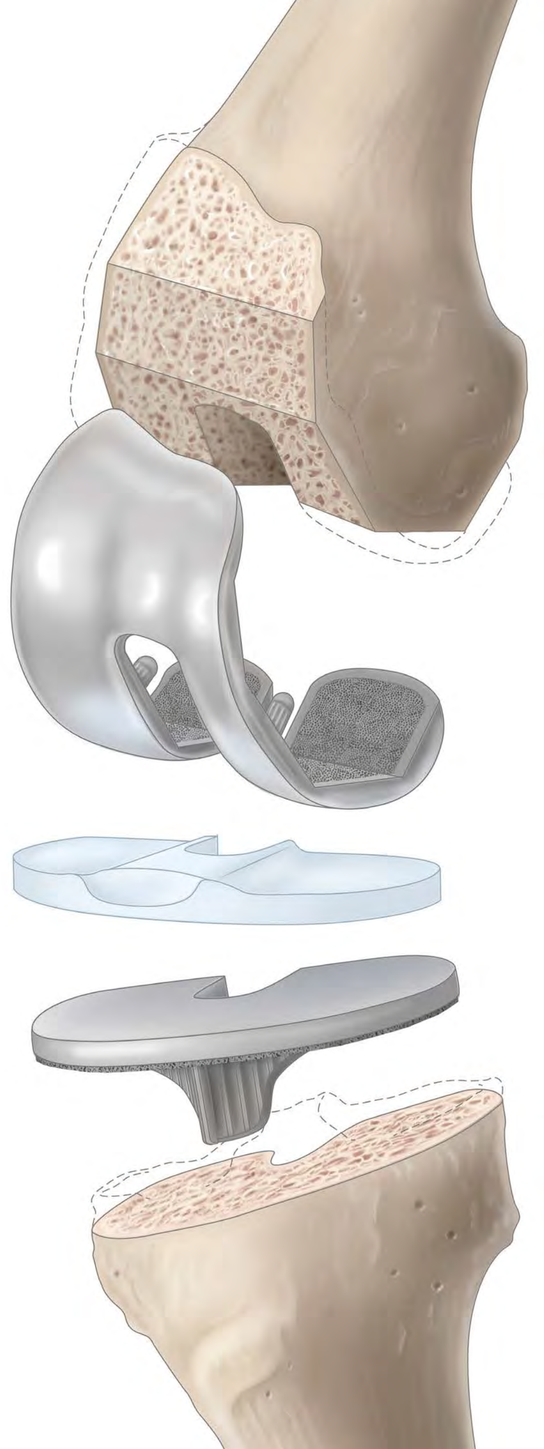
Scientific and Medical Illustrations

BY OLIVIA SYMONS



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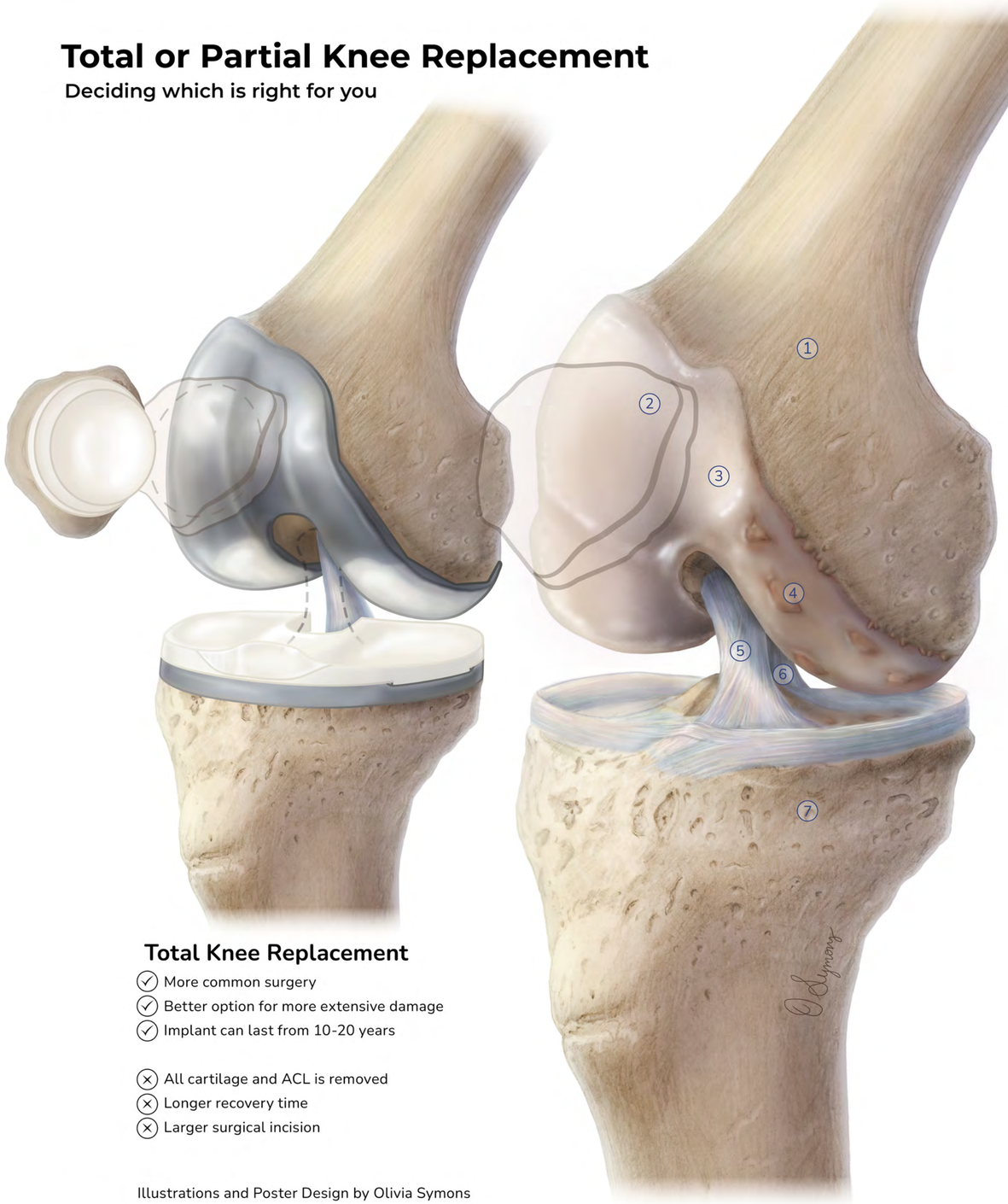
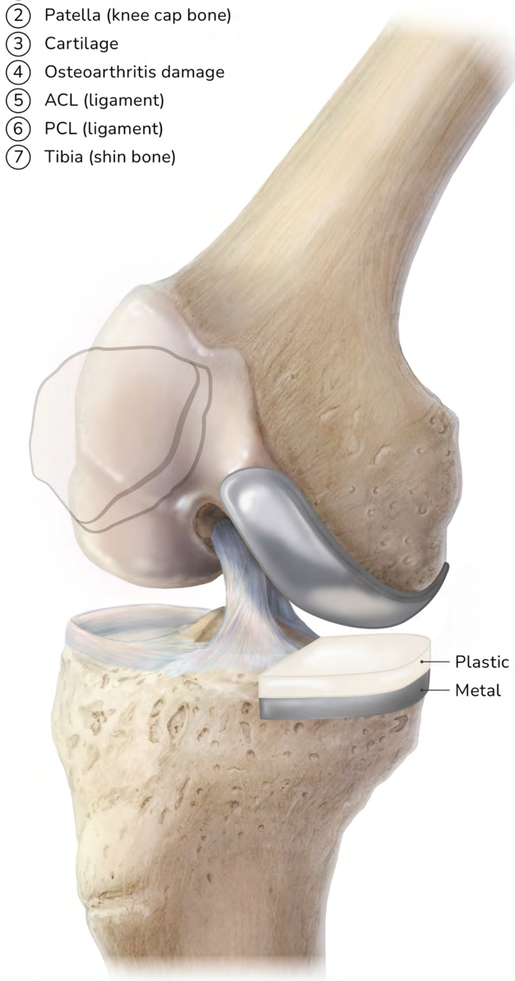
Total or Partial Knee Replacement

Deciding which is right for you

1. Femur (thigh bone)
2. Patella (knee cap bone)
3. Cartilage
4. Osteoarthritis damage
5. ACL (ligament)
6. PCL (ligament)
7. Tibia (shin bone)





Total Knee Replacement

- ✓ More common surgery
- ✓ Better option for more extensive damage
- ✓ Implant can last from 10-20 years

- ✗ All cartilage and ACL is removed
- ✗ Longer recovery time
- ✗ Larger surgical incision

Partial Knee Replacement

- ✓ Feels more like a natural knee
- ✓ Shorter recovery time
- ✓ Smaller surgical incision

- ✗ Difficult surgery without robotic assistance
- ✗ Does not always last as long
- ✗ Higher risk of needing a second surgery

Unicompartmental

One compartment is replaced

Medial (inside)

Lateral (outside)

Patellofemoral (top)

Bicompartmental

Two compartments are replaced

Medial patellofemoral

Total or Partial Knee Replacement
2025
Patient education material created for St. Josephs Healthcare Hamilton as part of my master thesis explaining the differences between total and partial knee replacements to individuals with osteoarthritis taking part in clinical research.
Graphite pencil, Adobe Photoshop, Adobe Illustrator

Illustrations and Poster Design by Olivia Symons

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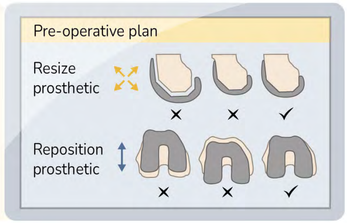
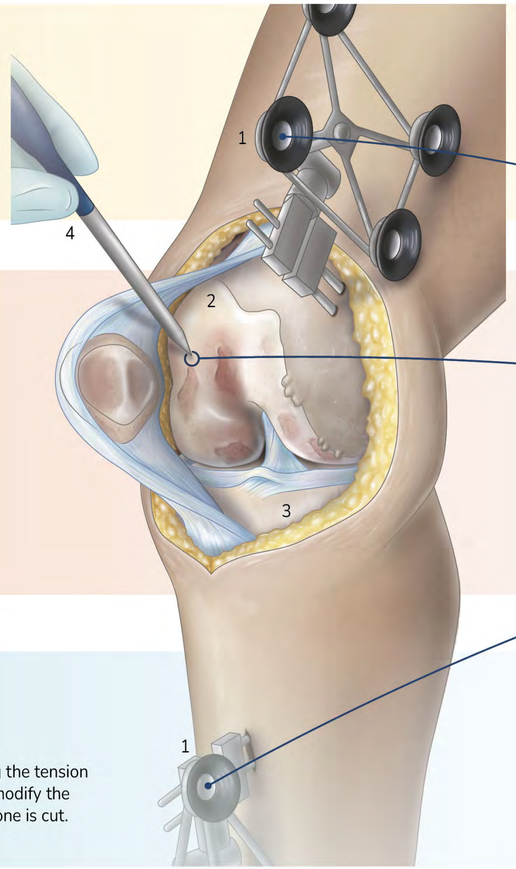
The Role of the Robot

Step 1: Pre-operative plan

Planning before surgery

Before surgery, the robot uses a CT-scan to create a 3D image of your bones, allowing surgeons to create a personalized plan of how the implant will fit.

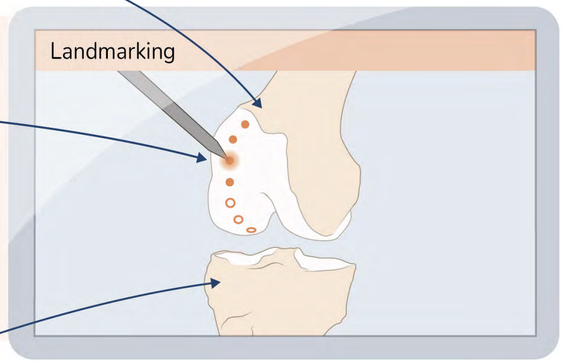




Step 2: Landmarking

Telling the robot where things are

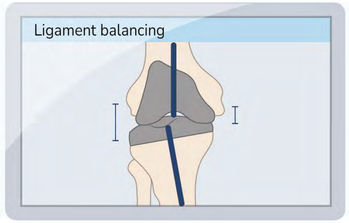
At the start of the procedure, a device with sensors called an array(1) is attached to your thigh(2) and shin(3) bone to provide the robot with real-time bone position and movement data. The surgeon will also use a probe(4) to refine the robots understanding of your specific anatomy.

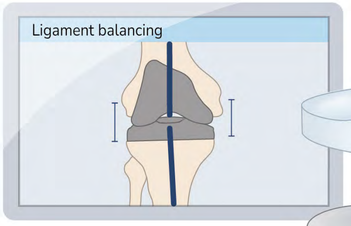


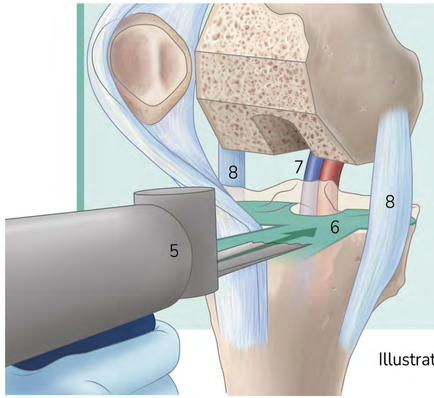
Step 3: Ligament balancing

Adjusting the plan

The robot now has more information about your knee, including the tension in the ligaments holding bones together. Surgeons use this to modify the initial plan, ensuring ligament tension is balanced before any bone is cut.



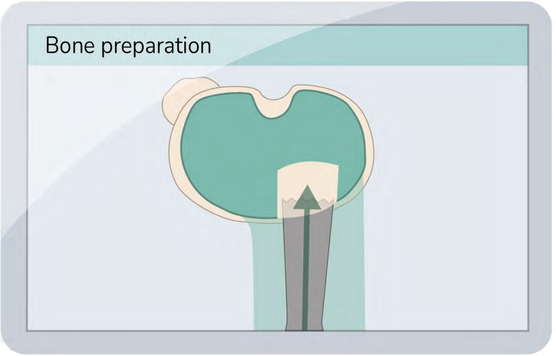




Step 4: Bone Preparation

Removing damaged cartilage

The surgeon prepares the knee for the implant by removing damaged cartilage with the robotic bone saw(5). The surgeon controls the saw but the robot ensures precise cuts are made by only allowing movement along the **virtual plane of the cut(6)**, and automatically stops if the saw goes too far, protecting surrounding tissues like blood vessels(7) and ligaments(8).



Illustrations and poster design by Olivia Symons

Robot Computer Screen

Role of the Robot
2025
Patient education material created for St. Josephs Healthcare Hamilton as part of my master thesis explaining the role of orthopedic surgical robotics in total knee replacement surgery to patients. Illustrations based on surgical observations at Zuyderland Medisch Centrum Sittard and St. Josephs Healthcare Hamilton.
Adobe Photoshop, Adobe Illustrator

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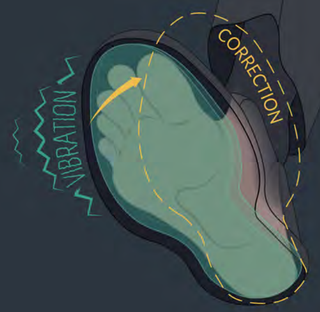
PROVIDING THE NEXT STEPS

How smart insole technology can treat and manage knee osteoarthritis with gait modification



SMART INSOLE TECHNOLOGY

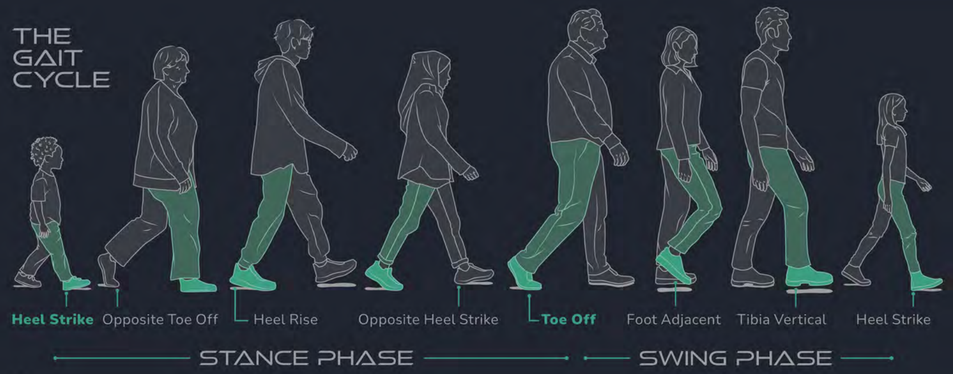
PROVA has developed a smart insole that has embedded pressure sensors to detect how you walk. The insole then gives gentle vibration and audio cues to help you make adjustments to your walking pattern. This revolutionary technology can be used to treat a variety of gait related conditions, including knee osteoarthritis.

HOW THE INSOLE WORKS FOR OSTEOARTHRITIS

The insole will guide you through gait modifications reccomended by your healthcare practitioner. For example, a gait modification that has been shown to improve knee osteoarthritis symptoms is foot progression angle (FPA), which describes the amount the toes face in or out while walking. Since most knee osteoarthritis occurs on the medial, or inner side of the knee, foot progression angle works by changing the load through the knee. Specifically, both toe in and toe out gait shift the force from the medial side to the center of the knee during specific phases of gait, and this reduces osteoarthritic pain.

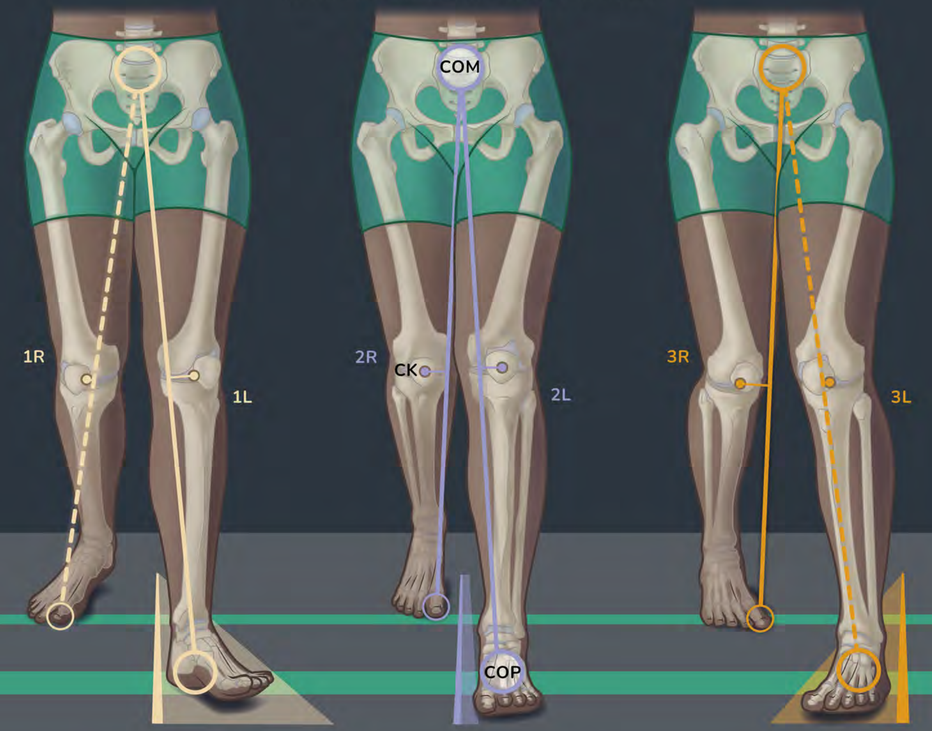
GAIT: HOW WE WALK

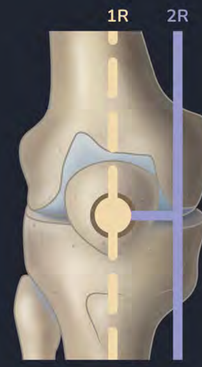
There are two main phases of gait: stance where the foot is in contact with the ground, and swing where the foot is in the air. These two phases can be further broken down into gait events. To understand foot progression angle modifications, there are two important events at the start and end of stance: **heel strike** at the beginning of stance when the foot makes contact with the ground and **toe off** at the end of stance when the foot is about to leave the ground.



LOCATING FORCE THROUGH THE KNEE

The load in the knee can be measured with ground reaction force. This force is identified by drawing a line from the center of pressure (COP) of the foot, to the center of mass (COM) of the body and looking where it falls relative to the center of the knee (CK). For individuals with knee osteoarthritis, the goal is to shift this force from the medial side, to the center of the knee.



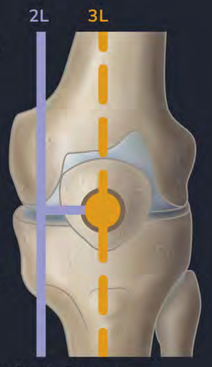


KNEE LOADING COMPARISON

In unchanged gait, the force travels through the medial side of the knee (2R and 2L).

In **toe out gait** and **toe in gait**, this force shifts towards the center of the knee at toe off (**1R**) and heel strike (**3L**) respectively, reducing force on the medial side of the knee.

In both FPA modifications, the force will shift back to the medial side of the knee at the other phase of gait (**1L** and **3R**). Despite this, studies have shown there is still a positive effect on knee loading and osteoarthritis symptoms.



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Smart Insole Infographic
2025
Educational infographic created for my master thesis explaining how smart insoles developed by PROVA Innovations work to modify biomechanic factors such as foot progression angle. This poster is targeted at PROVA clients and participants of a biomechanic research trial.
Adobe Photoshop, Adobe Illustrator

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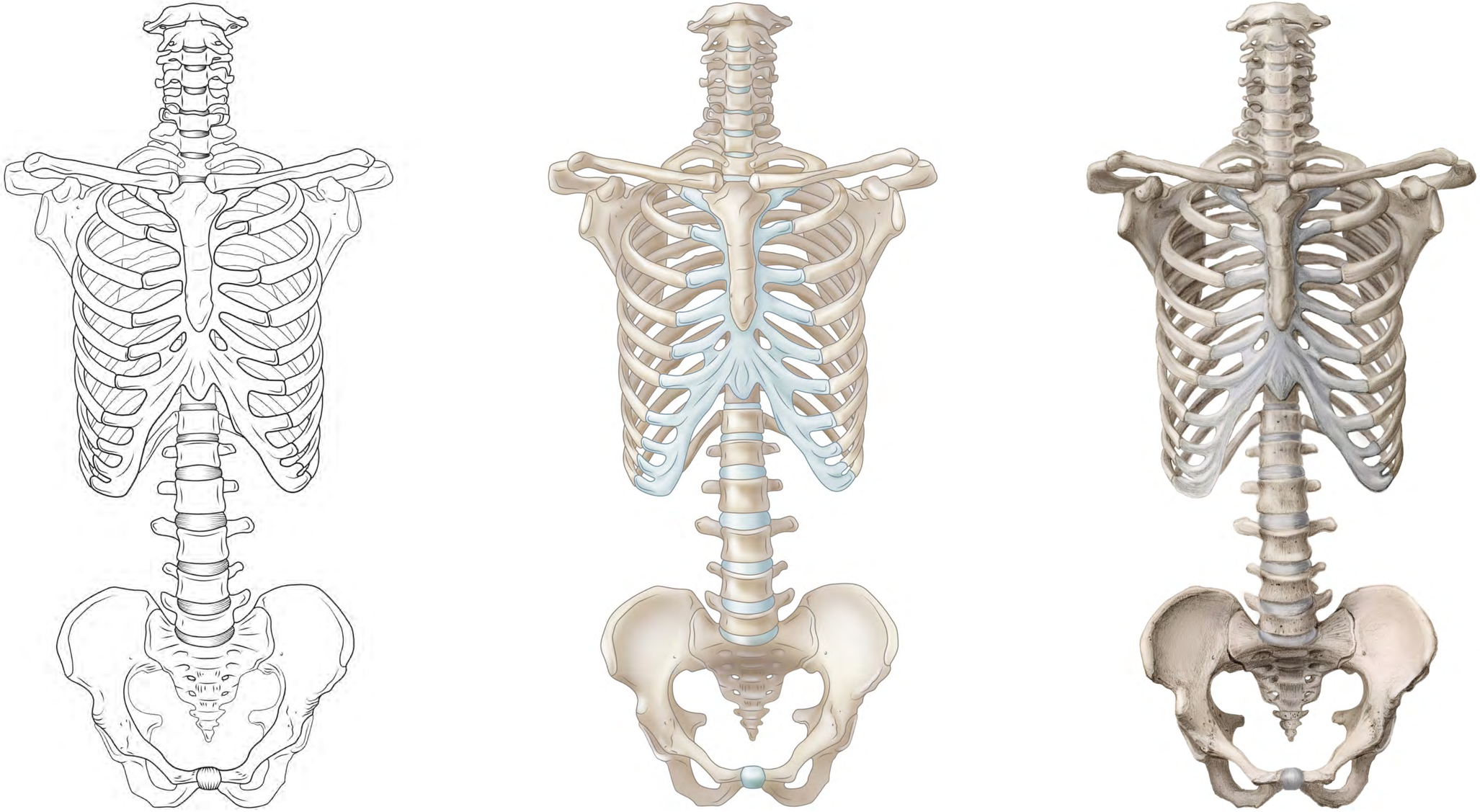

Human Torso Skeleton
2025
Line art (left), graphic style (middle), and detailed (right) depictions of the human skeleton illustrated to compare the different styles of scientific illustration.
Graphite pencil, Adobe Photoshop, Adobe Illustrator