A common injury seen in canines is the fracture of the mandible. The standard non-invasive method of treatment is a tape muzzle that helps to stabilize the fracture up to and after surgery. These muzzles however can cause further displacement of the fracture site due to the pivot point it generates. Our client, Dr. Thatcher, would like our team to design a nylon muzzle that provides adequate support and evenly distributes the bite forces in the jaw to aid in proper healing and to quantitatively prove that the nylon muzzle offers superior support. The team developed three designs and evaluated them using a design matrix against criteria developed by the team. Post evaluation, it was determined that we would focus on the mesh design. Using this design, we created a model in SolidWorks used simulations to analyze the stress distribution across the mandible. It was determined that peak stress decreased from 8.071 MPa with no support and 8.118 MPa with the tape muzzle to 0.821 MPa with full support. These calculations allowed us to prove a statistically significant effectiveness of the nylon muzzle.

**Design Motivation:**
- Create a nylon muzzle
- Must evenly distribute the forces exerted by a dog bite → approx. 620.33-1,091.1 N
- Design must be applicable to varying snout sizes
- Must prevent stress concentrations and further fracturing
- Must allow for proper healing
- Mathematically prove nylon muzzle superior to tape muzzles
- Quantitatively prove nylon muzzle provides more stability
- Must even distribute the forces exerted by a dog bite

**Background:**
- Current Treatment: Tape support muzzle creates an increase in maximum and average stress; three point bending occurs at the fracture site.
- Decreasing the stress experienced in the mandible limits displacement of fracture throughout healing process.

**Problem Statement:**
- Our client is in need of a nylon muzzle that provides superior support than the current practice of a tape muzzle.
- We were provided a 3D scanner of a mandible to use as the model for the prototype.
- The team developed three designs and evaluated them using a design matrix against criteria developed by the team. Post evaluation, it was determined that we would focus on the mesh design. Using this design, we created a model in SolidWorks used simulations to analyze the stress distribution across the mandible. It was determined that peak stress decreased from 8.071 MPa with no support and 8.118 MPa with the tape muzzle to 0.821 MPa when fully supported. These calculations allowed us to prove a statistically significant effectiveness of the nylon muzzle.

**Solution:**
- Create a nylon muzzle
- Must evenly distribute the forces exerted by a dog bite → approx. 620.33-1,091.1 N
- Design must be applicable to varying snout sizes
- Must prevent stress concentrations and further fracturing
- Must allow for proper healing
- Mathematically prove nylon muzzle superior to tape muzzles
- Quantitatively prove nylon muzzle provides more stability
- Must evenly distribute the forces exerted by a dog bite

**Design:**
- **Objective:**
  - Create a nylon muzzle
- **Materials:**
  - Nylon-spandex blend fabric
  - Mesh
  - Nylon thread
  - Parachute buckle
  - Nylon straps
  - Foam padding
  - Acrylic supports
- **Equipment & Software:**
  - Sewing machine
  - 3D scanner
  - 3D printer
  - SolidWorks
  - MeshMixer

**Testing:**
- **Finite element analysis of simple canine mandible model**
  - SolidWorks developed model of simplified canine mandible with the fracture site represented by an extruded cut at a location similar to that of the M1 tooth.
  - Stress values at the fracture site were used to compare the nylon muzzle support to the tape muzzle support.
  - The peak stress was lower with the nylon muzzle support.
- **Stress values at the fracture site**
  - No support: 8.071 MPa
  - Tape: 8.118 MPa
  - Full: 0.821 MPa

**Discussion:**
- Computer Modeling
  - Significantly less in stress at the fracture point mandible when fully supported along the jaw.
- Tape support muzzle creates an increase in maximum and average stress; three point bending occurs at the fracture site.
- Decreasing the stress experienced in the mandible limits displacement of fracture throughout healing process.

**Physical Prototype**
- Prototype was close fitting and secure around the snout.
- Support rods were secured in foam to provide additional comfort and protection.
- Stresses experienced with the physical model have not been conducted yet.

**Future Work**
- Improvements:
  - Order alternative materials for prototype
  - Enhance simplified mandible
  - Refine FEA simulation
- **Testing:**
  - Analyze components for durability, flexibility, and comfort

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**References**