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下颌骨缺损重建的研究进展

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摘　要

下颌骨节段性缺损的原因有很多，其中主要分为肿瘤、创伤及颌骨的炎症三个方面。下颌骨缺损后，对于患者面貌、言语、咀嚼、心理有重要的影响，因此恢复下颌骨的连续性，是重中之重。目前关于下颌骨缺损常用的分类方法有许多，临床医师需要根据缺损类型及重建方法来选择合适的分类方法。目前关于下颌骨缺损最常用的是带血管化的自体骨移植，主要有髂骨游离皮瓣、肩胛骨游离皮瓣、腓骨肌皮瓣等方法，而组织工程技术也是最近几年用于下颌骨缺损修复重建的新兴技术。本文将对下颌骨缺损重建的研究进行综述。

关键词

下颌骨缺损，血管化游离皮瓣，组织工程技术

Research Progress of Mandibular Defect Reconstruction

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Abstract

There are many causes of segmental mandibular defects, which are mainly divided into three aspects: tumor, trauma and inflammation of the jaw. After mandibular defect, it has an important impact on the patient's face, speech, chewing, and psychology. Therefore, restoring the continuity

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of the mandible is the most important. At present, there are many classification methods commonly used for mandibular defects. Clinicians need to choose the appropriate classification method according to the type of defect and the reconstruction method. Vascularized autogenous bone grafting is the most commonly used method for mandibular defect, including iliac free flap, scapula free flap, and fibular flap. Tissue engineering technology is also an emerging technology for mandibular defect reconstruction in recent years. This article will review the researches on mandibular defect reconstruction.

Keywords

Mandibular Defect, Vascularized Free Flap, Tissue Engineering Technology

1. 引言

下颌骨是支撑面部结构并实现咀嚼和说话的功能性骨骼。肿瘤、骨髓炎、外伤、放射治疗、先天性疾病和药物相关的骨坏死都可能导致下颌骨的破坏。下颌骨的严重缺陷可能会导致患者功能和美观的丧失，这对其生活质量具有重大影响[1] [2]。临床实践中已使用多种移植材料，例如异种移植物、同种异体移植物和自体骨。自体骨移植是从患者身体其他部位采集骨组织来填充骨缺损，修复效果最佳，与其他骨移植材料相比其优越性为：① 没有抗原性；② 新鲜自体骨移植后，受体周围血管可迅速长入，部分骨细胞可存活；③ 具备良好的成骨诱导能力和成骨能力。因此自体骨移植具有较好的细胞活力和生物相容性[3]。大的节段性缺损创面常伴有邻近皮肤、口腔粘膜、肌肉等软组织的丧失，多数情况下需要复合组织重建。迄今为止，血管游离皮瓣已成为下颌骨复合组织重建的金标准治疗选择[4]。本文将对下颌骨缺损的研究进展进行综述。

2. 下颌骨缺损的原因

下颌骨节段性缺损的原因有很多，其中主要分为肿瘤、创伤及颌骨的炎症三个方面[5]-[10]，其中，最常见的是因肿瘤切除部分下颌骨，其次是面部的创伤，更罕见的是炎症或感染性疾病。

肿瘤切除手术的特殊性在于它涉及到多种组织(骨、粘膜和肌肉)，修复重建时必须做好多重修复的准备。下颌骨的重建方案是根据手术的方式以寻求最优解的程序。此外，修复后骨的成功愈合是至关重要的，且放疗必须在手术后的 6 周内进行，以提高患者的生存率[11] [12]。因此，血管化组织移植是应用最广泛的一期节段骨重建技术。

由于损伤(例如，交通事故，枪击)导致的组织损失可导致撕裂伤和软硬组织的不受控制的损失。经常需要数个手术才能完成修复重建，然而功能和美学的结果往往不尽人意。目前常用的技术包括血管化组织游离移植、骨移植、骨牵引等[10] [13]。

头颈部癌患者围手术期放疗是常见的治疗方法。放射性骨坏死(ORN)是头颈部肿瘤放射治疗(RT)的一种严重晚期并发症，表现为放射治疗后至少 3 个月内创面不能自行愈合或经保守治疗不能愈合，且与肿瘤复发无关[14]。下颌骨是 ORN 的好发部位，对面部美学和口颌系统功能起着重要作用。据报告，5 年时 ORN 的发生率范围为 2%~40% [15] [16]。尽管采用了先进的预防方法，放射治疗后下颌骨放射性骨

坏死的发生率仍高达 5% [17]。其主要原因为放射对所有组织的微血管系统的严重损害导致了重建的失败率和并发症发生率大大提高。2009 年，Alam [18]等人及 2010 年 Suh [19]等人的研究结果报道了放疗后发生了较高的颌骨骨髓炎的发病率。下颌骨放射性骨坏死在临床上表现为疼痛和裸露的骨，伴或不伴脓性引流和/或可能的瘘管形成[20] [21]，下颌骨放射性骨坏死患者可能会出现疼痛、口干、吞咽困难、张口困难、溃疡和面部瘘管[22] [23]。最佳选择可能包括止痛药、抗生素、隔离物移除、高压氧治疗、节段性切除和游离皮瓣重建[24]。放射性骨坏死后重建下颌骨，因为放射性损伤导致愈合过程存在问题[9] [25] [26] [27]。因此，全面掌握下颌骨重建的新方法，处理好各种并发症是当务之急。

3. 下颌骨缺损的分类

由于下颌骨在头面部的形态类似“马蹄形”，同时双侧联动的关节使下颌骨功能变得复杂，由于各种原因造成的下颌骨缺损的解剖结构不同，导致修复重建下颌骨的要求也不同。因此如何选择合适的下颌骨缺损分类的方法，对重建后下颌骨功能行使及外形的恢复至关重要。分类的主要用途是评估缺损的特征，以定义重建的治疗算法。目前，关于下颌骨缺损的分类方法有很多。本文将现临床上用的较多的分类方法进行阐述。

David [28]等于 1988 年提出的下颌骨缺损分类总共分为 6 类，其中 A 型为仅存在下颌骨体部的缺损；B 型为单侧下颌角到颏部缺损；C 型为一侧下颌角区域到对侧下颌骨体部的缺损；D 型为双侧下颌角之间的骨缺损；E 型为单纯的颏部缺损；F 型为从中线到单侧髁状突的骨缺损。

Urken [29]等于 1991 年提出一种用字母表示下颌骨缺损的方式。字母 C 代表下颌骨髁突，字母 R 代表下颌骨升支，字母 B 代表下颌骨体部，字母 S 代表下颌骨正在联合，不同字母之间的组合也可以表达不同的下颌骨缺损情况。

Akiko Sakakibara [30]等于 2014 年提出分别以字母 C、A、T 表示下颌骨髁突缺损、下颌骨下颌角缺损、下颌骨颏结节缺损，不同字母之间的组合也可以表达不同的下颌骨缺损情况。

James S Brown [31]等于 2016 年提出一种下颌骨缺损分类方式：I 类：侧方缺损，不包括同侧尖牙及髁突；Ic 类：包括髁突在内的外侧方缺损；II 类：半下颌骨切除术，包括同侧尖牙，但不含对侧尖牙和双侧髁突；IIc 类：包括同侧髁突在内的缺损；III 类：前颌骨切除术，包括双侧尖牙，但不含下颌角；IV 类：广泛的前下颌骨切除术，包括双侧尖牙和一个或两个下颌角；IVc 类：包括一个或两 个髁突缺损。因为此方法兼顾了解剖及功能双重的标准，因此是现在学者广为使用的一种下颌骨缺损分类方式。

然而，目前关于下颌骨缺损没有一套理想的完整系统，特别是需要考虑到这些分类有时很复杂，且很难在日常实践中应用。实际上，关于下颌骨缺损的分类并不存在共识，下颌骨缺损重建的选择主要取决于手术团队的经验和习惯以及相关的软组织重建。

4. 下颌骨缺损后重建方式

既往研究中已经阐述了许多用于获取血管化游离皮瓣进行重建的部位;这些供体部位包括腓骨、肩胛骨、跖骨、前臂桡侧、股骨、髂骨和肋骨[32] [33]。最常见的供体部位是腓骨、肩胛骨和髂骨。这些供区根据软组织和骨的位置、体积和长度、缺损的类型和范围以及是否进行上颌骨或下颌骨重建而具有优点和缺点。根据血管蒂的长度、质量和数量、骨的可用性和长度供体部位皮瓣具有不同的特征。游离骨皮瓣是最经济、有效和可靠的下颌骨重建方法[34]。

4.1. 髂骨游离皮瓣

Taylor 等人[35]在 1979 年描述了髂骨血管游离皮瓣用于下颌骨的重建。髂骨游离皮瓣较为可靠，可

切取的骨量在大小和形状上接近下颌骨。与腓骨瓣相比，髂嵴瓣提供的骨组织宽度较小，但长度足够(可达 15 cm)用于下颌骨重建，并且可以获得更高的骨高度，以允许使用更长的种植体用于后续种植修复。带血管蒂髂骨皮瓣也具有丰富的软组织体积用于口内软组织重建，并且软组织的质地优于其他类型的皮瓣[36] [37]。然而，游离髂骨皮瓣不太适用于复合重建，因为其主要动脉为旋髂深动脉，活动性小，蒂短，导致柔韧性有限[38]。髂骨游离皮瓣由于其自身及周围组织的解剖复杂，并发症仍时有发生，如髂骨取骨术后疼痛、伤口感染、血肿，疤痕形成、 假性动脉瘤、肌疝、动静脉瘘、髂前上棘骨折等等。有的并发症可能会逐渐减轻或消除，但有些并发症却有可能长期存在，令患者不胜痛苦，其中最为常见的并发症是术后髂骨供区的慢性疼痛[39]。因此髂骨游离皮瓣供体部位的发病率也较其他皮瓣高。

4.2. 桡骨前臂皮瓣

1983 年 Soutar DS 等人引入了桡骨前臂皮瓣[40]，桡骨前臂皮瓣包含了部分桡骨，而桡骨前臂皮瓣有许多缺点，其一便是可用的桡骨数量与下颌骨缺损的部位匹配度都很差，其二没有足够的骨量来接受后期的种植修复，其三供体发病率较其他皮瓣很高。

4.3. 肩胛骨游离皮瓣

1986 年 Swartz WM 等人引入了肩胛骨皮瓣[41]，该皮瓣包含了部分肩胛骨的边缘骨。提供了约 11~14 厘米的骨量和两个大而薄且易于操作的皮岛。且肩胛骨皮瓣的骨量较为充足，易于后续种植修复的开展。但是肩胛骨皮瓣在定位供体方面来说较为复杂，往往须术前结合数字化技术对供体进行定位。肩胛骨皮瓣的供体发病率大大低于髂骨或桡骨的发病率。

4.4. 腓骨游离肌皮瓣

1975 年 Taylor [42]等人引入腓骨瓣用于长骨的重建。在口腔领域，Hidalgo [43]等人在 1989 年首次提出腓骨肌皮瓣用于下颌骨缺损的重建。腓骨肌皮瓣若采用双重折叠修复[44] [45]下颌骨缺损，可提供足够的下颌骨高度，用于后期种植体的修复。1995 年有学者[46]首次在手术中提供了种植体修复的方案。数十年来，腓骨肌皮瓣一直是下颌骨缺损的主要皮瓣选择[47]。游离腓骨肌皮瓣有较长的蒂、皮岛易于制取、皮质骨长度足够、骨形状一致、供体部位发病率最低、愈合率高和抗感染性强、穿支血管提供良好的血供、皮瓣存活率高达 95%，可以提供较大的骨量，约达 25 厘米，同时可提供较大的皮岛用于软组织缺损的重建[48] [49] [50] [51]，这些优点使得腓骨肌皮瓣因此被认为是下颌骨重建的金标准[51] [52] [53]。

4.5. 组织工程技术

根据定义，组织工程被定义为一个跨学科领域，它将工程和生命科学的原理应用于生物替代品的开发从而恢复、维持或改善组织功能[54]。骨组织工程是一种相对较新的方法，使用支架、生物活性物质和/或具有成骨潜力的细胞/组织，理想情况下，支架应为三维且高度多孔，具有互连的孔隙网络，用于细胞生长以及营养物质和代谢废物的流动运输，以及生物相容性和生物可吸收性，具有可控的降解和再吸收率，以匹配细胞或组织的生长。此外，这些支架应具有适合细胞附着、增殖和分化的表面化学性质，以及与植入部位组织相匹配的机械性能。目前，多种支架由各种材料[55]-[63]制成生物活性物质或成骨骨髓基质细胞(BMSC) [64] [65]相结合以启动或增强骨形成。BMSC 能够自我更新并分化为各种成骨谱系细胞[66]。此外，它们的成骨潜力已在体外和体内得到证实。因此，BMSCs 成为骨组织工程的主要种子细胞来源。许多先前的研究已经成功地在动物模型和人类中使用 BMSC 修复骨缺损[67] [68] [69]。目前，骨组织工程可以被认为是一种非常有前途的方法，并且可以作为替代骨源。良好的体外和体内实验对于确定所选概念的适用性以及在进入临床试验之前了解风险至关重要[70] [71]。

5. 总结

颌面部创伤、骨髓炎、骨坏死、良恶性肿瘤切除等多种原因导致下颌骨的连续性被破坏[72] [73]。下颌骨的缺损导致患者咀嚼能力降低、言语丧失，严重影响患者的生活质量。理想情况下，下颌骨缺损重建不仅要恢复缺失部分的解剖高度和轮廓，而且还应能重建口腔功能。到目前为止，自体骨移植——尤其是游离血管组织移植——是接受下颌骨大范围切除手术患者的首选。下颌骨缺损除了骨组织的缺损，往往伴有大面积的软组织的缺损，这就为下颌骨修复重建带来巨大的挑战。下颌骨缺损的重建需要恢复受影响的骨完整性。下颌骨重建适用于不同类型的颌面部缺陷，如创伤性缺损，肿瘤切除，先天性异常，骨放射性坏死等疾病造成的下颌骨阶段性缺损。目前，游离腓骨肌瓣是最常用的皮瓣选择，被认为是下颌骨重建的金标准，具有良好的成功率。目前，复杂的下颌骨重建可采用术前虚拟手术计划，在未来，数字化技术在口腔医学的应用会得到巨大的提升。

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