Plastic and Reconstructive Surgery

19

Edward Ray, Dhivya R. Srinivasa, and Randy Sherman

What Is Reconstructive Surgery?

Reconstructive surgery involves the repair and replacement of missing tissues as well as the improvement of function following trauma, cancer surgery, or in cases of congenital deformity. Tissues may be relocated from distant parts of the body or may be locally rearranged to repair defects. Reconstructive surgeons commonly work in close coordination with other surgical subspecialties, restoring physical integrity after a variety of antecedent procedures. Accordingly, clear communication, anticipation, and planning are critical for an optimal outcome.

Case Study

An example is provided to illustrate the importance of communication, planning, and anticipation in optimizing outcomes and the efficiency of the reconstructive surgical team.

The cancer surgeon is planning to remove a recurrent squamous cell cancer of the mouth that is invading the left side of the mandible. The patient is a VIP who has just arrived in the clinic from out-of-town, referred by a respected colleague. The cancer surgeon would like to perform the surgery as soon as possible and clears his schedule for the following day to accommodate the patient. He recruits his plastic surgery colleague to perform the reconstruction. An outside PET-CT scan has been performed and shows possible metastasis to the neck lymph nodes, so a radical left neck dissection is also planned. The cancer surgeon explains that in addition to a tracheostomy and neck dissection, he will be removing a portion of the left mandible and would like to have the oral floor and mandible reconstructed. The plastic

E. Ray (✉) · D. R. Srinivasa · R. Sherman
Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, CA, USA
e-mail: Edward.Ray@cshs.org

T. N. Cohen et al. (eds.), *Human Factors in Surgery*,
https://doi.org/10.1007/978-3-030-53127-0_19

surgeon prefers to have lower extremity imaging and 3D models made to plan reconstruction, but there is insufficient time to have these ordered. She examines the patient and finds a normal lower extremity vascular exam, so a left osteocutaneous (skin plus bone) fibula flap is planned to replace the mandible and oral mucosa.

The following day, the cancer surgeon gets a late start because there is an educational conference that he needs to attend as the guest speaker. In the rush to schedule surgery, he also forgot to consult General Surgery to perform the endoscopic gastric tube placement, so additional time is spent finding an available surgeon to do this. Once started, he finds the neck dissection challenging due to prior radiation therapy and is concerned that the contralateral nodes may also be affected. A bilateral neck dissection is performed. The mandible resection ends up quite a bit wider than originally planned, crossing the midline.

As the cancer surgeon performs his resection, the plastic surgeon begins to harvest the fibula from the left leg. She minimizes the amount of the skin to be harvested to ease closure of the donor site. The peroneal artery (supplying the bone to be transferred) is quite small in diameter and somewhat atherosclerotic, but a Doppler confirms blood flow. The bone has callus, apparently from a prior fracture.

The cancer resection is completed around 7 pm (Fig. 19.1)*. As the cancer surgeon departs, the plastic surgeon explores the neck to find suitable blood vessels to supply the flap. The left neck is quite scarred, and the branches of the external carotid artery have all been ligated close to their origin. She explores the*

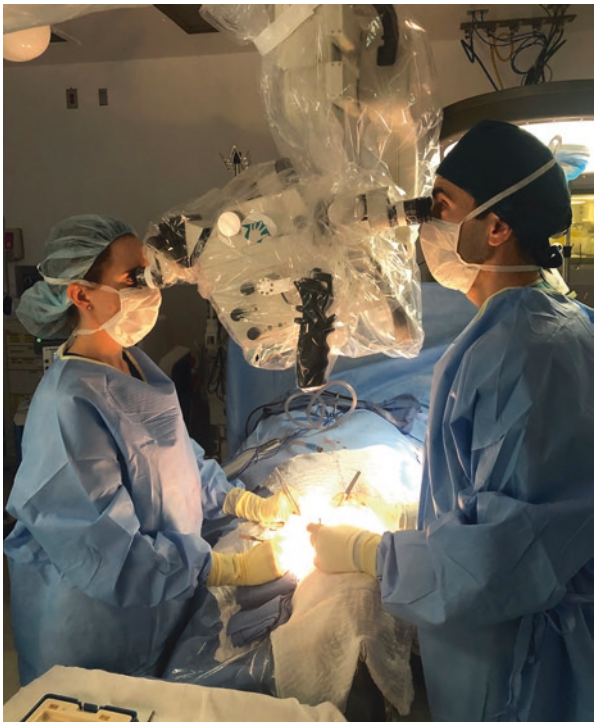

Fig. 19.1 The reconstructive dilemma following removal of the left hemi-mandible

contralateral neck and finds a suitable artery. The bone-skin flap is harvested, and the bone is cut and plated to the native remnant mandible. The vessels are found to be too short to reach the neck vessels for anastomosis. The skin paddle is also too small to replace the missing oral mucosa and external skin. As a result of these issues, a second flap must be harvested from the forearm along with some segments of vein to create "jump grafts" between the flap and its blood supply in the neck. There is a one-hour delay in getting the operating microscope into the operating room, because it was reserved for another operation that has not yet been completed. To make matters worse, the vascular anastomoses are particularly challenging due to the vascular disease in the peroneal artery. The reconstructive surgery takes most of the night, ending around 6 am. The plastic surgeon is exhausted but heads to clinic for a full day of patient visits. The patient is transferred to the Intensive Care Unit for postoperative care.

The patient's postoperative course is initially unremarkable, but he presents to clinic 8 weeks postoperatively with drainage of fluid from a hole in the skin over the mandible reconstruction. The plated jawbone is now loose and unstable, suggesting nonunion at the site of the distal fibula transferred to reconstruct the mandible. A bone scan confirms the bone adjacent to the old fracture site is dead. Another reconstruction must now be planned to replace the infected and non-viable mandible segment.

Analysis

In the rush to perform a cancer operation on a VIP patient, the surgeons in this example inadvertently donned "blinders" and abandoned their typical methodical approach to patient care that they are well trained for. The cancer surgeon went into the operation not knowing the approximate extent of the cancer excision he would have to perform, and he did not plan his day or the sequence of procedures. Communication was poor between the surgeons regarding not only the expected size of the defect, but also the need to preserve an appropriate blood supply to the transferred tissue.

While the extra time taken was an inconvenience to the cancer surgeon, the downstream effect of prolonging the reconstruction may have affected the reconstructive surgeon's judgment as well. The plastic surgeon did not examine the patient or obtain the appropriate history. Noting a prior tibia-fibula fracture would likely have prompted a more detailed workup and should have convinced the surgeon to choose the opposite fibula instead, avoiding the unhealthy bone segment. Surgical skill includes developing protocols and habitual sequences to prevent mistakes or missing details [1]. The plastic surgeon normally would have ordered a detailed 3D model of the mandible and leg to make sure the blood supply was adequate and that the bone stock could be cut to fit the anticipated defect. While each surgeon has his or her own approach, and there is considerable debate about the necessity of imaging prior to reconstructive surgery, deviating from one's own working approach lends to errors by drifting away from a tried-and-tested approach

into a less methodical on-the-fly sort of decision making. Cutting corners can be a costly mistake as seen here. In hastily adding this complex case onto the operating room schedule, the need for another specialist (the general surgeon) and equipment (the operating microscope) was neglected. The prolonged ischemia time before reattaching the flap to its new blood supply (exacerbated by other delays) may also have been a contributing factor to this non-ideal outcome.

How Can We Improve Reconstructive Surgery Utilizing Human Factors Principles?

Humans are fallible, and poor time management can lead to stressful conditions made worse by exhaustion and frustration with non-ideal circumstances [2]. There are many ways to classify and analyze failure, but a common theme in the analysis of medical mistakes relates to whether errors result from inadequate planning to achieve an end goal (i.e., "mistakes") or from failure to execute a reasonable plan. There is also often consideration as to whether the unintended outcome can be attributed to an error (an unexpected result following a well-intended plan) versus a "violation," which is a deviation from an established rule of practice [3]. Our example illustrates an inadequate plan (decisions were made early despite a lack of sufficient data) and violation of normal practices (steps that should have been followed by each specialist were skipped).

Reconstructive surgery is particularly vulnerable to inadequate planning and violations. A significant percentage of reconstructive procedures are planned close to the time of their execution and with inadequate data to make fully informed choices. As the adage goes, the devil is in the details. Choosing a form of reconstruction is contingent upon many invisible factors being ideal to make the plan viable (e.g., adequate flap vessels, adequate tissue quality/volume/area, and adequate recipient vessels). Experience helps the surgeon in several ways. Understanding what problems are likely to arise, what information is needed to make decisions, and what options are most likely to succeed—these get somewhat easier with experience. One habit that contributes to experience is the adoption of mental checklists. Airline safety and operating room best practices research have proven that checklists and repetition lead to fewer *violation* type errors [4]. Teaching surgery to postgraduate trainees is also more effective when a methodical approach is demonstrated and repeated [5].

When *experience is lacking*, or whenever unusual situations arise, thorough planning becomes most critical. Part of planning is accumulating data that will come in handy when decisions must be made (such as which flap to use, which vessel to plug into, and so on). And wherever *data is lacking*, the surgeon must (1) communicate thoroughly with cooperating specialists to minimize the unexpected and (2) anticipate "worst case" scenarios and have a back-up plan for as many situations as possible.

Another important lesson to this example is understanding that the surgeon and patient exist within a hospital system that has its own moving parts. Planning and

execution of a complex operation relies not just on available surgical expertise but also on the resources of time, personnel, and equipment. To be cavalier with these adjunctive components to patient care is to treat the entire endeavor as unworthy of careful planning. The butterfly effect can be applied to this notion [6]. A seemingly small misstep or miscalculation in the beginning can easily cause not just delays but *mistakes*, defined previously as adoption of an inadequate plan to achieve the end goal.

Lessons Learned/Personal Pearls

- Methodical planning is the most critical step in the execution of a complex procedure.
- Communication is vital to prevent errors of poor planning.
- Starting with a mental checklist and developing good practices through repetition are critical to establishing experience in complex problem-solving endeavors.
- Consider all the important resources needed for a successful operation, not just the surgical expertise at hand.

References

1. de Vries EN, Hollmann MW, Smorenburg SM, et al. Development and validation of the SURgical PAtient Safety System (SURPASS) checklist. BMJ Qual Saf. 2009;18:121–6.
2. Philibert I. Sleep loss and performance in residents and nonphysicians: a meta-analytic examination. Sleep. 2005;28:1392–402.
3. Reason J. Safety in the operating theatre – part 2: human error and organisational failure. Qual Saf Health Care. 2005;14:56–61.
4. Oak SN, Dave NM, Garasia MB, Parelkar SV. Surgical checklist application and its impact on patient safety in pediatric surgery. J Postgrad Med. 2015;61(2):92–4.
5. Burke CR, Mokadam NA. Repetition is the mother of skill. J Thorac Cardiovasc Surg. 2018;155(4):1694–5.
6. Oestreicher C. A history of chaos theory. Dialogues Clin Neurosci. 2007;9(3):279–89.