Adjustable Hip Orthotic Joint for the Treatment of Canine Hip Dysplasia

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Background

- Hip dysplasia is a skeletal condition characterized by the deterioration of the hip joint, which causes pain and discomfort.
- K-9 Orthotics offers a hip orthotic as a non-invasive method to treat dogs with hip dysplasia.
- In order to offer increased adjustability, the joint shown to the right was redesigned.

Joint to be redesigned. Retrieved from (Orthotics, 2020)

- The main objective was to add adjustability in the adduction and abduction planes

Design Process

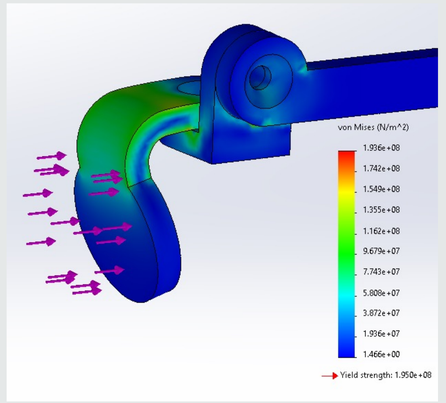
- Joint design options fell into two categories: flat plates, or a ball joint.
- The ball joint option allowed for adjustment in any axis, but there was concern over the joint slipping during application.
- Two options of flat plate joints were considered:
    1. Interlocking teeth, allowing for a secure hold or,
    2. Clamped surfaces allowing for more precise adjustments to be made.
- Due to high machining costs, the clamped surfaces option was chosen.

Requirements

- Mass of final joint and upright assembly: < 900g
- Joint must not yield when impacted
- Maximum extension of the farthest point of the joint from the dogs' body: < 3cm
- Minimum adduction/abduction range: > 15°
- Minimum transverse rotation range: > 15°
- Upright material strain hardening coefficient between 0.05 and 0.2
- Assembly must be resistant to periodic saltwater exposure

Design


How the redesigned joint (silver) will interface with the existing harness (black)



Stress analysis of joint


Alternate view of joint and harness

Verification

- The mass of the final assembly was weighed to be 104 g, which comes in far below the maximum allowable mass.
- Joint can withstand approximately 24 Nm of torque. Testing apparatus shown in figure.
- Joint could not withstand substantial impact.
- Adduction/abduction and transverse rotation range of 0° to 180°
- Aluminum 5052 was used, which ensures the assembly is corrosion resistant.


Test apparatus (water bottle used for weight)

Conclusion

- We designed an effective device which satisfied most of the outlined requirements. The redesigned joint offers adjustability in the adduction and abduction planes.
- We built a functioning prototype and used it to verify the joint's specifications. The prototype provided data which could be used to further refine the design.

Recommendations

- The bar which attaches to the harness should be modified so that the thicker side of the bar is flush with the harness. This would make it easier to fasten the joint to the existing harness. This modification was CAD modelled as shown in the figure to the right.
- It is also recommended that K-9 Orthotics acquires a universal bar bender to ease the process of bending the aluminum by 90 degrees.
- If manufacturing capabilities and cost allows, using an interlocking teeth design at the joint face should improve allowable torque.


Recommended modified design

References

- *Orthotics*. (2020). Retrieved from K-9 Orthotics: https://www.k-9orthotics.com/orthotics

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