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REVIEW ARTICLE

ORIGINS OF TISSUE ENGINEERING

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Tissue engineering conceptually partners engineering with the life sciences to provide living substitutes for medical and biologic applications. As we begin tracking the origins of tissue engineering, what stands out from the past and remains with us in the present, is the role played by surgeons in creating one body part for another to meet the needs of individual patients. Improvising anatomic repair using an individul's own organ or tissue is still a technique often used by the reconstructive surgeon. For example consider the dental surgeon's common practice of using a segment of a rib to reconstruct part of the jaw which have been resected due to cancer. The autotransplanted rib will support the function of mastication, deglution, speech as well as growth and development of the young jaw. The procedure has been remarkably successful, but in the new age of tissue engineering our thinking is directed to the fabrication of a substitute jaw constituting bone and cartilage that the surgeon can take off the shelf.

It was in the tradition of innovative surgical borrowing to rebuild a body part that new materials were sought to substitute for what the patient's own tissue might provide. The idea of improving on nature by using man made materials was nurtured by the discovery and availability of the new synthetics during World War II (1). Since that time of technological expansion the quest for substitutes for autologous tissues has decline but the synthetic replacements very rarely or almost never matches the quality of an autograft. Thermoplastic synthetic polymers such as nylon, dacron, polyurethane, polypropylene and many other industrial materials not designed for use in the human body as tissue replacement, were introduced by suppliers of surgical armementarium and were used by practitioners of the art of surgery for rebuilding damaged, diseased, aged or genetically deficient body parts. The synthetic materials were introduced into the human body as components of fabricated replacement parts at a time when possibility of reconstituting biologic substitutes was still unexplored. Many of the postwar synthetics are still in use today with major questions regarding their efficacy hanging over us.

Traditional Tissue Banking played a significant role in the development of present day multidisciplinary reconstructive science. Procurement, processing, packaging, sterilising and distribution of the final 'non-living' tissue graft product has always been regarded as the state of the art surgical craft. Nevertheless all tissue bank scientists agree that the replacement of the lost tissues using viable cells are superior to the utilization of processed tissue grafts even with the addition of growth factors.

Thus the past fifty years of worldwide modern tissue banking activities associated with reconstructive surgery now came to be called tissue engineering when the focus of attention became the fabrication of living replacement parts for the body in the tissue bank laboratory. The research and development activities include the fabrication of bones, cartilage, skin and muscle in tissue culture flask (2). The technology represented a dramatic shift to the development of combine synthetic and biologic components of actual tissues for reconstructing replacements with the aim of developing a composite 'life on dead tissue graft'

that will superseed the current gold standard autograft. Tissue building as it occurs in organisms during development and for same parts throughout life is being imitated. The field has brought to light the beginning of a multidisciplinary scientific breakthrough that promise better quality of life to millions of patients who need tissue replacements for functional restoration of deficient or lost body parts. The current mismatch between available organs for life-sustaining transplantation and the number of needy recipients is just one of the more obvious examples.

This dramatic shift required a total face lift in the infrastructure and equiptments in the tissue bank laboratory from a simple human spare part manufacturing room to a world class cutting edge cell and molecular biology laboratory that utilises the 'molecular scissors' to cut across the whole spectrum of material and life sciences (3). This new approach has timely arrived when biotechnology is achieving widespread acceptance, thus quickly gaining the interest of the financial market and the pharmaceutical companies because of its commercial potential (4).

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