



Be Careful Walking the Dog: An Orthopedic Leg Brace Failure

ESi was engaged in a personal injury matter to study the root cause of an orthotic leg brace failure.

The Situation

An intended leisurely evening walk ended in a fall with severe injuries for a middle-aged woman walking her pet dog. The woman, who suffered limited leg strength and range of motion from childhood polio, had been fitted with a left leg, knee-ankle-foot orthotic brace. Her fall was caused by the sudden fracture of one of the device's aluminum uprights.

A personal injury attorney representing the woman engaged ESi to investigate the root cause of the orthotic leg brace failure. The orthotic manufacturer and orthotist, who fitted the device to the injured woman, were also engaged to participate with ESi in a laboratory-based inspection in our Aurora, IL office.

Our Approach:

The orthotic leg brace consisted of two aluminum alloy upright bars that transmitted the upper leg weight to the lower leg, providing added knee support. The proximal (upper) and distal (lower) bar sections were joined by a drop lock joint at knee level that permitted articulation while sitting.

ESi Consultants:



Dale Alexander
Principal



Ellen Wright
Senior Managing Consultant



Robert Cooley
Senior Staff Consultant

Services Utilized:

- Failure Analysis
- Materials Testing
- Lab & Inspection Services

Our Approach *cont*

Lab inspection revealed that the lateral aluminum upright bar, in a purposefully bent portion immediately above the knee joint lock, had sustained a through-fracture with little overall deformation of the bar.

Optical microscopic and scanning electron microscopic examinations of the fracture surface revealed a region of transgranular fracture extending from the bar surface that was immediately adjacent to the knee. Surface residues were also present in this region and their analysis revealed the presence of various elements including sodium and chlorine. A region of fatigue striations was also observed extending from the transgranular area that transitioned into overload fracture.

Aluminum upright samples taken from the failed bar and from a non-failed bar did not reveal any material anomalies in their alloy chemistries nor their mechanical strength. This was consistent with manufacturing requirements.

It was concluded that the aluminum alloy bar failed due to stress corrosion cracking (SCC) initiating at its surface that transitioned to fatigue and eventual overload fracture. SCC is a metallic degradation phenomenon requiring a susceptible material, corrosive agent and tensile stress.

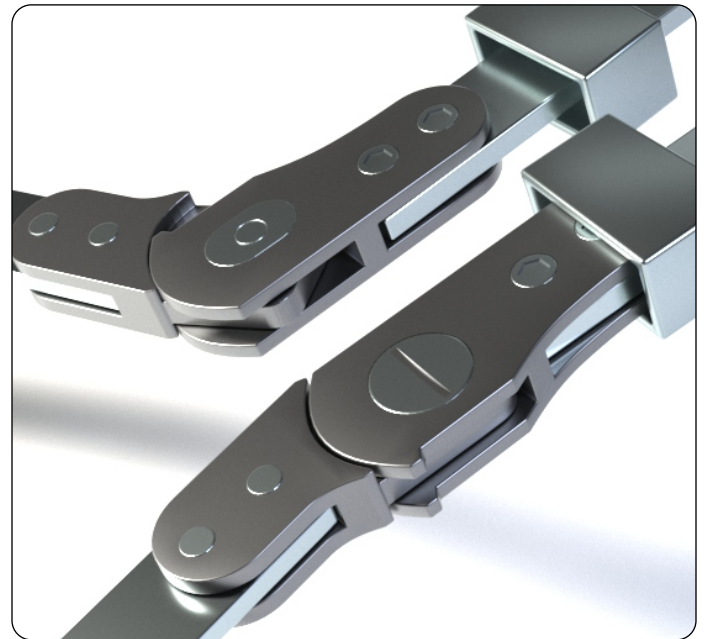
In fitting the orthotic device, the orthotist bends the upright to provide accommodation for the patient's knee. Since the subject bar fracture occurred in this deformed area, there was concern that excessive bending was performed, exacerbating residual stress and excessively concentrating applied stress. At the inspection, curvature measurements were taken on the bends in the area of fracture and confirmed the bends were not excessive and their curvature radii were not tighter than the manufacturer's minimum limit requirements. The stress

contributing to SCC and eventual fatigue and failure was primarily the cyclic loading experienced by the bar during the patient's ambulation.

The fact that the cracking initiated adjacent to the woman's knee was telling. That and the detection of quantities of sodium and chlorine confirmed the ESi investigator's experience that chlorides were the aggressive corrosive agent. The source of the chlorides was human perspiration. Review of literature supported the fact that chloride induced SCC was an issue in external fixation device composed these same type aluminum alloys.

The Outcome:

In large part, as a result of ESi's inspection and opinion findings, the injured woman received an undisclosed monetary settlement from the orthotic device manufacturer. Importantly, the manufacturer's technical representative who attended the inspection, complimented ESi on its lab inspection resources and capabilities – a not uncommon response from other parties visiting our facilities.



Engineering Systems Inc.
www.engsys.com

newmatters@engsys.com
(866) 596-3994

From complexity to clarity
Technical expertise you can trust

Established in 1987, Engineering Systems Inc. (ESI) is a forensic engineering and scientific consulting firm that delivers clear, data-driven solutions to complex technical challenges. Through advanced technologies, multidisciplinary expertise, and comprehensive testing capabilities, ESi equips clients worldwide with actionable insights and precise answers across projects of any size or complexity.

© 2026 ESI Engineering Systems Inc. All rights reserved. This case study is for informational purposes only. ESi makes no warranties, express or implied, in this study. ESI is a registered trademark in the United States and/or other countries. All other trademarks are property of their respective owners. Published June 2026.