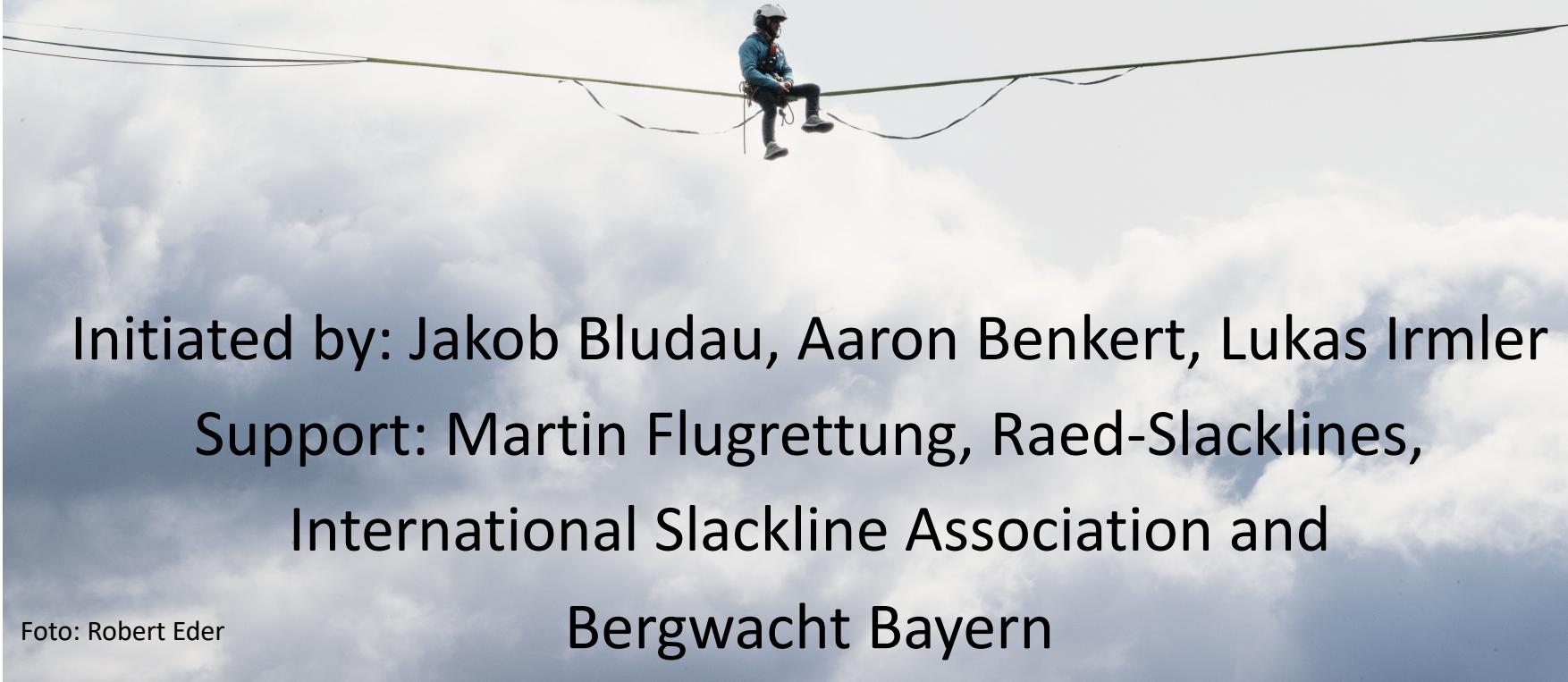






# Highline Helicopter Rescue Procedures, risks & mitigation



Initiated by: Jakob Bludau, Aaron Benkert, Lukas Irmler

Support: Martin Flugrettung, Raed-Slacklines,

International Slackline Association and

Bergwacht Bayern

Foto: Robert Eder



# Highline Helicopter Rescue

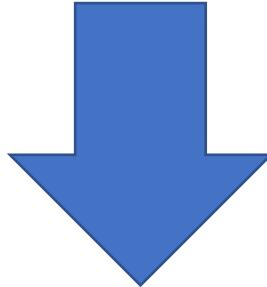
- Why air rescue off highlines
- Important risks
- Possible mitigation

Foto: Robert Eder

# Why air rescue off highlines



- Highlines in alpine terrain are a challenge – long & hard to get there
- Terrestrial rescue is limited to lowering directly from the line or getting to one of the anchors first
- **All terrestrial rescue requires long periods of hanging in a harness**



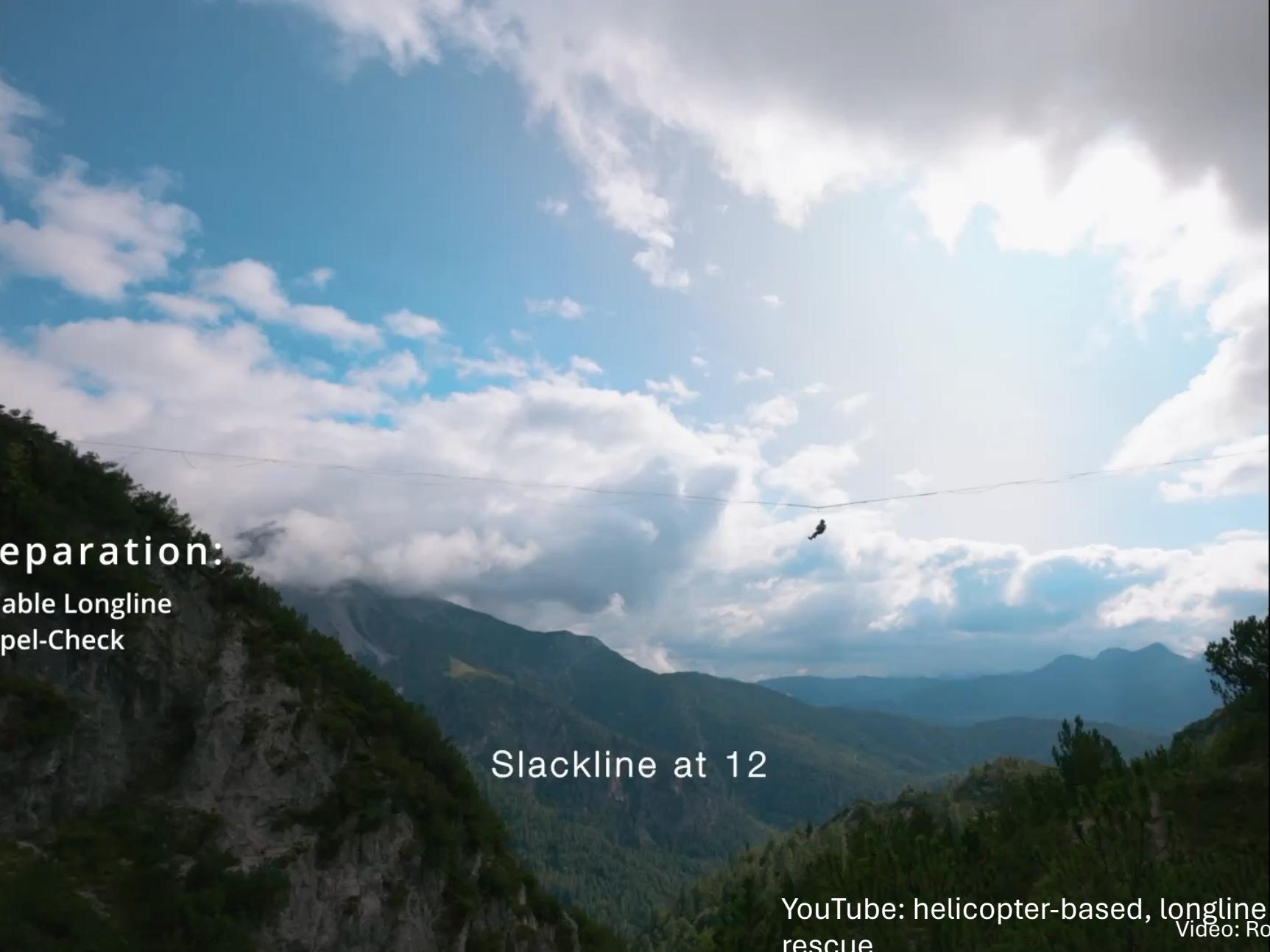
A direct air rescue off the highline can drastically  
improve the medical prognosis  
=> Suspension Syndrome

# Previous rescues with longline/hoist



- Hoist experiments by GMSP26, Crew of Dragon38 at Roi Gros Nez  
[facebook.com](https://facebook.com)
- Hoist experiments by PGHM Annecy [facebook.com](https://facebook.com)
- **Rescue Grünsteinscharte/ North Tyrol**  
by Martin Flugrettung, 2012  
Length of highline 40-50m
- **Rescue Training** by Martin Flugrettung, 2023





**Preparation:**

Variable Longline  
Rappel-Check

Slackline at 12

YouTube: helicopter-based, longline  
rescue

Video: Robert Eder

# Most important risks & mitigation



- Highline between rescuer and patient  
=> Approach from the side
- Entanglement with backup loops of highline  
=> Higliners at anchors pull back up line  
=> Approach from the side
- Twisting of hoist/longline and patient's leash  
=> Control distance to patient

# Most important question



Will a Slackline get cut by  
the hoist cable?

# Center of Safety & Instrucion – Bad Tölz



Highline and Helicopter Rescue  
ISA 2024 Bern

# Experimental Setup



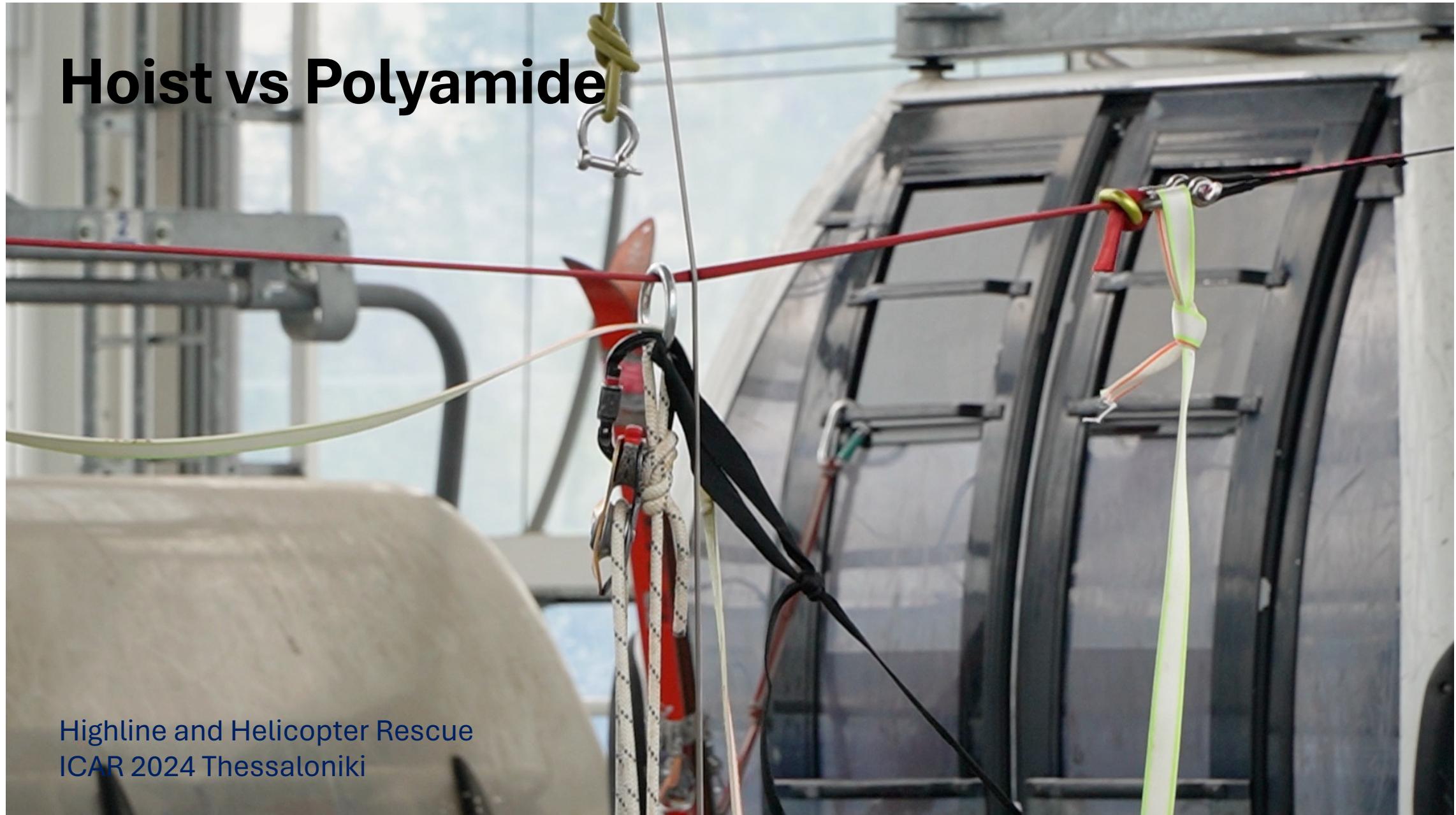
## Different Highline Materials

- Polyamide
- Dyneema

## Worst case setup

- ~50m line length, 3kN and 5kN pre-tension
- 70kg patient at 20% of line length
- 100kg rescuer
- Contact of highline and cable at leash ring
- Helicopter 5m above line with 2m overshoot

# Hoist vs Polyamide



Highline and Helicopter Rescue  
ICAR 2024 Thessaloniki

# Test polyamid sections vs hoist cable ( $\varnothing 4.7\text{mm}$ )



$5\text{kN} - < 1 \text{ cycle} = \sim 4.5 \text{ m}$

$3\text{kN}, \text{cable not at leash ring}$

$3\text{kN} - 1,5 \text{ cycles} = \sim 8.25 \text{ m}$

$3\text{kN} - 1,5 \text{ cycles} = \sim 8.25 \text{ m}$



# Hoist vs Dyneema



Highline and Helicopter Rescue  
ICAR 2024 Thessaloniki

# Test Dyneema sections vs hoist cable ( $\varnothing 4.7\text{mm}$ )



$5\text{kN} - < 1 \text{ cycle} = \sim 4.5 \text{ m}$

$3\text{kN}, \text{cable not at leash ring}$

$3\text{kN} - 1,5 \text{ cycles} = \sim 8.25 \text{ m}$

$3\text{kN} - 1,5 \text{ cycles} = \sim 8.25 \text{ m}$

$5\text{kN} - < 2 \text{ cycles} = \sim 6.5 \text{ m}$

$3\text{kN} - 2 \text{ cycles} = 7.0 \text{ m}$

$1\text{kN} - 4 \text{ cycles} = 14.0 \text{ m}$



# Test sections vs climbing rope ( $\varnothing$ 8,9mm Edelrid Swift)



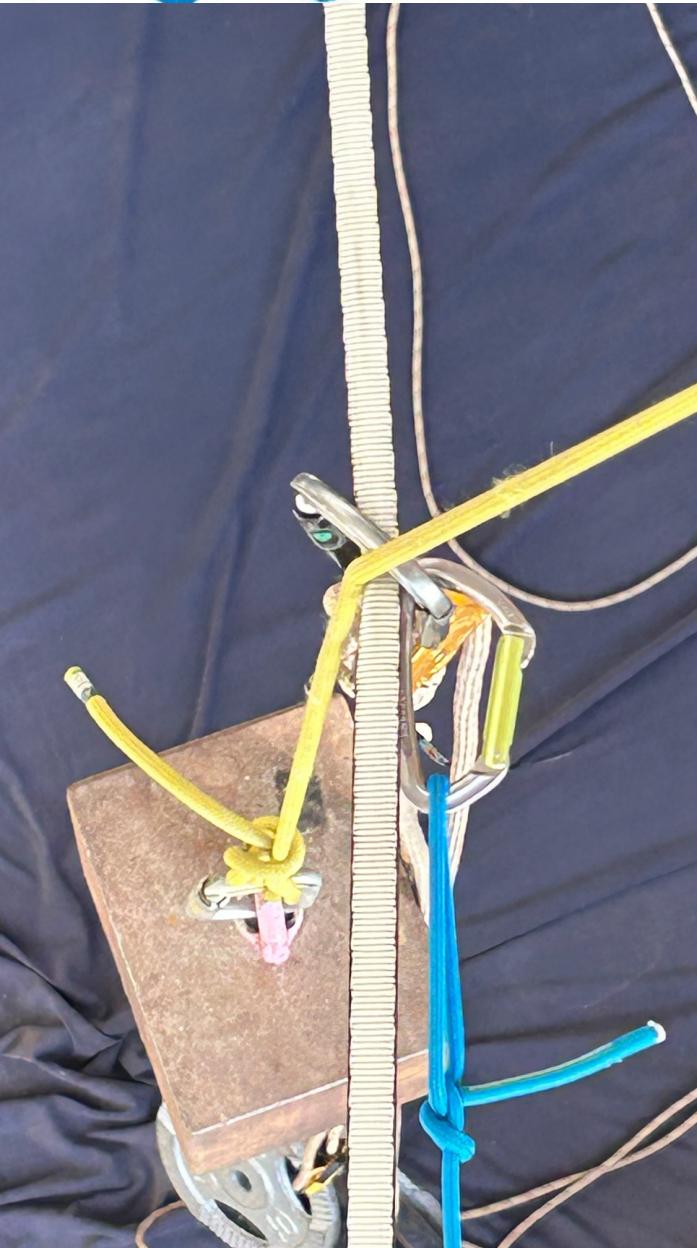
Set up: Climbing rope on hoist hook

3kN  
4kN  
3kN  
5kN

No breaks -  
@ 5 cycles = 35 m  
stopped testing



# More of line vs. climbing rope ( $\varnothing$ 8,9mm Edelrid Swift)



Same highline material & set up

- Dyneema
- Polyamid
- 70 kg „patient“
- 100 kg „rescuer“
- **25 cycles = 100 m**

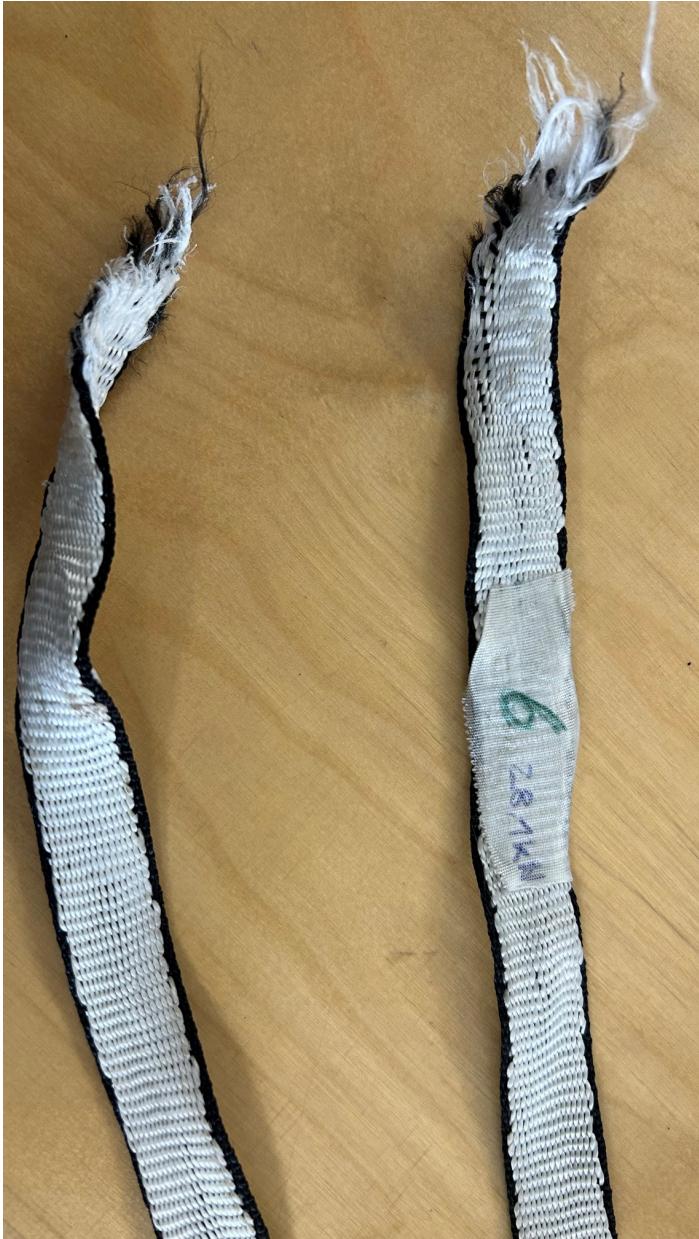
# More line vs. climbing rope ( $\varnothing$ 8,9mm Edelrid Swift)



Traces of damage after 25 cycles = 100 m



# More line vs. climbing rope ( $\varnothing$ 8,9mm Edelrid Swift)



Dyneema rated with 29 kN

=> blew @ 28.1 kN

# More line vs. climbing rope ( $\varnothing$ 8,9mm Edelrid Swift)



Polyamid rated with 27 kN

=> blew @ 27.4 kN

# Results (Preliminary)



- Both Polyamid and Dyneema are critically damaged by the hoist cable
- The higher the pre-tension, the faster critical failure occurs
- With climbing rope little to no damage regarding breaking strength



We are not too sure recommending a direct hoist rescue

**But:** Climbing/ static rope seem to inflict minimal damage

# Additional info



Jakob Bludau, PhD TU Munich

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more than happy to share  
additional info



# Thanks for highlining today

