Surgical Anatomy Model
SAM 1

Pelvic and Lower Limb Blast Injury

This representative image shows a model reproducing pelvic and perineal blast injury with intra-pelvic bleeding, traumatic trans-femoral amputation of the right lower limb, and major vascular injury to the left lower limb in the upper thigh junctional area.

Trauma Simulation Ltd develops complex life-sized models for surgical training in the context of damage control resuscitation.

Trauma Simulation Ltd

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Introduction

Trauma Simulation Ltd is a Swansea University spin-out created by Professor Ian Pallister specifically to develop complex life-sized models to enhance training in trauma care from the point of wounding to damage control intervention. The models are created from CT and MRI data from one volunteer, with replication of major muscle groups, bones, blood vessels and viscera to create models with tissues which look, feel and handle in a life-like manner. These silicone copies of a physically fit individual are then prepared to represent the required injury patterns, giving a unique combination of realism in appearance and function, enabling those using the model to experience immersion in the simulation.

Utilising the novel application of design technology available through the National Centre for Product Design and Development Research (PDR), supported by the development of custom silicone elastomers and special effects techniques with MBI (Wales) Limited, these complex and versatile models have been developed under contract with the Centre for Defence Enterprise, Porton Down.

Models have been used for teaching fasciotomy (emergency surgical decompression of the muscles of the lower leg) and temporary external fixation, on both the MSc Trauma Surgery Programme, Swansea University and the Management of Surgical Emergencies Course, supported by International Federation of Surgical Colleges, Association of Surgeons of Great Britain & Ireland, and the College of Surgeons of East, Central and Southern Africa (COSECSA).

Models of the severe blast injury pattern seen in the recent conflict in Afghanistan have been demonstrated on the Military Operational Surgical Training Course (MOST 2015) at the Royal College of Surgeons of England, the NATO Conference (2014) and the Defence Science Exhibition International (DSEI 2015).

The combination of clinical and production expertise means that custom models can be created in line with training requirements. Models are made to order and production for more complex requirements will take approximately 8 weeks.
Applications

Control of catastrophic bleeding is the key to successful damage control resuscitation.

Powerful improvised explosive devices were responsible for severe lower limb amputations, often associated with perineal wounds, pelvic fractures, massive haemorrhage and severe trauma to the pelvic vessels and viscera. This pattern of injury has become recognised as the signature injury of the Afghan Conflict.

SAM 1 reproduces the key features of these injuries, including a simulated circulation with real-time blood loss.

The model can be used to train in point of wounding techniques including tourniquet, pelvic binder and haemostatic dressing application.

Damage control surgical procedures include extra-peritoneal pelvic packing, junctional haemorrhage control, arterial shunting, lower limb fasciotomy and external fixation.

Individual elements of SAM 1 can be produced as separate models including SAM 2 Lower Limb Fasciotomy, SAM 5 Haemostasis, SAM 10 Haemostasis and Vascular Shunting Models.
Key Features

Real-time catastrophic bleeding requiring correct application of haemorrhage control techniques are the key features of this highly sophisticated model.

The model of a male extends from the costal margin and includes either the whole left lower limb and a simulated right transfemoral traumatic amputation on the right or bilateral traumatic amputations. The model contains the aorta, common, external and internal iliac vessels, along with the femoral vessels extending to the tibial vessels. All major muscle groups and osteofascial compartments are included along with the femora and bones of the pelvic ring and lower lumbar spine, tibia, fibula and foot (on the left).

The model is produced in tact and can then be prepared to reproduce any chosen injury pattern, such as a simulated perineal blast injury with an open wound, and separation (diastasis) at the front of the pelvic ring. Suitable for pelvic binder application, extraperitoneal pelvic packing, pelvic and lower limb external fixation and fasciotomy.

Extraperitoneal packing of the pelvis and direct control of the iliac vessels can be executed in the model via a lower midline incision as shown.

Elements of the model can be repaired (below). The lower midline incision has been repaired and was successfully reused for pelvic packing 6 times.
Key Features

Illustrated is the exposure of the femoral vessels at the left groin and insertion of a temporary vascular shunt, with restoration of flow to the limb below.

Fasciotomy of the osteofascial compartments of the leg are executed here, after restoring flow in the simulated limb.
Our Models in Use

Trauma Simulation Ltd models have been used both in the UK and abroad, including the MSc Trauma Surgery Programme, Swansea University and the Management of Surgical Emergencies Course, supported by International Federation of Surgical Colleges, Association of Surgeons of Great Britain & Ireland, and the College of Surgeons of East, Central and Southern Africa (COSECSA), along with UK Defence Medical Services events.

Please follow these links the see more:-

“The Technology Helping Military Medics Save Lives”  www.forces.tv/14354464

Development work supported by the National Centre for Product Design and Development Research (PDR), Cardiff Metropolitan University.

http://pdronline.co.uk/Portfolio/trauma-simulation
Our Model Range

Trauma Simulation Ltd models can be customised to meet specific requirements. A whole body simulator is in development, which will include the key functions of each of the models listed below. The range of Simulated Procedures

Emergency Surgical Airway Management:-
  Cricothyroidotomy

Thoracic Trauma:-
  Pleural space decompression and drainage
  Rib fracture fixation

Intraosseous infusion:-
  Proximal humerus
  Sternum
  Proximal tibia
  Distal femur

Haemorrhage Control:-
  Tourniquet application
  Pelvic Binder application
  Pelvic packing
  Junctional control proximal and distal to inguinal ligament
  Retrograde balloon occlusion of the aorta

Restoration of Perfusion:-
  Arterial shunt insertion
  Fasciotomy

Temporary External Fixation:-
  Pelvis
  Femur
  Spanning the knee or ankle
  Tibia

Emergency Pain Relief:-
  Fascia iliaca block
<table>
<thead>
<tr>
<th>Product Code</th>
<th>Anatomical Area</th>
<th>Brief Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAM1</td>
<td>Pelvis &amp; lower limbs</td>
<td>Pelvic &amp; lower limb blast injury</td>
<td>A model of a male from the umbilicus including either the whole left lower limb and a simulated right transfemoral traumatic amputation on the right or bilateral transfemoral amputations. The model contains the femora and bones of the pelvic ring and lower lumbar spine, tibia, fibula and foot (on the left). Included is a simulated perineal blast injury with an open wound, separation (diastasis) at the front of the pelvic ring. Suitable for pelvic binder application, extraperitoneal pelvic packing, pelvic and lower limb external fixation and fasciotomy.</td>
</tr>
<tr>
<td>SAM2</td>
<td>Lower limb (left)</td>
<td>Lower Limb Fasciotomy</td>
<td>All 4 osteo-fascial compartments of the leg, with the muscles reproduced in highly realistic silicone and a dense fascial envelop, in a model of a male lower limb from approximately 20cm above the knee to the foot containing bones of the distal femur, tibia, fibula and foot. Suitable for lower limb external fixation and fasciotomy.</td>
</tr>
<tr>
<td>SAM3.1</td>
<td>Shoulder</td>
<td>Intraosseous Infusion (Humerus)</td>
<td>A model of a male upper limb and shoulder girdle from approximately 8cm above the elbow containing the humerus, but with a hollowed proximal humerus lined with silicone and connected to an out-flow with a giving set connector.</td>
</tr>
<tr>
<td>SAM3.2</td>
<td>Lower limb (left)</td>
<td>Intraosseous Infusion (Tibia)</td>
<td>A model of a male lower limb from approximately 20cm above the knee to the foot containing bones of the distal femur, tibia, fibula and foot, but with a hollowed proximal tibia lined with silicone and connected to an out-flow with a giving set connector.</td>
</tr>
<tr>
<td>SAM3.3</td>
<td>Chest</td>
<td>Intraosseous Infusion (Sternum)</td>
<td>The sternum, skin, muscles and ribs of the chest wall are reproduced to enable landmarks to be established and intraosseous needle and infusion to be accomplished. Can be combined with SAM 3.1, SAM 5 and SAM 6.</td>
</tr>
<tr>
<td>SAM3.4</td>
<td>Lower limb (left)</td>
<td>Intraosseous Infusion (Femur)</td>
<td>The lower limb is reproduced including the relevant muscles and all the major bones, with hollow distal femur connected to an out-flow with a giving set connector.</td>
</tr>
<tr>
<td>SAM4</td>
<td>Lower limb (left)</td>
<td>Haemostasis</td>
<td>A model of a male lower limb from approximately 10cm above the groin to a simulated traumatic trans-femoral amputation and also another simulated wound in the groin region, too proximal for effective tourniquet application will allow practice of haemostatic dressing application.</td>
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<tr>
<td>SAM5</td>
<td>Throat</td>
<td>Emergency Surgical Airway (Cricothyroidotomy &amp; Tracheotomy)</td>
<td>The lower jaw, anatomical landmarks of the throat and root of neck are reproduced to allow needle cricothyroidotomy, tube insertion and tracheotomy to be executed. Can be combined with SAM 3.1 and SAM 4.</td>
</tr>
<tr>
<td>SAM6</td>
<td>Chest</td>
<td>Pleural Space Decompression (Needle Aspiration of Pneumothorax,)</td>
<td>Skin, muscles and ribs of the chest wall are reproduced to enable landmarks to be established and chest decompression using a needle, finger thoracostomy or chest drain insertion. Can be combined with SAM 3.1, 3.3 and 3.5.</td>
</tr>
<tr>
<td>SAM7</td>
<td>Shoulder &amp; Upper Limb</td>
<td>Venous Access</td>
<td>This model can be produced as a simple intravenous cannulation model, or including the shoulder SAM3.1 for IO cannulation as well.</td>
</tr>
<tr>
<td>SAM8</td>
<td>Pelvis &amp; lower limb (right)</td>
<td>Fascia Iliaca Block Model</td>
<td>A model to train in fascia iliaca blocks, a technique of regional analgesia for proximal femoral fracture patients. A female right upper thigh, groin and lower abdomen model with anatomical landmarks including a femoral pulse and fascial layers to replicate the correct depth of injection.</td>
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<tr>
<td>SAM9</td>
<td>Chest</td>
<td>Chest Wall Fixation</td>
<td>Skin, muscles and ribs of the chest wall are reproduced to enable landmarks to be established, fractures identified and operatively fixed Can be combined with SAM 3.1, SAM 3.3 and SAM 5.</td>
</tr>
<tr>
<td>SAM10</td>
<td>Lower limb (left)</td>
<td>Haemostasis and vascular shunting</td>
<td>A model of a male lower limb from approximately 10cm above the groin to a simulated traumatic trans-femoral amputation and also another simulated wound in the groin region, too proximal for effective tourniquet application will allow practice of haemostatic dressing application.</td>
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