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·临床研究·

改良U形前臂皮瓣修复口腔颌面部中小型软组织缺损的应用

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【摘要】 目的 探讨改良U形前臂皮瓣在口腔颌面部中小型软组织缺损修复中的应用效果，为临床工作提供参考。**方法** 本研究已通过单位伦理委员会审查批准，并获得患者知情同意。采用改良U形前臂皮瓣修复口腔颌面部中小型软组织缺损病例10例，其中男8例，女2例，年龄43～72岁，切取皮瓣后，前臂供区创面均可直接拉拢缝合，切取皮瓣面积最大8 cm×5 cm，最小6 cm×4 cm。术后随访6个月，观察手部运动（伸指、握拳、向上旋腕及向下旋腕）是否受限，前臂供区及手部是否存在感觉异常，以及前臂供区美观度（采用自主调查问卷，结果为0～10分，0代表非常不美观，10代表非常满意）。**结果** 10例患者接受改良U形前臂皮瓣的修复方式，所有病例皮瓣均存活，1例患者术后24 h发生静脉危象，经手术探查后皮瓣完全存活。1例患者前臂供区出现延期愈合，其余患者前臂供区创口均1期愈合。术后2周1例患者存在手部感觉异常，在术后3个月恢复。术后6个月时，所有患者手部无运动受限，前臂供区及手部无感觉异常，患者对供区修复美观度基本满意，自主调查问卷结果平均值8.4分。**结论** 改良U形前臂皮瓣可以直接闭合前臂供区的伤口，避免前臂供区植皮手术，减少了手术创伤，并明显减少了前臂供区的并发症。对于口腔颌面部中小型软组织缺损的修复，改良U形前臂皮瓣可以作为传统前臂皮瓣的替代，是一种比较可靠的修复方式。

【关键词】 前臂皮瓣；并发症；缺损；修复；重建；美观；手术方式；供区
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Application of a modified U-shaped forearm flap for the repair of small and medium-sized defects in the oral and maxillary areas

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【Abstract】 Objective To evaluate the applicability of a modified U-shaped forearm flap for the repair of small- and medium-sized defects in the oral and maxillary areas to provide a reference for clinicians. **Methods** This study was reviewed and approved by the Ethics Committee, and informed consent was obtained from the patients. Ten patients with small- and medium-sized defects in the oral and maxillary areas underwent surgical repair using modified U-shaped forearm flaps. There were 8 males and 2 females aged 43-72 years. The donor site was apposed primarily after harvesting the modified U-shaped forearm skin flap. The flaps ranged from 6 cm×4 cm to 8 cm×5 cm in size. Six months after

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the operation, hand movements (finger extension, fist clenching, wrist rotation upward and wrist rotation downward), the forearm donor site, hand sensations and the satisfaction score for the postoperative quality of the scar at the donor site were evaluated (0 to 10; 0: very unattractive, 10: very satisfactory). **Results** A total of 10 patients with modified U-shaped forearm flaps survived. One patient developed venous crisis 24 hours after surgery and survived after surgical exploration. Delayed healing occurred at the donor site of the forearm in 1 patient, and the wounds at the donor site of the forearm in the other patients all healed in the first stage. One patient presented with dysesthesia in the hand 2 weeks after surgery and recovered within 3 months. Six months after surgery, all patients had no limited hand movement and no paresthesia at the forearm donor site or hand. The patients were basically satisfied with the appearance of the donor site, and the average satisfaction score of the subjective questionnaire was 8.4 points. **Conclusion** Modified U-shaped forearm flaps can directly close forearm donor site wounds, which avoids surgical trauma to the secondary donor site and significantly reduces related complications. Modified U-shaped forearm flaps provide an alternative to conventional forearm flaps for the repair of small- and medium-sized defects in the oral and maxillary areas.

【Key words】 forearm flap; complication; defect; repair; reconstruct; aesthetics; surgical technique; donor site

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口腔颌面部软组织缺损会严重影响患者的美观和功能，重建缺损对患者至关重要[1-2]。1981年，中国学者杨果凡等[3]首次采用前臂皮瓣修复软组织缺损。与其他皮瓣相比，前臂皮瓣具备许多优势，已成为口腔颌面部软组织缺损修复的主力皮瓣[4-7]。然而前臂供区的关闭往往存在诸多问题。目前，临床中已经提出了几种方法来闭合前臂供区缺损，包括生物膜修复、带血管蒂皮瓣修复、全厚或中厚皮片修复、局部组织瓣修复等[8]，以上方法均存在不足。笔者采用改良U形前臂皮瓣对口腔颌面部中小型软组织缺损病例进行重建，同时对前臂供区创面进行直接关闭，取得了较好的临床效果，现报道如下。

1　资料和方法

本研究已通过四川省泸州市人民医院伦理委员会审批（批号：20200115），并获得患者知情同意。

1.1　临床资料

收集2020年7月至2023年5月于泸州市人民医院口腔科及耳鼻咽喉头颈外科住院治疗的患者，共计10例，其中男8例，女2例，年龄（63.5 ± 14）岁；病理类型，5例为高分化鳞状细胞癌，3例为基底细胞癌，2例为感染导致的颌面部软组织缺损。术前对双侧前臂行超声多普勒血流测量仪测定，确定前臂供区桡动静脉、尺动静脉及头静脉血管状态良好，同时进行Allen实验，再次确认尺动脉单独对手部供血的可靠，术前保护供区前臂[9]。

纳入标准：①术前患者诊断明确；②无重大系统性疾病；③口腔颌面部软组织缺损宽度不超过5 cm。排除标准：①前臂供区有明确血管、神经或骨科病变史；②前臂供区有手术和创伤史。

1.2　原发病变处理及受区血管预备

手术分两组同时进行，一组行原发灶切除及受区血管的制备，一组行改良U形前臂皮瓣制备。术中严格遵循恶性肿瘤切除原则，沿肿瘤边缘1.0 ~ 1.5 cm正常组织内切除病变组织，术中切缘行快速冷冻切片检查，确保原发灶切除干净彻底。行颈淋巴清扫术，视术中情况保留颌外动脉、面总静脉及颈外静脉或甲状腺上动、静脉，作为受区的吻合血管。对于因感染导致颌面部软组织缺损的患者，清创坏死组织后，采用下颌骨下缘切口，解剖颌外动脉、面前静脉及颈外静脉作为受区血管。

1.3　改良U形前臂皮瓣制备要点

皮瓣制备前，使用标准充气止血带，设定时间，根据软组织缺损的范围及形状设计改良U形前臂皮瓣，设计皮瓣略大于受区缺损面积[10]，皮瓣外形设计为U形，U形瓣的宽度相当于口腔颌面部软组织缺损宽度的一半，U形瓣的宽度不超过2.5 cm，长度根据受区缺损的大小进行调整，与传

统前臂皮瓣相同，改良U形前臂皮瓣包含桡动静脉及头静脉，U形瓣的顶端覆盖头静脉，U形瓣的底部覆盖桡动静脉，U形瓣之间有一定的夹角，避免供区拉拢缝合后，因张力问题导致皮缘坏死，影响愈合。由于手腕部的皮肤张力通常大于肘部的皮肤张力，术中切取时，可以适当加大靠近肘部的U形的长度及宽度。U形瓣之间的区域，术中切开皮肤，沿皮下组织锐性分离，皮瓣内应包含头静脉及其周围皮下组织，头静脉及桡动静脉的解剖分离应尽量靠近肘弯处，避免出现皮瓣靠拢缝合后，血管蒂长度不足的情况。皮瓣靠拢后如出现明显的皮肤褶皱，可去除突起的皮肤，不可过深，避免损伤皮瓣内的桡动静脉。皮瓣切取后，潜行分离供区上下的皮肤，拉拢缝合关闭供区创面，安置负压引流管。

1.4　血管吻合及缺损修复

将改良U形前臂皮瓣血管蒂经皮下隧道摆放至口腔颌面部软组织缺损区域，手术显微镜下使用8-0无损伤缝合线采用二点缝合法，将改良U形前臂皮瓣的桡动脉及头静脉与受区血管进行端端吻合，先吻合动脉，再吻合静脉。去掉血管夹后检查吻合口有无漏血，确认无漏血后，通过勒血实验确定吻合后血管是否通畅。本组患者术中受区选用与供区血管管径相近、匹配性好的血管。全部采用端端吻合，以保持血液的最大流速和流量，以保证血管吻合成功。

1.5　术后处理

术后应用抗血栓药物（右旋糖酐40葡萄糖注射液，500 mL/次，500 mL/d，静脉滴注，四川科伦药业股份有限公司），抗血管痉挛药物（罂粟碱，30 mg/次，90 mg/d，肌肉注射，东北制药集团沈阳第一制药公司），常规应用抗生素预防术区感染，并密切观察皮瓣的颜色、质地、皮温及肿胀程度等。术后一旦出现血管危象，及时进行手术探查。术区行持续负压引流，患者头颈部体位制动5～7 d。

1.6　术后功能评价指标

术后评估患者供区愈合情况，随访6个月，观察并评估患者手部运动是否受限、前臂供区及手部是否存在感觉异常以及供区美观度。通过伸指、握拳、向上旋腕及向下旋腕运动方式评估手部运动，通过患者的主诉评估前臂供区及手部的感觉，采用自主调查问卷评估供区美观度（0～10分，0代表非常不美观，10代表非常满意）。

2　结　果

2.1　术后功能评价

10例患者接受了改良U形前臂皮瓣修复，手术均取得成功，术后无明显并发症出现，所有皮瓣均从左前臂非优势侧制备，供区缺损均直接闭合，没有进行皮片移植。其中1例患者术后24 h出现静脉危象，术后探查后皮瓣存活。

术后10 d拆除前臂供区缝线，1例患者由于局部创缘减张不足而伤口张力过大，拆线后出现创口裂开，边缘部分皮肤坏死，经过换药后，供区创口闭合，但术后有明显的疤痕及皮肤紧张，其余患者前臂供区创口均1期愈合。

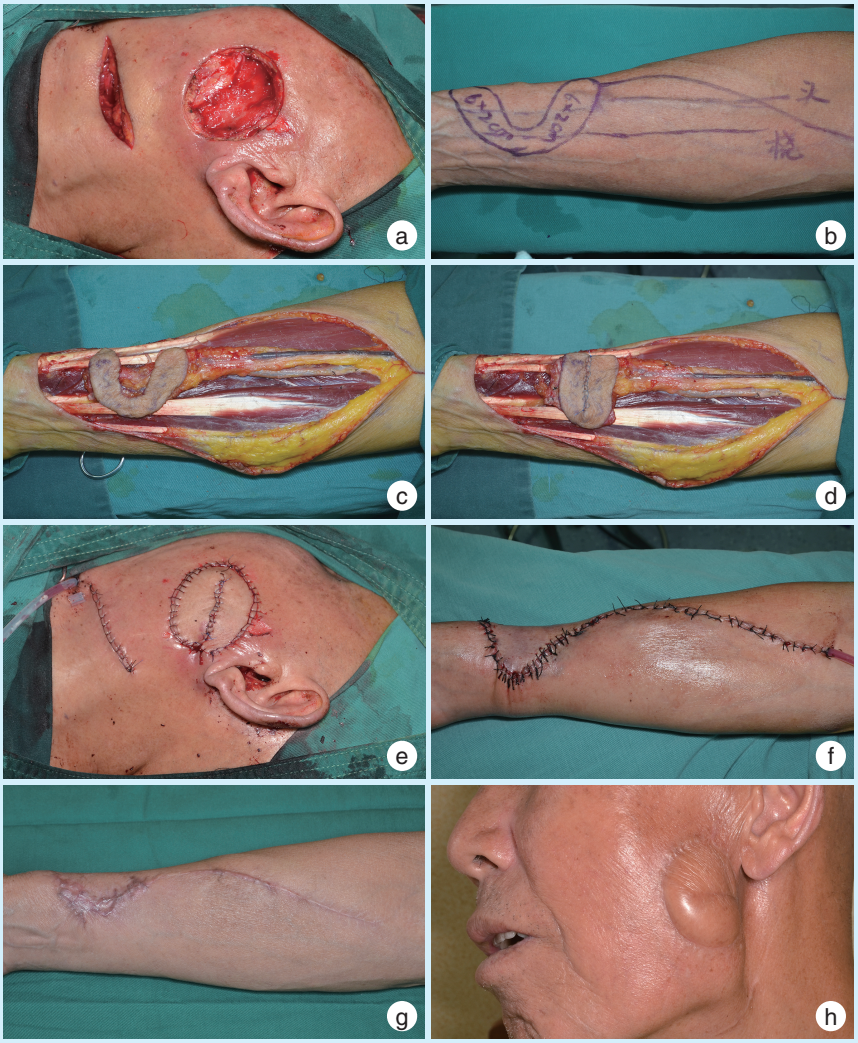
术后2周1例患者主诉前臂供区及手部麻木，给予患者营养神经药物（甲钴胺，0.5 mg/次，1.5 mg/日，口服，南京海鲸药业股份有限公司），术后3个月恢复。术后6个月，所有患者手部运动（伸指、握拳、向上旋腕及向下旋腕）无受限，自述前臂供区及手部无感觉异常，患者对供区修复美观度基本满意，自主调查问卷结果平均值8.4分。

2.2　典型病例

患者，男性，67岁，因“感染致左颊部及腮腺软组织缺损1月”入院，入院诊断：左颊部及腮腺感染伴软组织缺损。完善术前相关检查，排除手术禁忌证，行左颊部及腮腺坏死组织清创术、左侧改良U形前臂皮瓣修复术、动静脉吻合术。术中根据缺损范围设计切取改良U形前臂皮瓣，U形瓣的宽度为2 cm，长度为12 cm，U形设计的改良前臂皮瓣向中线靠拢缝合后，形成面积大小为6 cm × 4 cm的组织瓣，修复左颊部及腮腺软组织缺损，桡动脉、头静脉分别与颌外动脉及颈外静脉吻合，分离供区上下的皮肤，直接关闭前臂供区，术后皮瓣存活良好，供区、受区创面均愈合良好，供区无明显功能障碍，术后随访3个月，患者满意（图1）。

3　讨　论

前臂皮瓣已成为口腔颌面部软组织缺损修复最常用的游离皮瓣之一，该皮瓣具有血管解剖位置恒定、变异小、蒂长、管径大、皮瓣薄、存活率高及制备简单等优点，对于口腔颌面部软组织缺损特别适用。然而对于前臂供区的关闭存在诸多问题，术后供区可能会出现一定的并发症[11-12]。目前，中厚皮片或者全厚皮片修复前臂供区缺损是最常见的方法[13-19]，其优点是操作简单及能够关闭较大的缺损范围，但是皮片移植后供区容易形成



a: debridement of the cheek and parotid area; the size of the soft tissue defect was 5.5 cm×3.5 cm. b: preoperative design of the modified U-shaped forearm flap. c: the modified U-shaped forearm flap was harvested, and the size of the flap was 12 cm × 2 cm. d: sutured modified U-shaped forearm flap (6 cm × 4 cm); e: closure of the recipient site of the modified U-shaped forearm flap. f: closure of the donor site of the modified U-shaped forearm flap. g: the donor site of the modified U-shaped forearm flap recovered satisfactorily 3 months after surgery. h: the recipient site of the modified U-shaped forearm flap recovered well 3 months after surgery

Figure 1　A modified U-shaped forearm flap was used to repair soft tissue defects in the cheek and parotid areas

图1　改良U形前臂皮瓣修复颊部及腮腺区域软组织缺损

疤痕及取皮区出现并发症。此外，皮片移植失败后可能导致伤口延迟愈合及前臂肌腱暴露等。生物膜的使用可以避免取皮手术，能够关闭前臂供区较大范围的缺损[20-21]，但是由于成本高、感染率高及坏死率高，限制了其临床应用。带血管蒂皮瓣修复前臂供区创面，不可避免会增加第二个皮瓣的制备成本和血管危象的潜在风险，在前臂供区出现大面积坏死后，带血管蒂皮瓣的再次修复便凸显出明显的优势[22-23]。局部组织瓣修复和直接拉拢缝合是利用前臂皮瓣制备后周边存留的组织设计成不同形状的组织瓣，直接缝合供区创面[24-27]，然而切取皮瓣的大小受到前臂臂围和皮肤松弛程度的限制，只适用于制备小型的前臂皮瓣[28-29]。

本研究通过改良U形前臂皮瓣，对10例中小型口腔颌面部软组织缺损进行修复，所有患者的供区均无需进行全厚或半厚皮片移植，均实现了前臂供区的原位愈合，术后供区具有良好的功能和美学效果。同时避免了皮片移植后与前臂区皮肤颜色不匹配、疤痕挛缩、疼痛和感染风险等。此外，改良U形前臂皮瓣的制备与传统前臂皮瓣的制备相比，并没有增加手术操作难度。但是对于前臂供区的关闭而言，传统前臂皮瓣的程序更为复杂，其中包括开辟第三术区切取皮片、修薄、关闭以及压力敷料固定等。改良U形前臂皮瓣减少了手术时间，简化了外科手术操作，本研究中有1例患者术后供区出现明显的疤痕及皮肤紧张，考虑主要是因为供区创缘减张不足，导致局部伤口张力过大，边缘部分皮肤坏死。在随访期间，除术区瘢痕及对手部功能轻微影响外，没有出现前臂供区明显的并发症。

尽管改良U形前臂皮瓣修复口腔颌面部中小型软组织缺损有一定优点，但笔者也发现其临床应用中存一些问题，如U形瓣向中线靠拢缝合后，

需牺牲一部分血管蒂的长度，但是前臂皮瓣相对于其他组织瓣而言，桡动静脉及头静脉可以获得相当的长度[30]，术中做好受区血管的选择及术前设计，可以有效避免血管蒂长度不足。U形瓣向中线靠拢缝合后，因皮瓣下脂肪组织丰富，可以有效保护血管蒂，但是笔者在术中发现虽然血管蒂有皮下脂肪组织的保护，仍然可能出现尖锐角度的扭曲，术后出现动脉供血不足及静脉回流障碍，导致皮瓣坏死的风险，笔者的处理经验是使用5-0缝线，将血管周围的筋膜组织固定于周边的脂肪组织，缝合后，血管蒂表现为圆形和钝性扭曲，术后不会因血管蒂扭曲而出现血管危象。此外，改良U形前臂皮瓣切除组织量有限，主要适合口腔颌面部中小型软组织缺损的修复，尤其是对缺损区域的宽度有严格的要求，缺损区域的宽度要限定在5 cm以内[31]，对于前臂皮肤松弛的患者可放宽至6 cm以内，对过宽的缺损，建议选用传统前臂皮瓣修复或其他皮瓣修复。

改良U形前臂皮瓣供区创口闭合简单，手术时间短，皮瓣存活率高，患者满意度好（本研究中患者对前臂外观自主调查问卷结果平均值8.4分），术后手部功能影响小，并发症少，并且避免了供区缺损的植皮修复，因此对于口腔颌面部中小型软组织缺损，可以作为传统前臂皮瓣的替代方案，值得在临床工作中进一步推广应用。

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参考文献

[1] Bartella AK, Kamal M, Gerwing D, et al. Quality of life in patients with oral hard or soft tissue defects after reconstructive microsurgery[J]. Br J Oral Maxillofac Surg, 2021, 59(1): 70-75. doi: 10.1016/j.bjoms.2020.08.096.

[2] Matapathi N, Shenoy VK, Shenoy R, et al. Evaluation of the quality of life of patients with maxillofacial defects after prosthodontic rehabilitation: a cross-sectional study[J]. J Cancer Res Ther, 2022, 18(Suppl): S219-S225. doi: 10.4103/jcrt.JCRT_889_20.

[3] 杨果凡, 陈宝驹, 高玉智, 等. 前臂皮瓣游离移植术(附56例报告)[J]. 中华医学杂志, 1981, 61(3): 139-141.
Yang GF, Chen BJ, Gao YZ, et al. Free transplantation of forearm flap (report of 56 cases)[J]. Natl Med J China, 1981, 61(3): 139-141.

[4] Zhang CF, Liu XJ, Liu DW, et al. Comparison between radial forearm free flap and pectora is major myocutaneous flap for reconstruction in oral cavity cancer patients: assessment of the quality of life[J]. J Craniofac Surg, 2022, 33(3): 906-909. doi: 10.1097/SCS.0000000000008423.

[5] Wu TJ, Saggi S, Badran KW, et al. Radial forearm free flap reconstruction of glossectomy defects without tracheostomy[J]. Ann Otol Rhinol Laryngol, 2022, 131(6): 655-661. doi: 10.1177/00034894211038254.

[6] Lin NC, Lin SL, Tsai KY. Barrel-shaped design of the forearm free flap for lower lip reconstruction: a pilot case-control study[J]. BMC Surg, 2020, 20(1): 132. doi: 10.1186/s12893-020-00792-x.

[7] Ferrandis Perepérez E, Antón Almero M, Guillén Martínez A, et al. Versatility of the radial forearm free flap in head and neck reconstruction. A study of 58 cases[J]. Acta Otorrinolaringol Esp, 2020, 71(5): 275-280. doi: 10.1016/j.otorri.2019.10.001.

[8] 张秀杰, 任晓彦, 南欣荣. 游离前臂皮瓣术区闭合方法的研究进展[J]. 局解手术学杂志, 2022, 31(2): 177-181. doi: 10.11659/jjssx.09E021025.
Zhang XJ, Ren XY, Nan XR. Research progress in the closure method of radial forearm free skin flap surgical area[J]. J Reg Anat Oper Surg, 2022, 31(2): 177-181. doi: 10.11659/jjssx.09E021025.

[9] Breik O, Selbong U, Laugharne D, et al. Dealing with vascular anomalies during radial forearm free flap harvest: report of two cases and review of the literature[J]. Int J Oral Maxillofac Surg, 2019, 48(12): 1509-1515. doi: 10.1016/j.ijom.2019.06.003.

[10] Dennis SK, Masheeb Z, Abouyared M. Free flap volume changes: can we predict ideal flap size and future volume loss?[J]. Curr Opin Otolaryngol Head Neck Surg, 2022, 30(5): 375-379. doi: 10.1097/MOO.0000000000000832.

[11] Bruin LL, Hundepool CA, Duraku LS, et al. Higher incidences of neuropathic pain and altered sensation following radial forearm free flap: a systematic review[J]. J Plast Reconstr Aesthet Surg, 2022, 75(1): 1-9. doi: 10.1016/j.bjps.2021.09.028.

[12] Mashrah MA, Aldhohrah TA, Abdelrehem Moustafa A, et al. Are hand biomechanics affected following radial forearm flap harvest? A systematic review and meta-analysis[J]. Int J Oral Maxillofac Surg, 2021, 50(1): 21-31. doi: 10.1016/j.ijom.2020.06.016.[Link-Out]

[13] Mai L, Mashrah MA, Lin ZY, et al. Posterior tibial artery flap versus radial forearm flap in oral cavity reconstruction and donor site morbidity[J]. Int J Oral Maxillofac Surg, 2022, 51(11): 1401-1411. doi: 10.1016/j.ijom.2022.03.060.

[14] Cristofari S, Guenane Y, Atlan M, et al. Coverage of radial forearm flap donor site with full thickness skin graft and Matriderm®: an alternative reliable solution?[J]. Ann Chir Plast Esthet, 2020, 65(3): 213-218. doi: 10.1016/j.anplas.2019.06.009.

[15] Miller TJ, Lavin CV, Momeni A, et al. Prevention and management of complications of tissue flaps[J]. Surg Clin North Am, 2021, 101(5): 813-829. doi: 10.1016/j.suc.2021.06.009.

[16] Liu J, Liu F, Fang Q, et al. Long-term donor site morbidity after radial forearm flap elevation for tongue reconstruction: prospective observational study[J]. Head Neck, 2021, 43(2): 467-472. doi: 10.1002/hed.26506.

[17] Peters F, Smit N, Möhlhenrich SC, et al. Objective and subjective comparisons of split thickness skin graft and full thickness skin graft for radial forearm flap donor sites using a new measuring method[J]. J Craniofac Surg, 2021, 32(6): e594-e598. doi: 10.1097/SCS.0000000000007820.

[18] Krane NA, Mowery A, Azzi J, et al. Reconstructing forearm free flap donor sites using full-thickness skin grafts harvested from the ipsilateral arm[J]. Otolaryngol Head Neck Surg, 2020, 162(3): 277-282. doi: 10.1177/0194599819901124.

[19] Liu Z, Zhu C, Rui T, et al. Novel design for local full-thickness skin graft: optimizing donor sites of radial forearm free flap[J]. J Cosmet Dermatol, 2022, 21(10): 4595-4604. doi: 10.1111/jocd.14823.

[20] Hunger S, Krennmair S, Stehrer R, et al. Closure of the radial forearm free flap donor site with split-thickness skin graft or amniotic membrane: a prospective randomized clinical study[J]. J Craniomaxillofac Surg, 2021, 49(5): 403-414. doi: 10.1016/j.jcms.2021.02.015.

[21] Abbate V, Iaconetta G, Sani L, et al. The use of dermal substitutes for donor site closure after radial forearm free flap harvesting[J]. J Craniofac Surg, 2021, 32(2): e205-e208. doi: 10.1097/SCS.0000000000006808.

[22] Chaware SM, Dhopte AA. The superficial inferior epigastric artery based abdominal flap for reconstruction of extensive defects of the hand and forearm: a modified design with primary closure of the donor site[J]. Ann Plast Surg, 2021, 86(2): 162-170. doi: 10.1097/SAP.0000000000002669.

[23] Xu H, Guo L, Wang X, et al. An updated surgical approach of using flap and cutaneous nerve in the lateral arm to reconstruct complex injuries of the forearm and hand: a case series study[J]. Ann Plast Surg, 2023, 91(4): 468-472. doi: 10.1097/SAP.0000000000003649.

[24] Cai T, Chen S, Li Q, et al. The Tai Chi flap: a novel design for the radial forearm flap[J]. Ann Plast Surg, 2022, 89(1): 59-62. doi: 10.1097/SAP.0000000000003149.

[25] Yao L, Deng Z, Guo M, et al. Repair of donor site defects after forearm free flap harvest with dual triangular flaps and *in situ* small full-thickness skin flaps[J]. J Craniofac Surg, 2021, 32(5): 1853-1855. doi: 10.1097/SCS.0000000000007265.

[26] Gessert TG, Pflum ZE, Thompson JD, et al. The radial forearm snake flap: an underutilized technique for fasciocutaneous and osteocutaneous forearm flaps with primary closure[J]. Head Neck, 2022, 44(5): 1106-1113. doi: 10.1002/hed.27004.

[27] Potet P, De Bonnecaze G, Chabrillac E, et al. Closure of radial forearm free flap donor site: a comparative study between keystone flap and skin graft[J]. Head Neck, 2020, 42(2): 217-223. doi: 10.1002/hed.25977.

[28] 陈传俊, 王祎, 王来平, 等. 前臂Kiss皮瓣设计及其应用价值探讨[J]. 中国口腔颌面外科杂志, 2019, 17(4): 349-351. doi: 10.19438/j.cjoms.2019.04.014.
Chen CJ, Wang Y, Wang LP, et al. Kiss flap design of radial forearm flap for primary closure of donor-site without skin-grafting[J]. China J Oral Maxillofac Surg, 2019, 17(4): 349-351. doi: 10.19438/j.cjoms.2019.04.014.

[29] 韩生伟, 李浩, 刘锐, 等. 应用新型“V”形前臂皮瓣修复颊癌术后软组织缺损[J]. 中华显微外科杂志, 2021, 44(3): 279-282. doi: 10.3760/cma.j.cn441206-20200324-00167.
Han SW, Li H, Liu R, et al. Application of a new V-shaped forearm flap in reconstruction of buccal cancer[J]. Chin J Microsurg, 2021, 44(3): 279-282. doi: 10.3760/cma.j.cn441206-20200324-00167.

[30] Alasmari WA. The morphometric anatomy and clinical importance of the radial artery[J]. Folia Morphol, 2021, 80(4): 839-844. doi: 10.5603/FM.a2020.0139.

[31] Mashrah MA, Yan L, Handley TP, et al. Novel technique for the direct closure of the radial forearm flap donor site defect with a local bilobed flap[J]. Head Neck, 2019, 41(9): 3282-3289. doi: 10.1002/hed.25839.

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