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(收稿日期: 2022-05-15 本文编辑: 朱嘉)

· 经验交流 ·

掌指关节处带指动脉神经的 V-Y 成形皮瓣修复中远节指腹缺损

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【摘要】 目的: 探讨一种中、远节指腹软组织缺损创面覆盖、外形重建及感觉、血管修复的手术方法。方法: 自 2016 年 1 月至 2020 年 1 月, 用掌指关节处带指动脉、神经的 V-Y 成形皮瓣修复治疗 14 例拇指远节、2-4 指中、远节指腹软组织缺损患者。其中男 9 例, 女 5 例; 年龄 22~69 岁; 病程 0.5~2 d。指腹缺损面积约 (2.0~2.5) cm×(1.5~2.0) cm。术中自掌指关节以近至缺损处游离皮瓣, 掌指关节处切口设计成“V”形, 双侧血管、神经游离至指总动脉、指总神经分叉处。屈曲掌指、近指、远指关节, 远节指腹缺损皮瓣远端塑形后缝合覆盖, 中节指腹缺损皮瓣前移后吻合指动脉、指神经。术后 3 周患指功能锻炼。观察术后患者手指活动度、指腹感觉、外形等指标。依据中华医学会手外科学会上肢部分功能评定试用标准评定手术效果。结果: 14 例皮瓣全部成活, 10 例远节指腹缺损者术后指腹即恢复感觉, 4 例中节指腹缺损者术后 2~3 个月感觉逐步恢复。13 例患者获得随访, 时间 6~20 个月。指腹两点分辨觉 4~6 mm, 感觉功能评分达 S3 级以上, 指腹形状逼真, 皮色、皮温正常, 耐磨性、耐寒性好, 指关节功能基本正常。依据中华医学会手外科学会上肢部分功能评定试用标准评定手术效果, 功能总评分优 13 例, 良 1 例。结论: 掌指关节处带指动脉、神经的 V-Y 成形皮瓣修复中节或远节指腹缺损, 术式简单, 风险低, 可延长指动脉皮瓣修复范围, 恢复指腹外形、血供和感觉, 患者满意度高。

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【关键词】 软组织缺损； 指尖损伤； V-Y 皮瓣； 重建技术

中图分类号:R628

DOI:10.12200/j.issn.1003-0034.2023.06.012

开放科学(资源服务)标识码(OSID):



A V-Y shaped flap with digital artery nerve at metacarpophalangeal joint was used to repair the defect of middle and distal phalanx

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ABSTRACT **Objective** To explore a surgical method for the reconstruction of volar soft tissue defect and sensory and vascular repair in middle and far phalangeal digits. **Methods** From January 2016 to January 2020, a total of 14 patients, 9 males and 5 females, ages ranging from 22 to 69 years old, and with volar soft tissue defects in the middle and distal digits 2 to 4, underwent surgical reconstruction using the V-Y shaped flap with digital artery and nerve at the metacarpophalangeal joint. The defect area was (2.0~2.5) cm×(1.5~2.0) cm. The procedure involved the harvest of a V-Y shaped flap with the digital artery and nerve from the metacarpophalangeal joint. Flap design, dissection of blood vessels and nerves, and anastomosis with the digital artery and nerve were performed according to a standardized protocol. Functional exercise of affected finger was initiated 3 weeks postoperatively. Subsequent assessments were conducted to evaluate finger pulp sensation, shape and other relevant parameters. According to the upper extremity functional evaluation standard set up by Hand Surgery Branch of Chinese Medical Association, the surgical outcomes were evaluated. **Results** All 14 cases demonstrated successful tissue transplantation, with immediate recovery of sensation observed in 10 cases with distal finger pulp defects. Four patients with middle phalangeal defects experienced gradual sensory recovery within 2 to 3 months postoperatively. Thirteen patients were followed up for a mean duration of (8.8 ± 4.49) months, during which satisfactory outcomes were observed. The average two-point resolution of the finger pulp was 4~6mm, and sensory function evaluation yielded a score of S3 or above. Patients exhibited realistic finger shape, normal skin color and temperature, good wear resistance, and cold resistance. Furthermore, finger joint function was essentially normal. **Conclusion** The V-Y shaped flap with digital artery and nerve at the metacarpophalangeal joint offers a suitable solution for repairing the defect of the middle or distal phalangeal finger. This technique is characterized by its simplicity, low risk, and favorable outcomes, including restored finger shape, blood supply and sensation. Moreover, high patient satisfaction was achieved.

KEYWORDS Soft tissue defect; Fingertips injury; V-Y skin flap; Reconstructive technique

指腹修复除要求创面覆盖外,恢复手指长度、外形、感觉、耐寒性、耐磨性对手指功能尤为重要。“手的任何部位都是美容与功能的组织,爱护手的每一块组织,是手外科医生的神圣使命”^[1]。为探索能满足以上要求的修复中节或远节指腹缺损术式,自2016年1月至2020年1月,对收治的14例患者采用掌指关节处带指动脉、神经的V-Y成形皮瓣术修复,重建后的指腹部外形、感觉恢复较好,患者满意。现报道如下。

1 临床资料

选取2016年1月至2020年1月收治的中节或远节指腹部分缺损14例14指,其中男9例,女5例;年龄22~69岁。致伤原因:机器碾压伤4例,冲压伤8例,电锯伤2例。损伤部位:拇指2指,示指7指,中指3指,环指2指。损伤类型:远节(含拇指)指腹缺损10例,中节指腹缺损4例(其中3例合并远节血运障碍并指神经缺损)。缺损面积:(2.0~2.5) cm×(1.5~2.0) cm, (3.80±0.56) cm²。均合并肌腱、骨外露,所有患者在伤后2 h内就诊。受伤至手术时间0.5~2 d。

2 治疗方法

2.1 手术方法

臂丛神经阻滞麻醉,反复清创后患手外展位,碘伏浸泡创面10 min。甲床远端部分缺损者短缩指骨至甲缘以近1 mm,设计掌指关节处带指动脉、神经的V-Y皮瓣。将双侧指动脉指神经束包含在皮瓣中。在指末端平两侧甲缘纵行切开,在屈指肌腱腱鞘表面分离皮瓣,注意游离、保留近节指骨近、中部斜向背、远端的指动脉、静脉及指神经背侧分支。游离皮瓣至掌指关节时偏向指蹠掌侧,试行屈屈指间关节。如创面覆盖仍不完全,在掌指关节横纹以近设计尖端在近侧,开口约60°的“V”形切口,“V”形两臂与皮瓣双侧切口相续,注意避开指蹠。逐层切开并向近端延长,游离双侧指动脉及指神经束至指总动脉、指总神经分叉处。如远节指腹断面为斜形,把皮瓣斜形长头侧翻至短侧缝合;如断面为横行或弧形,皮瓣远端断面两边角向中间靠拢呈“V”字形边对边缝合,再造远节指腹凸出形态,并注意刀片修平过于突出的角质层。屈曲掌指、指间关节,4-0可吸收缝线将皮瓣远端缝合在甲床面下,包裹住指骨末端,皮瓣两

侧间断、疏松缝合。如修复中节指腹缺损并血管、神经缺损者,屈曲掌指关节、近指关节后前移皮瓣,如断面间仍然紧张,可切开分离远端断面两侧边。显微镜下吻合指动脉、指神经。掌指关节处“V”形切口缝合“Y”形。观察皮瓣远端及指背血运,如血运缓慢,疏松皮瓣拐角处缝线。切口两缘皮下注射罗哌卡因+得宝松混悬液镇痛。手术皮瓣设计原理示意图见图 1。

2.2 术后处理

术后 48 h 内抗生素预防感染,静脉应用甘露醇、地塞米松注射液减轻水肿,山莨菪碱针改善微循环,并镇痛治疗。如吻合指动脉、指神经者,普通肝素抗凝,罂粟碱注射液解痉及甲钴胺营养神经治疗。及时更换敷料,防止敷料渗血干结后卡压皮瓣。术后 3 周逐步进行患指主、被动屈、伸指功能锻炼。

2.3 观察项目与方法

观察手术修复后指腹的指关节活动范围、感觉、皮肤血液循环状态、外观、皮肤耐寒性、耐磨性以及恢复工作情况。

依据中华医学会手外科学会上肢部分功能评定试用标准^[2],从拇指对掌功能、手指活动度、感觉方面对手功能进行评价。拇指对掌功能:正常为 4 分,能对环指为 3 分,能对示中指为 2 分,不能对掌为 1 分。手指活动度:指屈伸好为 4 分、指屈伸活动为正常的 60%为 3 分,指有微屈或微伸活动为 2 分,指无活动为 1 分。感觉:S4,在单一神经支配区两点辨别试验恢复正常为 4 分;S3,在单一神经支配区有浅表痛觉、触觉,同时皮肤过敏反应消失为 3 分;S2,在单一神经支配区有浅表痛觉和触觉为 2 分;S0、S1,在单一神经支配区有深部组织痛觉及无感觉为 1 分。综合评价:10~12 分为优,7~9 分为良,4~6 分为可,3 分以下为差。

3 治疗结果

3.1 一般情况

14 例皮瓣全部成活。手术时间 50 min,术中出血 10 ml,术中 1 例分离血管神经束时不慎损伤一侧指动脉,经显微镜下修补处理并术后抗凝治疗后皮瓣成活良好。全部患者术中无医源性指神经损伤,无术后感染,随访 6~20 个月。末次随访患指皮瓣无萎缩,指背部皮肤感觉无减退,指甲无营养不良及勾甲畸形。术后除 1 例因瘢痕增生明显,伸指功能略差,予加强被动伸指功能锻炼后症状改善外,余患者掌指关节、指间关节无挛缩。典型病例图片见图 2。

3.2 临床疗效

术后 6 周 13 指关节活动恢复良好。14 指中 10 例远端指腹缺损患者麻醉苏醒后指端感觉即时恢复,指腹两点分辨觉 4~6 mm,感觉恢复分级达 S3+级以上;3 例中节吻合指神经患者术后随访 2~3 个月,感觉恢复分级至 S3 级。指腹血运正常,皮色与健康指无异。修复的指腹外形饱满,皮瓣耐寒性与耐磨性与健康手指无明显差别,恢复日常工作状态。功能总评分优 13 例,良 1 例。见表 1。

4 讨论

4.1 手指皮肤缺损修复的方式多样

手指指腹部软组织缺损的修复方式多样,包括保守治疗^[3-4],临床上手术治疗常选的有:(1)V-Y 皮瓣^[5-6]。(2)带指动脉或指动脉皮支血管蒂皮瓣^[7-9]。(3)各种带筋膜蒂皮瓣^[10]。(4)各种游离皮瓣,如桡动脉掌浅支腕横纹穿支皮瓣报道较多^[11]、游离尺动脉腕上皮支皮瓣^[12]及为修复指动脉缺损制作的微型 flow through 皮瓣^[13]、游离拇趾甲皮瓣^[14]、拇趾腓侧皮瓣^[15]、其他游离足部皮瓣^[16]等多种修复方式。指动脉皮瓣游离过程中如损伤指动脉伴行静脉或血管蒂扭转、静脉回流障碍会导致皮瓣坏死,且需要牺牲 1 条

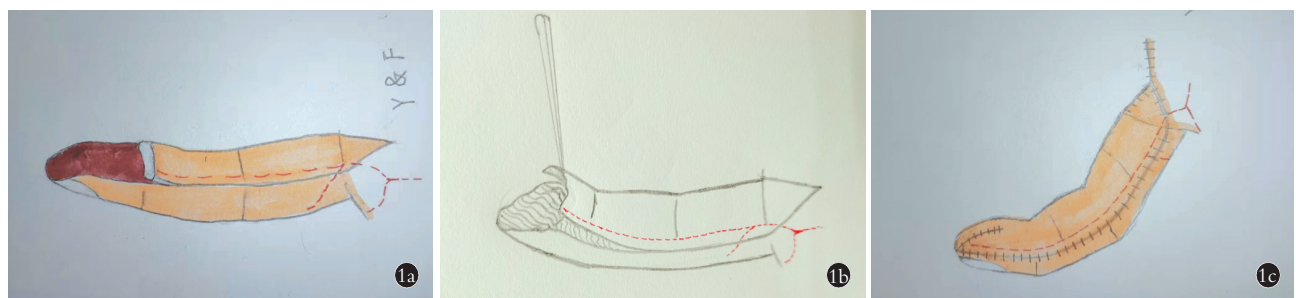


图 1 手术皮瓣设计原理示意图 1a. 皮瓣设计示意图:在手指双侧设计切口,“V”形切口设计在掌指关节以近 1b. 在屈肌腱鞘浅层切开、分离皮瓣,注意保护近节指骨指动脉、神经指背侧分支 1c. 皮瓣前移覆盖创面,皮瓣远端断面边对边缝合形成指腹凸出形态
Fig.1 Surgical flap design principles 1a. Schematic diagram of flap design:The incision was made on both sides of the finger, with a V-shaped incision close to the metacarpophalangeal joint 1b. Incision at the superficial layer of the flexor sheath,Separate the flap, pay attention to protect the proximal phalanx finger artery,nerve finger dorsal branches 1c. The flap moved forward to cover the wound, and the distal section of the flap was sutured side-to-side to form a protruding shape of the finger abdomen



图 2 男, 35 岁, 左环指挤压伤远节指腹缺损, 采用掌指关节处带指动脉、神经的 V-Y 成形皮瓣修复 **2a.** 左环指远节指腹坏死缺损 2.5 cm × 1.5 cm **2b.** 在手指掌侧设计皮瓣, V-Y 设计在掌指关节以近 **2c.** 在屈肌腱鞘浅层切取、分离皮瓣, 游离双侧指动脉血管、神经束至指总动脉、神经分叉处 **2d.** 保留近节指骨双侧指动脉、指神经的手背侧分支及伴行静脉 **2e.** 皮瓣游离后检查可前移距离 **2f.** 皮瓣试行前移覆盖指端 **2g.** 皮瓣远端断面对边缝合后形成指腹形态覆盖指端重建远节指腹外形, 并屈指缝合两侧切缘 **2h, 2i.** 皮瓣术后 18 个月随访, 手指屈伸功能良好, 指腹外形饱满、指端感觉正常

Fig.2 A 35-year-old male with a distal phalangeal defect caused by crush injury of the left ring finger was treated using a V-Y shaped flap with the digital artery and nerve at metacarpophalangeal joint **2a.** Preoperative image showing a necrotic defect of 2.5 cm × 1.5 cm in the distal phalanx of left ring finger **2b.** Flap design on the volar side of the finger, with a V-Y configuration close to the metacarpophalangeal joint **2c.** Dissection of the flap at the superficial layer of the flexor sheath, with dissociation of the bilateral digital artery and nerve bundle to the common digital artery and nerve bifurcation **2d.** Preservation of the dorsal branches of the bilateral digital arteries and nerves of the proximal phalanx, as well as the accompanying veins **2e.** Examination of the distance that the flap can be moved forward after dissociation of **2f.** Forward movement of the flap to cover the fingertip **2g.** Suture of the distal sides of the flap to reconstruct the shape of the distal phalanx by covering the fingertip, followed by suture of both cutting edges in the flexion position **2h, 2i.** Eighteen-month follow-up of the flap showing good flexion and extension function of the fingers, a full shape of the finger pulp and normal sensation of the fingertip

主要动脉。邻指带蒂皮瓣需 II 期断蒂且皮瓣无指纹, 角质层薄、耐磨性差, 需要 6 周左右的制动; 游离皮瓣技术要求高。携带神经皮支的带蒂、游离皮瓣存在感觉恢复不良, 手指感觉灵敏度差, 存在易磨破、对刺伤、烫伤无感等风险。指神经缺损的桥接移植感觉恢复效果更差, 患者满意度低。

4.2 传统 V-Y 推进皮瓣的局限性

利用掌侧皮肤的可移动性, 1935 年 Tranquilli-Lealli 首创报道的掌侧 V-Y 推进皮瓣, 推进距离小于 0.5 cm, 故传统 V-Y 推进皮瓣能覆盖的创面不超

过 1.0 cm × 1.0 cm。为了延长移行距离, 扩大修复范围, 1995 年 ELLIOT 等^[17]和 LANZETTA 等^[18]分别报告了带单侧和双侧血管蒂的 V-Y 推进皮瓣, 增加推进范围(推进可达 2 cm), 扩大了此术式的适应证。但皮瓣覆盖范围仍有限。侯桥等^[19]设计改良的 V-Y 推进皮瓣联合蒂部植皮能将皮瓣推进达 1.2 cm, 覆盖面积达 1.2~1.4 cm, 但皮瓣蒂部植皮存在植皮挛缩风险。吴泽勇等^[20]将 V-Y 切口线设计成弧形推进皮瓣修复手指近节及远节创面, 但其推进长度有限, 仍不能达到满意效果。沈小芳等^[21]利用指间关节屈曲

表 1 指腹缺损 14 例患者临床资料及疗效评价

Tab.1 Clinical data and curative effect evaluation of 14 patients with abdominal soft tissue defect in digits

患者序号	性别	年龄/岁	损伤指别	缺损面积	随访时间/月	术后 6 个月拇指对掌功能评分/分	手指活动度评分/分	感觉评分/分	手指功能总评分/分	综合评价
1	女	22	环指远节	2.0 cm×1.5 cm	8	4	4	4	12	优
2	女	24	拇指远节	2.1 cm×1.6 cm	10	3	4	4	11	优
3	女	32	中指远节	2.2 cm×1.7 cm	7	4	4	4	12	优
4	女	28	中指远节	2.1 cm×1.5 cm	6.5	4	4	3	11	优
5	女	45	示指远节	2.0 cm×1.6 cm	9	4	4	4	12	优
6	男	56	示指远节	2.4 cm×1.9 cm	6.5	4	4	4	12	优
7	男	47	中指中节	2.3 cm×1.7 cm	6	4	4	3	10	优
8	男	26	示指远节	2.5 cm×2.0 cm	20	4	4	4	12	优
9	男	62	示指远节	2.2 cm×2.0 cm	7	4	4	4	12	优
10	男	67	拇指远节	2.3 cm×1.7 cm	18	3	4	4	11	优
11	男	49	示指中节	2.2 cm×1.8 cm	6	3	3	3	9	良
12	男	35	环指远节	2.5 cm×1.5 cm	6.5	4	4	4	12	优
13	男	29	示指中节	2.0 cm×1.8 cm	6.2	4	4	4	12	优
14	男	69	示指远节	2.3 cm×1.6 cm	6.5	4	4	4	12	优

位设计的双侧指固有血管神经束皮瓣，其最大推进约 2 cm，但术后指腹的感觉受到影响。

4.3 应用组合皮瓣改善 V-Y 推进皮瓣移动距离

既往带蒂皮瓣与 V-Y 结合的手术方式多样，但均把“V”字设计在指的腹侧，术后缝合处手指周径缩小。本术式将“V”形设计在掌指关节横纹以近，解决了此问题。利用指动脉、指神经血管神经束的延展长度又增加皮瓣前置距离。周晓等^[22]在拇掌侧设计了双重“V”形指动脉皮瓣，大“V”形皮瓣近端达掌指关节不超过关节，在远节指再设计 1 个小“V”形皮瓣，据报道最大可切取 3.5 cm×1.5 cm，可明显增加皮瓣移位距离。ESTOPPEY 等^[23]报道了顺行同指神经血管岛状瓣合并单次或双次 V-Y 成形术也可以延长皮瓣移位距离。

本术式中，如为远节创面缺损纵径较长，也可在近、中节指腹处各再加，1 个 V-Y，多个 V-Y 组合可明显延长皮瓣移动距离，其原理是多处松解皮肤及皮下纤维间隔后可最大释放皮瓣内含血管神经束的延展长度，但分离过程中血管损伤的风险也将加倍。对手术操作的仔细程度要求更高，可作为本术式的一种有效补充。

4.4 感觉重建是手指功能恢复的重要前提

本术式的皮瓣携带双侧血管神经束并注意保护了指神经手背支，完整保留了指腹及指背侧的感觉，远节指腹修复术后感觉可即时恢复。中节指神经缺损者经神经断端吻合，将指神经桥接移植修复术式的 2 个吻合口减少为 1 个吻合口，指体感觉恢复效

果较原术式改善明显。中节指动脉缺损经血管断端吻合将指动脉桥接移植修复术式的 2 个吻合口减少为 1 个吻合口，指体血运重建的风险较原术式明显降低，同时避免了移植血管、神经的供区损伤。

4.5 手术操作注意事项

(1)“V”字切口臂长的设计根据皮瓣试行滑移后仍缺损的长度决定。(2)有的患者指动脉伴行静脉纤细肉眼不可及，分离指动脉血管神经束时尽量在放大镜下分离并携带袖套组织，避免损伤伴行静脉导致皮瓣坏死。(3)近节指骨近端的指动脉及指神经手背支向指背侧远端斜行走行，皮瓣滑移后分支较为松弛，能保留指背侧血运和感觉功能。(4)移行距离越大，指关节屈曲程度越大，及时进行手指关节主、被动锻炼对后期手指运动功能康复较重要。

4.6 本术式不足

(1)如指尖处理不佳，或会导致勾甲畸形。(2)纵行的切口瘢痕如增生明显会影响手指屈伸活动。(3)皮瓣移行距离仍有限，尤其对中节指腹缺损并血管、神经缺损者局限性大。下一步可进一步进行解剖学研究，明确皮瓣可覆盖范围与手指长度之间的比例关系，以指导临床工作。

综上所述，掌指关节处带指动脉、神经的 V-Y 成形皮瓣修复中、远节指腹部软组织缺损可重建指腹中、远节血运、外形和感觉，手术操作简单、安全性高，患者满意率高。可满足基层单位开展。

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