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GLOBAL MEDICAL & BIOMATERIALS INTELLIGENCE

MLJC EXCLUSIVE | SPECIAL RESEARCH REPORT

WHEN CORN ENTERS ORTHOPAEDICS: FROM AGRICULTURAL BIOMASS TO RESORBABLE BONE SCREWS

How a material technology is reshaping the question of whether medical implants need to be surgically removed

Biomaterials | Orthopaedic Innovation | Biodegradable Medical Devices | Biomanufacturing | Regenerative Medicine

I. FROM A KERNEL OF CORN TO A MEDICAL IMPLANT

Corn is traditionally associated with food, starch, animal feed and bioenergy. Modern biomanufacturing is expanding that definition.

Starch derived from corn can be processed into lactic acid and subsequently polymerised into polylactic acid (PLA), a biocompatible and biodegradable polymer with applications in medical materials, including resorbable bone screws and surgical sutures.

The real technological significance of “corn bone screws” is therefore not that corn is directly transformed into a finished bone screw. It is the broader value chain:



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Agricultural biomass → Bio-based chemicals → Advanced polymer materials →
Medical implants

This represents an important emerging model of bio-based medical manufacturing.





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II. WHY SHOULD A BONE SCREW DISAPPEAR?

Traditional fracture fixation commonly uses metals such as titanium alloys and stainless steel. These materials provide strength and reliability, but they remain in the body after healing and, in some clinical circumstances, may require a second procedure for removal.

Resorbable fixation materials seek to change this model:

First surgery → Fracture fixation → Bone healing → Gradual material degradation → Elimination or metabolism by the body → Potentially avoiding routine implant-removal surgery

This is one of the central clinical motivations behind absorbable bone-fixation materials.

III. THE REAL TECHNOLOGY IS NOT THE CORN

Corn is only the starting material. The decisive technologies lie in materials engineering, polymer science and medical engineering.

Key parameters include molecular structure, polymerisation, molecular weight, crystallinity, mechanical strength, degradation kinetics, biocompatibility, sterilisation stability and long-term performance in the body.

The real engineering challenge is therefore:

Agricultural feedstock → Controlled polymer chemistry → Medical-grade material → Predictable clinical performance



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IV. THE CRITICAL QUESTION: HOW FAST SHOULD THE MATERIAL DEGRADE?

A major challenge in resorbable bone fixation is balancing mechanical support with degradation.

If degradation occurs too quickly, the implant may lose structural support before sufficient bone healing has occurred.

If degradation occurs too slowly, the material may remain long after its mechanical function is no longer required.

The ideal design therefore seeks a controlled relationship between:

Bone healing

and

Material degradation

In principle, the implant provides temporary mechanical support while the patient's own tissue progressively restores structural function.

V. FROM “FIXING BONE” TO SUPPORTING BIOLOGICAL REPAIR

Traditional bone screws are primarily designed for mechanical fixation.

Next-generation biomaterials seek a more integrated function:

Mechanical support + Biocompatibility + Tissue integration + Controlled degradation + Bone regeneration

The ultimate objective is not simply to leave a permanent implant in the body, but to allow the material to perform its function and gradually withdraw as biological healing progresses.

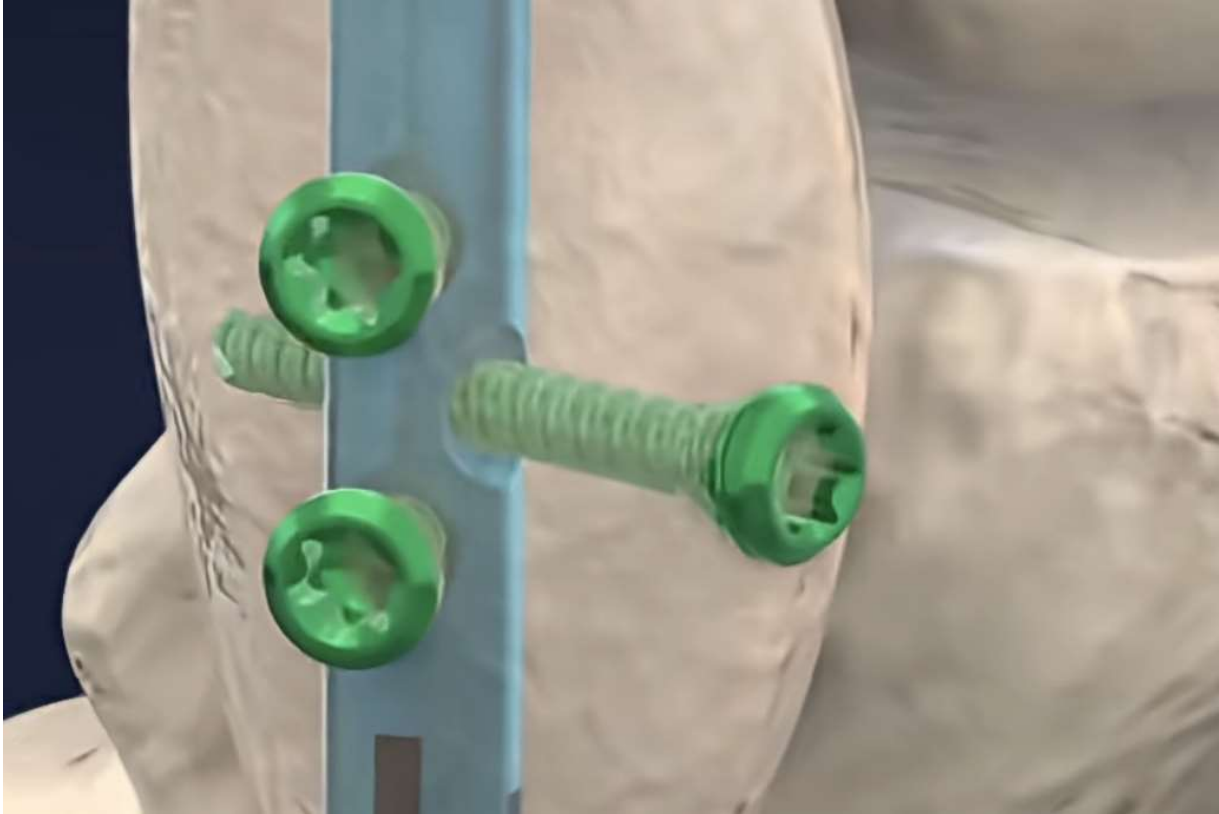


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VI. CHINA'S EMERGING BIOMATERIALS VALUE CHAIN

China is developing industrial and research capabilities across the broader chain:

Corn → Starch → Lactic acid → Polylactic acid → Biodegradable materials → Medical applications

This should not be viewed as a single-product story. It reflects a wider convergence between agricultural biotechnology, polymer science, advanced materials and medical-device manufacturing.



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VII. MLJC STRATEGIC VIEW

The most important point is not:

“Corn can become a bone screw.”

The more important development is:

Agricultural biomass is entering high-value medical manufacturing.

The traditional value chain:

Agriculture → Food / Feed / Energy

is increasingly being complemented by:

Agricultural biomass → Bio-based chemicals → Advanced materials → Medical devices → Regenerative medicine

A kernel of corn can therefore become more than a food commodity. Through biotechnology and materials engineering, it can become part of a high-value medical manufacturing chain.

VIII. JY HCG HEALTHCARE PERSPECTIVE

From a global healthcare perspective, resorbable orthopaedic materials form part of a broader trend toward temporary medical implants.

Future medical devices do not necessarily need to remain in the body permanently.

Increasingly, material design is exploring a different principle:

Complete the therapeutic function → Support biological recovery → Gradually degrade → Safely leave the body

This is closely connected with the future development of regenerative medicine, tissue engineering, precision drug delivery and absorbable medical devices.



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The design philosophy is shifting from:

“Can the material remain in the body?”

toward:

“Can the material perform its function at the right time and then safely exit?”

IX. THE MLJC THESIS

The real “corn bone screw” story is not about corn.

It is about:

Biology → Materials → Medicine

Agricultural resources → Materials engineering → Medical innovation

This connects directly with the broader MLJC strategic thesis:

BIOLOGY AS MANUFACTURING INFRASTRUCTURE

The same industrial logic can be observed across different fields—from recombinant spider-silk proteins to bio-based polymers and advanced medical materials.

Biological resources, engineered organisms and bio-derived molecules are increasingly becoming inputs into sophisticated manufacturing systems.

X. MLJC | JY HCG CONCLUSION

The future competition in medical materials will not necessarily be determined simply by who produces the hardest or cheapest material.

It may increasingly be determined by who can design materials that work in greater harmony with the body’s biological processes.



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An ideal temporary implant would:

Provide structural support → Enable tissue repair → Gradually degrade → Be replaced by the body's own tissue

This represents a broader transition:

FROM PERMANENT IMPLANTS

TO

BIOLOGICALLY INTEGRATED & RESORBABLE IMPLANTS

From permanent fixation toward materials designed to participate in the body's own healing process.





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MLJC | JY HCG

全球医疗健康与生物材料情报

MLJC 独家 | 特别报告

当玉米进入骨科：从农业生物质到可吸收骨螺钉

一项材料技术，正在重新思考：医疗植入物是否必须通过二次手术取出

生物材料 | 骨科创新 | 可降解医疗器械 | 生物制造 | 再生医学

I. 从一粒玉米到医疗植入物

玉米传统上主要用于食品、淀粉、动物饲料及生物能源。

现代生物制造正在重新定义这一农业资源的价值。

玉米淀粉可以进一步加工为乳酸，再通过聚合形成**聚乳酸（PLA）**。PLA 是一种具有生物相容性并可生物降解的聚合物，可应用于包括可吸收骨螺钉、手术缝线等医疗材料领域。

因此，“玉米骨螺钉”的真正技术意义，并不是把玉米直接加工成一枚骨螺钉，而是背后形成了一条更完整的价值链：

农业生物质 → 生物基化学品 → 高性能聚合物材料 → 医疗植入物

这代表了一种正在发展的生物基医疗制造模式。



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II. 为什么骨螺钉最终应该“消失”？

传统骨折固定通常采用钛合金、不锈钢等金属材料。

这些材料具有良好的强度与可靠性，但在骨骼愈合后仍可能长期留在人体内。在部分临床情况下，患者可能需要接受第二次手术进行植入物移除。



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可吸收骨固定材料试图改变这一模式：

第一次手术 → 骨折固定 → 骨骼愈合 → 材料逐步降解 → 被机体代谢或清除 → 在适当情况下减少常规取出手术的需求

这正是可吸收骨固定材料的重要临床价值之一。

III. 真正的技术并不是“玉米”

玉米只是起点。

真正决定产品性能的，是材料工程、聚合物科学及医疗工程技术。

关键技术参数包括：

- 分子结构
- 聚合工艺
- 分子量
- 结晶度
- 机械强度
- 降解动力学
- 生物相容性
- 灭菌稳定性
- 长期体内性能

因此，真正的工程挑战是：

农业原料 → 可控聚合物化学 → 医疗级材料 → 可预测的临床性能



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IV. 核心问题：材料应该多快降解？

可吸收骨固定材料面临的核心挑战之一，是如何平衡**机械支撑能力**与**材料降解速度**。

如果材料降解过快，植入物可能在骨骼尚未充分愈合之前失去必要的结构支撑。

如果降解过慢，材料则可能在其机械功能已经完成之后仍长期存在于体内。

因此，理想设计需要建立一种受控关系：

骨骼愈合速度



材料降解速度

从理论上讲，植入物承担的是一种**阶段性的机械支撑功能**，随后随着人体组织逐渐恢复结构功能，材料逐步退出。

V. 从“固定骨骼”走向“支持生物修复”

传统骨螺钉主要解决的是**机械固定问题**。

下一代生物材料则正在探索更加综合的功能：

机械支撑 + 生物相容性 + 组织整合 + 可控降解 + 骨组织再生



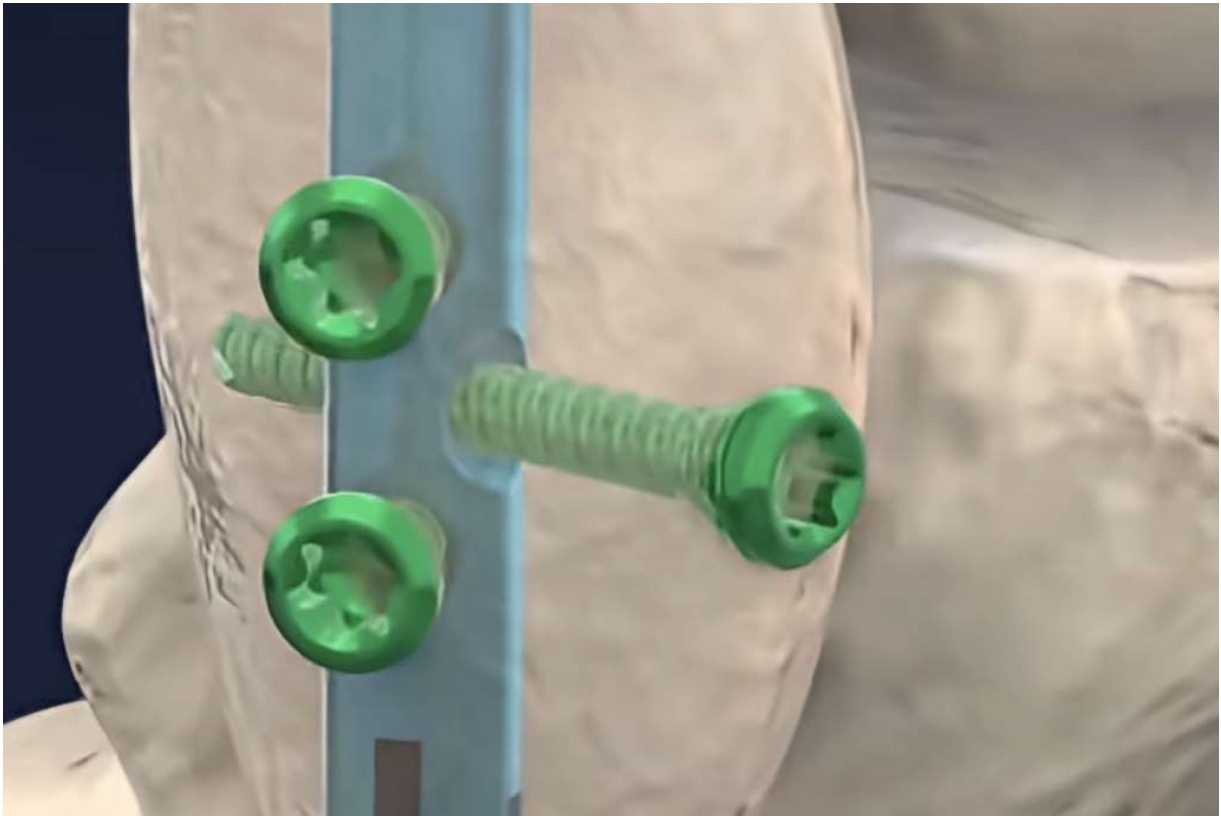
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最终目标并非单纯地让一个永久性植入物长期留在人体内，而是让材料在需要的时候发挥作用，并随着生物修复过程推进而逐渐退出。



VI. 中国正在形成的生物材料价值链

中国正在围绕更广泛的产业链建立科研与产业能力：

玉米 → 淀粉 → 乳酸 → 聚乳酸 → 可降解材料 → 医疗应用

因此，这不应该仅仅被理解为一个“玉米骨螺钉”的单一产品故事。



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其背后体现的是：

农业生物技术 + 聚合物科学 + 高端材料 + 医疗器械制造

之间正在发生的产业融合。

VII. MLJC 战略观察

真正值得关注的并不是：

“玉米可以变成骨螺钉。”

而是：

农业生物质正在进入高附加值医疗制造体系。

传统价值链：

农业 → 食品 / 饲料 / 能源

正在逐渐增加新的路径：

农业生物质 → 生物基化学品 → 高性能材料 → 医疗器械 → 再生医学

因此，一粒玉米不再只是食品或农业商品。

通过生物技术与材料工程，它可以成为高价值医疗制造产业链中的基础原料之一。



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VIII. JY HCG 医疗健康战略视角

从全球医疗健康产业的发展趋势来看，可吸收骨科材料属于“临时性医疗植入物”不断发展的重要方向。

未来的医疗器械，并不一定需要永久存在于人体内。

材料设计正在逐渐探索一种新的原则：

完成治疗功能 → 支持组织修复 → 逐步降解 → 安全退出人体

这一理念与未来的：

- 再生医学
- 组织工程
- 精准药物递送
- 可吸收医疗器械

具有高度关联。

医疗材料的设计理念正在从：

“这种材料能否长期留在人体内？”

逐渐转向：

“这种材料能否在正确的时间完成应有功能，并在完成任务后安全退出？”



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IX. MLJC 核心论点

真正的“玉米骨螺钉”故事，其实并不是关于玉米。

它真正讲述的是：

生物学 → 材料 → 医疗

以及：

农业资源 → 材料工程 → 医疗创新

这与 MLJC 长期关注的一个更广泛战略命题直接相连：

BIOLOGY AS MANUFACTURING INFRASTRUCTURE

将生物学本身视为未来制造业的基础设施

从重组蜘蛛丝蛋白，到生物基聚合物，再到先进医疗材料，都可以看到类似的产业逻辑：

生物资源、工程化生物体以及生物衍生分子，正在逐渐成为先进制造体系的重要投入要素。

X. MLJC | JY HCG 结论

未来医疗材料领域的竞争，未必只是：

谁能够制造出最坚硬的材料，或者成本最低的材料。

更重要的问题可能是：

谁能够设计出与人体生物过程更加协调的材料。



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理想的临时性植入物，应当能够：

提供结构支撑

- 支持组织修复
- 逐步降解
- 最终由人体自身组织接替其功能

这代表着医疗材料发展的一种更深层次转变：

从永久性植入

走向

生物整合与可吸收植入

从永久固定，逐渐走向能够配合人体自身修复过程而完成生命周期的材料体系。

