜和颊肌的损伤较轻，对组织血供的破坏也较小，且便于伤口闭合，对于 Pederson 量表评估难度为简单，且属于 1 类 A 位的牙齿，信封瓣是最推荐采用的切口设计[15]。但信封瓣也存在局限性，其颊侧瓣与第二磨牙远颊侧牙龈术后伤口裂开相关，有研究显示信封瓣的伤口裂开率高达 57%，切口裂开易导致食物嵌塞和细菌滋生，间接增加第二磨牙的牙周感染的风险[38]。关于信封瓣与其他瓣设计对第二磨牙牙周健康的影响，现有研究结果存在差异：部分研究支持三角形瓣组的牙周状况优于信封瓣组[8]，也有部分研究认为信封瓣能带来更优的牙周状况，但术后 7 天时，三角瓣的探诊深度低于信封瓣[39]。

## 3. 影响第二磨牙牙周健康的其他因素

### 3.1. 阻生牙类型

根据下颌阻生第三磨牙长轴与邻近第二磨牙的关系，Winter 将其分为垂直阻生、近中阻生、远中阻生、水平阻生和倒置阻生[40]。邻近第二磨牙远中牙槽骨吸收的发生率与下颌第三磨牙阻生类型显著相关[41]，其中近中阻生最易导致第二磨牙远中牙周袋和骨缺损，水平阻生次之，垂直阻生影响相对最低[42]。一方面，近中或水平阻生会导致口腔卫生难以维护，菌斑微生物堆积，进而在第二磨牙远中形成牙周袋、导致牙槽骨吸收[43]；另一方面，近中或水平阻生时，智齿与第二磨牙接触面积更大，持续施加的机械压力易诱发邻牙牙根表面骨缺失，加之拔除操作空间狭小，容易损伤第二磨牙牙周组织，因此对于此类高难度阻生病例，应选择兼顾视野暴露和牙周组织保护的切口[44]。对于未萌出的阻生下颌第三磨牙，可分

为完全阻生和黏膜下阻生，两者对术后牙周组织的影响不同。研究表明，若阻生下颌第三磨牙上方有骨板存在，术后牙周袋深度和临床附着丧失水平变化较小[45]。这与 Nunn 等人的研究一致：与完全阻生的下颌第三磨牙相比，黏膜下阻生的下颌第三磨牙牙周缺损风险显著增加，黏膜下阻生的下颌第三磨牙拔除后风险增加 4.8 倍，而完全阻生的阻生下颌第三磨牙拔除后仅增加 1.7 倍[46]。

### 3.2. 患者年龄

患者年龄是影响下颌阻生智齿拔除术后第二磨牙牙周健康的重要因素。研究表明，年轻患者下颌阻生第三磨牙拔除后，愈合效果更理想，第二磨牙的长期牙周预后也更佳[47]。随着年龄增长，牙根持续发育、牙周膜变薄、牙齿固连、下颌骨变硬变脆以及牙骨质增生，会导致阻生下颌第三磨牙拔除的难度增加，术后并发症发生率也随之升高[48]。目前主流观点认为，下颌阻生智齿最佳拔除时期为 25 岁之前，25 岁之后拔除会导致并发症显著增加，愈合时间延长[49]。研究显示，25 岁以上患者第三磨牙拔除术后，第二磨牙远中牙周探诊深度是 25 岁以下患者的 3 倍[50]。拔牙后 2 年，25 岁以下患者第二磨牙远中骨缺损超过 4 mm 的比例为 16.7%，25 岁以上患者为 40.7%；拔牙后 4 年，前者降至 4.2%，后者升至 44.4%，这提示 25 岁之前拔除阻生下颌第三磨牙可能对第二磨牙牙周健康更有益[34]。

### 3.3. 去骨方式及范围

过去常采用骨凿、骨锤去骨或劈牙以拔除阻生下颌第三磨牙，但该方法耗时较长，且易引发不良后果：Coomes 等人的研究表明，使用传统凿子劈开下颌第三磨牙牙冠后，颊侧骨板会出现 0.47~0.7 mm 的骨折缝[51]；Araújo MG 等人认为，颊侧骨板骨折会对邻牙产生不利影响，如牙槽骨吸收[52]。相比之下，旋转式手机作为一种电动器械，转速可达 35,000~40,000 转/分钟，不仅易于操作学习、去骨速度更快，还能更好地控制去骨量，目前已成为最常用的器械[53]，但仍存在局限性，例如钻孔过程中产生的高温可能导致骨坏死[54]。压电式手机是目前阻生下颌第三磨牙拔除术中最新的去骨技术之一，该设备利用超声频率的微振动原理，非常适合切割矿化组织，且不会损伤软组织[55]，对软组织的保护特性使其极具优势。在去骨的准确性和安全性方面，超声骨刀优于高速涡轮机，它不仅能减少术后肿胀、疼痛和软组织损伤，还能避免高速涡轮机产生的热量导致骨坏死等负面影响，使用超声骨刀可减少相邻第二磨牙远中骨缺损，增加手术区域的牙槽骨密度，更好地保留第二磨牙远中的骨量[56]。对于下颌阻生下颌第三磨牙，常规微创拔牙手术仍可能导致第二磨牙远中骨吸收和牙周袋形成[57]，因此学者们设计了超声骨刀开窗术：使用超声骨刀在下颌颊侧骨板上开窗，拔除牙齿后复位骨碎片[58]，使拔牙窝形成一个封闭空间，有效隔离上皮细胞生长，有利于骨组织再生，并缩短愈合时间[59]。

### 3.4. 缝合技术

单纯间断缝合技术是包括拔除阻生下颌第三磨牙手术在内的所有口腔外科手术中最常用的缝合技术，但部分患者单纯间断缝合无法实现伤口外翻，此时可使用其他缝合技术。水平褥式缝合也常用于皮瓣闭合，因其可以促进伤口外翻，减少伤口边缘的张力；若伤口边缘存在张力，该技术还可以缓解张力，获得更强的闭合强度[60]。Cetinkaya 等人[61]比较了间断缝合和锚定缝合对阻生下颌第三磨牙拔除后 6 个月相邻第二磨牙牙周组织的影响，发现间断缝合组第二磨牙远中牙周袋深度和临床附着丧失显著高于锚定缝合组，表明锚定缝合可能是更优选择，有助于维持牙周组织健康。此外，Zhu 等人[62]发现，术后 6 个月“8”字缝合相较于间断缝合更有利于邻牙远中牙周组织愈合，这可能是因为“8”字缝合使黏膜上皮更接近邻牙远中牙根表面，形成屏障，防止食物残渣嵌入，从而保护该区域的牙周组织再生修复[63]。

高位或低位完全骨埋伏阻生、需大量去骨的 III 类阻生齿，手术区域易形成血肿、组织渗出多，严密缝合会阻碍引流，导致肿胀、疼痛加重，此时可做松弛切口引流，仅对关键组织做简单拉拢，而非严密

初期闭合[64]。Danda 等人发现二期伤口闭合组患者的术后疼痛和肿胀程度低于初期伤口闭合组[65]；Osunde 等人发现阻生下颌第三磨牙手术后，无缝线技术相比于多缝线技术术后炎症反应更低[66]。二期伤口闭合组术后疼痛和肿胀程度较轻的原因可能是其有利于渗出液的引流，然而在某些情况下，如服用双膦酸盐类药物或免疫抑制剂的患者，或接受放射治疗的患者，初期伤口愈合更为可取，如果这些患者的初期伤口愈合延迟，可能会发生骨髓炎、放射性骨坏死和药物相关性颌骨坏死[46]。

## 4. 保障邻近第二磨牙牙周健康的材料

### 4.1. 富血小板纤维蛋白

近年来，富血小板浓缩物在现代牙科领域的应用范围不断扩大。纤维蛋白基质中的血小板会释放生长因子，这些生长因子能够刺激血管生成、促进骨再生与重塑，以及细胞的生长、增殖和分化[67]。研究显示，术后3个月，高级富血小板纤维蛋白在减轻探诊深度、临床附着丧失以及促炎细胞因子水平等不良影响方面具有显著效果[68]。Suwondo 多等人对比了高级富血小板纤维蛋白和传统血小板纤维蛋白在根分叉病变治疗中促进牙周组织再生的效果，发现高级富血小板纤维蛋白组的探诊深度和相对附着水平改善幅度显著大于传统血小板纤维蛋白组，而两组的骨高度改善无显著差异[69]。与经典的白细胞富血小板纤维蛋白相比，高级富血小板纤维蛋白在促进成纤维细胞愈合方面具有优势[70]。高级富血小板纤维蛋白和传统血小板纤维蛋白均能取得良好的治疗效果，其中传统血小板纤维蛋白组在骨再生方面效果更优，而高级富血小板纤维蛋白组在软组织愈合方面表现更佳[71]。

### 4.2. 填充胶原蛋白海绵

胶原蛋白海绵是一种结构类似人类胶原蛋白的生物医学材料，是细胞外基质的主要组成蛋白，也是细胞组织和支架的重要组成部分[72]。阻生牙拔除后，选用片状胶原蛋白海绵进行填充具有诸多优势，如能促进组织再生与愈合、降低感染风险及减轻患者的疼痛程度等[73]。临床上，胶原海绵主要用于预防和修复牙周缺损：Wang 等人发现第三磨牙拔除后填充胶原海绵时牙槽骨丧失显著减少，表明胶原海绵能预防术后牙周缺损并维持第二磨牙的牙周健康[74]。此外，Kim 等人还证明，放置可吸收胶原海绵减少了牙周探诊深度，加速了邻近第二磨牙牙周缺损的愈合[75]。胶原蛋白海绵还可减少创口暴露，防止外界细菌和异物进入创口，降低感染风险，进而减少因感染引起的继发出血[76]。阻生牙拔除后采用片状胶原蛋白海绵填充可使龈沟液炎症因子水平下降，减轻炎症反应，其原因在于胶原蛋白海绵具备抗炎特性，能减少炎症因子的释放及炎症细胞的浸润，进而降低龈沟液中的炎症因子水平。胶原蛋白海绵可以调节免疫细胞的功能，抑制过度的免疫反应和炎症因子的释放，这有助于维持创口微环境的稳定[77]。

## 5. 保障邻近第二磨牙牙周健康的方法

### 5.1. 引导组织再生术

引导组织再生(GTR)技术利用生物相容性屏障膜，在骨缺损区域与周围组织之间形成屏障，防止愈合过程中牙龈上皮和结缔组织侵入牙根表面，同时允许牙周细胞选择性迁移至缺损处，形成新的牙骨质和牙周膜纤维，即实现新的附着性愈合。多项研究证实，牙周再生手术能有效降低第二磨牙远中探诊深度，同时促进新骨形成[78]。Sammartino 等研究发现，牙周再生手术后12周术区组织学切片可见大量成骨细胞及新骨形成[79]；另有研究对该手术开展了为期5年的长期疗效随访，结果显示接受牙周再生手术的位点探诊深度显著低于未手术位点，且术后1至5年间，手术位点的探诊深度与附着水平均保持相对稳定[80]。为实现术后直接的抗感染效果，研究人员尝试将抗菌剂整合至膜材料中。临床研究显示，在膨体聚四氟乙烯膜表面结合四环素，能减少患者的致病菌感染，提升牙周附着水平[72]。Cortell-Ballester 等人发

现放置可吸收胶原膜术后 6 个月第二磨牙远中牙周袋深度和附着丧失水平较对照组显著降低, 表明可吸收胶原膜能刺激骨再生, 提高附着水平和骨填充量, 减少探诊深度, 促进牙周组织更快愈合[81]。Corinaldesi 等人对 11 例术前 PD $\geq$ 6 mm 且骨缺损  $\geq$ 3 mm 的双侧下颌第二磨牙进行可吸收胶原膜和不可吸收胶原膜引导组织再生治疗, 结果证实, 术后 9 个月, 可吸收胶原膜与不可吸收膜在探诊深度和附着丧失方面效果相同, 两种治疗方法均取得成功[82]。

## 5.2. 骨移植

骨替代品包括异体移植骨、异种移植骨以及合成骨。由于存在免疫排斥反应、疾病传播、伦理问题和感染风险, 异体移植骨目前很少用于第三磨牙拔除后邻牙远端缺损的修复[83]。自体骨移植被视为促进骨修复的“金标准”[84], 是从患者口腔内或口腔外的供骨区获取骨组织, 再将其移植到自身的骨缺损部位, 不仅具备诱导、生成和导向骨结构的多重优点, 还能与宿主的骨骼实现高效融合, 被认为是促进骨愈合的最佳选择, 在修复下颌第三磨牙拔除后邻牙远中的骨缺损中具有重要的作用[85]。Wushou 等人发现自源牙骨移植粉修复下颌第三磨牙拔除术后第二磨牙远中骨缺损成骨速度快、吸收率低、骨改建效果良好, 是修复第二磨牙远中骨缺损最经济、便捷且有效的骨移植替代材料[86]。研究显示, Bio-Oss 骨替代材料单独用于牙周骨缺损修复时即可取得良好疗效, 若与其他骨修复材料联合使用, 其修复效果还能得到进一步提升[87], 该材料不仅能有效促进第二磨牙周围骨组织的再生修复, 并且在下颌阻生第三磨牙拔除后联合使用时效果得到了广泛认可。

## 6. 结论

切口设计是决定下颌阻生智齿拔除术后第二磨牙牙周远期预后的核心环节, 其核心理念应从单纯追求术野暴露转向优先保护牙周血供与软组织附着。相较于标准三角瓣和信封瓣, 以微创、无垂直切口、保留龈缘结构为特点的牙周友好型切口, 能更有效降低术后牙周损伤风险, 更符合现代外科微创与牙周保护理念。除切口选择外, 患者年龄、阻生类型、去骨方式与缝合技术等因素同样会显著影响术后牙周组织愈合, 临床需进行综合评估与个体化方案设计, 同时联合生物材料与再生性技术可进一步改善术后牙周缺损, 提升远期疗效。当前研究仍以短期观察为主, 各类切口的长期适应证尚未统一, 未来仍需开展大样本临床研究, 以构建更完善的牙周风险评估体系与标准化手术方案, 实现最大化保护牙周组织的治疗目标。

## 基金项目

河北省自然科学基金(H2025209011); 河北省高等学校科学研究项目(BJ2026391)。

## 参考文献

- [1] Xiao, Y., Huang, J. and Xiao, L. (2019) Effects of Bone Grafting after Impacted Mandibular Third Molar Extraction for Treatment of Distal Periodontal Defects of Second Molar: A Meta-Analysis. *Clinical Stomatology*, **35**, 1-8.
- [2] Passarelli, P.C., Pasquantonio, G. and D'Addona, A. (2017) Management of Surgical Third Lower Molar Extraction and Postoperative Progress in Patients with Factor VII Deficiency: A Clinical Protocol and Focus on This Rare Pathologic Entity. *Journal of Oral and Maxillofacial Surgery*, **75**, 2070.e1-2070.e4. <https://doi.org/10.1016/j.joms.2017.06.010>
- [3] Galvão, E.L., da Silveira, E.M., de Oliveira, E.S., da Cruz, T.M.M., Flecha, O.D., Falci, S.G.M., *et al.* (2019) Association between Mandibular Third Molar Position and the Occurrence of Pericoronitis: A Systematic Review and Meta-Analysis. *Archives of Oral Biology*, **107**, Article 104486. <https://doi.org/10.1016/j.archoralbio.2019.104486>
- [4] Passarelli, P.C., Lopez, M.A., Netti, A., Rella, E., Leonardis, M.D., Svaluto Ferro, L., *et al.* (2022) Effects of Flap Design on the Periodontal Health of Second Lower Molars after Impacted Third Molar Extraction. *Healthcare*, **10**, Article 2410. <https://doi.org/10.3390/healthcare10122410>
- [5] Aniko-Włodarczyk, M., Jaroń, A., Preuss, O., Grzywacz, A. and Trybek, G. (2021) Evaluation of the Effect of Surgical

- Extraction of an Impacted Mandibular Third Molar on the Periodontal Status of the Second Molar—Prospective Study. *Journal of Clinical Medicine*, **10**, Article 2655. <https://doi.org/10.3390/jcm10122655>
- [6] Kugelberg, C.F., Ahlström, U., Ericson, S. and Hugoson, A. (1985) Periodontal Healing after Impacted Lower Third Molar Surgery: A Retrospective Study. *International Journal of Oral Surgery*, **14**, 29-40. [https://doi.org/10.1016/s0300-9785\(85\)80007-7](https://doi.org/10.1016/s0300-9785(85)80007-7)
- [7] Korkmaz, Y.T., Mollaoglu, N. and Ozmeriç, N. (2015) Does Laterally Rotated Flap Design Influence the Short-Term Periodontal Status of Second Molars and Postoperative Discomfort after Partially Impacted Third Molar Surgery? *Journal of Oral and Maxillofacial Surgery*, **73**, 1031-1041. <https://doi.org/10.1016/j.joms.2015.01.005>
- [8] Camps-Font, O., Caro-Bonfill, C., Sánchez-Garcés, M.À. and Gay Escoda, C. (2018) Periodontal Regenerative Therapy for Preventing Bone Defects Distal to Mandibular Second Molars after Surgical Removal of Impacted Third Molars: A Systematic Review and Meta Analysis of Randomized Clinical Trials. *Journal of Oral and Maxillofacial Surgery*, **76**, 2482-2514. <https://doi.org/10.1016/j.joms.2018.07.025>
- [9] Sifuentes-Cervantes, J.S., Carrillo-Morales, F., Castro-Núñez, J., Cunningham, L.L. and Van Sickels, J.E. (2021) Third Molar Surgery: Past, Present, and the Future. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, **132**, 523-531. <https://doi.org/10.1016/j.oooo.2021.03.004>
- [10] Briguglio, F., Zenobio, E.G., Isola, G., Briguglio, R., et al. (2011) Complications in Surgical Removal of Impacted Mandibular Third Molars in Relation to Flap Design: Clinical and Statistical Evaluations. *Quintessence International*, **42**, 445-553.
- [11] Zhao, J., Zhang, Y., Cheng, Y., Xie, S., Li, D., Zhang, P., et al. (2023) Effects of Modified Triangular Flap for Third Molar Extraction on Distal Periodontal Health of Second Molar: A Randomized Controlled Study. *Heliyon*, **9**, e16161. <https://doi.org/10.1016/j.heliyon.2023.e16161>
- [12] Suarez-Cunqueiro, M.M., Gutwald, R., Reichman, J., Otero-Cepeda, X.L. and Schmelzeisen, R. (2003) Marginal Flap versus Paramarginal Flap in Impacted Third Molar Surgery: A Prospective Study. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, **95**, 403-408. <https://doi.org/10.1067/moe.2003.84>
- [13] Chen, Y.W., Lee, C.T., Hum, L., et al. (2017) Effect of Flap Design on Periodontal Healing after Impacted Third Molar Extraction: A Systematic Review and Meta-Analysis. *International Journal of Oral and Maxillofacial Surgery*, **46**, 363-372. <https://doi.org/10.1016/j.ijom.2016.08.005>
- [14] Wang, Y., Lei, B., Cheng, Z., Yao, T. and Cheng, B. (2025) Comparative Study on the Short-Term Clinical Effects of Distal Incision Flap Technique in the Extractions of Mesially/Horizontally Impacted Mandibular Third Molar with High or Medium Position. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, **139**, 521-530. <https://doi.org/10.1016/j.oooo.2024.11.090>
- [15] De Marco, G., Lanza, A., Cristache, C.M., Capcha, E.B., Espinoza, K.I., Rullo, R., et al. (2021) The Influence of Flap Design on Patients' Experiencing Pain, Swelling, and Trismus after Mandibular Third Molar Surgery: A Scoping Systematic Review. *Journal of Applied Oral Science*, **29**, e2020093. <https://doi.org/10.1590/1678-7757-2020-0932>
- [16] Stephens, R.J., App, G.R. and Foreman, D.W. (1983) Periodontal Evaluation of Two Mucoperiosteal Flaps Used in Removing Impacted Mandibular Third Molars. *Journal of Oral and Maxillofacial Surgery*, **41**, 719-724. [https://doi.org/10.1016/0278-2391\(83\)90188-x](https://doi.org/10.1016/0278-2391(83)90188-x)
- [17] Xie, Q., Wei, S., Zhou, N. and Huang, X. (2021) Modified Envelope Flap, a Novel Incision Design, Can Relieve Complications after Extraction of Fully Horizontal Impacted Mandibular Third Molar. *Journal of Dental Sciences*, **16**, 718-722. <https://doi.org/10.1016/j.jds.2020.06.022>
- [18] Alqahtani, N.A., Khaleelahmed, S. and Desai, F. (2017) Evaluation of Two Flap Designs on the Mandibular Second Molar after Third Molar Extractions. *Journal of Oral and Maxillofacial Pathology*, **21**, 317-318. [https://doi.org/10.4103/jomfp.jomfp\\_75\\_17](https://doi.org/10.4103/jomfp.jomfp_75_17)
- [19] Ahmad, M., Khan, Z.A., Khan, T.U., Alqutub, M.N., Mokeem, S.A., AlMubarak, A.M., et al. (2021) Influence of Surgical Flap Design (Envelope and Szmyd) for Removal of Impacted Mandibular Third Molars on Clinical Periodontal Parameters: A Clinical Trial. *International Journal of Environmental Research and Public Health*, **18**, Article 4465. <https://doi.org/10.3390/ijerph18094465>
- [20] Bello, S.A., Adeyemo, W.L., Bamgbose, B.O., Obi, E.V. and Adeyinka, A.A. (2011) Effect of Age, Impaction Types and Operative Time on Inflammatory Tissue Reactions Following Lower Third Molar Surgery. *Head & Face Medicine*, **7**, Article No. 8. <https://doi.org/10.1186/1746-160x-7-8>
- [21] Rosa, A.L., Carneiro, M.G., Lavrador, M.A. and Novaes, A.B. (2002) Influence of Flap Design on Periodontal Healing of Second Molars after Extraction of Impacted Mandibular Third Molars. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, **93**, 404-407. <https://doi.org/10.1067/moe.2002.122823>
- [22] Kirtiloğlu, T., Bulut, E., Sümer, M. and Cengiz, İ. (2007) Comparison of 2 Flap Designs in the Periodontal Healing of Second Molars after Fully Impacted Mandibular Third Molar Extractions. *Journal of Oral and Maxillofacial Surgery*:

- Official Journal of the American Association of Oral and Maxillofacial Surgeons*, **65**, 2206-2210.  
<https://doi.org/10.1016/j.joms.2006.11.029>
- [23] Arta, S.A., Pourabbas Kheyradin, R., Mesgarzadeh, A.H., *et al.* (2011) Comparison of the Influence of Two Flap Designs on Periodontal Healing after Surgical Extraction of Impacted Third Molars. *Dentistry Research, Dentistry Clinic, Dentistry Prospects*, **5**, 1-4.
- [24] Yuan, L., Gao, J., Liu, S. and Zhao, H. (2021) Does the Lingual-Based Mucoperiosteal Flap Reduce Postoperative Morbidity Compared with the Buccal-Based Mucoperiosteal Flap after the Surgical Removal of Impacted Third Molars? a Meta-Analysis Review. *Journal of Oral and Maxillofacial Surgery*, **79**, 1409-1421.e3.  
<https://doi.org/10.1016/j.joms.2021.02.023>
- [25] Saravana Kumar, B., Sarumathi, T., Veerabahu, M., *et al.* (2013) To Compare Standard Incision and Comma Shaped Incision and Its Influence on Post-Operative Complications in Surgical Removal of Impacted Third Molars. *Journal of Clinical and Diagnostic Research*, **7**, 1514-1518.
- [26] Nageshwar (2002) Comma Incision for Impacted Mandibular Third Molars. *Journal of Oral and Maxillofacial Surgery: Official Journal of the American Association of Oral and Maxillofacial Surgeons*, **60**, 1506-1509.  
<https://doi.org/10.1053/joms.2002.36152>
- [27] Bailey, E., Kashbour, W., Shah, N., Worthington, H.V., Renton, T.F. and Coulthard, P. (2020) Surgical Techniques for the Removal of Mandibular Wisdom Teeth. *The Cochrane Database of Systematic Reviews*, No. 7, Article No. CD004345.  
<https://doi.org/10.1002/14651858.CD004345.pub3>
- [28] Ramalingam, S. and Bhargava, D. (2022) Advances in Surgical Extraction of the Mandibular Third Molars. In: *Transalveolar Extraction of the Mandibular Third Molars*, CRC Press, 163-175.  
<https://doi.org/10.1201/9781003324034-14>
- [29] Materni, A., Pasquale, C., Signore, A., Benedicenti, S. and Amaroli, A. (2023) Comparison between the Flapless Surgical Approach and a Novel Single Incision Access in Terms of Recovery Time and Comfort after Extraction of Impacted Inferior Third Molars: A Randomised, Blinded, Split-Mouth Controlled Clinical Trial. *Journal of Clinical Medicine*, **12**, Article 1995. <https://doi.org/10.3390/jcm12051995>
- [30] Feher, B., Spandl, L., Lettner, S., Ulm, C., Gruber, R. and Kuchler, U. (2021) Prediction of Post-Traumatic Neuropathy Following Impacted Mandibular Third Molar Removal. *Journal of Dentistry*, **115**, Article 103838.  
<https://doi.org/10.1016/j.jdent.2021.103838>
- [31] 阿布都卡地尔·巴吐尔, 郑思鹏, 万哲, 等. 龈沟内环形切口法用于下颌远中邻面暴露  $\geq 1/2$  的水平阻生第三磨牙拔除的研究[J]. 西部医学, 2024, 36(3): 438-442.
- [32] Song, G., Yu, P., Huang, G., Zong, X., Du, L., Yang, X., *et al.* (2020) Simultaneous Surgery of Mandibular Reduction and Impacted Mandibular Third Molar Extraction: A Retrospective Study of 65 Cases. *Medicine*, **99**, e19397.  
<https://doi.org/10.1097/md.00000000000019397>
- [33] Tuk, J., Yohannes, L., Ho, J. and Lindeboom, J. (2021) Oral Health-Related Quality of Life after Coronectomy for Impacted Mandibular Third Molar in the First Postoperative Week. *Medicina Oral Patología Oral y Cirugía Bucal*, **26**, e561-e567. <https://doi.org/10.4317/medoral.24506>
- [34] Baqain, Z.H., Al-Shafii, A., Hamdan, A.A. and Sawair, F.A. (2012) Flap Design and Mandibular Third Molar Surgery: A Split Mouth Randomized Clinical Study. *International Journal of Oral and Maxillofacial Surgery*, **41**, 1020-1024.  
<https://doi.org/10.1016/j.ijom.2012.02.011>
- [35] Tabrizi, R., Arabion, H. and Gholami, M. (2013) How Will Mandibular Third Molar Surgery Affect Mandibular Second Molar Periodontal Parameters? *Dental Research Journal*, **10**, 523-526.
- [36] Castagna, V., Pardo, A., Lanaro, L., Signoriello, A. and Albanese, M. (2022) Periodontal Healing after Lower Third Molars Extraction: A Clinical Evaluation of Different Flap Designs. *Healthcare*, **10**, Article 1587.  
<https://doi.org/10.3390/healthcare10081587>
- [37] Hur, Y. and Ogata, Y. (2017) Different Flap Designs Have No Impact on Periodontal Outcomes on Second Molars after Impacted Third-Molar Extraction. *The Journal of the American Dental Association*, **148**, 849-852.  
<https://doi.org/10.1016/j.adaj.2017.07.024>
- [38] Jakse, N., Bankaoglu, V., Wimmer, G., Eskici, A. and Pertl, C. (2002) Primary Wound Healing after Lower Third Molar Surgery: Evaluation of 2 Different Flap Designs. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, **93**, 7-12. <https://doi.org/10.1067/moe.2002.119519>
- [39] Lopes da Silva, B.C., Machado, G.F., Primo Miranda, E.F., Galvão, E.L. and Falci, S.G.M. (2020) Envelope or Triangular Flap for Surgical Removal of Third Molars? A Systematic Review and Meta-Analysis. *International Journal of Oral and Maxillofacial Surgery*, **49**, 1073-1086. <https://doi.org/10.1016/j.ijom.2020.01.001>
- [40] Weiliu, Q. (2008) *Oral and Facial Surgery*. 6th Edition, People's Medical Publishing House, 76.
- [41] Kim, E., Eo, M.Y., Nguyen, T.T.H., Yang, H.J., Myoung, H. and Kim, S.M. (2019) Spontaneous Bone Regeneration

- after Surgical Extraction of a Horizontally Impacted Mandibular Third Molar: A Retrospective Panoramic Radiograph Analysis. *Maxillofacial Plastic and Reconstructive Surgery*, **41**, Article No. 4. <https://doi.org/10.1186/s40902-018-0187-8>
- [42] Du, L.Z. (2011) The Effect of Impacted Mandibular Wisdom Teeth on the Health of Adjacent Teeth. *Proceedings of Clinical Medicine*, **20**, 1-5.
- [43] Leung, W.K., Corbet, E.F., Kan, K.W., Lo, E.C.M. and Liu, J.K.S. (2005) A Regimen of Systematic Periodontal Care after Removal of Impacted Mandibular Third Molars Manages Periodontal Pockets Associated with the Mandibular Second Molars. *Journal of Clinical Periodontology*, **32**, 725-731. <https://doi.org/10.1111/j.1600-051x.2005.00773.x>
- [44] Wang, D., He, X., Wang, Y., Li, Z., Zhu, Y., Sun, C., *et al.* (2017) External Root Resorption of the Second Molar Associated with Mesially and Horizontally Impacted Mandibular Third Molar: Evidence from Cone Beam Computed Tomography. *Clinical Oral Investigations*, **21**, 1335-1342. <https://doi.org/10.1007/s00784-016-1888-y>
- [45] Yan, Z.Y., Tan, Y., Xie, X.Y., He, W., Guo, C.B. and Cui, N.H. (2020) Computer-Aided Three-Dimensional Assessment of Periodontal Healing Distal to the Mandibular Second Molar after Coronectomy of the Mandibular Third Molar: A Prospective Study. *BMC Oral Health*, **20**, Article No. 264. <https://doi.org/10.1186/s12903-020-01250-z>
- [46] Nunn, M.E., Fish, M.D., Garcia, R.I., Kaye, E.K., Figueroa, R., Gohel, A., *et al.* (2013) Retained Asymptomatic Third Molars and Risk for Second Molar Pathology. *Journal of Dental Research*, **92**, 1095-1099. <https://doi.org/10.1177/0022034513509281>
- [47] Passarelli, P.C., De Angelis, P., Pasquantonio, G., Manicone, P.F., Verdugo, F. and D'Addona, A. (2018) Management of Single Uncomplicated Dental Extractions and Postoperative Bleeding Evaluation in Patients with Factor V Deficiency: A Local Antihemorrhagic Approach. *Journal of Oral and Maxillofacial Surgery*, **76**, 2280-2283. <https://doi.org/10.1016/j.joms.2018.06.022>
- [48] Rossi, D. (2019) Complication in Third Molar Extractions. *Biological Regulation and Homeostatic Agents*, **33**, 169-172.
- [49] Pogrel, M.A. (2012) What Is the Effect of Timing of Removal on the Incidence and Severity of Complications? *Journal of Oral and Maxillofacial Surgery*, **70**, S37-S40. <https://doi.org/10.1016/j.joms.2012.04.028>
- [50] Chiapasco, M., Crescentini, M. and Romanoni, G. (1995) Germectomy or Delayed Removal of Mandibular Impacted Third Molars: The Relationship between Age and Incidence of Complications. *Journal of Oral and Maxillofacial Surgery*, **53**, 418-422. [https://doi.org/10.1016/0278-2391\(95\)90715-7](https://doi.org/10.1016/0278-2391(95)90715-7)
- [51] Coomes, A.M., Mealey, B.L., Huynh-Ba, G., Barboza-Arguello, C., Moore, W.S. and Cochran, D.L. (2014) Buccal Bone Formation after Flapless Extraction: A Randomized, Controlled Clinical Trial Comparing Recombinant Human Bone Morphogenetic Protein 2/Absorbable Collagen Carrier and Collagen Sponge Alone. *Journal of Periodontology*, **85**, 525-535. <https://doi.org/10.1902/jop.2013.130207>
- [52] Araújo, M.G. and Lindhe, J. (2009) Ridge Alterations Following Tooth Extraction with and without Flap Elevation: An Experimental Study in the Dog. *Clinical Oral Implants Research*, **20**, 545-549. <https://doi.org/10.1111/j.1600-0501.2008.01703.x>
- [53] Maurer, P., Kriwalsky, M.S., Block Veras, R., *et al.* (2007) Light Microscopic Examination of Rabbit Skulls Following Conventional and Piezosurgery Osteotomy. *Biomedical Technology*, **52**, 351-355.
- [54] Pandey, R.K. and Panda, S.S. (2013) Drilling of Bone: A Comprehensive Review. *Journal of Clinical Orthopaedics and Trauma*, **4**, 15-30. <https://doi.org/10.1016/j.jcot.2013.01.002>
- [55] Ealla, K.R., Thomas, M., Akula, U. and Gajjada, N. (2017) Piezosurgery: A Boon for Modern Periodontics. *Journal of International Society of Preventive and Community Dentistry*, **7**, 1-7. <https://doi.org/10.4103/2231-0762.200709>
- [56] Daniel, A., Adarsh, V., Basheer, S.A., Govind, R.J. and Rao, A. (2017) Comparative Study of Piezoelectric and Rotary Osteotomy Technique for Third Molar Impaction. *The Journal of Contemporary Dental Practice*, **18**, 60-64. <https://doi.org/10.5005/jp-journals-10024-1990>
- [57] Falci, S.M., Stella, P.M., Oliveira de Medeiros, L., Douglas-de-Oliveira, D., Gonçalves, P., Flecha, O., *et al.* (2017) Impact of Mandibular Third Molar Extraction in the Second Molar Periodontal Status: A Prospective Study. *Journal of Indian Society of Periodontology*, **21**, 285-290. [https://doi.org/10.4103/jisp.jisp\\_79\\_17](https://doi.org/10.4103/jisp.jisp_79_17)
- [58] Zhang, X.M., Hou, G.Y., Wang, W.W., *et al.* (2019) Application of the Buccal Bone Osteotomy with Piezosurgery in Extracting Deeply Impacted Mandibular Third Molars. *Journal of Oral and Maxillofacial Surgery*, **29**, 30-33.
- [59] Mattout, P. and Mattout, C. (2000) Conditions for Success in Guided Bone Regeneration: Retrospective Study on 376 Implant Sites. *Journal of Periodontology*, **71**, 1904-1909. <https://doi.org/10.1902/jop.2000.71.12.1904>
- [60] Wu, T. (2006) Plastic Surgery Made Easy—Simple Techniques for Closing Skin Defects and Improving Cosmetic Results. *Australian Family Physician*, **35**, 492-496.
- [61] Cetinkaya, B.O., Sumer, M., Tutkun, F., Sandikci, E.O. and Misir, F. (2009) Influence of Different Suturing Techniques on Periodontal Health of the Adjacent Second Molars after Extraction of Impacted Mandibular Third Molars. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, **108**, 156-161.

- <https://doi.org/10.1016/j.tripleo.2009.03.024>
- [62] Zhu, Y.G., Zhong, Z.H. and Chang, S.H. (2014) Influence of the Suture Method of Mandibular Impacted Wisdom Tooth Extraction on the Distal Periodontal Tissue of Adjacent Teeth. *Jilin Medical Journal*, **35**, 3765-3766.
- [63] Jeong, J. and Chang, M. (2015) Food Impaction and Periodontal/Peri-implant Tissue Conditions in Relation to the Embrasure Dimensions between Implant-Supported Fixed Dental Prostheses and Adjacent Teeth: A Cross-Sectional Study. *Journal of Periodontology*, **86**, 1314-1320. <https://doi.org/10.1902/jop.2015.150322>
- [64] Hashemi, H.M., Beshkar, M. and Aghajani, R. (2012) The Effect of Sutureless Wound Closure on Postoperative Pain and Swelling after Impacted Mandibular Third Molar Surgery. *British Journal of Oral and Maxillofacial Surgery*, **50**, 256-258. <https://doi.org/10.1016/j.bjoms.2011.04.075>
- [65] Danda, A.K., Krishna Tatiparthi, M., Narayanan, V. and Siddareddi, A. (2010) Influence of Primary and Secondary Closure of Surgical Wound after Impacted Mandibular Third Molar Removal on Postoperative Pain and Swelling—A Comparative and Split Mouth Study. *Journal of Oral and Maxillofacial Surgery*, **68**, 309-312. <https://doi.org/10.1016/j.joms.2009.04.060>
- [66] Osunde, O.D., Adebola, R.A. and Saheeb, B.D. (2012) A Comparative Study of the Effect of Suture-Less and Multiple Suture Techniques on Inflammatory Complications Following Third Molar Surgery. *International Journal of Oral and Maxillofacial Surgery*, **41**, 1275-1279. <https://doi.org/10.1016/j.ijom.2012.04.009>
- [67] Gassling, V., Douglas, T., Warnke, P.H., et al. (2010) Platelet-Rich Fibrin Membranes as Scaffolds for Periosteal Tissue Engineering. *Clinical Oral Implants Research*, **21**, 543-549. <https://doi.org/10.1111/j.1600-0501.2009.01900.x>
- [68] Stefanescu, A., Sufaru, I., Chiscop, I., Lupu, F.C., Martu, C., Oprisan, B., et al. (2024) Clinical and Molecular Impact of Advanced Platelet-Rich Fibrin on Pain, Swelling, and Distal Periodontal Status of Mandibular Second Molars after Mandibular Third-Molar Extraction. *Medicina*, **60**, Article 2062. <https://doi.org/10.3390/medicina60122062>
- [69] Suwondo, C.I., Herawati, D. and Sudibyo, S. (2018) Effect of Advanced Platelet-Rich Fibrin Applications on Periodontal Regeneration in Infrabony Pocket Treatment. *Majalah Kedokteran Gigi Indonesia*, **4**, 154-160. <https://doi.org/10.22146/majkedgiind.37414>
- [70] Pitzurra, L., Jansen, I.D.C., de Vries, T.J., Hoogenkamp, M.A. and Loos, B.G. (2020) Effects of L-PRF and A-PRF+ on Periodontal Fibroblasts in *in Vitro* Wound Healing Experiments. *Journal of Periodontal Research*, **55**, 287-295. <https://doi.org/10.1111/jre.12714>
- [71] Leaper, D.J. and Edmiston, C.E. (2017) World Health Organization: Global Guidelines for the Prevention of Surgical Site Infection. *Journal of Hospital Infection*, **95**, 135-136. <https://doi.org/10.1016/j.jhin.2016.12.016>
- [72] Meyer, M. (2019) Processing of Collagen Based Biomaterials and the Resulting Materials Properties. *BioMedical Engineering Online*, **18**, Article No. 24. <https://doi.org/10.1186/s12938-019-0647-0>
- [73] 张则明, 邬志锋, 李佳, 等. 康复新液联合疮疡灵、明胶海绵对 2 型糖尿病患者阻生牙拔除术后干槽症发生的影响[J]. *中国药房*, 2018, 29(4): 516-519.
- [74] Wang, L.C., Chen, Z., Chen, J.P., et al. (2018) Comparison of Collagen Sponge and Gelatin Sponge in Preventing Complications after Impacted Tooth Extraction. *Journal of Guangdong Medical College*, **36**, 586-589.
- [75] Kim, J.W., Seong, T.W., Cho, S., et al. (2020) Randomized Controlled Trial on the Effectiveness of Absorbable Collagen Sponge after Extraction of Impacted Mandibular Third Molar: Split-Mouth Design. *BMC Oral Health*, **20**, Article No. 77. <https://doi.org/10.1186/s12903-020-1063-3>
- [76] 白希婧, 吕东升, 周贤, 等. 胶原蛋白海绵用于下颌阻生牙拔除术的效果分析[J]. *中国口腔颌面外科杂志*, 2019, 17(2): 155-158.
- [77] 苑绪光, 李天竹, 朱骏飞, 等. 医用胶原蛋白海绵预防下颌阻生智齿干槽症的临床应用[J]. *临床口腔医学杂志*, 2019, 35(2): 92-94.
- [78] Toledano-Serrabona, J., Ruiz-Romero, V., Camps-Font, O., Gay-Escoda, C. and Sánchez-Garcés, M. (2021) A Systematic Review and Meta-Analysis on the Effectiveness of Xenograft to Prevent Periodontal Defects after Mandibular Third Molar Extraction. *Medicina Oral Patología Oral y Cirugía Bucal*, **26**, e414-e421. <https://doi.org/10.4317/medoral.24260>
- [79] Sammartino, G., Tia, M., Gentile, E., Marenzi, G. and Claudio, P.P. (2009) Platelet-Rich Plasma and Resorbable Membrane for Prevention of Periodontal Defects after Deeply Impacted Lower Third Molar Extraction. *Journal of Oral and Maxillofacial Surgery*, **67**, 2369-2373. <https://doi.org/10.1016/j.joms.2009.04.093>
- [80] Sammartino, G., Tia, M., Bucci, T. and Wang, H. (2009) Prevention of Mandibular Third Molar Extraction-Associated Periodontal Defects: A Comparative Study. *Journal of Periodontology*, **80**, 389-396. <https://doi.org/10.1902/jop.2009.080503>
- [81] Cortell-Ballester, I., Figueiredo, R., Valmaseda-Castellón, E. and Gay-Escoda, C. (2015) Effects of Collagen Resorbable Membrane Placement after the Surgical Extraction of Impacted Lower Third Molars. *Journal of Oral and Maxillofacial*

- Surgery*, **73**, 1457-1464. <https://doi.org/10.1016/j.joms.2015.02.015>
- [82] Corinaldesi, G., Lizio, G., Badiali, G., Morselli-Labate, A.M. and Marchetti, C. (2011) Treatment of Intra-bony Defects after Impacted Mandibular Third Molar Removal with Bioabsorbable and Non-Resorbable Membranes. *Journal of Periodontology*, **82**, 1404-1413. <https://doi.org/10.1902/jop.2011.100466>
- [83] Liang, Y. and Kang, F.W. (2020) Repair of Distal Bone Defect of the Second Molar after Extraction of Fully Impacted Mandibular Third Molars. *Stomatology*, **40**, 76-79.
- [84] Lobb, D.C., DeGeorge Jr., B.R. and Chhabra, A.B. (2019) Bone Graft Substitutes: Current Concepts and Future Expectations. *The Journal of Hand Surgery*, **44**, 497-505.e2. <https://doi.org/10.1016/j.jhssa.2018.10.032>
- [85] 李芳, 石前会, 程余婷, 等. 牙槽骨增量材料的研究进展[J]. 临床口腔医学杂志, 2020, 36(7): 444-446.
- [86] Wushou, A., Zheng, Y., Han, Y., Yang, Z. and Han, F. (2022) The Use of Autogenous Tooth Bone Graft Powder in the Treatment of Osseous Defects after Impacted Mandibular Third Molar Extraction: A Prospective Split-Mouth Clinical Pilot Study. *BMC Oral Health*, **22**, Article No. 433. <https://doi.org/10.1186/s12903-022-02473-y>
- [87] 赵国廷, 姚毅章, 徐革英, 等. BioSS 骨粉对下颌水平阻生牙拔除术后并发症的预防作用及牙槽骨密度的影响[J]. 中国美容医学, 2019, 28(12): 142-145.