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Standard digit-based versus 90° rotation technique for supraglottic airway device insertion: a meta-analysis of randomized controlled trials

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Running title: Comparing of SGA insertion techniques

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Standard digit-based versus 90° rotation technique for supraglottic airway device insertion: a meta-analysis of randomized controlled trials

Running title: Comparing of SGA insertion techniques
Abstract

Background: Prompt insertion and placement of the supraglottic airway (SGA) devices in the correct position are required to secure the airway. This meta-analysis was performed to validate the usefulness of the 90° rotation technique as compared with the standard digit-based technique for the insertion of SGA devices in anesthetized patients in terms of success rate, insertion time, and postoperative complications.

Methods: A literature search of PubMed, EMBASE, CENTRAL, CINAHL, Scopus, and Web of Science was conducted. Randomized controlled trials, without limitations on publication period, language, journal, or region, until July 2021, that compared the 90° rotation and the standard digit-based techniques for insertion of SGA devices in anesthetized patients were included.

Results: The first-attempt (risk ratio [RR] 1.16, 95% confidence interval [CI] 1.09 to 1.25, p < 0.001) and overall success rates (RR 1.06, 95% CI 1.03 to 1.09, p < 0.001) were significantly higher in the 90° rotation group. The insertion time was shorter in the 90° rotation group (mean difference -4.42 s, 95% CI -6.90 s to -2.15 s, p < 0.001). The incidences of postoperative sore throat (OR 0.63, 95% CI 0.49 to 0.83, p < 0.001) and blood staining (RR 0.28, 95% CI 0.20 to 0.39, p < 0.001) were lower in the 90° rotation group.

Conclusions: The use of the 90° rotation technique increases the success rate of SGA device insertion and decreases pharyngeal mucosal trauma as compared with that of the standard digit-based technique in anesthetized patients.

Trial registration: CRD42021271253

Keywords: 90° rotation technique; airway management; insertion; laryngeal mask; meta-analysis; supraglottic airway device.
Introduction

Supraglottic airway (SGA) devices have increasingly been used to maintain the airway during anesthesia. The American Society of Anesthesiologists has recommended the use of SGA devices in the practice guidelines for management of difficult airways [1,2]. Various SGA devices have been developed and introduced, such as the Classic™ laryngeal mask airway (LMA), Proseal™ LMA, LMA flexible™, and i-gel™.

Prompt insertion and placement of the SGA device in the correct position are important during induction of anesthesia or emergency airway management. Conventionally, the standard digit-based technique involves using the index finger for SGA device insertion. However, this technique is somewhat difficult [3], and thus it requires certain training and some degree of skill [4]. Consequently, standard digit-based technique does not always ensure successful insertion and optimal placement of SGA device. The first-attempt success rate of standard digit-based technique is reported to be 67-90% [5,6].

Various techniques have been investigated to increase the success rate of SGA device insertion in the first attempt, including the 90° rotation technique, 180° rotation technique, head elevation, or rotation and guidance technique [7-12]. Among these approaches, the 90° rotation technique was first introduced by Hwang et al. in 2009 [7]. Thereafter, this technique has been investigated with a variety of SGA devices in several studies [8,11,12,13]. The 90° rotation technique has shown favorable results in increasing the success rate of SGA device insertion in several studies [8,12]. In contrast, it was unclear whether the 90° rotation technique could improve success rate of SGA insertion compared to the standard digit-based technique [11,13].

Given the conflicting reports of previous studies, this meta-analysis was designed to verify the superiority of the 90° rotation technique over the standard digit-based technique in terms of insertion success rate and pharyngeal trauma in anesthetized patients undergoing surgery.
Materials and Methods

2.1. Literature search

This study was performed in accordance with the Preferred Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines [14]. The protocol was registered in the International Prospective Register of Systematic Reviews (CRD42021271253). In this study, we searched studies comparing the 90° rotation and the standard digit-based techniques for the insertion of SGA devices in patients undergoing general anesthesia. Eligible studies published until July 26, 2021 were searched on electronic databases, such as PubMed, EMBASE, CENTRAL, CINAHL, Scopus, and Web of Science. The search terms consisted of Medical Subject Headings (MeSH) terms and keywords, such as “Laryngeal Masks”, “laryngeal mask”, “LMA,” or “rotation.” Terms were combined with the Boolean operators “AND” or “OR”. The detailed search strategies for each database are shown in table, Supplemental Digital Content 1. The search was conducted without limitations on publication period, language, journal, or region.

2.2. Study selection

Two authors (C.-H.K., J.-H.R.) independently screened papers and selected eligible studies according to predefined inclusion and exclusion criteria. The inclusion criteria were: (1) randomized controlled trials (RCTs); (2) studies including patients with SGA device insertion under general anesthesia; (3) studies comparing the 90° rotation technique with the standard digit-based technique for insertion of the SGA device; (4) studies reporting outcomes regarding insertion success rate and complication rate. Exclusion criteria were: (1) animal studies; (2) non-randomized studies (e.g., observational studies, retrospective studies, or case reports); (3) incomplete papers (e.g., conference abstracts, protocols, letters, or editorials). The results obtained by searching each database were combined, and the title and abstract of each paper was examined to screen for relevant studies.

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Subsequently, we found and reviewed the full text of the relevant studies and included RCTs that met the inclusion criteria in the final analysis. If any disagreement occurred during study selection, a third author (J.-W.H.) participated in study selection and made the final decision.

### 2.3. Data extraction

The RCTs included in the final analysis were reviewed, and data were extracted and summarized into Excel sheets (Microsoft Inc., Redmond, WA, USA). The data extracted were the following: (1) name of the first author; (2) publication year; (3) sample size; (4) age of participants; (5) type and size of SGA device; (6) cuff pressure of SGA device before insertion; (7) allowance of manipulation during SGA device insertion; (8) types of neuromuscular blocking agents (NMBA) used; (9) success rates for SGA device insertion; (10) insertion time; and (11) postoperative complications regarding SGA device placement. If the result in a study was only plotted as a graph, we extracted the numerical data using the GetData Graph Digitizer 2.26 (http://www.getdata-graph-digitizer.com). The primary outcome was the first-attempt success rate for SGA device insertion. Secondary outcomes included the overall success rate for insertion, insertion time, and postoperative complications regarding SGA device insertion. The definitions of success of SGA placement and insertion time in each RCT are summarized in table, Supplemental Digital Content 2. Complications were defined as postoperative sore throat and pharyngeal injury assessed by blood stains on the surface of the SGA device.

The risk-of-bias (RoB) of each RCT was assessed using the revised Cochrane risk-of-bias tool (RoB 2) [15]. Two authors (C.-H.K., J.-H.R.) independently reviewed the full text of each RCT and graded the level of the RoB. The RoB 2 has 5 domains (randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result) and each domain is graded as “low risk,” “some concerns,” or “high risk.” Subsequently, the overall RoB in each RCT was determined according to the RoB for each domain.
When all domains were graded “low risk,” the overall RoB was considered “low risk.” If there were “some concerns” without “high risk,” the overall RoB was determined to be “some concerns.” If at least one domain was graded “high risk,” the overall RoB was considered “high risk.” Any disagreements were resolved by participation of the third author (Y.-T.J.).

The level of evidence for each outcome was assessed using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system [16]. It has five domains including RoB, inconsistency, indirectness, imprecision, and publication bias.

2.4. Statistical analysis

To determine the degree of agreement between two authors for the study selection and data extraction, we calculated kappa value and interpreted the value as follows according to the Cochrane Handbook [17]: 0.4-0.59, fair agreement; 0.6-0.75, good agreement; 0.75-1.0, excellent agreement.

We used R statistical software version 3.6.1. (R Foundation for Statistical Computing, Vienna, Austria) with the “meta” and “metafor” package to conduct data synthesis and meta-analyses [18-20]. We calculated risk ratio (RR) for categorical variables, such as success rates and the incidence of postoperative complications. We calculated the mean differences (MDs) for the insertion time (a continuous variable). In addition, sensitivity analysis was performed by using the leave-one-out approach to assess the robustness of our findings. The level of heterogeneity across studies was determined by calculating the inconsistency index ($I^2$). If $I^2 < 50\%$, a fixed-effects model was used; otherwise, a random-effects model was used to estimate effect size. To explore the potential sources of heterogeneity, we planned to perform subgroup analysis according to the age of participants (adults vs. children), use of NMBAs, allowance of manipulation during SGA device placement, and cuff pressure before insertion. Additionally, we also conducted meta-regression analysis in case significant heterogeneity was observed. All subgroup-, sensitivity-, and meta-regression analyses were restricted.
to the primary outcome. We constructed funnel plots and conducted Egger’s linear regression analysis to detect publication bias. A p value < 0.05 was considered statistically significant.
Results

3.1. Included and excluded studies

The literature search yielded 589 papers, of which 300 were duplicate. The remaining 289 papers were screened, and of these, 275 irrelevant papers were excluded. A review of the remaining 14 papers led to the exclusion of 4 papers based on the exclusion criteria: incomplete papers (n = 3) and a non-randomized study design (n = 1). Therefore, 10 RCTs, with 1286 patients, were included in the final meta-analysis (Fig. 1) [7,8,11-13,21-25]. In the study selection, kappa value between two authors was 0.811, indicating excellent agreement.

Among the participants, 644 patients were allocated to the 90° rotation group and 642 patients were allocated to the standard group. The characteristics of each RCT are shown in Table 1. Since 9 of 10 RCTs included adult patients, we decided not to conduct subgroup analysis according to age. The Proseal™ LMA device was used in half of the included RCTs [7, 8, 12, 22, 24] and the i-gel™ device was used in 2 RCTs [21,25]. The Classic™, Unique™, and Flexible™ LMA devices were placed in the remaining RCTs [11,13,23]. In 6 RCTs, the SGA cuff was fully deflated before insertion and was inflated after placement [7,8,11-13,24]. The cuff was partially inflated before insertion in another 2 RCTs [22,23]. The remaining 2 RCTs employed the i-gel™, which has no cuff [21,25]. In 6 RCTs, authors performed manipulations, including chin lift, jaw thrust, head extension, neck flexion, or movement of the SGA device for device placement, if needed [7,11,13,21,24,25]. NMBAs were administered before SGA device insertion in 7 RCTs [8,11-13,21,24,25], whereas no NMBA was used in 3 RCTs [7,22,23]. In terms of interrater reliability for data extraction, kappa value was 0.759 that indicated excellent agreement between two authors.

3.2. First-attempt success rate

We extracted or estimated the first-attempt success rate for SGA device insertion in all 10 RCTs
[7,8,11-13,21-25]. The SGA device was placed properly in the first attempt in 612 patients (95.0%) in the 90° rotation group and in 522 patients (81.3%) in the standard group. Hence, the first-attempt success rate was significantly higher in the 90° rotation group than in the standard group (RR 1.16, 95% confidence interval [CI] 1.09 to 1.25, p < 0.001, I² 69%; random-effects model; Fig. 2A). Sensitivity analysis showed that the RR remained stable, implying that no single RCT skewed the pooled effect size (see figure, Supplemental Digital Content 3). In the subgroup analyses (see figure, Supplemental Digital Content 4), the RRs remained stable in NMBA (studies = 7, RR 1.12, 95% CI 1.04 to 1.22, p = 0.004), no NMBA (studies = 3, RR 1.27, 95% CI 1.11 to 1.44, p < 0.001), manipulation (studies = 6, RR 1.10, 95% CI 1.02 to 1.18, p = 0.008), no manipulation (studies = 4, RR 1.30, 95% CI 1.18 to 1.43, p < 0.001), no cuff (studies = 2, RR 1.11, 95% CI 1.02 to 1.20, p = 0.016), inflated cuff (studies = 2, RR 1.35, 95% CI 1.13 to 1.61, p = 0.001), and deflated cuff (studies = 6, RR 1.15, 95% CI 1.05 to 1.25, p = 0.003) subgroups. Meta-regression analysis showed that allowing manipulation during SGA device insertion had a significant influence on the pooled effect size (p = 0.005), accounting for the considerable level of heterogeneity (53.03%) (table, Supplemental Digital Content 5). The funnel plot is shown in figure, Supplemental Digital Content 6. Egger’s linear regression analysis revealed that publication bias was insignificant (p = 0.300).

3.3. Overall success rate

The overall success rate was reported in 7 RCTs, with a total of 917 patients [7,8,12,21,23-25]. It was 98.7% in the 90° rotation group and 93.0% in the standard group. An RR of 1.06 indicated that the 90° rotation technique significantly improved the overall success rate of SGA device insertion as compared to the standard technique (RR 1.06, 95% CI 1.03 to 1.09, p < 0.001, I² 0%, fixed-effects model; Fig. 2B). The funnel plot is shown in figure, Supplemental Digital Content 7. The results of Egger’s linear regression analysis proved that there was no significant publication bias (p = 0.662).
3.4. Insertion time

Insertion time was reported in all 10 RCTs [7, 8, 11-13, 21-25]. Mahmoodpoor et al. [23] showed the time for SGA device insertion as a graph, and the unit of time in the figure was “minutes.” However, according to the main text of their paper, the unit of time was “seconds.” We contacted study author and confirmed that the unit of time was “seconds.” In addition, we regarded that the error bar represented the standard error of mean. The results of our meta-analysis demonstrated that the 90° rotation technique required less time for SGA device placement than the standard technique (MD -4.42 s, 95% CI -6.70 s to -2.15 s, p < 0.001, I² 91%, random-effects model; Fig. 3). The funnel plot is shown in figure, Supplemental Digital Content 8. The results of Egger’s linear regression analysis confirmed that there was no significant publication bias (p = 0.173).

3.5. Postoperative complications

Postoperative sore throat was reported in 9 RCTs [7,8,11-13,21,22,24,25]. A total of 75 patients (12.7%) in the 90° rotation group experienced sore throat after surgery, while 118 patients (20.1%) in the standard group experienced sore throat after surgery. The meta-analysis confirmed that fewer patients in the 90° rotation group had postoperative sore throat than those in the standard group (RR 0.63, 95% CI 0.49 to 0.83, p < 0.001, I² 47%, fixed-effects model; Fig. 4A).

Blood staining on the SGA device surface was reported in all 10 RCTs [7,8,11-13,21-25]. The incidence of blood staining was 6.2% in the 90° rotation group and 22.3% in the standard group. An RR of 0.28 implied that the 90° rotation technique significantly decreased the incidence of blood staining on the SGA device surface as compared to the standard technique (RR 0.28, 95% CI 0.20 to 0.39, p < 0.001, I² 17%, fixed-effects model; Fig. 4B).

Given the symmetrical funnel plots and results of Egger’s linear regression analysis of funnel plot...
asymmetry (p = 0.968 and 0.806, respectively), publication biases for postoperative complications were considered insignificant (see figure, Supplemental Digital Content 9).

3.6. Risk of bias

As shown in figure, Supplemental Digital Content 10, the overall RoB was rated as “low risk” in 4 RCTs and “some concerns” in 5 RCTs. The reason for “some concerns” was the absence of descriptions of allocation concealment [4,10,16-18,20]. Due to the design of the studies, it was impossible to blind the anesthesiologists who inserted the SGA device in all studies. However, objective approaches, for example, a square wave of capnograph or a blinded observer were used to determine the success rate of SGA insertion. Therefore, we judged that the awareness of the allocated group may not have affected the assessment of outcome.

3.7. Level of evidence

The level of evidence for each outcome was shown in figure, Supplemental Digital Content 11. The level of evidence was moderate for first-attempt success rate and postoperative complications, high for overall success rate, and low for insertion time.
Discussion

The present meta-analysis showed that the 90° rotation technique increased both the first-attempt success and overall success rate as compared to the standard digit-based technique during the insertion of SGA devices in anesthetized patients. The 90° rotation technique also reduced SGA device insertion time. In addition, it was associated with less pharyngeal mucosal trauma, in that the incidence of postoperative sore throat and mucosal bleeding was lower in patients intubated using the 90° rotation technique than in those intubated with the standard digit-based technique.

Insertion success rate is the most critical outcome in terms of SGA device insertion. The 90° rotation technique increased both the first attempt and overall success rate as compared with the standard digit-based technique in anesthetized adults (9 studies) and children (1 study). These results correlate fairly well with a previous study and further support the role of the 90° rotation technique in SGA device insertion. Park et al. [26] conducted meta-analysis with 13 RCTs and concluded that rotation technique provided higher first-attempt and overall success rate. However, they included both 90° and 180° rotation technique. Among the included studies, there are only 4 studies that compared the 90° rotation to standard technique. Given that our results are based on more RCTs that validated the 90° rotation technique solely, our study may provide further evidence for usefulness of the 90° rotation technique. During the advancement of the SGA device by means of the standard digit-based technique, impaction and friction at the back of the mouth are often encountered, which are the main causes of failed insertion [27]. Furthermore, some types of SGA device have soft bowl, large cuff, or flexible shaft [28, 29]. These features may disturb the insertion of SGA device. In the 90° rotation technique, the SGA device is inserted until the cuff is inside the mouth; then, it is rotated 90° and advanced until resistance from the hypopharynx is felt; and finally, it is straightened out in the hypopharynx [7]. Therefore, the 90° rotation technique may reduce the resistance between the SGA and the posterior pharyngeal wall at the lateral edge of the oral cavity, making advancement of the
SGA device easier. The reduced insertion time of the 90° rotation technique may be explained by the same oral cavity anatomical factors mentioned above.

This meta-analysis included studies that used various SGA devices including the Classic™, Proseal™, Flexible™, Unique™, and i-gel™ devices. Hence, a moderate degree of heterogeneity may be shown for the first-attempt success rate. We performed subgroup, sensitivity, and meta-regression analyses to explore the potential sources of heterogeneity. We found that the allowance for manipulations of SGA device insertion accounted for the heterogeneity. It is reasonable to infer that manipulation could facilitate SGA device insertion and affect the success rate. It is notable in this study that the 90° rotation technique improved the first-attempt success rate for device placement, irrespective of whether NMBA was administered, whether manipulation for placement was allowed, or whether the cuff was inflated or deflated. We believe that the results of subgroup analyses emphasize the validity of the 90° rotation technique in various circumstances. There was a high degree of heterogeneity in the insertion time. We recognized that definitions of success and insertion time were slightly inconsistent among the studies, and that these discrepancies might cause heterogeneity in the first-attempt success rate and insertion time. Nevertheless, it is interesting to note that there was no heterogeneity in the overall success rate.

Pharyngeal trauma related to SGA device insertion results in postoperative sore throat and mucosal bleeding, which is manifested by blood staining on the surface of the removed SGA device. The 90° rotation technique was associated with a significantly reduced incidence of sore throat and mucosal bleeding as compared with the standard digit-based technique. This result may also be due to the reduced resistance and friction between the shaft of the SGA and the pharyngeal wall at lateral edge of the oral cavity [7].

This study had several limitations. First, generally, SGA insertion requires certain training and sufficient experience. The SGA could be skillfully inserted only after mastering the correct method.
Therefore, the professional title and experience of the researcher may be important factors for the success rate of SGA placement. Second, this study included electively anesthetized patients, and thus, it is difficult to extrapolate our findings to other fields, such as the emergency department. Third, RCTs included in this study used five types of SGA devices. However, there are various types of SGA device which are not included in this study, for example, Softseal LMA. Given that our findings are based on five types of SGA devices, the results from this analysis should be treated with caution and are hardly to be generalized to all types of SGA devices.

In conclusion, prompt and correct insertion of SGA devices, which are used for airway management, is essential. This meta-analysis of 10 RCTs demonstrated that the 90° rotation technique was superior to the standard digit-based technique during insertion of the SGA device in anesthetized patients in that it was associated with increased first-attempt and overall success rate of device insertion, decreased insertion time, and decreased pharyngeal mucosal trauma than the standard digit-based technique. Further research is needed in un-anesthetized patients with difficult airways in emergency airway management situations.
References


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27. Brimacombe J, Keller C. The ProSeal laryngeal mask airway: A randomized, crossover


Table 1. Characteristics of included randomized controlled trials (n = 10).

<table>
<thead>
<tr>
<th>Author &amp; Year</th>
<th>Sample size (Standard /rotation)</th>
<th>Age</th>
<th>Type and size of SGA device</th>
<th>Cuff pressure</th>
<th>Allowance of manipulation</th>
<th>Type and doses of NMBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhardwaj 2020</td>
<td>45/45</td>
<td>34.9 ± 10.9</td>
<td>i-gel\textsuperscript{TM} (3/4/5)</td>
<td>No cuff</td>
<td>Yes</td>
<td>Vecuronium 0.1 mg/kg</td>
</tr>
<tr>
<td>Dhulkhed 2017</td>
<td>60/60</td>
<td>28.8 ± 9.6</td>
<td>Proseal\textsuperscript{TM} (3/4)</td>
<td>Inflated</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hwang 2009</td>
<td>80/80</td>
<td>43 ± 11</td>
<td>Proseal\textsuperscript{TM} (3)</td>
<td>Deflated</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Jeon 2010</td>
<td>60/60</td>
<td>49 ± 12</td>
<td>Proseal\textsuperscript{TM} (4/5)</td>
<td>Deflated</td>
<td>No</td>
<td>Rocuronium 0.6 mg/kg</td>
</tr>
<tr>
<td>Kim 2014</td>
<td>90/91</td>
<td>65.9 ± 9.9</td>
<td>i-gel\textsuperscript{TM} (3/4)</td>
<td>No cuff</td>
<td>Yes</td>
<td>Rocuronium 0.6 mg/kg</td>
</tr>
<tr>
<td>Koo 2019</td>
<td>66/63</td>
<td>44.8 ± 11.1</td>
<td>Flexible\textsuperscript{TM} (3/4)</td>
<td>Deflated</td>
<td>Yes</td>
<td>Rocuronium 0.5 mg/kg</td>
</tr>
<tr>
<td>Mahmoodpoor 2015</td>
<td>50/50</td>
<td>62.5 ± 9.4</td>
<td>Classic\textsuperscript{TM}</td>
<td>Inflated</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nalini 2016</td>
<td>70/70</td>
<td>38.9 ± 13.8</td>
<td>Proseal\textsuperscript{TM} (3/4)</td>
<td>Deflated</td>
<td>Yes</td>
<td>Atracurium 0.5 mg/kg</td>
</tr>
<tr>
<td>Shyam 2021</td>
<td>60/60</td>
<td>35.5 ± 12</td>
<td>Unique\textsuperscript{TM} (3/4)</td>
<td>Deflated</td>
<td>Yes</td>
<td>Atracurium 0.05 mg/kg</td>
</tr>
<tr>
<td>Yun 2011</td>
<td>63/63</td>
<td>6 ± 2</td>
<td>Proseal\textsuperscript{TM} (2/2.5/3)</td>
<td>Deflated</td>
<td>No</td>
<td>Rocuronium 0.6 mg/kg</td>
</tr>
</tbody>
</table>

Data are presented as mean ± standard deviation. Abbreviations: SGA, supraglottic airway; NMBA, neuromuscular blocking agent.
Figure 1. PRISMA flow diagram for the included and excluded studies. A total of 589 papers were searched through databases. We excluded 300 duplicate papers and 275 irrelevant papers. The full texts of 14 eligible studies were reviewed, and 4 studies were excluded. Finally, a total of 10 randomised controlled trials were included in the final analysis.
Figure 2. Forest plots for success rates of supraglottic airway insertion. (A) First attempt success rate, (B) overall success rate. Both first attempt success rate and overall success rate were significantly higher in the 90° rotation group than in the standard group (p < 0.001, respectively). Abbreviations: RR, risk ratio; CI, confidence interval.
Figure 3. Forest plot for insertion time for supraglottic airway insertion. Insertion time was significantly lower in the 90° rotation group than in the standard group (p < 0.001). Abbreviations: MD, mean difference; CI, confidence interval; SD, standard deviation.
Figure 4. Forest plots for postoperative complications. (A) postoperative sore throat, (B) blood staining. The 90° rotation technique was associated with a significantly decreased incidence of postoperative sore throat and blood staining (p < 0.001, respectively). Abbreviations: RR, risk ratio; CI, confidence interval.
List of Supplemental Digital Content

Supplemental Digital Content 1
Search strategies for each database.

Supplemental Digital Content 2
Definitions of success and insertion time for supraglottic airway device placement in each study.

Supplemental Digital Content 3
Forest plot for sensitivity analysis for first-attempt success rate. Omitting each study in turn did not skew the pooled effect size.

Supplemental Digital Content 4
Forest plots for subgroup analyses of first-attempt success rate. Subgroup analysis was performed according to (A) the use of neuromuscular blocking agents (NMBA), (B) allowance for manipulation of supraglottic airway placement, and (C) cuff pressure before insertion. The first-attempt success rate remained significantly higher in the 90° rotation group than in the standard group in the NMBA (p = 0.004), no NMBA (p < 0.001), manipulation (p = 0.008), no manipulation (p < 0.001), no cuff (p = 0.016), inflated cuff (p = 0.001), and deflated cuff (p = 0.003) subgroups.

Supplemental Digital Content 5
Meta-regression analysis for the potential sources of heterogeneity.

Supplemental Digital Content 6
Funnel plot for first-attempt success rate. Egger’s linear regression analysis of the funnel plot
asymmetry revealed that publication bias was insignificant (p = 0.300).

Supplemental Digital Content 7
Funnel plot for overall success rate. Egger’s linear regression analysis of the funnel plot asymmetry revealed that publication bias was insignificant (p = 0.662).

Supplemental Digital Content 8
Funnel plot for insertion time. Egger’s linear regression analysis of the funnel plot asymmetry revealed that publication bias was insignificant (p = 0.173).

Supplemental Digital Content 9
Funnel plots for postoperative complications. (A) Postoperative sore throat, (B) Blood staining on supraglottic airway device surface. Egger’s linear regression analysis of the funnel plot asymmetry revealed that publication bias was insignificant (p = 0.968, 0.806, respectively).

Supplemental Digital Content 10
Risk-of-bias graph. D1, bias arising from the randomization process; D2, bias due to deviations from the intended intervention; D3, bias due to missing outcome data; D4, bias in measurement of the outcome; D5, bias in the selection of the reported results. Green circle: low risk; yellow circle: some concerns.

Supplemental Digital Content 11
Level of evidence for each outcomes