

# Analysis of Morbidity and Mortality in Patients Undergoing Skull Base Reconstruction

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**Abstract:** The relative rarity of skull base tumors has limited surgeons' ability to report on morbidity and mortality in a large and nationwide patient series. We aimed to assess the impact of reconstructive procedures on patients undergoing skull base surgery and to determine whether 30-day postoperative morbidity and mortality varied between patients who underwent reconstruction and those who did not. We performed a retrospective analysis using American College of Surgeons National Surgical Quality Improvement Program 2005 to 2012 databases. Chi-squared tests were used for categorical variables and *t*-tests were used for continuous variables. Multiple logistic regression analysis predicted the influence of preoperative and operative variables on complications. A total of 479 patients were included in our study; 199 patients received concurrent reconstruction. There was no statistically significant difference in wound complication, morbidity, length of total hospital stay, and mortality between the 2 groups. The reconstruction cohort showed significantly longer operative times (416.45 [207.585] versus 319.99 [222.813] min,  $P = 0.001$ ) and higher return to the operating room rate (13.6% versus 6.1%,  $P = 0.005$ ). Reconstruction using pedicled flaps was associated with increased odds of wound complications (odds ratio, 4.937;  $P = 0.023$ ), and microsurgical reconstruction was associated with return to the operating room (odds ratio, 2.212;  $P = 0.015$ ). According to logistic regression, dyspnea, diabetes mellitus, functional status, and tumor involving the central nervous system were associated with complications. This study is the first comprehensive analysis of reconstruction after skull base surgery. Additional measures involved in flap reconstruction are associated with an increase in operation time and return to the operating room rate but not with complications, morbidity, or mortality.

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The ACS-NSQIP databases are the source of information used in this study. Data extrapolated, statistical analysis performed, and conclusions reached have not been verified by the ACS-NSQIP but rather are the result of the work done by authors of this study.

Level of Evidence: III

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The primary aims of reconstructive surgery after resection of skull base tumors are (1) separation of the central nervous system (CNS) from the aerodigestive tract, (2) reestablishment of orbital and oral cavities, as well as (3) restoration of the three-dimensional appearance of bony and soft tissues.<sup>1</sup> Numerous reconstruction methods have been used, and their pros and cons have been examined.<sup>2–4</sup> Developments in surgical technique have made it possible to operate on lesions that were previously deemed inoperable.<sup>5</sup> However, despite these technical advancements in addition to improved preoperative radiographic assessment of tumor extent and postoperative care, complications remain an inherent occurrence in this patient population.<sup>6</sup> Indeed, a successful outcome after skull base tumor ablation based on patient mortality and morbidity is dependent as much on the reconstruction as it is on the resection.<sup>7</sup> Suboptimal wound coverage can result in life-threatening complications including brain abscess, meningitis, and osteomyelitis.<sup>6</sup> However, additional reconstruction procedures may contribute to increased duration of surgery, prolonged hospitalization, as well as potentially higher morbidity and mortality.

Notably, the relative rarity of skull base tumors has limited surgeons' ability to report on postoperative morbidity and mortality in a large patient series. A majority of studies have used small sample sizes. Furthermore, they are based on the experiences of single institutions, which limit the analysis of nationwide outcomes. Prior reports have indicated that free flap reconstruction offers superior functional results and lower wound complication rates.<sup>8–11</sup> However, there are scarce data available on the impact of reconstructive procedures on overall morbidity and mortality of skull base surgery and none, to our knowledge, specifically comparing outcomes in patients who did not undergo flap reconstruction procedures. In this study, we aimed to evaluate the morbidity and mortality of patients undergoing skull base surgery with and without flap reconstruction within 30 days postoperatively using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. In addition, we sought to determine whether any preoperative variables significantly affect the outcome of skull base surgery.

## METHODS

### Patient Identification

We performed a retrospective analysis using the ACS-NSQIP databases for the years 2005 to 2012. The ACS-NSQIP is a well-validated, observational cohort study of patients undergoing noncardiac procedures under general, spinal, or epidural anesthesia in more than 400 medical centers nationwide. The ACS-NSQIP tracks patients for 30 days after their operation, providing a more comprehensive understanding of their care.<sup>12</sup> The Current Procedural