

# Surgical Training Simulators for Rhinoplasty: A Systematic Review



Otolaryngology – Head & Neck Surgery  
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## BACKGROUND

- Rhinoplasty training currently follows an apprenticeship model that is largely observational.
- Trainees have limited experience in performing manoeuvres of this complex surgery.
- Rhinoplasty simulators can provide trainees with surgical simulator experience that could improve technical competences in the operating room.

## OBJECTIVES

- To amalgamate the collective understanding of rhinoplasty simulators described to date.

## METHODS & DESIGN

1143 studies from PubMed, OVID Embase, OVID Medline and Web of Science related to rhinoplasty surgical simulators imported

774 duplicate

669 titles & abstracts screened

649 excluded

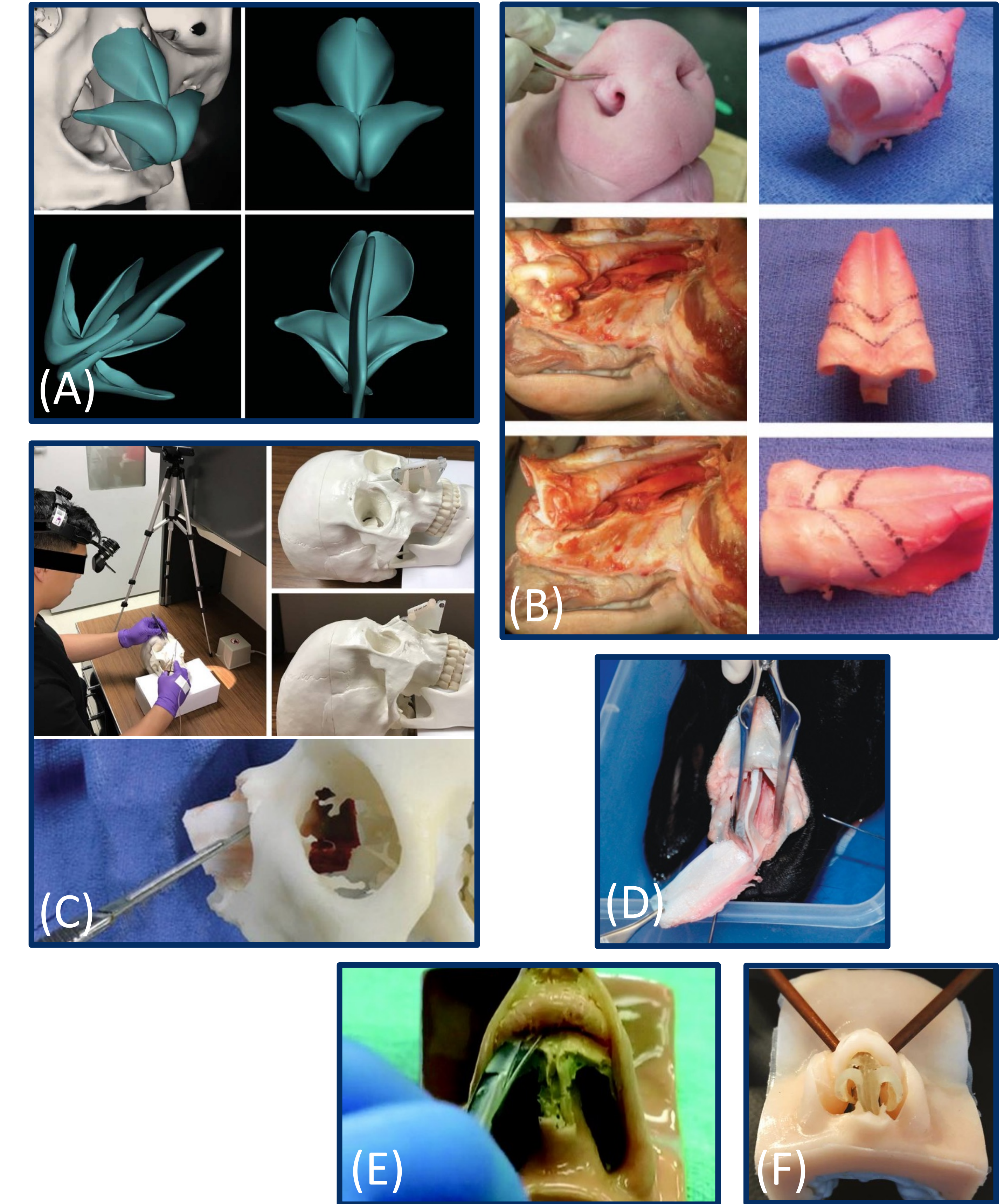
20 full-text studies assessed

3 excluded

17 studies included<sup>1-17</sup>

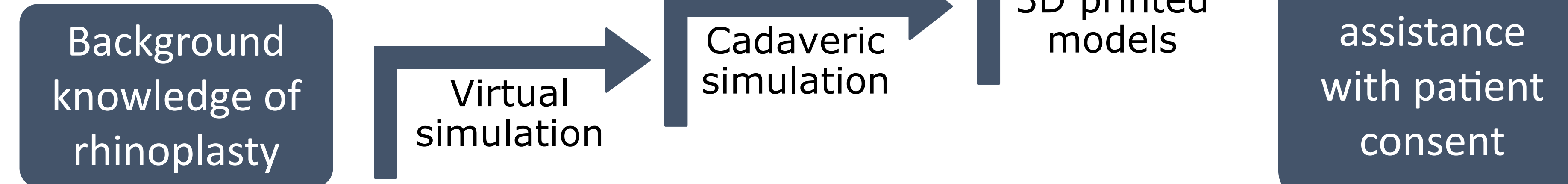
**Table 1. Summary of outcomes, strengths and weaknesses of current rhinoplasty simulator models.**

Type	Description	Strengths (+) & Weaknesses (-)
Virtual	Decision-making 2D and maneuverable 3D simulator	<ul style="list-style-type: none"> <li>+ Over 3000 choices and 200 unique solutions.</li> <li>+ Widely compatible, intuitive and effective teaching tool.</li> <li>- Lack skin textures, endonasal structures &amp; soft tissue layers.</li> </ul>
Animal Cadaver	Chicken, caprine, bovine and porcine septal cartilage	<ul style="list-style-type: none"> <li>+ Repeated practice, very low cost and accessible. Facial validity and increase in trainee confidence.</li> <li>- Less stable and biomechanical differences with human septum.</li> <li>- Wide exposure limited.</li> </ul>
Human Cadaver	Simulated osteotomies	<ul style="list-style-type: none"> <li>+ Valuable for teaching and improving confidence.</li> <li>+ Direct comparison of anatomy and physiology post-operatively.</li> <li>+ Low risk setting. Authentic surgical experience.</li> <li>- Healing and skin envelop-cartilage interaction unappreciable.</li> <li>- Unmeasurable effects of incisions affecting internal valve physiology.</li> <li>- Expensive [\$130/hour (\$53,646/5 years)].</li> </ul>
Live Animal	Surgery with live rabbits	<ul style="list-style-type: none"> <li>+ Techniques practiced with minimal modifications.</li> <li>+ Observable outcome, complications and mortality.</li> <li>- Rabbit deaths caused decreased nasal breathing.</li> </ul>
3D printed	Simulated anatomy, tissue properties, and surgery	<ul style="list-style-type: none"> <li>+ Low cost.</li> <li>+ Modular design with adjustable difficulty.</li> <li>+ Realistic anatomy, septal reconstruction, osteotomies and grafting.</li> <li>+ Properties of material resemble human skin, cartilage and mucosa closely.</li> <li>- 3D printer cost and lengthy print time.</li> </ul>



**Figure 2. Examples of virtual, cadaveric and 3D-printed simulators.** (A) Virtual 3-dimensional nose by Vartanian et al.<sup>9</sup> (B) Porcine cartilage model by Chark et al.<sup>12</sup> (C) Simulation of spreader graft procedure with plastic skull and porcine costal cartilage by Oh et al.<sup>14</sup> (D) Caprine model demonstrating septoplasty by Dini et al.<sup>1</sup> (E) 3D silicone nasal model by Zabaneh et al.<sup>2</sup> (F) 3D printed modular simulator by Zammit et al.<sup>4</sup>

**Figure 1. Proposed graduated approach for rhinoplasty simulation training.**



## CONCLUSION

- Rhinoplasty simulators can provide trainees with hands-on training to improve skill and develop competencies without putting patients in harm's way.
- Current literature on rhinoplasty simulators largely focuses on simulator development, with few validated and assessed for utility.
- For wider implementation and acceptance, further refinement of simulators, validation and assessment of outcomes is required.

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