Bench to Bedside
Integrating Advances in Basic Science into Daily Clinical Practice

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KEYWORDS

• Commercialization • Technology transfer process • Patenting • Marketing • Licensing • Company startup • Food and Drugs Administration • Clinical trials

KEY POINTS

- Reconstructive surgery is evolving; there are significant clinical needs for which tissue engineering may provide an elegant solution.
- Negotiating the interface between scientific research and commercialization is often confounding.
- Working with a technology transfer office (TTO) will facilitate the commercialization process.
- Patent attorneys and TTO collaboration is encouraged.
- Patents may take up to 3 years to be granted.
- Marketing and licensing should be approached cautiously so that the best licensing deal is achieved.
- Startup company development is a high-risk proposition.
- Exclusive licensing deals are the gold standard for startups.
- TTOs will insist on all conflicts of interest being addressed if the inventor is affiliated with a university.
- Entrepreneurial advice is critical and business planning pivotal to the investment potential of startups.
- One should take advantage of the overabundance of informal routes of communication possible with the Food and Drug Administration to obtain timely and accurate feedback from the agency regarding specific products to ensure efficient progression of new products toward clinical trials in the United States.
- All current good manufacturing practice guidelines must be adhered to and will be routinely inspected.

INTRODUCTION

Everybody always wants to know what's next. I always say that what I can imagine is rather dull. What I can't imagine is what excites me.
—Arthur Schawlow, Stanford physicist and Nobel Laureate.

Hand and upper extremity surgeons still face reconstructive tissue shortages following trauma, tumor ablation, or congenital absence. This shortage is compounded by the innate anatomic intricacy within the hand that is crucial for its form and function.

Current needs are such that hand surgeons should be familiar with autologous free tissue

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transfer and the immunologic and technical aspects of composite tissue allotransplantation. Indeed, vascularized composite allotransplantation has become increasingly practiced internationally following developments in microsurgical techniques, organ transplantation, and immunosuppression.[1] The technique, however, is still plagued by poor immune-tolerance profiles and the significant morbidity associated with pharmacologic immunosuppression.[1–3]

Therefore, in recent years great interest has developed in tissue engineering (TE) and regenerative medicine in reconstructive hand surgery. This concept combines the principles of life sciences and engineering in developing biological substitutes that will restore, maintain, or improve hand-tissue function. These frontiers are currently the focus of intense international surgical innovation efforts as a means of recapturing the natural form and function of the hand.

In addition to other surgical discoveries, TE is the catalyst for advances in clinical care, particularly in hand surgery, whereby many unmet clinical needs remain and useful inventions in this area could considerably improve the lives of patients. The challenge remains for the surgeon-scientist to successfully negotiate the path from new technology to the bedside of patients.

The process of discovery, invention, and subsequent commercialization of a product often takes substantial investment of time and money, and involves a substantial financial risk. Such investment can prove too much for most medical device start-ups, 90% of which do not progress to clinical trials.[4]

Many hand surgeons have new ideas with real commercial potential, but are not equipped with the tools to take such ideas forward. Plastic surgery is a specialty dependent on a rich heritage of innovation, so it is paramount that clinicians become enlightened in the process of taking ideas from the bench to the bedside.

This article focuses on the initial steps of commercial development of a patentable scientific discovery through to the marketing of a clinical product. First, the basic strategy of partnering with a technology transfer office (TTO) and the complex process of patenting are addressed. Next, marketing and licensing the patent to a company, in addition to starting a company, is discussed. Finally, the basics of obtaining clearance from the Food and Drugs Administration (FDA), production in a good manufacturing practice (GMP) facility, and bringing the product to clinical trial are addressed.

PARTNERING WITH A TECHNOLOGY TRANSFER OFFICE

The First Critical Steps After a Scientific Discovery

Antecedent to the pursuit of any funding streams, the time period following the discovery of a surgical innovation may be arguably the most critical to the idea successfully reaching patients. Intellectual property (IP) law is the legal field that establishes, protects, and arbitrates the ownership of the inventor's original ideas. The IP strategy for a university affiliated surgeon-scientist should start as soon as a discovery is made.

If one feels a discovery is worthy of patent protection, it is critical to avoid publicly disclosing this idea, as one may risk forfeiting rights to the IP. One should avoid publication, and even presentation at local meetings. It is essential to meticulously document the development of one's idea in the event that originality is contested. The process should be recorded in ink, with the use of pictures as appropriate, in a secure laboratory notebook, with countersignatures of a lay person for verification purposes.

In the United States, the inventor may have only 1 year to file a patent application to protect the IP from the time of initial public disclosure or effort at commercialization. If the inventor filed for a foreign patent more than 1 year before the domestic application, the domestic application will be disqualified. A 1-year period of grace does not exist for most foreign patents, so to capture foreign markets it is important to file the patent application before any public disclosure.[5]

The Role of the TTO and the Technology Transfer Process

A reliable framework for commercializing discoveries for the aspiring surgeon entrepreneur should include working with a TTO or an office that performs a similar function, which will protect an institution's IP and propel research efforts to commercialization by turning scientific progress into tangible products, while returning income to both the inventor and the university to support further research, as outlined in **Fig. 1**.

This competitive process starts with the submission of an Invention Disclosure. This written notice of invention begins the formal technology transfer process. It is a confidential document, and should fully describe the new aspects of the invention, including the critical solution it provides and its advantages and benefits over current technologies.

The office will work with the inventor to make an initial assessment concerning patentability,