

Knee Brace Joint Alignment Jig

Introduction

K-9 Orthotics & Prosthetics

A designer and manufacturer of the finest orthotics and prosthetics for canines of all sizes, as well as occasionally catering to livestock and other animals.

Project Scope

The objective of this project was to redesign the current alignment jig used by the technicians to accommodate a variety of dog sizes. The new jig must be light and stable for more easy and accurate knee brace alignment.

Requirements

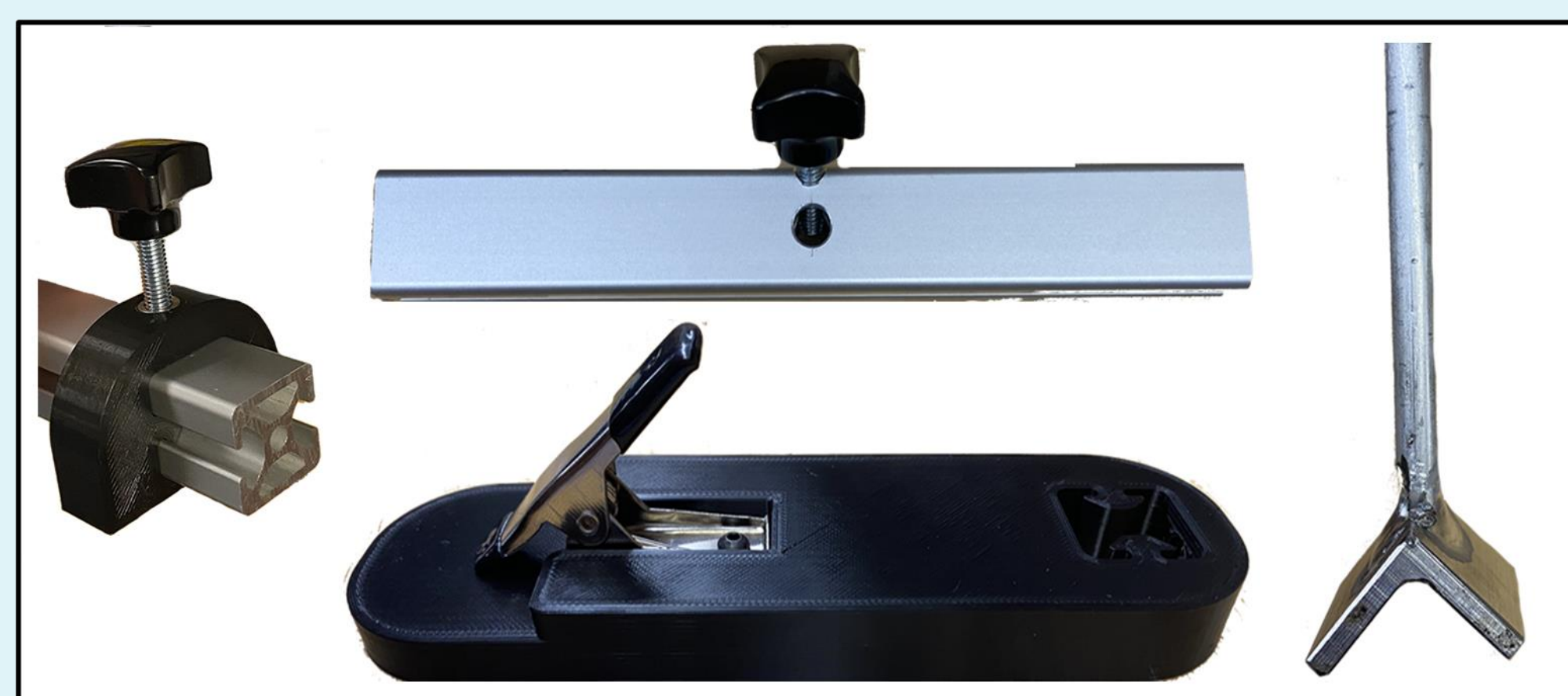
The final design shall:

1. Remain stable and reduce play in the interfaces between parts, for a maximum angle of 1°
2. Weigh less than its predecessor (870 g)
3. Accommodate 3 sizes of mechanical knee joints

An additional desire was given for a lengthened jig for use in hip brace alignment, and larger animals.

Design Process

- Conceptual designs were generated. Components of each were used for the final design, chosen through client consultations, weighted decision making, and iteration.
- **Aluminum T-Rail** was selected for the horizontal cross member for alignment as well as weight considerations
- An **interchangeable system of scaled parts** was decided as the best method to handle varying knee sizes of breeds
- The arms of the jig were made of **3D-printed PLA** for a **light-weight, easily-scalable, and reproducible product**
- **Clamps** were added for ease of securing joints to the jig



Various Parts of a Jig

Details of Design



A: Cross-Member B: Arms C: Tightening Bolts

Previously used Jig, Fillauer Universal Alignment Jig (Fillauer, 2021).

The client expressed a need for a lighter, more stable jig that could accommodate the variety of sizes needed (TPC, 2012).

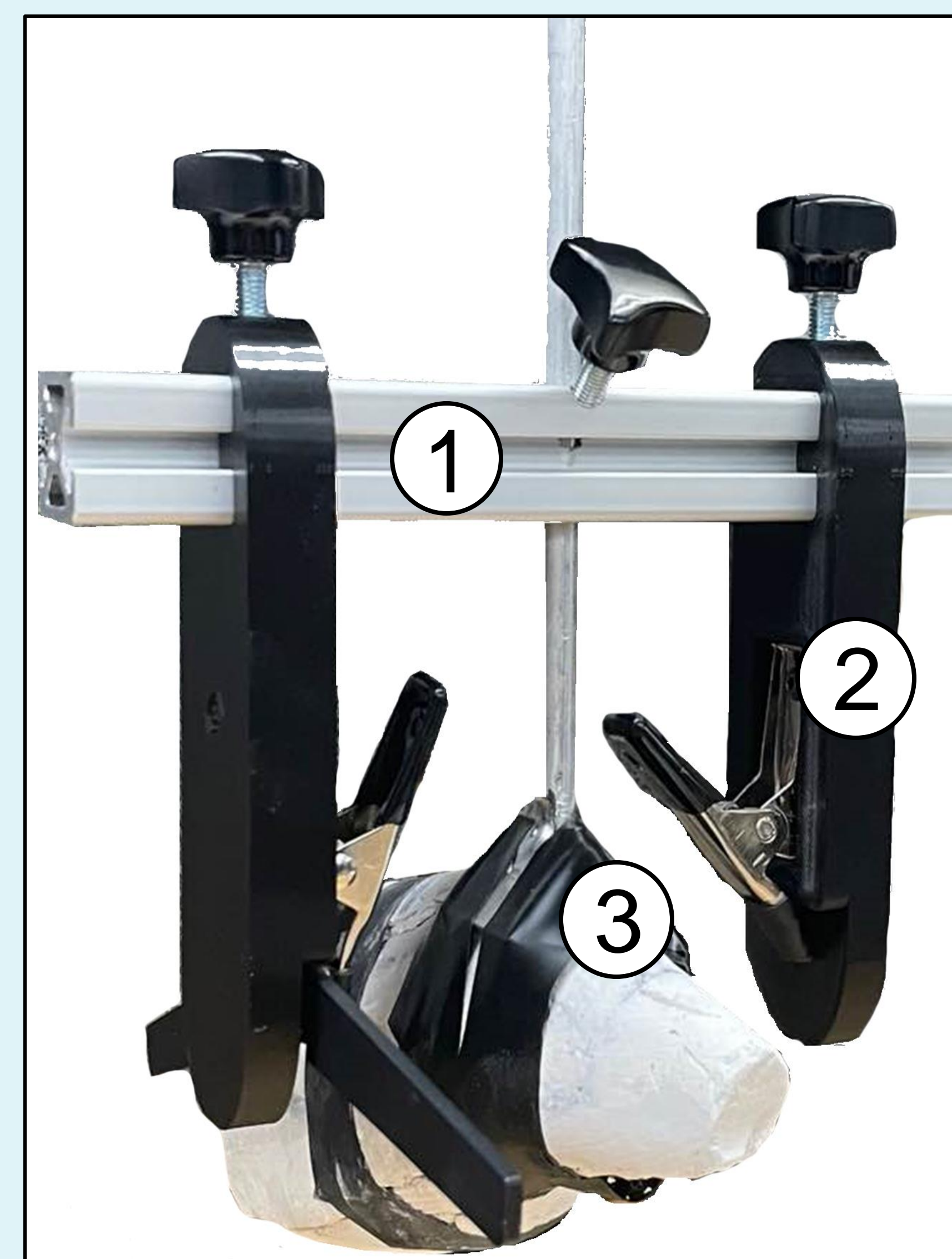
Finalized Design of the K9 Orthotics Alignment Jig

1. **T-Rail Cross Member:** ensuring lightness through aluminum material, and rigidity through its complex cross section.. Threaded at a 45° angle such that a thumb screw can be installed to secure knee rest shaft
2. **3D-Printed Arms with Installed Clamps:** ensures lightness with material properties, and tight tolerances at the material interface with the cross member due to iterative designing of the 3D printed part. Clamps facilitate an easier bracing process for the client. Fitted with thumb screws and heat set inserts to further ensure stability and rigidity.
3. **Knee Rest Shaft:** Aluminum shaft welded to aluminum angle iron ensures alignment of the knee of the cast to the centerline of the jig to create a custom fit for the bracing process



Variability in the Sizes of Canines

The modular toolkit/system of parts allows the jig to cater to the needs of dogs of any size



Final Medium Jig set up on plaster knee cast

Conclusion & Recommendations

Conclusion

- The enhanced Alignment Jig was produced and tested at Dalhousie's Mechanical Lab
- Total weight was 370 g, satisfying the weight requirement for the technicians to operate more easily
- Play in the interface of the arms and cross member was determined to be less than 1°, ensuring stability
- Jig system fulfills all established design requirements, as well as improving the clients manufacturing process
- Production of two of each jig type (six sets), including prototyping, costed \$278.16, within the allowed budget

This project was completed **on time** and **under budget**.

Recommendations

A spring-loaded concept identified during the conceptual design process could be further explored: springs attached to the arms themselves to secure the mechanical joint for the bracing process instead of using spring clamps.

With additional time, the design team would consider manufacturing custom made clamps, that would be integrated into the vertical alignment arms of the jig and for the specific to clamp onto the bracing joints.

Additional spare parts can be manufactured if required.

References

- Fillauer LLC. "Universal Alignment Fixture: Fillauer LLC: Orthotics and Prosthetics Manufacturer." Fillauer LLC | Orthotics and Prosthetics Manufacturer, October 11, 2021. <https://fillauer.com/products/universal-alignment-fixture/>.
- The Possible Canine, 2021