

# Hyperbaric Oxygen Therapy For Compartment Syndrome

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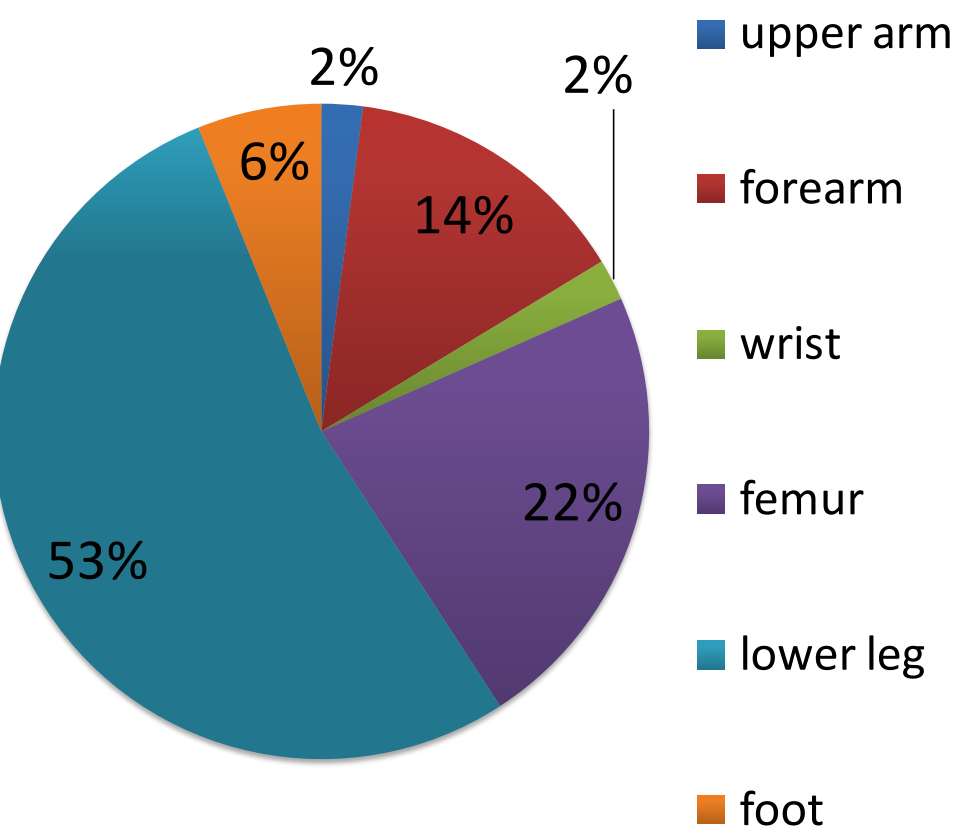
## Background

Compartment syndrome is a serious condition that occurs after an injury, it can result in necrosis of the muscles. When it is treated with the wrong care, it can lead to permanent muscle damage. The diagnosis can be difficult, and should be considered for all patients with extremity injuries.

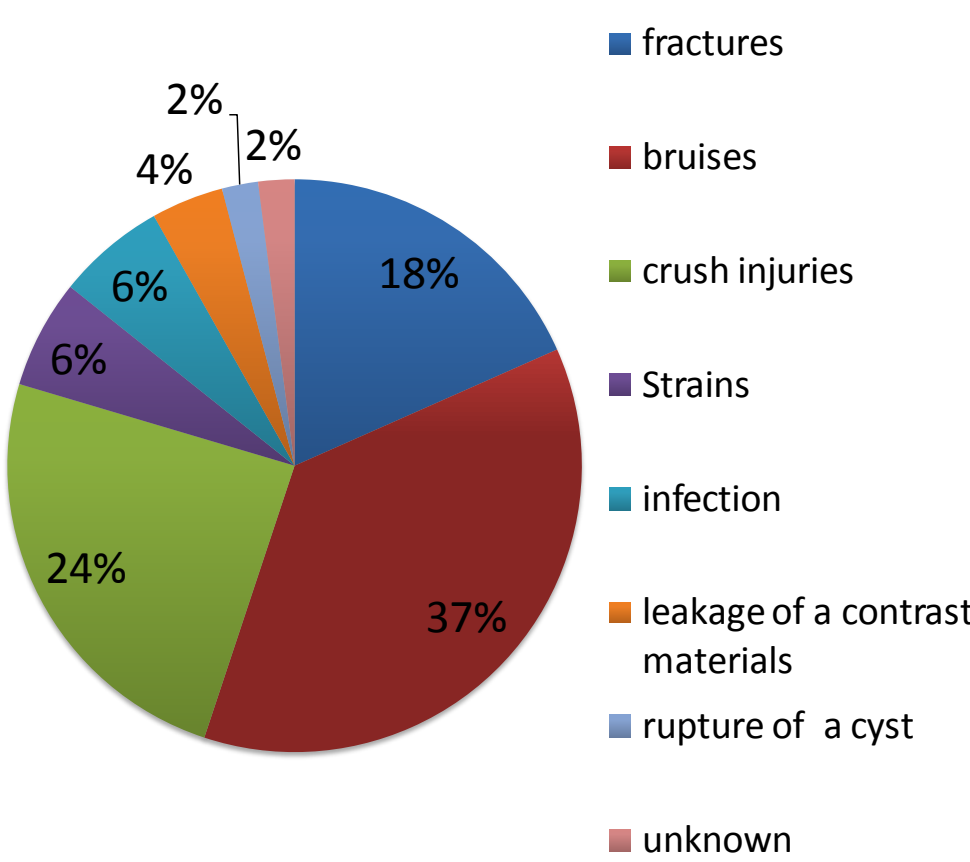
## Patients & Methods

- 49 patients (1989-2014); Male: 43, female: 6
  - Age: 13~87 y.o (mean 44.9 y.o)
  - Time to start HBOT from the initial evaluation : 1.5 hours~21 hours
  - \* Except for decompressive fasciotomy groups
  - The number of HBOT per patient ranged from 4 to 149(mean 21.6).
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- We selected conservative treatment such as RICE and HBOT, unless it was a serious condition in which emergent fasciotomy was required.
  - 90-minutes HBOT at 2.0-2.8 ATA once a day, every day as soon as possible.

## Sites of injuries



## Conditions of injuries

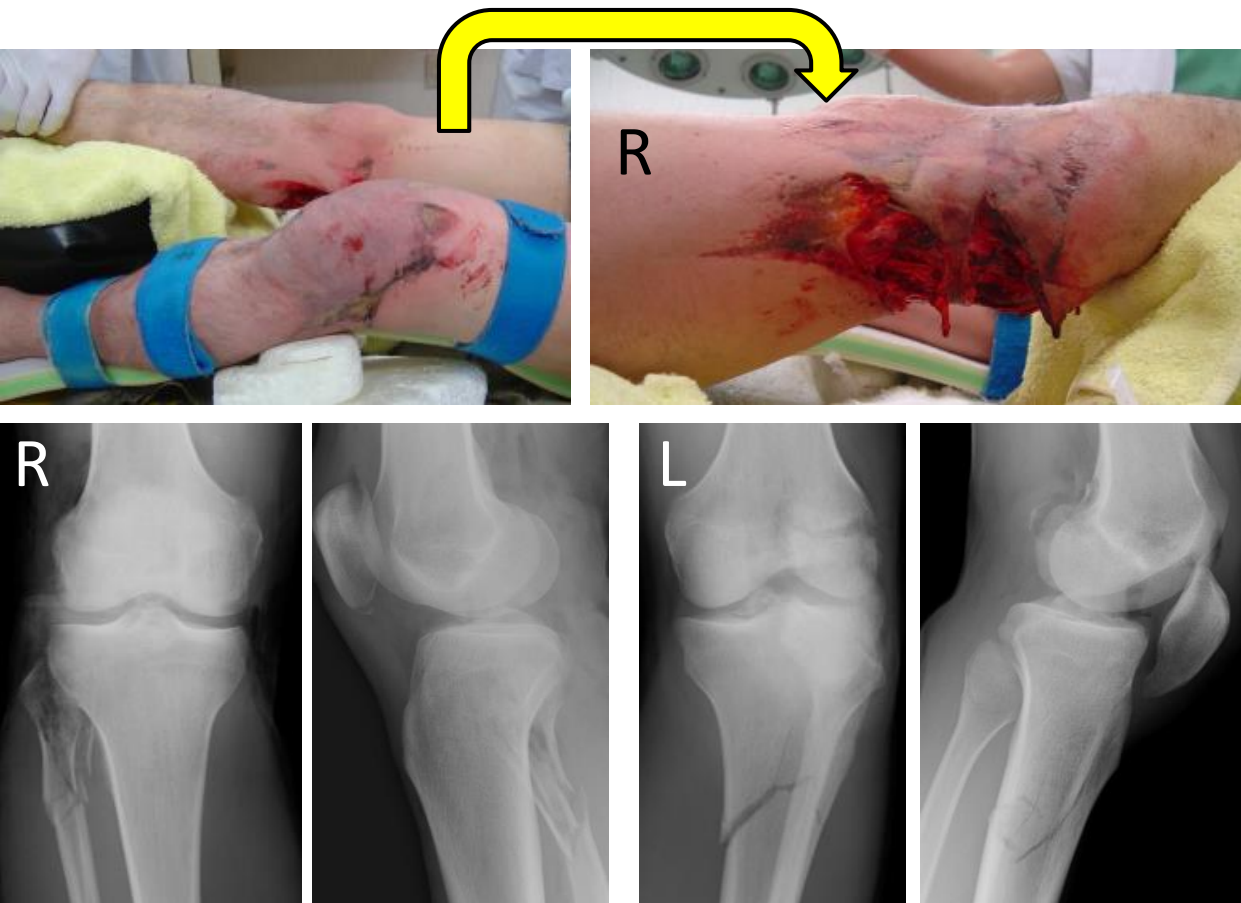


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## Case 1

- 32-year-old, male
- His both legs were crushed for 5 minutes under a machine for transporting which weighed 10 tons.



- Remarkable Swelling and pain, plus a little paresthesia
- Impairment of both lower limbs
- No paralysis and pulselessness

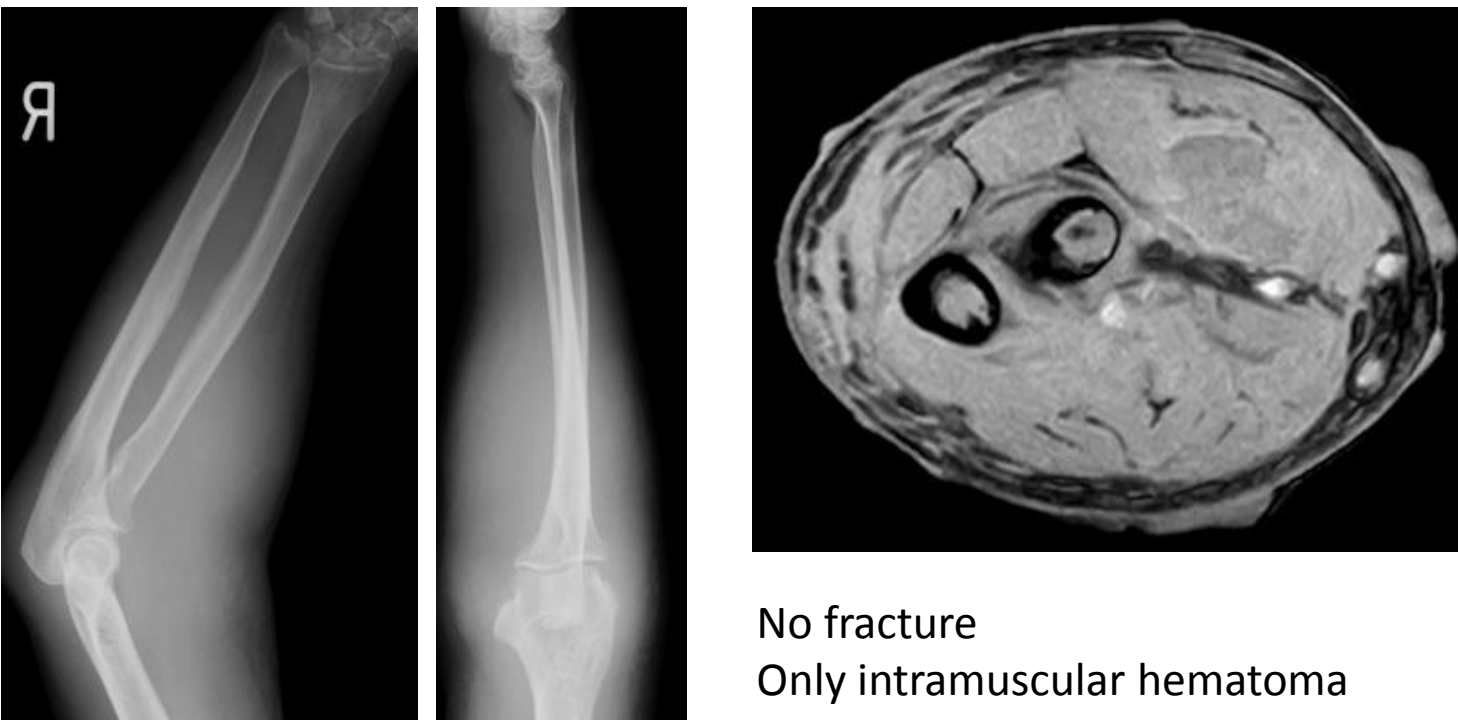
## Clinical course

- HBOT was started 6 hours after the injury.
- An operation was done 12 days after the injury.
- A total of 60 HBOT were done every day during hospitalization.
- A little pain in the knees and a slight paresthesia of the lower legs were still left, but he returned to his daily life without any major problems.



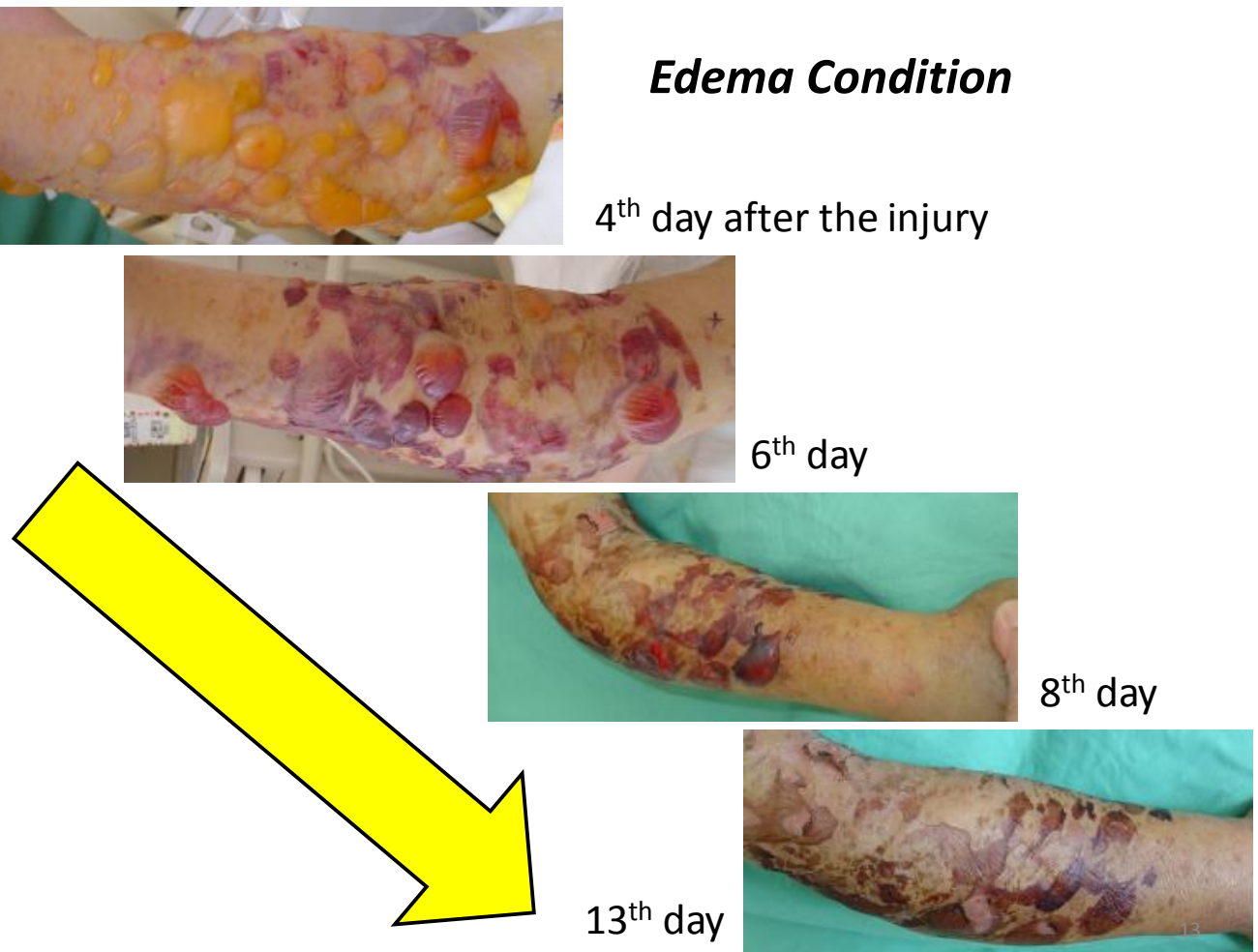
## Case 2

- 87-year-old, female
- Her right forearm was caught in the lift for about 1 minute.
- Swelling and pain occurred, especially with passive motion.
- She had a little hyposthesia.
- The compartment pressure measurement was 90 mmHg.
- Maximum circumference of forearm: Rt)31 cm Lt)23cm



## Clinical course

- HBOT was immediately started 1.5 hours after injury.
- We put her right forearm in a splint, and guided only active ROM exercise was given until swelling went down.
- A total of 26 HBOT were done.
- We were able to keep the limb without performing a fasciotomy.



## Results

- In the initial observation, symptoms were swelling and pain, especially with the passive stretch of the injured muscle of the diseased limbs.
- Intramuscular pressure measured 55-100 mmHg (mean 78.3mmHg).
- Decompressive fasciotomy had already been performed in 5 cases and the others received conservative treatment with HBO within 24 hours after the initial evaluation.
- In only 2 cases, we performed a hematoma removal due to severe swelling in the first few days after hospitalization.
- We were able to keep the diseased limb without any major complication in all cases.

## Discussion

Compartment syndrome can have disastrous consequences. Muscles tolerate 4 hours of ischemia well, but by 6 hours the results are uncertain; after 8 hours, the damage is irreversible<sup>1)</sup>. Ischemic injury begins when tissue pressure is 10 to 20 mmHg below diastolic pressure. Therefore, fasciotomy generally should be done when tissue pressure rises past 20 mmHg below diastolic pressure<sup>1)</sup>.

<sup>1)</sup>Mithofer K et al. Acute compartment syndrome: update on diagnosis and treatment. J Am Acad Orthop Surg 1996; 4 (4): 209-218

## Mechanism of Hyperbaric Oxygen Therapy (HBOT)

- Improvement of oxygen delivery
  - Preservation of tissue viability in ischemic areas
  - Vasoconstriction reducing vasogenic edema
  - Prevention of infection due to anaerobic microorganisms
  - Enhancement of the wound-healing process
- ⇒HBOT is an effective intervention that counteracts the pathophysiological events which occur with these conditions.

## Clinical Evaluation

- Mithofer K et al<sup>1)</sup> reported that, only pain with passive motion was present in all patients in his retrospective study of 29 thigh compartment syndromes.
- Whitesides TE et al<sup>2)</sup> reported that, paralysis and sensory changes are not noted until after ischemia has been present for a period of approximately 1 hour or more, pain with passive motion are the most sensitive clinical findings before the onset of ischemic dysfunction in the nerves and muscles.

<sup>1)</sup>Mithofer K et al. Clinical spectrum of acute compartment syndrome of the thigh and its relation to associated injuries. Clin Orthop Relat Res 2004; 425: 223-229

<sup>2)</sup>Whitesides TE et al. Acute compartment syndrome: update on diagnosis and treatment. J Am Acad Orthop Surg 1996; 4 (4): 209-218

## Our Recommendation

Depending on the situation, it is not always possible to measure compartmental pressure in all cases.

- We recommend as follows:
- 1. suspect a compartment syndrome at the point we notice swelling and pain with passive motion of the diseased limb
- 2. measure compartmental pressure and diagnose it, if possible
- 3. start HBOT, if the situation is not so severe to require an emergent fasciotomy
- 4. consider a surgical treatment when the effect is insufficient

## Conclusions

- We examined the treatment outcome of 49 compartment syndrome cases.
- We achieved good results with HBOT as soon as it was clinically diagnosed and we noticed swelling and pain with passive motion of the diseased limb.