CHAPTER 3

TYPES OF SIMULATION SURGERY

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Simulation surgery, as the author defines it, encompasses two main categories: empirical simulation surgery, dealing with operative simulation surgery on living patients, and computer aided simulated surgery, where presurgical examination and analysis of a patient’s disease and condition are simulated by means of computer data, either as video or virtually displayed 3D simulation, or as a computer aided and designed 3D solid representational model. In this chapter the author would like to examine the concepts behind these two categories, before going on to look at the practical application in actual simulation surgery.

3.1: Empirical Simulation Surgery

The collective and collected wisdom of eminent surgeons both past and present, as set out in the appropriate textbooks, guides the newly qualified surgeon and the medical student. To this is added the experience of their teachers. This encyclopedic range of knowledge comprises what the author refers to as empirical simulation surgery, and can be further subdivided into simulation surgery guided by the surgeon’s brain, and simulation surgery based on practice with prepared patterns.

Fig 3.1: Human brain aided simulation surgery in empirical simulation surgery. Experienced surgeons can draw on their mental storage of data from post operative procedures. Illustrated here are carefully mentally visualized and planned stages of a procedure, for example, in this case, cheiloplasty.
3.1.1: Human Brain Aided Simulation Surgery

The meticulous planning which precedes any simulative reconstructive operation demands a range of data. The type and volume of tissue, the preparation of the recipient site and identification of the best donor site are required in detail before the surgeon proceeds with the actual operation. While skin grafts and soft tissue flaps require this careful and comprehensive approach, in the case of the composite type of flap, involving both hard and soft tissue, careful preparation is critical. Empirically, the experienced surgeon draws on his or her vast store of accumulated experience, thus ensuring consistency and accuracy. While some degree of trial and error is inevitable in this process, it must be carefully limited when dealing with a living human patient.

Consistent success depends to certain degree on the surgeon’s level of skill, especially in postoperative wound management: the surgeon therefore draws first of all on the amassed experience of his predecessors and peers, and having digested this input of data, each stage of the procedure is carefully planned and visualized in the surgeon’s brain. Finally all the mentally simulated data and pictures coalesce into the actual clinical operative procedure (Figure 3.1).

The experienced surgeon is usually able to forecast the surgical process and its subsequent prognosis with great accuracy, having this great repository of knowledge to draw upon. Planning many moves ahead with sudden changes in strategy is also the strategy of the chess grand master, or Shogi champion. Up to and including the present day, this form of empirical simulation surgery has been practiced with collective data banks of empirical simulation surgery which are constantly growing and updated as new procedures, having been tried and tested in actual surgery, are added to the surgeon’s available options.

3.1.2: Pattern Aided Simulation Surgery

Whereas the above procedure of empirical simulation surgery alone is well-suited to the master surgeon with many years of successful clinical experience, the neophyte or ‘normal’ surgeon cannot always sit down and prepare the steps of a surgical procedure using the brain alone. It is perhaps only the really gifted surgeon who is capable of mentally factoring in simultaneously the concepts of the 3D understanding of the tissue, donor and transplant sites combined with the concept of tissue elasticity, contraction and expansion.

It is more usual for the ‘normal’ surgeon to employ practice and experimentation with a 2 dimensional tracing of the procedure design on some flexible material such as gauze, X-ray film, filter or tracing paper as a preliminary step before performing the actual surgery, thereby both removing some of the mental effort required for visualization and allowing pre-surgical evaluation of the optimal method to accomplish the desired surgical result. (Figure 3.2).

3.2: Computer Aided Simulation Surgery

The modern miracle of computer technology has enhanced the unique capability of man compared with any other animal to simulate mentally the answer to a problem, providing an almost infinitely variable intermediate stage between mental simulation of a process and realization of the process itself.

The computer allows a much more in-depth examination of the simulation than by the mental process alone, and is used in the preproduction stage in many of today’s modern industries. The computer-constructed image can be recalled at will, redesigned, reconstructed, rotated, stretched, twisted, adjusted, manipulated and analyzed before the actual item is fi-
nally committed to manufacture. Perhaps even more importantly, other minds can be brought to bear simultaneously on the same design concept, with the resultant advantage of synergic thought. This application of computer modeling has lead to better ergonomic design, greater comfort and safety in many aspects of our daily lives.

Although the advantages of such a computer-aided simulative approach are startlingly obvious in the medical and surgical field, computer simulation in the world of commerce and industry has far outstripped its use in the world of medicine. There have been isolated instances of its early application, however, and working as a surgeon in

Fig 3.2: Pattern-aided simulation surgery in empirical simulation surgery. (a): in reconstructing a case of microtia, residual skin tags were preserved. (b): A 2 dimensional film pattern was made from the normal 3 dimensional ear on the opposite side. Along this film model, a new cartilage frame was made with autogenous costal cartilage. (c): The remnant cartilage in the skin tags was removed, the new cartilage-constructed ear frame was inserted into the undermined skin, and tie-over dressings with silicone-coated bolsters were applied. (d): Thus, a 2 dimensionally assisted reconstructed ear, simulating the ear on the contralateral normal side is produced (Photographs by courtesy of Professor Yoshiaki Tai).
the field of reconstructive surgery, the author would like to declare his pioneering applications of the concept of simulation surgery in both its broadest and narrowest conceptions. As the reader will see, and as has become apparent in the past half-decade, computer aided simulation surgery, CASS, has much to offer the surgeon, the patient, and the medical student of the even the present, but in particular the future (Figure 3.3).

References