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柔性两阶段穿牙槽嵴上颌窦底提升术治疗上颌后牙区骨高度严重不足 1 例报告及文献复习

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[摘要] 穿牙槽嵴上颌窦底提升术 (TSFE) 在上颌后牙区垂直骨增量应用上具有侵入性小、术后反应小和手术时间短的优势。本文作者报道 1 例上颌后牙区剩余骨高度 (RBH) 严重不足, 上颌窦外侧壁可见一血管且上颌窦底可见分隔患者的临床资料, 应用柔性两阶段 TSFE, 在减小创伤和降低施耐德膜破裂及上颌窦感染等风险的同时, 改善了术区的垂直骨高度, 并结合相关文献进行复习。患者, 男性, 26 岁, 自诉左侧上颌后牙缺失 1 年余, 要求修复。患者 27 牙缺失, 角化龈正常, 牙槽嵴丰满, 对颌牙无伸长, 缺牙近远中间隙宽度尚可, 牙龈距离正常。锥形束 CT (CBCT) 显示 27 牙位处窦嵴距约 3 mm, 牙槽骨宽度约 12.8 mm, 骨密度正常, 未见残留牙根及其他异常情况; 双侧上颌窦壁未见囊肿样病变, 左侧上颌窦底可见分隔, 上颌窦外侧壁可见一血管。诊断为肯氏 III 类上颌牙列缺损。经过两阶段 TSFE, 施耐德膜完整, 上颌窦未发生感染, 种植区骨高度由术前的 3 mm 提升至修复完成后的 9.6 mm, 骨增量效果稳定, 骨结合良好, 恢复了正常的咬合功能。对于上颌后牙区骨高度严重不足的患者, 可以考虑柔性两阶段 TSFE, 在降低上颌窦感染和施耐德膜破裂等风险的同时, 减小损伤并获得理想的骨增量效果。

[关键词] 上颌窦底提升术; 穿牙槽嵴上颌窦底提升; 施耐德膜; 骨再生; 牙种植; 富血小板纤维蛋白

[中图分类号] R783.4 **[文献标志码]** B

Flexible two-stage transalveolar technique for sinus floor elevation for resolution of severe bone height deficiency in maxillary posterior region: A case report and literature review

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ABSTRACT Transalveolar technique for sinus floor elevation (TSFE) offers the advantages of minimal invasiveness, reduced postoperative reaction, and shorter operative time for vertical bone augmentation in the maxillary posterior region. The clinical data of one patient with severe deficiency of residual bone height (RBH) in the maxillary posterior region, a blood vessel visible in the lateral wall of the maxillary sinus and

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a visible septum at the floor of the maxillary sinus were reported, and two-stage flexible TSFE was used to improve the vertical bone height of the operated area while reducing trauma, the risk of Schneiderian membrane rupture and maxillary sinus infection, etc., and the relevant literatures were reviewed. The patient, male, 26 years old, complained of missing left maxillary posterior teeth for more than 1 year and requested restoration. The patient had 27 missing teeth, normal keratinized gingiva, full alveolar ridge, no elongation of the opposing teeth, fair width of the proximal and normal occlusal distance. The results of cone beam CT (CBCT) showed that the distance between the sinus crests at the site of the 27 teeth was about 3 mm, the width of the alveolar bone was about 12.8 mm, the bone density was normal, and there were no residual roots or other abnormalities; no cyst-like lesions were seen in the walls of the maxillary sinuses bilaterally, and separation was seen at the floor of the maxillary sinus on the left side and a blood vessel was seen in the lateral wall of the maxillary sinus. A diagnosis of Kennedy class II maxillary tooth defects was made. After two stages of TSFE, the Schneiderian membrane was intact and the bone height of the implant area was elevated to 9.6 mm from 3 mm preoperatively after the completion of the restoration, with stable bone augmentation, good osseointegration, and restoration of normal occlusal function. For the patients with severe bone height deficiency in the maxillary posterior region, flexible two-stage TSFE should be considered, which can help to reduce the risk of maxillary sinus infection and Schneiderian membrane rupture while minimizing the damage and obtaining the ideal bone augmentation results.

KEYWORDS Sinus floor elevation; Transalveolar technique for sinus floor elevation; Schneiderian membrane; Bone regeneration; Dental implantation; Platelet-rich fibrin

上颌窦的过度气化以及牙槽骨吸收会使缺牙区的剩余骨高度 (residual bone height, RBH) 降低, 因此标准种植体在上颌后牙区的植入往往受到限制^[1]。针对垂直骨量不足的问题, 目前有多种治疗方案, 包括植入短的种植体^[2]、倾斜的种植体^[3]、超长的颧骨种植体^[4]以及上颌窦底提升术 (sinus floor elevation, SFE) 等。SFE具有手术时间短、组织损伤轻微及术后不良反应较少等优点, 已成为增加上颌后部垂直骨增量的常规方法^[5]。

1986年, TATUM^[6]提出了侧壁开窗上颌窦底提升术 (lateral window technique for sinus floor elevation, LSFE), 也称上颌窦外提升术, 用于上颌骨后部骨增量。该方法的缺点包括术后肿胀、愈合期长以及需要多次手术等^[7]。此外, 由于眶下动脉、上牙槽后动脉及两者在前外侧壁的骨内外动脉吻合支的存在, LSFE有一定的出血风险^[8]。此后, SUMMERS^[9]提出了穿牙槽嵴上颌窦底提升术 (transalveolar technique for sinus floor elevation, TSFE), 也称上颌窦内提升术, 与LSFE比较, 该方法的优点是侵入性小、术后反应小和手术时间短。当RBH \geq 4 mm时, TSFE的临床效果是可预期的。研究^[10]表明: 当RBH $<$ 4 mm时, 随着施耐德膜需要抬高高度的增加, 穿孔的风险也在增加,

TSFE的成功率有显著差异。此外, RBH $<$ 4 mm会影响种植体的初期稳定性和种植体存留率^[11]。

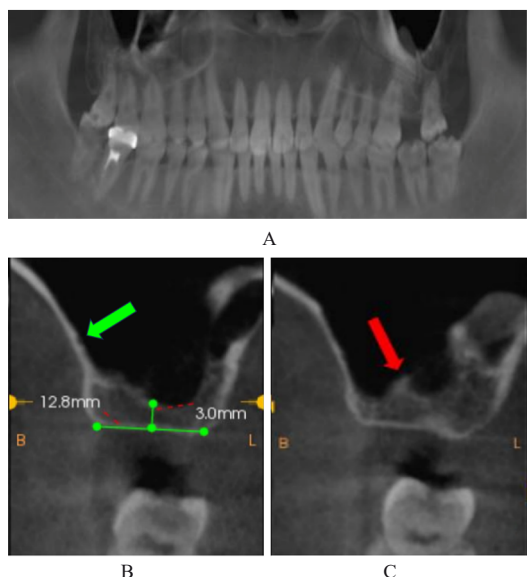
本文作者报道1例27牙缺失且RBH约为3 mm的患者的临床资料, 其上颌窦外侧壁可见一血管, 上颌窦底可见分隔。为避免上颌窦外侧壁血管损伤, 本文作者通过2次分阶段TSFE解决骨高度严重不足的问题, 减小了创伤与感染的风险。研究^[12]表明: 在骨凿敲击前使用结缔组织移植物或胶原蛋白等材料作为缓冲, 可减小敲击时的冲击力。本文作者将富血小板纤维蛋白 (platelet-rich fibrin, PRF) 作为缓冲材料, 包裹于内提工具的头部分作为缓冲后实施柔性TSFE, 在降低施耐德膜穿孔风险的同时, 改善缺牙区垂直骨高度。

1 临床资料

1.1 一般资料 患者, 男性, 26岁, 自诉左上颌后牙缺失1年余, 要求种植修复。患者27牙缺失, 角化龈正常, 牙槽嵴丰满, 对颌牙无伸长, 缺牙近远中间隙宽度尚可, 牙龈距离正常。锥形束CT (cone beam CT, CBCT) 断层扫描显示: 双侧上颌窦壁未见囊肿样病变 (图1A); 上颌窦外侧壁可见一血管 (图1B); 27牙位处RBH约3 mm, 牙槽骨宽度约12.8 mm, 骨密度正常, 未见残留牙根及其他异常, 左侧上颌窦底可见分隔 (图1C)。

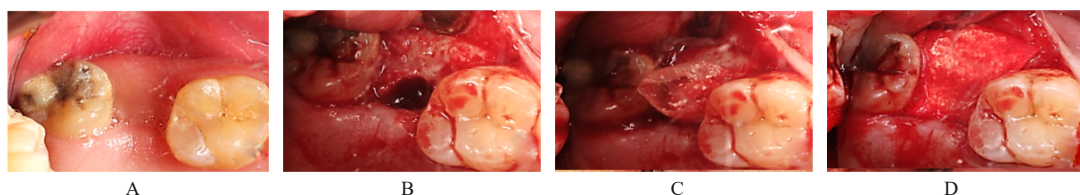
诊断: 肯氏Ⅲ类上颌牙列缺损。

1.2 治疗计划 告知患者及其家属病情和治疗计划, 患者知情同意; 与患者沟通后, 计划于27牙



A: Panorama; B: Measurement of remaining bone width and bone height of the alveolar bone in left maxillary second molar region (position of green arrow); C: Bone septum at floor of maxillary sinus(position of red arrow).

图1 上颌后牙区RBH严重不足患者术前CBCT图像
Fig. 1 Preoperative CBCT images of patient with severe deficiency of RBH in maxillary posterior region



A: Preoperative intraoral photograph; B: Implant socket preparation and flexible TSFE; C: Filling of PRF-coated collagen block; D: Covering of biofilm.

图2 上颌后牙区RBH严重不足患者第1次TSFE过程的图像

Fig. 2 Procedure images of first TSFE of patient with severe deficiency of RBH in maxillary posterior region

1.5 最终修复 4个月后复诊, 27牙龈正常, 种植体无松动或叩痛, 种植体稳定系数(implant stability quotient, ISQ)分别为77、73、75和77, 殆龈距离正常。殆曲线无偏斜, 咬合关系正常, 口腔卫生状况良好。根尖片显示: 27种植体周无明显透射影像, 骨结合良好(图6)。27牙采用转移体制取硅胶模型。2周后预约带牙, 取下愈合基台, 旋上永久基台及牙冠, 调整就位、邻接和咬合至正常(图7)。加力至35 N·cm, 抛光, 封闭螺丝孔。

分阶段行TSFE, 3个月后再第2次手术同期行种植体植入术。

1.3 第1次TSFE 因27牙位处RBH严重不足(3 mm), 且上颌窦底可见分隔和外侧壁血管, 考虑LSFE剥离窦底黏膜时破损风险较高, 遂考虑柔性两阶段TSFE。第一阶段(图2): 使用PRF膜包裹骨凿敲击进行TSFE。4%阿替卡因肾上腺素注射液局麻后, 于27牙位处做嵴顶H型切口, 翻开黏骨膜瓣, 于27牙位处行种植体窝预备, 术中使用冰生理盐水冷却, TSFE时用1块PRF包裹骨凿敲击(图3), 再用1块PRF包裹 Geistlich Bio-Oss® Collagen骨胶原放置于种植体窝中, 覆盖海奥生物膜1张, 缝合创口。术后CBCT显示缺牙区RBH提升至约10.1 mm, 宽度约为13.4 mm(图4A)。术后2周, 创口愈合良好, 牙龈无肿胀, 缝合在位, 拆除缝线。

1.4 第2次TSFE 3个月后, CBCT显示缺牙区RBH约8.0 mm, 宽度约为11.2 mm(图4B)。4%阿替卡因肾上腺素注射液局麻显效后, 于27牙位处逐级备洞后行常规TSFE, 植入 Straumann \varnothing 4.1 mm×8 mm种植体, 旋入2 mm愈合基台, 种植体初期稳定性良好, 严密缝合创口(图5)。术后2周, 创口愈合良好, 牙龈无肿胀, 缝合在位, 拆除缝线。

1.6 治疗结果 第1次TSFE后, 上颌窦底成功上移约7 mm, 达到了预期的理想提升效果。3个月后, CBCT显示患牙区RBH为8 mm, 进行第2次常规TSFE进一步提升垂直向骨量, 基于第1次柔性TSFE理想的骨增量效果, 同期行种植体植入术, 取得了足够的初期稳定性。最终修复完成后显示骨结合良好, 种植区RBH约为9.6 mm(图8), 骨增量效果稳定, 咬合功能恢复正常。

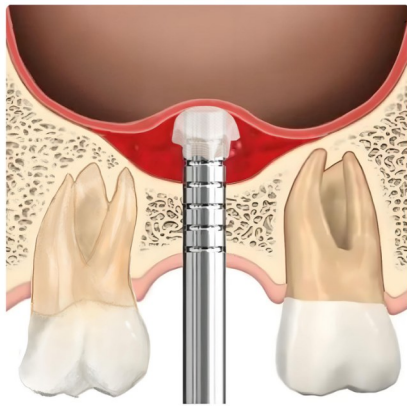
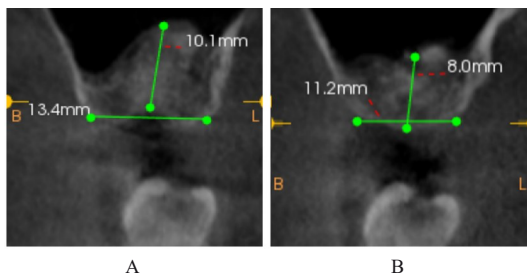


图3 使用PRF膜作缓冲的柔性两阶段TSFE示意图
Fig.3 Schematic of flexible two-stage TSFE using PRF membrane for cushioning



A:CBCT bone height and bone width measurements in operative area after first TSFE; B: CBCT bone height and bone width measurements in operative area 3 months after first TSFE.

图4 上颌后牙区RBH严重不足患者术后CBCT图像
Fig.4 Postoperative CBCT images of patient with severe deficiency of RBH in maxillary posterior region

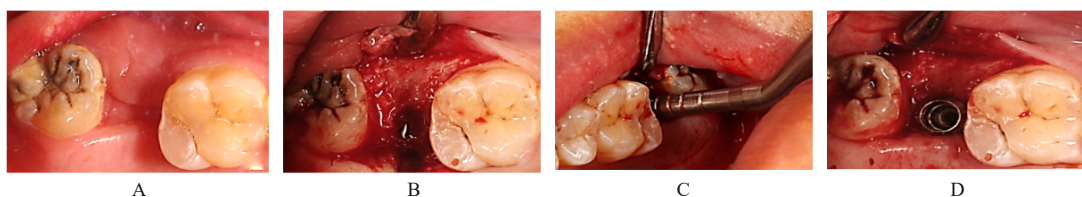
2 讨论

LSFE作为上颌骨后部垂直骨增量的方法,其缺点包括术后肿胀、愈合期长以及需要多次手术^[7]。为了改善这些不足, SUMMERS^[9]提出了TSFE,该技术使上颌窦底骨壁发生“青枝”骨折。与LSFE比较,TSFE的优点是侵入性小、术后反应少和手术时间短。CĂLIN等^[10]对1985—2011年8项TSFE的临床试验进行Meta分析发现:

RBH \geq 4 mm时,TSFE的成功率不受影响;RBH $<$ 4 mm时,TSFE成功率具有显著差异。本研究中,病例患牙区RBH仅为3 mm,本应选择LSFE,然而患牙区上颌窦前外侧壁可见一动脉,LSFE过程中易损伤该动脉导致出血,继而可能引起“冲洗”效应使骨移植材料移位,影响上颌窦底抬高后施耐德膜下方空间的维持,还可能导致血肿,引起患者不适和感染。该病例患牙区RBH仅为3 mm且CBCT可见窦底有明显骨性分隔,常规的内提方法极易导致施耐德膜穿孔,考虑引入柔性两阶段TSFE以降低剥离施耐德膜时的穿孔率。

施耐德膜的纤毛可排出上颌窦内的黏液以维持正常生理功能,对植入的种植体与骨移植材料起到生物屏障的作用^[13]。研究^[14]表明:施耐德膜内含间充质干细胞,PRF刺激可促进间充质干细胞增殖、迁移和成骨分化。WENG等^[15]进一步在小鼠的施耐德膜内鉴别出一种Krt14+Ctsk+细胞亚群,这些前体细胞通过分化成Krt14-Ctsk+后代,表现出强大的成骨能力。因此,施耐德膜的完整性不仅有助于稳定骨移植材料和血液供应,还可加速骨骼形成。目前,临床上已经引入了一些技术来降低剥离施耐德膜时的穿孔率,如球囊技术^[16]、超声液压法、手动旋拧推进、电动推进^[17]和垂直膨胀螺钉^[18]等。但上述研究中所采用的新式器械,不仅增加了手术操作的步骤,还导致了手术时间延长。然而,当患者张口受限或者缺失牙为上颌第二磨牙时,一些器械的入路及操作可能会有困难,使得部分方法受到一定限制。有研究^[12]提出:将胶原蛋白或结缔组织等作为缓冲材料放置于骨凿的尖端,可减小敲击骨凿时对上颌窦底的冲击力。本文作者将PRF包裹于骨凿头部作为缓冲进行柔性TSFE,并通过2次分阶段的TSFE,降低施耐德膜穿孔风险并改善患牙区垂直骨高度。

目前,关于SFE是否必须植入骨移植材料,学界仍存分歧。然而对于RBH高度严重不足、需要



A:Preoperative intraoral photograph; B: Implant socket preparation; C: TSFE; D: Implant placement.

图5 上颌后牙区RBH严重不足患者第2次TSFE过程的图像

Fig.5 Procedure images of second TSFE of patients with severe deficiency of RBH in maxillary posterior region

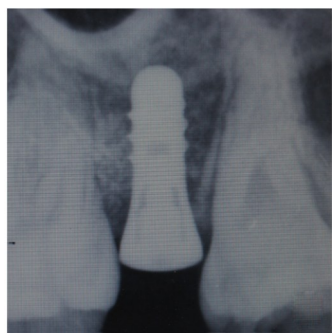


图6 第2次TSFE 4个月位根尖图像

Fig. 6 Apical radiographs 4 months after second TSFE



A: Completed restoration on buccal view; B: Completed restoration on occlusal view.

图7 上颌后牙区RBH严重不足患者修复完成图像

Fig. 7 Restoration complete images of patient with severe deficiency of RBH in maxillary posterior region

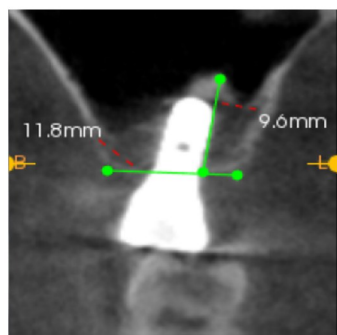


图8 CBCT检测修复完成后手术区域骨高度和骨宽度

Fig. 8 Bone height and bone width in operative area completion of restoration detected by CBCT

提升高度较高的病例,更偏向于植入骨移植材料。国际口腔种植学会口腔种植临床指南(第5卷)^[19]指出:施耐德膜提升后可生成长度2~3 mm新骨,当RBH较小且施耐德膜提升高度>3 mm时,推荐同期进行骨移植材料的植入。该患者RBH仅为3 mm,单独使用PRF作为SFE的支架材料不足以解决该患者的问题,因此本文作者考虑联合植入PRF与 Geistlich Bio-Oss[®] Collagen骨胶原。研究^[20]显示:

血小板浓缩制品的加入使得骨移植材料的愈合时间明显缩短,新骨的形成明显增强。PRF是源自患者自身的白细胞与纤维蛋白复合物,其制备过程简便,仅需离心患者血液即可获得,无需额外添加抗凝剂或活化剂,展现出成本低廉且易于获取的优势^[21]。该复合物内部具有富含多种生长因子及大量对创伤修复至关重要的蛋白质的致密纤维蛋白网络,能够诱导血管新生并促进细胞定向分化与特化,作为骨细胞生长的支撑架构有效加速了骨组织的愈合与形成进程^[22]。CHO等^[23]报道的随机对照试验比较了应用PRF与盐水对液压法TSFE提升术的效果,结果表明PRF可以比盐水更有效地占据升高的施耐德膜下产生的空间,并诱导更多鼻窦内骨形成。血小板浓缩物具有骨诱导特性与促进血管形成的能力^[24]。研究^[14]显示:PRF能促进施耐德膜中的间充质干细胞迁移、增殖和成骨分化,继而促进SFE中新骨的形成。Geistlich Bio-Oss[®] Collagen胶原蛋白由90%的松质骨微颗粒与10%的猪骨源性胶原蛋白复合而成。研究^[25]显示:在TSFE中应用Bio-Oss胶原蛋白,与无移植材料的对照组比较,实验组在上颌窦底的骨增量更明显,种植体与经骨胶原促进改建的新骨之间形成了良好的骨整合,验证了骨胶原在诱导上颌窦成骨方面的有效性。

研究^[26]显示:只有当RBH \geq 4 mm时,在SFE同期放置种植体可行,因为这是确保种植牙初级稳定性所需的最小骨高度。一项Meta分析^[10]表明:若剩余牙槽骨的高度<4 mm,骨凿上颌窦底提升技术(osteotome sinus floor elevation, OSFE)同期植入种植体的成功率将明显降低。另一项研究^[27]认为:如果RBH<3 mm,植入的种植体将缺乏初期稳定,不推荐在同一手术阶段完成SFE和种植体植入术。本病例的RBH约为3 mm,预计提升的骨高度较高,因此选择分2阶段完成手术,第1次行柔性TSFE,第2次行常规TSFE同时植入种植体,最终取得较好的临床效果。本病例取得的良好临床效果可能与多种因素有关,包括手术方式的选择、临床医生的临床经验以及患者良好的口腔卫生习惯和依从性等。此外,此类病例临床效果还需要更多类似病例、更长期的观察及进一步的临床研究支持和验证。

综上所述,对于上颌后牙区RBH严重不足,而上颌窦前外侧壁有血管通过且上颌窦底有骨分隔的病例,通过柔性两阶段TSFE可以获得理想的骨

增量效果, 且损伤较小, 降低了上颌窦感染及施耐德膜破裂等风险。此类病例可以尝试柔性两阶段TSFE作为改善上颌后牙区RBH严重不足的方案。

利益冲突声明:

所有作者声明不存在利益冲突。

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刘洋参与文献检索和论文撰写, 翟少博和杨征参与病例资料收集, 吴毓川和石晓璐参与研究结果分析及讨论, 储顺礼参与论文指导、审阅和修改。

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