

# 肌腱损伤的修复材料★

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## Materials for repair of tendon injury

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### Abstract

**BACKGROUND:** Currently, there are many problems that need to be solved in tendon repair research, including mechanism research of tendon suture and adhesion, exaltation the quality of tendon healing, improvement of suture materials and methods, study on tensile strength between joint of tendon, as well as biomaterials of tissue-engineered tendon. These are important issues that affect the research and development of tendon repair.

**OBJECTIVE:** To assess the trend of the academic literature in the field of the material for repair of tendon injuries and to provide reference for depth analysis by using Web of Science database.

**DESIGN:** Bibliometric data analysis.

**DATA RETRIEVAL:** An electronic search was performed by the first author in Web of Science database for related literature of material in repair of tendon injury using the key words of "tendon injury", "material" and "repair", from 2002-01 to 2011-12, to describe its distribution characteristics.

**SELECTION CRITERIA:** Peer-reviewed study on material for repair of tendon injuries of published literature, including the type of document of article, review, proceeding paper. Exclusive criteria: ①The article need to be collected by manual searches and phone retrieval. ②Unpublished papers. ③Correction.

**MAIN OUTCOME MEASUREMENTS:** In SCI database, academic journal articles published year, literature number, subject category, type of document, authors, source journals, proceeding paper, institutions, distribution of the country and region, distribution of the funds, language of Journal, literature citations were analyzed.

**RESULTS:** ①A total of 156 research literature related to material for repair of tendon injuries were retrieved in Web of Science database in the past 10 years. There are 141 articles and 13 reviews. From the trends of the number of literature, the number of papers was gradually increased. The number of related literatures in this field reached a peak in 2009 ( $n=28$ ). The studies were focused on bone science and surgery, followed by sports science and engineering. ②*American Journal of Sports Medicine*, *Foot Ankle International* and *Archives of Orthopaedic and Trauma Surgery* were three journals that published most of articles on repair of tendon injury. Most literatures were published by United States, accounting for 42.9% of all literatures. China ranked the 5<sup>th</sup> in the number of literature in past 10 years ( $n=9$ , 5.8%). ③Researches on materials for repair of tendon injuries were mainly supported by NIH. The articles with highest citations were mainly published on *Journal of Cellular Physiology* and *Cytokine & Growth Factor Reviews*.

**CONCLUSION:** Literature analysis shows that repair materials for tendon injuries tend to be mature in recent years; the number of literature is steady and shows an increasing trend, which is the focus research in orthopedics, surgery and sports medicine.

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### 摘要

**背景:** 目前肌腱修复研究需要解决的问题很多, 如肌腱缝合与粘连的机制研究, 提高肌腱愈合质量研究, 缝合材料与方法的改进, 肌腱缝合处的抗张强度研究, 组织工程肌腱的生物材料研究等, 这些都是影响肌腱修复研究发展的重要问题。

**目的:** 通过对汤森路透 Web of Science 数据库收录 2002/2011 有关肌腱损伤修复材料相关文献的献计量学分析, 评估该领域学术文献的总体趋势, 为该领域的深入研究提供参考。

**设计:** 文献计量学分析。

**资料提取:** 由第一作者以电子检索方式对汤森路透 Web of Science 数据库 2002-01/2011-12 肌腱损伤修复材料研究的文献进行分析, 采用检索词为 "tendon injury(肌腱损伤), material(材料), repair(修复)", 对检索的相关文献运用数据库中自带的分析功能和 Excel 软件绘制图表的功能进行分析, 描述其分布特征。

**入选标准:** 纳入经同行评议的肌腱损伤修复材料研究已发表的文献, 包括研究原著、综述和会议的文献类型。排除: ①需采用手工检索和电话检索方式收集的文章。②未正式出版的文章。③在收录数量之外排除勘误类文献类型。

**主要数据的判定指标:** 以 SCI 数据库相关文献出版时间、文献的数量、学科分类、文献类型、发文量较多的作者、来源出版物、会议、发文量较多的机构、国家地区分布、基金资助情况、文献语种和被引频次进行分析。

**结果:** ①汤森路透 Web of Science 数据库过去 10 年共收录肌腱损伤修复材料研究相关文献 156 篇。从文献发表数量的趋势上看, 总体呈现出逐步上升的状态, 2009 年收录该领域的相关文献达到顶峰, 为 28 篇。其中研究原著类文章共收录 141 篇, 综述类文章 13 篇。研究文字的学科领域集中在骨科学和外科学方向, 其次为运动科学和工程学。②目前发表量较多的出版物为 *American Journal of Sports Medicine* 《美国运动医学杂志》、*Foot Ankle International* 《足与踝国际杂志》和 *Archives of Orthopaedic and Trauma Surgery* 《矫形外科与创伤外科学文献集》。发表文献的国家以美国为主, 占全球相关领域发稿量的 42.9%。中国在过去 10 年间被收录文章总量位居第 5 名, 共发表 9 篇相关文章, 占全球相关文章的 5.8%。③肌腱损伤修复材料研究相关文献的基金以 NIH 资助为主。最高被引频次文章主要发表在 *Journal of Cellular Physiology* 《细胞生理学杂志》和 *Cytokine & Growth Factor Reviews* 《细胞分裂与生长因子评论》等期刊上。

**结论:** 文献分析显示, 近年来肌腱损伤修复材料的研究趋于成熟, 发文量稳定并且呈逐渐上升趋势, 是目前骨科、外科和运动医学领域的研究热点。

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## 0 引言

肌腱损伤是最常见的运动损伤, 损伤的机率高, 致残率也高。公元 10 世纪, 阿拉伯医生 Avicenne 首次报导了肌腱的缝合技术。1752 年, 法国医生 Albercht 在解剖学上证实了肌腱与神经组织的不同, 同时报道了临床肌腱缝合技术的成功。从此, 肌腱可以缝合修复的概念被广泛采用。随着肌腱缝合技术的开展, 肌腱粘连的问题一直困扰着研究者们, 大部分学者认为, 肌腱修复后组织愈合随周围组织长入的过程, 也就是组织粘连的过程, 认为粘连是肌腱愈合中必然产生的组织产物。

近年来, 组织工程肌腱的出现使肌腱修复研究取得很大的发展, 用于肌腱组织工程的材料主要有天然生物材料和合成高分子材料及两者的复合物, 天然高分子材料主要有胶原蛋白、纤维蛋白、壳聚糖、藻酸盐以及动物筋膜等, 合成高分子材料主要有碳纤维、聚乳酸、聚羟基乙酸和两者的共聚物, 两类材料各具优缺点, 利用两类材料性能上的互补有望构建较理想的细胞支架。目前, 组织工程肌腱在种子细胞性能研究、种子细胞与基质材料复合物构建及促细胞生长分化研究等方面均取得重要的进展。

本文对汤森路透 Web of Science 数据库文献计量学进行分析, 并结合应用文献计量学的定量分析结果, 帮助中国的肌腱损伤修复材料研究工作者了解目前这一领域的国际研究动态和发展趋势。

## 1 资料和方法

### 1.1 资料来源

检索数据库: 文献分析数据来源于汤森路透 Web of Science 数据库。Web of Science 是世界上最有影响的大型综合性、多学科、核心期刊的学术文献文摘索引数据库, 由美国汤姆森科技信息集团开发, 包括美国科学情报研究所 (Institute for Scientific Information) 三大引文数据库的网络版 Science Citation Index

Expanded(简称 SCI, 1994-present)、Social Sciences Citation Index(简称 SSCI, 1997-present) 和 Arts & Humanities Citation Index(简称 A&HCI, 1997-present)。引文子数据库 (Science Citation Index Expanded) 收录了 10 000 多种世界权威的、高影响力的学术期刊, 内容涵盖自然科学、生物医学、生命科学等领域, 最早回溯到 1899 年。

检索时间范围: 2002-01/2011-12。

检索关键词: tendon injury(肌腱损伤), material(材料), repair(修复)。

### 1.2 入选标准

纳入标准: 经同行评议的肌腱损伤修复材料研究已发表的文献, 包括研究原著、综述和会议的文献类型。

排除标准: ①需采用手工检索和电话检索方式收集的文章。②未正式出版的文章。③在收录数量之外排除勘误类文献类型。

1.3 分析方法 本文使用的分析方法是 Web of Science 数据库自带的分析功能和 Excel 软件的绘图功能相结合, 从时间分布、地区分布、机构分布、学科分类和文献类型等对肌腱损伤修复材料研究相关文献进行统计和计量分析。

## 2 结果

### 2.1 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究文献分析

#### 2.2.1 相关文献数量分析 见图 1。

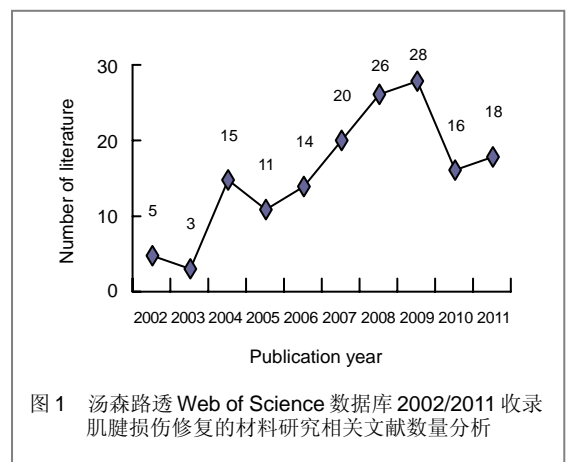


图 1 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究相关文献数量分析

近 10 年来, SCI 数据库收录肌腱损伤修复的材料研究相关文献共 156 篇, 从文献数量的趋势上看, 总体呈现出逐步上升的状态, 发文量最多是在 2009 年, 发表文献 28 篇, 占全部文献量的 17.9%。

### 2.2.2 文献学科分类情况 见表 1。

表 1 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究相关文献的学科分布

Subject category	Record publication	Count % of total publication
Orthopedics	82	52.6
Surgery	62	39.7
Sport Sciences	24	15.4
Engineering	11	7.1
Radiology Nuclear Medicine Medical Imaging	8	5.1
General Internal Medicine	7	4.5
Cell Biology	6	3.8
Materials Science	6	3.8
Emergency Medicine	5	3.2

文献的学科分类结果可能会有交叉学科的现象出现, 但并不影响对结果的分析。由表 2 可见, 肌腱损伤修复材料研究涉及最多的是骨科学, 共有文献 82 篇。

### 2.2.3 文献的来源出版物分布 见表 2。

表 2 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究发文量  $\geq 4$  篇的来源出版物

Journal	杂志中文名	Record count	Count % of total publication
<i>American Journal of Sports Medicine</i>	《美国运动医学杂志》	11	7.1
<i>Foot Ankle International</i>	《足与踝国际杂志》	10	6.4
<i>Archives of Orthopaedic and Trauma Surgery</i>	《矫形外科与创伤外科学文献集》	9	5.8
<i>Journal of Hand Surgery American Volume</i>	《美国手外科杂志》	7	4.5
<i>Revue De Chirurgie Orthopedique Et Reparatrice De L Appareil Moteur</i>	《矫形外科与运动器官修复杂志》	7	4.5
<i>Journal of Orthopaedic Research</i>	《骨科研究杂志》	6	3.8
<i>Journal of Shoulder and Elbow Surgery</i>	《肩与肘外科学杂志》	5	3.2
<i>ACTA Chirurgiae Orthopaedicae Et Traumatologiae Cechoslovaca</i>	《外科矫形学报》	4	2.6
<i>Biomaterials</i>	《生物材料》	4	2.6
<i>Journal of Surgical Research</i>	《外科研究杂志》	4	2.6
<i>LASERS in Surgery and Medicine</i>	《激光在外科与内科中的应用》	4	2.6

肌腱损伤修复的材料研究发文量  $\geq 4$  篇的来源出版物共 11 种, *American Journal of Sports Medicine* 《美国运动医学杂志》发表文献量最多, 发表文献为 11 篇, 占全部文献的 7.1%。通过来源期刊的统计分析, 可帮助从事肌腱损伤修复的材料研究人员及时了解和掌握该国际研究领域的核心出版物, 确定跟踪研究的文献基础; 同时可以用于指导投稿, 指导研究者尽可能选择学

科类别, 收录相关文献量大、收录侧重与研究内容相一致的期刊, 提高投稿命中率, 有利于在本领域扩大研究成果的影响范围。

2.2.4 相关文献研究类型分析 文献类型分析结果也存在交叉现象, 在收录的 156 篇肌腱损伤修复的材料研究文献中, 研究原著类文献有 141 篇, 占全部文献的 90.4%。综述类文献共发表 13 篇, 占全部文献的 8.3%。另外, 数据库还收录了 5 篇会议文章。

### 2.2.5 文献作者分析, 见表 3。

表 3 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究的文献作者分析

Author	Record count	Count % of total publication
OBUTLER DL	4	2.6
CHANG J	4	2.6
FUNG DTC	4	2.6
NG GYF	4	2.6
SILVA MJ	4	2.6
GELBERMAN RH	3	1.9
LEUNG MCP	3	1.9
LINDSEY DP	3	1.9

### 2.2.6 会议文献分析 见表 4。

表 4 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究的会议文献分析

Titel	Author	Publication year	Meeting
Stiffness comparison of coracoclavicular ligament and anatomic reconstruction complexes: Overall and individual complex components <sup>[1]</sup>	Costic RS, Labria JE, Rodosky MW, et al.	2003	ASME INTERNATIONAL MECHANICAL ENGINEERING CONGRESS
Muscle force and power following tendon repair at altered tendon length <sup>[2]</sup>	Krochmal Daniel J, Kuzon William M. Jr, Urbanchek Melanie G.	2004	49TH ANNUAL MEETING OF THE PLASTIC SURGERY RESEARCH COUNCIL
Functional tissue engineering parameters toward designing repair and replacement strategies <sup>[3]</sup>	Butler DL, Shearn JT, Juncosa N, et al.	2004	CARL T BRIGHTON ANNUAL WORKSHOP
Recurrent symptoms after shoulder instability repair: Direct MR arthrographic assessment-correlation with second-look surgical evaluation <sup>[4]</sup>	Probyn Linda J, White Lawrence M, Salonen David C, et al.	2005	91ST SCIENTIFIC ASSEMBLY AND ANNUAL MEETING OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA
Long-term survivorship and outcomes after surgical repair of full-thickness rotator cuff tears <sup>[5]</sup>	Millett Peter J, Horan Marilee P, Maland Katie E, et al.	2009	CONFERENCE ON AMERICAN SHOULDER ELBOW SURGEONS

会议文献共 5 篇, 文献 Functional tissue engineering parameters toward designing repair and replacement strategies 被引 26 次, 文献 Recurrent symptoms after shoulder instability repair: Direct MR arthrographic assessment-correlation with second-look surgical evaluation 被引 16 次。

2.2.7 相关文献的机构分布 见表 5。

表 5 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究文献的机构分布

Institutions	Record count	Count % of total publication
STANFORD UNIV	5	3.2
WASHINGTON UNIV	5	3.2
HONG KONG POLYTECH UNIV	4	2.6
UNIV CINCINNATI	4	2.6
UNIV PITTSBURGH	4	2.6
CLEVELAND CLIN	3	1.9
UNIV TORONTO	3	1.9
CHONNAM NATL UNIV	2	1.3
COLORADO STATE UNIV	2	1.3
DOKUZ EYLUL UNIV	2	1.3
DREXEL UNIV	2	1.3
DUKE UNIV	2	1.3
DUNEDIN PUBL HOSP	2	1.3
STEADMAN HAWKINS CLIN CAROLINAS	2	1.3
THOMAS JEFFERSON UNIV HOSP	2	1.3
UNIV CALIF SAN DIEGO	2	1.3
UNIV N CAROLINA	2	1.3
UNIV TOKYO	2	1.3
UNIV WASHINGTON	2	1.3
UNIV ZURICH HOSP	2	1.3

目前肌腱损伤修复的材料研究已发表的文献以 STANFORD UNIV 美国史丹佛大学和 WASHINGTON UNIV 美国华盛顿大学为主, 各占全球相关领域发稿量的 3.2%; 此外, HONG KONG POLYTECH UNIV 香港理工大学、UNIV CINCINNATI 美国辛辛那提大学以及 UNIV PITTSBURGH 美国匹兹堡大学的发稿量也较多。

美国史丹佛大学发表文章的被引情况:

Pectoralis Major Tendon Rupture: A Biomechanical Analysis of Repair Techniques<sup>[6]</sup>. 作者 Hart Nathan D, Lindsey Derek P, McAdams Timothy R. 没有被引, 发表时间为 2011 年, 来源出版物 *Journal of Orthopaedic Research* 《矫形研究杂志》。

Three-Dimensional-Construct Bioreactor Conditioning in Human Tendon Tissue Engineering<sup>[7]</sup>. 作者 Woon Colin Y. L, Kraus Armin, Raghavan Shyam S, et al. 引频次 2 次, 发表时间为 2011 年, 来源出版物 *Tissue Engineering Part A* 《组织工程》。

Flexor Tendon Tissue Engineering: Bioreactor Cyclic Strain Increases Construct Strength<sup>[8]</sup>. 作者 Saber Sepideh, Zhang Andrew Y, Ki Sae H, et al. 被引频次 13 次, 发表时间为 2010 年, 来源出版物 *Tissue*

*Engineering Part A* 《组织工程》。

Flexor Tendon Tissue Engineering: Temporal Distribution of Donor Tenocytes versus Recipient Cells<sup>[9]</sup>. 作者 Thorfinn Johan, Saber Sepideh, Angelidis Ioannis K, et al. 被引频次 5 次, 发表时间为 2009 年, 来源出版物 *Plastic and Reconstructive Surgery* 《整形与改造外科学》。

Flexor Tendon Tissue Engineering: Acellularized and Reseeded Tendon Constructs<sup>[10]</sup>. 作者 Chong Alphonsus K. S, Riboh Jonathan, Smith R. Lane, et al. 被引频次 11 次, 发表时间为 2009 年, 来源出版物 *Plastic and Reconstructive Surgery* 《整形与改造外科学》。

美国华盛顿大学发表文章的被引情况:

Use of a Magnesium-Based Bone Adhesive for Flexor Tendon-to-Bone Healing<sup>[11]</sup>. 作者 Thomopoulos Stavros, Zampiakis Emmanouil, Das Rosalina, et al. 被引频次 2 次, 发表时间为 2009 年, 来源出版物 *Journal of Hand Surgery-American Volume* 《美国手外科杂志》。

Biomechanical evaluation of 2 techniques for ulnar collateral ligament reconstruction of the elbow<sup>[12]</sup>. 作者 Paletta George A. Jr, Klepps Steven J, Difelice Gregory S, et al. 被引频次 11 次, 发表时间为 2006 年, 来源出版物 *American Journal of Sports Medicine* 《美国运动医学杂志》。

Zone I flexor digitorum profundus repair: An ex vivo biomechanical analysis of tendon to bone repair in cadavera<sup>[13]</sup>. 作者 Dovan TT, Gelberman RH, Kusano N, et al. 被引频次 8 次, 发表时间为 2005 年, 来源出版物 *Journal of Hand Surgery-American Volume* 《美国手外科杂志》。

香港理工大学发表文章的被引情况:

The combined treatment effects of therapeutic laser and exercise on tendon repair<sup>[14]</sup>. 作者 Ng Gabriel Y.F, Fung Dicky T.C. 被引频次 6 次, 发表时间为 2008 年, 来源出版物 *Photomedicine and LASER Surgery* 《光医学与激光外科学》。

Ultrastructural comparison of medial collateral ligament repair after single or multiple applications of GaAIs laser in rats<sup>[15]</sup>. 作者 Ng GYF, Fung DTC, Leung MCP, et al. 被引频次 11 次, 发表时间为 2004 年, 来源出版物 *LASERS in Surgery and Medicine*. 《激光在外科与内科中的应用》。

Comparison of single and multiple applications of GaAIs laser on rat medial collateral ligament repair<sup>[16]</sup>. 作者 Ng GYF, Fung DTC, Leung MCP, et al. 被引频次 20 次, 发表时间为 2004 年, 来源出版物

LASERS in Surgery and Medicine.《激光在外科与内科学中的应用》。

Effects of a therapeutic laser on the ultrastructural morphology of repairing medial collateral ligament in a rat model<sup>[17]</sup>. 作者 Fung DTC,Ng GYF,Leung MCP,et al.被引频次 29 次, 发表时间为 2003 年, 来源出版物 LASERS in Surgery and Medicine.《激光在外科与内科学中的应用》。

美国辛辛那提大学发表文章的被引情况:

Mechanical stimulation of tendon tissue engineered constructs: Effects on construct stiffness, repair biomechanics, and their correlation<sup>[18]</sup>. 作者 Shearn Jason T,Juncosa-Melvin Natalia,Boivin Gregory P,et al.被引频次 22 次, 发表时间为 2007 年, 来源出版物 Journal of Biomechanical Engineering-Transactions of the ASME《生物力学工程杂志》。

Effect of length of the engineered tendon construct on its structure-function relationships in culture<sup>[19]</sup>. 作者 Nirmalanandhan Victor S,Rao Marepalli,Sacks Michael S,et al.被引频次 11 次, 发表时间为 2007 年, 来源出版物 Journal of Biomechanics《生物力学杂志》。

Effects of age on the repair ability of mesenchymal stem cells in rabbit tendon<sup>[20]</sup>. 作者 Dressler MR,Butler DL,Boivin G.被引频次 30 次, 发表时间为 2005 年, 来源出版物 Journal of Orthopaedic Research《矫形研究杂志》。

Functional tissue engineering parameters toward designing repair and replacement strategies<sup>[21]</sup>. 作者 Butler DL,Shearn JT,Juncosa N,et al.被引频次 26 次, 发表时间为 2004 年, 来源出版物 Clinical Orthopaedics and Related Research《临床矫形学及相关学科研究》。

美国匹兹堡大学发表文章的被引情况:

Effect of length of the engineered tendon construct on its structure-function relationships in culture<sup>[22]</sup>. 作者 Nirmalanandhan Victor S,Rao Marepalli,Sacks Michael S,et al.被引频次 11 次, 发表时间为 2007 年, 来源出版物 Journal of Biomechanics《生物力学杂志》。

Extracellular matrix scaffolds are repopulated by bone marrow-derived cells in a mouse model of Achilles tendon reconstruction<sup>[23]</sup>. 作者 Zantop T,Gilbert TW,Yoder MC,et al.被引频次 53 次, 发表时间为 2006 年, 来源出版物 Journal of Orthopaedic Research《矫形研究杂志》。

Biomechanics of knee ligaments: injury, healing,

and repair<sup>[24]</sup>. 作者 Woo SLY,Abramowitch SD,Kilger R,et al.被引频次 60 次, 发表时间为 2006 年, 来源出版物 Journal of Biomechanics《生物力学杂志》。

Stiffness comparison of coracoclavicular ligament and anatomic reconstruction complexes: Overall and individual complex components<sup>[25]</sup>. 作者 Costic RS,Labriola JE,Rodosky MW,et al.没有被引, 发表时间为 2003 年, 来源出版物 Advances in Bioengineering《生物工程进展》。

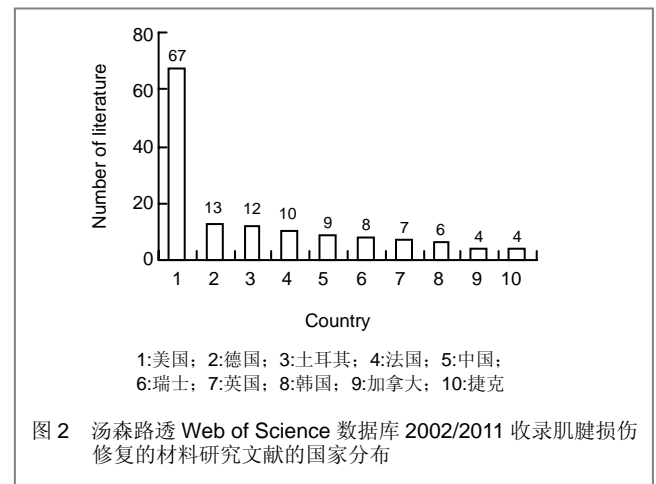
2.2.8 相关基金分析 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复的材料研究的基金项目共 42 项, NATIONAL INSTITUTES OF HEALTH( NIH 基金) 和 VA MEDICAL MERIT REVIEW AWARD(弗吉尼亚州医疗价值评论奖)基金资助文献各 2 篇。

2.2.9 文献语种 见表 6。

表 6 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复材料研究文献的语言种类

Language	Record count	% of total publication
ENGLISH	133	85.3
FRENCH	9	5.8
UNSPECIFIED	9	5.8
GERMAN	4	2.6
CZECH	1	0.6

2.2.10 文献的国家分布 见图 2。



目前, 肌腱损伤修复的材料研究已发表的文献以美国为主, 占全球相关领域发稿量的 42.9%。德国被收录文章总量排在第 2 名, 共发表 13 篇, 占全球相关文章的 8.3%。土耳其收录文章排在第 3 名, 共发表 12 篇相关文章, 占全球相关文章的 7.7%。法国、中国、瑞士、英国、韩国发文量分别为 10、9、8、7、6 篇。加拿大、捷克、印度、日本、瑞典分别发表文献 4 篇, 各占全球相关文章的 2.6%。其余国家发文量均不足 4 篇。中国作者发表的肌腱损伤修复材料研究文献, 见表 7。

表 7 汤森路透 Web of Science 数据库 2002/2011 收录中国作者发表的肌腱损伤修复材料研究文献情况

Title	Author	Journal	Publication year	Total citation	Impact factor
An Experimental Study on the Effect of Safflower Yellow on Tendon Injury-Repair in Chickens <sup>[26]</sup>	Liu BB, Luo C, Ouyang LS, <i>et al.</i>	Journal of Surgical Research	2011	1	2.239
A nerve graft constructed with xenogeneic acellular nerve matrix and autologous adipose-derived mesenchymal stem cells <sup>[27]</sup>	Zhang YJ, Luo HL, Zhang ZQ, <i>et al.</i>	Biomaterials	2010	10	7.883
Strength of Tendon Repair Decreases in the Presence of an Intact A2 Pulley: Biomechanical Study in a Chicken Model <sup>[28]</sup>	Cao Y, Tang JB	Journal of Hand Surgery-American Volume	2009	4	1.439
The combined treatment effects of therapeutic laser and exercise on tendon repair <sup>[14]</sup>	Ng Gabriel YF, Fung Dicky TC	Photomedicine and LASER Surgery	2008	6	1.633
Functionalization of polymer surface for nerve repair <sup>[29]</sup>	Cui FZ, Jiao YP, Lee In-Seop	Journal of Photopolymer Science and Technology	2008	6	1.029
Ultrastructural comparison of medial collateral ligament repair after single or multiple applications of GaAlAs laser in rats <sup>[15]</sup>	Ng GYF, Fung DTC, Leung MCP, <i>et al.</i>	LASERS in Surgery and Medicine	2004	11	3.000
Comparison of single and multiple applications of GaAlAs laser on rat medial collateral ligament repair <sup>[16]</sup>	Ng GYF, Fung DTC, Leung MCP, <i>et al.</i>	LASERS in Surgery and Medicine	2004	20	3.000
Effects of a therapeutic laser on the ultrastructural morphology of repairing medial collateral ligament in a rat model <sup>[17]</sup>	Fung DTC, Ng GYF, Leung MCP, <i>et al.</i>	LASERS in Surgery and Medicine	2003	29	3.000
A comparative study of bone to bone repair and bone to tendon healing in patella-patellar tendon complex in rabbits <sup>[30]</sup>	Leung KS, Qin L, Fu LK, <i>et al.</i>	Clinical Biomechanics	2002	25	2.036

2.2.11 文献的被引情况 在 156 篇有关肌腱损伤修复的材料研究的文章中, 其总被引次数排在前十名的文章来源期刊较广, 最高被引频次文章主要发表在

Journal of Cellular Physiology 《细胞生理学杂志》和 Cytokine & Growth Factor Reviews 《细胞分裂与生长因子评论》等期刊上, 详见表 8。

表 8 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复材料研究文献的被引情况

Title	Author	Journal	Publication year	Total citation	Impact factor
Adult mesenchymal stem cells for tissue engineering versus regenerative medicine <sup>[31]</sup>	Caplan Arnold I	Journal of Cellular Physiology	2007	269	3.986
Delivery of bone morphogenetic proteins for orthopedic tissue regeneration <sup>[32]</sup>	Seeherman H, Wozney JM	Cytokine & Growth Factor Reviews	2005	116	8.239
A biomechanical evaluation of an anatomical coracoclavicular ligament reconstruction <sup>[33]</sup>	Mazzocca AD, Santangelo SA, Johnson ST, <i>et al.</i>	American Journal of Sports Medicine	2006	62	3.821
Biomechanics of knee ligaments: injury, healing, and repair <sup>[24]</sup>	Woo SLY, Abramowitch SD, Kilger R, <i>et al.</i>	Journal of Biomechanics	2006	60	2.463
Extracellular matrix scaffolds are repopulated by bone marrow-derived cells in a mouse model of Achilles tendon reconstruction <sup>[23]</sup>	Zantop T, Gilbert TW, Yoder MC, <i>et al.</i>	Journal of Orthopaedic Research	2006	53	2.976
A histological and immunohistochemical study of the subsynovial connective tissue in idiopathic carpal tunnel syndrome <sup>[34]</sup>	Ettema AM, Amadio PC, Zhao CF, <i>et al.</i>	Journal of Bone and Joint Surgery-American Volume	2004	49	2.967
Techniques of medial retinacular repair and reconstruction <sup>[35]</sup>	Davis DK, Fithian DC	Clinical Orthopaedics and Related Research	2002	40	2.116
Biomechanics and pathophysiology of overuse tendon injuries - Ideas on insertional tendinopathy <sup>[36]</sup>	Maganaris CN, Narici MV, Almekinders LC, <i>et al.</i>	Sports Medicine	2004	32	5.072
Athletic pubalgia and the "Sports Hernia": MR imaging findings <sup>[37]</sup>	Zoga Adam C, Kavanagh Eoin C, Omar Imran M, <i>et al.</i>	Radiology	2008	31	6.069
Material properties of polymerized NDGA-collagen composite fibers: development of biologically based tendon constructs <sup>[38]</sup>	Koob TJ, Hernandez DJ	Biomaterials	2002	30	7.883
Effects of age on the repair ability of mesenchymal stem cells in rabbit tendon <sup>[20]</sup>	Dressler MR, Butler DL, Boivin GP	Journal of Orthopaedic Research	2005	30	2.976

## 2.2.12 相关性较强的文献情况 见表 9。

表 9 汤森路透 Web of Science 数据库 2002/2011 收录肌腱损伤修复材料研究相关性较强的文献

Title	Author	Journal	Publication year	Impact factor
An Experimental Study on the Effect of Safflower Yellow on Tendon Injury-Repair in Chickens <sup>[26]</sup>	Liu BB, Luo C, Ouyang LS, et al.	<i>Journal of Surgical Research</i>	2011	2.239
A new material for prevention of peritendinous fibrotic adhesions after tendon repair: oxidised regenerated cellulose (Interceed), an absorbable adhesion barrier <sup>[39]</sup>	Temiz A, Ozturk C, Bakunov A, et al.	<i>International Orthopaedics</i>	2008	1.561
Zone I flexor digitorum profundus repair: An ex vivo biomechanical analysis of tendon to bone repair in cadaver <sup>[13]</sup>	Dovan TT, Gelberman RH, Kusano N, et al.	<i>Journal of Hand Surgery-American Volume</i>	2005	1.439
Outcome of early active mobilization after flexor tendons repair in zones II-V in hand <sup>[40]</sup>	Saini Narender, Kundnani Vishal, Patni Purnima, et al.	<i>Indian Journal of Orthopaedics</i>	2010	0.285
Encircling the Tendon Repair Site with Collagen-GAG Reduces the Formation of Postoperative Tendon Adhesions in a Chicken Flexor Tendon Model <sup>[41]</sup>	Bhavsar Dhaval, Shettko Donna, Tenenhaus Mayer	<i>Journal of Surgical Research</i>	2010	2.239
Augmentation of Achilles Tendon Repair With Extracellular Matrix Xenograft A Biomechanical Analysis <sup>[42]</sup>	Magnussen Robert A, Glisson Richard R, Moorman Claude T.III	<i>American Journal of Sports Medicine</i>	2011	3.821
Strength of Tendon Repair Decreases in the Presence of an Intact A2 Pulley: Biomechanical Study in a Chicken Model <sup>[28]</sup>	Cao Yi, Tang Jin Bo	<i>Journal of Hand Surgery-American Volume</i>	2009	1.439
Effect of glucosamine chondroitine sulphate on repaired tenotomized rat Achilles tendons <sup>[43]</sup>	Ozer Hamza, Taskesen An, et al.	<i>Eklem Hastaliklari VE Cerrahisi-Joint Diseases and Related Surgery</i>	2011	0.404
Flexor Tendon Tissue Engineering: Acellularized and Reseeded Tendon Constructs <sup>[10]</sup>	Chong Alphonsus KS, Riboh Jonathan, Smith R. Lane, et al.	<i>Plastic and Reconstructive Surgery</i>	2009	2.647
The influence of ultrasound on the mechanical properties of healing tendons in rabbits <sup>[44]</sup>	Larsen A, Kristensen G, Thorlacius-Ussing O, et al.	<i>ACTA Orthopaedica</i>	2005	1.897

## 3 讨论

目前在临床上用于肌腱修复的材料主要有自体肌腱、同种异体肌腱、人工肌腱和组织工程肌腱。理想的肌腱修复材料应该具有良好的组织相容性，移植排斥反应较轻，生物力学性能强，并能够提供良好的连接作用，生物材料能够被宿主吸收等，目前的研究暂时还未达到理想的标准。本文通过对汤森路透 Web of Science 数据库肌腱损伤修复材料研究相关的文献计量学分析，可以得出以下几点结论：

①汤森路透 Web of Science 数据库过去 10 年共收录肌腱损伤修复材料研究相关文献 156 篇，从文献数量的趋势上看，总体呈现逐步上升的状态，发文量最多是在 2009 年，发表文献 28 篇，占全部文献量的 17.9%。

②目前发文量较多的出版物为 *American Journal of Sports Medicine* 《美国运动医学杂志》、*Foot Ankle International* 《足与踝国际杂志》和 *Archives of Orthopaedic and Trauma Surgery* 《矫形外科与创伤外科学文献集》。

③发表文献国家以美国为主，占全球相关领域发稿量的 42.9%。中国在过去 10 年被收录文章总量中位居第 5 名，共发表 9 篇相关文章，占全球相关文章的 5.8%。

④最高被引频次文章主要发表在 *Journal of Cellular Physiology* 《细胞生理学杂志》和 *Cytokine & Growth Factor Reviews* 《细胞分裂与生长因子评论》等杂志上。

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Mesh 词表词汇实用例句：“器官保存液-Organ Preservation Solutions”

例句: Organ preservation is accompanied with ischemia, hypothermic injury and reperfusion injury.

译文: 器官保存伴随损伤有缺血和低温导致的损伤,以及再灌注时产生的再灌注损伤。

英文主题词	Organ Preservation Solutions
英文注释	Solutions used to store organs and minimize tissue damage, particularly while awaiting implantation.
中文主题词	器官保存液
中文注释	尤其是在等待移植时,用于保存器官并使组织损伤最小的溶液。