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拇指背侧皮神经营养血管皮瓣修复对拇指远端软组织缺损的效果观察

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摘要 目的:探讨拇指背侧皮神经营养血管皮瓣修复拇指远端软组织缺损的临床效果。**方法:**选取我院 2014 年 1 月至 2016 年 12 月收治的拇指远端软组织缺损患者 100 例,随机分为对照组和观察组。对照组采取腹部皮瓣对拇指远端软组织缺损进行修复,观察组采取拇指背侧皮神经营养血管皮瓣对其进行修复。通过随访患者,记录分析皮瓣的生存状况、感觉指标、外观以及手部功能的 DASH 评分比较两组的修复效果。**结果:**观察组 50 例患者皮瓣全部成活。对照组 50 例皮瓣全部成活。与对照组相比,观察组在触觉、温度觉、单丝、两点辨别觉、瘢痕挛缩方面明显优于对照组($P<0.05$),肿胀发生率明显低于对照组($P<0.05$)。观察组 DASH 评分为 29.56 ± 2.14 分,对照组为 38.13 ± 3.12 分,观察组的 DASH 评分明显低于对照组($P<0.05$)。**结论:**拇指背侧皮神经营养血管皮瓣修复拇指远端软组织缺损手术不破坏主要血管神经,对供区影响小,操作简单,修复的指腹感觉,拇指外形较佳,是较为理想的选择。

关键词:拇指背侧皮神经营养血管皮瓣;腹部皮瓣;拇指远端软组织缺损

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Clinical Efficacy of Neurocutaneous Vascular Flap in Repairing the Soft Tissue Defects of Thumb Distal with Dorsal

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ABSTRACT Objective: To analyze and investigate the clinical efficacy on repairing soft tissue defects of the thumb distal with dorsal neurocutaneous vascular flap. **Methods:** Select 100 cases of patients with soft tissue defects of the thumb distal from January 2014 to December 2016, who were randomly divided into two groups, the control group and observation group. Take the abdominal skin flap to repair soft tissue defects of the thumb distal in the control group, with the thumb distal with dorsal neurocutaneous vascular flap in the observation group. The survival condition, the indicators of feelings, the appearance of skin flap, as well as the DASH score of the hand function have been recorded and analyzed through follow-up patients, to observe the effects on repairing soft tissue defects in the two groups. **Results:** All transplanted tissues were all survived in the observation group and control group. Compared with control group, the sense of touch, temperature sense, monofilament, two-point discrimination, scar contracture of the observation group were better ($P<0.05$), the incidence of bloat was lower ($P<0.05$). The DASH scores were 29.56 ± 2.14 , 38.13 ± 3.12 in the observation group and control group, which was significantly lower in the observation group than that of the control group ($P<0.05$). **Conclusion:** The clinical efficacy of the dorsal neurocutaneous vascular flap is better than that of abdominal skin flap on repairing soft tissue defects of the thumb distal. For no injury for major vascular nerves, little influence on donor area, being simple to operate, being better feelings of the finger pulp, appearance, dorsal neurocutaneous vascular flap on repairing soft tissue defects of the thumb distal is an ideal choice.

Key words: Thumb dorsal neurocutaneous vascular flap; Abdominal skin flap; Soft tissue defects of the thumb distal

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前言

手在一个人的生活中具有重要的作用,是非常重要的劳动器官,而拇指对于手功能而言又举足轻重,在握物、按压、敲击时必不可少。随着工业化的进程以及更复杂的手工操作等原因,手指缺损在手部创伤中很常见,而拇指远端软组织缺损在

手指缺损中是最常见的,其缺损会给患者日常生活及工作带来极大的影响,有时甚至会严重影响患者的心理健康。

由于该部位的皮肤在结构、厚度与质地上与身体其他部位的皮肤在一定程度上是不同的,所以当其缺损时,若要修复就显得较为困难。在手外科手术中,因其部位皮肤的特殊性,常用皮瓣对拇指远端软组织缺损进行修复^[1-3]。目前,外科手术中会采用带蒂筋膜皮瓣、游离皮瓣、中环指指动脉岛状皮瓣、腹部皮瓣^[4-7]、示指背侧动脉岛状皮瓣、拇指背侧皮神经营养血管皮瓣等对手部创伤进行修复。临床上针对不同患者、不同部位的手部创伤,可采用不同的皮瓣进行修复^[8-10]。不同皮瓣修复疗效各

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异,因而修复时需谨慎选择皮瓣,若选择的皮瓣不当,患者在术后会感觉皮肤不适,耐磨性差,需要多次反复的修型,这不仅延长了治疗周期,而且增加了治疗成本^[11,12]。

在临床实践里,皮神经营养血管皮瓣应用于手部创面已有近30年之久,长久对该类皮瓣的基础和临床研究使得该类皮瓣在修复手部缺损时临床应用的较为广泛,特别是应用于远端软组织缺损。因手部皮瓣损伤小,对手术操作技术要求不高,且为同指内切取的皮瓣等,采用拇指背侧皮神经营养血管皮瓣对拇指远端软组织缺损患者进行治疗的治疗效果较好。本研究主要探讨拇指背侧皮神经营养血管皮瓣修复拇指远端软组织缺损的临床效果。

1 资料与方法

1.1 一般资料

选取我院2014年1月至2016年12月收治的拇指远端软组织缺损患者100例,其中男62例,女38例,年龄17-56岁,平均年龄 33.1 ± 3.1 岁,拇指远端软组织缺损范围为 1.8×2.0 cm- 2.5 cm $\times$ 3.0 cm,伤后入院时间为0.5 h-22.5 h,伤因:碾压伤12例,电锯伤16例,挤压伤23例,切割伤25例,绞轧伤11例,其他伤12例。所有患者入院后均为亚急诊手术。

1.2 治疗方法

将患者随机分为两组,每组50例,分别为对照组和观察组。两组患者性别、年龄等资料差异均无统计学意义($P>0.05$),具有可比性。对照组采用腹部皮瓣对拇指远端软组织缺损患者进行治疗,观察组采用拇指背侧皮神经营养血管皮瓣对拇指远端软组织缺损患者进行治疗。术后,与所有患者保持联系并定期随访,了解患者病情变化,指导患者康复,时间为7~12个月,平均 10.2 ± 1.6 个月。采用DNSH (disability of the arm, shoulder and hand)^[13-15]调查表格对手部整体功能进行评价。

1.2.1 拇指背侧皮神经营养血管皮瓣的设计 皮瓣面积的设计:应在第1腕关节至掌指关节的两侧,皮瓣长与宽的比为大于1.5:1,小于2:1,若超过一定比例,皮瓣远端可能会出现血运障碍或坏死,同时,皮瓣还应使蒂部略宽,循环血管的行走方向,以保证血液循环。皮瓣应比实际创面大20%左右,形状宜为网球拍状或水滴状。轴线:根据缺损区情况,将拇指桡侧,或尺侧指背神经行径作为轴线,在设计皮瓣长轴时,需与皮神经走行一致。旋转点:不超过拇指指间关节近侧部分0.5 cm,若超过,将会破坏其与两侧指背神经营养血管交通,进而影响血运。尽可能在掌背侧选择桡侧皮瓣,但切不可在大鱼际桡侧,虎口区不可是尺侧皮瓣的着落点。

1.2.2 皮瓣切取及移植 观察组患者仰卧,采取臂丛麻醉,患肢置于木桌上,以气囊止血带控制上臂。清除损伤部位坏死组织和皮肤。将皮瓣近端切开,在浅筋膜层找到皮神经,在近侧游离0.5-1 cm之后,将之切断。浅腱膜层掀起皮瓣之后,将深筋膜层与真皮层的间断缝合,进而避免出现皮肤与皮下组织分离的情况。切取皮瓣的蒂部,确保皮下筋膜组织1 cm左右的宽度,以避免损伤神经旁血管层,且利于静脉血的回流。将蒂部旋转点与受区创面之间切开,皮瓣旋转180°,吻合指神经残端与皮神经,缝合创面。供瓣区创面若可拉拢缝合则拉拢,若不可则选取全厚皮植皮,之后打包加压包扎。

皮瓣的血液运输和营养在早期完全依靠蒂部供应。皮瓣在移植处愈合后3周左右,又逐渐建立起新的血液循环系统,此时就可以切断蒂部,完成皮瓣移植。

1.2.3 术后处理 手术后将患肢抬高,以改善患者缺损处的微循环。烤灯照射,在防止灼伤的同时以预防创面感染,同时需对创面进行抗栓和抗凝治疗。皮瓣要保持湿润,防止血管因干燥而痉挛。患者术后要忌烟酒。术后及时复查凝血时间,以避免受瓣区高凝状态。当拇指可以进行一些简单的活动时,进行功能的锻炼。

1.2.4 腹部皮瓣手术方法 对照组患者采取仰卧位,对患者腹部及手部实施局部麻醉。创面常规清创,对创面边缘进行修复,彻底止血。设计好腹部皮瓣,在无张力下,将腹部皮瓣和创缘进行缝合。为确保皮瓣无折叠,无张力,7天内将患肢固定于腹部。待3~4周伤口愈合后,即可断蒂。

1.3 观察指标

(1)皮瓣生存状况及感觉指标。检查皮瓣是否全部成活。对患者触觉,温度觉,压觉(单丝法),皮瓣两点辨别觉,供区瘢痕挛缩程度进行记录^[16-20]。

a.触觉:在患者保持闭目时,通过软毛笔,轻刺皮瓣,再轻刺对侧的相同位置,刺激的频率不要过于频繁。之后询问患者的感觉。

b.温度觉:将5℃-10℃的冷水,40℃-50℃的温水分别装入5 mL试管里,让患者保持闭目,用冷水试管接触患者的皮瓣2-3秒,之后用温水试管接触患者的皮瓣2-3秒,用两种试管交替接触,询问患者的冷热感觉。

c.单丝法:选取1.65-6.65 mm的尼龙丝,将尼龙丝一端游离,一端系于塑料棒,手持塑料棒,使丝与棒成直角。让患者保持闭目,手背放于毡垫桌上。以1.65号丝开始,保持丝不打滑,垂直作用于患者手背皮瓣,保持1-1.5秒,之后提起保持1-1.5秒,此流程作为一次。当丝弯曲时,若患者无感觉,换较大一号丝重复上述流程,直至患者连续两次对丝刚弯曲即有感觉,就可依此号丝来查表找结果。但对于4.17-6.65号丝,只需试一次。将数据分为5个级别,分别为2.5 mm-3.5 mm,3.5 mm-4.5 mm,4.5-5.5,5.5 mm-6.5 mm,>6.5 mm。

d.两点辨别觉:让患者保持闭目,用分开的双脚规轻刺两点皮肤,如果病人有两点感觉,再将两脚规距离缩短,直到病人感觉为一点为止。

e.瘢痕挛缩: +/- 表示瘢痕正常或不明显, + 表示瘢痕较少, ++ 表示瘢痕范围中等, +++ 表示瘢痕范围较广。

(2)皮瓣外观:对皮瓣颜色、质地、肿胀情况进行观察。

(3)DASH评分。患肢进行写字,扫地,推门,钥匙开门,铺床,拧瓶盖,擦背,打牌,开车,切食物,换灯泡,打羽毛球,搬重物等活动时是否影响患者的生活和工作。对活动或休息时修复处是否僵硬,疼痛,乏力,麻木,影响自信,影响睡眠等34项进行评分。对患肢一周以内的上述症状进行记录,按严重程度进行1-5的评分。DASH值0表示功能完全正常,100则说明完全无功能。

1.4 统计学分析

选择SPSS17.0软件,计数资料用百分比表示,用卡方检验对比分析,计量资料用 $\bar{x} \pm s$ 表示,用t检验对比分析。以 $P <$

0.05 为差异有统计学意义。

2 结果

2.1 两组皮瓣的生存状况及感觉指标比较

观察组 50 例患者皮瓣全部成活。对照组 50 例皮瓣全部成活。与对照组相比,观察组在触觉、温度觉、单丝、两点辨别觉方面明显优于对照组($P<0.05$),在瘢痕挛缩方面组间无统计学意义($P>0.05$)。

表 1 两组皮瓣感觉指标的比较

Table 1 Comparison of the feelings indicators of skin flap between two groups

Cases	Sense of touch	Thermo-esthesia	Monofilament(mm)	Two-point	Discrimination (mm)
	Sensitive / subside	Exist/No	2.5-3.5/3.5-4.5/4.5-5.5/5.5-6.5/>6.5		
50	34/16	35/15	17/20/8/3/2	6.09± 0.58	21/23/6
50	7/43	5/45	2/5/8/13/22	16.61± 0.82	20/22/8
	5.689	6.021	4.298	7.236	1.235
	0.031	0.026	0.043	0.012	0.156

2.2 两组皮瓣外观的比较

观察组皮瓣颜色红润,无色素沉着,质地良好,45 例患者无臃肿现象,5 例患者轻度臃肿,外形较好。对照组皮瓣颜色红润,但 21 例患者出现臃肿现象,质地与外形较差。观察组外观

臃肿发生率明显低于对照组($P<0.05$)。

2.3 两组 DASH 评分的比较

观察组 DASH 评分为 29.56 ± 2.14 分,对照组为 38.13 ± 3.12 分,观察组的 DASH 评分显著低于对照组($P<0.05$),见表 2。

表 2 两组手部功能的 DASH 评分比较

Table 2 Comparison of the DASH score of hand function between two groups

Groups	n	DASH scores	DASH
			20~30/40~50/50~60/>70
Observation group	50	29.56± 2.14	42/3/2/1
Control group	50	38.13± 3.12	30/8/7/4/1
χ^2/t	-	5.187	3.126
P		0.034	0.043

3 讨论

自 Bertelli 等报道皮神经营养血管皮瓣以来,通过对皮神经周围血管的解剖研究,皮神经营养血管皮瓣已得到越来越广泛的应用,特别是在拇指背侧、尺侧皮神经,其和伴行血管关系密切,血运可靠。皮神经营养血管皮瓣的解剖学含义:从深部主干动脉的血管神经皮穿支开始,经由神经旁血管网,与神经内血管相互连接,相互吻合,形成皮神经营养血管丛^[21,22]。此血管丛是丰富的,广泛沟通的纵向血管丛,与浅静脉干血管网,深筋膜血管网,皮下组织血管网和皮肤血管网存在极为丰富的吻合,通过加强这些血管网的作用,构成皮神经营养血管皮瓣的解剖学基础。以此理论为基础,设计皮神经营养血管皮瓣,由于供血系统的增加,提高了皮瓣的成活率。

针对外伤导致拇指远端软组织缺损、肌腱、骨外露,本研究采用了拇指背侧皮神经营养血管皮瓣对其进行修复,同时将修复效果和腹部皮瓣对拇指远端软组织缺损修复的效果加以对比。观察组 50 例患者皮瓣全部成活。对照组 50 例皮瓣全部成活。与对照组相比,观察组在触觉、温度觉、单丝、两点辨别觉、瘢痕挛缩方面明显优于对照组, $P<0.05$ 。观察组 5 例患者轻度臃肿,对照组 21 例出现臃肿。观察组 DASH 评分为 29.56 ± 2.14 分,对照组为 38.13 ± 3.12 分,观察组的 DASH 评分及例数明显优于对照组, $P<0.05$ 。表明指背侧皮神经营养血管皮瓣修复拇指远端软组织缺损手术不破坏主要血管神经,对供区影

响小,操作简单,修复的指腹感觉,拇指外形较佳。主要是由于治疗拇指远端软组织缺损时,拇指背侧皮神经营养血管皮瓣具有以下优点:(1)在同一部位进行手术,不需要游离血管,神经等组织^[23-25],操作简单,手术时间短,一次完成;(2)设计较为灵活,在皮神经轴线上,可任意切取皮瓣。同时皮瓣血管蒂旋转灵活,且较长,能覆盖较大面积缺损;(3)皮瓣与拇指指端皮肤颜色,质地相近,薄厚适中不臃肿,耐摩擦,修复后外形美观;(4)不损伤主要血管神经,对患肢破坏较少;(5)采取仰卧位,不固定肢体,对术后康复较为有利,如早期即可开始拇指与邻指功能锻炼,避免长期固定造成指间关节僵硬^[26,27];(6)当皮瓣面积较小时,供区可直接缝合,不需植皮^[28,29],若供区需要植皮,植皮也较容易成活,且瘢痕较小。缺点为:(1)术者需掌握显微外科技术,因吻合神经需在显微镜下完成;(2)无法修复较大的创面,指甲无法恢复生长;(3)切取皮瓣时,需要切断一条皮神经,供区部分感觉会丧失,少数患者甚至会出现残端神经痛。而腹部皮瓣缺点为:(1)需要固定患者的体位 3 周左右,长时间固定容易导致关节僵硬,且需要二次手术断蒂;(2)腹部皮瓣的细腻程度及延展性不及拇指背侧皮神经营养血管皮瓣,无掌指横纹^[30],有色素沉着,修复之后手部外形不佳。

综上所述,在患者触觉、压觉以及整体功能等的恢复上,腹部皮瓣不如拇指背侧皮神经营养血管皮瓣,且其臃肿程度较大,而拇指软组织缺损患者对手指的精细功能,外形要求较高,因而对其的修复不宜选择腹部皮瓣。经拇指背侧皮神经营养血

管皮瓣修复的拇指外形、指腹感觉等都使患者感到满意,且皮瓣切取较为安全,成活率高,对供区影响较小,是较为理想的选择。

参考文献(References)

- [1] Karbalaekhiani A, Saied A, Heshmati A. Effectiveness of the Gastrosoleus Flap for Coverage of Soft Tissue Defects in Leg with Emphasis on the Distal Third [J]. The archives of bone and joint surgery, 2015, 3(3): 193
- [2] Chang S S, Jin W H, Wei Z R, et al. Repair of skin and soft tissue defects at distal end of finger with serrated flap with digital proper artery and nerve pedicle combined with bilaterally pedicled V-Y advancement flap of the injured finger [J]. Chinese journal of burns, 2016, 32(4): 204
- [3] Deng C, Wei Z, Sun G, et al. Repair of skin and soft tissue defects at distal end of finger and donor site with relaying reversed perforator flaps.[J]. Chinese journal of burns, 2015, 31(2): 107
- [4] Bagdas D, Etoz B C, Gul Z, et al. Chlorogenic Acid Enhances Abdominal Skin Flap Survival Based on Epigastric Artery in Nondiabetic and Diabetic Rats[J]. Annals of Plastic Surgery, 2016, 7(2): E21-E25
- [5] Lee T J, Oh T S, Kim E K, et al. Risk factors of mastectomy skin flap necrosis in immediate breast reconstruction using low abdominal flaps[J]. Journal of Plastic Surgery & Hand Surgery, 2016, 50(5): 1
- [6] Ma G, Pei J, Li Y, et al. Cytotoxic T Lymphocyte-associated Protein 4 Acts on Local Draining Lymph Nodes in the Allogeneic Abdominal Skin Flap of a Rat Model to Extend Its Survival [J]. Transplantation Proceedings, 2016, 48(10): 3415-3421
- [7] Zhang M, Song K, Ding N, et al. Using a Distant Abdominal Skin Flap to Treat Digital Constriction Bands: A Case Report for Vohwinkel Syndrome[J]. Medicine, 2016, 95(6): e2762
- [8] Zhong W, Lu S, Chai Y. Distally Based Saphenous Neurocutaneous Perforator Flap: A Versatile Donor Site for Reconstruction of Soft Tissue Defects of the Medial Malleolar Region [J]. Journal of Foot & Ankle Surgery Official Publication of the American College of Foot & Ankle Surgeons, 2015, 55(2): 391-396
- [9] Javaid R H, Chamaidi E, Hardwicke J T, et al. Elbow defect coverage using a capillary perforator flap arising from the vasa nervosum of the ulnar nerve[J]. Journal of Plastic Reconstructive & Aesthetic Surgery, 2015, 68(4): 592-594
- [10] Jadhav C N, Sharma R K. Flap within a first dorsal metacarpal artery flap for recurrent thumb injury [J]. European Journal of Plastic Surgery, 2016, 39(4): 1-2
- [11] Korkmaz Y T, Mollaoglu N, Ozmeriç N. Does Laterally Rotated Flap Design Influence the Short-Term Periodontal Status of Second Molars and Postoperative Discomfort After Partially Impacted Third Molar Surgery?[J]. Journal of Oral & Maxillofacial Surgery Official Journal of the American Association of Oral & Maxillofacial Surgeons, 2015, 73(6): 1031-1041
- [12] Coltro P S, Ferreira M C, Busnardo F F, et al. Evaluation of cutaneous sensibility of the internal pudendal artery perforator (IPAP) flap after perineal reconstructions [J]. Journal of Plastic Reconstructive & Aesthetic Surgery, 2015, 68(2): 252-261
- [13] Rodrigues J, Zhang W, Scammell B, et al. Validity of the Disability of the Arm, Shoulder and Hand patient-reported outcome measure (DASH) and the Quickdash when used in Dupuytren's disease. [J]. 2016, 41(6): 589
- [14] Klerk S D, Buchanan H, Jerosch-Herold C. The Validity and Clinical Utility of the Disability of the Arm, Shoulder and Hand (DASH) Questionnaire for Upper Limb Injuries in Developing Country Contexts: A Systematic Review[J]. Hand, 2016, 11(1 Suppl): 140S-140S
- [15] Davies, Claire, Brockopp, et al. Test-retest and Internal Consistency of the Disability of Arm, Shoulder and Hand (DASH) Outcome Measure in Assessing Functional Status among Breast Cancer Survivors with Lymphedema[J]. Rehabilitation Oncology, 2015, 33
- [16] Nghiem B T, Sando I C, Gillespie R B, et al. Providing a sense of touch to prosthetic hands [J]. Plastic & Reconstructive Surgery, 2015, 135(6): 1652-1663
- [17] Barbagallo B, Garrity P A. Temperature sensation in Drosophila[J]. Current Opinion in Neurobiology, 2015, 34: 8-13
- [18] Luo S, Billings A, Josef M. Shaped monofilaments with grooves and the fabrics made thereof: WO, US9315939[P]. 2016
- [19] Noh J W, Park B S, Kim M Y, et al. Differences in two-point discrimination and sensory threshold in the blind between braille and text reading: a pilot study [J]. Journal of Physical Therapy Science, 2015, 27(6): 1919-1922
- [20] Kim M G, Park I H, Chang S P, et al. Bone Framework Graft through an Intraoral Approach in a Patient with Columellar Scar Contracture [J]. 2016, 22(3): 149
- [21] Winter K, Scheibe P, Köhler B, et al. Local Variability of Parameters for Characterization of the Corneal Subbasal Nerve Plexus[J]. Current Eye Research, 2016, 41(2): 186
- [22] Khadilkar S V, Yadav R S, Soni G. A practical approach to enlargement of nerves, plexuses and roots [J]. Practical Neurology, 2015, 15(2): 105
- [23] Zhang W, Zhang Y S, Bakht S M, et al. Elastomeric free-form blood vessels for interconnecting organs on chip systems[J]. Lab on A Chip, 2016, 16(9): 1579
- [24] Zhang W, Zhang Y S, Bakht S M, et al. Elastomeric free-form blood vessels for interconnecting organs on chip systems[J]. Lab on A Chip, 2016, 16(9): 1579
- [25] Chakraborti T, Jha D K, Chowdhury A S, et al. A self-adaptive matched filter for retinal blood vessel detection [J]. Machine Vision and Applications, 2015, 26(1): 55-68
- [26] Christen S, Hirschmann M T. Case Discussion to Chap. 15: Stiff Knee Joint After TKR Due to Tight Flexion Gap in Oversized TKR [M]// The Unhappy Total Knee Replacement. Springer International Publishing, 2015: 185-188
- [27] Fletcher M D. Joint preservation of the wrist using articulated distraction arthroplasty: a case report of a novel technique [J]. Case Rep Orthop, 2015, 2015(1)
- [28] Iinuma S, Aikawa E, Tamai K, et al. Transplanted Bone Marrow-Derived Circulating PDGFR α + Cells Restore Type VII Collagen in Recessive Dystrophic Epidermolysis Bullosa Mouse Skin Graft[J]. Journal of Immunology, 2015, 194(4): 1996
- [29] Riecke B, Assaf A T, Heiland M, et al. Local full-thickness skin graft of the donor arm-a novel technique for the reduction of donor site morbidity in radial forearm free flap [J]. International Journal of Oral & Maxillofacial Surgery, 2015, 44(8): 937-941
- [30] Xu M, Liu B, Graham G, et al. High resolution characterization of grain boundaries in Cu₂ZnSnSe₄ solar cells synthesized by nanoparticle selenization [J]. Solar Energy Materials & Solar Cells, 2016, 157: 171-177