UV Clinical Article

UV

临床论著

01 种植体复杂病例 解决方案 [UV光照种植体]
02 UV照射的种植体长期安全性相关论文
03 UV照射的生物学安全性及有效性的相关论文

目录

种植体复杂病例解决方案 [UV光照种植体]

UV光照种植体长期稳定性相关论文

UV照射的生物学稳定性及有效性的相关论

临床论著

01

种植体复杂病例 解决方案
[UV光照种植体]

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常规和复杂病例中光照种植体的稳定程度：一项病例对照研究

Implant Stability Development of Photofunctionalized Implants Placed in Regular and Complex Cases: A Case-Control Study

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研究目的及方法

本研究旨在对常规和复杂病例中一般种植体和光化种植体的稳定程度进行比较。

对常规和复杂情况下（并行引导骨再生、上颌窦提升、或即拔即种）49个种植体（24个一般种植体和25个光化种植体）进行了研究。使用光照设备在植入前对种植体进行15分钟紫外线（UV）照射，以完成光化。结果显示，种植体具超亲水性。通过测量种植体在植入时（ISQ1）和二期手术时（ISQ2）的种植体稳定系数（ISQ）评估其稳定性。通过计算骨结合速度指数（OSI），即每月ISQ增量（[ISQ 2-ISQ 1]/愈合时间以月为单位），来评估种植体达到稳定的速度。并通过临床诊断和放射学检查评估植入时先天性骨支持的百分比。

The objective of this study was to compare the rate of implant stability development of as-received and photofunctionalized dental implants in regular and complex cases.

Forty-nine implants (24 as-received and 25 photofunctionalized) placed in regular or complex cases (simultaneous guided bone regeneration, sinus elevation, or fresh extraction sockets) were studied. Photofunctionalization was performed by ultraviolet (UV) treatment of implants for 15 minutes using a photo device immediately prior to placement, and the generation of superhydrophilicity was confirmed. Implant stability was evaluated by measuring the implant stability quotient (ISQ) at placement (ISQ1) and at stage-two surgery (ISQ2). The rate of implant stability development was evaluated by calculating the osseointegration speed index (OSI), defined as the ISQ increase per month ([ISQ2–ISQ1]/healing time in months). The percentage of innate bone support at placement was evaluated clinically and radiographically.

研究结果

光化种植体（3.7±2.9）的平均OSI显著大于一般种植体（0.0±1.0）。在复杂病例中光化种植体OSI为4.2±3.2，一般种植体为0.2±0.9。在同期窦提升的病例中，光化种植体OSI为5.5±3.5，一般种植体OSI为0.2±1.1。光化种植体的ISQ2值显著高于一般种植体。光化种植体ISQ2值大于60，与种植体的初期稳定性和先天性骨支持无关。在光化作用、患者年龄、性别、种植体直径、种植体长度等多变量分析中，光化对常规病例和复杂病例OSI的影响最大，而其他因素仅在一定条件下对OSI产生影响。

相较于一般种植体，光化处理加快了种植体达到稳定的速度，并提高了种植体的最终稳定性，特别是骨质较差或其他复杂情况下植入的种植体。光化处理是提高种植体稳定性的决定因素，其影响远远高于其他所有与受测种植体和宿主相关的因素。

The average OSI was considerably greater for photofunctionalized implants (3.7 ± 2.9) than for as-received implants (0.0 ± 1.0). The OSI in complex cases was 4.2 ± 3.2 for photofunctionalized implants and 0.2 ± 0.9 for as-received implants. The OSI in cases with simultaneous sinus elevation was 5.5 ± 3.5 for photofunctionalized implants and 0.2 ± 1.1 for as-received implants. Photofunctionalized implants showed significantly higher ISQ2 values than as-received implants. Photofunctionalized implant ISQ2 values were greater than 60, regardless of primary stability and innate bone support at placement. In multivariate analysis including the effects of photofunctionalization, age and sex of patients, and diameter and length of implants, photofunctionalization showed the strongest influence on the OSI for both regular and complex cases, while other factors influenced the OSI only in certain conditions.

Photofunctionalization accelerated the rate and enhanced the final level of implant stability development compared with as-received implants, particularly for implants placed into poor-quality bone and other complex cases. Photofunctionalization was a stronger determinant of implant stability than all the other tested implant- and host-related factors.

[出处：《口腔与上颌面植入国际杂志》/ Quintessence Publishing co, Inc.]

光照种植体：一组骨缺损病例系列研究

Photofunctionalized Dental Implants: A Case Series in Compromised Bone

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研究目的及方法

本临床病例系统研究旨在探讨修复1年后，光化处理对种植成功率、愈合时间、骨结合速度以及种植体周围骨水平变化的影响。

本研究为4个局部无牙颌病例。在研究中，用紫外光对7个具有相同微粗糙表面的种植体进行了15分钟的光化处理。通过测量每个月种植体稳定性系数（ISQ）增量计算骨结合速度。用放射学方法对修复当天及修复1年后的边缘骨水平进行评估。

This clinical case series sought to examine the effect of photofunctionalization on implant success, healing time, osseointegration speed, and peri-implant marginal bone level changes at 1 year after restoration.
Four partially edentulous patients were included in the study. Seven implants with identical microroughened surfaces were photofunctionalized with UV light for 15 minutes. Osseointegration speed was calculated by measuring the increase in implant stability quotient (ISQ) per month. Marginal bone levels were evaluated radiographically at crown placement and at 1 year.

研究结果

即便使用早期功能性负重方案（2.1~4.5个月），在新拔牙窝、垂直向有增量的骨、同期上颌窦提升或种植失败部位再次植入的病例中，所有种植体在术后1年后仍可正常使用。种植体在植入时ISQ值为48~75，在负重时ISQ值增至68~81。对于初期稳定性较低（初期ISQ < 70）的种植体，ISQ显著增加。

将光化种植体应用于这些具有临床挑战性的病例似乎能够在更短时间（相较于标准方案和已发表文献所建议的时间）内完成骨结合。此外，相较于文献已报告的类似结果，光化种植体的植入稳定性更强、骨结合速度更快。在1年随访期间，所有光化种植体的边缘骨水平均从冠下向冠状位方向增加，而在冠状位周围骨支持式种植体的边缘骨水平则保持不变。负重后1年内无手术或修复体并发症。光化处理流程简便，适用于各种表面类型的钛基材料和钛基合金材料。结合其他体外和体内数据，本次初步研究中较好的临床结果表明，光化处理适用于具挑战性的临床病例并颇具效用。作为一种全新方式，光化可用于克服种植牙领域长期存在的挑战。

All implants placed into fresh extraction sockets, vertically augmented bone, simultaneously augmented sinuses, or the site of a failing implant remained functional and healthy at 1 year, even with an earlier loading protocol (2.1 to 4.5 months). ISQs of 48 to 75 at implant placement had increased to 68 to 81 at loading. In particular, implants with low primary stability (initial ISQ < 70) showed large increases in ISQ.
The use of photofunctionalized dental implants in these clinically challenging cases appeared to result in osseointegration in a shorter period of time than currently suggested by standard protocols and the published literature. In addition, the increases in implant stability and osseointegration speed were considerably greater for photofunctionalized implants than similar results reported in the literature. During a 1-year follow-up period, the marginal bone level increased toward the coronal for all photofunctionalized implants whose platform had been subcrestal at crown placement, while those implants that had supracrestal peri-implant bone at crown placement maintained their marginal bone level without loss. No surgical or prosthetic complications were reported up to 1 year after loading. The procedure for photofunctionalization is simple and applicable to titanium-based and titanium alloy–based materials of various surface types. Together with other in vitro and in vivo data, the promising clinical outcomes presented in this preliminary study suggest that photofunctionalization is useful and effective for challenging clinical situations and represents a novel avenue to overcome some of the ongoing challenges in implant dentistry.

[出处:《口腔与上颌面植入国际杂志》/ Quintessence Publishing co, Inc. 2013]

光照种植体的成功率、愈合时间和稳定性

Success Rate, Healing Time, and Implant Stability of Photofunctionalized Dental Implants

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材料及调查方法

本研究系回顾性研究，分析共植入了222颗未经光化处理的种植体的95名连续患者与共植入了168颗光化种植体的70名患者在术后2.5年随访期间的情况。

在植入前，使用光照设备用紫外光对种植体处理15分钟，进行光化处理，然后立即植入种植体。光化处理后，种植体产生了超亲水性和亲血性，大幅度降低了表面碳的原子百分比。两组的复杂病例中，90%的种植体需要分阶段或同时进行种植牙周围的组织重建。

采用种植体稳定系数（ISQ）测量种植体植入和负重时的稳定性；然后，通过计算每个月ISQ的增量来评估种植体达到稳定的速度。

This retrospective study analyzed 95 consecutive patients who received 222 untreated implants and 70 patients who received 168 photofunctionalized implants over a follow-up period of 2.5 years.

Photofunctionalization was performed by treating implants with UV light for 15 minutes using a photo device immediately before placement. The generation of superhydrophilicity and hemophilicity along with a substantial reduction in atomic percentage of surface carbon was confirmed after photofunctionalization. In both groups, 90% of the implants were placed in complex cases requiring staged or simultaneous site-development surgery.

The implant stability was measured at implant placement and loading using the implant stability quotient (ISQ) values; then, the rate of implant stability development was evaluated by calculating the ISQ increase per month.

研究结果

在本研究范围内（主要包括复杂情况下的种植体植入），未经处理的种植体的负重前愈合时间为6.5个月，而光化种植体的负重前愈合时间明显缩短（3.2个月），种植成功率高达97.6%。光化种植体的ISQ每月增量为2.0~8.7（这取决于最初的ISQ值），显著高于文献中报告的ISQ每月增量（-1.8~2.8）。光化处理的应用导致更频繁地使用10mm或更短的种植体，并导致种植体的平均直径减小。总之，尽管更频繁地使用了更短和更小直径的种植体，但光化处理允许采用更快的负重方案且不影响成功率。就光化种植体而言，该结果与种植体达到稳定的速度增加有关。结果表明，光化处理为进一步推进种植体治疗提供了一条新的、实用的途径。

Within the limits of this study, which mainly included implant placement in complex cases, the use of photofunctionalization resulted in a high success rate of 97.6%, even with a substantially decreased healing time of 3.2 months before loading as compared with 6.5 months for untreated implants. The ISQ increase per month for photofunctionalized implants ranged from 2.0 to 8.7 depending on their initial ISQ values, and it was considerably higher than that reported in the literature, which ranged from –1.8 to 2.8. The use of photofunctionalization resulted in the more frequent use of implants in 10 mm or shorter and a decrease in average implant diameter. In conclusion, despite more frequent use of shorter and smaller diameter implants, the use of photofunctionalization allowed for a faster loading protocol without compromising the success rate. The outcome was associated with the increased rate of implant stability development for photofunctionalized implants. The results suggest that photofunctionalization may provide a novel and practical avenue to further advance implant therapy.

种植复杂病例
解决方案
[UV光照种植体]

[出处:《种植牙医学》/第25卷第6期/Wolters Kluwer Health, Inc.]

紫外线照射功能对老龄鼠骨结合的效果

Effect of UV Photofunctionalization on Osseointegration in Aged Rats

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研究目的及方法

本研究评估了在衰老的生物学不利条件下光化处理对骨结合的效果。首先，对从幼龄鼠（8周龄）和老龄鼠（15月龄）的骨髓中获取的成骨细胞进行生物特性研究。然后将老龄鼠的成骨细胞移植到经过光化和未经光化的钛片上，并评估其初始细胞黏附力和成骨功能。将光化和未经光化的迷你钛种植体置入老龄鼠的股骨中，在愈合第2周时测量骨结合强度。分别用扫描电子显微镜检查法和X射线能量色散谱对种植体周围组织进行形态学检查和化学检查。

This study evaluated the effect of photofunctionalization on osseointegration under the biologically adverse conditions of aging. First of all, bone marrow–derived osteoblastic cells from young (8 weeks old) and aged (15 months old) rats were biologically characterized. Then, the osteoblasts from aged rats were seeded on titanium discs with and without photofunctionalization, and assessed for initial cell attachment and osteoblastic functions. Titanium mini-implants, with and without photofunctionalization, were placed in the femur of aged rats, and the strength of osseointegration was measured at week 2 of healing. Periimplant tissue was examined morphologically and chemically using scanning electron microscopy and energy dispersive x-ray spectroscopy, respectively.

研究结果

与幼龄鼠的细胞相比，老龄鼠细胞的生物功能明显下降。老龄鼠的细胞在光化钛上的细胞黏附力和成骨细胞功能表现明显比在未经处理的钛上的细胞黏附力和成骨细胞功能表现更强。此外，植入光化种植体的老龄鼠中，骨结合强度增强40%。光化种植体周围骨形成情况很好，钙、磷元素峰较强，而未经光化处理的种植体周围软组织的钙、磷信号比钛种植体更弱。体内结果和体外结果证实，光化处理是增强老龄鼠骨结合的有效手段。

Cells from the aged rats showed substantially reduced biological capabilities compared with those derived from young rats. The cells from aged rats showed significantly increased cell attachment and the expression of osteoblastic function on photofunctionalized titanium than on untreated titanium. In addition, the strength of osseointegration was increased by 40% in aged rats carrying the photofunctionalized implants. Robust bone formation was observed around the photofunctionalized implants with strong elemental peaks of calcium and phosphorus, whereas the tissue around untreated implants showed weaker calcium and phosphate signals than titanium ones. These in vivo and in vitro results corroboratively demonstrate that photofunctionalization is effective for enhancing osseointegration in aged rats.

光化处理的效果是通过三种机制实现的：（1）从种植体表面去除碳氢化合物；（2）表面疏水性向亲水性转化；（3）表面电荷由负电向正电转换。

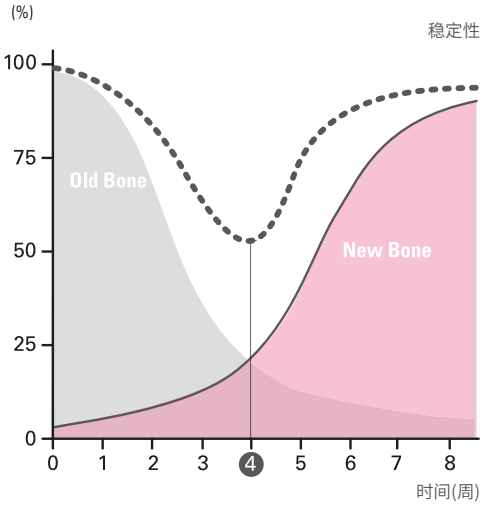
The effect of photofunctionalization is achieved by virtue of 3 mechanisms: (1)removal of hydrocarbons from an implant surface (2)conversion of surface hydrophobicity to hydrophilicity; and (3)conversion of surface charge from negative to positive.

UV种植体加快植体周围骨的骨结合

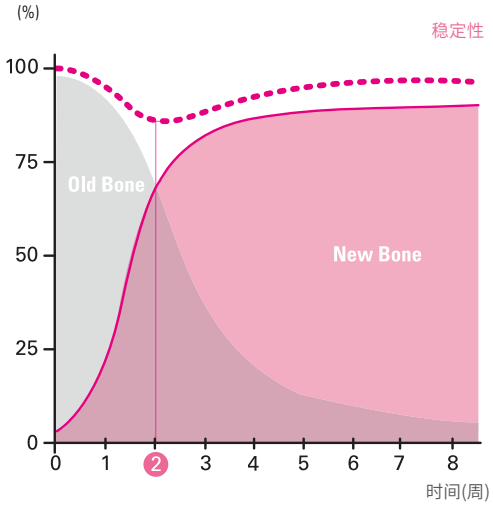
治疗时间缩短一半

一般种植体

UV种植体



植体植入4周之后，稳定性急剧下降，三个月以后才开始进入骨结合稳定期



快速的骨形成能使植体植入后2~4周进入骨结合稳定期

▼

可安装临时修复冠

临床论著

02

UV光照种植体长期稳定性
相关论文

UV光照种植体长期稳定性相关论文

[出处 :《临床口腔种植研究》25, 2014 / John Wiley & Sons A/S. 由Blackwell Publishing Ltd出版]

关于在长期愈合过程中光催化诱导亲水性对家兔骨重建影响的研究

Photocatalytically induced hydrophilicity influences bone remodelling at longer healing periods: A rabbit study

M. Hayashi / R. Jimbo / A. Wennerberg /Y. Xue / K. Mustafa / M. Andersson

研究目的及方法

我们之前已经报告过，涂于商用纯钛片上的具有光催化活性的锐钛型二氧化钛（TiO2）纳米粒子经紫外线照射后，亲水性显著提高。由于亲水性增强了骨结合，因此对体内反应产生了极大的兴趣。本研究的目的是评估植入时产生的光活化亲水性是否对骨结合较长的愈合期有影响。具有光催化活性的TiO2粉体（Degussa P-25）为纳米结构，大约包含80%锐钛矿和20%金红石。将该粉末旋转涂于商用纯钛片上，之后进行热处理。实验组（+UV）纯钛片（涂有P-25）经紫外线（UV）照射，对照组（－UV）则未经过紫外线照射，两组钛片均植入受试兔胫骨之中。愈合12周后，采用实时RT-PCR进行组织学分析和基因表达分析。

Previously, we have reported that photocatalytically active hydrophilicity of the anatase titanium dioxide (TiO2) nanoparticles coated onto commercially pure titanium discs presented significantly improved hydrophilicity after ultraviolet irradiation. As hydrophilicity has shown enhancement of osseointegration, the in vivo responses were of great interest. The aim of this study was to evaluate whether or not the photo-activated hydrophilicity generated at the time of implant placement has an effect on the longer healing periods for osseointegration. Photocatatytically active nanostructured TiO2 powder (Degussa P-25), which consists of approximately 80% anatase and 20% rutile, was spin-coated onto commercially pure titanium discs and was heat-treated thereafter. These P25-coated discs were irradiated with ultraviolet (UV) light for the test (+UV) group, and non-irradiated discs were prepared for the control (_UV) group. Both groups of discs were placed in the rabbits' tibiae. After 12 weeks of healing period, histological analysis and gene expression analysis using real-time RT-PCR were performed.

研究结果

组织学分析显示，经过12周的愈合，紫外线照射组和非照射组在骨形成方面没有定性和定量上的差异。然而，通过实时PT-PCR进行基因分析发现，+UV组骨重建活性显著增强；此时，抗炎细胞因子IL-10显著提高后，抑制了炎症和破骨反应。因此，“两组在愈合12周后不会有任何差异”的最初假设被否决了。由于光催化活化表面的作用仅局限于骨结合的初始阶段，因此本研究的结果可能表明，即使在愈合12周后，仍然存在生物强化效果。

Based on the histological analysis, after a healing period of 12 weeks, there seemed to be no qualitative and quantitative differences in bone formation between the UV-irradiated and non-irradiated groups. However, the genetic analysis using the real-time RT-PCR suggested that for the +UV group, osteogenesis was significantly enhanced in terms of active remodelling; at the same time, inflammatory and osteoclastic responses were suppressed as a result of significantly increased anti-inflammatory cytokine IL-10. Thus, the initial hypothesis that there would be no differences between the two groups after 12 weeks of healing was rejected. As it was believed that the effect of photocatalytically activated surface was restricted only to the initial stages of osseointegration, the results of this study may suggest that the biologically enhancing effect remained even after 12 weeks of healing time.

UV光照种植体长期稳定性相关论文

[出处 :《种植牙医学》/第25卷第6期/Wolters Kluwer Health, Inc.]

对种植体表面进行紫外线照射处理对种植体周围炎发展的影响—关于受试犬的初步研究

Effect of Ultraviolet Irradiation of the Implant Surface on Progression of Periimplantitisd: A Pilot Study in Dogs

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研究目的及方法

本项研究旨在从形态学角度研究受试犬体内经紫外线照射处理过的种植体所致种植体周围炎的进展情况。

将纯钛种植体（直径3.3mm，长8mm）置于受试犬颚骨双侧。使用照射装置（UV组）用紫外线光照射一侧种植体15分钟，而另一侧种植体（非UV组）不予照射。植入后90天，借助放射线照相术确认骨结合程度。施用牙线90天以上，诱导受试犬出现实验性种植体周围炎。90和180天后进行临床和影像学检查以及微型计算机断层扫描（显微CT），并测量骨吸收。通过光学显微镜检查组织切片中的骨-种植体结合面。

The objective of this study was to investigate morphologically the progression of periimplantitis around an ultraviolet (UV)-light-irradiated implant in dogs.

Pure titanium implants (3.3 mm in diameter and 8 mm long) were placed into dog jawbone bilaterally. Implants on one side were irradiated with UV light for 15 minutes using a photodevice immediately before placement (UV group), whereas those on the other side were not irradiated (non-UV group). Osseointegration was confirmed 90 days after implant placement by radiography. Experimental periimplantitis was induced by the application of dental floss over 90 days. Clinical and radiographic examination and micro–computed tomography (micro-CT) were performed after 90 and 180 days, and bone resorption was measured. The bone– implant interface in tissue sections was examined by light microscopy.

研究结果

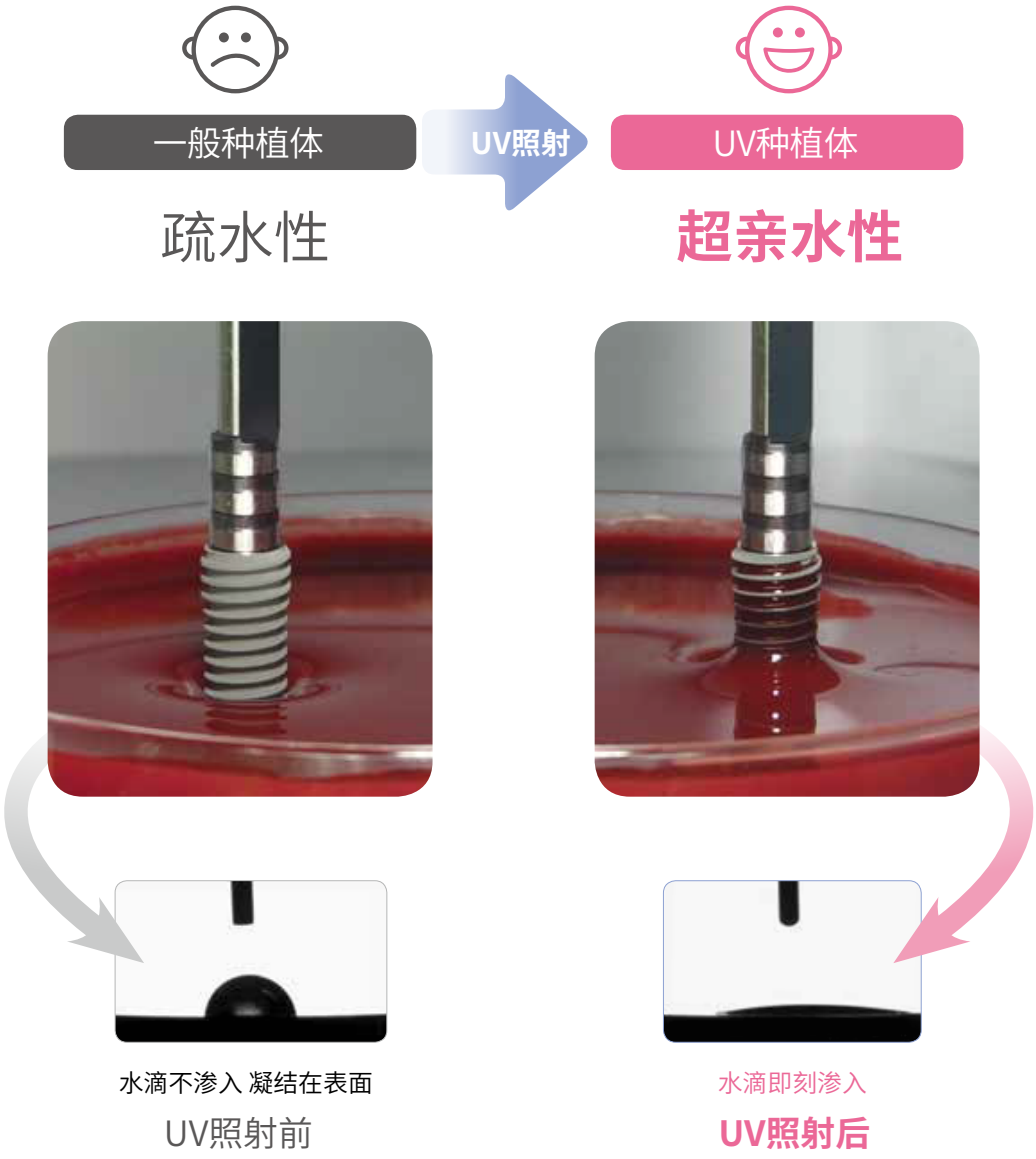
对于结扎诱导的种植体周围炎模型而言，经紫外线照射处理过的种植体周围的骨吸收不如未经紫外线照射处理过的种植体周围的骨吸收明显。

组织切片的组织学观察结果还表明，未经UV照射处理的种植体在骨-种植体结合面处未出现附着和部分破坏。因此，紫外线照射的种植体似乎会抑制种植体周围炎的自发进展。

Bone resorption around the UV-irradiated implant was less pronounced than around the non–UVirradiated implant in the ligatureinduced periimplantitis model.

Histological observation of tissue sections also revealed no attachment and partial destruction at the bone–implant interface in non–UV-irradiated implants. As a result, UV-light irradiation of implants seems to suppress spontaneous progression of periimplantitis.

表面处理过的植体快速吸收血液(超亲水性)
能够促进骨形成



临床论著

03

UV照射的生物学
稳定性及有效性相关论文

UV照射的生物学
稳定性及有效性
相关论文

[出处：《种植牙医学》/第22卷第1期/Lippincott Williams & Wilkins]

通过光化处理实现较高骨–种植体结合率以减少种植体周围应力： 三维有限元分析

High Bone-Implant Contact Achieved by Photofunctionalization to Reduce Periimplant Stress: A Three-Dimensional Finite Element Analysis

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研究目的及方法

最近一项研究表明，对钛种植体进行紫外线处理（光化功能）能够实现更高水平的骨结合。其中原理是光化种植体可使骨-种植体结合率（BIC）达98.2%，而未经处理种植体周围的BIC仅为53.0%。该研究主要研究BIC增加是否会影响种植体的机械应力以及其影响方式。光化功能报告对BIC不同（53.0%和98.2%）的种植体进行三维有限元分析，还测试了不同长度的种植体（7、10和13mm）。

recent study demonstrated that UV treatment of titanium implants (photofunctionalization) enabled a higher level of osseointegration by establishing a 98.2% boneimplant contact (BIC) as opposed to a 53.0% BIC around untreated implants. This study examined whether, and how, the BIC increase affects the periimplant mechanical stress. Three dimensional finite element analysis was performed on implants of different degrees of BIC (53.0% and 98.2%) based on the report of photofunctionalization. The different lengths of implants (7, 10, and 13 mm) were also tested.

研究结果

将种植体长度从7mm增加到13mm时，垂直负重下的种植体周围应力水平仅减少15%，而将BIC从53.0%增加到98.2%时，垂直负重下的种植体周围应力水平减少量达50%。因此，种植体为7mm和BIC为98.2%时，种植体周围应力甚至低于种植体为13mm和BIC为53.0%时的应力。BIC为98.2%时，种植体上均未出现当BIC为53.0%时所有长度种植体周围观察到的高应力区域，即使7mm的种植体上也未出现。在斜向负重作用下也获得了类似的结果。这项研究表明，若将BIC从53.0%增加到98.2%（可通过光化功能实现）比使用更长的种植体能更有效地改善种植体周围应力的分布和扩散，这为抵消应力诱发种植体边缘骨吸收提供了一种潜在的新策略。

Increasing the implant length from 7 to 13 mm diminished the periimplant stress level by only 15% under vertical load, whereas increasing BIC from 53.0% to 98.2% diminished it by 50%. Consequently, stress around 7-mm implants with 98.2% BIC was even lower than that around 13-mm implants with 53.0% BIC. High-stress areas, which were observed around implants in all lengths with 53.0% BIC, disappeared on implants with 98.2% BIC even on 7-mm implants. Similar results were obtained under oblique load. This study demonstrated that a BIC increase from 53.0% to 98.2%, which can be achieved by photofunctionalization, improves distribution and diffusion of periimplant stress more effectively than using longer implants, providing a potential novel strategy to counteract stressinduced periimplant marginal bone loss.

UV照射的生物学稳定性及有效性相关论文

[出处:Quintessence Publishing co, Inc. 2016 第31卷 第4期]

自发成形纳米结构紫外线照射钛种植体的体内骨反应：关于家兔的实验研究

The In Vivo Bone Response of Ultraviolet-Irradiated Titanium Implants Modified with Spontaneously Formed Nanostructures: An Experimental Study in Rabbits

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研究目的及方法

玻璃蚀刻法与水溶液储存相结合可诱导钛表面上自发形成纳米结构，但纳米结构演变的同时可能会出现生物降解。本研究旨在研究紫外线（UV）辐射是否能有效解决这一问题并进一步提高生物活性。

本研究中分析了五组钛种植体（SLAnew、SLAold、modSLA、UV-SLA和UV-modSLA）的表面特征及其体内骨响应。用接触角测量结果、扫描电子显微镜和X射线光子光谱评估表面特征。总共将160个种植体（每组32个）插入40只家兔的胫骨干骺端和股骨髁中。在3周和6周后，对家兔实施安乐死，进行旋出扭矩实验和组织形态学分析。

Acid etching in conjunction with storage in an aqueous solution can induce nanostructures forming spontaneously on titanium surfaces, but an inevitable biologic degradation is suspected to accompany the evolution of nanostructures. The aim of this study was to investigate whether ultraviolet (UV) irradiation is effective to solve this problem and further enhance the bioactivity.

Surface characteristics of five groups of titanium implants (SLAnew, SLAold, modSLA, UV-SLA, and UV-modSLA) and their in vivo bone response were analyzed in this study. The surface characteristics were evaluated with contact angle measurements, scanning electron microscopy, and x-ray photon spectroscopy. A total of 160 implants (32 for each group) were inserted into the tibial metaphyses and femoral condyles of 40 rabbits. After 3 and 6 weeks, the rabbits were euthanized for removal torque tests and histomorphometric

研究结果

在贮水表面观察到自发形成的纳米结构，直径大小约为15nm，并且随着纳米结构的演变，不可避免地出现了碳氢化合物污染。UV辐射有效地消除了伴随纳米结构演变的烃污染。UV-modSLA种植体的旋出扭矩实验值最高，并且经UV照射的种植体的骨与种植体接触面积和骨面积更高。结论：紫外线照射可以有效地消除伴随纳米结构演变的碳氢化合物污染，并进一步增强骨结合。纳米结构和紫外线处理在增强钛和骨的结合强度方面具有综合效果，而紫外光化功能对组织学和组织形态学性能的影响明显更大。

Spontaneously formed nanostructures were observed on water-stored surfaces with a size of approximately 15 nm in diameter, and an inevitable contamination of hydrocarbons accompanied the evolution of nanostructures. UV irradiation effectively eliminated hydrocarbon contamination that accompanied nanostructure evolution. UV-modSLA implants showed the highest removal torque value, and UV-irradiated implants exhibited higher bone-to-implant contact and bone area. Conclusion: UV irradiation can effectively eliminate the hydrocarbon contamination accompanying the evolution of nanostructures and further enhance the osseointegration. Nanostructures and UV treatment have combined effects in enhancing the interfacial strength between titanium and bone, while UV photofunctionalization has much more overwhelming effects on histologic and histomorphometric performance.

UV照射的生物学稳定性及有效性相关论文

[出处 :Quintessence Publishing co, Inc. 2015 第30卷 第4期]

紫外光化功能对矫正微型骨钉生物学性能和支抗能力的影响

Effect of UV Photofunctionalization on Biologic and Anchoring Capability of Orthodontic Miniscrews

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研究目的及方法

用紫外线处理钛种植体（经处理后立即使用）或将钛种植体进行光化，可提高种植牙的生物学特性和临床性能，这一方法正获得广泛支持。

本研究旨在检查光化功能对矫正微型骨钉的生物学性能和机械支抗能力的影响。

将未经处理的和经光化作用处理的Ti-6Al-4V矫正微型骨钉植入大鼠股骨中。在植入前，立即采用一个照射装置用紫外光对微型骨钉进行12分钟的光化处理。手术部位愈合3周后，横向推动微型骨钉，测量微型骨钉应对倾翻力的抵抗力。

同时，使用扫描电子显微镜和能量色散光谱法评估微型骨钉周围形成组织的形态和化学性质。分别在经过和没有经过光化功能处理的Ti-6Al-4V盘上培养来源于大鼠骨髓的成骨细胞。对附着于盘上的成骨细胞数量和成骨细胞行为、碱性磷酸酶活性和矿化能力进行评估。

Treatment of titanium with UV light immediately before use, or photofunctionalization, is gaining traction as a simple method to improve the biologic capability and clinical performance of dental implants.

The objective of this study was to examine the effect of photofunctionalization on the biologic capability and mechanical anchorage of orthodontic miniscrews.

Untreated and photofunctionalized Ti-6Al-4V orthodontic miniscrews were placed into rat femurs. Photofunctionalization was performed by treating miniscrews with UV light for 12 minutes using a photo device immediately before placement. After 3 weeks of healing, miniscrews were pushed laterally to measure the resistance against the tipping force.

The miniscrews were also evaluated for morphology and chemistry of tissue formed around them using scanning electron microscopy and energy dispersive spectroscopy. Rat bone marrow–derived osteoblasts were cultured on Ti-6Al-4V disks with and without photofunctionalization. The number of osteoblasts attached to the disks and the behaviors, alkaline phosphatase activity, and mineralization capability of osteoblasts were evaluated.

研究结果

本研究探讨UV处理（或光化功能）对矫正微型骨钉支抗能力的影响。使用前，立即采用UV光对骨钉内Ti-6Al-4V合金片进行光化12分钟。Ti-6Al-4V表面经光化后，由疏水性变成了超亲水性。体内生物力学实验表明，微型骨钉经光化处理后，在相同侧翻力情况下，位移减少30%至40%。支抗增强与依附、初始扩散行为、粘附增强以及光化处理Ti-6Al-4V圆盘上培养的成骨细胞的功能表型表达有关。这些结果综合一致地表明，光化功能提高了Ti-6Al-4V的生物活性，增强了矫正骨钉的支抗能力。

This study examined the effect of UV treatment, or photofunctionalization, on the anchoring capability of orthodontic miniscrews. Photofunctionalization was performed by treating Ti-6Al-4V alloy in screw and disk forms with UV light for 12 minutes immediately before their use. Ti-6Al-4V surfaces were converted from hydrophobic to superhydrophilic after photofunctionalization. In vivo biomechanical testing revealed that photofunctionalized miniscrews were displaced 30% to 40% less under lateral tipping force than untreated miniscrews. The increased anchorage was associated with enhanced attachment, initial spreading behavior, adhesion, and expression of functional phenotypes of osteoblasts cultured on photofunctionalized Ti-6Al-4V disks. These results comprehensively and consistently suggest that photofunctionalization increases the bioactivity of Ti-6Al-4V and increases the anchoring capability of orthodontic miniscrews.

UV照射的生物学稳定性及有效性相关论文

[出处:《口腔与上颌面植入国际杂志》Quintessence Publishing co, Inc.]

钛种植体紫外线光化功能
Ultraviolet Photofunctionalization of Titanium Implants

Takahiro Ogawa博士（牙科博士）

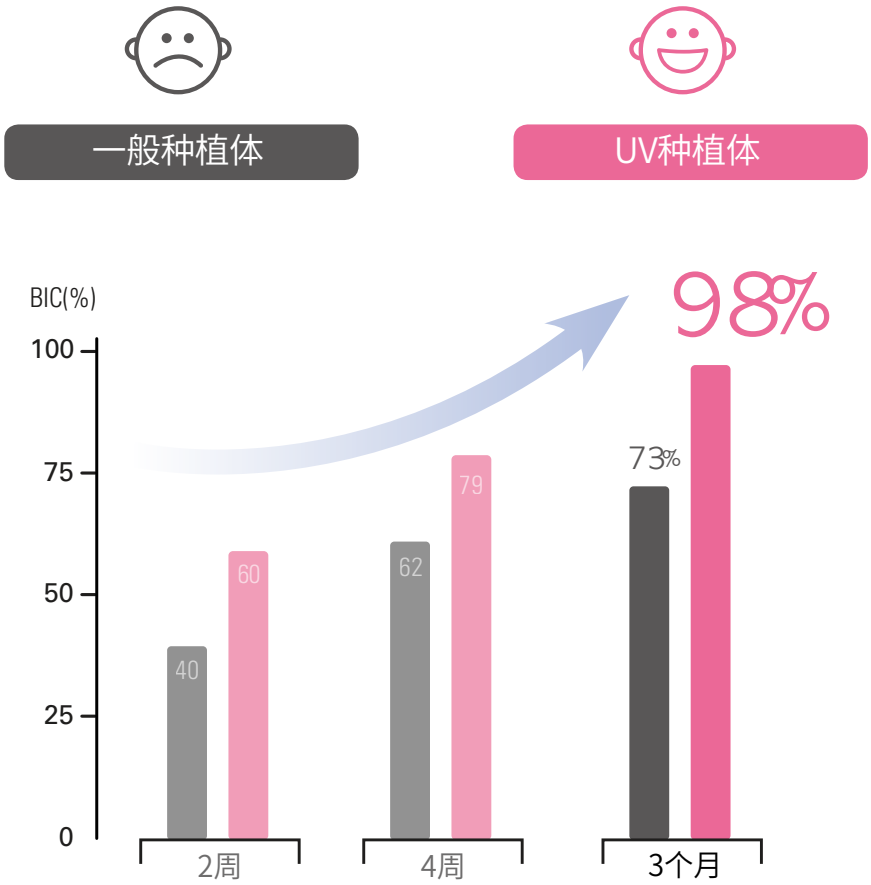
研究结果

面对对种植治疗日益增长的需求和随之而来的挑战，需要具有更好生物功能的种植体表面。本文综述了近年来有关钛紫外线（UV）光化功能体外体外研究的进展。UV光化功能是指经过UV处理后钛表面发生改变的一种整体现象，其中包括物化特性改变和生物性能增强。在动物模型中，与未经处理的对照种植体相比，经UV处理的钛种植体周围的骨形态发生明显改善，骨头快速彻底结合，骨-种植体结合率几乎达到100%，而未处理的种植体中低于55%。一系列体外研究表明，从动物和人体中提取的骨原细胞经UV处理后，粘附力、保留率、和后续功能级联大大增强。UV处理改变了钛表面性质（疏水至超亲水），不可避免地移除了受污染的碳氢化合物。经过UV处理的钛表面也表现出独特的静电状态，在不借助离子和有机桥梁的情况下，直接充当细胞引诱剂，由此一直视作生物惰性材料的钛便具有了一种新的物理化学功能。UV处理简单，成本低，已被证明对所有测试钛表面有效。这些数据表明，UV光化功能是一种新型有效的措施，可以提高种植体治疗在牙科和骨科的应用。

In the face of growing demands and challenges in implant therapy, implant surfaces with improved biologic capabilities are required. This review paper summarizes the findings of recent in vitro and in vivo studies related to ultraviolet (UV) photofunctionalization of titanium. UV photofunctionalization is defined as an overall phenomenon of modification of titanium surfaces occuring after UV treatment, including the alteration of physicochemical properties and the enhancement of biologic capabilities. Bone morphogenesis around UV-treated titanium implants is distinctly improved compared with that seen around untreated control implants, leading to rapid and complete establishment of osseointegration with nearly 100% bone-toimplant contact in an animal model, as opposed to less than 55% for untreated implants. A series of in vitro studies demonstrated considerable enhancement of attachment, retention, and subsequent functional cascades of osteogenic cells derived from animals and humans after UV treatment. UV treatment converts titanium surfaces from hydrophobic to superhydrophilic and removes unavoidably contaminated hydrocarbons. UV-treated titanium surfaces also manifest a unique electrostatic status and act as direct cell attractants without the aid of ionic and organic bridges, which imparts a novel physicochemical functionality to titanium, which has long been understood as a bioinert material. UV treatment is simple and low in cost, and it has been proven effective for all types of titanium surfaces tested. These data suggest that UV photofunctionalization can be a novel, effective measure to improve implant therapy in the dental and orthopedic fields.

骨形成稳定、骨结合强度高

种植手术失败率低



UV Active植体通过快速的骨再生，提高骨和种植体表面接触面积(BIC)，让骨形成更稳定、骨质更强韧。

UV 临床论著