Does practice really make perfect? The answer might not be as obvious as we think. Yoon and colleagues\(^1\) have retrospectively analyzed all digit replantations and revascularizations over a 20-year period at a single academic institution to assess variations among surgeons' operative proficiency—based on surgeon proficiency scores using a formula devised by the authors—and examined whether surgeon proficiency is associated with surgical outcomes. In summary, the answer is yes, but there is more to the story. The authors used outcomes from more than 31 studies that reported survival rates of digit replantation compared with revascularization to determine a procedure difficulty scoring system, which was an important variable that helped determine a surgeon's proficiency score. In short, the authors found that higher proficiency scores were associated with fewer case failures; each point increase was associated with a 40% decreased odds of failure. Every 3-point increase in proficiency score was associated with 1 fewer complication, and surgeon proficiency score had a greater association with case failure than surgeon volume. I applaud the authors for a well-designed and well-executed study, in addition to an interesting question with some fascinating answers.

The study by Yoon et al\(^1\) sheds some light on the relationship between practice and perfection, showing that it might not be as linear as we think. In this study, each additional year of surgeon experience was associated with an increased likelihood of case failure. Table 3 in the study by Yoon et al\(^1\) shows that surgeon proficiency scores decreased from a mean of 3.4 in the first half of a surgeon's case series to a mean of 2.0 in the second half. Not only are surgeons not perfect, but interestingly—at least in this study—the more we practice, the worse we seem to get. This seems to go against everything we have learned about expertise. In 1973, Simon and Chase\(^2\) published a famous article on the subject of expertise using experiments with chess-playing tasks and computer simulation of skilled performance, arguing that it takes a lot of practice to be good at complex tasks. They estimated that a chess master has spent 10 000 to 50 000 hours staring at chess positions. This notion of 10 000 hours of practice appeared again in 1993, when Ericsson\(^3\) suggested that 10 000 hours of deliberate practice can overcome innate differences in human ability to become an expert. Malcolm Gladwell further popularized the work of Simon, Chase, and Ericsson in his best-selling book *Outliers*,\(^4\) in which Gladwell repeatedly mentions the 10 000-hour rule.

The interesting finding that surgeons in this series by Yoon et al\(^1\) actually performed worse in the second half of the series is difficult to explain. Is it possible that early in a surgeon's career, they are more involved throughout the replantation/revascularization procedures and then later in their careers, they let the trainees do more? The authors did not factor in the time of year relative to the academic calendar—maybe outcomes were worse in August when residents and fellows are new and better in June when the residents and fellows are more experienced. Regardless, the findings of this study by Yoon and colleagues\(^1\) contradict a key assumption of the framework proposed by Tang and Giddins,\(^5\) who argued that the level of expertise of surgeons performing procedures in original research studies should be listed to help us interpret the results. If the grading system proposed by Tang and Giddins\(^6\) had been applied to this study, involvement of residents and fellows during the replantations and revascularizations would have been scrutinized.

However, the main limitation of this retrospective study was the relatively small sample size, which the authors acknowledge. This retrospective review included 145 patients and 226 digits treated by 11 surgeons (9 fellowship-trained hand surgeons and 2 fellowship-trained microsurgeons) for a total of 116 replantations and 110 revascularizations. Although at first glance this seems like a
lot of cases, when spread out over 20 years, it comes to 7.25 patients and 11.3 digits per year. When it comes to replantations and revascularizations, this is not a particularly high volume compared with other centers in the United States (and compared with replantation centers outside of the United States). When evaluating surgeon proficiencies, it is hard to draw conclusions from an average of 21 cases per surgeon, with 1 surgeon performing only 9 cases overall. This is hardly 10 000 hours’ worth of cases for each surgeon, and we should keep this in mind when interpreting the findings of this study.

With 10 000 hours of deliberate practice, surgeon proficiency—and digit survival outcomes—might improve, especially at a higher volume replantation center. Centralization of replantation in the United States may lead to the deliberate practice that the authors espouse to become experts at replantation and revascularization. As the authors alluded to, combining these data with other high-volume replantation centers might provide more insight into the associations between surgeon proficiency, case volumes, and outcomes, which could have ramifications on health care payer practices and the move toward centralization of replantation in the United States, which has already been successful in other countries. Although I doubt payers could drill down to granular details, such as 1 surgeon with a high proficiency score vs another surgeon at the same institution with a lower proficiency score, directing—or centralizing—patients to designated replantation centers (or centers known to have better outcomes and higher surgeon proficiency scores) might be feasible, especially given some of the cost considerations the authors of this study, along with Hustedt et al, have demonstrated. In the end, however, we have to remember that replantations and revascularizations are emergency surgeries, and getting quick and efficient treatment is of the utmost importance. Payers will only be able to control so much in those situations.

Overall, this was a very interesting study that was well designed but had some considerable limitations. Despite the surprising findings of decreased surgeon proficiency over time, my guess is that practice still does make perfect—it just takes a lot of replantations and revascularizations to reach 10 000 hours. Perhaps centralization of replantation could improve patient outcomes and decrease costs by helping surgeons at those centers become experts as they get closer to 10 000 hours of deliberate practice. This is an intriguing concept that deserves further study.