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Design Simulator Dental Unit For Practice Of Dental Medicine Students

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Abstract; Objective: The dental simulator is very important for dental education at the stage of preclinical education. Training with dental simulators is expected to provide easy adaptation for students to work on patients in professional education in hospitals.
Methods: Make of the body and phantom head simulator, maxilla and mandible typodonts, lamp arms, instrument table arms, and box. Use other components hight speed, low speed, tree way syringe, valve handle, control valve, pressure valve, integral valve, connectors, air pressure matter, and power window.
Results: Vertical direction movement on the instrument table arms and arms of the operating lamp made from Spring Shock-Breaker. LED lamps as illumination are made of iron plate frame; instrument box and body made from a mixture of resin and fiber; phantom head simulator made from a mixture of resin and ceramic adhesive consists of typodont with teeth fixed with glass glue, resin teeth, and room-temperature vulcanizing (RTV) silicone gingiva can be removed, articulators in place of typodont, part maxilla of typodont is fixed on horizontal plate. Movement of head simulator forward - down and slope of the body simulator is controlled by power window.
Conclusions: The dental simulator works well as a learning tool for dental students and designed to follow the principles of dental unit technology.

KEYWORDS: Dental simulator; Phantom head simulator; Typodont; Silicon RTV; Resin; Articulator.

1. INTRODUCTION

Clinical simulations have created widespread interest in all dental institutions in Indonesia and the world. Clinical simulations that mimic clinical conditions of "real life" becomes very important for example head, jaw, teeth, ergonomic dental chair, standard patient, and computer-based interactive communication.[1] The training of students with dental simulators at the undergraduate level will facilitate the adaptation of students at the Hospital.

Suvinen, et al. (1998), an interest in dental education in the world by using patient simulators whose technology resembles real conditions in clinics is increasingly widespread. The patient simulator in the form of a head, teeth, silicone material, and jaw simulator is most often developed by several factories.[2] All dentistry education in Indonesia uses dental simulators along with a competent and skill-based dentistry curriculum in preparation for

serving patients in hospitals. But the design of dental simulators currently in use in Indonesia is still diverse.[2,3]

In addition to dental simulators that resemble dental unit designs, some factories make various types of dental simulators such as dental articulators, simulate temporomandibular joint movements, removable typodont teeth simulators, dental patient simulator in the form of skull human skull simulators coated with skin, upper jaw, bottom and tongue.[3,4]

2. SUBJECTS AND METHODS

The research method :

Prepare: integral valve, pressure valve, 2 hole foot control, strong suction valve, handpiece holder, connector, bottle cover, water tank, wind control, water control, water reducer, on-off switch, tree way syringe, hight speed-low speed handpiece, polystyrene hose(size 2x3,4x6 and 5x6), sheet metal, bar plate, shock-breaker spring, galvanized pipe, LED lights, resin, RTV silicon 585 (polysiloxane chain is poly-di-methyl-siloxane with a hydroxyl terminal group), bluesil catalyst 60R, cement adhesives, transformers, straight gears, Galvanized pipes diameter 1 1/4 inch, thick 0.8 mm, vertical pipe 1 inch, pipe 4x4 inch. Springs for operating lamp arms, instrument tables, and typodont. Cutting sheet iron, thickness 1 mm for box units. Make of pipe 4x4 inch for vertical movement - horizontal operating lamp. Inner arms consist of iron plate 20 x 2 mm, round iron and shock-breaker spring. Spring is fixed on one end with a plate of 20 x 2 mm. Pipe 4 x 6 inch for the instrument table arms, moves vertically - horizontally. Making molds typodont, gingival, phantom head and body, and table instrument. Making an operating lamp frame.

3. RESULTS

The dental simulator equipped the head and body. The instrument table is placed on the right side of the box and the right of the operator, easy to reach with the operator's hands. The lamp is placed in front of the simulator. The operator can easily adjust the head and body simulator tilt movements. The simulator is controlled by 2 power windows motor which is placed in the box and body. The current comes from the transformer 5A, 15V. The stretch of iron in the body simulator, conveyor plate iron, springs, and gear power windows in the box will regulate body tilt. Straight gear fixation on the gear power window in the body will regulate head movements. The illustrations are presented in figure 1, as shown below.

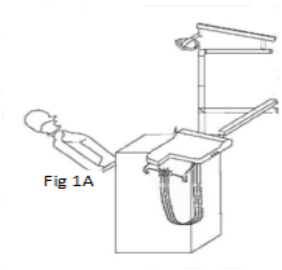
Fig 1A

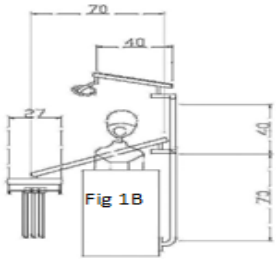
Fig 1B

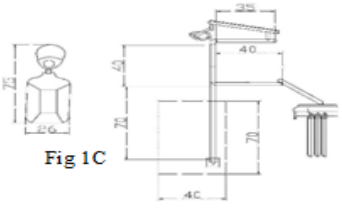
Fig 1C


Fig 1D


Fig 1E


Fig 1F

Figure 1 Right view(1A), front view(1B), left view p(1C). Dental simulator assembly(1D). Power window motor(1E). The transformer converts AC to DC(1F). Body simulators, stretch and power window motor(1G). Consist power window, conveyor plate iron, Output air reducer, tensile spring(1H).

A vertical round pipe connected to the lamp arm, horizontal arm to instrument table are presented in figure 2. Both, equipped with different spring diameters. The diameter of the spring iron-on lamp arm of the unit is 2 cm, the length 24 cm (figure 2). a spring can accept a load of 12 kg. The diameter of the spring of the instrument table arm 2, 3 cm, the length 24 cm. A spring can accept a load of 19 kg. The middle of the two springs are round iron and are assisted by a retaining plate whose function is to resist resilient forces (figure 2 D).

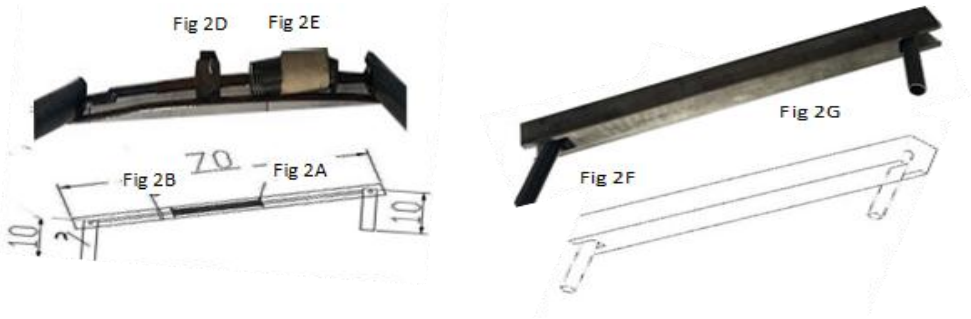

Figure 2 Operator lamp arms and instrument table arms, Length of the instrument table arms(70cm) and operator lamp arms(80cm), shock breaker spring(2A, 2E); limiting spring(2B); vertical round iron 10 cm(2C, 2F); retainer(2D).

The articulator binds to typodonts and is fixed on the base of the head. The articulator is made of iron plate 1 mm. The opening and closing is controlled by a spring 15 mm, rivet nails, and bending. Consists of 32 teeth and removable gingiva. Fixation of teeth and gingiva using silicone glue (figure 3).

Figure 3 Typodont, side view(3A); back view(3B); articulator fixation on the base of the head (3C).

Work functions of hight speed, low speed, and tree way syringe are regulated by installation in the instrument table. Air reducer output through the air hose to the 5 adapters

of the connector. The wind output connector goes to 2 hose foot control, tree way syringe, water tank, and 3 handle valves. The wind foot control to adapter D which supply wind to H1, J1 and K1 adapters. H1, J1, and K1 output tubes go to the large hole of the handpiece as the energy source rotates the turbine handpiece. When the handpiece is raised for use, the output wind from the valve handle will go to the H2, J2 and K2 adapters, this wind opens the valve while supplying the H3, J3 and K3 adapter winds. The output from the H3, J3 and K3 adapters go to the small hole of the handpiece whose function is to help the water that comes out of the handpiece hole to form water spray. Water hose on the handpiece successively from the water tank adapter line, water pressure valve, water control, A, H, J, and K (figure 4).

Figure 4 Integral valve 3 in 1 valve. Yellow line supplies 3 high speed or low-speed handpieces. The wind output of the 3 handpieces is controlled by the wind control.

The water from the pressure valve 5C to the waterway in the integral valve and the handpiece water hole is regulated by water control, usually the location next to or under the instrument table can be seen in figure 5. Tree way syringe water does not flow through the integral valve but directly from the adapter 5B water output. Lane K, K1, K2, K3 on the integral valve in this article are not functional.

Figure 5 Pressure valve for 4 adapters. Waterway from water tank(A), to tree way syringe(B), Waterway to water control input adapter(C), wind from connector(D).

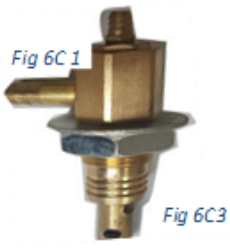

Figure 6 Shank weak suction(6A), Handle valve(6B1), weak suction valve(6C1-C3), suction saliva ejector(6D).

Connector wind hose leading to the valve handle input (6B1), handle valve output hose towards the 6C2 adapter (opening valve). Saliva ejector (6D) sucks up wastewater that each end of the hose is connected to a weak suction shank (6A) and a weak suction valve adapter. Handle valve (6B1) as a weak suction shank holder. When the suction shanks are lifted from the valve handle and the installation contains pressurized wind, the output hose from the valve handle to 6C2, pushing the weak suction valve. Compressed wind will flow into the drain tank towards 6C1. This wind will suck the waste water in typodont toward 6C1. Sucking wastewater requires a suction tube saliva ejector (6D) that connects from a weak suction shank to a weak suction valve through 6C3 (figure 7).

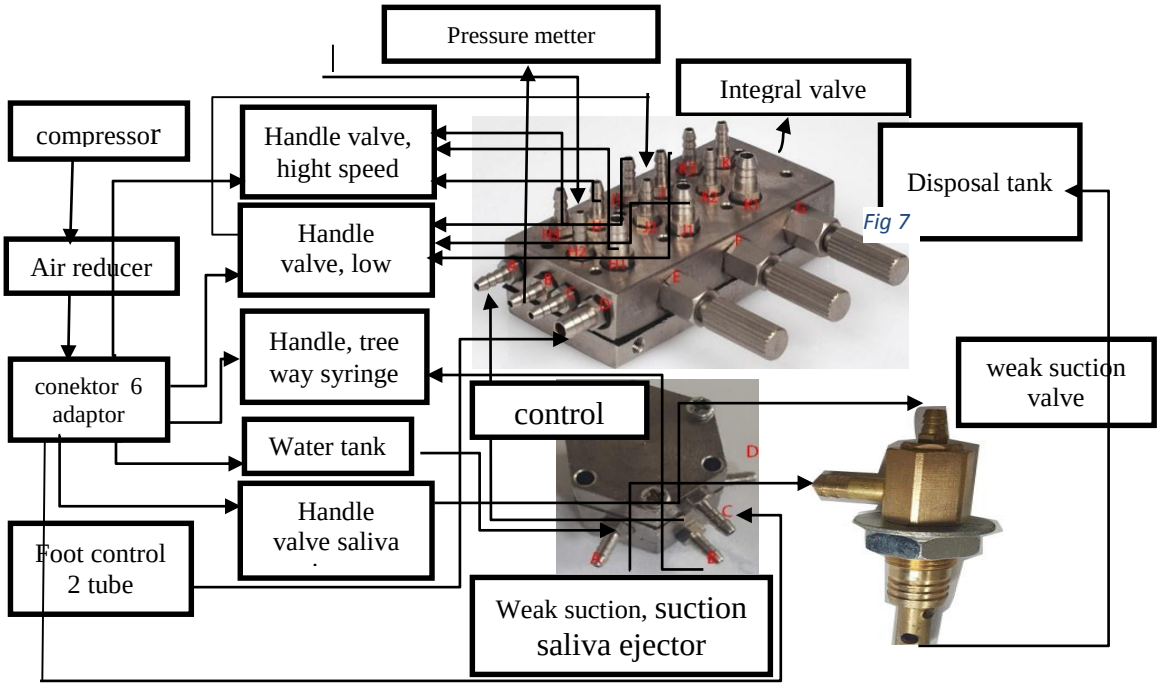

Figure 7 The wind source from the compressor to a handpiece, tree way syringe, and weak suction saliva ejector.

4. DISCUSSION

Frank and Long (1992) made a dental simulator, a teaching tool that can simulate dental clinical work practices or surgical procedures.[5] Patient simulators consisting of head and body simulators are fused with box units and instrument handles. so that can be positioned individually, especially for space or site limited, can be moved for saves space, also for schedule practice that does not change, pleasing to left-handed people. Head and body simulators can be folded up to touch the unit box and separated from the table where the operator stores the device. The box unit has 4 drawers on the side and 4 wheels on the bottom. The wind and water circuit in the box unit. The lighting fixed on a table that can be moved according to operator requirements.

Hemmer (2014) made a preclinical dental practice tool. This tool is resembled a dental unit using a simulator patient as if sitting on a dental chair.[6] The simulator patient composed the head, neck, body, legs, but our innovation there is not leg. Equipped a film viewer. The

instrument table is connected to the dental chair. Mouth liquid waste disposal tank, a stretch of light is connected to the box to the left of the dental chair. The control of the movement of the simulator patient is set through the PC located on the side.[6] Huang and Hung (2009) adding a dental simulator by a monitor screen and two optical cameras that can determine the coordinate system, help measure the area and score of teeth in a typodont. Has two vertical arms for the operating lamp arm and optical camera arm.[7] Functionally have similarities by our innovation but different designs and components.

The articulation of the mandible can be moved using the actuator. The maxilla is fixed to the base of the head. The mandible and maxilla can receive dentures or other tooth restorations. The mandibular movement consists of six actuators that are mounted at different angles, can move freely.[8] Our articulators do not use an actuator but use rivet nails, located to the posterior maxilla plate which functions as a TMJ (Temporo Mandibular Joint) which is assisted with 15 mm pull springs so that the articulations can be moved easily in the vertical direction. A slight bend at the posterior maxilla plate as a barrier so that the maximal typodont opening is kept constant at 42.2 mm. The maximal mouth opening size in humans is different in each country as the results of the study in table 1.

Table 1 Maximum mouth opening (MMO) distance by age of several countries.

Size sample	Country	Age group	MMO* (mm)	Researcher
140	USA	21-42	48.8	[8]
1513	Ireland	16-99	42.2	[9]
303	Brazil	6-14	43.70	[10]
1442	China	20−80	49.10	[11]
254	Mexico	14-24	46.61	[12]
894	India	21-70	47.8	[13]
1825	Saudi Arabia	12-16	43,9	[14]

There are two typodont categories in use today, Fixation permanent teeth in typodont and removed from typodont.[16] The teeth are removable, fixation can be done using screws or with silicone adhesive. The permanent tooth is the crown of his teeth seen in the typodont while the root is not visible. Typodont made in dentistry can be used for practices in several cases. The case of periodontia is made a simulation of periodontal tissue abnormalities in which the teeth are generally removable. Case extraction, it is usually the crown until the roots are made similar to natural teeth fixed by silicone adhesive into the socket. Randoll and McShurley (1981) made a typodont for repair dental cavities. The student makes the repairs to teeth that removable and returns it to the typodont for the lecture to evaluate.[16] The teeth in typodont can be replaced with new teeth. Each tooth has a single lock. Replacement teeth have an indentation in the root. Kumaresan et al. (2014) made facial skin from elastomers to practice surgery procedures such as suturing.[17]

The hydraulic usually for the movement of the patients, sometimes adding springs under the patient's seat. Our article, use a power window motor and a spring. Spring by five sizes: springs for articulation in typodont, the slope of the body and head simulator, for up and down stretch unit lights and up and down movements on the instrument table.

Suction and electrical installations are in the box. Installation of wind and water on the instrument table. one water control to supply a high-speed handpiece valve. Another product can use two pressure valves and two water controls because it supplies two high-speed and low-speed handpieces.

5. CONCLUSION

This dental simulator can be useful as a simulation patient for dental students and is designed to follow the principles of the dental unit before hospital education.

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